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C Programming Language–Still Ruling the World

By Saphalya Peta

Chaitanya Bharathi Institute of Technology

Abstract- C Programming Language, developed by Dennis Ritchie in 1972, is an evergreen programming language. It is the backbone of the Unix operating system and paved the way for the development of object-oriented programming. C has been around for 30 years, and there are many source codes available which means there is a lot to learn and a lot to use.

C programming language is that which sits close to the operating system. This feature makes it an efficient language because system-level resources, such as memory, can be accessed easily. The features like fast, flexible, portable, and structured programming language with a rich library makes the C programming language not to have an expiry date.

C programming language closeness to the hardware and great portability make it ideal for low-level development such as operating systems, kernels, and embedded systems. Its versatility, efficiency, and good performance make it an excellent choice for high complexity data manipulation software, like databases or 3D animation. The fact is that many programming languages today are better than C for their intended use, which does not mean that they beat C in all areas. C is still unsurpassed when performance is the priority.

Keywords: *language, programming, importance.*

GJCST-H Classification: *DDC Code: 401.93 LCC Code: P118*



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in usage, but relatively, JavaScript or its variants, or XML, will continue to become more central.” ~ Dennis Ritchie (Computer Scientist, Bell Labs, New Jersey, USA)

- “C: A programming language that is sort of like Pascal except more like assembly except that it is not very much like either one, or anything else. It is either the best language available to the art today, or it is not.” ~ Raymond Simard (Former Clerk of the House of Commons of Canada, Canada)
- “Java is, in many ways, C++.” ~ Michael Feldman (Communications Consultant, The Glover Park Group, USA)
- “Assembly, while extremely powerful, is simply too difficult to program large applications and hard to read or interpret in a logical way. C is a compiled language, which creates fast and efficient executable files. It is also a small “what you see is all you get language.” ~ (Wiki Books, C Programming)
- “C++ would make a decent teaching language if we could teach the ++ part without the C part.” ~ Dr. Michael B. Feldman (Professor Emeritus Department of Computer Science, The George Washington University, Washington, DC)

III. REVIEW OF LITERATURE

C language is one of the easiest languages to learn. People all over the world prefer the C language to begin their programming because it is easy to understand and has easy syntaxes⁸. Moreover, the C language has a fixed number of keywords⁹, which are 32¹⁰ long, with the fixed set of control primitives like if¹¹, for¹², while¹³, switch¹⁴ and do while¹⁵. It also includes a set of standard C functions, which are commonly used while writing simple as well as complex programs.

One of the main reasons C has always been a popular language and is still in use is its portability. With slight modifications, one can run a C program on any other platform or computer system. C is a Portable Assembly language. It is as close to the machine as possible while it is almost universally available for all existing processor configurations. Because of this all the

compilers¹⁶, libraries, and interpreters¹⁷ of other programming languages are often implemented in C. Many interpreted languages like Python have their primary implementations written in C.

C is considered an essential and a vital programming language because of which it is still ruling the world: it is a powerful language that includes a collection of in-built functions and operators that help in writing any complex program. C programs are very efficient because they contain a variety of datatypes¹⁸ and robust operators. The capabilities of an assembly language and high-level languages are combined in the C compiler, which makes it the most suitable language for writing system software and commercial software.

Despite the prevalence of higher-level languages, the C programming language continues to empower the world. There are plenty of reasons to believe that C programming was, is, and will remain active for a long time. Here are some reasons why C is unbeatable:

1. **Legacy:** C has been around a long time, and virtually anything ever made, which can be called a computer, includes a C compiler. Even most better programming languages are built on and using C.
2. **Portability:** C is the oldest language which can generally be considered cross-platform. Although it requires being recompiled on the target platform, most C source runs precisely the same on any platform.
3. **Libraries:** Because C is as old as it is, it has the most extensive collection of optimized libraries and source code extent. C is the most hyper-efficient Programming language as part of the STL¹⁹ library. Also, one can extend libraries in C while programming.
4. **Raw Performance:** Because C is so old, much of it has been optimized to run extremely fast on 10MHz²⁰ 8-bit systems with less than 640k²¹ RAM.
5. **Low-Level Accessibility:** Due to its age, C includes native support for inline Assembler²² for even greater optimization. No other language (except C++) offers the full spectrum from high-level abstraction to low-level control.

⁸ Reema Tharaja “Introduction to C Programming”, Second Edition, OXFORD Press, 2015.

⁹ Pradeep Deyand Manas Ghosh, “Programming in C”, Oxford Press, 2nd Edition, 2017.

¹⁰ <https://ict.iitk.ac.in/c-the-mother-of-all-languages/>

¹¹ Byron Gottfried, Schaum’s Outline of Programming with C”, Mc Graw-Hill.

¹² Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India.

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¹⁶ AK Sharma, “Computer Fundamentals and Programming”, 2nd Edition, UniversityPress, 2018

¹⁷ C From Theory to Practice Second Edition 2017 by George S. Tselikis, Nikolaos D. Tselikas, Taylor, and Francis

¹⁸ Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India.

¹⁹ https://en.wikipedia.org/wiki/Standard_Template_Library

²⁰ Google

²¹ Google

²² AK Sharma, “Computer Fundamentals and Programming”, 2nd Edition, UniversityPress, 2018

6. *Relationship with Machine Language:* Most modern high-level languages take abstraction to such extremes that even veteran programmers have no real clue of how a CPU executes their code. By contrast, C is combination of high-level abstraction and low-level control keeps programmers mindful of precisely how a CPU functions - leading to better, faster, cleaner code.
7. *Flexibility:* C programming language is used widely because of the flexibility of its use for memory management. Programmers of C have opportunities to control how, when, and where to allocate and deallocate memory. Memory is allocated statically, automatically, or dynamically in C programming with the help of malloc²³ and calloc²⁴ functions.
8. *Memory Manipulation:* Arbitrary memory address access and pointer arithmetic is a vital feature that creates C as an ideal system programming. At the hardware/software boundary, computer systems and microcontrollers map their peripherals and I/O pins into memory addresses. System applications must read and write to those custom memory locations to communicate with the globe. So, C has the ability to control arbitrary memory addresses is imperative for system programming.

The TIOBE²⁵ (The Importance of Being Earnest) Programming Community index indicates the popularity of programming languages. The ratings are based several skilled engineers worldwide, courses, and third-party vendors. Popular search engines such as Google, Bing, Yahoo!, Wikipedia, Amazon, and YouTube calculate the ratings. The index can be used to check whether one's programming skills are still up to date or to make a strategic decision about what programming language should be adopted when starting to build a new software system.

Below, is the graph showing TIOBE ratings throughout different years for the C Programming Language:



Fig. 1: The graph showing TIOBE ratings throughout different years for the C Programming Language

Below, are the TIOBE indexes for various programming languages:

| Programming Language | 2022 | 2017 | 2012 | 2007 | 2002 | 1997 | 1992 | 1987 |
|----------------------|------|------|------|------|------|------|------|------|
| C | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| Python | 2 | 5 | 8 | 8 | 18 | 28 | - | - |
| Java | 3 | 1 | 1 | 1 | 2 | 16 | - | - |
| C++ | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 4 |
| C# | 5 | 4 | 4 | 7 | 12 | - | - | - |
| Visual Basic | 6 | 14 | - | - | - | - | - | - |
| JavaScript | 7 | 7 | 10 | 9 | 9 | 21 | - | - |
| Assembly language | 8 | 10 | - | - | - | - | - | - |
| PHP | 9 | 6 | 5 | 5 | 8 | - | - | - |
| SQL | 10 | - | - | - | 38 | - | - | - |
| Prolog | 24 | 33 | 45 | 28 | 29 | 15 | 10 | 3 |
| Ada | 28 | 30 | 17 | 17 | 17 | 11 | 3 | 14 |
| Lisp | 32 | 28 | 13 | 13 | 11 | 8 | 12 | 2 |
| (Visual) Basic | - | - | 7 | 4 | 4 | 3 | 7 | 5 |

Fig. 2: The TIOBE Indexes for other Programming Languages

C Programming Language in Operating Systems: C language was initially developed to write down UNIX software. Also, the execution time of the programs written in C language is reminiscent of the assembly language, which has made C language the foremost crucial part of the development of various operating systems. Most of the Operating Systems have lots of their features implemented in C because of its swiftness. Unix-Kernel, Microsoft Windows utilities and Operating System applications, and an enormous segment of Android have all been written in C language.

Though C is considered a high-level language, it is far closer to the hardware than most other languages. For that reason, many languages “higher” than C will use C to compile. Most modern programming languages have their compilers written in C because of the C Programming Language proximity to the hardware, whose response time is way better than high-level languages exerting easier control. Embedded systems²⁶ used in electrical appliances like sensors, Arduino²⁷, and many more mostly run on the C platform or a platform whose libraries are coded in C and C++.

