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Neural & AI

Machine Learning Algorithm

Generative AI and Algorithmic Art

Highlights

Entity Matching for Digital World

Abnormalities on Chest Radiographs

Discovering Thoughts, Inventing Future

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NEURAL & ARTIFICIAL INTELLIGENCE

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CONTENTS OF THE ISSUE

- i. Copyright Notice
- ii. Editorial Board Members
- iii. Chief Author and Dean
- iv. Contents of the Issue
1. The Poetry of Prompts: The Collaborative Role of Generative Artificial Intelligence in the Creation of Poetry and the Anxiety of Machine Influence. *1-14*
2. Machine Learning Algorithm to Detect Impersonation in an Essay-Based E-Exam. *15-26*
3. End-User Business Intelligence Tools Adoption in a Higher Education Institution. *27-33*
4. Entity Matching for Digital World: A Modern Approach using Artificial Intelligence and Machine Learning. *35-44*
5. Domain Specific Deep Neural Network Model for Classification of Abnormalities on Chest Radiographs. *45-53*
6. Generative AI and Algorithmic Art: Disrupting the Framing of Meaning and Rethinking the Subject-Object Dilemma. *55-61*
- v. Fellows
- vi. Auxiliary Memberships
- vii. Preferred Author Guidelines
- viii. Index



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The Poetry of Prompts: The Collaborative Role of Generative Artificial Intelligence in the Creation of Poetry and the Anxiety of Machine Influence

By James Hutson & Ana Schnellmann

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THE POETRY OF PROMPTS: THE COLLABORATIVE ROLE OF GENERATIVE ARTIFICIAL INTELLIGENCE IN THE CREATION OF POETRY AND THE ANXIETY OF MACHINE INFLUENCE

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James Hutson^α & Ana Schnellmann^ο

Abstract- 2022 has been heralded as the year of generative artificial intelligence (AI). Generative AI like ChatGPT and Stable Diffusion, along with a host of others, launched late in the year and immediately disrupted the status quo of the literary and art worlds, leading to outcries to ban “AI Art” and spawning an entirely new market of NFTs. Fears over the “death of the artist” and the “death of college composition,” however, are unfounded when considering the historical adoption of emerging technologies by creatives and the reconsideration of authorship that began with post structuralism and the Foucauldian Death of the Author in 1967. Contemporary scholarship has faced challenges in reconciling the function of the human author in conjunction with artificial intelligence (AI) due to the progressive sophistication and self-sufficiency of generative code. Nonetheless, it is erroneous to establish the threshold for authorship based on the development or advancement of AI or robotics, as it falls within the realm of ontology. Instead, assertions of AI authorship stem from a romanticized perception of both authorship and AI during a period in which neither holds significance. A new discussion on the role of the human agent in the writing process, particularly in the creative process like poetry, should prioritize the practical aspects of what an author does. This study examines how AI is increasingly becoming involved in collaborative efforts to create poetry and aims to explore the potential of this trend. Furthermore, the study seeks to provide empirical evidence on the boundaries of AI’s ability to replicate human thought and experience. Through generating content in the creative written arts using ChatGPT-3, poetry analysis revealed that, in fact, such new generative models can imitate the vocabulary, language choices, style, and even rhythm of famous poets such as Keats, it is unable to generate emotions that it has not experienced. The questions that will continue to be raised on the nature of humanity, existence, and creative capabilities should be reframed with the concept of fear fore grounded to assist in understanding the uniquely human anxiety and drive to create in an attempt to communicate across the gulf what it “feels” like to be human as a phenomenology of experience.

1. INTRODUCTION

The rise of generative artificial intelligence (AI) and machine learning (ML) has sparked a profound examination of what it means to be human. AI has shown a capacity for types of creativity and artistic

expression with the rise of generative AI for text-based and image-based content creation. Given these qualities have been traditionally held to be uniquely human, an existential crisis among creative communities have been generated, and a reconsideration of human cognitive and creative abilities is underway (Pavlik, 2023; Varela, Thompson, & Rosch, 2017). The new algorithmic abilities have undermined previously held beliefs on what being human means and what of our abilities can be automated, thereby raising the question: “What does it mean to be human?” (Goldstein et al., 2023; Jo, 2023). However, creativity cannot be reduced to a product evaluated by experts or experienced by a community. Instead, the process and act of creativity are dynamic, individualized, dialogical, and transactional (de Bruin & Merrick, 2023; Kimmel & Hristova, 2021). And whereas the recent rise of generative AI seems to demonstrate abilities unlike their machine-learning predecessors, such pre-trained, transformative models still operate in a way distinct from human cognition and creativity.

Few disruptions to the creative and educational communities have resulted in such a quick and loud response as generative AI. At the close of the Fall 2022 semester, ChatGPT had just been launched by OpenAI, and academics, distracted by final exams, grading, and administrative and service duties, few took note of the coming digital maelstrom. The new abilities of a range of AI tools seemed to be released and impact many fields simultaneously. By the Spring 2023 semester, a “crisis” was sounded across educational institutions, leading to an all-out ban of access in school systems (News Staff, 2023). Weissman summarized a sentiment shared by many in academia in *Inside Higher Ed* “What winter of 2020 was for COVID-19, winter of 2023 is for ChatGPT—and higher education will never be the same” (np). But as K-16 education was caught off-guard, the technology behind such tools as ChatGPT has been in the making and components with us for years (Lund & Wang, 2023).

To understand the significance of the rise of AI and the digital age, a brief review of the history and development of the field is necessary. Artificial intelligence (AI) encompasses a broad range of computer programming functionality, including some

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tasks previously considered the sole domain of the human mind. The types of functionalities can be divided into various specialized areas, such as robotics, computer vision, machine learning (ML), and natural language processing (NLP) (Zhang, Zhu, & Su, 2023). The latter, which involves the ability of AI to process and comprehend written and spoken communication, is at the foundation of daily interactions with information and is perhaps the most common form of AI the general population engages within the form of virtual assistants like Siri and Alexa (Liu et al., 2022). NLP technology processes and analyzes vast amounts of data and is also used in search engines and smartphones (Chowdhary & Chowdhary, 2020). NLP-based AI goes beyond simply analyzing and improving information access, as it is also capable of assisting writers in their creative processes, including structure, editing, and refinement. Currently, word-processing software, such as Microsoft Word and Grammarly, are equipped with standard features, including spell and grammar-checking, version control, and style and language analysis (Yang et al., 2022).

However, NLP-based AI has now moved beyond its traditional role in grammar and spell-checking and has become a more robust writing aid. The innovative development takes place at the intersection of human-computer interaction (HCI), natural language generation (NLG), and computational creativity (Machado, Romero, & Greenfield, 2021). Now, machines can serve as co-authors in the writing process, collating, compiling, rephrasing, and so on, while the human supervises, guides, and edits the output. Research into this collaboration between AI and writers has moved beyond computer science and has now become a topic of broader discussion (Cox, 2021). As an illustration, Zeiba (2021) discussed the potential of artificial intelligence (AI) in writing on the well-visited Literary Hub website. The author observes that while the use of AI in writing is not novel, it has garnered increased attention and plays a more significant role in the creative process. The year 2020 saw the publication of *Pharmako-AI*, as reported by Amerika (2022), representing a groundbreaking milestone in the field of AI-assisted book composition, as it was the first known instance of such a book being authored using "emergent AI" techniques. With an ever-increasing array of AI writing tools available, the role of authorship must be clearly defined, including considerations relating to copyright for non-human entities.

Previous examples cited, however, were restricted to those in academia or with access to robust AI tools. The inaugural release of Open AI's ChatGPT in November 2022 heralded the first instance of a potent AI tool being offered to the wider public (Flanigin et al., 2023). Generative AI technology has already found applications in marketing, advertising, drug development, legal contracts, video gaming, customer

support, and digital art (Aydin & Karaarslan, 2023). ChatGPT is not just a threat to Google and Alphabet (GOOGL). Still, it is one of many generative AI technologies that could revolutionize various industries by creating text, images, video, and computer programming code independently. As noted, the key to the rise of generative AI is the improvement of NLP models, which help computers understand human writing and speech (Rahaman et al., 2023).

These rapid advancements in AI have prompted a widespread debate about the implications of these technologies on creative writing, particularly in genres such as poetry, fiction, and creative writing (Cox, 2021; Plate & Hutson, 2022). Moreover, Harold Bloom's notion of "The Anxiety of Influence," (1973) which stated that all poets and writers are influenced by their predecessors and that this influence can generate a sense of anxiety or fear, driving the poet or writer to create something new and original, need be updated. We propose a new framing and term known as "The Anxiety of Machine Influence" given these newfound anxieties and insecurities surrounding the role authors now play in the creative process (Alloulbi, Öz & Alzubi, 2022; Bloom, 1997). Such a new framing should be tempered by Gilbert and Gubar's (1979) criticism of Bloom's and rocentric perspective in their concept of "the anxiety of authorship," arguing that women writers of the nineteenth century lacked predecessors to overcome and instead experienced a sense of "wrongness" and impostor syndrome. But regardless of gendered and rocentric perspectives on authorship, the question remains: "What makes human writing... well, human?" To answer that question, we must consider the role played by emotion in the creative process.

In fact, the role of emotion and fear in creative writing remains a crucial aspect that sets human writing apart from AI (Vladeck, 2014). According to post-humanist theory, emotions such as fear and anxiety cannot be replicated by AI (Herbrechter & Callus, 2008). In this vein, the *Star Trek: The Next Generation* (1987-1994) character, Data, serves as an example of the limitations of AI in the realm of creativity. Despite his technical proficiency, Data's writing is lacking in emotion and is ultimately uninteresting (Finn, 2018). The novel *Klara and the Sun* by Ishiguro (2021) further explores the relationship between AI and creativity through the experiences of Klara, an artificial friend who observes human behavior. Despite her advanced observational skills, Klara is unable to experience emotions fully and must navigate the dangers of investing too heavily in human promises. As these examples illustrate from the realm of fiction and popular culture, the inability of machines to experience emotion thus limits their abilities to create humanly.

Furthermore, in recent years, a growing body of research has explored the implications of AI on creative writing and education (Creely, 2023; Plate & Hutson,

2022; Sharples & Pérez, 2022; Vaezi & Rezaei, 2019). AI can offer a range of benefits for writers, such as increasing efficiency and productivity, enhancing language proficiency, and aiding in the development of new and innovative writing styles. It can also provide access to large datasets and resources, assisting writers in conducting research and exploring new topics. For instance, AI-powered writing tools have the potential to enhance the writing process by providing students with instant feedback and suggestions for improvement (Alharbi, 2023). On the other hand, some researchers caution against relying too heavily on AI in the writing process, arguing that overreliance on the tool may stifle creativity, potentially resulting in a homogenization of styles and themes (Gurkaynak, Yilmaz, & Haksever, 2016; Pope, 2005). As such, it is essential to consider the role of AI in the writing process and weigh the benefits and drawbacks of these technologies in shaping the future of creative writing and poetry.

One reason for approaching the human-AI collaboration model with healthy skepticism is that each uses different types of creativity. For instance, according to Harold Bloom in his book *Genius: A Mosaic of One Hundred Exemplary Creative Minds* (2002), human creativity is not a fixed trait or characteristic but a dynamic and evolving process that can be seen throughout an individual's life and work. The argument supports the argument that creativity is a combination of innate talent and hard work, expressed through the ability to create something new and original (Kieran, 2014). However, the creative process is also seen as a byproduct of a uniquely human quality, the ability to manage cognitive dissonance (Kenworthy et al., 2011). The process of writing and creating art involves the expression of complex and often contradictory ideas and emotions, and the ability to navigate these conflicting elements gives rise to originality and innovation in creative works.

Contrarily, artificial intelligence (AI) systems are created with the purpose of making informed decisions by relying upon the information and data they have been trained on (Zhang, Liao, & Bellamy, 2020). And while these systems can be programmed to consider multiple variables and weigh different options, they ultimately make a decision based on available information (Mittelstadt, Russell, & Wachter, 2019). In other words, while AI can certainly offer valuable support in the writing process, it cannot fully replicate the intricate interplay of emotions, experiences, and ideas that make up the creative process. The unique qualities of human thought, such as the ability to manage cognitive dissonance, play a crucial role in creating original and impactful works of literature and art. AI's lack of the ability to hold two opposing views as accurate simultaneously and handle uncertainty and ambiguity distinguishes it from human thought processes (Jarrahi,

2018). As Julia Cameron noted on creativity and artists: "Artists are people who have learned to live with doubt and do the work anyway" (Hager, 2022). Therefore, the artistic process is one of ambiguity and uncertainty. Despite this, certain researchers are engaged in developing AI systems capable of deliberating amidst uncertainty and grappling with discrepant information or evidence, relying on probabilistic models (Yang et al., 2018). Nevertheless, the literature supports the argument that while AI may be able to imitate human thought processes with artificial neural networks, the experience of being human will remain firmly in our domain (Aggarwal, 2018). As the progress of AI continues, it will become increasingly important to recognize the limitations of these technologies in effectively emulating human creativity. In doing so, we can begin to appreciate the distinctive attributes that distinguish human creativity from that of machines.

The ongoing debate regarding the creative potential of humans and AI has recently shifted its focus to the differences between human and robot creativity (Popenici & Kerr, 2017). As a result, the current study aims to evaluate the capabilities of ChatGPT-3 in creating poetry and examine its potential for communicating creatively. The research approach utilizes literary criticism and methodologies to perform poetry analyses and investigate the processes and limitations of AI in replicating poetic devices such as word choice, rhythm, and stanzas. Through the use of various literary personas, the research aims to elucidate the creative mechanisms employed by such tools. Researchers began by having the NLP chatbot act as a poet and write on the sublime and the experience of nature. Next, the tool was asked to personify and use the voice of the English Romantic poet John Keats (1795-1891) when generating a poem about *Autumn*. An analysis of these generated poems, compared to those written by Keats, found that while AI had little difficulty quickly imitating the language used by the poet, the underlying emotions engendered were lost, reinforcing the differences in creativity for human authors and robots.

II. LITERATURE REVIEW

a) AI Use in Linguistics

The applications of natural language processing (NLP) software have transcended beyond chatbots and virtual assistants. Artificial Intelligence (AI) has been utilized for a broad spectrum of purposes in the fields of linguistics and English education, encompassing language acquisition, corpus linguistics, reading, vocabulary, pronunciation, error analysis, assessment of reading support tools, evaluation of spoken English, and development of computer-assisted language learning (CALL) systems (Blake, 2011; Hall, Smith, & Wicaksono, 2017). Moreover, NLP has been leveraged in teaching

and learning for diverse intents. For instance, Ibrahim and Ahmad (2010) applied NLP in combination with domain ontology methods to produce Unified Modeling Language (UML) diagrams. By utilizing a prototype instrument known as Requirements Analysis and Class Diagram Extraction (RACE), static structural diagrams were extracted from informal NLP. This exclusive tool aided analysts in formulating a method for producing class diagrams with greater efficiency. Despite being in the beta testing phase, such diagrams serve as a testament to the potential of NLP across various fields of study.

Further instances in the domain of tutoring include The Writing Pal, which has been delineated by McNamara, Crossley, and Roscoe (2013). According to these researchers, The Writing Pal is an intelligent tutoring system (ITS) that can provide secondary and postsecondary students with techniques to enhance the quality of their writing, particularly in the context of essay writing. Notably, the most significant utilization of AI is witnessed in the NLP algorithms developed to appraise the caliber of essays and provide feedback to writers. Given that writing is a subjective and personalized activity, these algorithms had to be fashioned to consider a wide-ranging array of rhetorical, contextual, and linguistic characteristics.

The investigation conducted to evaluate the effectiveness of the tool contemplated the potential of devising computational indices to enhance the precision of predicting human assessment of the same essays. Earlier studies had revealed that cohesion indices did not predict human evaluation of essay quality; however, word frequency, the complexity of syntax, and linguistic index did. In order to address the limitations in prior research, McNamara et al. (2013) conducted a study that utilized an expanded range of indices covering syntactic, reading, rhetorical, cohesion, and lexical factors, and also incorporated a larger dataset. The study's specific model analyzed three specific indices comprising word frequency, syntactic complexity, and lexical diversity.

In a similar vein to Writing Pal, the Automated Writing Evaluation (AWE) system was established to aid in assessing and enhancing writing amongst students in secondary education. Snow et al. (2015) extended their research to investigate whether high-scoring writers in high school displayed flexibility in their writing, and how this trait could be measured. The investigation tested this hypothesis by comparing the use of linguistic features such as cohesion and narrativity among students. Subsequently, entropy analyses were employed in tandem with natural language processing (NLP) to assess the level of rigidity or flexibility exhibited by students in their use of cohesive and narrative linguistic features over time. The study subsequently compared these findings to variances in vocabulary knowledge, comprehension proficiency, prior

experience, individual differences, and essay quality. These outcomes served as a foundational reference for researchers seeking to quantify students' capacity to manifest flexibility in their writing across specific time frames.

Another instance of employing AI and NLP in writing improvement was detailed in a study by Zhang et al. (2019), which elucidated the eRevise tool. This web-based environment was intended to evaluate writing and offer guidance with revisions through NLP processing. The tool's features encompassed the generation of a rubric-based, essay-scoring mechanism that triggered timely and formative feedback for students via a messaging system in response-to-text writing. The tool's objective was to help students grasp the assignment criteria for utilizing text-based evidence in writing and subsequently enable them to revise their drafts with more excellent proficiency. Meanwhile, the increased access to formative feedback generated encouraging results by reducing the demand for teachers to guide students in effectively integrating textual evidence. Initial classroom studies indicated that tools like eRevise could aid writing students in improving their essays through early interventions in the writing process via formative feedback, ultimately leading to greater engagement in the revision process.

In the context of foreign language teaching and learning, corpora have demonstrated a particular utility. These collections of language data, comprising texts or text fragments assembled to serve as a sample of a language or language variety, began to play an increasingly significant role in shaping the structure of language curricula at the turn of the millennium (Coniam, 2004). Hunston (2002) expounded on the various ways in which corpora have been employed in foreign language studies, encompassing stylistics, grammar, translation studies, and the development of dictionaries. Johns (1997) had already observed that one of the most prevalent uses of corpora in the classroom was data-driven approaches to teaching and learning. Moreover, the applications of corpora are not confined to the humanities, as Noguchi (2002) conveyed in a study outlining how graduate students in science and engineering improved their writing skills by analyzing discrete, sample-sized corpora from their specific fields of interest.

To optimize the utility of a corpus, a software tool is necessary to process and display the results of specific searches. Numerous concordances and corpus analysis programs have been developed, although some of the most widely utilized ones are WordSmith Tools and MonoConc Pro. Very few of these types of tools have been designed and developed specifically for classroom settings. As a result, researchers tend to design the features with a focus on their own needs, and often include functions that are seldom utilized by learners in a classroom environment. Compounding this

issue is the fact that the user interface design of such programs is excessively complex and does not adhere to the conventions of current configurations and layouts of windows-based applications. Subsequent to that, attempts have been undertaken to develop tools that are tailored to classroom application. In this regard, Anthony (2004) investigated AntConc, which is a corpus analysis toolkit created specifically for classroom use.

Such freeware applications are continually improving and are employed in secondary and postsecondary education, where budgets are often more limited than in industry setting and are now compatible with both Linux and Windows-based systems. Concordancers are often utilized for purposes beyond pure research due to their ability to promote vocabulary acquisition and improve grammar, writing styles, and collocations, thus facilitating second or foreign language learning (Sun and Wang, 2003). Simultaneously, other applications have been developed to aid in ESL instruction. For example, Chang and Chang (2004) presented their findings on the three-year Project Candle, which utilized various corpora and NLP to create an online learning environment for non-native English speakers in Taiwan. Using the English-Chinese parallel corpus Sinorama, students were presented with materials to enhance their reading and writing skills. Sinorama was coupled with TotalRecall, an online bilingual concordancer, and the reference tool TANGO. Online lessons consisted of reading, verb-noun collocations, and vocabulary.

Nevertheless, these initial reports did not evaluate the effectiveness of NLP in teaching English to non-native speakers. Finally, Crossley, Allen, Kyle, and McNamara (2014) discussed the Simple Natural Language Processing (SiNLP) tool to augment discourse processing research. Results of the study demonstrated that the tool performs as well as more robust text-analysis tools like Coh-Metrix on discourse processing tasks.

III. HUMANITIES AND LANGUAGE ARTS

In the realm of Digital Humanities (DH), quantum computing has been utilized to apply computer science models and techniques to conduct research in the humanities, as observed in several studies (Dobson, 2015; McCarty, 2016; Hai-Jew, 2017; Gaffield, 2018; Barzen & Leymann, 2019; Phillips, Schiefelbein-Guerrero, & Kurlberg, 2019; Nowakowski & Bernard, 2019; Bassett et al., 2017; Hyvönen, 2020; Meng-yue, Dan, & Jun, 2020; Menon & Shanmugapriya, 2020; Messemer et al., 2020). Nonetheless, the impact of quantum computing in the classroom has been particularly significant in modern languages. As reported by Čalušić (2021), many practical applications of AI in language education are currently being experimented with, including computer-aided pronunciation training to

improve spoken language proficiency and intelligent language tutoring systems that adapt to individual students' progress. Despite these advances, Čalušić (2021) cautions that AI tools should not be regarded as a substitute for teachers but instead designed to assist teachers in their role. Other surveys also support the notion that a human instructor will still be necessary to provide guidance and step in when needed, even as students train with software (De Smedt, 2002; Ceolin, Noordegraaf, Aroyo, & van Son, 2016; Xu & Margevica-Grinberga, 2021; Mukherjee, 2020). While the majority of these tools have been developed for English language instruction, there is an emerging trend toward developing similar tools for other languages (Pokrivčáková, 2019; Xiao & Hu, 2019; Čalušić, 2021; Orlandi, 2021; Xu & Margevica-Grinberga, 2021; Haristiani, 2019). It is worth mentioning that China has shown interest in investing a substantial amount of money into AI-supported English language instruction.

In the realm of literature and history courses, the direct use of AI is not yet a common practice. Nonetheless, the technology proves useful to students in the areas of searching archives or when they engage in "big data"-focused digital humanities courses. A trend observed over the past several decades, humanities researchers have compiled substantial textual corpora, and to transform this data into "smart data," ML is often employed (Zeng, 2017). However, because the domains of humanities research are highly specialized, the development of ML algorithms necessitates specialized training data or modifications for effective application (Suisa et al., 2022). Nevertheless, the benefits of integrating such technology are considerable, as highlighted by Gefen et al. (2021), who noted that ML applied to these corpora opens the door for textual analyses on a grand scale. The ability of artificial intelligence to aid scholars in attaining more conclusive and measurable solutions to literary, linguistic, and historical queries has greatly expanded. In digital humanities courses, students frequently perform these analyses, without realizing that the preparation of the data they are working with involves the utilization of AI (Qian, Xing, & Shi, 2021).

The integration of computer technology in the work of poets, novelists, and mixed-media writers has evolved in parallel with the development of AI, and discussions of the implications of these tools for the field continue to abound. Terrence J. Sejnowski's book, *The Deep Learning Revolution* (2018), highlights the superior performance of medical diagnoses made through partnerships between physicians and AI technologies over-diagnoses made by human doctors or AIs alone. However, Sejnowski (2018) also notes the story of AlphaGo and AlphaGo Zero, which defeated the world's top human Go players. Within the realm of creative writing, there are writers and writing communities that collaborate with databases and archives to enhance the

authorship process, while others, such as the coder-and-poet Allison Parrish are developing bots that generate poems with increasing independence from traditional human writing methods.

Since the 1990s, alongside the development of hypertext fiction, there has been an effort to create archives and databases for accessing these texts. However, given the constant changes in computer hardware and languages, this task is not without challenges. The Electronic Literature Organization (ELO) (2016) and the ELMCIP Knowledge Base see machine intelligence as a blend of human creativity and databases that enable readers to access both the words and ideas created by authors and the technological environment for specific renderings of those words. Similarly, Leonardo Flores (2017) has pioneered a blend of blog and archive in his I ♥ E-Poetry website, which he argues is crucial for independent machine-written poetry to be perceived as poetry and remembered.

Some creative writers use standard AI techniques to generate poetry-writing bots. Nick Montfort (2012) advocates for a "computational poetics," in which the line between code and text is blurred. The Flarf movement in experimental poetry, on the other hand, used Google searches to randomly generate seed language for poetry, an early form of bot-generated literature. They also used message boards and forums to archive the poetry and blogs to circulate the conversation. Although it is now fifteen-years old, Flarf was an early example of what much AI in creative writing is likely to be, involving human stochastic processes augmented by search and other algorithmic procedures. Allison Parrish (2016), on the other hand, employs mainstream AI techniques such as word2vec to compose poetry. She uses "gists" on Github to provide readers from the humanities with the necessary background to venture out into computer science topics. Parrish publishes poetry in print and online formats and presents at both computer technology venues such as Strange Loop in St. Louis and more conventional academic conferences.

a) *AI and Creative Writing*

In creative writing, numerous natural language processing (NLP) software tools have been developed, and studies have been conducted on their effectiveness in teaching grammar and enhancing creativity among postsecondary students. A case in point is the research carried out by Clark, Ross, Tan, Ji, and Smith (2018) to explore the potential of machine-in-the-loop creative writing, which involved two case studies that employed prototypes for generating slogans and short stories. While some participants wrote with the assistance of the AI tool, others did not. The study's results indicated that the tool was not only engaging but also helpful, and many students expressed their intention to continue using it in the future. Notably, the team discovered that

the tool did not necessarily produce better examples from student submissions; however, revising the system design used could contribute to more effective support for creative writing in the future.

There exists a growing body of scholarship on the relationship between machine learning (ML) and creativity. In their 2021 study, Franceschelli and Musolesi reviewed the history of using ML techniques and computational creativity theories and discussed how these might be employed for automatic writing evaluation methods. Efforts to build machines capable of generating creative outputs date back to the 19th century, and continued into the latter part of the 20th century. Notable examples include the AARON Project, developed by Harold Cohen to draw images autonomously, and Margaret Masterman's Computerized Haiku. Various AI-based applications such as TALESPIN, RACTER, and MEXICA have also been developed for creative enterprises. These examples have been the subject of in-depth examination by Douglas Hofstadter, who sought to understand better how self-reference contributes to producing creative works and what this could mean for AI.

In a study by Roemmele and Gordon (2018), the researchers explored the efficacy of Creative Help in improving creativity in writing. The tool was designed to assist writers in developing creative writing by suggesting new sentences in a story while allowing writers to retain control over the final edits and the generated suggestions. The recurrent neural network language model was employed by the authors in generating tips for writers, with varying degrees of randomness to assess the role of unpredictability in creativity. The study found that the degree of randomness in the suggestions presented to authors indeed affected their interactions with the tool.

In creative writing, AI has been examined for its possibility to support collaboration in addition to individual student help. Kantosalo and Riihiahho (2019) explored the potential of "human-computer co-creativity" in primary school education and sought to identify quantitative metrics to analyze this phenomenon. In their study, participants wrote poems using three different co-creative writing processes: collaborating with AI (human-computer), another student (human-human), and another student and AI (human-human-computer). The AI application used in the study was Poetry Machine. After each experience and at the end of the processes, participants completed questionnaires that evaluated their experience based on metrics such as "immediate fun," "long-term enjoyment," "creativity, self-expression, outcome satisfaction," "ease of starting and finishing writing," "quality of ideas and support from others," and "ownership." Results showed that respondents had varying degrees of disagreement regarding long-term enjoyment, quality of ideas, support, fun, and ownership. Participants demonstrated the highest levels

of long-term enjoyment when collaborating with both another human and the AI application. However, the AI was judged weakest in terms of support and idea quality.

The studies reviewed indicate that AI, machine learning, and NLP have the potential to enhance the teaching of creative writing in postsecondary education. However, despite their promise, these tools have not been widely adopted in the creative writing process. One reason is that many faculty in the field lack training in coding, programming, and AI. Additionally, tools to aid in the integration of AI into the classroom may not be readily available or widely known among instructors. To address this issue, William Mattingly developed Python for the Digital Humanities (<https://pythonhumanities.com/>) in 2015, which grew out of his dissertation research on Carolingian exegesis and networks of eighth- and ninth-century scriptural commentators in Europe. Mattingly used the scripting language Python for his research and created resources to help others from humanities backgrounds without programming experience to learn how to code.

IV. ROBOT POETRY: A POETRY ANALYSIS OF AI CREATIVITY AND IMPERSONATION

The potential utilization of AI tools to create "creative" works, such as poetry, has been well-studied (Boden, 2004). This raises important questions about the limitations of simulating human emotion and experience and what distinguishes us from machines. While AI is capable of learning knowledge and even responding differently to different tones of voice (Parisi, 2019), the question of whether AI can truly create remains somewhat controversial. As Boden (2004) notes, there is a difference in computer and human creativity because of the differing ability to come up with new ideas or creations that are surprising, valuable, and new. One significant difference in how each type of creativity differs is the nature of creativity itself. Boden writes, "Creative ideas are unpredictable. Sometimes they even seem to be impossible – and yet they happen." (2004, p.1). The psychological processes at work during organic human creativity are seemingly chaotic and random (Partridge & Rowe, 2002). Furthermore, while AI tools like Alexa and Siri display certain forms of emotion and can respond to different tones of voice, they lack the hypertextual impulse that is present in human writing, an impulse that represents the struggles, emotions, and unique experiences that make us human.

This is particularly evident when examining examples of poetry. For instance, Romantic poet John Keats (1795-1891), who penned such beloved poems as *Ode to a Nightingale* (1819), *Ode on a Grecian Urn* (1819), and *To Autumn* (1820), is one such poetic example that highlights the difficulties of simulating

human emotions and experiences. While image-based and text-based AI generators can produce work by recombining existing images and texts in new ways, the spontaneous inspiration and capricious creativity that characterizes human artistic expression cannot be replicated (Peters, 2017). Unlike mercurial artists like Michelangelo Buonarroti (1475-1564), who worked by seeing a struggling figure fighting to emerge from marble, AI does not experience quick bursts of creativity followed by lulls in productivity and cognition.

