Online ISSN : 0975-4172
Print ISSN : 0975-4350

Global Journal

of Computer Science and Technology: C

Software & Data Engineering

Real-Time Big Data

Forensic Data Analysis

Highlights

Data Labelling Method

External Quality Factors

Discovering Thoughts, Inventing Future

VOLUME 15 ISSUE 5 VERSION 1.0

Global Journal of Computer Science and Technology: C
Software & Data Engineering

Global Journal of Computer Science and Technology: C
Software & Data Engineering

Volume 15 Issue 5 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: *Open Association of Research Society*
Open Scientific Standards

Publisher's Headquarters office

Global Journals Headquarters
301st Edgewater Place Suite, 100 Edgewater Dr.-Pl,
Wakefield MASSACHUSETTS, Pin: 01880,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Including by Air Parcel Charges):

For Authors:
22 USD (B/W) & 50 USD (Color)
Yearly Subscription (Personal & Institutional):
200 USD (B/W) & 250 USD (Color)

Integrated Editorial Board
(Computer Science, Engineering, Medical, Management, Natural Science, Social Science)

Dr. Bart Lambrecht
Director of Research in Accounting and FinanceProfessor of Finance
Lancaster University Management School
BA (Antwerp); MPhil, MA, PhD (Cambridge)

Dr. Carlos García Pont
Associate Professor of Marketing
IESE Business School, University of Navarra
Doctor of Philosophy (Management), Massachusetts Institute of Technology (MIT)
Master in Business Administration, IESE, University of Navarra
Degree in Industrial Engineering, Universitat Politècnica de Catalunya

Dr. Fotini Labropulu
Mathematics - Luther College
University of ReginaPh.D., M.Sc. in Mathematics
B.A. (Honors) in Mathematics
University of Windso

Dr. Lynn Lim
Reader in Business and Marketing
Roehampton University, London
BCom, PGDip, MBA (Distinction), PhD, FHEA

Dr. Mihaly Mezei
ASSOCIATE PROFESSOR
Department of Structural and Chemical Biology, Mount Sinai School of Medical Center
Ph.D., Etvs Lornd University
Postdoctoral Training,
New York University

Dr. Söhnke M. Bartram
Department of Accounting and FinanceLancaster University Management SchoolPh.D. (WHU Koblenz)
MBA/BBA (University of Saarbrücken)

Dr. Miguel Angel Ariño
Professor of Decision Sciences
IESE Business School
Barcelona, Spain (Universidad de Navarra)
CEIBS (China Europe International Business School).
Beijing, Shanghai and Shenzhen
Ph.D. in Mathematics
University of Barcelona
BA in Mathematics (Licenciatura)
University of Barcelona

Philip G. Moscoso
Technology and Operations Management
IESE Business School, University of Navarra
Ph.D in Industrial Engineering and Management, ETH Zurich
M.Sc. in Chemical Engineering, ETH Zurich

Dr. Sanjay Dixit, M.D.
Director, EP Laboratories, Philadelphia VA Medical Center
Cardiovascular Medicine - Cardiac Arrhythmia
Univ of Penn School of Medicine

Dr. Han-Xiang Deng
MD., Ph.D
Associate Professor and Research
Department Division of Neuromuscular Medicine
Davee Department of Neurology and Clinical NeuroscienceNorthwestern University
Feinberg School of Medicine

Dr. Pina C. Sanelli
Associate Professor of Public Health
Weill Cornell Medical College
Associate Attending Radiologist
NewYork-Presbyterian Hospital
MRI, MRA, CT, and CTA
Neuroradiology and Diagnostic Radiology
M.D., State University of New York at Buffalo,School of Medicine and Biomedical Sciences

Dr. Roberto Sanchez
Associate Professor
Department of Structural and Chemical Biology
Mount Sinai School of Medicine
Ph.D., The Rockefeller University

Dr. Wen-Yih Sun
Professor of Earth and Atmospheric SciencesPurdue University Director
National Center for Typhoon and Flooding Research, Taiwan
University Chair Professor
Department of Atmospheric Sciences, National Central University, Chung-Li, TaiwanUniversity Chair Professor
Institute of Environmental Engineering, National Chiao Tung University, Hsin-chu, Taiwan.Ph.D., MS The University of Chicago, Geophysical Sciences
BS National Taiwan University, Atmospheric Sciences
Associate Professor of Radiology

Dr. Michael R. Rudnick
M.D., FACP
Associate Professor of Medicine
Chief, Renal Electrolyte and Hypertension Division (PMC)
Penn Medicine, University of Pennsylvania
Presbyterian Medical Center, Philadelphia
Nephrology and Internal Medicine
Certified by the American Board of Internal Medicine

Dr. Bassey Benjamin Esu
B.Sc. Marketing; MBA Marketing; Ph.D Marketing
Lecturer, Department of Marketing, University of Calabar
Tourism Consultant, Cross River State Tourism Development Department
Co-ordinator , Sustainable Tourism Initiative, Calabar, Nigeria

Dr. Aziz M. Barbar, Ph.D.
IEEE Senior Member
Chairperson, Department of Computer Science
AUST - American University of Science & Technology
Alfred Naccash Avenue – Ashrafieh

Contents of the Issue

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 15 Issue 5 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

A New Approach for Improving Computer Inspections by using Fuzzy Methods for Forensic Data Analysis

By P. Jyothi & S. Murali Krishna
University MITS College Madanapalli, India

Abstract- Now a day's digital world data in computers has great significance and this data is extremely critical in perspective for upcoming position and learn irrespective of different fields. Therefore we the assessment of such data is vital and imperative task. Computer forensic analysis a lot of data there in the digital campaign is study to extract data and computers consist of hundreds of thousands of files which surround shapeless text or data here clustering algorithms is of plays a great interest. Clustering helps to develop analysis of documents under deliberation. This document clustering analysis is extremely useful to analyze the data from seized devices like computers, laptops, hard disks and tablets etc. There are total six algorithms used for clustering of documents like K-means, K-medoids, single link, complete link, Average Link and CSPA. These six algorithms are used to cluster the digital documents. Existing document clustering algorithms are operated in single document at a time. In the proposed approach of these working algorithm applied on multiple documents at a time. Now we using clustering technique named as agglomerative hierarchical clustering which gives better finer clusters compared to existing techniques.

Keywords: clustering, forensic analysis, clustering algorithms, hierarchical agglomerative clustering algorithm.

GJCST-C Classification : I.5.1

Strictly as per the compliance and regulations of:

A New Approach for Improving Computer Inspections by using Fuzzy Methods for Forensic Data Analysis

P. Jyothi [α] & S. Murali Krishna [σ]

Abstract- Now a day's digital world data in computers has great significance and this data is extremely critical in perspective for upcoming position and learn irrespective of different fields. Therefore we the assessment of such data is vital and imperative task. Computer forensic analysis a lot of data there in the digital campaign is study to extract data and computers consist of hundreds of thousands of files which surround shapeless text or data here clustering algorithms is of plays a great interest. Clustering helps to develop analysis of documents under deliberation. This document clustering analysis is extremely useful to analyze the data from seized devices like computers, laptops, hard disks and tablets etc. There are total six algorithms used for clustering of documents like K-means, K-medoids, single link, complete link, Average Link and CSPA. These six algorithms are used to cluster the digital documents. Existing document clustering algorithms are operated in single document at a time. In the proposed approach of these working algorithm applied on multiple documents at a time. Now we using clustering technique named as agglomerative hierarchical clustering which gives better finer clusters compared to existing techniques. Finally estimated clusters and it takes less time for analyze the clusters in forensic analysis; they also find similarity between all documents in clusters.