Also, C Programming Language has led to the

²³ Reema Tharaja "Introduction to C Programming", Second Edition, OXFORD Press, 2015.

²⁴ C From Theory to Practice Second Edition 2017 by George S. Tselikis, Nikolaos D. Tselikas, Taylor, and Francis.

²⁵ <https://www.tiobe.com/tiobe-index/>

²⁶ <https://www.toptal.com/c/after-all-these-years-the-world-is-still-powered-by-c-programming>

²⁷ <https://www.arduino.cc/>

development of several new languages such as C++, C#, Java, JavaScript, Python, Verilog, etc. C Programming language is also used for creating a variety of graphics and gaming applications.

IV. SURVEY

A standard procedure and Empirical Research Methodology was used to survey the chosen topic. Demographically, the total number of respondents were 623, among which 364 were Male, and 259 were Female. The tools used in performing this survey were: Direct Interaction, Emailing, social media, etc. The respondents were from various parts of the globe like India, the USA, the UK, China, Singapore, Australia, New Zealand, etc. The survey reports were as follows:

Question 1: Do you belong to the IT or Software Industry?

623 responses

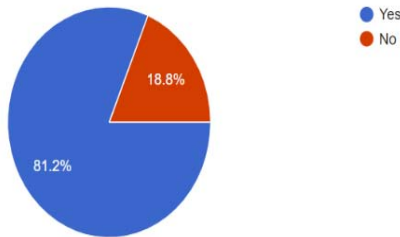


Fig. 3: Survey Result for Question 1

The above pie chart exhibits the survey result for the first question that states that 81.2% of the respondents were from the Information Technology-IT or Software industry while 18.8% of the respondents were not.

Question 2: Did you learn C Programming Language?

623 responses

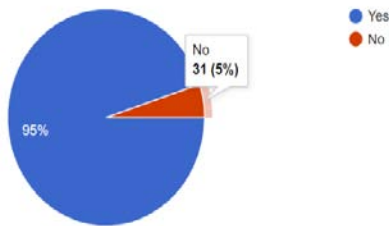


Fig. 4: Survey Result for Question 2

The above pie chart indicates the result of the survey for the second question, which states that 95% of the respondents learned C programming language while 5% of the respondents did not.

Question 3: Do you agree that the C Programming language helped learn other programming languages?

623 responses

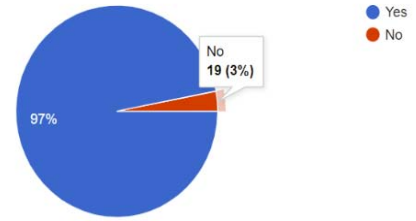


Fig. 5: Survey Result for Question 3

The above pie chart illustrates the survey result for the third question, which states that for 97% of the respondents, C programming language helped in learning other programming languages, in comparison for 3% of the respondents, it did not.

Question 4: Do you think that 'C' Programming is language the base for programming?

623 responses

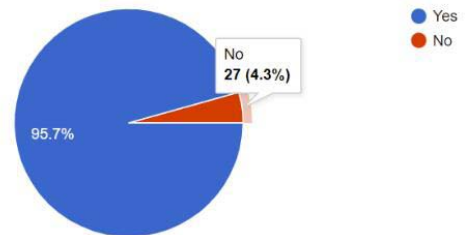


Fig. 6: Survey Result for Question 4

The above pie chart demonstrates the survey result for the fourth question, which states that 95.7% of the respondents thought that C programming language is the base for programming while 4.3% of the respondents did not.

Question 5: Do you feel that 'C' programming is language ruling the software world to date?

623 responses

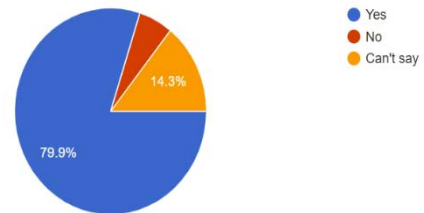


Fig. 7: Survey Result for Question 5

The above pie chart displays the result of the survey for the fifth question, which states that 79.9% of the respondents felt that the C programming language is ruling the world to date, while 14.3% of the respondents could not conclude that while 5.8% of the respondents did not feel that.

V. CONCLUSION

C language is simple, elegant, and wicked fast; it's compact and efficient. Because C has raw pointers²⁸, bitwise operators²⁹, and the keywords: extern³⁰, volatile³¹, static³², and register³³, makes it focuses more on writing efficient code than one can glean from any higher-level language. C continues to empower the world.

Many latest programming languages have been borrowed directly or indirectly from C, such as: C++, C#, Unix's Cshell, D, Go, Java, JavaScript, Julia, Limbo, LPC, ObjectiveC, Perl, PHP, Ruby, Rust, Swift, Verilog, SystemVerilog, Python, etc. These languages have drawn many of their control structures and other basic features from C. Most of them express highly similar syntax to C, and they tend to combine the recognizable expression and statement syntax of C with underlying type systems, data models, and semantics that can be radically different.

The most commonly programmed language is the C, due to the language features such as: flexibility, efficiency, performance, and closeness to the hardware.

C is the foundation of: Operating systems (Unix, Linux), Compilers (C compilers, FORTRAN compilers, Pascal), Run Time libraries (for C, C++, FORTRAN), Interpreters (Python, Ruby, Smalltalk, Java Virtual Machine), Databases (Oracle), Shells (C Shell, Born Shell, Koran Shell).

The world is running on C-powered devices. C is the past, the present, and the future in many areas of software. Each, every programmer will start their programming journey with C as their first programming language because it is the base for all the programming languages as it is called the mother language of all the programming languages. So, this is also one of the main reasons for the C Programming Language to rule the software world to date.

Hence, it can be concluded that C PROGRAMMING LANGUAGE IS STILL RULING THE WORLD!

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²⁸ Byron Gottfried, Schaum's Outline of Programming with C", Mc Graw-Hill.

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Application of Decision Trees in the Identification of Fraudulent Websites

By Christian Layme Fernández, José Manuel Suri Canaza, David Jose Peña Ugarte
& Jhon Yoset Luna Quispe

Universidad Nacional de San Agustín

Abstract- Computer security is a very important area in any system that has an internet connection, because there are fraudulent websites that can carry out criminal actions towards a person, organization or other entity. Therefore, it is necessary to be able to detect which websites are fraudulent before being able to enter it, for this an implementation was developed through Decision Trees with the Python language to detect and classify them as Legitimate, Suspicious and Fraudulent through 1353 cases that they rank websites.

Keywords: árboles de decisión, crisp-dm, minería de datos, clasificación, sitios web.

GJCST-H Classification: DDC Code: 621.38928 LCC Code: TH9737



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Application of Decision Trees in the Identification of Fraudulent Websites

Aplicación De Los Árboles De Decisión En La Identificación De Sitios Web Fraudulentos

Christian Layme Fernández ^α, José Manuel Suri Canaza ^σ, David Jose Peña Ugarte ^ρ & Jhon Yoset Luna Quispe ^Ω

Resumen- La seguridad informática, es un área muy importante en cualquier sistema que tenga conexión a internet, debido a que existen sitios Web fraudulentos que pueden realizar acciones delictivas hacia una persona, organización u otra entidad. Por lo cual es necesario poder detectar qué sitios web son fraudulentos antes de poder ingresar a ella, para ello se desarrolló una implementación mediante Árboles de Decisión con el lenguaje de Python para poder detectar y clasificarlos en Legítimos, Sospechosos y Fraudulentos por medio de 1353 casos que clasifican a los sitios webs.

Palabras clave: árbol de decisión, python, seguridad informática, web sites.

Abstract- Computer security is a very important area in any system that has an internet connection, because there are fraudulent websites that can carry out criminal actions towards a person, organization or other entity. Therefore, it is necessary to be able to detect which websites are fraudulent before being able to enter it, for this an implementation was developed through Decision Trees with the Python language to detect and classify them as Legitimate, Suspicious and Fraudulent through 1353 cases that they rank websites.

Keywords: árboles de decisión, crisp-dm, minería de datos, clasificación, sitios web.

I. INTRODUCCIÓN

Uno de los cambios más notorios actualmente en el mundo, aún más por el tiempo de cuarentena, es el uso de Internet y de servicios Web, como son el comercio electrónico, el cual aumentó, por las circunstancias que atraviesa el mundo, Internet se convirtió no solo en un gran apoyo para la sociedad, que utiliza el E-commerce para poderse suministrar las necesidades que tenga, Internet también está siendo utilizado por delincuentes que roban la información de muchas personas y cometiendo actos fraudulentos, el cual genera pérdidas de miles de millones cada año, estos sitios web suelen presentarse como sitios web amigables y de fuentes legítimas de información, productos y servicios en línea.