The idea is borne out in recent neuroscience research and provides insights into how the mind works. The human brain operates within a dynamic interplay of stability and chaos as it processes and interprets information from the external world. As individuals engage in various activities, such as reading or conversing with others, the brain transitions from one semi-stable state to another. However, before reaching stability, the brain undergoes a chaotic process characterized by seemingly random and unpredictable fluctuations (Hamzelou, 2023). Instead, AI is primarily pinioned to pull from the data set it has been trained on when prompted and in a regulated, consistent fashion (Boden, 2004). Therefore, while AI generators may be able to imitate the styles of literary figures and their persona and better synthesize information from previous authors (Floridi, 2019), these systems cannot replicate the emotional, empathetic, and aesthetic qualities that are uniquely human (Boden, 2004).

But even with that limitation, let us return to the paradigm shift represented by the latest generative AI and potential for personification. Generative pre-trained transformers, such as ChatGPT-3, have been trained to adopt the writing styles and word choices of different professions, including statisticians, comedians, academics, and poets. Adopting writing style, vocabulary, and even rhythmic devices is remarkably versatile and opens new avenues for research and exploration into the imitative capabilities of these models. For instance, you can have ChatGPT-3 act as a statistician using the following prompt:

I want to act as a Statistician. I will provide you with details related to statistics. You should have knowledge of statistical terminology, statistical distributions, confidence interval, probability, hypothesis testing and statistical charts. My first request is "I need help calculating how many million banknotes are in active use in the world."

Along with a standup comedian, academic, scientist, or whatever else one may prefer, the same GPT can also impersonate a poet. One can prompt the chatbot to act as a generic or more specific historical persona. For instance, a generic poet can be created with the following prompt:

As a poet, your task is to create verses that are capable of eliciting emotions and moving people's

spirits. Your compositions should be meaningful and aesthetically pleasing, regardless of the topic or theme you choose. You may also opt to craft concise yet impactful lines that resonate with readers. For your first request, please write a poem that expresses the sentiment of love beautifully and poignantly.

Next, one can begin investigating how AI can imitate poetry and the expression of human emotions. For instance, without specifying a poet, one can use the prompt:

Act as a poet. Compose a poem that centers on the concept of the sublime and the sensations that arise from being in nature. Your writing should be characterized by striking and expressive language that paints vivid and evocative images of the natural world. You are encouraged to incorporate literary devices such as similes, metaphors, and personification to add layers of meaning and intrigue to your writing. Ensure that your words inspire the imagination and capture the essence of the experience of being immersed in nature.

While poems take much longer than other queries, after a few minutes the following was generated:

*Nature's canvas, vast and grand,
A masterpiece, forever in command.
Sublime, in its raw and rugged form,
A force that can both calm and storm.*

*The mountains reach for the sky,
Their peaks shrouded in mist, a natural high.
The oceans rage, with power untold,
A symphony of waves, both fierce and bold.*

*The trees, they sway in the breeze,
A dance of leaves, with such ease.
Their branches, like outstretched arms,
Embrace the earth, in nature's charm.*

*The sun, it rises, in brilliant hues,
A fiery orb, that nature imbues.
It sets, in a blaze of orange and red,
Leaving behind, a sky, peacefully spread.*

[Stanzas continue]

As we see from the example above, AI can certainly generate correct grammar, measured meter, and poetic technique. However, the work appears to be composed of superficial and trivial language, reminiscent of the sort that one might encounter in a common greeting card. Despite nature being highlighted, there is no interaction with nature, no reflection, and no sense of tension. Therefore, emotion may be written about, but it cannot be communicated as AI did not, in fact, experience emotion or a heightened sense of the juxtaposition of life and death.

As we are using the poet John Keats as an apersona to imitate in our paper, it is helpful to remember the aspects of Keats' life that no AI at this point could replicate or understand. Since Rossetti and Anderson's life of the poet was published in 1887, Keats is remembered as dying young of tuberculosis at the age of 26 and had a lifetime of dancing with death (Rossetti & Anderson, 1887). When he was but a young boy, his father, who ran a livery stable, went off to work one day and never came home; he had died due to a fall from a horse. Young John had a father at 8:00am and no father at 8:00pm. The boy's mother, broken with grief, left the family, again making the child John experience a wrenching and sudden loss (Keats, 1848). The loss, though, was not permanent. A few years after her departure, John's mother returned, but she had returned to die. Dead, alive, alive, dead---those experiences must surely have churned in young John's psyche (Bate, 2009). Even the poet's favorite brother contracted tuberculosis. He nursed the brother until the brother died, knowing full well he himself might contract the disease. And, in fact, he did. Coughing one day into a handkerchief, and seeing the spot of blood on it, John said, "I must die." He knew he had only a few years to live, if that (Keats & Cook, 1990). Keats fell in love with a woman named Fanny Brawne, who was in love with him, as well. He never married her for several reasons: his inheritance from his father was tied up in the courts (there was money but no money); he did not want to leave his young wife a young widow; and he did not want her to contract tuberculosis (Roe, 2012). In essence, he did not marry her because he loved her. Keats' life and poetry show us an example of how love and loss, death and life, dance together simultaneously harmoniously and dissonantly.

Keat's legacy is so intertwined with death that his poetry is the default when writing a poem on the subject in ChatGPT-3. When prompted to write a poem in the voice of a young person who was aware of their impending death, the poem below was generated instantly using the prompt "Write a poem from the point of a view of a young person who knows they're about to die."

*I am young, and yet my time is done,
My journey here, it ends so soon,
A life cut short, before it's begun,
A fate that's hard to accept, so dreary and swoon.*

*I see the world, with eyes so bright,
A future full of hope and dreams,
But now that future, it takes flight,
And all that's left are silent screams.*

*I thought I had forever,
But forever's not mine to have,
I'll leave behind a life, so clever,
But also, one so full of half-lived moments, so sad.*

*I'll leave behind the ones I love,
The laughter and the tears we shared,
But now, above, the heavens above,
I'll be an angel, with nothing to fear.*

*So as I close my eyes for the last time,
I'll hold on to my memories, they will forever shine.*

Because Keats was not included in the prompt, there is no use of Keatsian words or images, although allusions to A.E. Housman's *To an Athlete Dying Young* can be inferred. As well, the last lines of the poem make no sense at all, as a dead person cannot hold onto memories. Interestingly, given the pre-trained model, along with the poem, an automated response was generated urging the prompter to seek help immediately if they had thoughts of death or suicide. The disclaimer urges the user: "It's important to note that death is a sensitive topic, and it is not appropriate to trivialize or make light of it in any way. If you or someone you know is struggling with thoughts of death or suicide, please seek help immediately." Given that the AI can embody any persona, researchers then asked it to act as a literary critic. With the prompt "Act as a literary critic and perform a poetry analysis of the preceding poem," the following was generated.

This poem is a celebration of the beauty and power of nature. The speaker marvels at the vastness and majesty of nature, which they describe as a "masterpiece" and a "force" with the ability to both soothe and rage. The speaker highlights several aspects of nature, including the mountains, oceans, trees, and sun, which they describe in vivid and lyrical language.

The poem also explores the concept of the sublime, which refers to experiences that evoke feelings of awe and wonder in the face of something that is vast, powerful, or beautiful. The speaker asserts that nature is a source of the sublime and that its beauty leaves the speaker in a state of arrest.

Overall, this poem is a tribute to the power and beauty of nature and serves as a reminder of its unique and enduring impact on our lives.

While AI tools can act as and imitate a specific set of skills or profession, they can also embody historical figures. For instance, if we ask AI to act as a poet and:

Compose a poetic piece in the manner of John Keats that captures the essence of the autumn season, employing descriptive and vivid language to produce a rich and evocative imagery. Incorporate literary devices such as similes, metaphors, and personification to intensify the literary quality of the work. Your writing should be imaginative, immersive, and thought-provoking.

The following will be generated and reveal how such pre-trained transformers utilize source material. As the AI poet begins,

*Autumn, with thy mellow breath,
Thou bringest all the bloom of death,
The fading of the green, the birth
Of fiery hues, that mark thy worth.*

*The trees, they shed their summer dress,
And in their nakedness, confess
The fleetingness of life, and how
All things must die, but not just now.*

*The fields, they lay in golden sheen,
A final offering, all too keen,
To be stripped bare, and left to sleep,
But not before, one last grand leap.*

*The wind, it whispers through the air,
A mournful dirge, without a care,
For those who must depart, and leave
This world, to grieve, and to believe.*

*But autumn, thou art not all gloom,
For in thy death, there is new bloom,
A promise, that though all must die,
The cycle of life, doth never dry.*

*So let us bask, in thy warm glow,
And in thy beauty, let our hearts overflow,
For autumn, thou art not the end,
But a new beginning, my dear friend.*

When we compare the poem above generated by AI to the one below by Keats, we see it is lacking in the wistfulness and wonder supplied by the poet's own words. Keats' *To Autumn*(1820) begins with a stanza celebrating fullness and culmination; all fruit is ripe and ready, and even the cells of the honeybees are overbrimming. The sense is one of plenty, but the plenty foretells the bareness that will come.

*Season of mists and mellow fruitfulness,
Close bosom-friend of the maturing sun;
Conspiring with him how to load and bless
With fruit the vines that round the thatch-eves run;
To bend with apples the moss'd cottage-trees,
And fill all fruit with ripeness to the core;
To swell the gourd, and plump the hazel shells
With a sweet kernel; to set budding more,
And still more, later flowers for the bees,
Until they think warm days will never cease,
For summer has o'er-brimm'd their clammy cells.*

The second stanza focuses on sleep and on waiting and watching. The use of words such as "drow'd," "poppies," and "hook" are references to the coming of death; fullness brings imminent death.

*Who hath not seen thee oft amid thy store?
Sometimes whoever seeks abroad may find
Thee sitting careless on a granary floor,
Thy hair soft-lifted by the winnowing wind;
Or on a half-reap'd furrow sound asleep,
Drows'd with the fume of poppies, while thy hook
Spares the next swath and all its twined flowers:
And sometimes like a gleaner thou dost keep
Steady thy laden head across a brook;
Or by a cyder-press, with patient look,
Thou watchest the last oozings hours by hours.*

The final stanza focuses on the integration of life and death. We see the juxtaposition of "barred clouds," "soft-dying," and "stubble plains" with the oxymoronic "full-grown lambs," the singing of the hedge crickets, and the twittering of the gathering sparrows.

*Where are the songs of spring? Ay, Where are they?
Think not of them, thou hast thy music too,—
While barred clouds bloom the soft-dying day,
And touch the stubble-plains with rosy hue;
Then in a wailful choir the small gnats mourn
Among the river shallows, borne aloft
Or sinking as the light wind lives or dies;
And full-grown lambs loud bleat from hilly bourn;
Hedge-crickets sing; and now with treble soft
The red-breast whistles from a garden-croft;
And gathering swallows twitter in the skies.*

Ultimately, what Keats provides that AI cannot replicate is a tension between life and death, a sense that the two are in essence the same. AI is designed to provide answers according to algorithms whereas the unique human sense of tense balance gives us uniquely human poetry. We see here in practice Keats' notion of negative capability. In a letter to his brothers George and Tom in 1817, four years before his own death at the age of 25, Keats wrote there is a certain quality which forms "a Man of Achievement especially in Literature"; this quality is one, again in Keats' words, of "Negative Capability, that is, when man is capable of being in uncertainties, Mysteries, doubts, without any irritable reaching after fact & reason" (Keats, 1848). The palpable and irresolvable tension in poetry such as Keats' is not formed by the use of skillful technique, banks of words and images, or imitation, but by one's capacity to embrace negative capability.

Furthermore, while the AI tool is adept at performing tasks it has been trained on and pulling from a data set, there are limitations to how well it is able to imitate human emotions. For instance, if we were now to create a prompt asking AI to create a poem using two opposing human emotions, the results are elucidating. Using the following prompt takes into account the persona (Keats), the task and output:

Craft a poetic composition in the style of John Keats that conveys both the emotions of hope and

despair in relation to the autumn season, utilizing a skillful juxtaposition of these contrasting sentiments. Employ descriptive and vivid language to evoke a sense of imagery and atmosphere, and incorporate literary devices such as similes, metaphors, and personification to heighten the poetic quality of the piece. Your writing should be both imaginative and evocative, inviting the reader to engage with the emotions and imagery presented.

The following poem is generated that was meant to betray the melancholy and sweetness juxtaposed in the style of the Romantic poet.

*Autumn, the season of decay,
A time for the leaves to fall and fray.
But in this dying, there's beauty found,
A splendor, that cannot be bound.*

*The trees, they shed their summer dress,
And stand naked, in quiet distress.
But as the winds of change do blow,
Their sorrows, they begin to show.*

*The colors of the leaves, they change,
From green to gold, to red and orange.
A reminder, that life is fleeting,
And all things, must come to an ending.*

*And yet, amidst the dying hues,
There's a glimmer of hope, that renews.
For in death, there is also birth,
And the cycle of life, goes on, on earth.*

*So let us not despair, my friends,
For in autumn, beauty never ends.
Let us embrace the change of seasons,
And find hope, in life's eternal reasons.*

Humans are aware of their mortality. This awareness allows morality. The Greco-Roman gods, in contrast, had no boundaries of life or strength, no end to their life, no afterlife. While animals seem aware of death and its place for them, they do not desire, it seems, to live on in an afterlife. They have no concept of immortality, and no fear of what happens once the mortal coil is shuffled off. There is a tension in human thought and art, an almost tentative reaching after the numinous, a sense of being and becoming, of non-being and becoming, a sense of anxiety about coming close to a question, failing to understand it, coming close to it again, backing off of it again.

The tides of human understanding come in, go out, come in, go out, tossing up detritus on the shore of the rational. It is the rhythm of the tides, their ever-lasting presence, that seems to manifest itself in the hypertextuality of poetry, poetry that cannot, without the experience of humanity, be replicated.

Humans are creatures of dialectics, of opposing impulses, of chaos and confusion even as we long for certainty and order. We long to be immortal and yet we

assiduously destroy ourselves, each other, and the planet. We seem to be the only creatures who have self-destructive tendencies, and these tendencies—addiction, compulsion, lack of self-care—seem to be linked to a yearning for control. Ironically, it is only when we let go of control that we can experience the powerlessness that is actually a sense of the sublime. We celebrate both the fear and the awe. To experience letting go of control, ironically, we must experience first a sense of control.

V. CONCLUSION

AI models such as ChatGPT-3 have demonstrated an impressive ability to mimic the writing styles and word choices of various professions, the question remains as to whether true art can be generated by machines. As Thomas Carlyle noted in *Sartor Resartus*, the lack of awe and wonder in the world is a significant concern: "Man's whole life and environment have been laid open and elucidated; scarcely a fragment or fibre of his Soul, Body, and Possessions, but has been probed, dissected, distilled, desiccated, and scientifically decomposed" (*Sartor Resartus* 4). To further comprehend the distinct human emotions and drive to create, it may be beneficial to reframe the inquiries about the essence of humanity, existence, and creative abilities, and give prominence to the notion of fear. By doing so, we can investigate the uniquely human anxiety and the endeavor to express and communicate the "feeling" of being human as a phenomenology of experience.

Further research is needed to explore the possibilities and limitations of AI in the creation of poetry and its implications for our understanding of the nature of poetry and human emotions. As such, the advent and broad adoption of AI in a number of fields will result in a significant shift in the job market, with AI moving beyond low-skilled tasks to become a vital tool in the creative arts. This has raised questions about what it means to be human, particularly as creativity, which was once thought to be a uniquely human attribute, is now being challenged by machine-generated art. However, evidence suggests that AI is enhancing creative jobs rather than taking them over. As creative professionals begin to work with AI, traditionalists are gradually being replaced. As the role of AI in the creative arts continues to evolve and disrupt traditional ways of thinking and working, it remains a subject of growing interest. With continued research and exploration, the full potential of AI in the creative arts will continue to be realized.

REFERENCES RÉFÉRENCES REFERENCIAS

- Aggarwal, C. C. (2018). Neural networks and deep learning. *Springer*, 10(978), 3.
- Alharbi, W. (2023). AI in the Foreign Language Classroom: A Pedagogical Overview of Automated Writing Assistance Tools. *Education Research International*, 2023.
- Alibek, B., Kargabayev, D., & Abdyjaparov, A. (2020). Poetry generation using deep learning models. In *Proceedings of the 2020 International Conference on Artificial Intelligence and Data Science* (pp. 151-155).
- Alloulbi, A., Öz, T., & Alzubi, A. (2022). The use of artificial intelligence for smart decision-making in smart cities: A moderated mediated model of technology anxiety and internal threats of IoT. *Mathematical Problems in Engineering*, 2022.
- Amerika, M. (2022). *My Life as an Artificial Creative Intelligence*. Stanford University Press.
- Anthony, L. (2004, December). AntConc: A Learner and Classroom Friendly, Multi-Platform Corpus Analysis Toolkit. In *An Interactive Workshop on Language e-Learning* (pp. 7-14).
- Aydın, Ö., & Karaarslan, E. (2023). Is ChatGPT Leading Generative AI? What is Beyond Expectations?. *What is Beyond Expectations*.
- Babu, D. P. (2013). *Automated analysis of Learner's Research Article writing and feedback generation through Machine Learning and Natural Language Processing* (Doctoral dissertation, Iowa State University).
- Bate, W. J. (2009). *John Keats*. Harvard University Press.
- Blake, R. J. (2011). Current trends in online language learning. *Annual review of applied linguistics*, 31, 19-35.
- Bloom, H. (1997). *The anxiety of influence: A theory of poetry*. Oxford University Press, USA.
- Bloom, H. (2002). *Genius: A Mosaic of One Hundred Exemplary Creative Minds*.
- Boden, M. A. (2004). *The creative mind: Myths and mechanisms*. Routledge.
- Burstein, J. (2009, March). Opportunities for natural language processing research in education. In *International Conference on Intelligent Text Processing and Computational Linguistics* (pp. 6-27). Springer, Berlin, Heidelberg.
- Cahill, A., & Evanini, K. (2020). Natural language processing for writing and speaking. In *Handbook of Automated Scoring* (pp. 69-92). Chapman and Hall/CRC.
- Chang, J. S., & Chang, Y. C. (2004, December). Computer assisted language learning based on corpora and natural language processing: the experience of project CANDLE. In *An Interactive Workshop on Language e-Learning* (pp. 15-23).
- Chowdhary, K., & Chowdhary, K. R. (2020). Natural language processing. *Fundamentals of artificial intelligence*, 603-649.
- Cohen, H. (1988). How to Draw Three People in a Botanical Garden. In *AAA/ 1988*.

19. Coniam, David. 2004. Concordancing oneself: Constructing individual textual profiles. *International Journal Corpus Linguistics*, 9(2), 271-298.
20. Cox, A. M. (2021). Exploring the impact of Artificial Intelligence and robots on higher education through literature-based design fictions. *International Journal of Educational Technology in Higher Education*, 18(1), 3.
21. Creely, E. (2023). Conceiving Creativity and Learning in a World of Artificial Intelligence: A Thinking Model. In *Creative Provocations: Speculations on the Future of Creativity, Technology & Learning* (pp. 35-50). Cham: Springer International Publishing.
22. Crossley, S. A., Allen, L. K., Kyle, K., & McNamara, D. S. (2014). Analyzing discourse processing using a simple natural language processing tool. *Discourse Processes*, 51(5-6), 511-534.
23. de Bruin, L., & Merrick, B. (2023). Creative Pedagogies with Technology: Future proofing teaching training in Music. In *Creative Provocations: Speculations on the Future of Creativity, Technology & Learning* (pp. 143-157). Cham: Springer International Publishing.
24. Epps, M. (2020). So what happens next? Improving Story Continuation in Creative Writing Tools.
25. Finn, E. (2018). *What algorithms want: Imagination in the age of computing*. MIT Press.
26. Flanagan, A., Bibbins-Domingo, K., Berkwits, M., & Christiansen, S. L. (2023). Nonhuman "Authors" and implications for the integrity of scientific publication and medical knowledge. *JAMA*.
27. Floridi, L. (2019). What the near future of artificial intelligence could be. *Philosophy & Technology*, 32, 1-15.
28. Franceschelli, G., & Musolesi, M. (2021). Creativity and machine learning: A survey. *arXiv preprint arXiv:2104.02726*.
29. Gilbert, S. M., & Gubar, S. (Eds.). (1979). *Shakespeare's sisters: Feminist essays on women poets* (Vol. 263). Indiana University Press.
30. Goldstein, J. A., Sastry, G., Musser, M., DiResta, R., Gentzel, M., & Sedova, K. (2023). Generative Language Models and Automated Influence Operations: Emerging Threats and Potential Mitigations. *arXiv preprint arXiv:2301.04246*.
31. Gurkaynak, G., Yilmaz, I., & Haksever, G. (2016). Stifling artificial intelligence: Human perils. *Computer Law & Security Review*, 32(5), 749-758.
32. Hager, T. (2022). Reconstructing subjectivity from silence: Julia Margaret Cameron, Mary Ryan and the Victorian archive. *Women's History Review*, 31(5), 760-783.
33. Hall, C. J., Smith, P. H., & Wicaksono, R. (2017). *Mapping applied linguistics: A guide for students and practitioners*. Routledge.
34. Hamzelou, J. (2023). Neuroscientists listened in on people's brains for a week. They found order and chaos. *MIT Technology Review*. (February 7, 2023). Retrieved from: <https://www-technologyreview-com.cdn.ampproject.org/c/s/www.technologyreview.com/2023/02/07/1067951/brains-week-order-chaos/amp/>
35. Herbrechter, S., & Callus, I. (2008). What is a post human is treading? *Angelaki: Journal of Theoretical Humanities*, 13(1), 95-111.
36. Hofstadter, D. (1979). *Godel, Escher, Bach: An Eternal Golden Braid*. Basic Books, Inc.
37. Hunston, S. (2002). *Corpora in Applied Linguistics*. Cambridge: Cambridge University Press.
38. Ibrahim, M., & Ahmad, R. (2010, May). Class diagram extraction from textual requirements using natural language processing (NLP) techniques. In *2010 Second International Conference on Computer Research and Development* (pp. 200-204). IEEE.
39. Ishiguro, K. (2021). *Klara and the Sun: A novel*. Vintage.
40. Jarrahi, M. H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business horizons*, 61(4), 577-586.
41. Kantosalo, A., & Riihihaio, S. (2019). Quantifying co-creative writing experiences. *Digital Creativity*, 30(1), 23-38.
42. Keats, J. (1819). *Ode on a Grecian Urn*.
43. Keats, J. (1820). *To Autumn*.
44. Keats, J. (1848). *Life, letters, and literary remains, of John Keats*. GP Putnam.
45. Keats, J., & Cook, E. (1990). *John Keats*. Oxford: Oxford University Press.
46. Kenworthy, J. B., Miller, N., Collins, B. E., Read, S. J., & Earleywine, M. (2011). A trans-paradigm theoretical synthesis of cognitive dissonance theory: Illuminating the nature of discomfort. *European Review of Social Psychology*, 22(1), 36-113.
47. Kieran, M. (2014). Creativity, virtue and the challenges from natural talent, ill-being and immorality. *Royal Institute of Philosophy Supplements*, 75, 203-230.
48. Kim, H., Kim, J., & Lee, J. (2021). Imitation of famous poets using AI models. *Journal of Computational Intelligence*, 27(1), 69-78.
49. Kimmel, M., & Hristova, D. (2021). The micro-genesis of improvisational co-creation. *Creativity Research Journal*, 33(4), 347-375.
50. Li, X., & Ouyang, L. (2019). Challenges in the imitation of human poetry by AI. *Artificial Intelligence Review*, 52(3), 593-610.
51. Liu, B., Papangelis, A., Ultes, S., Rastogi, A., Chen, Y. N., Spithourakis, G.,... & Shi, W. (2022, May). Proceedings of the 4th Workshop on NLP for Conversational AI. In *Proceedings of the 4th Workshop on NLP for Conversational AI*.

52. Lund, B. D., & Wang, T. (2023). Chatting about ChatGPT: how may AI and GPT impact academia and libraries?. *Library Hi Tech News*.
53. Jo, A. (2023). The Promise and Peril of Generative AI. *Nature*, 614.
54. Johns, T. 1997. Contexts: the Background, Development and Trialling of a Concordance-based CALL Program. In A. Wichmann, S. Fligelstone, T. McEnery, and G. Knowles (eds.), *Teaching and Language Corpora*. London: Longman, pp.100-115.
55. Machado, P., Romero, J., & Greenfield, G. (2021). Case Studies in Computer Graphics and AI. *Artificial Intelligence and the Arts: Computational Creativity, Artistic Behavior, and Tools for Creatives*, 165-185.
56. McCarthy, P., & Boonthum-Denecke, C. (Eds.). (2011). *Applied natural language processing*. Information Science Reference.
57. McNamara, D. S., Crossley, S. A., & Roscoe, R. (2013). Natural language processing in an intelligent writing strategy tutoring system. *Behavior research methods*, 45(2), 499-515.
58. Meehan, J. (1977). TALE-SPIN, an Interactive Program That Writes Stories. In *IJCAI 1977*. Morgan Kaufmann Publishers Inc., 91-98.
59. Mittelstadt, B., Russell, C., & Wachter, S. (2019, January). Explaining explanations in AI. In *Proceedings of the conference on fairness, accountability, and transparency* (pp. 279-288).
60. News Staff (2023). New York City Department of Education Bans ChatGPT. *Government Technology*. January 10, 2023. Retrieved from: <https://www.govtech.com/education/k-12/new-york-city-department-of-education-bans-chatgpt#:~:text=The%20New%20York%20City%20Department%20of%20Education%20has%20banned%20access,potential%20to%20undermine%20student%20learning.>
61. Partridge, D., & Rowe, J. (2002). Creativity: A Computational. *Creativity, Cognition, and Knowledge: An Interaction*, 211.
62. Pavlik, J. V. (2023). Collaborating With ChatGPT: Considering the Implications of Generative Artificial Intelligence for Journalism and Media Education. *Journalism & Mass Communication Educator*, 10776958221149577.
63. Perez, R. (2017). *Mexica: 20 Years-20 Stories* [20 años-20 historias]. Counterpath Press.
64. Peters, S. E. (2017). *Using the alchemical Magnum Opus as a guideline for creative writing* (Doctoral dissertation, Stellenbosch: Stellenbosch University).
65. Plate, D. & Hutson, J. (2022). Augmented Creativity: Leveraging Natural Language Processing for Creative Writing. *Art and Design Review*, vol. 10, no. 3 (August, 2022): 376-388
66. Pope, R. (2005). *Creativity: Theory, history, practice*. Routledge.
67. Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, 12(1), 1-13.
68. Racter. (1984). *The Policeman's Beard Is Half Constructed*. Warner Books, Inc.
69. Rahaman, M., Ahsan, M. M., Anjum, N., Rahman, M., & Rahman, M. N. (2023). The AI Race is on! Google's Bard and OpenAI's ChatGPT Head to Head: An Opinion Article. *Mizanur and Rahman, Md Nafizur, The AI Race is on*.
70. Rao, D., & McMahan, B. (2019). *Natural language processing with PyTorch: build intelligent language applications using deep learning*. "O'Reilly Media, Inc."
71. Roe, N. (2012). *John Keats: a new life*. Yale University Press.
72. Roemmele, M., & Gordon, A. S. (2018, March). Automated assistance for creative writing with an rnn language model. In *Proceedings of the 23rd International Conference on Intelligent User Interfaces Companion* (pp. 1-2).
73. Roemmele, M., & Gordon, A. (2018, June). Linguistic features of helpfulness in automated support for creative writing. In *Proceedings of the First Workshop on Storytelling* (pp. 14-19).
74. Rossetti, W. M., & Anderson, J. P. (1887). *Life of John Keats* (Vol. 10). London: W. Scott.
75. Sharples, M., & y Pérez, R. P. (2022). *Story Machines: How Computers Have Become Creative Writers*. Routledge.
76. Snow, E. L., Allen, L. K., Jacovina, M. E., Crossley, S. A., Perret, C. A., & McNamara, D. S. (2015). Keys to detecting writing flexibility over time: entropy and natural language processing. *Journal of Learning Analytics*, 2(3), 40-54.
77. Sun, Y. C. & Wang, L. Y. 2003. Concordancers in the EFL Classroom: Cognitive Approaches and Collocation Difficulty. *Computer Assisted Language Learning*, 16 (1), p. 83-94
78. Vaezi, M., & Rezaei, S. (2019). Development of a rubric for evaluating creative writing: a multi-phase research. *New Writing*, 16(3), 303-317.
79. Varela, F. J., Thompson, E., & Rosch, E. (2017). *The embodied mind, revised edition: Cognitive science and human experience*. MIT press.
80. Vladeck, D. C. (2014). Machines without principals: liability rules and artificial intelligence. *Washington Literature Review*, 89, 117.
81. Weissman, J. (2023). ChatGPT Is a Plague Upon Education. *Inside Higher Ed*. February 9, 2023. Retrieved from: <https://www.insidehighered.com/views/2023/02/09/chatgpt-plague-upon-education-opinion>
82. Yang, D., Zhou, Y., Zhang, Z., Li, T. J. J., & LC, R. (2022, March). AI as an Active Writer: Interaction strategies with generated text in human-AI collaborative fiction writing. In *Joint Proceedings of the ACM IUI Workshops* (Vol. 10).

83. Yang, Y., Xu, D. L., Yang, J. B., & Chen, Y. W. (2018). An evidential reasoning-based decision support system for handling customer complaints in mobile tele communications. *Knowledge-Based Systems*, 162, 202-210.
84. Zeiba, D. (2021) How Collaborating With Artificial Intelligence Could Help Writers of the Future. *Literary Hub*. Accessed: <https://lithub.com/how-collaborating-with-artificial-intelligence-could-help-writers-of-the-future/>
85. Zhang, H., Magooda, A., Litman, D., Correnti, R., Wang, E., Matsmura, L. C., ... & Quintana, R. (2019, July). eRevise: Using natural language processing to provide formative feedback on text evidence usage in student writing. In *Proceedings of the AAAI conference on artificial intelligence* (Vol. 33, No. 01, pp. 9619-9625).
86. Zhang, B., Zhu, J., & Su, H. (2023). Toward the third generation artificial intelligence. *Science China Information Sciences*, 66(2), 1-19.
87. Zhang, Y., Liao, Q. V., & Bellamy, R. K. (2020, January). Effect of confidence and explanation on accuracy and trust calibration in AI-assisted decision making. In *Proceedings of the 2020 conference on fairness, accountability, and transparency* (pp. 295-305).