Keywords: clustering, forensic analysis, clustering algorithms, hierarchical agglomerative clustering algorithm.

I. Introduction

In computer forensic process is impacted by large amount of data. This has roughlydistinct asrestraints that mergeelement of law and computer sciences to gather and examine information from computer systems. In our study there are hundreds of files are there in instructed format. For this analysis they have some methods like machine learning and data mining are of great importance. Clustering algorithms are usually needed to grouping data in files, where there is practically no prior knowledge about the information[1][13]. From a more specialized perspective, our datasets comprise of unlabeled objects. In addition, actually expecting that named datasets could be accessible from previous analysis, there is very nearly no hope that the same classes would be still legitimate for the upcoming information, got from different computers also related to different examinations. More definitely, it is likely that the new information would come from different locations. In this way, the utilization of clustering algorithms, which are fit for discovering latent patterns from content documents found in seized computers, can improve the analysis performed by the expert examiner. The methods of rational clustering algorithm objects within a substantial group are more like one another than they are two objects belongs to alternative group[1]. Along those data partition has been actuated from data. The export examiner may concentrate on interesting on delegated documents from the obtained set of groups by performing this task of examination of all documents. In a more functional and sensible situations, domain experts are rare and have limited time accessible for performing examinations. Therefore it is sensible to expect that finding a significant document. The examiner could prioritized the investigation of different documents belongs to the cluster interest.

Clustering algorithm has been mulled over for a considerable length of time and the literature on the subject is huge. Therefore, we decided to demonstrate the capability of the proposed methodology, namely: the partition algorithms K-Means, K-Medoids, the hierarchical single link, complete link, average link and the cluster ensemble algorithm known as CSPA[3].It is well known that the number of clusters demonstrating parameter of many algorithms and it is generally having an earlier knowledge. However the number of clusters has not been examined in the computer forensics. Really we could not even spot one work that is sensibly close in its application area and that reports the utilization of number of algorithms capable finding the number of clusters [3].

II. Review of Related Research

In our software development process research is the most important one. In this is based on the time factors, economy and company strength we can determine the developing process. Once the programmer start the work based on experts

Author α: (M. Tech) Department of Computer Science & Engineering, Madanapalle Institute of Technology &Sciences, Madanapalle, Andhra Pradesh, India. e-mail: jyothi.pitti4@gmail.com
Author σ: Professor and Head of the Department, Department of Computer Science & Engineering, Madanapalle Institute of Technology & Sciences, Madanapalle, Andhra Pradesh, India.

suggestions and gather related information to different websites based on their work. Before building the system each and developer can maintain the above requirements report.

C. M. Fung et al. [7] have present an agglomerative and divisive hierarchical clustering to group the documents into clusters, cluster in a documents have high similarity to each other, the dissimilar documents into other group. Likewise no labeled documents are provided in clustering. Hence these are known as unsupervised learning. Hence the clusters are analyzed into a tree that facilitates browsing. The parent- child relationship among the nodes in the tree can be viewed as a topic-subtopic relationship.

B. Fei *et al.* [3] have discusses the application of a self-organizing map (SOM) is to support decision making by computer forensic investigators and assist them in conducting data analysis in a more efficient manner and also SOM produces patterns similarity in data sets. Author explores great ability to interpret, explore data generated by computer forensic tools.

Alexander Strehlet al. [2] hasintroduces three effective and efficient techniques to obtaining high quality combiners. In first combiner induce Partitioning and re-clustering of objects is based on similar measure, second is based on hyper-graph and third is based on collapse group of clusters into meta-clusters which participate to find individual object to the combined clustering. By using the three approaches to provide the low computational costs and feasible to use a supra-consensus function against the objective function and provide the best results.

L. F. Nassif et al. [5] have present an approach that applies document clustering algorithms to forensic analysis of computers seized in police examinations. Author represents experimentation with six well-known clustering calculations (K-Means, K-medoids, Single Link, Complete Link, Average Link, and CSPA) applied to five certifiable datasets acquired from computers seized in true examinations. Investigations have been performed with different combination of parameters, resulting in 16 different instantiations of algorithms. Moreover, two relative legitimacy records were utilized to consequently appraise the quantity of clusters. In the event that suitably introduced, partition algorithms (K-means and K-medoids) can likewise respect great results.

Ying Zhao et al. [8] have use high quality clustering algorithms play an essential part in giving intuitive navigation and browsing mechanism by sorting large amount of data into a little number of meaningful clusters. Specifically clustering algorithm, hierarchical clustering that assemble meaningful hierarchies out of large amount of accumulations. This all concentrates on document clustering algorithm that manufactures such various leveled solutions.

a) Hierarchical Agglomerative Algorithm

Hierarchical clustering algorithms are either top-down or bottom up. Bottom-up algorithms treat each one record as a single cluster at the beginning and after that progressively merge (or agglomerate) sets of clusters until all groups have been merged into a single group that contains all documents. Bottom-up hierarchical clustering is in this way called hierarchical agglomerative grouping or HAC. Top-down clustering requires a technique for splitting a group. It continues by splitting clusters recursively until individual documents are arrived. In the Hierarchical Agglomerative Algorithm assumes each one document as a solitary of cluster at beginning and after that progressively agglomerative pair of clusters into single group of clusters have been agglomerate into single group that contain similar type of documents.