Los sitios web fraudulentos tienen características, como son: *SFH*, Si el sitio web tiene

definido la propiedad action en sus formularios de forma correcta dirigiendo los datos de los formularios a direcciones del mismo sitio web. *PopUp Windows*, Si el sitio tiene ventanas emergentes (PopUp). *SSL Final State*, Si el sitio web utiliza conexión SSL, que la misma presente un estado final válido. *Request URL*, cuando son objetos (imágenes, scripts, hojas de estilos) que son cargadas de otra URL distinta a la del sitio. *URL of Anchor*, cuando los objetos de una página son cargadas desde el mismo sitio o desde un subdominio del mismo. *Web Traffic* Si tiene configurado un analizador de tráfico web como el Google Analytics. *URL Length* Cantidad de caracteres de la dirección URL. *Age of Domain*, Cantidad de años que lleva activo el dominio de la URL. *Have IP*, Si tiene o no dirección IP. Las medidas existentes, que disponen los buscadores han mejorado pero no son suficientes para detectar sitios web fraudulentos, aún más por el esfuerzo de los que generan este tipo de sitios web para poder eludir estas medidas.

El uso de Árboles de Decisión resulta ser una buena opción para poder detectar los sitios web fraudulentos. Un árbol de decisión es una forma gráfica y analítica de representar todos los eventos (sucesos) que pueden surgir a partir de una decisión asumida en cierto momento. Nos ayudan a tomar la decisión “más acertada”, desde un punto de vista probabilístico, ante un abanico de posibles decisiones. Permite desplegar visualmente un problema y organizar el trabajo de cálculos que deben realizarse.

El propósito de este artículo, es el desarrollo un detector de sitios web fraudulentos, a través de inteligencia artificial usando árboles de decisión, con uso librerías para desarrollar el aprendizaje en Python, teniendo 1353 casos en los que se clasifican los sitios web, que serán evaluados y empleando la herramienta Graphviz para visualizar el Árbol decisión resultante.

II. HERRAMIENTAS

a) Dataset

Es un conjunto de datos conocido también por el anglicismo dataset, es una colección de datos habitualmente tabulados. En general, y en su versión más simple, un conjunto de datos corresponde a los

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contenidos de una única tabla de base de datos o una única matriz de datos estadística, donde cada columna de la tabla representa una variable en particular, y cada fila representa a un miembro determinado del conjunto de datos en cuestión [1].

La publicación de los conjuntos de datos usados en un experimento son clave para su reproducibilidad, y cada vez son más las leyes públicas y normas de revistas científicas que obligan a hacerlos públicos, para evitar sesgos. Existen muchas fuentes de datasets como kaggle, el mismo google tiene una plataforma para buscar dataset "Dataset Search" [2].

b) Colab

Colaboratory es un proyecto de investigación de Google creado para ayudar a difundir la educación y la investigación sobre Machine Learning. Es un entorno de Jupyter que no requiere configuración para su uso y se ejecuta completamente en la nube [3].

c) Funcionamiento

Colaboratory es gratuita y forma parte de la suite de aplicaciones de Google en la nube. Por ello, para utilizarlo basta con acceder a nuestra cuenta de Google y, o bien entrar directamente al enlace de Google Colab o ir a nuestro Google Drive, pulsar el botón de «Nuevo» y desplegar el menú de «Más» para seleccionar «Colaboratory», lo que creará un nuevo cuaderno (notebook) [4].

d) Entorno de Ejecución

Cada celda es independiente, pero todas las celdas en un cuaderno utilizan el mismo kernel. El kernel es el motor de computación que está por debajo y que se encarga de ejecutar nuestro código y devolver el resultado para mostrarlo en la celda. El estado del kernel persiste durante el tiempo, con lo que, aunque cada celda sea independiente, las variables declaradas en una celda se pueden utilizar en las demás celdas [4].

```
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import classification_report
import sklearn.metrics
```

Figura 4: Librería Matplotlib

Scikit-learn anteriormente scikits.learn y también conocido como sklearn es una biblioteca de machine learning de software libre para el lenguaje de programación Python. [9] Cuenta con varios algoritmos de clasificación, regresión y agrupamiento que incluyen support-vector machines, random forests, gradient boosting, k-means y DBSCAN, y está diseñado para interoperar con las bibliotecas numéricas y científicas de Python NumPy y SciPy, sus principales algoritmos realizan [8]:

e) Librerías

```
from pandas import Series, DataFrame
import pandas as pd
```

Figura 1: Librería Pandas

Pandas es una herramienta de manipulación de datos de alto nivel desarrollada por Wes McKinney. Es construido con el paquete Numpy y su estructura de datos clave es llamada el DataFrame. El DataFrame te permite almacenar y manipular datos tabulados en filas de observaciones y columnas de variables [5].

```
import numpy as np
```

Figura 2: Librería Numpy

Numpy es la biblioteca central para la computación científica en Python. Proporciona un objeto de matriz multidimensional de alto rendimiento y herramientas para trabajar con estas matrices.[6].

```
import os
import matplotlib.pyplot as plt
```

Figura 3: Librería Matplotlib

Matplotlib es una biblioteca de trazado 2D de Python que produce figuras de calidad de publicación en una variedad de formatos impresos y entornos interactivos en todas las plataformas. matplotlib se puede usar en scripts de Python, el shell de python e ipython, servidores de aplicaciones web y seis juegos de herramientas de interfaz gráfica de usuario. matplotlib intenta hacer las cosas fáciles fáciles y las difíciles posibles. Puede generar gráficos, histogramas, espectros de potencia, gráficos de barras, gráficos de error, gráficos de dispersión, etc., con solo unas pocas líneas de código [7].

- Classification: Identifica a qué categoría pertenece un objeto
- Regression: Predice un atributo de valor continuo asociado con un objeto.
- Clustering: Agrupación automática de objetos similares en conjuntos.
- Dimensionality reduction: Reduce el número de variables aleatorias a considerar.
- Model selection: Compara, valida y elige parámetros y modelos.

- Preprocessing: Extrae y normaliza las características.

III. MÉTODOS Y METODOLOGÍA COMPUTACIONAL

Se usó para el desarrollo de este detector de sitios web fraudulentos usamos el modelo CRISP-DM, la cual comprende de seis fases: análisis del problema, análisis de Datos, preparación de los Datos, modelado, evaluación y explotación[10].

- La fuente de información fue un Dataset.csv, esto fue sacado de internet con datos reales, para poder construir un árbol de decisión utilizando las librerías sklearn, y se hizo uso de las funciones que nos brinda.
- Análisis del problema: Identificamos qué tipos de clasificación tendrán las páginas que se van a probar, viendo que pueden ser tres, y también identificamos la información necesaria para poder hacer esta clasificación.
- Análisis de Datos: con el dataset que obtuvimos, vimos que cantidad de información tiene, y las variables lingüísticas las clasificamos en números para su uso correcto con la librería que se trabajaría.
- Preparación de Datos: Se hizo una limpieza del dataset, con las funciones que nos brinda la libre, como eliminación de campos vacíos, datos irrelevantes.
- Modelado: Seleccionamos la técnica adecuada para poder hacer la clasificación.
- Evaluación: Tuvimos que corroborar efectivamente que el modelo escogido se ajuste a lo que estamos buscando, en este caso poder clasificar los diferentes sitios web.

IV. RESULTADOS

Teniendo en cuenta las fases de la metodología CRISP-DM los siguientes son los resultados de cada una de las etapas:

a) Análisis Del Problema

La Dirección de Seguridad Informática de una universidad pretende desarrollar un sistema informático capaz de detectar si un sitio web es fraudulento.

b) Análisis De Los Datos

Del *dataset* descargado de internet, después de consultar el número de casos de las tablas de hechos para los nueve eventos en cuestión como se muestra en la Figura 5, se cuenta con un número de 1353 datos por cada categoría. Sin embargo, no todos los eventos comparten las mismas características. Una primera modificación de atributos se realizó para estandarizar aquellas variables lingüísticas dentro del *dataset*. El número de eventos modificado es 7, y son

los siguientes: SFH, popUpWindows, SSLfinalState, Request URL, URL of Anchor,web Traffic,Have IP y Clasificación del sitio web. Con el fin de obtener los atributos estandarizados para el estudio, se realizó una búsqueda y análisis inicial de errores de los atributos, cambiando la codificación utilizando el rango establecido entre -1, 0 y 1. Basado en la información recepcionada se selecciona *Clasificación del sitio web* como variable objetivo. Como resultado se obtuvo el repositorio inicial con los 1353 datos, y sirvió de base para las siguientes etapas de este proceso.