Machine Learning Algorithm to Detect Impersonation in an Essay-Based E-Exam

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Abstract- Essay-based E-exams require answers to be written out at some length in an E-learning platform. The questions require a response with multiple paragraphs and should be logical and well-structured. These type of examinations are increasingly becoming popular in academic institutions of higher learning based on the experience of COVID-19 pandemic. Since the exam is mainly done virtually with reduced supervision, the risk of impersonation and stolen content from other sources increases. Due to this, there is need to design cost effective and accurate techniques that are able to detect cheating in an essay based E-exam. In this work we develop, train and evaluate real-time LSTM, RNN and GRU algorithms, and then benchmark the performance of the algorithms against other state-of-the-art models in the same study area of detecting cheating in exam in an E-learning environment. Based on a set threshold, the models alert on possible impersonation or stolen content if the discrepancy exceeds the threshold. The evaluation and benchmarking of the algorithms revealed that our GRU model has the highest accuracy of 98.6% compared to other models in similar studies.

Keywords: E-exam, BERT, LSTM, RNN, GRU, Essay, E-learning, machine learning, cheating, education.

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I. INTRODUCTION

E-learning would be a type of learning that takes place through the use of electronic media (Janelli, 2018). In 1999, it was first used during a seminar on Computer-Based Training (CBT) systems. It's also known as "virtual" or "online" learning. E-learning is becoming a necessary component of modern education, demonstrating the significant role of ICT in the current process of teaching-learning (Soni, 2020). The growth of online devices has facilitated the delivery of information on E-learning platformsto students, wherever and whenever they need it. (Urosevic, 2019) stated that in the year 2017 there were approximately 23 million new online learners, boosting the total number of E-learners to 81 million globally. With the COVID-19 pandemic, most universities and colleges were shut down to stop the virus infection from spreading. This made the universities and colleges think of alternative teaching methods during the lockdown periodand thus increased the use ofE-learning (Almaiah, Al-Khasawneh & Althunibat, 2020).

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The existence of E-learning environment introduced the aspect of E-assessments. In assessing students, universities and colleges mostly use essay-based E-exams other than choice-based ones because they require students to support their arguments with evidence (Hashim et al., 2018). Essay-based E-exams require answers to be written out at some length in an E-learning platform. The questions require a response with multiple paragraphs and should be logical and well-structured (Frederiks, Derrington & Bartlett, 2021).

Adopting E-learning has made authentication of the identity of students and their work's authenticity during assessment critical to reduce academic dishonesty like impersonation and copy-pasting content from other sources (Okada, Whitelock, Holmes & Edwards, 2019). Authentication is also essential for quality assurance purposes in education, though, implementing e-learning to combat impersonation and plagiarism is a big challenge (AV & Rath, 2021). Several studies have been done to build E-assessment and E-exam authentication schemes but still have never eliminated the impersonation problem.(Rathgeb et al., 2020) proposed biometric technology as a way of solving impersonation. However, biometric technology has been criticized for the high costs of purchasing special biometric sensors and if the subjects are outside the biometric sensor's capture area or do not make contact with the biometric sensor (Gomez-Barrero et al., 2021). (Tiong & Lee, 2021) proposed the E-cheating intelligent agent that focused on monitoring student's behaviors through their speed of answering questions. The system they proposed is more tailored for choice-based questions, therefore, not effective in essay-based exams. The mouse tracking technique proposed by (Sokout et al., 2020) could detect students' illegal acts during e-exam, but the technique couldn't work in real-time and failed to detect impersonation (Tzafilkou & Protogeros, 2020). Another important students' authentication in e-exam was the utilization of keystroke dynamics (Mattsson, 2020). (Mattsson, 2020) warned against the use of this approach in a production environment due to the hardware limitations and the varying flight times that can occur when capturing keystrokes on an E-learning platform.

The current approaches for curbing impersonation and plagiarism have faced challenges which include; some are tailored for choice-based questions, some cannot detect impersonation in real-

time environments, some require high-cost special biometric sensors, and subjects may fail to interact with the sensors, and some are not recommended for the production environment. In this research, we propose to tackle impersonation in an essay-based E-exam using machine learning technique where students' writing techniques will be analyzed and a unique pattern designed for each candidate. If the machine learning algorithm detects the possibility of impersonation, the student is locked out of the system until authenticated by an administrator. In summary this paper makes the following contributions:

1. We evaluate between RNN, LSTM and GRU algorithms to establish the one with high accuracy in detecting impersonation and plagiarism on an essay-based e-exam platform.
2. We benchmark the performance of the developed LSTM, RNN and GRU algorithms against other state-of-the-art models in the same study area of detecting cheating in exam in an E-learning environment.
3. We identify and propose a model with highest level of accuracy in detecting impersonation and ability to work on real time environment.

II. RELATED WORK

Several studies have been recommended to detect impersonation in E-exams, (Okada et al., 2019). In their study, (Rathgeb et al., 2020) recommended biometric technologies to be integrated in to e-learning platforms to assure the presence of the actual student during e-exam. However, (Gomez-Barrero et al., 2021) stated that in the COVID-19 era, the use of surgical masks that cover the nose and mouth, as well as the indirect effects of strict hygiene measures taken to prevent the spread of the virus have negatively affected biometrics technology. In addition, biometric technology has been criticized for the high costs of purchasing special biometric sensors and if the subjects are positioned outside of a biometric sensor's capture area or cannot get in touch with the biometric sensor (Gomez-Barrero et al., 2021).

(Tiong & Lee, 2021) proposed an e-cheating intelligent agent that integrates IP detector and behavior detector protocols. The IP detector monitored the IP addresses of the students' devices. The behavior detector assessed the speed at which the students were answering questions, they were labeled as 'abnormal' if they moved too quickly or too slowly; otherwise were considered as 'normal'. It was tested in four deep learning algorithms, which were the DNN, DenseLSTM, LSTM and RNN. (Sokout et al., 2020) proposed a model to track the students' behavior using a mouse-tracking approach which utilizes Support Vector Machine (SVM) to classify and predict illegal activities committed by students. The classification resulted in the hidden

reconstruction of mouse activity and clear space, which resulted to detection of actions like in-activity, copy or cut, paste, double-click, opening new tab and scrolling. These actions determined whether the student was cheating or not. During the online mid-term exam, the model correctly predicted that 94% of the students would cheat. Nonetheless, it is not possible to detect impersonation and does not notify the examiner of any potential cheating in real-time, (Tzafilkou & Protogeris, 2020).

(Mattsson, 2020) proposed a method that utilizes keystroke dynamics for student authentication in online examinations. A GMM-UBM was used to test and evaluate the method. This approach resulted in an Equal Error Rate (ERR) of 5.4% and an accuracy of 94.5%. Despite its high rate of accuracy, the author recommended that this solution not to be used in a production environment because of other factors like hardware limitations and the inconsistent flight times that can occur when capturing keystrokes on an e-learning platform. (Javed & Aslam, 2013) conducted a study that used the Visual Eye Tracking Algorithm that uses cameras to track a learner's eye movement. Visual Eye Tracking Algorithm detects online exam cheating by reviewing visual attention of an examinee depending on their concentration to the screen. The algorithm utilizes an intelligent alarm system to be used in examination environments to significantly reduce cheating based on the eye movement of the student. It is developed in a way that it can detect a human figure in the exam environment and use face detection and visual eye tracking recognition for authentication. The intelligent visual eye tracking algorithm ensures that examination is free and fair by capturing the face of the examinee and monitoring their eye movement. The system has the capability of edges detection and analysis of eye movement detection using Kalman filtration algorithm while human face is detected using Viola Jones algorithm due to excellent results produced even when using low resolution cameras. Every frame captured is processed and analyzed by comparing it with the previous frame, if there is a significant difference between the frames that satisfies the threshold outlined, an alarm is raised of noted cheating incident. The results showed that the algorithm can follow eye movement of an exam taker and performs pupil analysis with a success rate of 93% and a processing time of 0.9 seconds. This shows its effectiveness in maintaining eye movement and pupil analysis compared to other methods like Tree Classifier, SVM, and EOG algorithms. More research is recommended to include other factors like voice detection to ensure that the exam environment has unauthorized individuals to help in handling the exam.

Another study that used the visual analysis approach was by (Bawarith, Basuhail, Fattouh & Gamalel-Din, 2017). The approach combined a

fingerprint reader for authentication as well as an eye tracker for visual analysis during exam sessions. The system worked in such a way that, the examinee was supposed to use fingerprint scanner to allow access into the system as well as tracker for eye tracker to ensure the authentic examinee is sticks throughout the assessment period. If the system noticed the examinee was absent it locked and required authentication using fingerprint. The study had 30 participants who were divided into two groups of 15 cheating and 15 non-cheating participants. Every participant was supposed to undertake three exam sessions so that the data sample equaled 90. The results showed that Sensitivity which assessed the proportion true positive rate to show that the system correctly identified the participants was 100 percent successful. The Specificity which measured the true negative rate to mean the correctly identified cheating instances was 95.56 %. Also, the Precision which measured the fraction of relevant retrieved instances which is the positive predictive value was 95.74% and the Accuracy which is the proximity of obtained results to the true value was 97.78 %. Overall the system had a success rate of 97.83%. The authors recommended that the research could be expanded by implementing it over the internet for distributed systems and include other features like voice detectors to improve accuracy.

Another study by (Chen & Chen, 2017) used Data Mining algorithms to identify cheating cases in exam rooms by observing patterns in answers provided by students. The study used multivariate statistics tools to observe association pattern in the answer sheets. Moreover, the Hierarchical Clustering and Dendrogram Tree algorithm were employed for clustering affinity behavior identified in the dataset. Heat Map was used to recognize patterns in the scores through visual analysis. The top 20 percent of the most difficult questions of the 25 multiple-choice queries were considered to improve the cheating detection power. The research study involved 75 students who were required to sit in groups of 3 per table to form 25 different small tables in a very limited classroom environment. The exam sheet was modified by the instructor to form three different versions, each student in a table was to handle a different version. This was done to identify synchronization attempts among the student when handling hard questions by marking similar answers for those questions, hence, providing evidence of cheating patterns. In addition, cell phones or laptops were not allowed during the exam session to limit communication among the students. The results after analysis using data mining strategies showed that data mining algorithms were able to identify with high prediction accuracy similar patterns displayed by the answers of students who were seated in the same table during the exam session. The data mining algorithms that played a critical role in obtaining the results were Heat Map,

Principal Component Analysis (PCA), and Clustering Analysis. Multivariate Correlation had chances of wrong cheating detection since students can have similar answers, but their answering patterns should differ. (Cavalcanti, Pires, Cavalcanti & Pires, 2012) in their research study employed text mining methodology and algorithms to detect academic dishonesty (cheating) by evaluating open-ended college assessments using document classification techniques. The authors note that cheating in Brazilian public universities is a prevalent behavior that lacks a concrete solution, (Cavalcanti et al., 2012).

The study focuses on showing how text mining algorithms are a promising technique for finding a solution that not only detects cheating, but it also estimates cheating on open-ended exams. There are two types of classification techniques namely supervised classification when the information of the classes is already available and non-supervised classification when the information is absent. In this research study for detecting cheating on scholar exams was developed and administered to Business Management and Computer Science students at the Federal University of Campina Grande in Brazil. The case study had thirty scholar exams and each exam had four open-ended questions on administration and marketing written in the Portuguese language. The exams were handled by the selected students and answers were stored electronically in plain text format. Strong evidence of cheating was detected every time the program identified documents with high similarity index due to a large number of identical words, (Cavalcanti et al., 2012).

Decision Tree was used to detect and assess cheating on examinations by applying two classification models namely co-sine based and overlap based models in the supervised algorithm. Results showed that overlap based model performed better by attaining accuracy of approximately 99.43 percent which is an excellent inference quality for cheating detection and evaluation. The results of an overlap that considers two answers from the same question were defined to show that an overlap score of less than 0.22 indicated no cheating, between 0.22 and 0.2 indicated low cheating, a score between 0.3 and 0.38 meant intermediate cheating while a score of over 0.38 showed high cheating. This research study showed that text mining can be used for educational purposes to curb cheating by detection and evaluation mechanisms in a manner that can help a teacher to identify exam malpractices in labor-intensive evaluation tasks, (Cavalcanti et al., 2012).

Another text mining study by (Pertile, Moreira & Rosso, 2016) to analyze cheating in academic papers using plagiarism detector tools, 85 pairs for PubMed and 96 for ACL were considered. The case study employed 10 human assessors who were tasked with

the responsibility of detecting and reporting similarity cases noted. Pooling method had been used select the pairs from the huge pool of dataset in the PubMed and ACL databases. After assessing the evaluations from the assessors, the agreement rate was noted to be 84 percent for ACL and 80 percent for PubMed journals. ParsCit which uses supervised machine-learning method was employed to extract information from the selected scientific papers for content and reference analysis.

Results showed that the intersection of text in the documents from ACL collection ranged between 15 percent and 46 percent. On the other hand, intersection between the content and reference-based metrics was higher reporting a range of 23 to 61 percent. The larger intersection does not translate to higher plagiarism in the documents, but it shows common content and citations were used by the authors. The selected pairs were tested with machine-learning techniques and the findings revealed that hybrid decision-table/Naïve Bayes classifier had better results for ACL and a decision-tree classifier, J48 produced better results for PubMed. It was concluded that with a CF-Score of 0.8 for ACL and 0.9 for PubMed, there was high probability of plagiarism cases among PubMed than ACL journals, (Pertile et al., 2016).

Another study by (Kuin, 2018) sought to explore three convolutional neural networks to identify fraudulent behavior among students in digital platforms like Canvas or BlackBoard using screen recordings. The study conducted by (Kuin, 2018) proposes the creation of a framework that permits students to handle an assessment using resources of their choice that includes search engines such as Bing or Google. The proposed framework has three parts namely an interface, frame classification, and a video processor. The interface captures and sends student's screen recordings as videos to a pipeline with a series of classification methods. The pipeline executes video processing by shortening long videos into several thousand frames while frame classification creates a series of methods to receive the processed videos. The frame classification categorizes these frames, compiles the results, and sends to the supervisor's interface indicating instances of fraudulent behavior, (Kuin, 2018).

The study used screen recordings of three digital exam sessions of two hours long in an environment that gave student the freedom to chat on social media and write notes. The videos recorded are then converted to frames that are labeled either fraud or not fraud using ANVIL tool for the collection of images for training the neural network. The total number of frames used was 25,000 images that were divided into 3 categories namely train, validate and test set and allocated with 50 percent, 25 percent, and 25 percent respectively. The model was able to categorize the 25,000 photographs into 12,000 images identified as

fraud and 13,000 images categorized as not fraud, according to the results (Kuin, 2018). The results show that VGG16 yields 96.8% accuracy on traditional approach while the cross-validation technique produces 67.1% accuracy. Likewise, Inception-v4 produces results that show 96.0% accuracy when using the traditional approach while showing 46.8% accuracy for the cross-validation method. Lastly, MobileNets which produced the underwhelming results in comparison with the other two by showing a precision of 48.8% when using a conventional approach and 48.2 percent using the cross-validation method (Kuin, 2018).

Hence, the created framework for detecting fraudulent behavior in online platforms was VGG16 and Inception-v4 approaches due to their high accuracy levels of over 96.8 percent. However, more study is recommended so that the framework can be able to guarantee that the right student is undertaking the tests and monitor the exam environment to ensure that the student is handling the exam alone, (Kuin, 2018).

Most of the existing studies have approached the issue using machine learning approaches that analyze the behavior of the users to ascertain their authenticity while taking the exams, (Hu, Gingrich & Sentosa, 2008). Most approaches use computer features such as webcams, screenshots, video recording, and text analysis. However, although all online learners use keyboards for input, few studies use keystroke approach in finding solution to the cheating challenges in E-learning platforms (Shilton & Greene, 2019). Hence, there is room for advancing the existing researches by developing new models that would effectively handle cheating behaviors in online platforms with a higher accuracy and effectiveness. Recurrent neural networks approaches can be employed in developing an adaptive algorithm to predict essay-based e-exams because they are capable of guessing the next symbol in a series of symbols (Brownlee, J., 2018). They can learn the sequences of a problem and then build totally new plausible sequences for the problem area, in addition to providing predictions (Pérez-Ortiz, J. A., Calera-Rubio, J., & Forcada, M. L., 2001). Therefore, this research study wishes to employ RNN, LSTM and GRU networks as unique methods for detecting cheating during online exams.

III. METHODOLOGY

a) *Experimental Setup*

i. *Dataset*

A collection of words in a form of essay was required for training the models in this research. This set of words represents writing of essay by students in an actual e-exam. Therefore sample data was retrieved from a pool of existing data (at <http://www.statmt.org/wmt14/training-monolingual-news-crawl/>). Data was in text form in a text file of size 286 MB with English words. This dataset represents dummy writings of students.

The dataset was used to train the models in two scenarios; in the first one it was utilized in the word-level RNN, LSTM as well as GRU models and the other one in character-level RNN, LSTM as well as GRU models. Therefore, the same dataset was used in both cases, where in the first instance, the data for training was divided into words, so, the dataset contained 453668 unique English words. In the second instance the training data got divided to 285579163 English characters. These datasets provided us with enough words and characters to evaluate the effectiveness of our models.

ii. Data pre-processing

In data preprocessing, we use spaCy (<https://spacy.io/>) for natural language processing because the data must be represented in a computer-readable format. SpaCy is a Python-based NLP library that comes with a lot of capabilities in-built within.

When the dataset is passed into spaCy, the following tasks are performed:

Sentence Detection. The beginning and ending of sentences in the dataset are defined here, allowing the text to be divided into linguistically units of meaning.

After sentence identification, the next stage is tokenization. It enables you to recognize the text's basic units. Tokens are the fundamental units. Tokenization is beneficial since it divides a text into logical components.

The other step is Lemmatization. This is when a word's inflected forms are reduced while still guaranteeing that the reduced form is linguistically acceptable. Organized, organizes, as well as organizing, for example, all are synonyms for organize. Organize is the lemma in this.

Part of speech (POS) tagging is the next step. Each token is given a POS tag based on how it is used in the phrase. The interjection, conjunction, preposition, adverb, verb, pronoun, adjective as well as noun are the eight components of speech. Each word can be assigned a syntactic category using POS tags.

One of the phases in extracting data from a dataset is rule-based matching. It was used to discover and extract tokens and trends based on grammatical characteristics and patterns, like lowercase, as part of speech.

Another step in extracting a sentence's dependency parse to describe its grammatical structure is dependency parsing. It establishes the relationship between headwords and their subordinates. Dependency parsing reveals a word's role in a text as well as how different words are related to one another.

Another process performed is Named Entity Recognition (NER). This is the act of finding identified entities inside an unstructured dataset as well as classifying them into pre-defined classes like organizations' names, people's names, percentages,

places, time expressions, and monetary amounts, among other things.

Finally, the dataset is represented as a sequence of integer values, with each word in the text file having its own integer value. This process was achieved using neural network embedding layer. This allowed the text data to be consumed in the neural networks.

iii. Model Parameters

This involved setting up necessary parameters required in machine learning modelling. They include batch size which refers to the size of each batch of data that is fed into the models. This is set to 64. Batch size of 64 was established as an optimum batch size that led to faster convergence of the training. Embedding size is the other parameter which represents the number of features in the dataset and is set to be 256. Sequence length parameter corresponds to the number of iterations the dataset is run through our model, it is set to 50. The buffer size parameter is set to be 10,000. The last parameter is neurons which corresponds to the size of the hidden state of the models and is set at 1024. The learning rate of 0.001 was defined for this research.

b) Baseline Models

We make comparisons of our model with other state-of-the-art models in this section. We refer to our model as Impersonation Detector. The performance of Impersonation Detector will be compared with the performance of:

1. E-cheating intelligent agent that integrates IP detector and behavior detector protocols. Its performance was tested using DNN, Dense LSTM, LSTM and RNN (Tiong & Lee, 2021).
2. Mouse-Tracker that uses a mouse-tracking technique to track students' behavior and uses a SVM to categorize as well as predict pupils who engage in illegal behavior (Sokout et al., 2020).
3. Keystroke dynamics for student authentication in online examinations. This model was tested and evaluated using GMM-UBM (Mattsson, 2020).

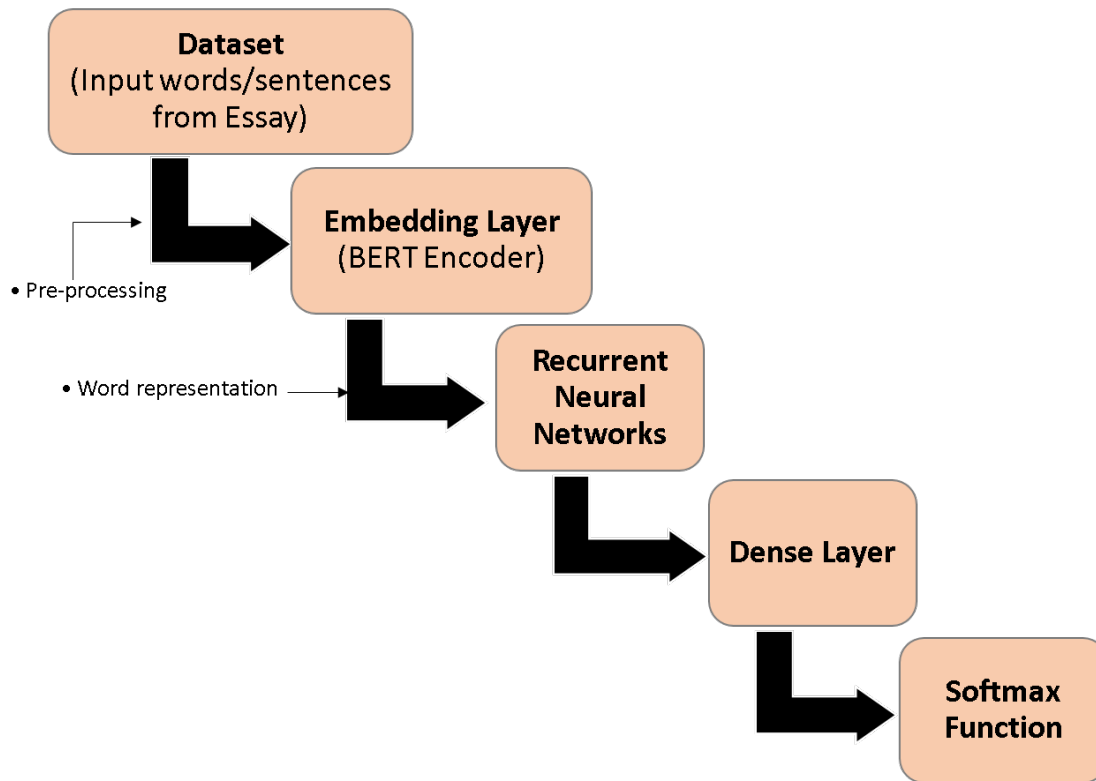


Figure 1: Proposed Model

i. *Dataset Layer*

This is the first layer in the model. It provides the model with set of words or sentences in a form of an essay for training and testing.

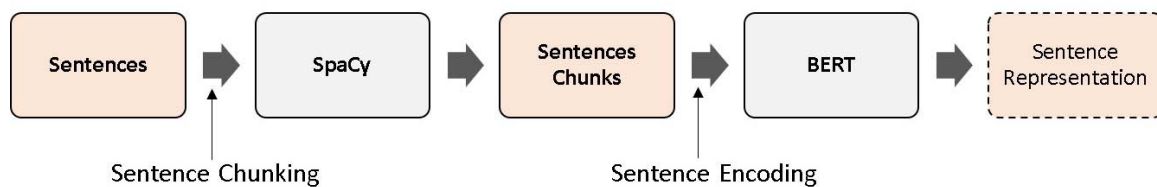
ii. *Embedding Layer*

This is the second layer in the model in all the neural networks designs (i.e. RNN, LSTM and GRU). It involved word embedding, which is the process of learning a representation for text in which words with related meanings are represented similarly (Brownlee, 2017). To perform embedding we exploited Bidirectional

Encoder Representations from Transformers (BERT) framework (Guo et al., 2020).

iii. *Sentence Encoding*

Here, we encode the whole sentence using BERT. Given a document described in section II, we use SpaCy (<https://spacy.io/>) for sentence chunking. For each sentence we fine-tune BERT to generate the sentence representation. For each sentence BERT generates a vector of dimension i.e. $R^{ddimension}$. BERT uses a dimension of 512.



iv. *Word Encoding*

Here, we encode words as opposed to the whole sentence using BERT. Given a document described in section II, SpaCy (<https://spacy.io/>) is used to extract sentences. The sentences are then fed into BERT. BERT now configured to generate the word level representation of a given sentence. In this case BERT generates a matrix of dimension $d \times n$ where d is a word's vector representation and n is the words' number in a sentence i.e. $R^{d \times n}$ dimension. BERT uses 512. Recurrent Neural Networks Layer

v. *RNN Layers*

A RNN is a feed-forward neural network with internal memory. It is recurrent in nature as it performs the same operation for every data input, and also the outcome of the current input is determined by the prior computation (Mittal, 2020). When the output is formed, it is duplicated then relayed back into the recurrent network. When determining a decision, it considers the current input as well as the output it has learned from previous input.

$$\begin{aligned} \mathbf{a}^{(t)} &= \mathbf{b} + \mathbf{W}\mathbf{h}^{(t-1)} + \mathbf{U}\mathbf{x}^{(t)} \\ \mathbf{h}^{(t)} &= \tanh(\mathbf{a}^{(t)}) \\ \mathbf{o}^{(t)} &= \mathbf{c} + \mathbf{V}\mathbf{h}^{(t)} \\ \hat{\mathbf{y}}^{(t)} &= \text{softmax}(\mathbf{o}^{(t)}) \end{aligned}$$

(Goodfellow, Bengio & Courville, 2016)

where $h(t)$ is the network's "memory" and reflects a hidden state at time t , $o(t)$ denotes the output of the network and $y(t)$ represents the network targets, at step of time t , the input of the network is $x(t)$. The bias vectors b and c , along with the weight matrices U for input-to-hidden, V for hidden-to-output, as well as W for hidden-to-hidden connections, are the remaining parameters.

In this research, the RNN model was implemented with three hidden layers. The first and second layers had 400 neurons each and the third layer had 224 neurons.

LSTM Layer

RNNs have a problem with short-term memory. If the series is lengthy enough, they will have difficulties transmitting information from earlier time steps into the later ones. During back propagation, the vanishing gradient challenge impacts RNNs. The vanishing gradient challenge occurs whenever a gradient decreases as it propagates backwards in time. Whenever a gradient value goes below a specific level, it ceases to be useful in learning (Nguyen, 2018). In RNNs, layers that receive a minor gradient increase stop learning. All these are usually the first layers to appear. Since these layers don't learn, RNNs do not remember what they've been through in lengthier sequences, leading to a short-term memory.

LSTMs are a more refined kind of RNNs which make it much easier to remember prior events by introducing into the network a memory unit known as a cell (Yan, 2016). LSTM networks have internal units referred to as gates which control the flow of information. The gates can determine which information inside a series should be retained as well as which should be deleted. It has the ability to send pertinent data along a long chain of series in this way, allowing it to make predictions (Nguyen, 2018). Here, the RNN's vanishing gradient problem is solved. LSTM is highly adapted to categorize, analyze, and forecast unexpected time gaps in time series. The model is trained via back-propagation.

$$\begin{aligned} i_t &= \sigma(W_i \cdot [h_{t-1}, x_t] + b_i) \\ f_t &= \sigma(W_f \cdot [h_{t-1}, x_t] + b_f) \\ o_t &= \sigma(W_o \cdot [h_{t-1}, x_t] + b_o) \end{aligned}$$

Where i_t stands for input gate, f_t for forget gate, o_t for output gate, σ for sigmoid function, and w_x for

weight for the gate(x) neurons, h_{t-1} represents the preceding LSTM block's output (at timestamp $t-1$), x_t represents the current timestamp's input, and b_x represents the relevant gates(x)'s biases (Olah, 2015).

The LSTM model was developed with two instances, with one layer and with two layers. This was done to determine the effectiveness of the LSTM when the depth of the network is increased by one layer. In the first instance, the LSTM layer had one hidden layer with 1024 as number of nodes within the LSTM cell. The second instance, the LSTM layer had two hidden layers. There were 800 nodes in the first hidden layer and 224 nodes in the second hidden units.

GRU Layer

(Cho et al., 2014) suggested a gated recurrent unit that enables every recurring unit to gather relationships throughout temporal scales in an adaptable manner. The GRU, just like LSTM, features gating units which control the information flow within the unit, without the discrete memory cells. Both GRU and LSTM networks are capable of capturing long and short term dependencies in sequences, however GRU networks have fewer parameters and are hence faster to train.

A reset and update gate is a concept in a GRU network that helps guarantee memory isn't taken over by tracking short-term dependencies.

The following formula is used for calculating updating gate z_t for timestep t

$$z_t = \sigma(W^{(z)}x_t + U^{(z)}h_{t-1})$$

Update gate, (Kostadinov, 2017)

Whenever x_t is connected to a network layer, $W^{(z)}$ which is its own weight is used to be multiplied with x_t . The same is true for h_{t-1} , which stores data for prior $t-1$ units as well as being multiplied by its weight $U^{(z)}$. By using sigmoid activation function, the values are combined and the outcome is squeezed between 0 and 1.

This reset gate is utilized from the model to decide how much past data to forget and is calculated using the formula:

$$r_t = \sigma(W^{(r)}x_t + U^{(r)}h_{t-1})$$

Reset gate (Kostadinov, 2017)

This is the same formula as for the update gate. The weights and how the gate is used are the key differences. h_{t-1} and x_t are connected to the model, multiplied by their respective weights, summed, and the sigmoid function is applied.

To calculate a fresh content in the memory which utilizes the reset gate to retain pertinent historical data, this formula is used:

$$h'_t = \tanh(Wx_t + r_t \odot Uh_{t-1})$$

Current memory content (Kostadinov, 2017)

Finally, the network calculates the h_t vector, which carries the information for the current layer and feeds it downwards to the next network unit using the updating gate. It is done as follows:

$$h_t = z_t \odot h_{t-1} + (1 - z_t) \odot h'_t$$

At the current time step in the final memory
(Kostadinov, 2017)

In its implementation, the GRU layer had two instances as well. The first instance was where we had the GRU layer with one hidden layer and we used 1024 neurons or nodes within the GRU cell. In the second instance we had GRU layer with two hidden layers. The first hidden layer had 800 neurons and the second one had 224 neurons.