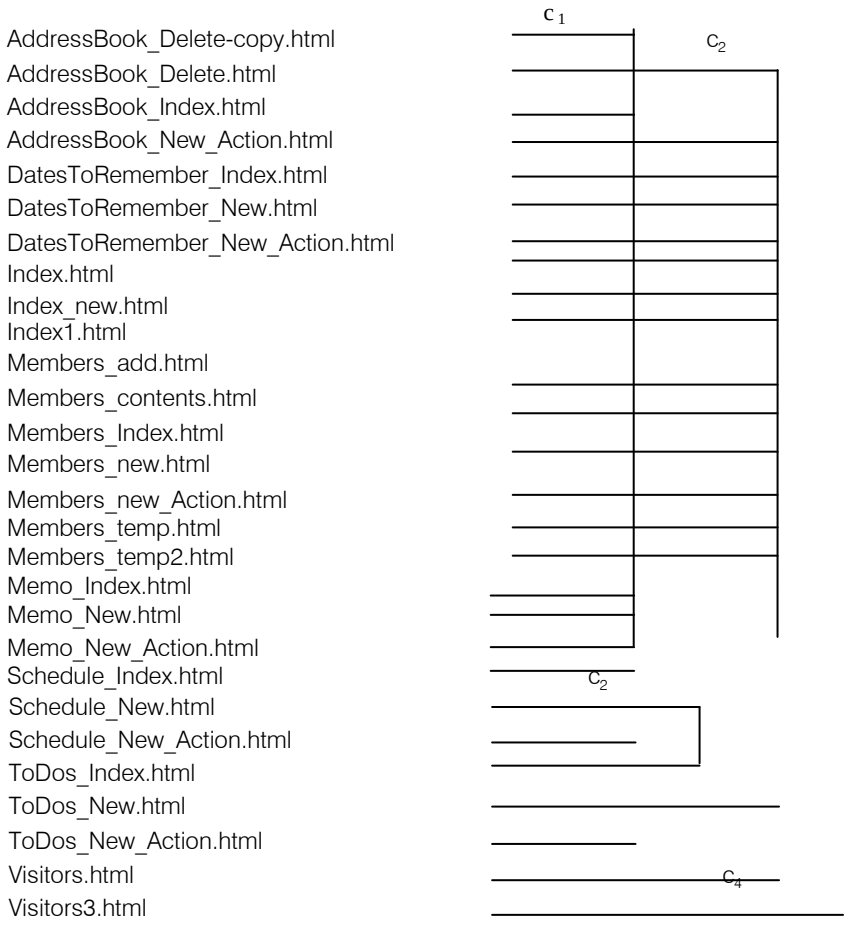


Figure 1 : A diagram shows the clustering of 28 documents

i. *Cluster Formation*

By passing up from the bottom to top process of clusters the dendrograms used to reproduce the historical environment of consolidations that brought about the represented clustering. For example, we see that the two documents permittedAddressBook_Delete-copy.html and AddressBook_New_Action.html were combining in Figure(1) and that the last combine added Visitors.html to a cluster comprising of the other 27 documents.

ii. *Finding Similarity*

The Hierarchical Agglomerative clustering is usually defined as a dendrograms as illustrate in Fig (1). Each combination is signified by a horizontal line. That line represents similarity between two documents, where documents are viewed as single clusters. We call this similarity the combination similarity of the combined documents. For example, the combination similarity of the documents Schedule_New.html and ToDos_Index.html consisting of Figure (1) is≈0.19 . This defines the cosine similarity of clusters as 1.0.

III. Framework Requirements

For finding the meaningful data from the dataset, researchers have used data mining techniques, in which clustering is one of the popular techniques. Let DS will taking as our dataset represented as DS={d_1 d_2, … d_n }; 1≤ I ≤ n, where n is the number documents in a dataset DS. In our propose system basically there are three important steps which are as follows

1) Preprocessing
2) Cluster Formulation
3) Forensic analysis

1. *Preprocessing*

In preprocessing step there are three steps such as a) fetch a file contents, b) Stemming, c) Stop word Removal. These 3 steps are used to remove the noise and inconsistent data. In first step fetch the dataset and perform the second operation with the help of porter stemming. In this stemming is based on the idea that the suffixes in the English language are mostly made up of a combination of smaller and simpler suffixes. If the words end with ed, ing, ly etc that words are removed. This step is a linear step stemmer [16]. In this last step is remove the stop words with the help of Stop token filter.[17] Stop words in a document like to, I, has, the, be, or etc. stop words are the foremost frequent words with in the English language. Stop words blot your index while not providing any additional worth.

frequent words with in the English language. Stop words blot your index while not providing any additional worth. At that point, we received a customary statistical methodology for text mining, in which documents are meant in a vector space model. In this each one model, each one document is denoted by vector containing the frequencies of events of words. To process the distance between reports, two measures have been utilized specifically: cosine-based separation and hierarchical agglomerative clustering. After these steps our data will be relevant.

2. *Cluster Formulation*

This session exhibits the mining of datasets from the preprocessed dataset. For each document the similarity of the concentrated words from the preprocessed step is processed and the top comparability documents are clustered first this. This session depicts the mining of successive item sets from the preprocessed content documents. For each document the recurrence of the concentrated words from the preprocessing step is registered and the top continuous words from each are taking out. From the set of top frequent words, the binary database is framed by getting the unique words.

a) Hierarchical Agglomerative Clustering Algorithm

Hierarchical agglomerative algorithms treat every one document as a singleton cluster toward the starting and thereafter dynamically consolidation set of clusters until all clusters have been melded into a single cluster that contains all documents.

Input: List of Documents $D=d_1,d_2\ldots d_n$

Output: Clusters result$C=\{c_1, c_2\ldots c_n\}$

1. For i=1 to n do
2. For the given list of documents each document is treated as a specified
3. Finding parsers //those are theunique words in documents
4. Suppress non-dictionary words
5. Get unique edges in this documents
6. Initialize clusters
   a. For n←1 to N
   b. Applying clustering to the items

Constructing histogram //for analyzing clusters

h_{min} should be 1.0; h_{max} should be 0.0

For T to 1←n-2

For J to 1←n-1

t_{sim}=sim(doc[t], doc[j]) {If($h_{min}>t_{sim}$) $h_{min}=t_{sim}$;

If ($h_{max}<t_{sim}$) $h_{max}=t_{sim}$; }

7. Finding analogousity

3. Forensic Analysis

This will be the last step in proposed method. Here the algorithm process initially provides a topological arrangement between neurons at convergence of documents. Here we can analyze the number of clusters from our selected dataset. At final step this process will calculate the similarity between formed documents with less time compared to other algorithms.

III. Implementation

The implementation process of clusters can done through number of steps that process will needed for the purpose of good cluster similarity between clusters. The follower can do these steps very care full. In this process first collect the documents from local systems then perform preprocessing- In preprocessing step there are three steps such as a) fetch a file contents, b) Stemming, c) Stop word Removal. These 3 steps are used to remove the noise and inconsistent data. In first step remove the stop word prepositions, pronouns, irrelevant documents data(a, an ,the etc)[17] and later on to do stemming on that file which will be removing Portuguese words(ing and edetc)[16] from the upcoming data. At that point, we received a customary statistical methodology for text mining, in which documents are meant in a vector space model.[19] In this model, each one document is denoted by vector containing the frequencies of events of words. To process the distance between reports, two measures have been utilized specifically: cosine-based separation and hierarchical agglomerative clustering. After these steps our data will be relevant.