Figura 5: Mapa De Burbujas De Los Rasgos a Evaluar

c) Preparación De Los Datos

Se realizó un análisis de la calidad de los datos del *dataset*, donde se identificó por cada atributo el número de valores distintos, el número de valores nulos, el valor máximo, valor mínimo, media y moda. Como resultado de este proceso, se seleccionaron los 9 eventos, sobre el cual se aplicaron las técnicas de modelado. Todos estos atributos son características propias del tema evaluado.

d) Modelado

Con el fin de encontrar o descubrir sitios web fraudulentos, se seleccionó el modelo de clasificación basado en árboles de decisión. La clasificación con árboles de decisión considera clases disjuntas, de forma que el árbol conducirá mediante sus hojas a la predicción diseñada. Después de construido el modelo servirá para determinar en nuevos casos, el tipo de sitio web visitado. Para esta tarea, se escogió como clase el atributo *clasificación* que determina si el sitio web es fraudulenta, sospechosa, o legítima.

Para evaluar la calidad del modelo, se dividió el repositorio de datos en dos conjuntos: entrenamiento y prueba. Se empleó el 75% de los datos para el entrenamiento del modelo, mientras que el 25% restante se utilizó para la prueba. Los grupos de datos antes explicados se toman de forma aleatoria en cada iteración. Se calculó el error de muestra parcial del modelo por cada iteración. Por último se construyó el modelo con todos los datos.

Para la lectura de los resultados de la evaluación se utiliza la matriz de confusión. Se visualiza

una matriz de confusión tomada de un ejemplo aleatorio del proyecto. Además de la matriz, se visualiza la precisión del árbol, todo esto se muestra en la Figura 6.

| Predicted | -1 | 0 | 1 | All |
|-----------|-----|----|-----|-----|
| True | | | | |
| -1 | 149 | 4 | 18 | 171 |
| 0 | 5 | 16 | 7 | 28 |
| 1 | 14 | 6 | 120 | 140 |
| All | 168 | 26 | 145 | 339 |

0.8407079646017699

Figura 6: Matriz De Confusión Y Precisión Del Árbol

e) Evaluación

Analizando los resultados de las pruebas de clasificación con árboles de decisión realizadas con el conjunto de datos, en el cual se almacenan los datos de 1353 casos, se puede observar que el árbol de decisión construido con un factor de entrenamiento del 75%, esto quiere decir 1014 casos tomados aleatoriamente, y un número de casos de evaluación correspondiente al 25% que representa a los 339 casos restantes, con 285 instancias correctamente clasificadas, que corresponden a un porcentaje de precisión del 84,07% y 54 instancias incorrectamente clasificadas, correspondiente a un porcentaje de error del 15,93%. El árbol de decisión generado evalúa cada caso buscando que la entropía se iguale a cero. En algunas ramas, los resultados se visualizan en capas superiores, y de esta manera, mientras se aumenta la profundidad del árbol se encuentra mayor cantidad de resultados. El árbol de decisión es de tipo binario, ya que solo muestra dos ramas hijas, algunas concluyendo en hojas de manera temprana. El algoritmo genera la repartición y categorización de los nodos hijos haciendo una evaluación ponderada, utilizando teoría de árboles de decisión, y brindando un número que sirve de particionador en nodo hijo izquierdo y nodo hijo derecho, así sucesivamente hasta llegar al final. Cada nodo hoja evalúa la partición de cada evento, además de su entropía, mostrando también el número de datos evaluados y mostrando cuantos pertenecen a cada sección de la clasificación (fraudulento=-1, sospechoso=0 y legítimo=1).

f) Implementación

Teniendo en cuenta los patrones descubiertos, es importante implementar planes de prevención que permitan disminuir los sitios web fraudulentos. Implementar programas de de ciber seguridad que permitan prevenir la infiltración delictiva. De igual manera, se deben redoblar esfuerzos en educación de seguridad cibernética y sanciones más enérgicas contra los infractores.

Este conocimiento descubierto se incorporará al existente y se integrará a los procesos de toma de decisiones de los analizadores de sitios web fraudulentos, proporcionando nuevos panoramas.

V. DISCUSIÓN

Según la matriz de confusión de la Figura 2, el modelo clasifica correctamente al 43,95% de casos fraudulentos, al 4,72% de casos sospechosos y al 35,40% de casos legítimos. Por otra parte, la precisión con la clase real de este modelo es de 0,84 que se considera aceptable (1,0 significa que ha habido precisión absoluta). Los porcentajes de instancias correctamente clasificados presentados en el árbol como en la matriz de confusión indican que el modelo tiene una buena precisión, por lo tanto es confiable y eficiente, para clasificar nuevos casos, especialmente fraudulentos y legítimos. Este estudio da resultados aceptables que servirán de base al estudio futuro de reconocimiento de sitios web fraudulentos.

VI. CONCLUSIONES

Los resultados obtenidos con el modelo de clasificación por árboles de decisión, indican que este es capaz de generar modelos consistentes con la realidad observada y el respaldo teórico, basándose únicamente en los datos que se encuentran almacenados en el dataset.

Los porcentajes de instancias correctamente clasificadas presentados en el árbol como en la matriz de confusión muestran que el modelo tiene una precisión buena y por consiguiente es confiable para clasificar nuevos casos, especialmente de sitios web fraudulentos y legítimos. El factor de confianza sirve de respaldo a los porcentajes antes expuestos.

Como trabajos futuros se plantea utilizar otros clasificadores para comparar estos resultados y mejorar la precisión (por ejemplo regresión logística), especialmente en los sitios web fraudulentos y aumentar el porcentaje de evaluación de sospechosos; aplicar tareas descriptivas de minería de datos como asociación y agrupación, con el fin de encontrar relaciones y similitudes, según el tipo de sitio web analizado.

Dentro de esta investigación no hubo conflicto de intereses.

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Biological Analysis and Linear Block Hidden Markov Model for Gene and Labelled

By Dr. Suneel Pappala

Abstract- Hidden Markov models (HMMs) have been extensively used in biological sequence analysis. HMMs and their applications in a variety of problems in molecular biology. The difficulty of using computational approaches to discover genes in DNA sequences is yet unsolved. gene prediction from within genomic DNA are far from being powerful enough to elucidate the gene structure completely. We develop a hidden Markov model (HMM) to represent the degeneracy features of splicing junction donor sites in eucaryotic genes. he HMM system is fully trained using an expectation maximization algorithm and the system performance is evaluated using the 10-way cross-validation method. he HMM system is fully trained using an expectation maximization algorithm and the system performance is evaluated using the 10-way cross-validation method.

Keywords: *hidden markov model (HMM), pair-hmm, profile-HMM, context-sensitive HMM (csHMM), profile-csHMM, sequence analys.*

GJCST-H Classification: *DDC Code: 572.8633 LCC Code: QP620*



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Biological Analysis and Linear Block Hidden Markov Model for Gene and Labelled

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I. HIDDEN MARKOV MODEL

A *hidden Markov model (HMM)* is a statistical model that can be used to describe the evolution of observable events that depend on internal factors, which are not directly observable. We call the observed event a 'symbol' and the invisible factor underlying the observation a 'state'. An HMM consists of two stochastic processes, namely, an invisible process of hidden states and a visible process of observable symbols. The hidden states form a *Markov chain*, and the probability distribution of the observed symbol depends on the underlying state. For this reason, an HMM is also called a doubly-embedded stochastic process.

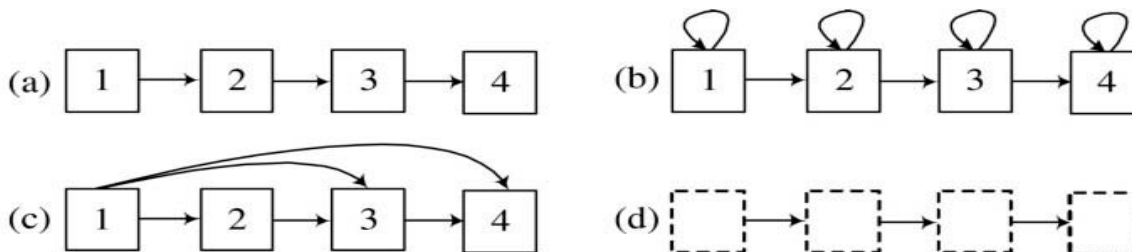


Figure 1

- a) HMM blocks that compose the whole HMM structure
1. linear block
 2. self-loop block (tying is optional)

3. forward-jump block (tying is optional)
4. zero block.