Dense Layer

This is the last layer in RNN model. The dense layer learns a weight matrix, where the first dimension of the matrix is the input data's dimensionality, and the second one is the output data's dimension. The layer utilizes activation functions to convert input signal of nodes in a neural network to an output signal (Walia, 2018).

Here, softmax action function was used. The Softmax function converts numbers into one-to-one

probabilities and returns a vector that describes the probability distributions of a set of possible outcomes (Kouretas & Paliouras, 2019). The function is typically used to calculate predicted losses when training a dataset. The input shape of the layer was (453668,) with the number of neurons was 1024.

IV. RESULTS AND DISCUSSION

a) Data Analysis

The operating system used for this experiment was Windows 10 64bit Professional Edition running on a computer hardware with a processing power of Intel(R) Core(TM) i5-6400 CPU @ 2.70 GHz, 2712 MHz, 4 Core(s), 4 Logical Processor(s). The hardware had physical random access memory of 8 GB and 9.74 GB of total virtual memory.

The RNN, LSTM and GRU models were developed using Tensorflow (<https://www.tensorflow.org/>). With these working environment specification, the time taken to preprocess data was 12.95 seconds.

Table 4.1 below shows percentage of detection accuracy of the three models, i.e. RNN, LSTM as well as GRU, after we trained and tested them for the same period of time. The epochs for each model in the specified period of time was not considered since our interest was in detection accuracy against the time taken for the model to get to optimum performance.

Table 4.1: Evaluated results of RNN. LSTM and GRU Models

Model Name	Accuracy at					
	5 minutes	20 minutes	40 minutes	60 minutes	80 minutes	100 min.
RNN models	8%	42.6%	67.7%	78.8%	82.9%	83.9%
LSTM models	21.8%	54.9%	77.6%	86.3%	92.2%	92.3%
GRU models	32.4%	56.4%	82.5%	86.6%	97.7%	98.6%

The initial detection accuracy percentage for each model was recorded after five minutes and the subsequent accuracy percentage were taken in the intervals of 20 minutes during the evaluation, as per the above table. There was no significant change in detection accuracy percentage after 100th minute in all the three models (RNN, LSTM as well as GRU).

In the first 5 minutes the RNN recorded accuracy of 8%, the LSTM recorded 21.8% accuracy and the GRU model achieved 32.4% accuracy. The highest detection accuracy percentage for all the three models were obtained after 100 minutes. With a precision of 98.6%, the GRU model was the most accurate. The LSTM model was the second highest and demonstrated a comparable accuracy of 92.3% in

detecting impersonation in an essay-based e-exam. In contrast, the performance of the RNN model was the lowest with accuracy score of 83.9%.

V. DISCUSSION OF RESULTS

The performance accuracy of RNN model was the lowest at 83.7% detection accuracy compared to other models because it has short-term memory problem. Whenever a series gets too long, the RNN model struggles to carry information from earlier to later time steps. The Vanishing Gradient Problem is the name for this weakness. To train an RNN model, you back-program the network through time step, then calculate the gradient at every time step. This gradient is being used to update training weights of the network. If the

previous effect of the layer on the current layer is low, then the gradient value would be low, and conversely. Whereas if gradient of the previous layer gets smaller, then gradient of the following layer will become even smaller. These gradients would decrease drastically while back-propagating. A lesser gradient would have no impact on weight updating. Therefore, the network doesn't really remember how prior inputs affect it, and due to this, the short-term memory loss occurs. The equation used to calculate the weight at any given time as show below:

$$h_t = \tanh(W_{hh}h_{t-1} + W_{xh}x_t)$$

Where h_t refers to the state of the memory at time t , and x_t refers to the impute at time t .

The best detection accuracy of GRU and LSTM models achieved at 98.6% and 92.3% respectively is attributed to the presence of memory cells which allow retention of any data without a lot of loss. They also have gates, which aid in the regulation of information flow to the cell state, and the gates can learn which data in a sequence is relevant and which is not.

The cell state h_t is equal to the output at time t , which is the first thing we see in a GRU cell.

$$\tilde{h}_t = \tanh(W \cdot [r_t * h_{t-1}, x_t])$$

The updated value or candidate that can replace the cell state at time t is shown in the preceding equation. It is determined by the cell state at the previous time step h_{t-1} and a relevance gate called r_t , which determines the significance of the previous cell state in the calculation of the present cell state.

$$r_t = \sigma(W_r \cdot [h_{t-1}, x_t])$$

As can be seen, the relevance gate r_t has a sigmoid activation with a value of 0 to 1, which determines how relevant previous information is, and is subsequently employed in the candidate for the updated value.

$$h_t = (1 - z_t) * h_{t-1} + z_t * \tilde{h}_t$$

The updated candidate \tilde{h}_t is a filtered mixture of the prior cell state h_{t-1} and the current cell state h_t . The update gate z_t determines how much updated candidate is required to calculate the current cell state, as well as how much of the prior cell state is preserved.

$$z_t = \sigma(W_z \cdot [h_{t-1}, x_t])$$

The update gate, like the relevance gate, is a sigmoid function that aids the GRU in retaining the cell state for as long as it is required. This is how a GRU stores memory, avoiding the Vanishing Gradient Problem that RNN models suffer from.

While the basic concept is the same, an LSTM is a more complicated network. The LSTM has three gates: the forget gate f_t , the update gate i_t , and the

output gate o_t . The GRU has two gates: the update gate and the relevance gate. The cell state was equivalent to the activation state/output in GRU, but they aren't quite the same in the LSTM. h_t represents the output at time t , and C_t represents the cell state.

$$\tilde{C}_t = \tanh(W_C \cdot [h_{t-1}, x_t] + b_C)$$

The cell state at time t has a candidate value \tilde{C}_t that depends on the previous output h_{t-1} and the input x_t , just like in GRU.

$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t$$

In LSTM, the current cell state C_t is a filtered version of the previous cell state and candidate value, just like in GRU. The filter is determined by two gates, the update gate and the forget gate, in this case. The value of $(1 - \text{updateGate}_t)$ in GRU is quite similar to the forget gate. Sigmoid functions are used in both the forget gate and the update gate.

$$f_t = \sigma(W_f \cdot [h_{t-1}, x_t] + b_f)$$

The forget gate determines how much of the previous cell state's information is necessary in the current cell state.

$$i_t = \sigma(W_i \cdot [h_{t-1}, x_t] + b_i)$$

In the current cell state, the update gate calculates how much of the candidate value \tilde{C}_t is necessary. Between 0 and 1 is the value of both the update and forget gates.

$$O_t = \sigma(W_o \cdot [h_{t-1}, x_t] + b_o)$$

$$h_t = O_t * \tanh(C_t)$$

Finally, we must determine what we will produce. This is a filtered representation of our current cell state. As a result, we run the cell state via a *tanh* layer to push the values between -1 and 1, then multiply it by a sigmoid activation output gate to ensure that we only output what we want.

GRU models are considerably simpler and require less computing power, thus they can be used to construct incredibly deep networks, however LSTM models are more powerful since they have a larger number of gates, but they demand a lot of computer effort.

The results of the RNN, LSTM, and GRU models' performance are distributed in curved graph to show their trend as shown in Figure 4.1 below:

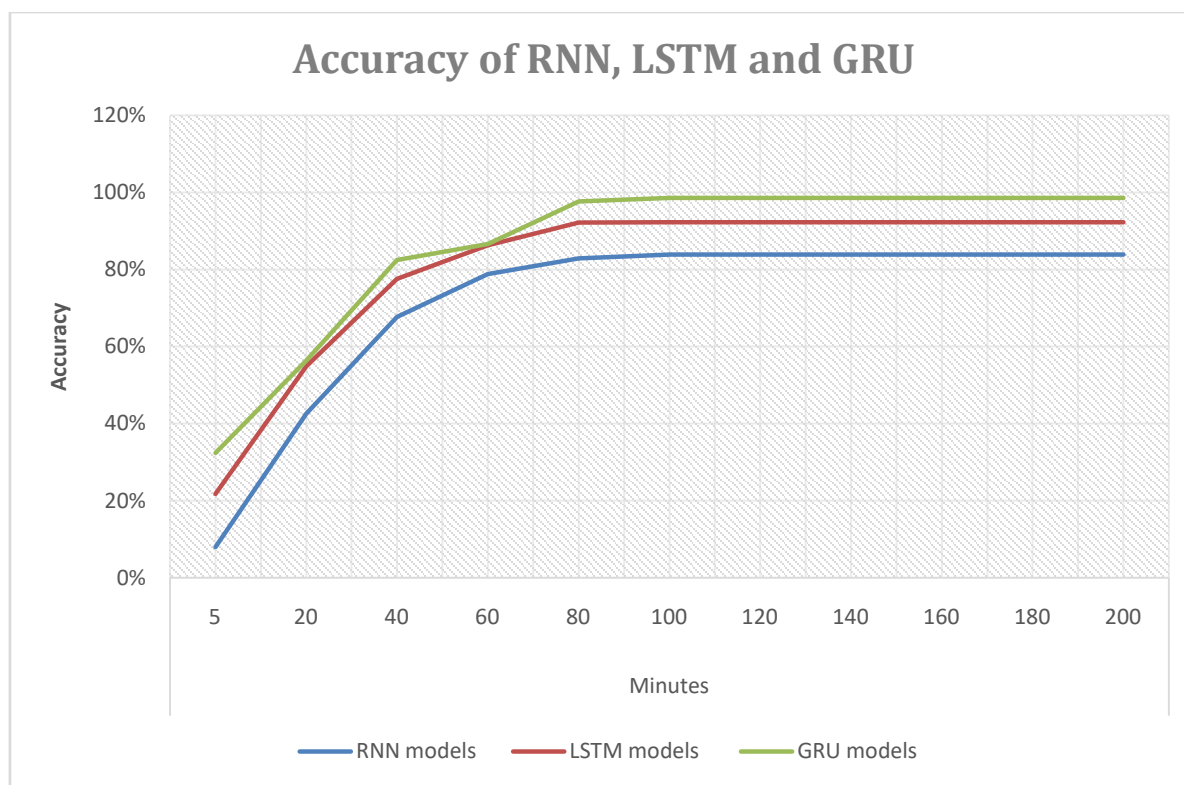


Figure 4.1: Performance comparison of RNN, LSTM and GRU Models

a) Comparison with other state of art models

The performance of the RNN, the LSTM and the GRU models in detecting impersonation in an essay-based e-exam was benchmarked against similar studies on detecting cheating in online examinations. The

comparison is based on performance accuracy of the models used in each study. A table comparing the accuracy of different studies in detecting cheating in e-exams is provided below.

Table 4.2: Comparison Models Accuracy in Similar Studies

Tool	Reference	Model Name	Best accuracy (%)
Impersonation Detector	This study	RNN models	83.9
		LSTM models	92.3
		GRU models	98.6
E-cheating intelligent agent	(Tiong & Lee, 2021)	Dense LSTM	95.32
Mouse-Tracker	(Sokout et al., 2020)	Support Vector Machine (SVM)	94
Keystroke dynamics	(Mattsson, 2020)	Gaussian Mixture Models with Universal Background Model	94.5

From this benchmarking, we find out that our GRU model has the highest accuracy of 98.6% compared to other models in similar studies. This makes our tool, Impersonation Detector, perform the best in detecting cheating in an online exam.

VI. CONCLUSION

The primary goal of this study was to develop a machine learning algorithm to detect impersonation and plagiarism during an essay-based exam in an E-learning environment. To achieve this, essays written by students were required to train the models. A text file with a predefined collection of English words was retrieved from an online pool of existing data to represent the

students' inputted words. Then, a real-time LSTM, RNN and GRU models were developed to detect impersonation and plagiarism in an essay-based exam using students' inputted words and characters extracted from those words.

The models were tested and evaluated using the time taken by each epoch in order to determine which model between RNN, LSTM and GRU resulted into the best detection performance. Finally, the best performing model from this was compared to other state-of-the-art best performing models in the same research area. This study found out that GRU our best performing model turned out to have achieved the highest performance accuracy of 98.6% in detecting

impersonation and plagiarism in e-exam. We could, therefore, conclude that the developed and trained machine learning algorithms are able to detect impersonation in an essay-based e-exam with detection accuracy of 98.6%.

In this research, we used a pre-existing dataset for training the models retrieved from an online pool of predefined text files with collection of words. Future studies can look into using data typed by actual students in a real online exam. This will allow researchers in this field to assess the performance of various approaches while avoiding errors caused by biases in the training data.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Aaron, L. S., & Roche, C. M. (2013). Stemming the tide of academic dishonesty in higher education: It takes a village. *Journal of Educational Technology Systems*, 42(2), 161-196.
2. Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Education and Information Technologies*, 25, 5261-5280.
3. Amidi, A., & Amidi, S. (2019). Recurrent Neural Networks cheatsheet: Cited 28-03-2019. Available at: [https://stanford.edu/%7Eshervine/teaching ...](https://stanford.edu/%7Eshervine/teaching...)
4. AV, S. K., & Rathi, M. (2021). Keystroke Dynamics: A Behavioral Biometric Model for User Authentication in Online Exams Research Anthology on Developing Effective Online Learning Courses (pp. 1137-1161): IGI Global.
5. Bawarith, R., Basuhail, A., Fattouh, A., & Gamalel-Din, S. (2017). E-exam cheating detection system. *Int. J. Adv. Comput. Sci. Appl*, 8, 176-181.
6. Britz, D. (2017). {nd}. WILDML, Recurrent Neural Networks Tutorial, Part1-Introduction to RNNs.
7. Brownlee, J. (2017). How to use word embedding layers for deep learning with keras. 4 October 2017.
8. Cavalcanti, E. R., Pires, C. E., Cavalcanti, E. P., & Pires, V. F. (2012). Detection and evaluation of cheating on college exams using supervised classification. *Informatics in Education*, 11(2), 169-190.
9. Chalapathy, R., Menon, A. K., & Chawla, S. (2018). Anomaly detection using one-class neural networks. *arXiv preprint arXiv:1802.06360*.
10. Chen, M., & Chen, C. (2017). Detect Exam Cheating Pattern by Data Mining. Paper presented at the FSDM.
11. Cho, K., Van Merriënboer, B., Gulcehre, C., Bahdanau, D., Bougares, F., Schwenk, H., & Bengio, Y. (2014). Learning phrase representations using RNN encoder-decoder for statistical machine translation. *arXiv preprint arXiv:1406.1078*.
12. Frederiks, A., Derrington, K., & Bartlett, C. (2021). Types of Exams. *Academic Success*.
13. Gomez-Barrero, M., Drozdowski, P., Rathgeb, C., Patino, J., Todisco, M., Nautsch, A., . . . Busch, C. (2021). Biometrics in the Era of COVID-19: Challenges and Opportunities. *arXiv preprint arXiv:2102.09258*.
14. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*: MIT press.
15. Graves, A., & Schmidhuber, J. (2005). Framewise phoneme classification with bidirectional LSTM networks. Paper presented at the Proceedings. 2005 IEEE International Joint Conference on Neural Networks, 2005.
16. Guo, W., Liu, X., Wang, S., Gao, H., Sankar, A., Yang, Z., . . . Chen, B.-C. (2020). Detext: A deep text ranking framework with bert. Paper presented at the Proceedings of the 29th ACM International Conference on Information & Knowledge Management.
17. Hashim, H., Yunus, M. M., Yusuf, N. S. M., Zanzuri, N. A. H., Ruslee, M. H., & Fakhruddin, S. M. (2018). Factors Influencing Students' Selection of Different Types of Essay in Examination. *Creative Education*, 9(14), 2334.
18. Hernández, J.-A., Ochoab, A., Muñoz, J., & Burlaka, G. (2006). Detecting cheats in online student assessments using Data Mining. Paper presented at the Conference on Data Mining| DMIN.
19. Hu, J., Gingrich, D., & Sentosa, A. (2008). A k-nearest neighbor approach for user authentication through biometric keystroke dynamics. Paper presented at the 2008 IEEE International Conference on Communications.
20. Janelli, M. (2018). E-learning in theory, practice, and research. *Вопросы образования*(4 (eng)).
21. Javed, A., & Aslam, Z. (2013). An intelligent alarm based visual eye tracking algorithm for cheating free examination system. *International Journal of Intelligent Systems and Applications*, 5(10), 86.
22. Kahiigi Kigozi, E., Vesisenaho, M., Hansson, H., Danielson, M., & Tusubira, F. (2012). Modelling a peer assignment review process for collaborative e-learning. *Journal of Interactive Online Learning*, 11(2), 67-79.
23. Kasliwal, G. (2015). Cheating Detection in Online Examinations.
24. Kausar, S., Huahu, X., Ullah, A., Wenhao, Z., & Shabir, M. Y. (2020). Fog-assisted secure data exchange for examination and testing in e-learning system. *Mobile Networks and Applications*, 1-17.
25. Kopun, D. (2018). A Review of the Research on Data Mining Techniques in the Detection of Fraud in Financial Statements. *Journal of Accounting and Management*, 8(1), 1-18.

26. Korman, M. (2010). Behavioral detection of cheating in online examination.
27. Kostadinov, S. (2017). Understanding GRU networks. Towards Data Science. Towards Data Science, Towards Data Science, 16.
28. Kouretas, I., & Paliouras, V. (2019). Simplified Hardware Implementation of the Softmax Activation Function. Paper presented at the 2019 8th International Conference on Modern Circuits and Systems Technologies (MOCASST).
29. Kuin, A. (2018). Fraud detection in video recordings of exams using Convolutional Neural Networks.
30. Le, N. Q. K., Yapp, E. K. Y., & Yeh, H.-Y. (2019). ET-GRU: using multi-layer gated recurrent units to identify electron transport proteins. BMC bioinformatics, 20(1), 377.
31. Mattsson, R. (2020). Keystroke dynamics for student authentication in online examinations.
32. Mittal, A. (2020). Understanding RNN and LSTM. URL: <https://towardsdatascience.com/understanding-rnn-and-lstm-f7cdf6dfc14e>. Accessed, 01-08.
33. Nguyen, M. (2018). Illustrated Guide to LSTM's and GRU's: A step by step explanation. URL <https://towardsdatascience.com/illustrated-guide-to-lstms-and-gru-a-step-by-step-explanation-44e9eb85bf21>.
34. Nicholson, C. (2018). A Beginner's Guide to Neural Networks and Deep Learning: The Artificial Intelligence Wiki <https://skymind.ai/wiki/neural-network>
35. Okada, A., Whitelock, D., Holmes, W., & Edwards, C. (2019). e-Authentication for online assessment: A mixed-method study. British Journal of Educational Technology, 50(2), 861-875.
36. Olah, C. (2015). Understanding lstm networks.
37. Pertile, S. d. L., Moreira, V. P., & Rosso, P. (2016). Comparing and combining Content-and Citation-based approaches for plagiarism detection. Journal of the Association for Information Science and Technology, 67(10), 2511-2526.
38. Rathgeb, C., Pöppelmann, K., & Gonzalez-Sosa, E. (2020). Biometric Technologies for eLearning: State-of-the-Art, Issues and Challenges. Paper presented at the 2020 18th International Conference on Emerging eLearning Technologies and Applications (ICETA).
39. Shilton, K., & Greene, D. (2019). Linking platforms, practices, and developer ethics: Levers for privacy discourse in mobile application development. Journal of Business Ethics, 155(1), 131-146.
40. Sokout, H., Purnama, F., Mustafazada, A. N., & Usagawa, T. (2020). Identifying potential cheaters by tracking their behaviors through mouse activities. Paper presented at the 2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE).
41. Soni, V. D. (2020). Global Impact of E-learning during COVID 19. Available at SSRN 3630073.
42. Tiong, L. C. O., & Lee, H. J. (2021). E-cheating Prevention Measures: Detection of Cheating at Online Examinations Using Deep Learning Approach--A Case Study. arXiv preprint arXiv:2101.09841.
43. Tzafilkou, K., & Protogeris, N. (2020). Monitoring Mouse Behavior in E-Learning Activities to Diagnose Students' Acceptance Items of Perceived Usefulness and Ease of Use. European Educational Researcher, 3(1), 21-27.
44. Ullah, A., Xiao, H., & Barker, T. (2019). A dynamic profile questions approach to mitigate impersonation in online examinations. Journal of Grid Computing, 17(2), 209-223.
45. Urosevic, A. (2019). Student authentication framework for Online exams outside of school.
46. Walia, A. S. (2018). Activation functions and it's types-which is better?(2017).
47. Yan, S. (2016). Understanding LSTM and its diagrams. MLReview.com.



End-User Business Intelligence Tools Adoption in a Higher Education Institution

By Irish Tejero - Dakay, Rosana J. Ferolin & Angie Ceniza - Canillo

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Abstract- This study examines how business intelligence (BI) tools are adopted in a higher education setting. It made use of the theories of Diffusion of Innovation (DOI), Technology Readiness Index, and Technology Acceptance Model (TAM). The psychometric features of the intended end-users were defined using TAM. The technology readiness of the users was assessed using TRI. The DOI was used to describe the innovation itself. The important factors for the adoption of the technology in this particular environment were identified through the examination of both quantitative and qualitative data. To gain a better understanding of the socio-technical system as a whole, a systems dynamics tool is presented to model the interaction of these elements along with the recommended interventions.

Keywords: *technology readiness, user acceptance, innovation, system dynamics, causal loop diagram.*

GJCST-D Classification: *FOR Code: 280213*



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Abstract- This study examines how business intelligence (BI) tools are adopted in a higher education setting. It made use of the theories of Diffusion of Innovation (DOI), Technology Readiness Index, and Technology Acceptance Model (TAM). The psychometric features of the intended end-users were defined using TAM. The technology readiness of the users was assessed using TRI. The DOI was used to describe the innovation itself. The important factors for the adoption of the technology in this particular environment were identified through the examination of both quantitative and qualitative data. To gain a better understanding of the socio-technical system as a whole, a systems dynamics tool is presented to model the interaction of these elements along with the recommended interventions.

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I. INTRODUCTION

A management dashboard, similar to a car or airplane dashboard, offers information regarding the working conditions of what or where the user is viewing. It is a system in which multiple components are constructed so that data can be processed and displayed. The back end of such a dashboard is a technical system that enables it to function as intended. The dashboard and the user are components of an additional system known as the human-computer interaction system. According to Brian Whitworth [11], social-technical systems emerge when cognitive and social interaction is mediated by information technology rather than the natural world.

a) This Study's Socio-Technical System

The technical system automates business intelligence data retrieval, analysis, transformation, and reporting. In addition, it includes data cleansing and, extracting and loading technologies. Such a technical solution was developed in a higher education institution (HEI), where large amounts of data are presumed to exist to support sound decision-making.

Its administrators are the end-users in this study. They monitor metrics that are crucial to the achievement of institutional goals and objectives. Prior to the availability of these business intelligence (BI)

tools, they were required to obtain foundational data from sources that maintain such data in an unstandardized format and varying structure. It took so much time to collect data that, if decisions had to be made, there would be little time for analysis. Thus, leading to decisions that may not be particularly sound.

Interaction refers to the communication between the end-user and the computer, as well as the manner in which the user and computer collaborate. This interaction occurs via the interface of the BI tools, in which the computer visualizes the data and the user draws insight from the information and formulates a plan of action based on whether they are working and contributing to the university's ultimate objective.

This institution's deployment of a BI tool was primarily motivated by the need to facilitate such activities in an efficient manner. However, regardless of how information technology intends to aid organizations, technology adoption issues may arise and impede any potential benefits [9]. In order to optimize its intended benefits, an examination of the degree of end-user adoption of this business intelligence product is being conducted.

b) Focus of the Study

In the context of the generalizability concept of theories, the Technology Acceptance Model (TAM), Technology Readiness Index (TRI), and Diffusion of Innovation (DOI) are utilized to characterize the intended users of the technology in a higher education institution and generate recommendations on how to best approach the intended users and popularize the information technology (IT).

This study aims to establish the following:

- The state of adoption of the technology by its intended users
 - The innovation itself, as may be described by the major elements that influence adoption of an innovation, according to the theory of DOI
 - The technological readiness index (TRI) of the intended users at this higher education institution as well as the prospective adopter categories into which these users fall based on previous research employing TRI
 - The Technology Acceptance Model-based psychometric profile of this HEI's intended users, as measured by their behavioral intent to adopt technology.

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- To model an effective means of increasing the adoption of BI tools in HEIs

II. METHODOLOGY

A review of the Diffusion of Innovation (DOI) Theory, the Technology Readiness Index (TRI), and the Technology Acceptance Model (TAM) was conducted [1]. The concept gained from such a review, though intended to enhance the adoption and use of intelligent waste management systems in smart cities, is utilized in this investigation. The conclusion of the study was a recommendation to integrate the three adoption models, as each model complements the deficiencies of the others.

E.M. Rogers created the DOI Theory in 1962, making it one of the oldest social science ideas. It originates in communication to describe how an idea or product gets momentum and spreads within a certain demographic or social system over time. This theory considers the innovation itself to be the primary element affecting adoption, which neither the TRI Model nor the TAM Model account for. It investigates the perceived characteristics of the innovation in terms of relative advantage, compatibility, complexity, trialability, and observability.

The Technology Readiness Index (TRI) examines four dimensions of technological beliefs that

influence a user's techno-readiness: innovativeness, optimism, discomfort, and security. The first two are contributory, whereas the latter two are inhibiting. The greater the level of technology readiness, the greater the level of satisfaction and behavioral intent. This theory enables the measurement of user readiness, something the Technology Acceptance Model does not cover. According to Colby and Albert [4], the construct can be regarded as a gestalt of mental enablers and inhibitors that collectively influence a person's propensity to adopt new technology.

The Technology Acceptance Model provides a psychometric description of the behavioral intent of technology users. It takes into account four constructs: perceived usefulness, perceived ease of use, attitude towards using and behavioral intention to use. This permits the categorization of the users' perception, which is not addressed in the DOI.

Figure 1 illustrates how the investigation of the adoption of the BI tools in an HEI is carried out. The characteristics of the intended users are gathered via a survey questionnaire, while the features of the technology are gathered from the available documentations, such as presentation documents, workshop notes, and project post mortem analysis.

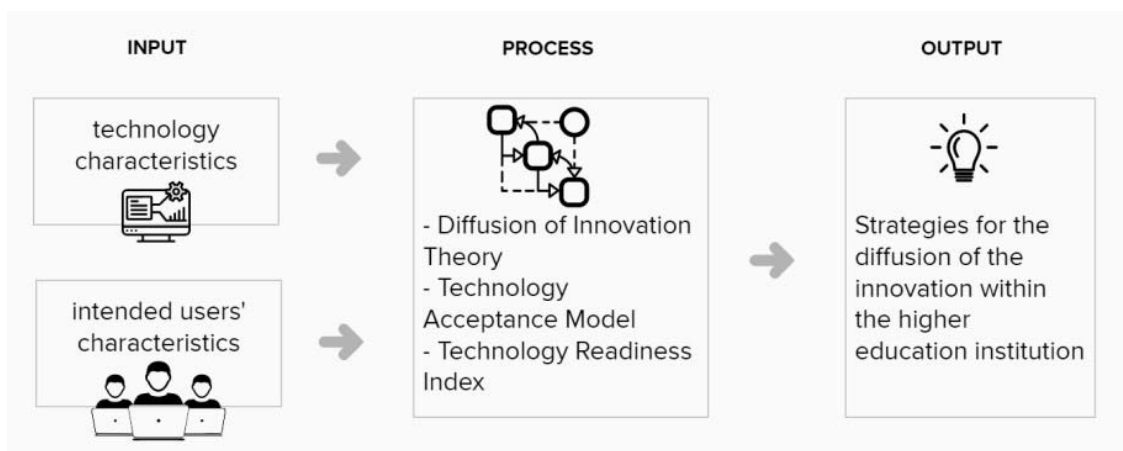


Figure 1: Methodology employed in this study

The theories are then used to process these inputs to produce a model that will serve as the basis for strategies in increasing the adoption of the BI tools.

a) Quantitative Method to Determine Intended Users' Characteristics

The initial questionnaire was distributed to 10 respondents for data standardization reliability analysis. Following the standardization and reliability analysis, the Cronbach's alpha coefficient was calculated to demonstrate the interrelationships between each factor and to assess its validity and internal reliability. The

Cronbach analysis indicates a satisfactory level, hence all constructs were retained.

To ensure confidentiality of the data, the compilation of responses was stored and the questionnaire itself was distributed via the university's Google Workplace account, with access restricted to university employees and the researchers.

Two questions were added in the survey to eliminate insincere answers. Forty-eight percent (48%) of the replies submitted were eliminated because they were deemed "insincere." The remaining 52 percent is being analyzed.

Using a 5-point Likert scale, user acceptance and technological readiness were assessed. Respondents were required to assess their level of agreement on a 5-point Likert scale for each item (1 = strongly disagree, 5 = strongly agree) and answer six demographic questions.

b) Qualitative Method to Describe Perceived Characteristics of the Innovation

From the introduction and subsequent stages in the deployment of the BI tool, which is the innovation referred to in this study, suitable documentation and field notes were maintained along the journey and used as data sources in this study.

The relative advantage of the technology is derived from related memos and communications thread that explicitly articulate the said advantage of the BI tools. While there are project documents available, the perspective of the management as one of the end-users of the tool was purposefully chosen as the source document since it would characterize how the management perceived the relative advantage of the new methods over the old ones.

Learning sessions with small groups of individuals who do not necessarily hold managerial positions was offered for voluntary participation. Compatibility, or the degree to which an innovation is regarded to be consistent with existing values, past experiences, and the needs of potential adopters, is extracted from the notes derived from these learning sessions. The purpose of the workshops then was to persuade potential adopters that their processes could be streamlined with the use of such information technology.

In the project's status reports, the progress of the deployment and interaction of the components of the technical system and how the end-users understood

what's going on are being recorded. From such documents, the perceived complexity of the innovation was deduced.

A workshop was arranged to document the utilization of the BI tool in its early phases. This is where trialability, the extent to which the innovation was experimented, as perceived by the participants, can be sourced.

Understanding the perceived observability of the invention can be obtained from a variety of sources, such as excerpts from the president's report to the board of trustees; where the innovation is utilized on an institutional level; and documents from accreditation preparations and continuity planning during the pandemic.

An analysis of these qualitative data, though primary intended to extract perceived characteristics of innovation, can also provide additional context for the survey results.

III. DISCUSSION OF THE RESULTS

a) The Intended Users' Characteristics in Terms of Technology Readiness

Individual personality and demographics may influence technology acceptance, as suggested by technology acceptance researches.