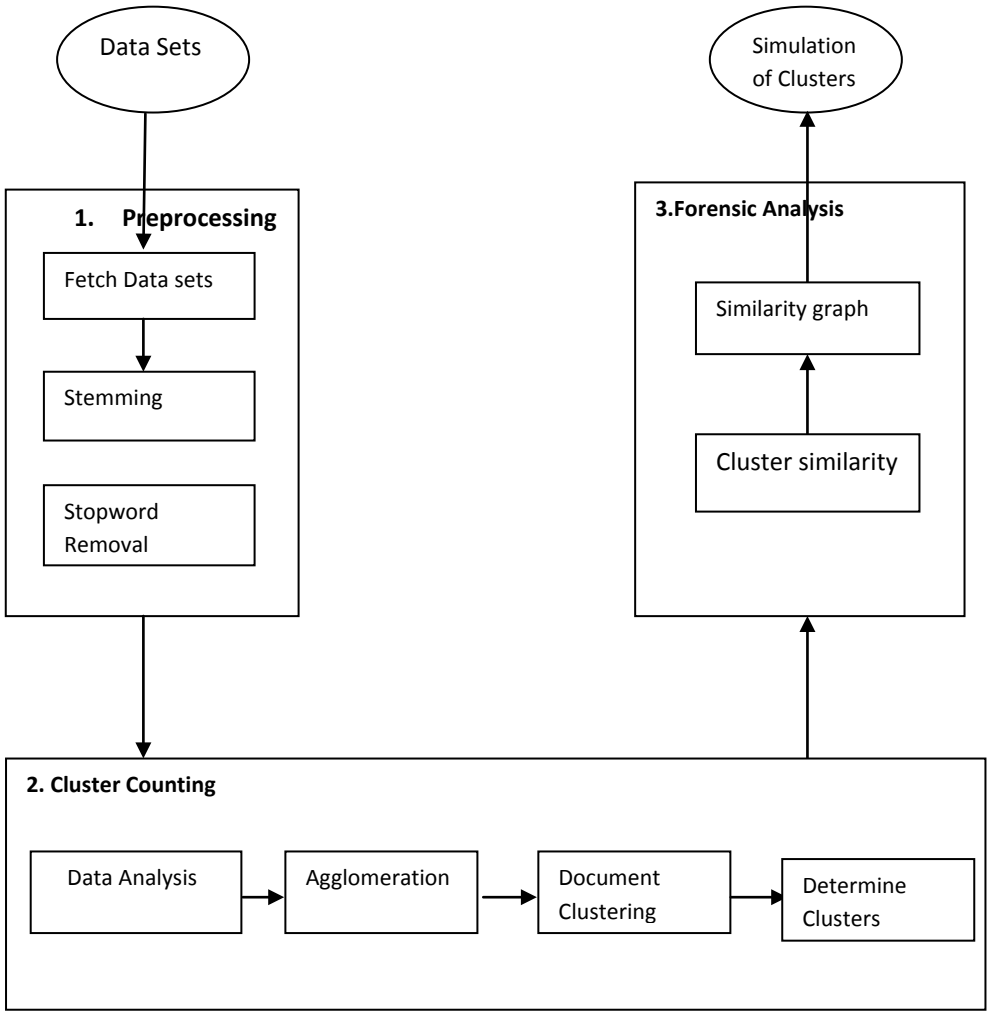


Figure 1 : Architecture implementation of clustering process

The next step of this process will take clusters counting. Here, data will collect from the previous step. Then analyze data for estimating relevant clusters, by using agglomerative algorithm. In this algorithm data is analyzes from multiple documents, and then divide similar documents and dissimilar documents. Based on the priority of data high priority documents are saved under one cluster and comparison of first cluster less similarity documents are stored under next cluster based on the algorithmic perspective. Then, the last step algorithm finds the similarity of all cluster consisting documents. In this comparison include clusters containing each and every document is compared and finds similarity between them. This algorithm plays a important role in this process compared to other algorithms.

IV. Experimental Results

In this proposed approach experimentation developed by java (JDK 2.0). In the process of running and executing the main file. After executing main file dataset containing documents are loaded that are shown in figure (1). Here we are taking 26 documents[0-25] these all documents are under 8 different areas. Like Address Book [0-2], Members[8-14] etc those are shown in figure (2). These 8 different partitions are clustered into 4 groups named as C1,C2,C3, C4. In C1 under documents are [0, 1, 7, 8, 9, 11, 15], C2 under documents are [2, 3, 4, 5, 6, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24], C3 under documents are [10, 12] and C4 under documents are [25] shown in figure (3) and finding similarity between all documents shown in figure (4).