Linear blocks consist of N states (labelled from 1 to N) where state n is only connected to state $n + 1$ (with $1 \leq n < N$). Self-loop blocks are linear blocks in which each state has an additional loop to itself. A

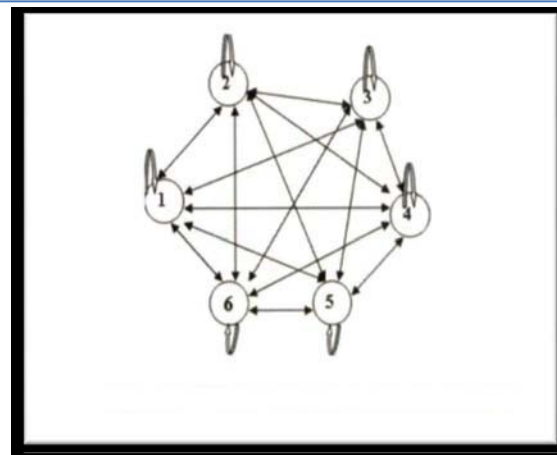


Figure 2.1: A Markov chain with 6 stses (labelled 1 to 6)

II. BLOCK-HMM FOR LABELLED SEQUENCES

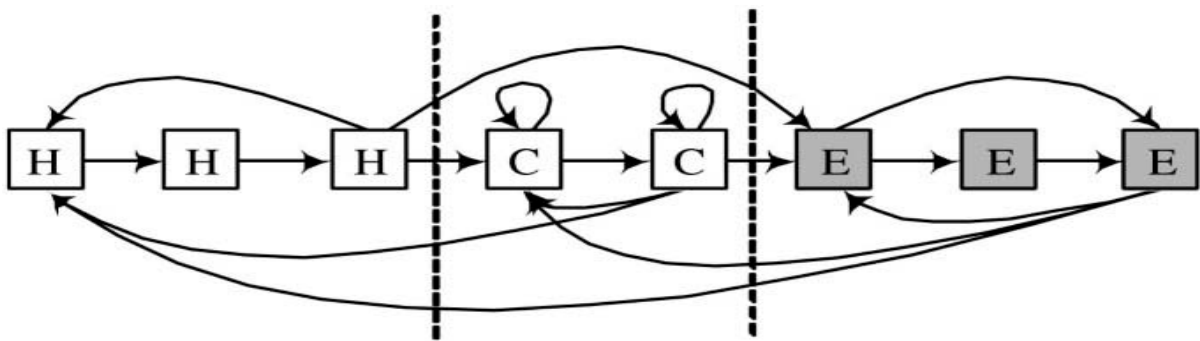
Block-HMM restricts its search to a subset of HMM topologies made up of blocks of states. Each block is assigned a label that corresponds to one of the three secondary structure classes. The states that make up the blocks emit amino acid symbols. Secondary structure prediction is done by inferring the values of the hidden states for a given amino acid sequence, and examining the secondary structure labels of the blocks these states belong to. Four types of blocks are used: linear, self-loop, forward-jump blocks and zero blocks (figure 1).

forward-jump block is a linear block where the first state is also connected to the last M states (with $1 \leq M < N$). Zero blocks are empty blocks with no states: they can replace other block types during the GA procedure and thus allow the exploration of simpler topologies.

The self-loop and forward-jump blocks can be either tied (in the figures, tied blocks are shaded) or untied. When a block is tied all the emission and transition probabilities of states inside the block are equal. In the case of linear blocks we did not consider tying because tying a linear blocks is equivalent to a single-state self-loop block.

The various blocks can model different types of sequence fragments. A linear block can model a particular conserved sequence pattern. The self-loop block can model a sequence of any length, while the

forward-jump block can be used to represent subsequences with varying length up to some fixed length. Initially, the blocks are fully linked to form HMM architectures. In this context, fully linked means that the end state of each block is connected to the starting states of all other blocks and itself. Each block is labelled with one of the three protein structure classes 'H' (helix), 'E' (strand), or 'C' (coil). Figure 2 shows a simple example of HMM structure. The HMM structure is composed of 3 blocks. From the left it has blocks labelled with 'H', 'C' and 'E'. Each block also can be tied. After training, most of the transition probabilities are close to zero, resulting in a final structure that is typically much simpler than the fully connected HMM shown in the figure.



b) An Example if an HMM Composed of Blocks Resulting from the Block-HMM Procedure

Three blocks are used in this model and all the blocks are fully connected to each other. The blocks are divided by dotted lines. The states in tied blocks are shaded in grey.

III. GENETIC OPERATORS FOR BLOCK-HMM

Genetic algorithms evolve a population of solutions with genetic operators. Inside the genetic cycle, genetic operators select members of the population (called parents) and evolve them to produce new members (called children). New children after the genetic operators along with the remaining old members in a population are evaluated to calculate fitness. According to the fitness selection procedure select a number of members in a population for the next genetic cycle.

We used three genetic operators in Block-HMM: crossover, mutation and type-mutation. The number of blocks is kept fixed but the number of the states of an HMM can be changed by the genetic operators. Crossover swaps a number of blocks in two parents to create two children. The crossover points and the number of blocks are chosen randomly. Figure 3 shows an example of the crossover scheme. The last block of the first child crosses with the first block of the second

child. To simplify the diagram, transitions between blocks are not shown here. The crossover operator enables HMMs to exchange states without breaking basic blocks. Several blocks can be chosen to be crossed, which allows GA to search broad area of solution space. Mutations can take place inside any block of the HMM. A forward-jump block can have 6 different types of mutation, which are illustrated in figure 4. It can delete or insert.

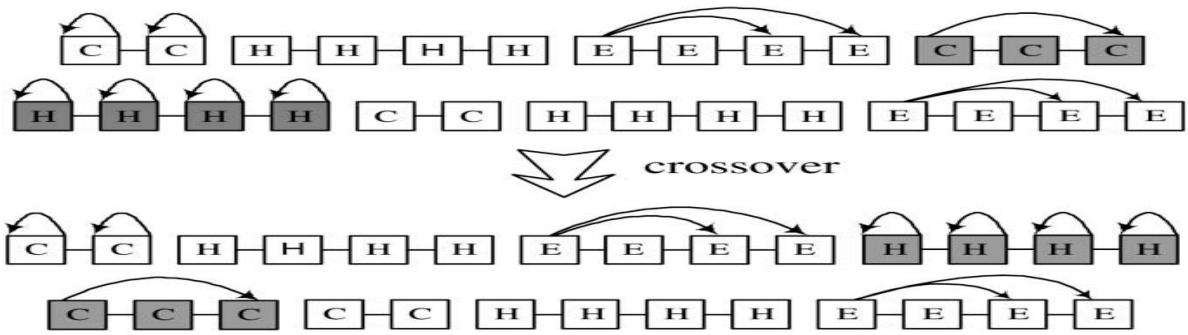


Figure 3

a) Crossover in Block-HMM

Crossover swaps the HMM states without changing the properties of an individual HMM block.

Here, the last block of the first child crosses with the first block of the second child. To simplify the diagram, transitions between blocks are not shown.

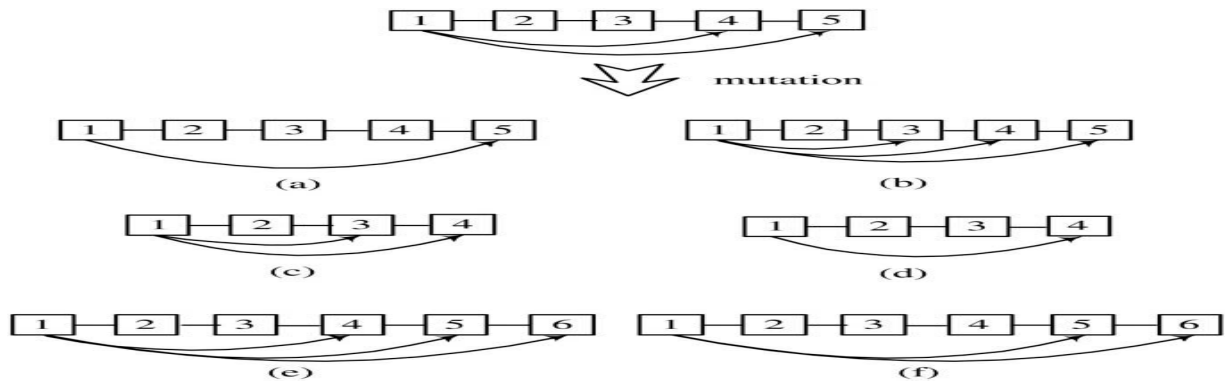


Figure 4

b) Mutation in Block-HMM

Six possible types of mutations from a 5-state forward-jump block: (a) a transition from the first to the fourth state is deleted (b) a transition from the first to the third state is added (c) the second or the third state is deleted (d) the fourth state is deleted (e) a state is added between the fourth and the fifth state (f) a state is added between the first and the fourth state.