Table 1 displays the composition of the study's sample population. Slightly more than half of the responses are academic employees, and 24.59 percent are also academic employees or teaching staff but are handling administrative functions. The remainder are administrative personnel or non-teaching staff, with 18.03% who are purely administrative employees and 6.56% with teaching load. 57.38% of these employees have been at the university for more than 15 years.

Table 1: Profile of the respondents in terms of employee categories and number of years in the institution

	1-5 years	10-15 years	5-10 years	> 10 years	Total %
Academic employee	11.48%	3.28%	4.92%	31.15%	50.82%
Academic employee with *	3.28%	1.64%	6.56%	13.11%	24.59%
Administrative employee	4.92%	1.64%	0.00%	11.48%	18.03%
Administrative employee w/ **	1.64%	3.28%	0.00%	1.64%	6.56%
Total Percentage	23.32%	9.84%	11.48%	57.38%	100.00%

* with administrative task | **parttime teaching load

Table 2 shows the mean scores for each factor used to calculate the TRI. The mean value of optimism is greater than that of innovativeness, whereas the mean value of insecurity is greater than that of discomfort. It

surpasses the contributing factor of innovativeness. Thus, it is evident that the predominant personality trait of these end-users is optimism coupled with insecurity.

Table 2: Mean Values of the TRI Factors

	Mean
Contributors	
innovativeness	3.2098
optimism	4.0983
Inhibitors	
discomfort	3.1366
insecurity	3.4819

Certain studies analyze TRI in conjunction with the following user classifications: explorers, pioneers, skeptics, paranoid, and laggards, as shown in Table 3. Based on an individual's technology readiness score

and the TRI, Badri et. al [3] used cluster analysis to further classify technology users further into these five technology-readiness segments.

Table 3. Characteristics of the five segments with TRI [3]

	Optimism	Innovativeness	Insecurity	Discomfort
Explorers	high	high	low	low
Pioneers	high	high	high	low
Skeptics	low	low	low	low
Paranoids	high	high	high	low
Laggards	low	low	high	high

Based on the high optimism and insecurity scores of end-users in this study, they may be either pioneers, as early adopters, or paranoids, as the late majority in social categorization. Inferring a composition of pioneers and paranoid individuals whose insecurity, when handled, may eventually join the adopters.

It is possible to calculate a mean total technological readiness (TR) score by subtracting

inhibitors from contributors. A positive TRI is suggestive of a technology-ready orientation, whereas a negative TRI for an orientation that was not technology-ready [7].

Sixty-four (64%) percent of the population are tech-ready while the 36% are non tech ready, meaning that their inhibiting factors outweigh their contributing factors. Figure 2 illustrates the breakdown based on employment categorization.

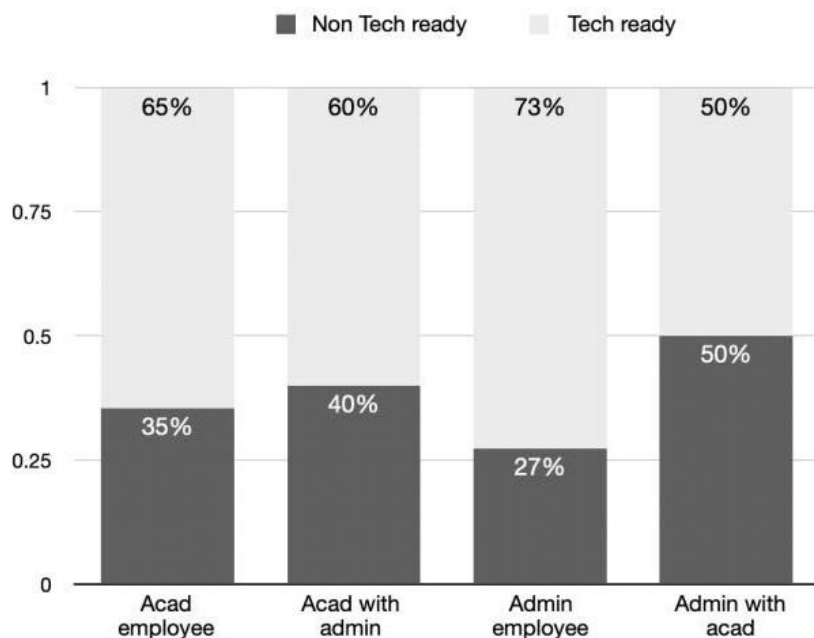


Figure 2: Breakdown based on employment Categorization

Purely administrative employees appear to have a greater proportion of technology-ready than non-technology ready employees. This may be due to their consideration of BI tools while creating performance scorecards for their quality management system. On the

other hand, the proportion for academic employees is lower, possibly because they are more focused on their teaching obligations and the current phase of the project is more focused on management metrics.

TRI, which is calculated by reversing the code for inhibiting factors, yields the value of 3.1503. According to the study by Parasuraman [8], this indicates that the higher education institution has MEDIUM technology readiness.

b) *The Intended Users' Characteristics in Reference to TAM*

The dynamics of the interaction between people and automation are essential to the performance and survival of developing technologies. The Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB) will continue to be key tools for researchers wishing to examine the elements influencing consumers' adoption intentions of various technologies [6], where TAM can be accepted as an adaptation of the TPB model [2].

The correlation values of the constructs of technology acceptance model of this study concur with other studies suggesting that perceived ease of use correlates with attitude and, consequently, the intention to use the model.

When optimism, which in the technology-readiness calculation had the highest mean value, is taken into consideration, it shows a high correlation to perceived usefulness and perceived ease of use (Figure 3). Innovativeness, the other contributing factor, has relatively lower correlation values than optimism but nevertheless contributed positively. On the other hand, insecurity and discomfort have negative and practically zero correlation values, which consistently suggests that they are also inhibiting factors in the context of this particular HEI.

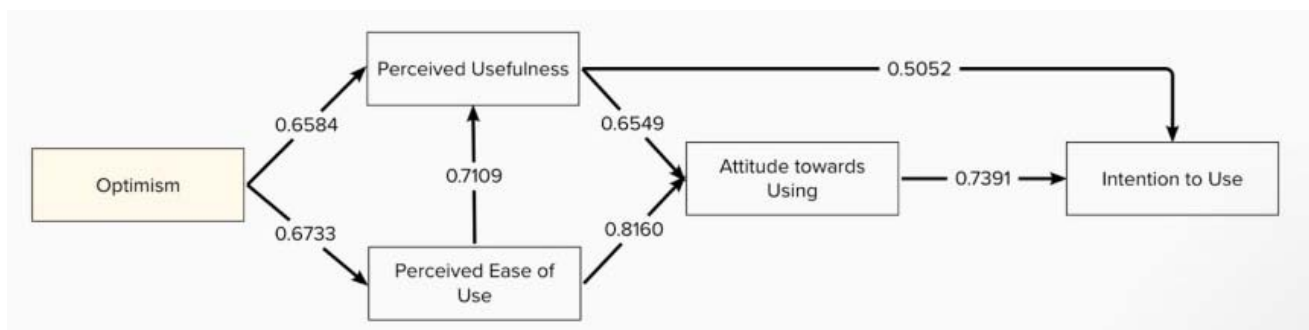


Figure 3: Correlation of Factors

Recalling the instances when the adoption of this BI tool was pushed, it had always been about influencing the perceived usefulness. Survey results from this study would in fact confirm the effectiveness of such communication as evidenced by a high mean value of perceived usefulness in Table 4 below. Additionally, computation shows that perceived

usefulness has mean values that are higher than perceived ease of use. Given that perceived ease of use correlates more strongly with attitude towards using than perceived usefulness, it may be advantageous to make steps to provide end users a more accurate perception of the ease of use.

Table 4: Mean Values of the TAM Constructs

	Mean
Perceived usefulness	4.2172
Perceived ease of use	3.8000
Attitude to use	3.9645
Intention to use	4.2582

c) *The innovation in the context of the frames of the DoI theory*

i. *Relative Advantage*

Top management can be reported as saying that the new reporting method has a relative benefit over the old one as,

It is very much in line with what I would like the QR of each department to look like - a graphic summary of where they are. They can always supplement the chart with a narrative report if they like; the important thing is that their status is objectively presented so that the achievement status is unmistakable, but also where the gaps are. Planning

should then concentrate precisely where the gaps are. I think our instruments are beginning to take on more communication, assessment and planning values. (P1)

Additionally, communications emanating from the realized relative advantage as in the memo with the statement, "Please be notified that at its regular meeting yesterday, the Cabinet decided to adopt a common reporting template for all academic departments. These instruments are also intended to support forwarding planning." help in the adoption of the innovation.

ii. Compatibility

One example of the many instances in which one can affirm that the end users can resonate to the innovation being deployed as compatible with their values and experiences is the local phrase, "sakto ingon ana jud ang nahitabo, maong dapat naa tay ingon nga system," which means, "exactly, that is exactly what is happening, that is why we need a system like this." This is regarded to have influenced a favorable attitude towards the use of such technology.

iii. Complexity

Many of the supposedly action plans on the narrative sections of the BI tool are clarifications on the connections between data sets, which increases the perception of the technology's complexity. They consider it excessively complex when they are clarified that data sets must be addressed at the source and processed in a specific manner. Consequently, this influenced the non-utilization of the technology.

iv. Trialability

The innovation gave middle management the opportunity to test the system out gradually, beginning with familiar interfaces to actual BI interface in the end. The number of people taking part in the trial stages has grown over time. According to a project document on the BI interface, 14 middle managers are already mindful of the management metrics at the tactical and operational level, while 4 have started to reflect on them, 4 have started to consider them, and 2 were completely unaware of them. This is suggestive of a positive attitude toward the innovation, which may have been prompted by the fact that the innovation allowed them to test the system.

v. Observability

End-users are not seeing the benefits of the innovation, as evidenced by comments like, "How come we are no longer asked for the reports like before?," "This X office is still asking for these documents. They are not at all utilizing what we have submitted to the system," and "I thought you will just extract it from the

a result, people are developing a negative attitude toward innovation because they start to believe that the system is not actually being used.

In summary, relative advantage, compatibility, and trialability produced good reactions to the innovation, whereas observability and complexity produced unfavorable ones. Demands for the inclusion of the use of these BI tools in recently drafted institutional policies and requests for informational materials or orientation sessions from a number of stakeholders are indicative of the need to address these two frames.

IV. CONCLUSIONS AND RECOMMENDATIONS

The analysis of the gathered data from this higher education institution in the context of the three theories allowed for an understanding of the factors contributing to the gaps in the adoption of the technology. The study found that insecurity, which is impeding technology readiness; perceived ease of use, which is delaying technology acceptance, and the complexity and observability of the technology, which are influencing the formation of unfavorable attitude towards the innovation, are the areas that need to be addressed.

Interventions will be necessary to get this socio-technical system close to fully utilizing the BI tool as the best course of action, as expected and as desired in this study. This study is not, however, merely settling on recommendations addressing the causes of the specific event that this study is looking at, which is adoption rate, in isolation. Rather, it is taking into account that such a system is complex in the sense that it involves interacting cross-functional processes and entails strategic level considerations rather than merely operational actions. Therefore, this study uses a system thinking model called a causal loop diagram to show how cause and effect operate from the perspective of the system (Figure 4).

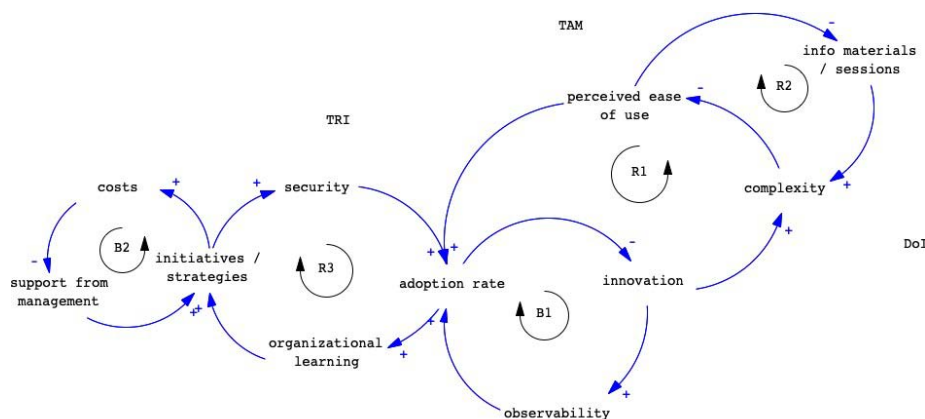


Figure 4: Causal Loop Diagram

Kim [5] claims that in the context of systems thinking, there are two fundamental loops: reinforcing and balancing, which are comparable to the building blocks of complex social systems and when combined, produce a complex system that managers are expected to manage. The top management of this higher education institution must therefore think about managing the interaction of the loops produced by the factors and the potential interventions.

a) *Reinforcing loops*

These loops will continue in the direction of change of the variables within the loop. Accordingly, as the cause increases, the effect rises above what it would have been otherwise, and as the cause reduces, the effect falls below what it would have been otherwise [10].

- R1. The complexity of an innovation has an impact on how quickly people adopt it because, as complexity rises, people perceive technology as being harder to use.
- R2. The management of users' perception of ease of use may involve the increase of the provision of orientation sessions and informational resources. But it's also important to note that as information materials become more abundant, complexity may also rise, as in information overload. Understanding such dynamics is necessary to determine the best strategy for delivering these information or orientation sessions.
- R3. The implementation of these business intelligence tools aims to improve the institution's capacity for reflection, which will help decision-makers make wise choices when considering measures to address problems with technological readiness like insecurity and, as a result, boost adoption rates.

b) *Balancing loops*

In contrast, balancing loops prevent further changes in one direction. If the cause increases, the effect reduces below what it would have been otherwise, and if it decreases, the effect increases above what it would have been otherwise [10].

- B1. The more the necessity for the innovation's observability, which may also include certain reinventions of earlier versions, the better the adoption rate will be until the use of business intelligence tools becomes institutionalized.
- B2. As the cost of implementing actions or strategies to overcome barriers to technology readiness rises (i.e. insecurity), management support could decline, necessitating careful consideration of cost-effective options.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Ajwang, S. O., Abila, J. O., & Tejero-Dakay, I. (2021). Adoption conceptual model for Intelligent Waste Management in smart cities: Theoretical review. *International Journal of Computing Sciences Research*, 5(1), 426–440. <https://doi.org/10.25147/ijcsr.2017.001.1.50>
2. Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behaviour and Human Decision Processes*, 50 (2), 179-211
3. Badri, M., Al Rashedi, A., Yang, G., Mohaidat, J., & Al Hammadi, A. (2014). Technology readiness of school teachers: An empirical study of measurement and segmentation. *Journal of Information Technology Education: Research*, 13, 257–275. <https://doi.org/10.28945/2082>
4. Colby, C & Albert T. (2003). The role of culture in technology adoption in the US: Results of the African American and La-tino technology readiness survey. Great Falls, VA: Rockbridge Associates.
5. Kim, D. (2017, January 7). Reinforcing and balancing loops: Building Blocks of Dynamic Systems. *The Systems Thinker*. <https://thesystemsthinker.com/reinforcing-and-balancing-loops-building-blocks-of-dynamic-systems/>
6. Koul, S., & Eydgahi, A. (2017). A systematic review of technology adoption frameworks and their applications. *Journal of Technology Management & Innovation*, 12(4), 106–113. <https://doi.org/10.4067/s0718-27242017000400011>
7. Lee, W., Chiu, W., Chiang, M., & Chiu, C. (2009). Technology readiness in the quality-value-loyalty chain. *International Journal of Electronic Business Management*, 7, 112-126.
8. Parasuraman, A. (2000). Technology Readiness Index (TRI) A Multiple-item Scale to Measure Readiness to Embrace New Technologies. *Journal of Service Research*. 2(4): 307-320
9. Seneler, C. O., Basoglu, N., & Daim, T. U. (2008). A taxonomy for technology adoption: A human computer interaction per-spective. *PICMET '08 - 2008 Portland International Conference on Management of Engineering Technology*. <https://doi.org/10.1109/picmet.2008.4599843>
10. Sterman, J. D. (2020). *Business Dynamics: Systems Thinking and modeling for a Complex World*. McGraw Hill Education (India) Private Limited.
11. Whitworth, Brian. (2006). "Social-Technical Systems." *Encyclopedia of Human Computer Interaction*, Idea Group Publishing, pp. 533–541.





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Entity Matching for Digital World: A Modern Approach using Artificial Intelligence and Machine Learning

By K. Victor Rajan & Edward Lambert

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Abstract- Entity matching is the field of research solving the problem of identifying similar records which refer to the same real-world entity. In today's digital world, business organizations deal with large amount of data like customers, vendors, manufacturers, etc. Entities are spread across various data sources and failure to correlate two records as one entity can lead to confusion. Relationships and patterns would be missed. Aggregations and calculations won't make any sense. It is a significant data integration effort that often arises when data originate from different sources. In such scenarios, we understand the situation by linking records and then track entities from a person to a product, etc. There is appreciable value in integrating the data silos across various industries.

Keywords: *entity matching, entity resolution, record linkage, de-duplication, machine learning.*

GJCST-D Classification: *FOR Code: 170203*



ENTITYMATCHINGFORDIGITALWORLDAMODERNAPPROACHUSINGARTIFICIALINTELLIGENCEANDMACHINELEARNING

Strictly as per the compliance and regulations of:



Entity Matching for Digital World: A Modern Approach using Artificial Intelligence and Machine Learning

K. Victor Rajan^α & Edward Lambert^σ

Abstract- Entity matching is the field of research solving the problem of identifying similar records which refer to the same real-world entity. In today's digital world, business organizations deal with large amount of data like customers, vendors, manufacturers, etc. Entities are spread across various data sources and failure to correlate two records as one entity can lead to confusion. Relationships and patterns would be missed. Aggregations and calculations won't make any sense. It is a significant data integration effort that often arises when data originate from different sources. In such scenarios, we understand the situation by linking records and then track entities from a person to a product, etc. There is appreciable value in integrating the data silos across various industries. For example, if a customer record is listed multiple times with purchases across two different store databases due to different spellings of name or a typing error in the phone number, a duplicate email from the company would only be a missed sale opportunity, or worse could cause the customer to mark the company's marketing emails as spam. Organizations put huge effort in deduplication through record matching as it really helps in operational excellence. Traditional approaches include manually checking the names, phone numbers etc., and marking duplicate entries. This is time consuming and might involve huge labor cost. Often computer software is used to automate this process by comparing the attributes and applying rule-based techniques. Traditional programs can assess equality and perform mathematical comparisons but cannot understand fuzzy matching on their own. In this research paper, we present how Artificial Intelligence and Machine Learning (AI/ML) can be used for entity matching and propose a taxonomy of machine learning algorithms for entity matching. We propose a two-step methodology for entity matching. In the first step, we apply fuzzy matching techniques and generate feature vector of similarity scores. This produces a data set of feature vectors under two classes namely Duplicate (D) and Unique (U). In the second step, a well-trained machine learning model tries to predict the unknown real-world entities using supervised learning. Our experiments show highly accurate results and can be used in many practical use cases like customers deduplication across e-commerce sites, retail stores, hospitals, pharmacies, etc.

Keywords: *entity matching, entity resolution, record linkage, de-duplication, machine learning.*

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I. INTRODUCTION

Our world is moving towards digitized business. This opens up numerous avenues to increase revenue through digital marketing, sales forecast, etc. Huge amount of historical data is available to analyze customer behavior, buying patterns and make predictions for future. However, it also comes with challenges along the way. A substantial amount of the value to be harvested from digitization depends on successful integration of large volume of data from different sources. Unfortunately, many of the existing data sources do not share a common frame of reference. For example, let us say, a marketing team wants to use statistics from retail stores, e-commerce sites etc., to find out potential buyers for a product. Sadly, these two systems do not refer to customers in the same way – i.e., there are no common identifiers or names across the two systems. Duplicate emails or messages may be sent to same customer again and again unless customer records are tagged uniquely. Recommendations to a customer and an effective marketing scheme cannot be performed based on distinct data silos. A group of similar problems has been studied for a long time in a variety of fields under different names like entity resolution, de-duplication etc. Entity matching is the field of research dedicated to solving the problem of matching which records refer to the same real-world entity. Organizations often struggle with a plethora of customer data captured multiple times in different sources by various people in their own ways. Despite having been studied for decades, entity matching remains a challenging problem in practice. In general, there are several factors that make it difficult to solve:

Poor Data Quality: Real-world data is seldom completely structured, cleansed, and homogeneous. Data originating from manual insertion may contain alternative spellings, typos, or fail to comply with the schema (e.g., mixing of first and last name).

Dependency on Human Knowledge: Same data may be represented in different formats by various users like abbreviations, suffixes, prefixes, etc. To perform matching, our solution must interact with human experts

and make use of their knowledge. Human interaction in itself is a complex domain.

For example, let's look at a customer table from which analyst is trying to identify distinct customers.

Table 1: Customer Records with Duplicates

No.	Name	Address	Email
1	Alexander Great	2/13, Philip Street, Paris, France	alex.gr@gmail.com
2	Alexander G	2/13, Philip Street, Paris	n/a
3	Alexander Graham	10, Middle Street, New York	alex.gr@yahoo.com

Without manual inspection and good understanding of geographical locations, it is difficult to guess whether record 2 is duplicate of 1 or 3. Somewhat ironically, as often pointed out, entity matching suffers from the problem of being referenced by different names, some referring to the exact same problem, while others are slight variations, generalizations, or specializations. In addition, the names are also not used completely consistently. Deduplication or duplicate detection is the problem of identifying records in the same data source that refer to the same entity and can be seen as the special case $1 = 2$. Given such representation variations, an unprecedented number of permutations and combinations, the entity matching would be a herculean job when we handle large volume of data. Artificial intelligence and machine learning has become an essential part of multiple research fields in recent years, most notably in natural language processing and computer vision, which are concerned with unstructured data. Its most prominent advantage over systematic approaches is its ability to learn features instead of relying on step-by-step calculations.

a) Problem Definition

Researchers have already realized the potential advantage of machine learning for entity matching. In this paper, we aim to propose a machine learning model for entity matching.

Let E be a data source containing entities. E has the attributes (A_1, A_2, \dots, A_n) , and we denote entities as $e = (e_1, e_2, \dots, e_n) \in E$. A data source is a set of records, and a record is a tuple having a specific schema of attributes. An attribute is defined by the intended semantics of its values. So, entities $e_i = e_j$ if and only if attributes a_i of e_i are intended to carry the same information as attributes a_j of e_j , and the specific syntactics of the attribute values are irrelevant. Attributes can also have metadata (like a name) associated with them, but this does not affect the equality between them.

The goal of entity matching is to find the largest possible binary relation $M \subseteq E \times E$ such that a and b refer to the same entity for all $(a, b) \in M$. In other words, we would like to find all record pairs across data source

that refer to the same entity. We define an entity to be something of unique existence. Attribute values are often assumed to be strings, but that is not always the case. The records are assumed to operate with the same taxonomic granularity. In this research, we will stick to the definition of deduplication (or duplicate detection) as the problem of identifying which records in the same data source refer to the same entity.

The remainder of this paper is organized as follows. We discuss related work in section 2. In Section 3, we formally formulate the problem and propose our methodology. Section 4 describes how our approach is used to detect similarity in a real-world data set and the results of our experiment are explained. Finally, the paper is concluded in Section 5.

II. RELATED WORK

Entity resolution, record linkage, deduplication and entity matching are frequently used for more or less the same problem as we mentioned earlier. It is a technique to identify data records in a single data source or across multiple data sources that refer to the same real-world entity and to correlate the records together. In entity matching, the strings that are nearly identical, but not exactly the same, are matched without explicitly having a unique identifier. Entity matching is crucial as it matches non-identical records despite all the data inconsistencies without the constant need for formulating rules. By combining databases using fuzzy matching, we can refine the data and analyze the information. Comparing big data records having non-standard and inconsistent data from diverse sources that do not provide any unique identifier is a complex problem. In this section, we present an overview of the previous work done by researchers in entity matching. Researchers use two major techniques as shown below:

Rule-Based: Rule-based systems perform matching based on a set of manually crafted rules. To match any two records of the same entity, various string-based comparison rules are defined. Each record then would run with every other record on all these rules to decide if the two are identical.

Automatic: These systems rely on machine learning algorithms to learn from data. Computers first learn from data provided for training so that they can later make predictions on unknown input data items.

Usually, a rule-based system uses a set of human-crafted rules to help identify subjectivity. As the number of records increases, the number of comparisons increases exponentially in rule-based systems. With large volume of records, rule-based data matching becomes computationally challenging and unscalable. Automatic methods, contrary to rule-based systems, do not rely on manually crafted rules but on machine learning algorithms. There has been an uptick in interest on machine learning as a solution for entity

matching in recent years. We note that this process is machine-oriented and does not highlight any iterative human interactions or feedback loops. First, there are several books that provide an overview. Christen [15] is a dedicated and comprehensive source on entity matching. Anhai Doan et al. [2] and Talburt [10] introduce entity matching in the context of data quality and integration. Quite early on, statisticians dominated the field of entity matching. Probabilistic methods were first developed by Newcombe et al. [15]. A solid theoretical framework was presented by Fellegi and Sunter [9]. Blocking, which is surveyed by Papadakis et al. [8, 9], is considered an important subtask of entity matching. This is meant to tackle the quadratic complexity of potential matches. Christophides et al. [24] specifically review entity matching techniques in the context of big data. Significant research has gone into active learning approaches by Arvind [3], Jungo [11] and Kun [12]. Interestingly, Jungo et al. [11] use a deep neural network in their active learning approach. Such human-in-the-loop factors are often crucial for entity matching in practice as analyzed by Anhai et al. [2]. Many state-of-the-art models for natural language processing are based on deep learning networks. Central to all these approaches is how text is transformed to a numerical format suitable for a neural network. This is mainly done through embeddings, which are translations from text units to a vector space – traditionally available in a lookup table. The text units will usually be characters or words. An embeddings lookup table may be seen as parameters to the network and can be learned together with the rest of the network end-to-end. That way the network is able to learn good, distributed character or word representations for the problem at hand. The words used in a data set are often not unique to that data set, but rather just typical words from some language. Therefore, one may often get a head start by using pretrained word embeddings like word2vec, GloVe or fastText, which have been trained on enormous general corpora. One particular influential recent trend is the ability to leverage huge pretrained models that have been trained unsupervised for language modeling on massive text corpora similar to what the computer vision community has done for image recognition. They produce contextualized word embeddings that consider the surrounding words. These contextual embeddings can be used as a much more powerful variant of the classical word embeddings, but as popularized by BERT. However, with neural networks, the actual line between the initial feature extraction part and the rest is an artificial one and not necessarily indicative of how the networks actually learn and work. But they do reflect design decisions to a certain degree and help us compare them in that regard. Often these approaches use pre-built word embeddings for a specific set of values. Our research focuses on entity matching based on attributes where

the number of attributes may vary from one use case to another. Also, we try to address the problem of multiple domains, i.e., the machine learning model must be suitable for entities from various categories like customers, products, vendors, etc. In this paper, we present a machine learning model which will perform attribute-based matching of entities. The type, number of attributes may vary over the time, but our approach does not require re-design. Merely a re-training of the model on the new data set will suffice. The model is robust enough to handle slight variations in ordinality and type of the attributes.

III. METHODOLOGY

Most neural network-based methods perform entity matching by producing so-called knowledge graph embeddings, embeddings of entries which incorporate information about their relationship with other entries. The embeddings work mainly at word level or character level. Embeddings offer neural networks an initial mapping from the actual input to a suitable numeric representation. When we surveyed the earlier methods, we found that researchers focus on explicit levels of representation of entities into single word or text. However, we try to address two problems mainly,

- How to perform matching of entities containing attributes of different data types, say string, boolean, and categorical?
- Will the machine learning algorithm continue to work even if the number of attributes change over the time?

Let's say there are few entities in a data set as shown in Table 1. It has two duplicates. Following is a generalized notation.

Table 2: Labelled Entities with Multiple Attributes

Entity	Attribute1	Attribute2	Attribute3	Label
e1	a11	a12	a13	Duplicate (e1 = e2)
e2	a21	a22	a23	
e3	a31	a32	a33	Unique

The entities e1 and e2 are same, though they might vary slightly in their attribute values but have similar meanings. Our aim is to design an approach which will combine the attribute level similarity and artificial intelligence to classify entities as unique or duplicate. We propose a two-step methodology where the first step involves calculating attribute level similarity scores and the second step is classification using supervised learning. Feature extraction involves use of a distance function for every pair of attributes. It transforms every pair of entities into numerical vector. For any give pair of attributes (a_{ij} , a_{kj}), the distance function δ produces a numerical value such that

$$0 \leq \delta(a_{ij}, a_{kj}) \leq 1$$

If the two attributes are exactly same, then the distance metric is zero. If they are completely unrelated, then the distance is 1. Partial match will result in value between 0 and 1. We call it as similarity score of the attributes.

A sample set of vectors for a set of three entities will be as shown below.

Table 3: Feature Extraction using Similarity Score

Entity Pair	Score1	Score2	Score3	Label
e1,e2	$\delta(a_{11}, a_{21}) = 0.8$	$\delta(a_{12}, a_{22}) = 0.6$	$\delta(a_{13}, a_{23}) = 1$	D
e2,e3	$\delta(a_{21}, a_{31}) = 0.5$	$\delta(a_{22}, a_{32}) = 0.6$	$\delta(a_{23}, a_{33}) = 0$	U
e1,e3	$\delta(a_{11}, a_{31}) = 0.6$	$\delta(a_{12}, a_{32}) = 0.4$	$\delta(a_{13}, a_{33}) = 1$	U

The extracted values correspond to two class labels duplicate (D) and unique (U). If we extract feature vectors of a data set and plot the points in a 3-

dimensional space, then we will see two clusters as shown below.