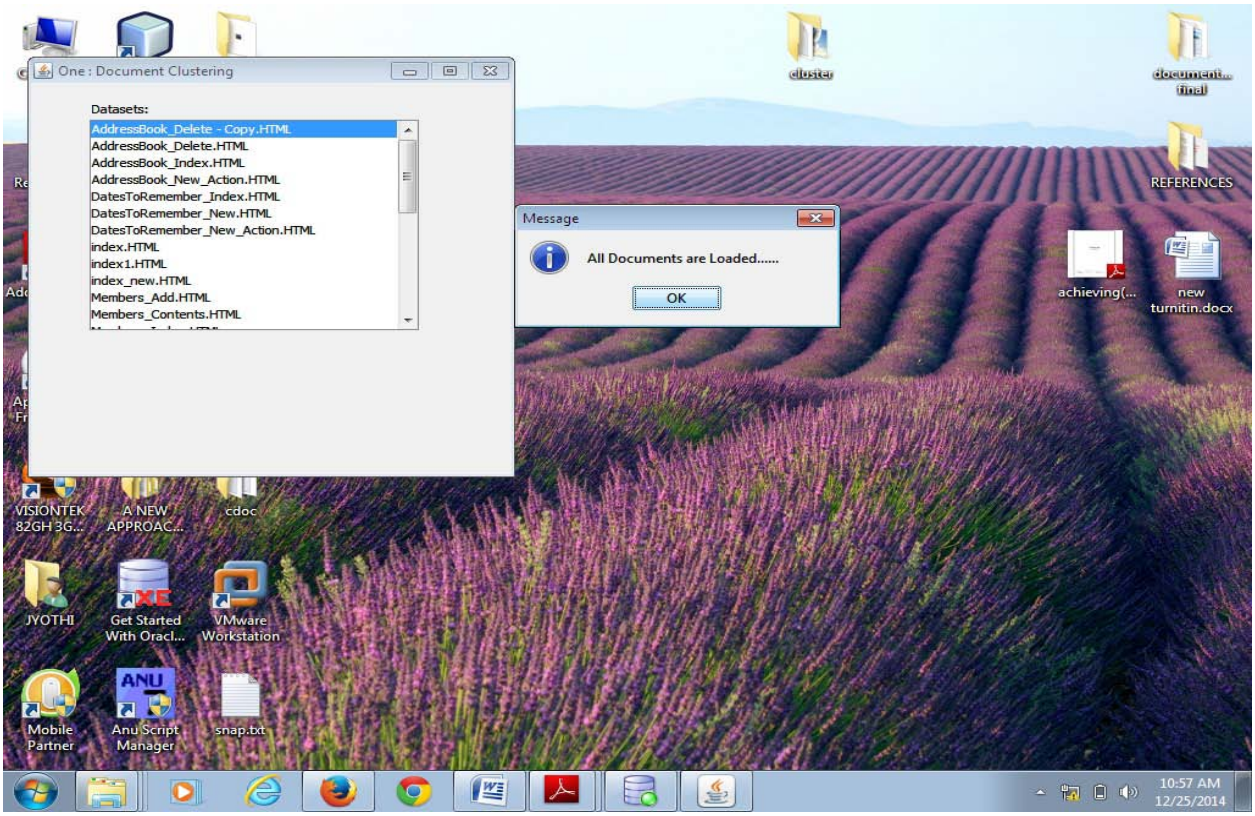


Figure (1) : Loading documents

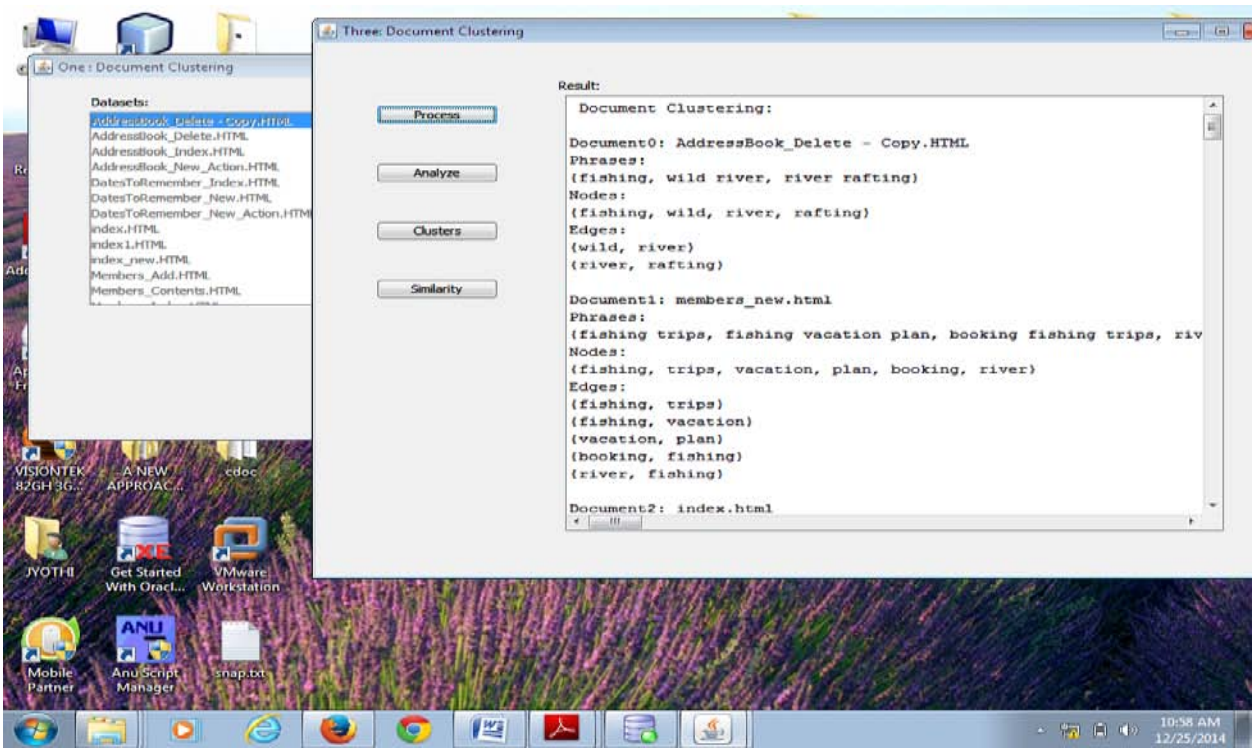


Figure (2) : Processing input documents

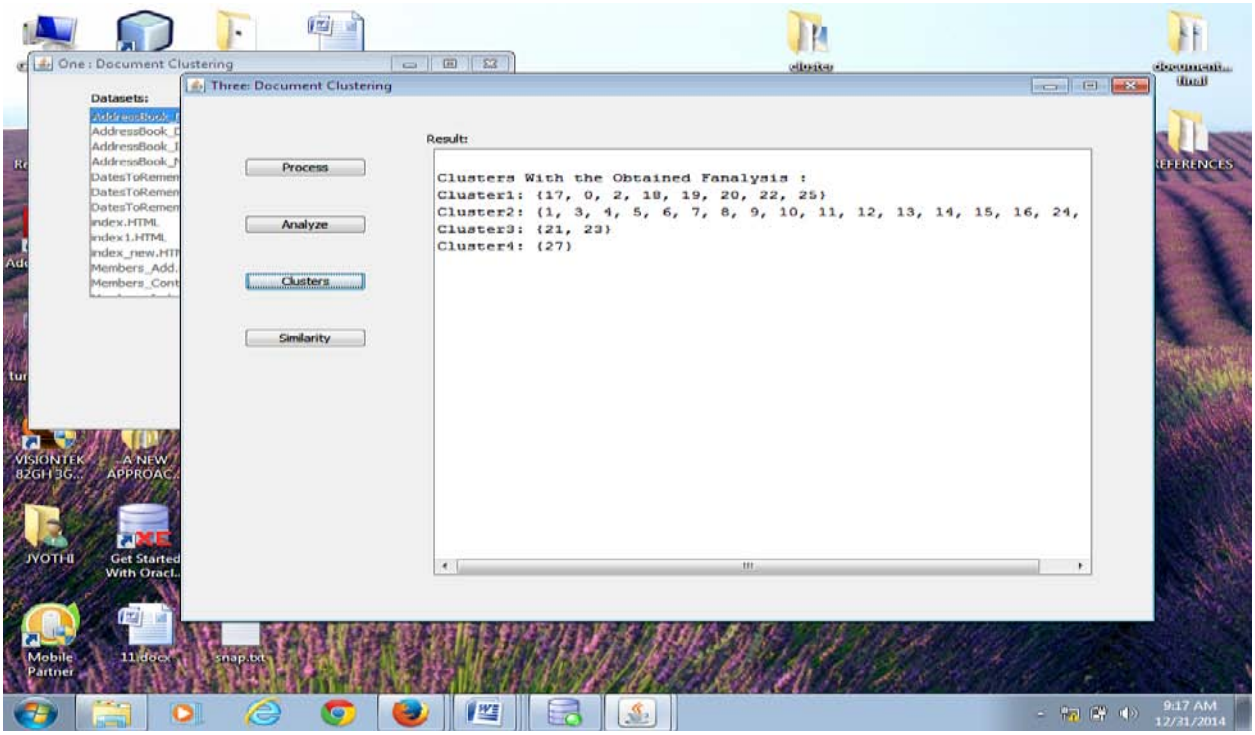
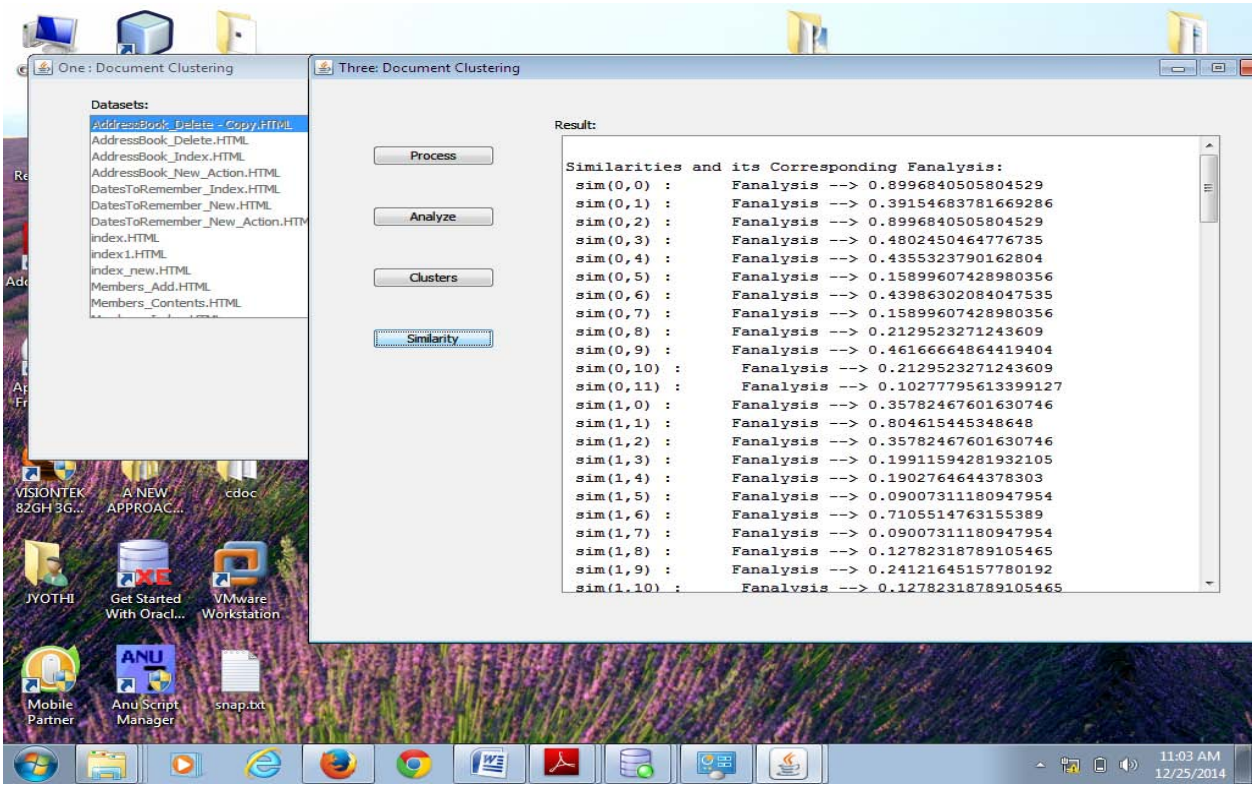