In addition to changing the length of a block and its transitions, we also allow another form of

mutation, called *type-mutation*, that changes the type or label of a block. Type-mutation to a zero block is also allowed (figure 5). When a type mutation transforms the type of a block, new transition probabilities are generated randomly. Self-loop and forward-jump blocks can type-mutate between tied and untied versions. Zero-blocks can be type-mutated to any of the other block forms.

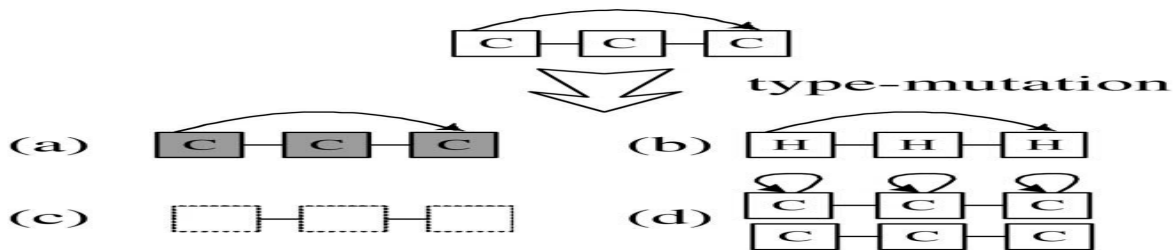


Figure 5

c) Type-Mutation in Block-HMM

A forward jump block is type mutated (a) to a tied block (b) to a block with a different label (c) to a zero block (d) to a self loop block or a linear block.

E ran the GA that hybridize the parameter learning method with these genetic operators that train

the structure of HMMs. The detailed description of the whole procedure is on Methods.

IV. ANALYSIS OF THE EVOLVED HMM

a) The Evolved Model

Figure 6 illustrates the structure of the best result of Block-HMMs. The simulation used 30 blocks,

but the result shows only 26 blocks: the remaining 4 are zero blocks. Figure 7 shows the full HMM structure. Assigned with each state is one of the label of 3 states of secondary structure $l \in \{H, E, x\}$. It is composed of 22 states for helix (H), 15 for β -strand (E), and 15 for coil (x)

region. Each state emits a set of symbols of 20 amino acids according to the given probability. The full HMM structure is trained using 1662 sequences (see Methods).

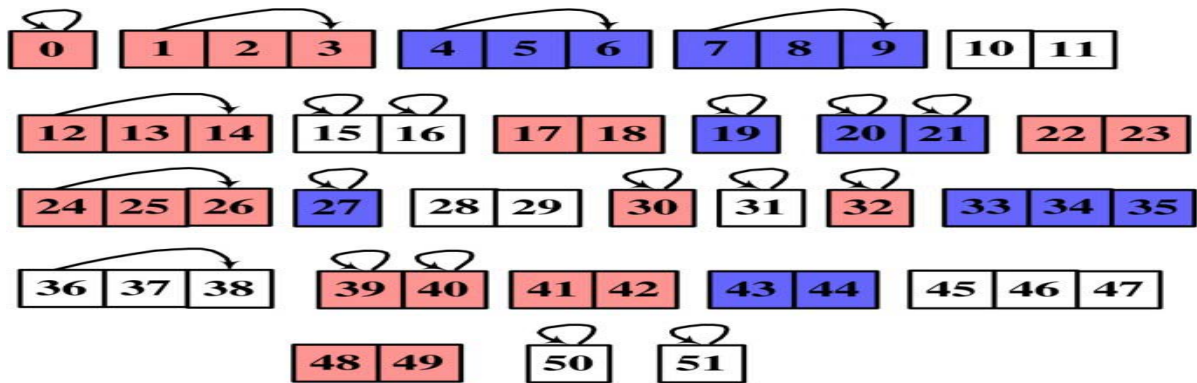


Figure 6

b) *The Best HMM Topology*

The best HMM topology evolved using Block-HMM. It is composed of 26 non-zero blocks and 52 states. Transitions between blocks are not shown here (including the transition from a block to itself). On each state a label is assigned ('H' for helices, 'E' for β -strands and 'x' for coils). Helix states are red colored and β -strand states are blue colored.

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Internet of Everything: A Solution to Mobile Banking using Voice Recognition

By Ebole Alpha Friday, Shomope Adewale Abduirasaq & Amusu Mary

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Abstract- The advancement in banking transaction system over the years has been enormous, and the needs for identifications of customer's authentication, validation and confirmation are of utmost priority and should be dealt with judiciously. Mobile banking has emerged as one of the main division in digital world of financial transactions and consists of information inquiry, notifications and alerts, applications and payment transfer. Mobile based application is used for connecting customer handset with bank server for all such services in the banking industry. The current trend of Mobile banking as gone beyond the use of One Time Password (OTP) applications used by banks. The problem with current banking applications is that they send data directly to customer in plain text form compromising with security recognised as OTP in most of the online transaction. An online banking customer logging in to the bank's website with username and password triggers a request to send an OTP to his or her registered mobile phone or the OTP may not be necessary after one or two transaction. There is every likely hold of Mobile phone been stealing, access by unauthorised person or being hacked. Upon receipt of a text message with the OTP, the customer enters it with an additional field on the banking site's login page to complete the login process since your details are already on your phone. It could have been fine if the mobile network can act immediately but blocking of network provider involves the presentation of National Identification Number (NIN), which is a chain reaction.

GJCST-H Classification: DDC Code: 401.93 LCC Code: P118



INTERNET OF EVERYTHING AS SOLUTION TO MOBILE BANKING USING VOICE RECOGNITION

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Inernet of Everything: A Solution to Mobile Banking using Voice Recognition

Ebole Alpha Friday ^α, Shomope Adewale Abdurasaq ^σ & Amusu Mary ^ρ

Abstract The advancement in banking transaction system over the years has been enormous, and the needs for identifications of customer's authentication, validation and confirmation are of utmost priority and should be dealt with judiciously. Mobile banking has emerged as one of the main division in digital world of financial transactions and consists of information inquiry, notifications and alerts, applications and payment transfer. Mobile based application is used for connecting customer handset with bank server for all such services in the banking industry. The current trend of Mobile banking as gone beyond the use of One Time Password (OTP) applications used by banks. The problem with current banking applications is that they send data directly to customer in plain text form compromising with security recognised as OTP in most of the online transaction. An online banking customer logging in to the bank's website with username and password triggers a request to send an OTP to his or her registered mobile phone or the OTP may not be necessary after one or two transaction. There is every likely hold of Mobile phone been stealing, access by unauthorised person or being hacked. Upon receipt of a text message with the OTP, the customer enters it with an additional field on the banking site's login page to complete the login process since your details are already on your phone. It could have been fine if the mobile network can act immediately but blocking of network provider involves the presentation of National Identification Number (NIN), which is a chain reaction. The purpose of this research work is to provide cost effective, secure, fast Mobile banking solution combining features of cryptography as well as behavioural pattern and Interactive Voice Response for final authentication and authorisation of costumer identification in all form of financial transactions.

I. INTRODUCTION

Mobile banking system is recognised as daily banking operations to customer with mobile handset and a supported application software, it includes all potential to provide access or delivery of very specific and highly necessary information to customer as given by Venugopal, H et al (2012) "Enhanced voice recognition to reduce fraudulence," it is driven by various facilities like convenience of banking operations, greater reach to consumers and Integration of other electronic commerce services with mobile banking as stated by Mohammad Shirali-Shahreza and Hassan Shirali-Shahreza (2007).

Recently there has been a tremendous increase in use of biometric features in recognition systems such

as voice, fingerprints, face, iris etc. The development of real time Mobile Banking in Africa has taking another dimension and an avenue for criminals to hack customer account in case of misplacement of mobile devices or being stealing. The criminal gain access to the details of information, such as costumer bank transaction which are stored in individual handset. The ideal of mobile banking was to pave way for quick servicers and safety of customer's funds in the bank account but this objective were not met due to unlawfully accomplishments endanger by conspirator. Presently, the only method for authentication is customer entering his or her password in the device (mobile handset) in other to carry out transactions but it has some problems associated with it, if the user is not the actual owner of the device such password can be entered and the unauthorised person gain access to the account and perform his illegitimate activities on the account.

A voice-dependent access control system is necessary for third level validation and will help in verifying the authenticity of a person by the electronic assessment of voice characteristics of the person concerned. Of late, the biometric methods used to remove the loopholes associated with the Mobile banking and for validation of legitimate person for device accessibility may include any of the following face, voice, hand-shape, fingerprint and iris. This paper discusses a voice-dependent on Mobile transaction as a means of final level authentication and access control system which can provide correct verification of identity from individual's voice characteristics in term of pattern recognition store in the database of the bank database tier (server). The preference of voice as a biometric feature is necessary because it is easily accepted by the users, can be recorded by any voice sensor, the hardware costs are reduced significantly etc.