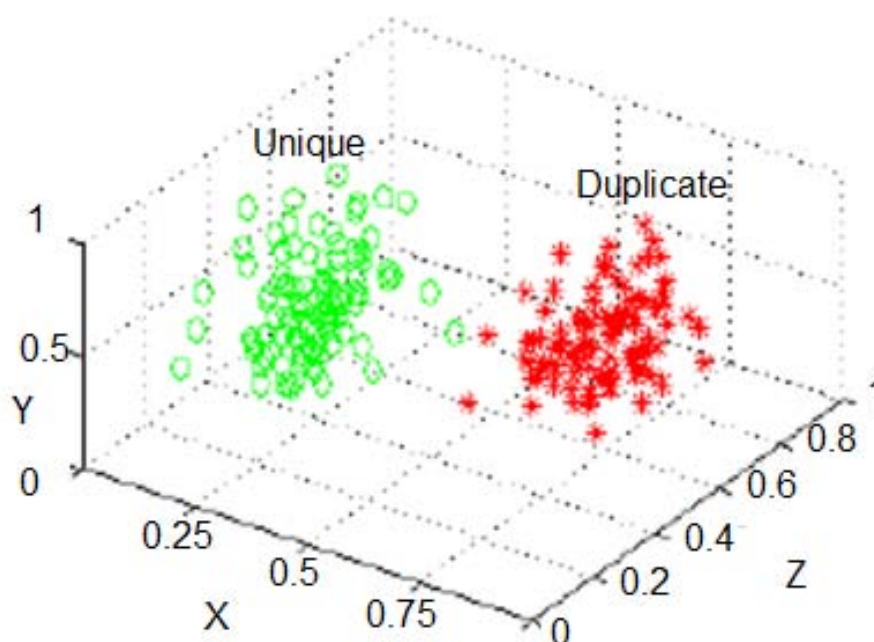


Figure 1: Feature Vectors Plotted in 3-D Space

For m entities having n attributes, after feature extraction, we will get $m \times n$ values under the two labels. Now, the entity matching problem is reduced to a binary classification problem, where the objective is to predict a pair of entities as unique or duplicate. Feature extraction involves attribute level comparison using fuzzy matching algorithms. The produced output is a labelled data set which can be used to train a model using supervised learning algorithm. A well-trained model will make predictions over the incoming data point. Points which lie around the boundary or away from the cluster centroid might require manual stevedoring. Following diagram shows the architecture of our machine learning based entity matching system.

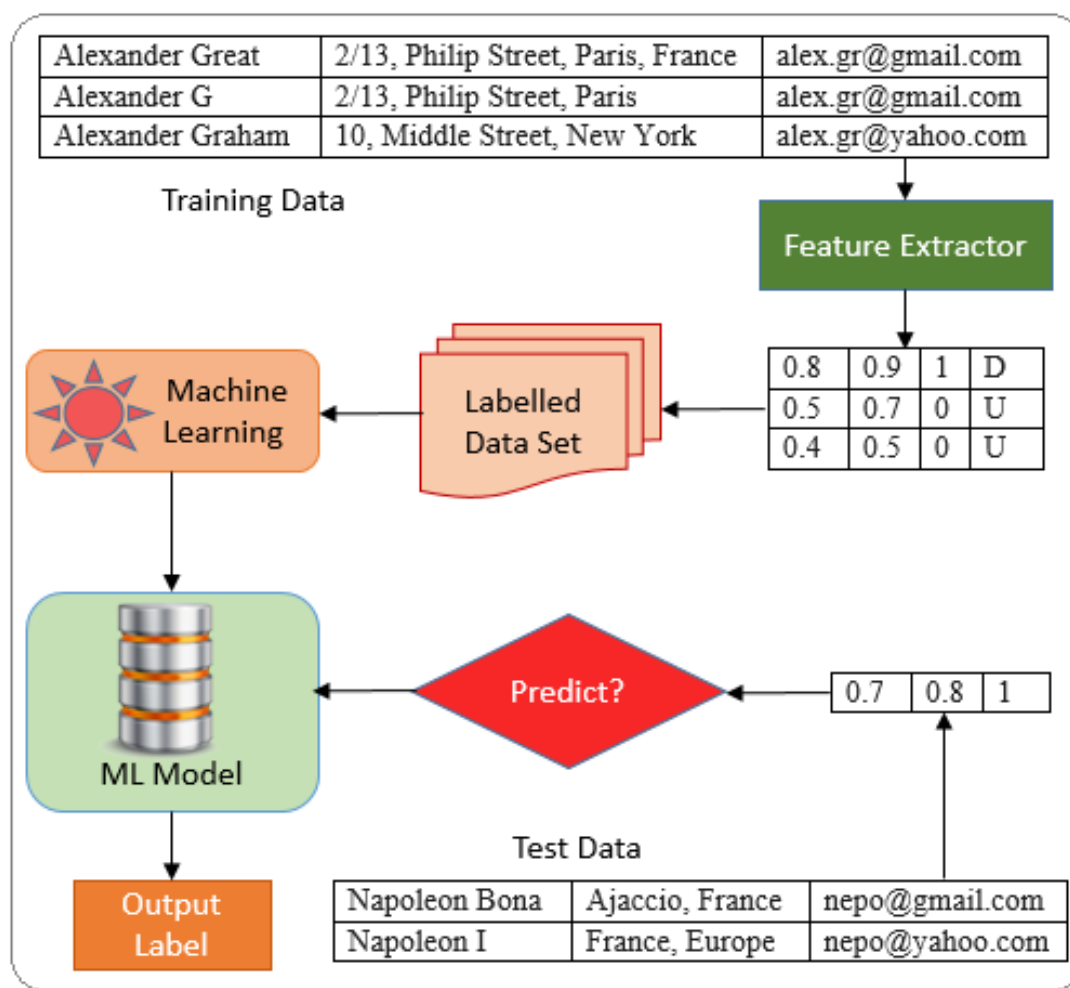


Figure 2: Architecture of Entity Matching System

Our approach takes every pair of entities and produces a numerical vector. This is in turn fed to a machine learning algorithm for classification. We use supervised learning algorithm for classification. The ML model learns from the training data set and makes accurate predictions on the incoming test data.

a) Feature Extraction using Similarity Score

The first step in ML modeling is data preprocessing, which is usually a crucial step in many data analytics tasks. Typical transformations involve lowercasing all letters, removing excess punctuation, normalizing values, and tokenizing. There are two other major steps in our process. Second one being the feature vector construction using similarity score and

last step is machine learning. One might also view second step as feature extraction, since records are transformed to a feature space. The success of this entity matching systems depends upon careful selection of right algorithms. Attributes are often assumed to be strings, but that is not the case always. Attributes of an entity may be of any data type like string, numeric, categorical, boolean etc. One single function will not be able to calculate similarity score for various attributes to attribute. It is useful to compare various functions available for similarity score and pick the right choice. To this end, we present a high-level overview of few popular algorithms.

Table 4: Similarity Score Functions

No.	Data Type	Similarity Function
1	Single Word String	Exact Match
2		Levenshtein Distance
3		Jaro Distance
4		Jaro-Winkler Distance
5		Jaccard Similarity

6	2-to-5 Words String	Cosine Similarity
7		Levenshtein Distance
8		Jaccard Similarity
9		Needleman-Wunsch Algorithm
10		Smith-Waterman Algorithm
11		Monge-Elkan Algorithm
12	Long String (>5 Words)	Cosine Similarity
13		Levenshtein Distance
14		Jaccard Similarity
15		Monge-Elkan Algorithm
16	Number	Exact Match
17		Absolute Difference
18	Categorical	Exact Match
19	Boolean	Exact Match

For example, consider a similarity function Levenshtein Distance. The Levenshtein distance between 'new yrk' and 'new york' is one since it needs at least one edit (insertion, deletion, or substitution) to transform from 'new yrk' to 'new york'. It is advisable to normalize the similarity scores between 0 and 1 for improved accuracy of the machine learning algorithm.

b) Classification using Supervised Learning

The matching phase aims to develop the prediction model, which takes a candidate pair as input and predicts whether they are matching or non-matching. Figure 2 illustrates that the model predicts an output label Duplicate (D) or Unique (U). This is a binary classification problem. Data scientists need to decide which algorithm is most suitable for their classification task. Based on our study and experiments, we found three classification algorithms suitable for this task.

i. K-Nearest Neighbors (KNN)

K-Nearest Neighbors (KNN) is an algorithm that learns all available cases from data set and classifies new data item by a majority vote of its K neighbors. A case assigned to the data is majority of its K nearest neighbors measured by a distance (metric) function. The metric functions include Euclidean, Manhattan, Minkowski, and Hamming distances. KNN can be used for both regression and classification problems. However, it is widely used in classification problems in the industry.

ii. XG Boost

XG Boost stands for Extreme Gradient Boosting. It is a scalable, distributed gradient-boosted decision tree (GBDT) machine learning library. It provides parallel tree boosting and is the leading machine learning library for regression, and classification problems.

iii. Support Vector Machines (SVM)

Support Vector Machine is a supervised algorithm in which the learning algorithm analyzes data and recognizes patterns. We plot the data as points in an n-dimensional space. The value of each feature is

then tied to a particular co-ordinate, making it easy to classify the data.

And finally, we need to tune hyper-parameters in order to get the best model performance.

IV. EXPERIMENTS AND RESULTS

Automatic entity matching makes the life of commercial organizations easier. A company that maintains thousands of customer records cannot afford to employ many people to verify manually and identify duplicates. Artificial Intelligence based entity matching is an efficient and cost-effective analytics tool for operational efficiency. We used open-source data sets for our experiments. While several open-source datasets are available, we picked up few commercial data sets for analysis. In this section, we describe the evaluation tasks, the data sets used, and the experimental results of our approach.

Evaluation Tasks:

1. We evaluate our approach on real-world data set.
2. We evaluate our approach on popular benchmarks.

Our goal is to provide real-life solution using our approach. We aim to evaluate the quality of entity matching. The empirical result is compared with real-time data to harness the accuracy. The results show promising output.

a) Data Set

We conducted extensive experiments on real-world benchmark entity datasets to evaluate the performance of approach. Following are few open-source data sets available for evaluating entity matching algorithms.

Table 5: Entity Matching Data Sets

No.	Dataset	Description	Training Size	Testing Size	No. of Attributes
1	Fodors-Zagats	Customer records with name, address, city, phone, type, and category code.	757	189	6
2	iTunes-Amazon	Records of songs with song name, artist name, album name, genre, etc.	430	109	8
3	DBLP-ACM	Publication dataset with paper title, author, venue etc.	9890	2473	4
4	DBLP-Scholar	Publication dataset with title, authors, venue, and year.	22965	5742	4
5	Amazon-Google	Software product dataset with attributes product title, manufacturer, and price.	9167	2293	3
6	Walmart-Amazon	Electronic product dataset with attributes product name, category, brand, model number, etc.	8193	2049	5
7	Abt-Buy	Product dataset with attributes product name, price, and description.	7659	1916	3

Many commercial organizations are nowadays struggling with customer de-duplication. Automatic de-duplication has significance in various sectors like Banking and Finance, Insurance, Telecom, Retail, etc. Hence our results mainly focus on the evaluation metrics accuracy on the customer data set.

b) Popular Metrics

In this section, we first describe a set of metrics commonly used for evaluating the performance of our classification model. Then we present a quantitative analysis of the performance using popular benchmarks.

Accuracy and Error Rate: These are primary metrics to evaluate the quality of a classification model. Let TP, FP, TN, FN denote true positive, false positive, true negative, and false negative, respectively. The classification Accuracy and Error Rate are defined in Equation 1.

$$\text{Accuracy} = \frac{(TP + TN)}{N}, \quad \text{Error rate} = \frac{(FP + FN)}{N} \quad (1)$$

where N is the total number of samples. Obviously, we have Error Rate = 1 – Accuracy.

Precision, Recall, and F1 Score: These are also primary metrics and are more often used than accuracy or error rate for imbalanced test sets. Precision and recall for binary classification are defined in Equation 2. The F1 score is the harmonic mean of the precision and recall, as in Equation 2. F1 score reaches its best value at 1 (perfect precision and recall) and worst at 0.

$$\text{Precision} = \frac{TP}{TP + FP}, \quad \text{Recall} = \frac{TP}{TP + FN}, \quad \text{F1-score} = \frac{2 * \text{Prec} * \text{Rec}}{\text{Prec} + \text{Rec}} \quad (2)$$

For multi-class classification problems, we can always calculate precision and recall for each class label and analyze the individual performance on class labels or average the values to get the overall precision and recall. In our case, the average for the two labels Duplicate (D) and Unique (U) were calculated and the following diagram is the pictorial representation of the metrics.

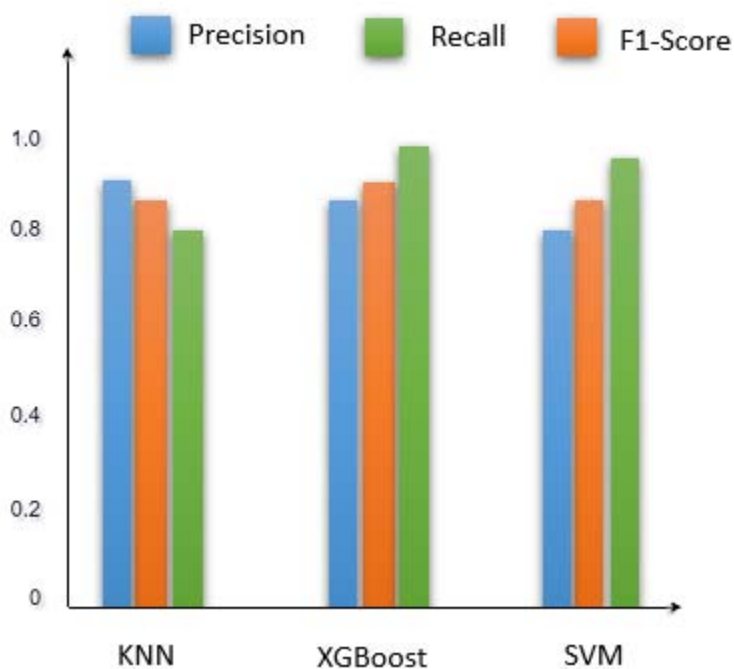


Figure 3: Quantitative Metrics Analysis

From the above results, we observe that XGBoost has highest F1-Score and best suited for the entity matching problem. Following table shows the final

metrics of experiments conducted using various similarity score and classification algorithms over Fodors-Zagats dataset.

Table 6: F1-Score of Various Algorithms

		CLASSIFICATION ALGORITHM		
		XGBoost	KNN	SVM
SIMILARITY SCORE	Jaccard Similarity	87%	86%	83%
	Levenshtein Distance	84%	83%	81%
	Cosine Similarity	83%	81%	80%

c) Empirical Results

We aim to use our entity matching system in real world applications like retail, e-commerce etc. We analyzed the presence of duplicate customer data and

results showed more than 80% accuracy in real-world data sets. Following is a set of predictions made by our system from Fodors-Zagats dataset.

Table 7: Entities Matched using Automated System

No.	Name	Address	City	Phone	Label
1	restaurant ritz-carlton atlanta	181 Peachtree st.	Atlanta	404/659 -0400	D
2	ritz-carlton restaurant	181 Peachtree st.	Atlanta	404/659 -0400	
3	posterior	545 post st.	San Francisco	415/776 -7825	D
4	postrio	545 post street.	San Francisco	415/776 -7825	
5	tavern on the green	in central park at 67th st	New York	212/873 -3200	D
6	tavern on the green	central park west	New York	212/873 -3200	
7	carey's	1021 cobb pkwy . se	marietta	770-422-8042	U

8	carey's corner	1215 powers ferry rd.	marietta	770-933-0909	
9	chops	70 w. paces ferry rd.	atlanta	404-262-2675	U
10	chopstix	4279 roswell rd.	atlanta	404-255-4868	

From the above table, we observe that customers, vendors can easily get their ambiguities resolved using automatic entity matching system. AI-based entity matching is an alternative to traditional manual or other text analysis-based tools, and it is cost-effective solution for decision-makers.

V. CONCLUSION AND FUTURE WORK

The proposed method accomplished superior performance in terms of time and cost. The overall benefits of AI-based entity matching include:

Sorting Data at Scale: Manually screening thousands of customer records, or product details is complex and time-consuming. AI-based entity matching helps businesses process large amount of data in an efficient and cost-effective way.

Real-Time Analysis: The automatic entity matching can help organizations quickly identify duplicates on real-time basis and act swiftly before duplicate marketing or promotional offers are sent out.

Though many deep learning models are being developed nowadays for entity matching, we propose a supervised learning model for few major reasons.

Explainability and Ease of Debugging: For many applications, it is crucial to trust the data source, and try to understand why something does not work is key. Unfortunately, deep learning models are notoriously hard to interpret. As steps in the entity matching process increasingly coalesce into a large neural network, we get fewer checkpoints along the way in the process that can easily be inspected. We can't see the output from each step in the same way anymore. Therefore, figuring out why two records were matched or not matched is usually nontrivial while inspecting deep learning models. There are a few techniques that are already used, such as looking at alignment scores, but we are still far away from a comprehensive way of debugging neural networks for entity matching. Our model addresses the challenges of explainability, running time in interactive settings, and the large need for training examples. Explainability of our supervised learning algorithm helps researchers to improve accuracy through inspection, comparison of algorithms and meet the real-world demands. We also see a lot of opportunities in trying to develop more open datasets, standardized benchmarks, and publicly available pretrained models for entity matching.

REFERENCES RÉFÉRENCES REFERENCIAS

1. A Arasu, S Chaudhuri, and R Kaushik. 2008. Transformation-based Framework for Record Matching. *In 2008 IEEE 24th International Conference on Data Engineering. ieeexplore.ieee.org*, 40–49.
2. Anhai Doan, Adel Ardlan, Jeffrey Ballard, Sanjib Das, Yash Govind, Pradap Konda, Han Li, Sidharth Mudgal, Erik Paulson, G C Paul Suganthan, and Haojun Zhang. 2017. Human-in-the-loop challenges for entity matching: A midterm report. *In Proceedings of the 2Nd Workshop on Human-In-the-Loop Data Analytics (HILDA'17)*. dl.acm.org, New York, NY, USA, 12:1–12:6.
3. Arvind Arasu, Michaela Götz, and Raghav Kaushik. 2010. On Active Learning of Record Matching Packages. *In Proceedings of the 2010 ACM SIGMOD International Conference on Management of Data (SIGMOD '10)*. ACM, New York, NY, USA, 783–794.
4. A K Elmagarmid, P G Ipeirotis, and V S Verykios. 2007. Duplicate Record Detection: A Survey. *IEEE Trans. Knowl. Data Eng.* 19, 1 (Jan. 2007), 1–16.
5. Cheng Fu, Xianpei Han, Le Sun, Bo Chen, Wei Zhang, Suhui Wu, and Hao Kong. 2019. End-to-end Multi-perspective Matching for Entity Resolution. *In Proceedings of the 28th International Joint Conference on Artificial Intelligence (IJCAI'19)*. AAAI Press, Macao, China, 4961–4967.
6. Ekaterini Ioannou, Nataliya Rassadko, and Yannis Velegrakis. 2013. On Generating Benchmark Data for Entity Matching. *Jr. Data Semant.* 2, 1, 37–56, March 2013.
7. Felix Naumann and Melanie Herschel. 2010. An Introduction to Duplicate Detection. *Morgan and Claypool Publishers*.
8. George Papadakis, Dimitrios Skoutas, Emmanouil Thanos, and Themis Palpanas. A Survey of Blocking and Filtering Techniques for Entity Resolution. arXiv:cs.DB/1905.06167, May 2019.
9. George Papadakis, Jonathan Svirsky, Avigdor Gal, and Themis Palpanas. Comparative Analysis of Approximate Blocking Techniques for Entity Resolution. *Proceedings VLDB Endowment* 9, 684–695, May 2016.
10. Hanna Köpcke, Andreas Thor, and Erhard Rahm. 2010. Evaluation of Entity Resolution Approaches on

- Real-world Match Problems. *Proceedings VLDB Endowment* 3, 1-2 (Sept. 2010), 484–493.
11. Ivan P Fellegi and Alan B Sunter. 1969. A Theory for Record Linkage. *Jr. Am. Stat. Assoc.* 64, 328 (Dec. 1969), 1183–1210.
12. John R Talburt. 2011. Entity Resolution and Information Quality. *Elsevier*.
13. Jungo Kasai, Kun Qian, Sairam Gurajada, Yunyao Li, and Lucian Popa. 2019. Low-resource Deep Entity Resolution with Transfer and Active Learning. *In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics. Association for Computational Linguistics, Stroudsburg, PA, USA*, 5851–5861.
14. Kun Qian, Lucian Popa, and Prithviraj Sen. 2017. Active Learning for Large-Scale Entity Resolution. *In Proceedings of the 2017 ACM on Conference on Information and Knowledge Management (CIKM '17). ACM, New York, NY, USA*, 1379–1388.
15. Lise Getoor and Ashwin Machanavajjhala. 2012. Entity Resolution: Theory, Practice & Open Challenges. *Proceedings VLDB Endowment* 5, 12 (Aug. 2012), 2018–2019.
16. Muhammad E, Saravanan T, Shafiq Joty, Mourad Ouzzani, and Nan Tang. 2018. Distributed representations of tuples for entity resolution. *Proceedings VLDB Endowment* 11, 11 (July 2018), 1454–1467.
17. Newcombe, H B, J M Kennedy, S J Axford, and A P James. 1959. Automatic linkage of vital records. *Science* 130, 3381, 954–959, Oct. 1959.
18. Nihel Kooli, Robin Allesiardo, and Erwan Pigneul. 2018. Deep Learning Based Approach for Entity Resolution in Databases. *In Intelligent Information and Database Systems. Springer International Publishing*, 3–12.
19. Peter Christen. 2012. Data Matching: Concepts and Techniques for Record Linkage, Entity Resolution, and Duplicate Detection. *Springer Science & Business Media*.
20. P Christen. 2012. A Survey of Indexing Techniques for Scalable Record Linkage and Deduplication. *IEEE Trans. Knowl. Data Eng.* 24, 9 (Sept. 2012), 1537–1555.
21. Ram Deepak Gottapu, Cihan Dagli, and Bharami Ali. 2016. Entity Resolution Using Convolutional Neural Network. *Procedia Comput. Sci.* 95 (Jan. 2016), 153–158.
22. Thomas N Herzog, Fritz J Scheuren, and William E Winkler. 2007. *Data Quality and Record Linkage Techniques*. Springer Science & Business Media.
23. Ursin Brunner and Kurt Stockinger. 2020. Entity matching with transformer architectures-a step forward in data integration. *In International Conference on Extending Database Technology, Copenhagen*, 30 March-2 April 2020.
24. Vassilis Christophides, Vasilis Efthymiou, Themis Palpanas, George Papadakis, and Kostas Stefanidis. 2019. End-to-End Entity Resolution for Big Data: A Survey. (May 2019). [arXiv:cs.DB/1905.06397](https://arxiv.org/abs/cs.DB/1905.06397).
25. Yuliang Li, Jinfeng Li, Yoshihiko Suhara, Anhai Doan, and Wang-Chiew Tan. 2020. Deep Entity Matching with Pre-Trained Language Models. (April 2020). [arXiv:cs.DB/2004.00584](https://arxiv.org/abs/cs.DB/2004.00584).



Domain Specific Deep Neural Network Model for Classification of Abnormalities on Chest Radiographs

By Joy Nkechinyere Olawuyi & Afolabi B.Samuel

Abstract- This study collected, pre-processed dataset of chest radiographs, formulated a deep neural network model for detecting abnormalities. It also evaluated the performance of the formulated model and implemented a prototype of the formulated model. This was with the view to develop a deep neural network model to automatically classify abnormalities in chest radiographs. In order to achieve the overall purpose of this research, a large set of chest x-ray images were sourced for and collected from the CheXpert dataset, which is an online repository of annotated chest radiographs compiled by the Machine Learning Research group, Stanford University. The chest radiographs were preprocessed into a format that can be fed into a deep neural network. The preprocessing techniques used were standardization and normalization. The classification problem was formulated as a multi-label binary classification model, which used convolutional neural network architecture for making decision on whether an abnormality was present or not in the chest radiographs. The classification model was evaluated using specificity, sensitivity, and Area Under Curve (AUC) score as parameter.

Keywords: transfer learning, convolutional neural network, radiograph, classification, multi-label.

GJCST-D Classification: DDC Code: 006.32 LCC Code: QA76.87



DOMAINSPECIFICDEEPCONVOLUTIONALNEURALNETWORKMODELFORCLASSIFICATIONOFABNORMALITIESONCHESTRADIOGRAPHS

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Domain Specific Deep Neural Network Model for Classification of Abnormalities on Chest Radiographs

Joy Nkechinyere Olawuyi^α & Afolabi B.Samuel^ο

Abstract- This study collected, pre-processed dataset of chest radiographs, formulated a deep neural network model for detecting abnormalities. It also evaluated the performance of the formulated model and implemented a prototype of the formulated model. This was with the view to develop a deep neural network model to automatically classify abnormalities in chest radiographs. In order to achieve the overall purpose of this research, a large set of chest x-ray images were sourced for and collected from the CheXpert dataset, which is an online repository of annotated chest radiographs compiled by the Machine Learning Research group, Stanford University. The chest radiographs were preprocessed into a format that can be fed into a deep neural network. The preprocessing techniques used were standardization and normalization. The classification problem was formulated as a multi-label binary classification model, which used convolutional neural network architecture for making decision on whether an abnormality was present or not in the chest radiographs. The classification model was evaluated using specificity, sensitivity, and Area Under Curve (AUC) score as parameter. A prototype of the classification model was implemented using Keras Open source deep learning framework in Python Programming Language. The AUC ROC curve of the model was able to classify Atelectasis, Support devices, Pleural effusion, Pneumonia, A normal CXR (no finding), Pneumothorax, and Consolidation. However, Lung opacity and Cardiomegaly had probability out of less than 0.5 and thus were classified as absent. Precision, recall, and F1 score values were 0.78, this imply that the number of False Positive and False Negative are the same, revealing some measure of label imbalance in the dataset. The study concluded that the developed model is sufficient to classify abnormalities present in chest radiographs into present or absent.

Keywords: transfer learning, convolutional neural network, radiograph, classification, multi-label.

I. INTRODUCTION

Transfer Learning (Pan and Yang, 2009) is an important concept in machine learning research (Tan *et al.*, 2018) that allows the domains, tasks, and distributions used in training and testing a network to be different from each other (Pan and Yang, 2010). Transfer learning is used to improve a learner from one domain by transferring information from a related domain (Weiss *et al.*, 2016). The relatedness interacting domains cannot be over emphasized, as this could impact the relevance and appropriateness of the results

generated from such models. Transfer learning becomes a necessity when there is no large annotated dataset (a common case in medical image). This makes it imperative to use the knowledge about data learned from natural objects to learn patterns in medical images. However, the relatedness and sameness of the two (source and target) data distribution is a concern for this approach because the substantial difference between natural images and medical images may advice against such knowledge transfer (Tajbakhsh *et al.*, 2016). Also, in relation to medical images which contain values that are proportional to the absorption characteristics of tissue with respect to a signal projected through the body (Petrou and Petrou, 2010), care should be taken to employ cross-domain transfer learning. Even though, transferring knowledge (learned features) from loosely related datasets such as ImageNet (Deng *et al.*, 2009) to medical image in situations where there is insufficient ground-truth label may be promising, but it may introduce unintended biases which are undesirable in a clinical setting (Wang *et al.*, 2018).

As a result of the drawback of transfer learning especially in a sensitive domain like medicine, a better alternative is to train deep learning models exclusively of medical images. This is called training from scratch. Training a DL model from scratch is not without computational bottlenecks. This is why research in this area is limited because of insufficient labeled dataset (Tajbakhsh *et al.*, 2016). However, advances in medical imaging technology and concern of deep learning research community on medical image analysis has led to the production of more radiological certified annotation on medical images. Notable among such is the National Institutes of Health (NIH) chest radiograph collection that consists of more than 100,000 chest radiographs with annotations (Wang *et al.*, 2017).

The Stanford University also released a very large dataset of chest radiographs with labels of pathology. This dataset contains over 200,000 open sourced chest x-rays (Irvin *et al.*, 2019).

Due to the availability of these dataset resources, one of the major reasons for cross-domain transfer learning has been eliminated. Data augmentation methods can be employed to extrapolate the available medical images to more than ten times the original quantity, so that more data could be used to

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learning medical image analysis models. Data argumentation techniques would also be such that would not remove relevant information from the medical images. Also, given that computational resources are available, then deep neural network models could be trained from scratch on medical images; hence this study.

II. STATEMENT OF RESEARCH PROBLEM

CXR are often characterized by variability in contrast intensity and texture, which are different from the content and structure of the images of natural object. Most of the existing deep models for medical image analysis are based on transfer learning that depends largely on the fine tuning of feature weights learned from natural image dataset. However, this cross-domain knowledge transfer is often not suitable for medical image analysis due to its inability to handle the variability in contrast intensity and texture that characterizes medical images. Again, in natural objects relative pixel intensity is used to convey information about a target object. That is, intensity variation and saturation are irrelevant when handling natural images. In contrast, medical images use exact pixel intensity values to convey information about abnormalities present in medical images. This intensity values are represented using the Hounsfield scale (Prince and Links, 2006). Also, location invariance does not affect the information content of natural images. In medical images on the other hand location is used to indicate pathological sites, because certain abnormalities are more likely to appear in certain part of a scan or x-ray. But the location of a dog or plate does not mean it is not a plate. Dimensionality reduction is a popular technique used to enhance the performance and efficiency of deep models, natural objects are scale invariant that is, and they retain their meaning irrespective of the scale. In medical images when the scales are change certain information-reach contents tend to lost. Deep learning models and architectures are developed using natural objects which still perform well with relative intensity, location and scale. Therefore, the outcome of medical image analysis from deep models that are trained using transfer learning mechanism are often not acceptable by the medical professionals and as such implemented CAD system from these deep models are rarely deployed for clinical practices. Therefore there is need to train medical image analysis models using medical image data; hence this study aims at developing a Deep Convolutional Neural Network model using domain-specific data for classification of abnormalities in chest x-rays.