Figure (3) : Cluster Analysis



Finding (4) : Finding similarity between documents

V. Conclusion

We use an approach for clustering documents which can become an ideal application forensic analysis of computers. There are several practical results based on our work which are extremely useful. In our work, the algorithm known as hierarchical clustering algorithm that yields the best results. In spite of this algorithm we find the number of similar and dissimilar documents in our input documents and also finding the similarity between the documents.

References Références Referencias

1. B. S. Everitt, S. Landau, and M. Leese, *Cluster Analysis*. London, U. K.: Arnold, 2001.
2. S. Haykin, *Neural Networks: A Comprehensive Foundation*. Englewood Cliffs, NJ: Prentice-Hall, 1998.
3. A. Strehl and J. Ghosh, "Cluster ensembles: A knowledge reuse framework for combining multiple partitions," J. Mach. Learning Res., vol.3, pp. 583–617, 2002.
4. B. K. L Fei, J. H. P. Eloff, H. S. Venter, and M. S. Oliver, "Exploring forensic data with self-organizing maps," in Proc. IFIP Int. Conf. Digital Forensics, 2005, pp. 113–123.
5. K. Stoffel, P. Cotofrei, and D. Han, "Fuzzy methods for forensic data analysis," in Proc. IEEE Int. Conf. Soft Computing and Pattern Recognition, 2010, pp. 23–28.
6. L. F. Nassif and E. R. Hruschka, "*Document clustering for forensic computing: An approach for improving computer inspection*," in Proc. Tenth Int. Conf. Machine Learning and Applications (ICMLA), 2011.
7. S. Decherchi, S. Tacconi, J. Redi, A. Leoncini, F. Sangiacomo, and R. Zunino, "Text clustering for digital forensics analysis," *Computat. Intell. Security Inf. Syst.*, vol. 63, pp. 29–36, 2009.
8. Y. Zhao, G. Karypis, and U. M. Fay yad, "Hierarchical clustering algorithms for document datasets," *Data Min. Knowl. Discov.*, vol. 10, no. 2, pp. 141–168, 2005.
9. Y. Zhao and G. Karypis, "Evaluation of hierarchical clustering algorithms for document datasets," in *Proc. CIKM*, 2002, pp. 515–524.
10. Y. Loewenstein, E. Portugaly, M. Fromer, and M. Linial, "*Effcient algorithms for exact hierarchical clustering of huge datasets: Tackling the entire protein space*," *Bioinformatics*, vol. 24, no. 13, pp. i41–i49, 2008.
11. B. Mirkin, *Clustering for Data Mining: A Data Recovery Approach*. London, U.K.: Chapman & Hall, 2005.
12. L. Hubert and P. Arabie, "Comparing partitions," *J. Classification*, vol.2, pp. 193–218, 1985.
13. C. M. Bishop, *Pattern Recognition and Machine Learning*. New York: Springer-Verlag, 2006.
14. A. K. Jain and R. C. Dubes, *Algorithms for Clustering Data*. Englewood Cliffs, NJ: Prentice-Hall, 1988.
15. K. Kishida, "*High-speed rough clustering for very large document collections*," *J. Amer. Soc. Inf. Sci.*, vol. 61, pp. 1092–1104, 2010, doi:10.1002/asi.2131.
16. Daniel Waegel. "*The porter Stemmer*".CISC889/Fall 2011.
17. Swatantrakumarsahu and NeerajSahu, G.S,Thakur, "*Classification of Document Clustering Approach".* Volume 2, issue 5, may 2012.

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 15 Issue 5 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Testability Assessment Model for Object Oriented Software based on Internal and External Quality Factors

By Harsha Singhani & Dr. Pushpa R. Suri
Kurukshetra University, India

Abstract- Software testability is coming out to be most frequent talked about subject then the underrated and unpopular quality factor it used to be in past few years. The correct and timely assessment of testability can lead to improvisation of software testing process. Though many researchers and quality controllers have proved its importance, but still the research has not gained much momentum in emphasizing the need of making testability analysis necessary during all software development phases. In this paper we review and analyse the factors affecting testability estimation of object oriented software systems during design and analysis phase of development life cycle. These factors are then linked together in the form of new assessment model for object oriented software testability. The proposed model will be evaluated using analytical hierarchical process (AHP).

Keywords: *software testability, testability factors, object oriented software testability assessment model.*

GJCST-C Classification : *D.2.2*

Strictly as per the compliance and regulations of:

Testability Assessment Model for Object Oriented Software based on Internal and External Quality Factors

Harsha Singhani [α] & Dr. Pushpa R. Suri [σ]

Abstract- Software testability is coming out to be most frequent talked about subject then the underrated and unpopular quality factor it used to be in past few years. The correct and timely assessment of testability can lead to improvisation of software testing process. Though many researchers and quality controllers have proved its importance, but still the research has not gained much momentum in emphasizing the need of making testability analysis necessary during all software development phases. In this paper we review and analyse the factors affecting testability estimation of object oriented software systems during design and analysis phase of development life cycle. These factors are then linked together in the form of new assessment model for object oriented software testability. The proposed model will be evaluated using analytical hierarchical process (AHP).

Keywords: software testability, testability factors, object oriented software testability assessment model.

I. Introduction

Testability is one of the qualitative factors of software engineering which has been accepted in McCall and Boehm software quality model, which build the foundation of ISO 9126 software quality model. Formally, Software testability has been defined and described in literature from different point of views IEEE [1] defines it as "The degree to which a system or component facilitates the establishment of test criteria and performance of tests to determine whether those criteria have been met" and ISO [2] has defined software testability as functionality or "attributes of software that bear on the effort needed to validate the software product".