However, there are several challenges that need to be addressed to completely utilize the benefits of the Mobile Banking like handset compatibility, security, scalability, reliability etc. Due to increase in use of mobile handsets for many electronic commerce applications, chances of mobile hacking for financial benefits are heavily increased. Currently, most banks in Nigeria and outside are sending text SMS directly to the customer handset for basic bank services without any security and this can be accessed by any malicious person because the information is over the air and can

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be hijacked. There is every likelihood that Mobile data can be hacked in network path from bank to customer mobile handset and all-inclusive in the device that can identify end user identity in Mobile banking. Thus, there is a need of secure and cost effective solution which can easily be available on all types of handsets. The significance of this research work is to include a voice authentication on the back end at customer server network in the banking system as additional security level for the protection and authorisation of an individual identity on Mobile banking in case of customer misplacement of their mobile phone or any form of being hacked.

Voice signal identification transforms a speech signal into features which aid for further processing. Quite a number of algorithms and techniques are used as stated by Muda, M., Begam, and I. Elamvazuthi (2010), "Voice recognition algorithms using Mel frequency cepstral coefficient (MFCC) and dynamic time warping (DTW) techniques. The ability of a system or program to receive as well as interpret dictation, or to understand and follow the matching spoken instructions

store in the database or inform of cloud storage of the Bank. In general, it is regarded as one of the convenient and safest recognition techniques. The basic block diagram for voice recognition is given in Figure 1. A big challenge of proliferating accuracy and recognition speed is faced by the real time automatic system for speech recognition. Degradation in performance of speech recognition system occurs due to noise. Also it is affected by modifying speech data due to dependence on speaker's gender, environmental conditions and style in which it is spoken. The accuracy of recognition depends on the method of feature extraction and training, so one of the core issues of speech recognition research is the recognition accuracy, speed and the aim.

Moreover, system performance improves in the presence of noise with the use of noise robust feature extraction and training technique Chavan R. C and Sable, G.S (2013) "An Implementation of Text Dependent Speaker Independent Isolated Word Speech," International Journal of Engineering Sciences and Research Technology.

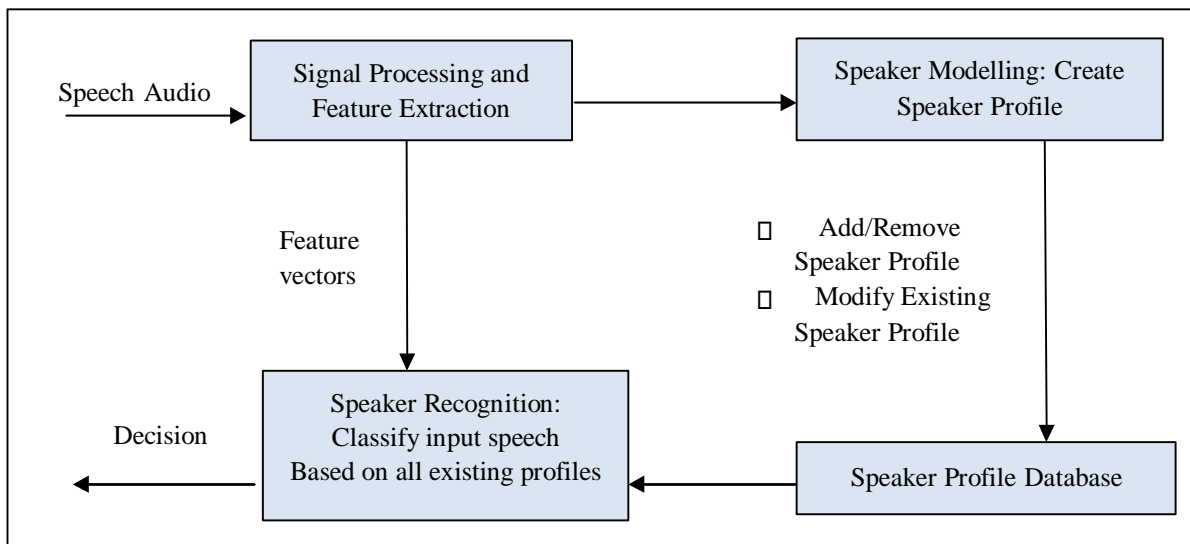


Figure 1: Voice recognition System by Chavan. C and Sable, G.S (2013)

A two-factor authentication of an individual can help voice to combine what masses say and the way in which they say it. Other identifications such as fingerprints, handwriting, iris, retina, face scans can also help, whilst voice identification is required as an authentication that is not only secure but unique also. Voice recognition systems are economical and easily understood by users. There are some problems associated with Voice recognition such as However, it is the most popular and widely used method of password less authentication but it suffers from some inherent limitations of human voice given such as

1. Low Signal to Noise Ratio, which can be caused because of background noises, low quality microphone, interference by electrical devices.

2. Difficult to recognize and individual when in a meeting, conference, etc.
3. Unable to identify words that have similar spelling and pronunciation but differs in their meaning.
4. It is difficult to identify whether the voice sample submitted for authentication is presented by some machine (recorded voice) or by the individual itself.

II. RELATED WORK

[1] Human identification of characteristics such as: face, fingerprint, iris, hand geometry, voice, or Biological biometrics such as DNA, blood, hair, etc. and Behavioural biometrics such as the signature, the keystroke dynamics, the gait recognition, etc. In the literature, biometrics based mobile authentication is an

emerging issue. Some researcher considers the following modalities as biometrics such as fingerprint, face, voice and iris. In the recent paper Wang, S. and Liu, J. (2011) on *Biometrics on Mobile Phone*, the authors propose an overview about biometrics on mobile phone through some standard modalities (fingerprint, speaker recognition, iris recognition, gait). Most authors recognise that specific Speaker Recognition for Mobile User Authentication modality as well as Face recognition is dealt with in the paper written by Hadid, A., Heikkilä, A. J., Silven, O. and M. Pietikainen, M. (2017) on Face and eye detection for person authentication in mobile phones, or as in Mohammad Shirali-Shahreza (2016), where a real time training algorithm is developed for mobile devices. The authors propose to extract local face features using some local random bases and then to incrementally train a neural network. Image processing also concerns hand biometrics on mobile as in the reference, where hand images are acquired by a mobile device without any constraint in orientation, distance to camera or illumination. The author of Jiehua Wang, Song Yuan, "A Novel Security Mobile Payment System Based On Watermarked Voice Cheque". details an iris recognition system, based on a three-step pre-processing method relying on (a) automatic segmentation for pupil region, (b) helper data extraction and pupil detection and (c) eyelids detection and feature matching. Some recent papers N.L. Clarke and S.M. Furnell (2007). Advanced user authentication for mobile devices. *Computers & Security*, Mohammad Shirali-Shahreza and M. Hassan Shirali-Shahreza, (2007) "Text Steganography on International Conference on Convergence Information Technology, and Martinez Borreguero, F. Javier and Chaparro Peláez, Julián, "Spanish (2005) Mobile Banking Services: An Adoption Study", Proceedings of the International Conference on Mobile Business. deal with keystroke based recognition. The first paper makes a study about user identification using keystroke dynamics-based authentication (KDA) on mobile devices, relying on 11-digit telephone numbers and text messages as well as 4-digit PINs to classify users. The second develops a more performant KDA process, with optimized enrolment and verification steps, whose principle is extended in the latter paper for touch screen handled mobile devices, along with a pressure feature measurement. The reference [7] presents a new modality for authentication on mobile device, namely gait recognition. The first deals with text-dependent speaker verification. It means that both the user's voice and the uttered text itself are used for the verification. The second paper proposes a new method to extract features from speech spectra called slice features. The aforementioned references show that many biometric modalities can be used for user authentication on mobile device. Therefore, speaker recognition seems the most natural modality choice for implementation on

mobile phone. In the vast literature dealing with speaker recognition, two trends stand out: text dependent and text-independent speaker recognition techniques. We are only interested in the second field Yekini NA et al. (2012) presented a voice-dependent access control system for ATMs. Figure 3 shows the block diagram of the discussed system. The system consists of 3 important components: Voice sensor e.g. microphone, speaker verification system and access control system for ATM machine. A low cost voice sensor is used to record the ATM user's voice and subsequently send it to the voice-dependent verification system to validate the authenticity of the user[5].