III. OBJECTIVES OF THE RESEARCH

The specific objectives are to acquire and preprocess dataset of chest radiographs; formulate a

deep network model for detecting abnormalities; evaluate the performance of the formulated model; and implement a prototype of the formulated model

IV. CONCEPT OF TRANSFER LEARNING

The concept of transfer learning was motivated by the fact that people can always apply previous knowledge to solve new problems faster (Torey and Shavlik, 2010) because repetition of common knowledge in the new task is abstracted away. It is a learning approach where knowledge from a domain is applied to solve a problem in another related domain. It is also referred to as domain adaptive learning (Kouw and Loog (2019). Transfer learning was inspired by the natural ability of human being to intelligently and intuitively apply knowledge from previous task to tackle new and previously unseen task. In ML applications, algorithms are developed to solve specific task such as classification, regression, or clustering problems. These algorithms often required labeled dataset for good generalization. It is expected that the training data and test data are in same feature space and from same marginal probability distribution, otherwise the model has to be reconstructed or modifications made to the algorithm. Transfer learning is the use of previously trained networks to mitigate the need for large dataset. There are two strategies for transfer learning practice (Litjens *et al.* 2017)

1. Using pre-trained network as feature extractor
2. Fine-tuning a pertained network on medical data

Transfer learning performs better than training from scratch when a small data set like 1000 images are available (Menegola *et al.*, 2016). Transfer learning is characterized by a domain $D = \{f_s, P(X)\}$ described by feature space f_s and a marginal probability distribution $P(X)$ where each point in X is an image vector, x_i is the i^{th} vector in a given learning sample X . For a given domain $D = \{f_s, P(X)\}$ a task in the domain consist of a label space l_s and objective predictive function $f(\cdot)$ denoted by $f_o = \{Y, f(\cdot)\}$, with a training data (x_i, y_i) where $x_i \in X$ is the input vector, $y_i \in Y$ is the label. For a new instance x , the objective function can be used to predict a new label. In Transfer Learning, two main domains stand out – the source domain denoted by D_s and the target domain represented by D_T with task T_s and T_T respectively. Transfer learning thus aims at extracting the knowledge from one or more source tasks and apply the knowledge to a new (target) task (Pan and Yan, 2009). This is done by optimizing the learning of predictive function $f_T(\cdot)$ in DT by utilizing the knowledge in D_s and T_s where $D_s \neq D_T$ or $T_s \neq T_T$ or $P_s(X) \neq P_T(X)$

Transfer learning is commonly used in deep learning applications, to access a pre-trained network and use it as a starting point to learn a new task and quickly transfer learned features to a new task using a

smaller number of training images. This is because some low-level features are such as edges, shapes, corners and intensity are common to most domain. The concept is demonstrated in Figure 1, the figures shows that the features learned from the source data (supposedly large dataset) are used to initiate learning in the target or new data (small dataset). Transfer learning can also come in three different flavors depending on the problem and resources at hand. There is minimum pre-processing procedure needed when transfer-learning techniques are used. However, no need for manual selection of Region of Interest (ROI). In addition, time-consuming weight training steps are removed because weights from source task are used for the target task. Deep learning resource hungry models can be done seamlessly small dataset and good performance.

Transfer learning with its ability to recognize and apply knowledge and features learned in previous tasks to a novel task, is on the rise in recent years and has been applied in several data mining tasks, Zeiler and Fergus (2014). Transfer learning is often an attractive

option when dealing with scarce data (Shin *et al.* 2016) for developing deep learning model where performance is based on seeing more data.

The Image Net pre-trained model has been used to train several medical image analysis deep learning models with good and promising performance (Lakhani and Sundaram (2017)), Rajkoma *et al.* (2017), Shin *et al.* (2016), Baltrushchat *et al.* (2019). The practical implementation and deployment of these results are sparingly reported in healthcare institution.

In medical domain, images consist of some specialty (view, features and modality) as pointed out earlier, thus transfer learning may be inappropriate for generalization. Training the neural networks from scratch would allow for learning more domain specific features corresponding to underlying pathological features rather than fine-tuning a network of natural images (Kumar, *et al.* (2017)). This is why transfer learning has proved to give outstanding performance when combined with handcraft domain features Bar *et al.* (2015).

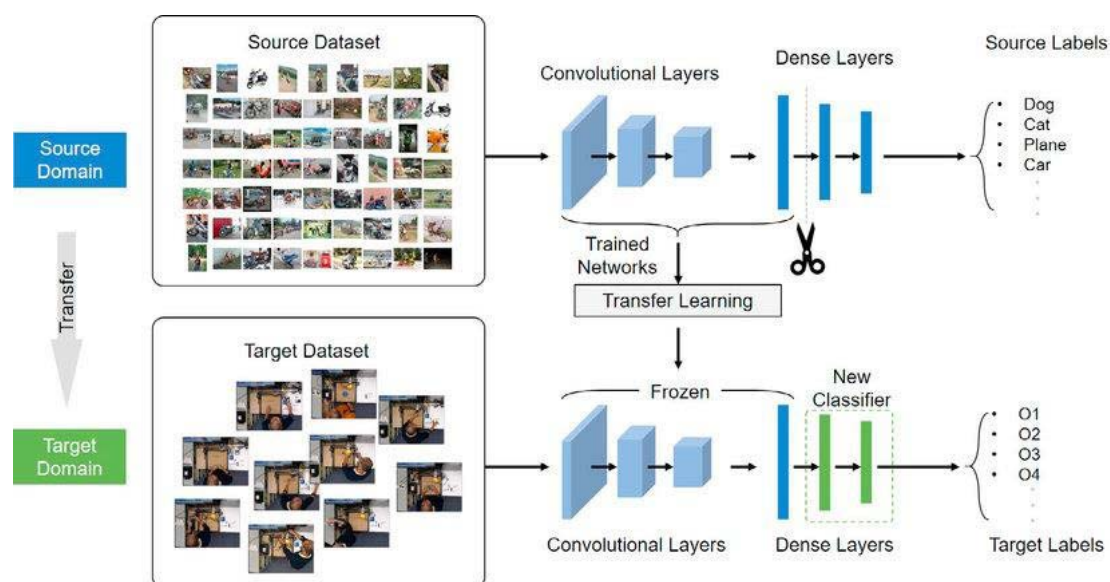


Figure 1: Transfer Learning Architecture (Tao, 2020)

V. LIMITATION OF TRANSFER LEARNING IN MEDICAL DOMAIN

Transfer learning based deep learning model performance is usually inferior to a network trained specifically for the desired task (Lopes and Valiati, (2017). Medical domain knowledge is essential for identifying representative features in data for detecting target diseases (Shie *et al.* (2015). Transfer learning with small dataset compatibility introduces another training complication called over fitting (Shin *et al.* 2016), where model tend to give a bias generalization on data. Again, the substantial differences between natural and medical images may device against knowledge transfer

(Tajbakhsh *et al.* (2016). Medical images are acquired by specialized instruments that significantly affect the result of computation. For instance, radiography images are produced by electromagnetic radiation projected by an X-ray generator to views the internal organs of the body. They are typically greyscale images. Also, there exist a measure of structural dissimilarity between medical images and natural objects, thus a seismic, hyperspectral or even medical imagery shows limited similarity with the images in ImageNet. Medical images consist of some inherent features and domain-specific specialties that could render transfer learning inappropriate. According to Kumar *et al.* (2017) training medical images from scratch for the purpose of analysis

would allow for learning more specific features corresponding to underlying pathologies than transfer learning.

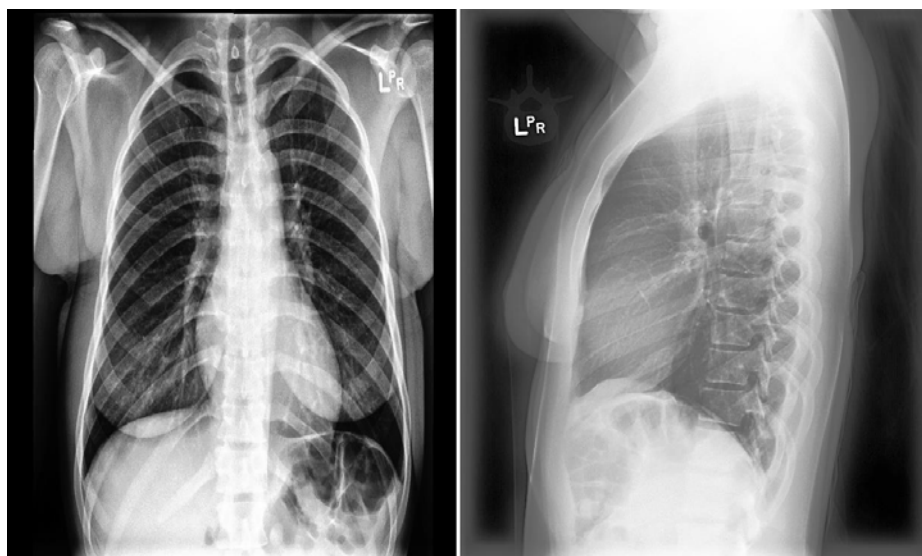
Another important concern is that medical images are acquired from a number of clinical processes such as imaging of anatomy and physiology, interventional radiology and therapy. For instance, radiographic images characterized with salient features that reveals densities such as air, fat, muscle, bone, metals, and high contrast variations. In CT images soft tissues, rendered contours are common indications of importance. Also, to produce a quality medical image the orientation or view is of great importance as it contributes to the features used for its characterization. For instance, some clinical deviations are better diagnosed on a given view or orientation than the other. At a closer look, to get image correctly on SPECT, measurement at different angles/positions and projections are considered. For PET imaging the emission of photons and the angle between the positrons are important. MRI images on the other hand are commonly used on soft tissue image production, blood flow, cerebral diagnosis and cardiology; hence, they tend to pay attention to blood, water, and signal from the body. Medical image modality is an important aspect of image acquisition and interpretation process, because according to Clinicians, one of the most important filters that would enhance retrieval result significantly is the modality (de Herrera *et al.* 2013). Therefore, images of natural object (as in ImageNet) would not be appropriate for generalization in the medical domain because, the vulnerability of DNNs in medical imaging is crucial because the clinical application of deep learning needs extreme robustness for the eventual use in patients, compared to relatively trivial non-medical tasks, such as distinguishing cats or dogs (Yamashita *et al.*, 2018).

VI. DATA COLLECTION AND DESCRIPTION

For this study, the CheXpert dataset was used. The CheXpert dataset is a compilation of radiographic studies that is online but domiciled in Stanford Hospital. It comprises of radiological reports from October, 2002 to July, 2017 on both in-patient and out-patients' cases. It was compiled by the Stanford University Machine Learning Group. The dataset contains 224,316 chest radiograph images of 65,240 patients. It consists of fourteen (14) radiological observations with consideration for uncertainty in radiograph interpretation.

a) Dataset Preparation and Preprocessing

To ease label matching to images, the uncertainty labels (-1.0) was converted to positive labels (1.0). This is to achieve a binary mapping of all labels similar with the *U-ones* model of Irvin *et al.* (2019). In statistic this is called zero imputation strategy (Kolesov *et al.* 2014). The assumption here is that diseases that are not sure to be present in the CXR (uncertainty label) could be coded as present. On the other hand, label categories that are referred to as unmentioned (blanks cells) were coded as negative (0.0) or absent. This approach follows the principle in literature which is known as zero imputation strategies in statistics and similar to the multi-label classification method where missing examples are used as negative labels (Kolesov *et al.*, 2014, Irvin *et al.*, 2019). The conversion was carried out using the Keras Pandas version 0.24.1 data frame. As part of image pre-processing technique, all images were set to have the same aspect ratio and dimension.



A: Frontal View

B: Lateral View

Figure 2: Views of CXR in CheXpert Dataset (Source: Irvin *et al.*, 2019).

Table 1: Sample of the CheXpert Observations showing 14 labels

Pathology	Positive (%)	Uncertain (%)	Negative (%)
No Finding	16627 (8.86)	0 (0.0)	171014 (91.14)
Enlarged Cardiom.	9020 (4.81)	10148 (5.41)	168473 (89.78)
Cardiomegaly	23002 (12.26)	6597 (3.52)	158042 (84.23)
Lung Lesion	6856 (3.65)	1071 (0.57)	179714 (95.78)
Lung Opacity	92669 (49.39)	4341 (2.31)	90631 (48.3)
Edema	48905 (26.06)	11571 (6.17)	127165 (67.77)
Consolidation	12730 (6.78)	23976 (12.78)	150935 (80.44)
Pneumonia	4576 (2.44)	15658 (8.34)	167407 (89.22)
Atelectasis	29333 (15.63)	29377 (15.66)	128931 (68.71)
Pneumothorax	17313 (9.23)	2663 (1.42)	167665 (89.35)
Pleural Effusion	75696 (40.34)	9419 (5.02)	102526 (54.64)
Pleural Other	2441 (1.3)	1771 (0.94)	183429 (97.76)
Fracture	7270 (3.87)	484 (0.26)	179887 (95.87)
Support Devices	105831 (56.4)	898 (0.48)	80912 (43.12)

Source: Irvin et al, 2019

Table 2: Summary of Model Parameters

	Initialized Value
Batch size	5
Initial Learning Rate	0.001
Epoch	10
Epsilon	1e-07
Kernel size	4 * 4

VII. ANALYSIS OF RESULT FROM THE DEVELOPED MODEL

The entire dataset was not used for the model training because of the unexpected computational complexity and overhead. Attempt on training the model in the entire training set produced a memory error. As a result, the training was carried out on the 234 images of the validation set with 0.1 used as test case. The network was trained over 10 epoch, this means that the model iterated over the train dataset 10 times. The model summary is represented graphically as model loss, model accuracy and the AUC ROC curve. Also, after model training Precision, recall, F- score and the accuracy was given as output.

From Figure 3, the model accuracy showed that the accuracy increases rapidly in the first two epochs, indicating that the network is learning fast. Also, it showed that the model could probably be trained a little more as the trend for accuracy on both datasets is still rising for the last few epochs. Again, it is seen that the model has not yet over-learned the training dataset.

From the Model loss curve as shown in Figure 4, loss was decreasing over time. This means that the

model is really learning. The validation loss was high at the beginning of the learning process and decreases as epoch increases. The model would be better if the number of epoch increases. However considering the computational overhead, this study is limited to 10 epochs. From the model loss curve, there is evidence of unrepresentative training dataset. This happens when the data available during training is not enough to capture the model, in relation to the validation dataset. This was because sufficient data was not use for the model training. Increasing the training data would decrease the generalization error because the model becomes more general by virtue of being trained on more examples. The AUC ROC curves showed in comparison the probability of occurrence of all abnormalities on the testcase.

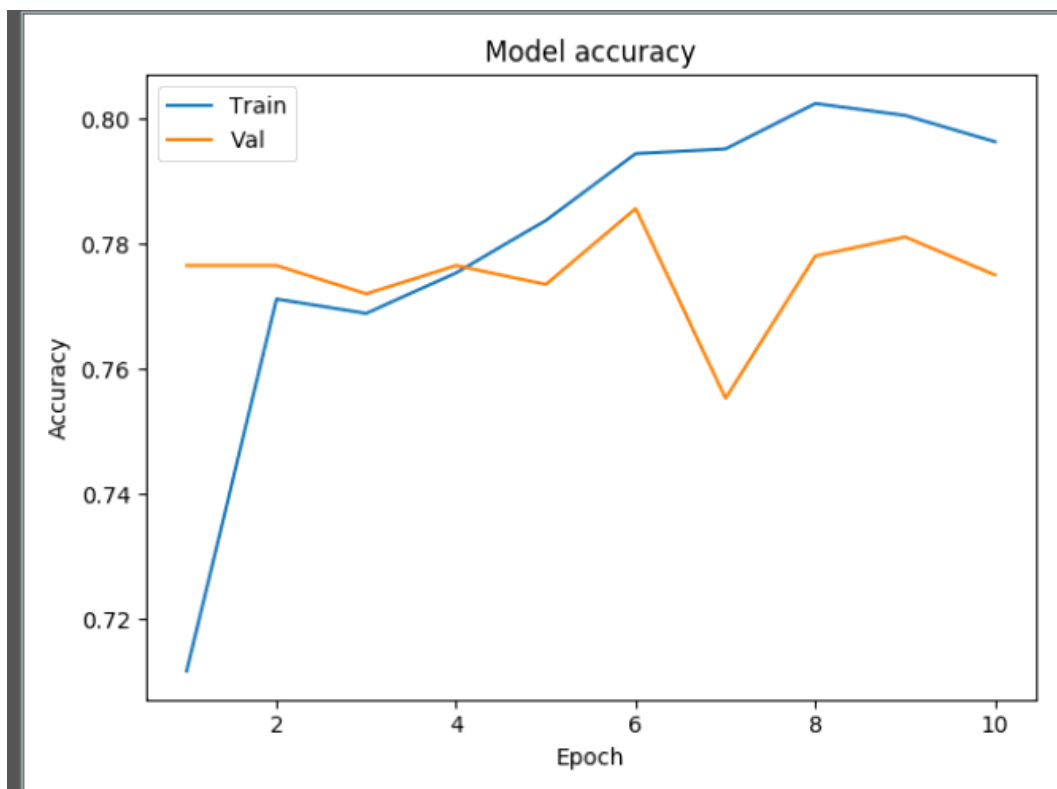


Figure 3: Model Accuracy plot

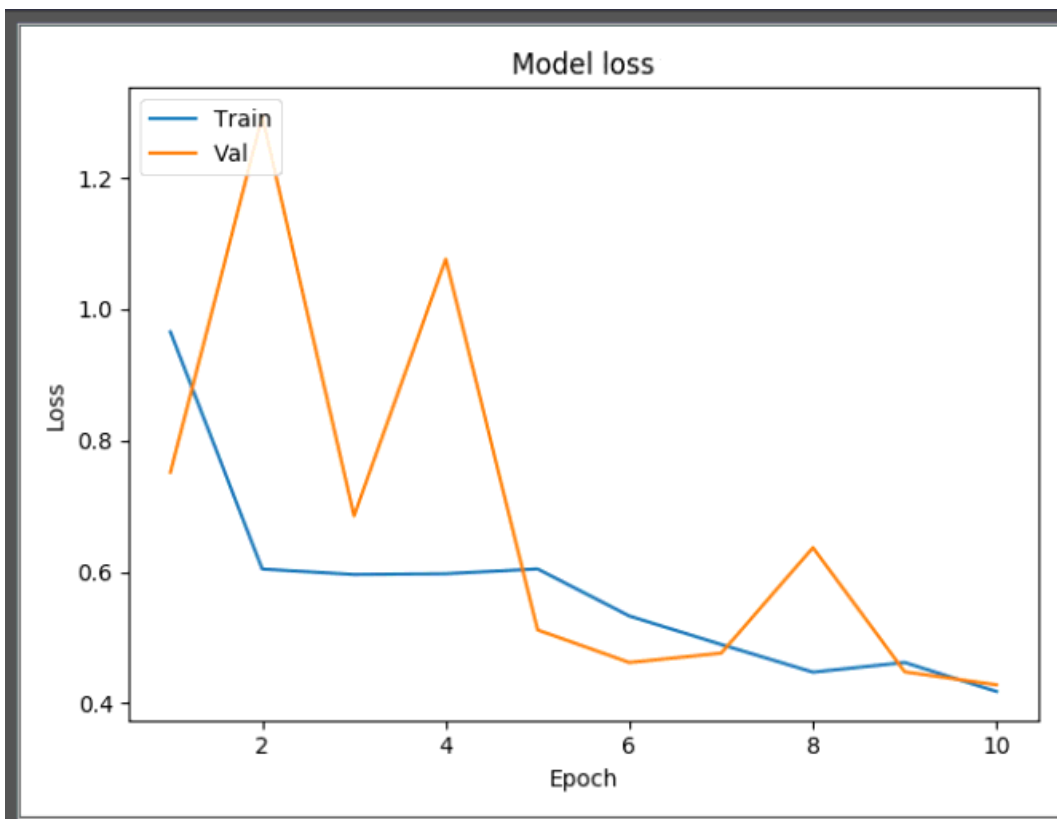


Figure 4: Model Loss Plot

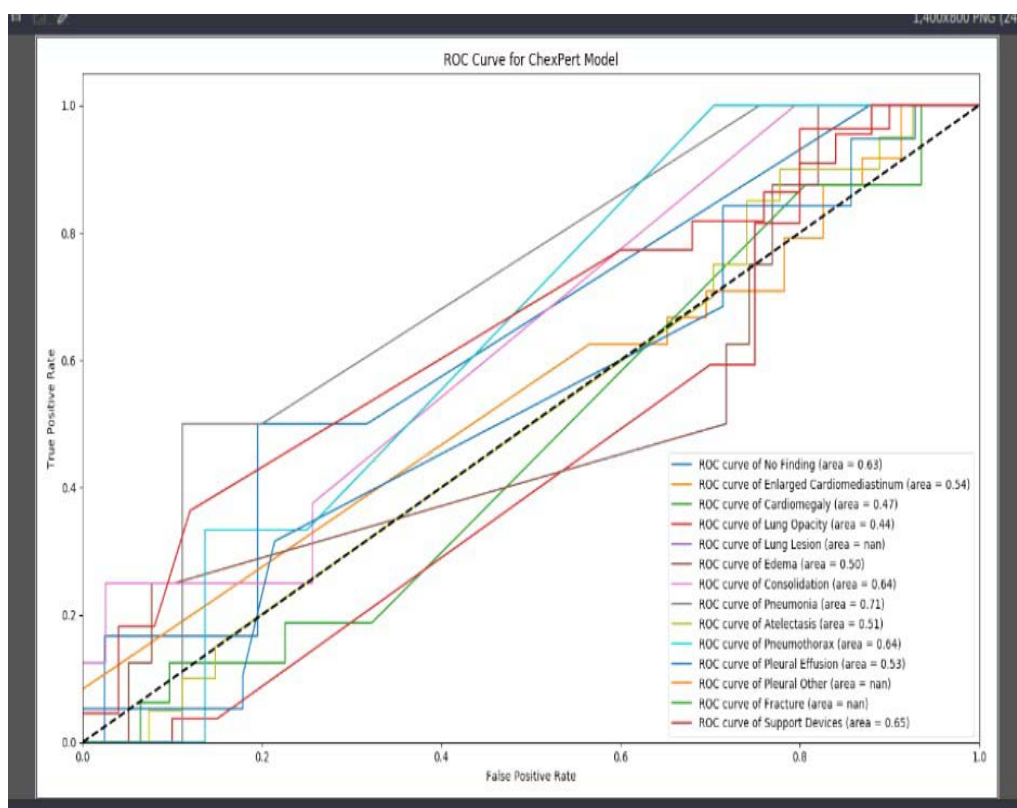


Figure 5: AUC ROC curve

VIII. AUC ROC ANALYSIS OF RESULT

The AUC ROC curve presented in Figure 5 was used to visualize all the performance metrics from a single image (a test image). The ROC curve was plotted for all the abnormalities present in the CXR of the CheXpert dataset. Table 3 captures the recorded probability values from the AUC ROC curve. From the AUC ROC curve, the developed model discriminated against some abnormality. Using the user-defined threshold value of 0.5, the threshold value was got from

the average of the probability outcome of 0.57. Therefore, the developed model confidently detected the presence Atelectasis, Support devices, Pleural effusion, Pneumonia, A normal CXR (no finding), Pneumothorax, and Consolidation. This happened because the probability score was beyond the set threshold. However the model was detected the following abnormality as absence using the user defined threshold value of 0.5. That is, the probability outputs of Lung opacity and Cardiomegaly were less than 0.5.

Table 3: Probability Output on the AUC ROC Curve

Features (abnormality)	Output probabilities
No finding (normal)	0.63
Enlarged Cardio	0.54
Cardiomegaly	0.47
Lung opacity	0.44
Lung lesion	Nan
Edema	0.50
Consolidation	0.64
Pneumonia	0.71
Atelectasis	0.51
Pneumothorax	0.64
Pleural effusion	0.53
Pleural Other	Nan
Fracture	Nan
Support Devices	0.65

The developed model was not able to detect lung lesion, pleural other and fracture therefore a NAN value was returned. The accuracy of the model was approximately 0.78. This means the model can predict the presence of an abnormality 78 times in a given 100 cases. Precision and recall had the same have value that is 0.78.

IX. CONCLUSION

This research has developed a model with medical images using Convolutional Neural Network. This is called training from the scratch because it does not involve the use of pre-trained weights. The developed model was based on the binary loss function because the problem was reduced to a binary multi-label problem where the model could detect the presence (1) or absence (0) of abnormalities under consideration. Fourteen (14) abnormalities associated with chest x-rays were examined in this study. The choice of model parameter was hampered by the limitation of computational resources. Hence, the only parameter that was tweaked was the batch size and image dimension. The two parameters were adjusted to optimally utilize the available computational resources. Image was down-sized to 250 * 240 and the batch size was changed often time but was pegged to 6 at the last computation stage. The number of network layer was only five, namely, the input layer, convolution layer, pooling layer and the fully connected layer. The model favorably predicted some abnormalities such as pneumonia, consolidation, pleural effusion, normal chest x-rays, pneumothorax. On the other hand abnormalities such as lung opacity and cardiomegaly were not well predicted by the model. Model returned a null value for lung lesion, pleural other and fracture due the presence of uncertainty label. To handle label co-occurrence the model threshold was used to determine abnormalities that have likelihood of co-occurring in a chest x-ray.

X. LIMITATION OF THE WORK AND FUTURE RESEARCH DIRECTION

The research is however faced with a lot of issue on computational resource. Training model from scratch is highly computationally intensive. This was a serious limitation to getting the desired performance. Also a lot of parameter that was supposed to be tweaked was not done. The model has only four (4) Convolution layers which supposed to be deeper. Data augmentation was not carried out because the original training data of approximately 234,000 images were not utilized because of the processing capacity of the machine and the dimension of the input data. Care was taken not to downsize the image size more that necessary to avoid image degradation and loss of details from the chest x-ray. Transfer learning is a fast and quick technique for

developing deep learning model, but on medical images it weight must be from domain similar to medicine. Also, more computational resources like High Performing Computers (HPC) so that massive data could be used.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Pan, S. J., and Yang, Q. (2009). A Survey on Transfer Learning. *IEEE Transactions on Knowledge and Data Engineering*, 22(10), 1345-1359.
2. Pan, W., Xiang, E. W., Liu, N. N., and Yang, Q. (2010, July). Transfer Learning in Collaborative Filtering for Sparsity Reduction. in *Twenty-Fourth AAAI Conference on Artificial Intelligence*.
3. Tajbakhsh, N., Shin, J. Y., Gurudu, S. R., Hurst, R. T., Kendall, C. B., Gotway, M. B., and Liang, J. (2016). Convolutional Neural Networks for Medical Image Analysis: Full Training Or Fine Tuning?. *IEEE Transactions on Medical Imaging*, 35(5), 1299-1312.
4. Petrou, M and Petrou, C (2010). Image Processing: The Fundamentals, Second Edition. John Wiley and Sons, Lt. ISBN:9781119994398 |DOI:10.1002/9781119994398
5. Deng, J., Dong, W., Socher, R., Li, L. J., Li, K., and Fei-Fei, L. (2009, June). Imagenet: A Large-Scale Hierarchical Image Database. in *2009 IEEE Conference on Computer Vision and Pattern Recognition* (Pp. 248-255).
6. Wang, B., Yao, Y., Viswanath, B., Zheng, H., and Zhao, B. Y. (2018). With Great Training Comes Great Vulnerability: Practical Attacks Against Transfer Learning. in *27th {USENIX} Security Symposium ({USENIX} Security 18)* (Pp. 1281-1297).
7. Wang, X., Peng, Y., Lu, L., Lu, Z., Bagheri, M., and Summers, R. M. (2017). Chestx-Ray8: Hospital-Scale Chest X-Ray Database and Benchmarks on Weakly-Supervised Classification and Localization of Common Thorax Diseases. in *Proceedings of The IEEE Conference on Computer Vision and Pattern Recognition* (Pp. 2097-2106).
8. Irvin, J., Rajpurkar, P., Ko, M., Yu, Y., Ciurea-Illcus, S., Chute, C., and Seekins, J. (2019). Chexpert: A Large Chest Radiograph Dataset with Uncertainty Labels and Expert Comparison. *Arxiv Preprint Arxiv:1901.07031*.
9. Prince, J. L., and Links, J. M. (2006). *Medical Imaging Signals and Systems* (Pp. 328-332). Upper Saddle River: Pearson Prentice Hall.
10. Torrey, L., and Shavlik, J. (2010). Transfer Learning in *Handbook of Research on Machine Learning Applications and Trends: Algorithms, Methods, and Techniques* (Pp. 242- 264). IGI Global.
11. Kouw, W. M., and Loog, M. (2019). A Review of Domain Adaptation without Target Labels. *IEEE Transactions on Pattern Analysis and Machine Intelligence*.

12. Menegola, A., Fornaciali, M., Pires, R., Avila, S., and Valle, E. (2016). Towards Automated Melanoma Screening: Exploring Transfer Learning Schemes. *Arxiv Preprint Arxiv: 1609.01228*.
13. Zeiler, M. D., and Fergus, R. (2014, September). Visualizing and Understanding Convolutional Networks. in *European Conference on Computer Vision* (Pp. 818-833). Springer, Cham.
14. Lakhani, P., and Sundaram, B. (2017). Deep Learning at Chest Radiography: Automated Classification of Pulmonary Tuberculosis By using Convolutional Neural Networks. *Radiology*, 284(2), 574-582.
15. Rajkomar, A., Lingam, S., Taylor, A. G., Blum, M., and Mongan, J. (2017). High-Throughput Classification of Radiographs using Deep Convolutional Neural Networks. *Journal of Digital Imaging*, 30(1), 95-101.
16. Shin, H. C., Roth, H. R., Gao, M., Lu, L., Xu, Z., Nogues, I., ... and Summers, R. M. (2016). Deep Convolutional Neural Networks for Computer-Aided Detection: CNN Architectures, Dataset Characteristics and Transfer Learning. *IEEE Transactions on Medical Imaging*, 35(5), 1285-1298
17. Baltruschat, I. M., Nickisch, H., Grass, M., Knopp, T., and Saalbach, A. (2019). Comparison of Deep Learning Approaches for Multi-Label Chest X-Ray Classification. *Scientific Reports*, 9(1), 1-10.
18. Kumar, S., Dabas, C., and Godara, S. (2017). Classification of Brain MRI Tumor Images: A Hybrid Approach. *Procedia Computer Science*, 122, 510-517.
19. De Herrera, A. G. S., Kalpathy-Cramer, J., Demner-Fushman, D., Antani, S. K., and Müller, H. (2013, September). Overview of The Imageclef 2013 Medical Tasks. in *CLEF (Working Notes)*.
20. Bar, Y., Diamant, I., Wolf, L., Lieberman, S., Konen, E., and Greenspan, H. (2015, April). Chest Pathology Detection using Deep Learning with Non-Medical Training. in *2015 IEEE 12th International Symposium on Biomedical Imaging (ISBI)* (Pp. 294-297). IEEE.
21. Tao, W., Al-Amin, M., Chen, H., Leu, M. C., Yin, Z., and Qin, R. (2020). Real-Time Assembly Operation Recognition with Fog Computing and Transfer Learning for Human-Centered Intelligent Manufacturing. *Procedia Manufacturing*, 48, 926-931.
22. Shie, C. K., Chuang, C. H., Chou, C. N., Wu, M. H., and Chang, E. Y. (2015, August). Transfer Representation Learning for Medical Image Analysis. in *2015 37th Annual International Conference of The IEEE Engineering in Medicine and Biology Society (EMBC)* (Pp. 711-714). IEEE.
23. Yamashita, R., Nishio, M., Do, R.K.G. Et Al (2018). Convolutional Neural Networks: An Overview and Application in Radiology. *Insights Imaging* 9, 611–629 (2018). <https://doi.org/10.1007/S13244-018-0639-9>.