The testability research actually is done from the prospect of reducing testing effort and testing cost which is more than 40% of total development cost of any software [3]. Still, the research in the field of testability has not been done in much detail. It mainly affects the efficiency of overall software development team from project managers, software designers to software testers. As they all need testability assessment in decision making, software designing, coding and testing[4].So keeping that in mind, we will take this study further. As discussed in our previous work about testability and testability metrics[5], [6], it has been found that testability research has taken a speed up in past few years only and much of the work has been done using various object oriented software metrics.

In this paper we have proposed a testability evaluation model for assessment during design and analysis phase based on external quality factors and their relation with internal object oriented programming features which affect testability as shown earlier in our work [7].This paper is organized as follows: Section2 gives brief overview of software testability related work. Section3 gives the details of internal object oriented features needed for testability assessment followed by section 4 which gives the details of external quality factors linked and affected due to these features. Section 5 describes the proposed assessment model. It is followed by conclusion and future scope in section 6.

II. Software Testability Related Work

Software Testability actually acts as a software support characteristic for making it easier to test. As stated by Binder [8] and Freedman [9] a Testable Software is one that can be tested easily, systematically and externally at the user interface level without any ad-hoc measure. Whereas Voas [10] describe it as complimentary support to software testing by easing down the method of finding faults within the system by focussing more on areas that most likely to deliver these faults. Hence, over the years Testability has been diagnosed as one of the core quality indicators, which leads to improvisation of test process. The insight provided by testability at designing, coding and testing phase is very useful as this additional information helps in product quality and reliability improvisation [11][12]. All this has lead to a notion amongst practitioners that testability should be planned early in the design phase though not necessarily so. As seen by experts like Binder it involves factors like controllability and observability i.e. ability to control software input and state along with possibility to observe the output and state changes that occur in software. So, overall testable software has to be controllable and observable [8]. But

Author α: Research Scholar, Department of Computer Science and Applications, Kurukshetra University, Kurukshetra, Haryana, India.
e-mail: harshasinghani@gmail.com
Author σ: Department of Computer Science and Applications, Kurukshetra University, Kurukshetra, Haryana, India.
e-mail: pushpa.suri@yahoo.com

over the years more such quality factors like understandability, traceability, complexity and test–support capability have contributed to testability of a system [4].

Software testability measurement refers to the activities and methods that study, analyze, and measure software testability during a software product life cycle. Unlike software testing, the major objective of software testability measurement is to find out which software components are poor in quality, and where faults can hide from software testing. In the past, there were a number of research efforts addressing software testability measurement. Now these measurements can be applied at various phases during software development life cycle of a system. The studies mostly revolve around the measurement methods or factors affecting testability along with how to measure software testability at various phases like Design Phase[8], [12]–[18] and Coding Phase[19]–[22]. Lot of stress has been given upon usage of object oriented metrics for object oriented software testability evaluation during these researches. The metrics investigated related to object oriented software testability assessment mostly belong to static software metrics category. These metrics were mostly adapted from CK [23], MOOD [24], Brian [25], Henderson-Sellers [26] metric suite along with others [27]. Lot of empirical study has been done by researchers like Badri [28], Bruntink [29] and Singh [30] in showing the correlation of these metrics with unit testing effort. Few studies done by Baudry and Genero [31]–[34] have been focussed on UML diagram features from software testability improvisation prospect as found during review of these design diagrams. All this work has been explained in depth in our previous research work [4],[5].

We would take this study further keeping focus mainly on object oriented system as object oriented technology has become most widely accepted concept by software industry nowadays. But testability still is a taboo concept not used much amongst industry mainly due to lack of standardization, which may not be imposed for mandatory usage but just been looked upon for test support[35]. We would actually like to propose a model for testability evaluation based on key programming features and quality factors which in turn make testing easier or difficult within this software. We have followed the steps as mentioned below to formalize the model:

- Identification of internal design features for object oriented software testability assessment
- Identification of static metrics out of many popular metrics for each of these.
- Identification of external factors affecting software testability.
- Establishing link between theses external quality factors and internal features which are evaluated through selected object oriented metrics.
- Establishing link between testability and these identified external factors which indirectly link it to identified internal features.
- The Model is followed with evaluation using AHP technique.

III. Testability Factors Identification

Before proposing the testability assessment model we have to first identify the key object oriented programming features which affect the testability at internal level. As already known the object oriented programming is based on three core concepts- Inheritance, Encapsulation and Polymorphism. Where, Inheritance is a mechanism for code reuse and to allow independent extensions of the original software via public classes and interfaces. Whereas, Polymorphism mainly provides the ability to have several forms, and Encapsulation an after effect of information hiding is actually play significant role in data abstraction by hiding all important internal specification of an object and showing only external interface. Now, a programming without these characteristics is distinctly not object-oriented that would merely be programming with some abstract data types and structured coding [36]. But these are not the only factors directing the course of testing in object oriented software, along with them three more identified features namely coupling, cohesion and size complexity. All these features and their influence on testability has already been highlighted in our previous work[4], [5]. Hence these six identified object oriented programming core features would be necessarily required to assess testability for object oriented software at design level. All these internal quality characteristics – Encapsulation, Inheritance, Coupling, Cohesion, Polymorphism and Size & Complexity are as defined below in Table 1along with details of their specific relation on testability. The relation between these features and testability has been build based on thorough study of many publications [2], [20], [35], [38], [39]etc.

Table 1 : Object Oriented Design Feature Affecting Testability

OO Feature Affecting Testability	Definition	Testability Relation
Encapsulation	It is defined as a kind of abstraction that enforces a clean separation between the external interface of an object and its internal implementation	Encapsulation provides explicit barriers among different abstractions and thus leads to a clear separation of concerns. Thus if not used appropriately it makes system more complex and difficult to trace and test. But yes separation of concerns is good for testability.
Inheritance	It is a measure of the 'is-a' relationship between classes.	Inheritance has a significant influence on complexity, understandability, reusability and testability. Inheritance is one of the major test generation factors[29].
Coupling	It is defined as the interdependency of an object on other objects in a design.	Strong coupling complicates a system since a module is harder to understand, change, or correct by itself if it is highly interrelated with other modules. Thus low coupling is considered good for understandability, complexity, reusability and testability or maintainability
Cohesion	It defines as the internal consistency within the parts of design.	Cohesion is one of the measures of goodness or good quality in the software as a cohesive module is more understandable and less complex. Low cohesion is associated with traits in programming such as difficult to maintain, test, reuse, and even understand.
Size & Complexity	It's the measure of size of the system in terms attributes or methods included in the class and capture the complexity of the class.	Size & Complexity has a significant impact on understandability, and thus testability or maintainability of the system.
Polymorphism	Polymorphism allows the implementation of a given operation to be dependent on the object that "contains" the operation such that an operation can be implemented in different ways in different classes.	Polymorphism reduces complexity and improves reusability. More use of polymorphism leads more test case generation [29].

Now all the above mentioned key features can be measured by many object oriented metrics options available as discussed earlier in our previous article [6]. Most of these metrics are accepted by practitioners on 'heavy usages and popularity' and by academic experts on empirical (post development) validation. But to keep study simple from further evaluation perspective we have suggested the few basic but popular metrics amongst testability researchers. Out of all the popular metrics suites discussed in our previous work [41] few of these static metrics are as explained below in Table2 have been suggested for the evaluation of each of these feature and their effects on any object oriented software testability at design time.