The human voice is a complex information-bearing signal, depending on physical and behavioral characteristics. The raw speech signal, uttered by any person, is extremely rich in the sense that it involves high dimensional features. To perform efficient speaker recognition, one must reduce this complexity, while keeping sufficient information in the extracted feature vector.

a) Principles of Speaker Recognition

Both speaker recognition and speech recognition belong to the category of voice signal processing, but speaker recognition focuses on the identity information of the speaker, while speech recognition focuses on the text information corresponding to the voice Martinez Borreguero, F. Javier and Chaparro Peláez, Julián, "Spanish Mobile Banking Services: An Adoption Study", Proceedings of the International Conference on Mobile Business 2005. Voiceprint can be understood as the pattern of the voice frequency spectrum obtained by the time-frequency analysis technology of the wave-form signal of human voice. Due to the inherent differences in the physiological structure of each person, it also causes the diversity of human speech styles, which provides us with a principle basis for automatically identifying the speaker's identity information through machines.

b) Speaker Recognition Classification

According to different application scenarios, speaker recognition can be divided into two tasks: speaker verification and speaker identification. The former refers to judging whether the current speaker is a certain identity entered in the system, which is a 1:1 confirmation question; The latter means that you don't know the identity of the current speaker, and you need to find the most similar one among the N speakers that the system has entered. It is an N:1 classification problem. According to the different recognition objects, speaker recognition can be divided into three categories: text-related, text-independent and text-prompt. The text-related speaker recognition method requires the speaker's pronunciation keywords and key sentences as training text, and the pronunciation is based on the same content during recognition. The text-

independent speaker recognition method does not need to limit the speech content during training and recognition, and the recognition object is a free voice signal. The speaker recognition of text prompts, as the name suggests, the recognition object is the random generation of some specific text given by the system.

c) *Speaker Recognition Process*

Speaker recognition technology recognizes the identity of the speaker by analyzing the speaker

characteristic information contained in the voice signal, which mainly includes two stages of training and recognition: In the training phase, according to the training speech of each speaker, feature parameters are extracted to establish a speaker model; in the recognition phase, after the speech features of the speaker to be recognized are extracted, it is matched with the established speaker model for judgment . The basic principle is shown in Figure 1.

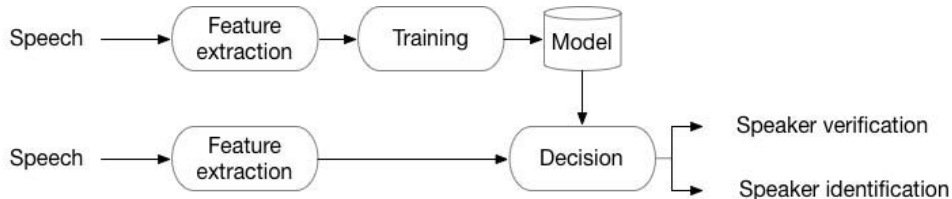


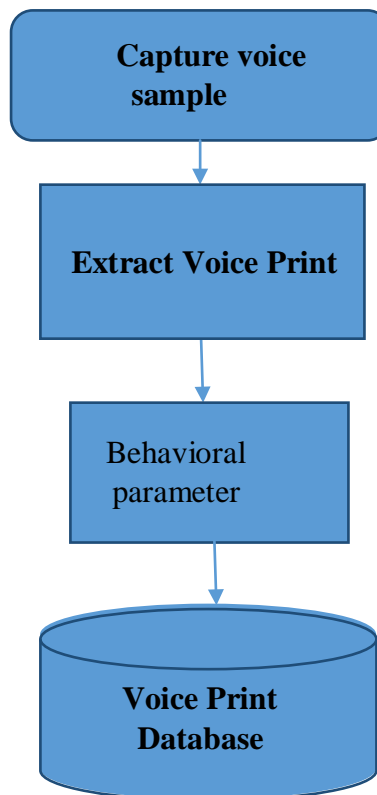
Figure 1: Basic Speaker Recognition System Framework

III. RESEARCH METHODOLOGY

a) *Proposed Work*

Getting motivated from the above discussed issues being faced in voice authentication system, a new method is proposed below. The proposed method is a hybrid of Behavioral Identification along with Voice Recognition. While registering an individual for first time, along with taking its voice samples for extracting voice prints, the behavioral parameters also get extracted and

stored in a database. This behavioural parameter can be voice message identification, to be provided by end users for negative emotional information sympathy by the bank for reference purpose. Whenever an individual claims its identity for authentication, then it will be first verified message store in the database in line with the saved voice print as an additional layer of security. It will be authenticated automatically only after successful passing both the stages. It can be illustrated by following flow diagrams:

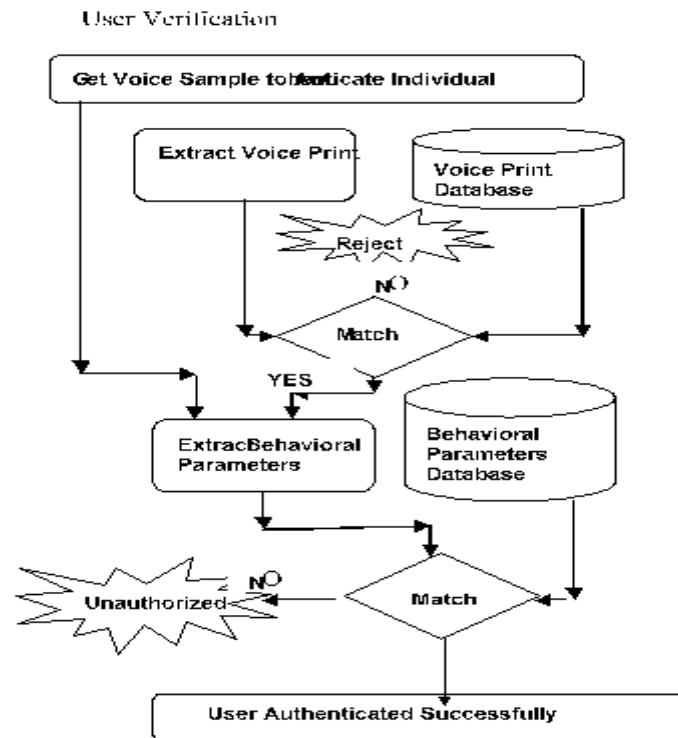


Voice / Behavioural Enrolment Process



The voice samples of first time user are taken in order to extract and save its voice print as well as behavioural parameter in the databases.

b) Speech Verification Process



The Voice samples are presented for extraction of voice prints and matched with the saved details in database. If the match is successful, then the match of behavioral parameters is done. If the individual qualifies both the tests, only then the access is granted otherwise rejected.

Since the proposed method is verifying the individual with an additional layer, higher security is supposed to be achieved. The proposed method may be modified to counter attacks against impersonation where in the speaker's voice get recorded and presented later on impersonating the speaker. A human is not supposed to match behavioral parameters 100% each time. There comes an obvious and slight deviation. If there is a case of impersonation of the speaker by some machine then there will be 100% match of the behavioral parameters. On the basis of this fact, mathematical model can be prepared and simulated as well to justify the intended result.

IV. CONCLUSION

Different finance firms as well as industry are relying on voice recognition authentication for their security. Speech recognition can be used for disable person who are otherwise not able to authenticate themselves using traditional techniques. In Africa, it can play a major role in moving the technology to the door

step of a common man who is not much literate and not familiar with digital media techniques. As the current system need to be changed for software only not specific hardware in order to deploy this technology, hence it is cost efficient and feasible to deploy too. In the current work, its hybridization with behavioral authentication technique is proposed as it would result in an additional layer of secure authentication and is expected to be withstand impersonation attack.

Nowadays, mobile Technology have become a definite requirement for carrying out millions of transactions that happen in day to day life. Large number of frauds can be carried out using mobile system, In order to overcome these problems hackers, misplacement of mobile phone, it is highly recommended that the banking sector should make the use of voice biometric. This method when fully taken into practise will not only enhance secured and correct authentication, but will also render support in the implementation of complex banking mobile transactions in terms of performs deposits and money transfer, as this system provides enhanced security.

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The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.



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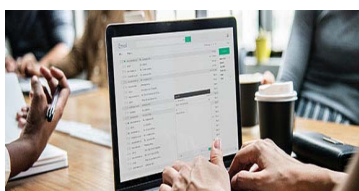
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Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

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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.
- Line spacing of 1 pt.
- Large images must be in one column.
- 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.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



FORMAT STRUCTURE

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

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.

Keywords

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.

Formulas and equations

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.



Figures

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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Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

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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.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

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.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

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.



Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- 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.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

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.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

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.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

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.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- 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:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

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

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

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.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- 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:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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| <i>References</i> | Complete and correct format, well organized | Beside the point, Incomplete | Wrong format and structuring |



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