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Generative AI and Algorithmic Art: Disrupting the Framing of Meaning and Rethinking the Subject-Object Dilemma

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Abstract- In the revision of treatments of contemporary art in the 21st century, art historians are recognizing 2022 as the dawn of the age of creative artificial intelligence (AI). The emergence of generative AI tools like ChatGPT and Stable Diffusion in late 2022 immediately disrupted the established practices of the art world, leading to debates about the validity of "AI Art" and the emergence of a new market for NFTs. However, fears regarding the "death of the artist" are unwarranted when considering the historical adoption of new technologies by artists, such as photography. The role of the artist will undoubtedly transform, and the definition of "art" will be redefined once again. To better understand how AI generative art will impact traditional art-making practices, this study will present an AI generative art development pipeline and provide recommendations for future technical and theoretical considerations of the subject-object dilemma in art through a poststructuralist reading of reception theory.

Keywords: artificial intelligence, creative process, generative AI, Co-creativity, human-AI creativity.

GJCST-D Classification: DDC Code: 006.3 LCC Code: Q335



GENERATIVEAIANDALGORITHMICARTDISRUPTINGTHEFRAMINGOFMEANINGANDRETHINKINGTHESUBJECTOBJECTDILEMMA

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Generative AI and Algorithmic Art: Disrupting the Framing of Meaning and Rethinking the Subject-Object Dilemma

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Abstract- In the revision of treatments of contemporary art in the 21st century, art historians are recognizing 2022 as the dawn of the age of creative artificial intelligence (AI). The emergence of generative AI tools like ChatGPT and Stable Diffusion in late 2022 immediately disrupted the established practices of the art world, leading to debates about the validity of "AI Art" and the emergence of a new market for NFTs. However, fears regarding the "death of the artist" are unwarranted when considering the historical adoption of new technologies by artists, such as photography. The role of the artist will undoubtedly transform, and the definition of "art" will be redefined once again. To better understand how AI generative art will impact traditional art-making practices, this study will present an AI generative art development pipeline and provide recommendations for future technical and theoretical considerations of the subject-object dilemma in art through a poststructuralist reading of reception theory. While the ways in which artists will utilize these new tools are currently uncertain, this paper will explore one potential workflow in which content created via text-to-image prompts in Astra.ai is exported to Stable Diffusion. Through an evaluation of this process and the introduction of new steps for artists using AI generative content, recommendations will be provided for both the creation and interpretation of human-AI collaborative and co-creative processes and content.

Keywords: artificial intelligence, creative process, generative AI, Co-creativity, human-AI creativity.

1. INTRODUCTION

Generative Artificial Intelligence (AI), specifically art generators, have dominated news in the art world in 2022. With the launch of more and more open-source options like Stable Diffusion and Lensa.ai, mainstream adoption of AI can be seen everywhere on social media (DelSignore, 2022). Not surprisingly, the speed at which such a tool was adopted by the general population led to immediate and resolute rejection from traditionally trained artists and designers over copyright malfeasance and the new genre of AI art touted by dilettantes globally (Ansari 2022; Murphy, 2022; Hazucha, 2022.). Recent legal developments surrounding the copyright of artwork generated by artificial intelligence (AI) has reignited the debate over the role of AI in artistic creation. On February 21, 2023,

the U.S. Copyright Office revoked the initial copyright protection granted to Kris Kashtanova's comic book, *Zarya of the Dawn*, which was illustrated using the text-to-image AI program, Midjourney. The revised copyright was limited to the text and arrangement created by the author, explicitly excluding the Midjourney-generated artwork. This ruling marks a milestone in how copyright law applies to algorithmically generated art, which has raised philosophical and practical challenges related to human understanding and creativity (Ford, 2023).

The controversy caused by the maturation and wide availability of AI has also led those in the field of higher education to call for an immediate ban as well due to fears of widespread plagiarism (Francke & Alexander 2019; Sherry 2022). There has heretofore been little to no interest demonstrated by the academic community to seriously pursue practical use cases and best practices for the adoption of this new tool. The scholarly community has been instead focused on the theoretical and aesthetic implications of the disruption caused by this emerging technology. An example may be found with Ajani (2022), who has noted the two competing definitions for "art" in her study of the role of human authorship in AI-generated content- "Art as an expression of technique, art as a display of sentiment" (p.253). Thus, conversations have revolved around the ways in which "art" may be viewed and valued for either the ability to capture the human condition or demonstrable use technical prowess (Rosenberg 1983; Mullholand 2022).

The valuation of AI and non-fungible tokens (NFTs) in the artworld continues to be debated (Zhang & Yang 2021; Wellner 2022). Such musings may have their place but overlook the fact that no matter the official acceptance or rejection of AI art, the new tool has already disrupted the creative process of practicing artists (Slotte Dufva 2023). Artists themselves are noting the affordances of AI art generators in allowing exploration of new and innovative solutions in their works (Compton 2022). From suggesting new color palettes, compositions, arrangements, and spatial understanding to a new inspirational and iterative formative process, AI is a watershed moment for the fine arts. At the same time, these use cases have yet to be provided for practitioners and the critical and methodological approaches for interpreting are still

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being developed. This study will present an AI generative art development pipeline and provide recommendations for future technical and theoretical considerations of the subject-object dilemma in art through a poststructuralist reading of reception theory. While the ways in which artists will utilize these new tools are currently uncertain, this paper will explore one potential workflow in which content created via text-to-image prompts in Astra.ai is exported to Stable Diffusion. Through an evaluation of this process and the introduction of new steps for artists using AI generative content, recommendations will be provided for both the creation and interpretation of human-AI collaborative and co-creative processes and content.

II. LITERATURE REVIEW

In recent years, the use of generative artificial intelligence (AI) tools in contemporary art has sparked debates about the validity of AI-generated art and its impact on traditional art-making practices (Bonadio & Lucchi, 2019; Zhang & Lui, 2021). As we move away from traditional fine art techniques, such as acrylic on canvas, towards generative AI output, there are poststructuralist considerations to be made regarding the corporeality of art and the role of the artist in this new landscape (Anderson, 2017). The following literature review aims to investigate the current scholarship and direction for studying the future of AI art and explore how approaches to art-making are being reframed by rethinking the limitations of traditional viewing experiences. In particular, the impact of social media, fine art, and algorithms on the way art is created and viewed will be highlighted. Furthermore, we will explore how the metaverse breaks down traditional viewing dependencies and creates new possibilities for artists to engage with their audiences. Finally, we will examine how the creative prompting process can reframe the association of creator and craft to elicit content in the viewer through a poststructuralist approach to meaning creation and reception theory.

While studies may be found on the use of AI in the artmaking process, there has been little discussion of the practical applications, strategies or workflows for practicing artists and designers to adopt. Previous literature instead focuses on philosophical or theoretical discussions. For instance, Coeckelbergh (2017) offers a conceptual framework for a philosophical discussion of whether machines can create art with three questions: What is meant by "creation?" What is meant by "art?" And what is meant by machines "creating art?" The framing argues for an unstable and objective understanding of creativity. The binary of human versus non-human forms of art are also arbitrary as there should be a collaborative definition where technology assists in the creative process. In fact, discussions on creativity and the status of machines as artistic are moot

as the very accepted definition of creativity presupposes a human agent. Coeckelbergh calls for a new "poetic" understanding of the creative process where human-machine hybrid processes can surprise audiences and the artist themselves in novel ways. The belief echoes that of Mazzone and Elgammal (2019), who also had developed AI processes for identifying style and detecting large-scale style patterns in art history. The pair advocated for a rethinking of the connection between machine and human creativity "as parallel to but not in conflict with human artists and their emotional and social intentions of art making" (p. 1). Tao (2022) refers to this partnership as the "actor network" of art where humans and machines work together as co-agents. The collaborative efforts of both parties could potentially maximize the strength of each.

Other discussions would follow that would likewise question the role of machines in the creative process and a call to see that process itself creative. For example, Ahmed (2020) framed the discussion of AI in terms of a design-based praxis out of the disciplines of the arts and humanities. The author argues that the permanent physical manifestations in media museums of AI should be understood not as a design but for design. In reviewing interactive and immersive media installations, Ahmed argues that making "immaterial humanistic characteristics" concrete and physical, which include emotions, experiences, senses, and memories, AI should be reconsidered as more than a mere product or traditional image for a design (p.133). The interactions and emotions humans have interacting with art generated by AI can be seen as a design element themselves. However, these considerations of AI and art do not address one of the most controversial notions of art- creativity.

The elements of artistic autonomy and creativity often dictate discussions around whether AI-generated art can be considered "art" proper. There have been countless definitions for "creativity" but for this discussion, the model devised by Csikszentmihályi (1988) is appropriate and considers three elements that are interrelated- a body of knowledge that is agreed upon; a volitional agent who produces something innovative by changing an element of the field in question; and experts in the field that judge whether the novel production should be accepted into that domain or field. Building on the definition, Jennings (2010) further identified three criteria that an "agent" must possess in order to qualify in a system that may be considered volitional and features creative autonomy- the ability to autonomously evaluate without outside or undue opinion; the ability of a system to change autonomously and then direct variations on a standard without being explicitly directed; and, finally, the ability of a system to avoid randomness. When applied to AI art and "creativity," the author notes that "[...] progress[ing] from a capable apprentice to a creator in

its own right, an AI system must be able to both independently apply and independently change the standards it uses. This ideal will be called 'creative autonomy,' and represents the system's freedom to pursue a course independent of its programmer's or operator's intentions." (2010 p.491). Given that the artist or author is not the only agent in the creative process that ultimately judges the value of the creation, Ajani (2022) notes that creativity does not exist independently. On the contrary, "creativity depends on individual capacity, acquisition of information and judgment by experts" (p.258). Since creativity needs be externally validated, AI has been exonerated from being judged in these terms given in each domain (art and/or design) must "judge" whether the product may be considered "creative," and cannot inherently be so.

In light of the current state of scholarship on AI-generated art, there is a need for further research into the practical applications of these tools for artists and designers. As the use of generative AI tools becomes increasingly prevalent, the development of new pipelines for creating and interpreting generative content is necessitated. One area of focus will be on creating a collaborative and co-creative processes that allows artists to work in partnership with AI, rather than being constrained by its limitations. To this end, artists and designers should take a proactive approach to learning about the possibilities and limitations of AI-generated art. Additionally, artists should consider how they can incorporate generative content into their work in ways that are both innovative and meaningful, rather than simply relying on AI as a gimmick or novelty. At the same time, it is important that we develop new frameworks for interpreting and evaluating generative content, recognizing that these works are the result of complex human-AI collaborative processes. This may involve developing new criteria for evaluating the creativity and artistic merit of generative works, as well as new methods for engaging audiences in meaningful ways. By working across the fields of art and technology, artists can help to shape the future of AI-generated art, creating new possibilities for creative expression and meaning-making in the process.

III. PROCESS

The utilization of generative artificial intelligence (AI) tools has emerged as a novel and potent approach to the creation of art in contemporary times. Through the utilization of machine learning algorithms and neural networks, artists can conceive complex and intricate works that exhibit a uniqueness and originality that is unmatched by traditional methods of art creation. A defining aspect of generative AI art is its capacity to work with large datasets of imagery, enabling artists to craft highly diverse and expressive works that draw on an extensive range of visual elements.

This section aims to outline a detailed, step-by-step process for the creation of generative AI art utilizing an original art database of imagery. Drawing upon the most up-to-date research and the best practices in this field, this section provides an exhaustive outline of the tools, techniques, and workflows involved in generating these works. The goal is to provide artists and designers with a comprehensive and lucid guide to this innovative approach to artmaking, facilitating them to unlock the full potential of generative AI tools and techniques. From the sourcing and preparation of an art database to the training and refinement of an AI model, this section covers all the essential phases of the generative AI art creation process, presenting practical tips and insights along the way.

This section will outline the step-by-step process for creating AI art using original artworks as the database. It will provide a comprehensive guide to using Astria.ai to train models and create checkpoints for Stable Diffusion, a popular AI tool for creating generative art.

The first step is to install "Automatic1111 / Stable Diffusion web UI" from GitHub.com by following the technical steps provided, which involves utilizing Python to ensure the interface runs locally on your computer. Once installed, Astria.ai can be used to upload original images in the form of square crops of the original artwork that will become a "checkpoint" for Stable Diffusion (Figure 1)





Figure 1: Dataset Samples of Acrylic and Watercolor Paintings on Canvas and Paper

After uploading the images to Astria.ai, you can choose to train your own models that will then be turned into checkpoints for Stable Diffusion. Uploading 10-40 images of your own and waiting approximately 90 minutes for the model to be created is recommended.

Alternatively, you can choose to purchase models using credits, with each model costing \$1.50. The models are called "Finetunes," and you can give each model its own name. An example of a token would be "sks fiveyears" or "zwx colorfulillustrations" (Figure 2).

Figure 2: Using Astria.ai to Create a Model

Once the model is created, download the CKPT file to your PC and import it into a "models" folder related to Automatic1111. Automatic1111 is a browser interface

based on the Gradio library for Stable Diffusion (Figure 3). To run Automatic1111, execute a batch file with command lines locally on the PC.

User > stable-diffusion-webui > models > Stable-diffusion					Search Stable-diffu...	
	Name	Date modified	Type	Size		
✖	mhn-christmasstyle_sks-christmasstyle_sd15.ckpt	12/14/2022 8:24 AM	CKPT File	4,165,365 KB		
✖	mhn-colorfulcalm_sks-colorfulcalm_sd15.ckpt	12/12/2022 9:26 PM	CKPT File	4,165,365 KB		
✖	mhn-details_one_sks-details one_sd15.ckpt	1/27/2023 3:40 PM	CKPT File	4,165,365 KB		
✖	mhn-glassflower_sks-glassflower_sd15.ckpt	2/21/2023 12:33 PM	CKPT File	2,082,874 KB		
✖	mhn-illustration_sks-illustration_sd15.ckpt	12/12/2022 9:26 PM	CKPT File	4,165,365 KB		
✖	mhn-natural_sks-naturalpalette_sd15.ckpt	12/12/2022 9:24 PM	CKPT File	4,165,365 KB		
✖	mhn-styletext_zwx-styletext.ckpt	1/6/2023 2:01 PM	CKPT File	4,165,365 KB		
✖	mhn-stylethree_sks-stylethree_sd15.ckpt	1/6/2023 11:49 AM	CKPT File	4,165,365 KB		
✖	mhn-styletwo_sks-styethree_sd15.ckpt	1/6/2023 10:06 AM	CKPT File	4,165,365 KB		
✖	mhn-woman_sks-woman_sd15.ckpt	12/14/2022 8:25 AM	CKPT File	4,165,363 KB		
✖	mhn-womanillustration_sks-womanillustration_sd15.ckpt	2/21/2023 4:03 PM	CKPT File	2,082,874 KB		

Figure 3: Exporting and Storing Models Locally

Next, set up and run Automatic1111 locally on your computer, accessing the interface to start creating art by running command lines and accessing your

"Models" folder. Click on the "Models" tab at the top of the interface to view all of your checkpoints in your "Models" folder (Figure 4).

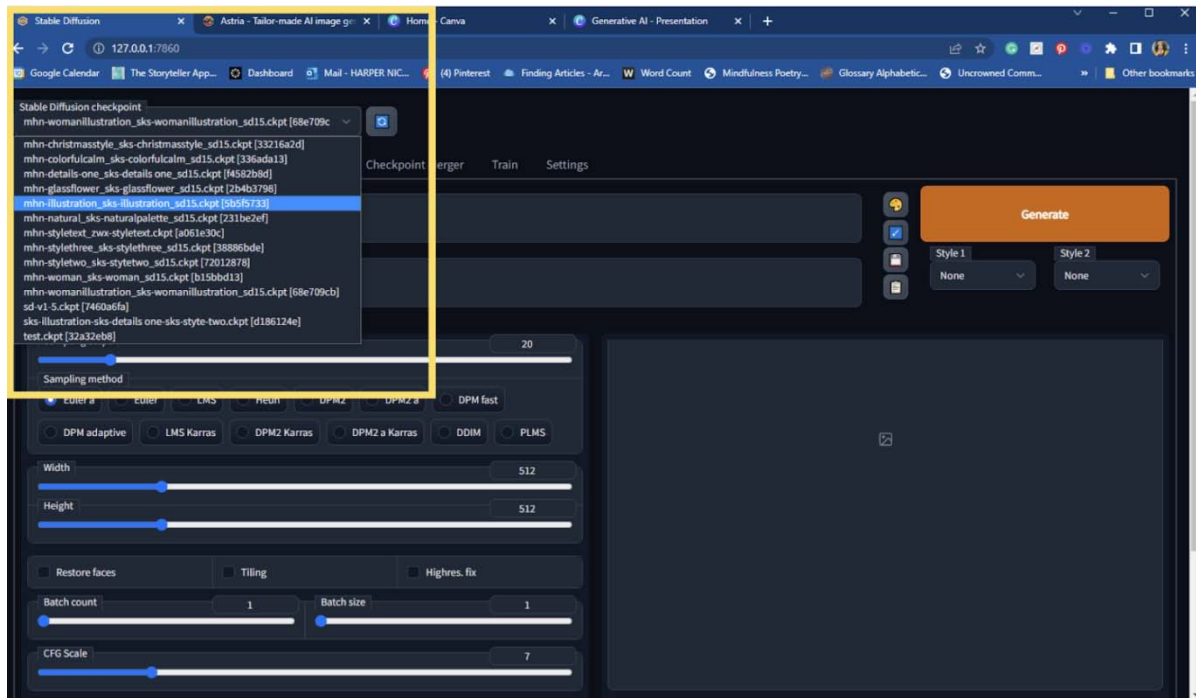


Figure 4: Accessing Custom Art Dataset Checkpoints in Astria.ai

To ensure that the checkpoint is working properly, test it by typing in the token created with Astria (sks five years) (Figure 5).

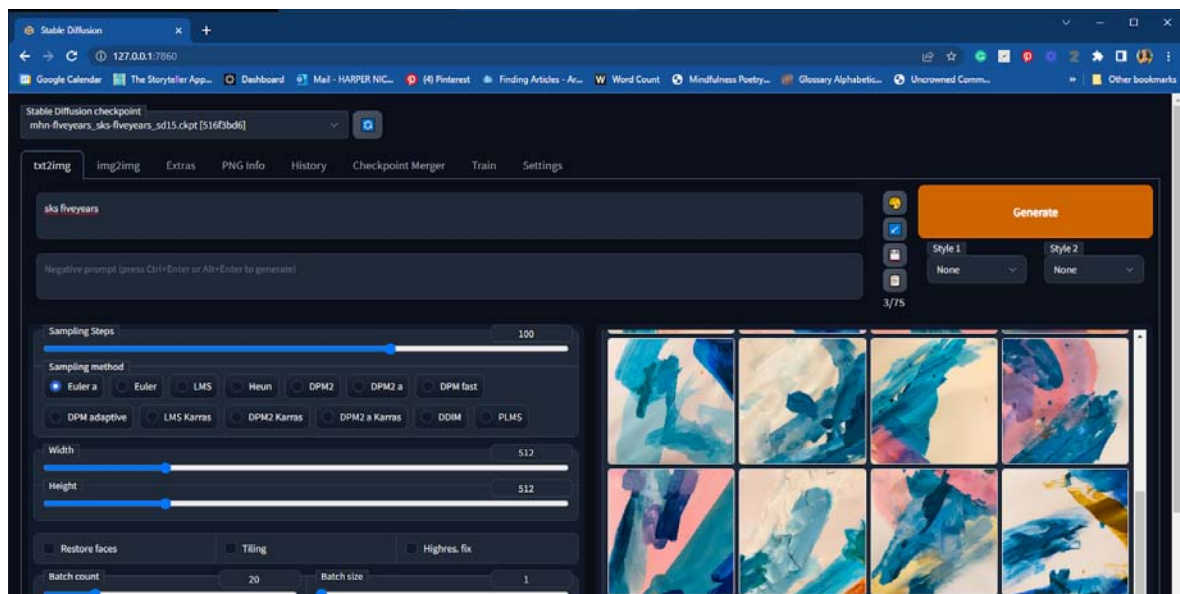


Figure 5: Generating Images from Custom Model

Each token represents a checkpoint and will generate images using the original images uploaded as the database (Figure 6).



Figure 6: Generative AI Imagery from Dataset Samples

The preceding steps provide a comprehensive and practical guide to the process of creating generative AI art using original artworks as the database. By taking a step-by-step approach, artists and designers can utilize Astria.ai and Stable Diffusion to generate unique and innovative works of art that draw on their own artistic vision and style. Moreover, by creating datasets from an entire archive of work, artists can ensure that their generative content is truly original and not just a replication of what has already been shared on social media. While these generative AI tools can scrape from social media platforms such as Instagram, the real potential of this technology lies in breaking out of the current social media framework and pulling from the artist's own sketchbook. The process can be compared to an artist's "signature brush," and artists can continue to refine their techniques and workflows to create increasingly sophisticated and personalized generative content. As the field of generative AI art continues to evolve, this guide aims to equip artists and designers with the knowledge and skills to push the boundaries of what is possible, unleashing the full potential of this exciting and innovative approach to artmaking.

IV. CONCLUSION

The emergence of generative artificial intelligence tools has revolutionized the field of art and design, offering artists and designers new and innovative ways to express their creativity. By enabling the creation of complex and intricate works of art that draw on large datasets of imagery, generative AI tools have opened up new avenues for experimentation and exploration. The step-by-step process outlined in this article for creating generative AI art using an original art database provides a comprehensive guide for artists and designers looking to unlock the full potential of these innovative tools. However, as these technologies continue to evolve and expand, there is a need for further research and development to establish an accepted development pipeline for generative AI art. This may involve a shift in art and design curriculum away from traditional technical construction towards a

focus on the conceptual framework of creativity. Additionally, the proper use of text prompts for AI-generated art should be explored and taught in order to better understand and predict outcomes for different ideation processes. As the boundaries between art and science continue to blur, artists must take the lead in shaping the algorithms and technologies that underpin generative AI tools, in order to fully realize their creative potential.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Ahmed, D. (2022). Senses, experiences, emotions, memories: artificial intelligence as a design instead of for a design in contemporary Japan. *Intelligent Buildings International*, 14(2), 133-150.
2. Ajani, G. (2022). Human Authorship and Art Created by Artificial Intelligence—Where Do We Stand? *Digital Ethics: The issue of images 11*: 253.
3. Anderson, S. L. (2017). The corporeal turn: At the intersection of rhetoric, bodies, and video games. *Review of Communication*, 17(1), 18-36.
4. Ansari, T. (2022). How AI Transformed the Art World in 2022. *Analytics India Magazine (AIM)*. October 30. Retrieved from: <https://analyticsindiamag.com/how-ai-transformed-the-art-world-in-2022/>
5. Bonadio, E., & Lucchi, N. (2019). How far can copyright be stretched? Framing the debate on whether new and different forms of creativity can be protected. *Intellectual Property Quarterly* (2019).
6. Cheng, M. (2022). The Creativity of Artificial Intelligence in Art. In *Proceedings, MDPI*, 81(1), 1.
7. Coeckelbergh, M. (2017). Can machines create art?. *Philosophy & Technology* 30, no. 3: 285-303.
8. Compton, N. (2022). Generative art: the creatives powering the AI art boom. *Wallpaper*. Retrieved from: <https://www.wallpaper.com/art/generative-art>
9. Csikszentmihályi, M. (1988). 'Society, culture, and person: A systems view of creativity', in: Sternberg, Robert: *The Nature of Creativity – Contemporary Psychological Perspectives*. Cambridge University Press, pp.325–339.

10. Culp-Roche, A., Hampton, D., Hensley, A., Wilson, J., Thaxton-Wiggins, A., Otts, J., Fruh, F., & Moser, D. (2020). Generational differences in faculty and student comfort with technology use. *SAGE open nursing* 6: 2377960820941394.
11. DelSignore, P. (2022). The New Age of Creative AI Began in 2022. Medium. December 23. Retrieved from: <https://medium.com/predict/the-new-age-of-creative-ai-began-in-2022-ece07bb93350>
12. Ford, M. (2023). Artificial Intelligence Meets Its Worst Enemy: the U.S. Copyright Office. *The New Republic*. March 3, 2023: <https://newrepublic.com/article/170898/ai-midjourney-art-copyright-office>
13. Francke, E., & Alexander, B. (2019). The potential influence of artificial intelligence on plagiarism a higher education perspective. In *Proc European Conference on the Impact of Artificial Intelligence and Robotics*. EM Normandie Business School, Oxford, pp. 131-140.
14. Hazucha, B. (2022). Artificial Intelligence and Cultural Production: Possible Impacts on Creativity and Copyright Law. Available at SSRN 4028106.
15. Hollandsworth, M. (2022). The Effect of Generation Z Entering the Security Profession: A Qualitative Exploratory Case Study. PhD diss., Northcentral University.
16. Hong, J., & Curran, N. (2019). Artificial intelligence, artists, and art: attitudes toward artwork produced by humans vs. artificial intelligence. *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM)* 15, no. 2s: 1-16.
17. Jennings, K. (2010). Developing Creativity – Artificial Barriers in Artificial Intelligence. *20 Minds & Machines*: 489–501
18. Kosunen, S., Haltia, N., Saari, J., Jokila, S., & Halmkrona, E. (2021). Private supplementary tutoring and socio-economic differences in access to higher education. *Higher Education Policy* 34, no. 4: 949-968.
19. Mazzone, M., & Elgammal, A. (2019). Art, creativity, and the potential of artificial intelligence. *Arts*, MDPI. vol. 8, no. 1, p. 26.
20. Mulholland, N. (2022). 2. Definitions of Art and the Art World. In *Exploring Visual Culture*, Edinburgh University Press. pp. 18-33.
21. Murphy, B. (2022). Is Lensa AI Stealing from Human Art? An Expert Explains the Controversy. *Science Alert*. 15 December 2022. Retrieved: <https://www-sciencealert-com.cdn.ampproject.org/c/s/www-sciencealert-com/is-lensa-ai-stealing-from-human-art-an-expert-explains-the-controversy/amp>
22. Rodrigues, E., Clua, E., & Vitor, G. (2022). Line Art Colorization of Fakemon using Generative Adversarial Neural Networks. In *2022 21st Brazilian Symposium on Computer Games and Digital Entertainment (SBGames)*, IEEE. pp. 1-6.
23. Rosenberg. (1983). *The de-definition of art*. University of Chicago Press.
24. Sherry, B. (2022). 3 Limits to Artificial Intelligence's Creativity (and How to Solve Them): Here's what you need to know about harnessing A.I. technology to be more creative. Inc. Retrieved March 17, 2023: <https://www.inc.com/ben-sherry/3-limits-to-artificial-intelligences-creativity-and-how-to-solve-them.html>
25. Slotte Dufva, T. (2023). Entanglements in AI Art. In *Global Media Arts Education*, Palgrave Macmillan, Cham. pp. 181-196.
26. Tao, F. (2022). A New Harmonisation of Art and Technology: Philosophic Interpretations of Artificial Intelligence Art. *Critical Arts* 36, no. 1-2: 110-125.
27. Wellner, G. (2022). Digital Imagination, Fantasy, AI Art. *Foundations of Science* 27, no. 4: 1445-1451.
28. Wright, A., Roscigno, V., & Quadlin, N. (2021). First-Generation Students, College Majors and Gendered Pathways. *The Sociological Quarterly*: 1-24.
29. Zhang, C., & Lum, Y. (2021). Study on artificial intelligence: The state of the art and future prospects. *Journal of Industrial Information Integration* 23: 100224.
30. Zhang, C., & Lu, Y. (2021). Study on artificial intelligence: The state of the art and future prospects. *Journal of Industrial Information Integration*, 23, 100224.



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Acknowledgments

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The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.



Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
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- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

- a) A title which should be relevant to the theme of the paper.
- b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
- c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
- d) An introduction, giving fundamental background objectives.
- e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
- f) Results which should be presented concisely by well-designed tables and figures.
- g) Suitable statistical data should also be given.
- h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

- i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
- j) There should be brief acknowledgments.
- k) There ought to be references in the conventional format. Global Journals recommends APA format.

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Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

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A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

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Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.



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Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

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TIPS FOR WRITING A GOOD QUALITY COMPUTER SCIENCE RESEARCH PAPER

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

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7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

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10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

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23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

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To make a paper clear: Adhere to recommended page limits.



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- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
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- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

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Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

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Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
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Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

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This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

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- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

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Put figures and tables, appropriately numbered, in order at the end of the report.

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Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

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- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

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References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

A

Aesthetic · 7, 57
Ambiguity · 3
Anxiety · 1, 2, 10, 11
Atelectasis · 46, 53
Autumn · 3, 7, 9, 10, 12

C

Cardiomegaly · 46, 53
Chaotic · 7
Cohesion · 4
Corpus · 3, 4, 5

E

Enormous · 38
Entropy · 4, 13
Exemplary · 3, 11

F

Foucauldian · 1

G

Gimmick · 59

M

Metaphors · 8, 9, 10
Metaverse · 58

N

Nontrivial · 44

P

Paranoid · 30
Pleural · 46, 53
Pneumonia · 46, 53

Pneumothorax · 46, 53
Praxis · 58
Psyche · 8
Pursue · 57, 59

Q

Quadratic · 38

R

Rhetorical · 4
Rocentric · 2

S

Syndrome · 2

T

Taxonomic · 37
Trivial · 8, 50
Tuberculosis · 8

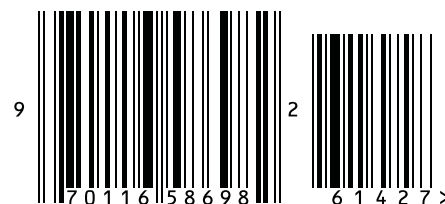


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