As described in Table2 below for Encapsulation evaluation number of methods metrics (NOM) is being suggested by many researchers for the effect of information hiding on testability[16], [42]. So we kept it for encapsulation evaluation for our model too. Inheritance is evaluated either using Number of Children metrics (NOC) or Depth of Inheritance Tree (DIT) two of the most popular and efficient inheritance metrics [22], [36], [41], [42]. For Coupling we suggested coupling between objects (CBO) and for cohesion Li & Henry Cohesion between Methods metrics version (LCOM). These two were the most sought after and unparalleled metrics available for assessing coupling and cohesion effect on testability as per literature study and popularity amongst industry practitioners [10], [20], [22], [24], [37], [43].Though Size & Complexity can be easily measured by many metrics in this category such as number of classes (NOC) ,number of attributes (NOA), weighted method complexity (WMC) metrics but due to its significant role, popularity and association in number of test case indication pointed WMC is most appropriate [8], [28], [44]. Polymorphism is one of the underlying factors affecting testability but as quite stressed by early researchers like Binder and others [8], [25] as it results in testability reduction ,we suggest chose polymorphism factor metrics (POF/PF) one of the quick and reliable polymorphism evaluation method for testability assessment.

Table 2 : Selected Metrics Details for Testability Evaluation

Testability Factor	Metrics Name	Description
Encapsulation	No of Method (NOM)	This metric is the count of all the methods
Inheritance	No of Children (NOC)/ Depth of Inheritance Tree (DIT)	Where NOC metric is the count of children of super-class in the design and DIT metric is the distance of a class from the root.
Coupling	Coupling Between Object (CBO)	This metric count of the different number of other classes that a class is directly coupled to. (Two classes are coupled when methods declared in one class use methods or instance variables defined by the other class)
Cohesion	Cohesion Metric (LCOM)	This metric computes the relatedness among methods of a class based upon the parameter list of the methods.
Size & Complexity	Weighted Method Complexity (WMC)	It s the count of sum of all methods complexities in a class
Polymorphism	No of methods overridden (NMO)	It is count of overridden method in a subclass

IV. Quality Factors & Proposed Testability Assessment Model

Our proposed testability model is based on Dromey's software quality model [39] which has been a benchmark in use for various quality features as well as many testability models so far. So, as discussed above we have already highlighted all the internal design features from testability perspective as pointed by many researchers. These features directly or indirectly affect the quality factors which further make software may or may not more testable. The studies indicate encapsulation promotes efficiency and complexity. Inheritance has a significant influence on the efficiency, complexity, reusability and testability or maintainability. While low coupling is considered good for understandability, complexity, reusability and testability or maintainability, whereas higher measures of coupling are viewed to adversely influence these quality attributes. Cohesion is viewed to have a significant effect on a design's understandability and reusability. Size & Complexity has a significant impact on understandability, and testability or maintainability. Polymorphism reduces complexity and improves reusability. Out of six identified features four features have been proposed in MTMOOD testability model [16], which does not cover the polymorphism and size & complexity feature, which have also been found as essential internal features by many researchers in testability study [15], [22], [36], [37]. These six object oriented features play a very significant role in testability improvisation directly or indirectly through other quality factors.

All the above mentioned studies lead to mainly six identified external quality factors to assess testability for object oriented software. These factors are –Controllability, Observability, Complexity, Understandability, Traceability and Built-in-Test. Most of these factors were pointed in Binder's [8] research work on testability. Many other researchers established these factors relation too with testability as mentioned below in table 3.We have identified these factors keeping in mind significant role in testability as found out in our previous research work and surveys e have identified These factors get directly or indirectly affected by all of the above mentioned internal features and further complicate or reduce the task of testing hence reducing or increasing overall testability of the software.

Table 3 : External Software Quality Factors Affecting Testability

External Factors Affecting Testability	Definition	Significant Testability Relation in Literature
Controllability	It is the ability to control software input and state. During software testing, some conditions like disk full, network link failure etc. are difficult to test. Controllable software makes it possible to initialize the software to desired states, prior to the execution of various tests.	Controllability is an important index of testability as it makes testing easier [9], [47]–[49].
Observability	Software observability indicates how easy to observe a program in terms of its operational behaviours, input parameters, and outputs. In the process of testing, there is a need to observe the internal details of software execution, to ascertain correctness of	Observable software makes it feasible for the tester to observe the internal behaviour of the software, to the required degree of details, Hence observability increases testability in the system [9], [47], [49].

	processing and to diagnose errors discovered during this process possibility to observe the output and state changes that occur in software.	
Complexity	It is basically described as the difficulty to maintain, change, understand and test software.	High Complexity of the system is actually an indicator of decreased system testability [43], [42], [50], [51].
Understandability	It is the degree to which the component under test is documented or self-explaining.	An understandable system is easily testable and [14], [52]–[54].
Traceability	It is the degree to which the component under test is traceable in other words the requirements and design of a given software component match.	A non-traceable software system cannot be effectively tested, since relations between required, intended and current behaviours of the system cannot easily be identified[8], [44].
Built In Test(BIT)	Built in testing involves adding extra functionality within system components that allow extra control or observation of the state of these components.	BIT actually provides extra test capability within the code for separation of test and application functionality which makes software more testable by better controllability and improved observability [8], [19], [55], [56].

Now after listing all the internal object oriented programming features which directly affect testability and all external quality factors which are also indicators of testable software, we have to identify the link between the two. As found on the basis of above literature survey the influence of all internal features over external quality features is briefly explained below in Table 4 below:

Table 4 : Influence of Internal Object Oriented Programming Features over External Software Quality Factors Affecting Testability

	Encapsulation (E)	Inheritance (I)	Coupling (Cp)	Cohesion (Ch)	Size (S)	Polymorphism (P)
Controllability (Ct)	↓ High E-Low Ct	-	↓ High Cp - Low Ct	↑ High Ch- High Ct	-	↓ High P-Low Ct
Observability (O)	↓ High E - Low O	↑ High I -High O	-	-	-	↓ High P-Low O
Complexity (Cx)	-	↓ Low I - High Cx	↑ High Cp- More Cx	↓ High Ch - Reduce Cx	↑ Big S- More Cx	↓ High P - Reduce Cx
Understandability (U)	-	↓ Low I - High U	↓ Low Cp- High U	↑ High Ch- High U	↓ Big size - Low U	-
Traceability (T)	↓ High E – Low T	-	↓ High Cp- Less T	-	↓ Low Size - More T	-
Built In test (BIT)	↑ High E – More BIT	-	↑ High Cp- More BIT	↓ High Ch- Less BIT	-	-

(Where ↓ indicates inverse relation and ↑ indicates parallel relation)

The table actually elaborates the contribution of each of these internal programming features towards the six major quality factors which are directly linked to testability. Hence we may say that Testability requires Low Coupling, Adequate Complexity, Good Understandability, High Traceability, Good observability, Adequate control and more Built in test. In spite of having lot of measurement techniques for testability evaluation using some or the factor or few of the above mentioned metrics, testability has not yet been found to be evaluated from these factor perspectives. The study still does not show an elaborative impact of all of them together for testability improvisation or test effort reduction which is what motivated us for proposing this new model.

So, the proposed testability assessment model with respect to internal design features using static metrics is based on six above mentioned object oriented features from testability perspective as pointed in Binders research too [8]. The proposed model is as follows:

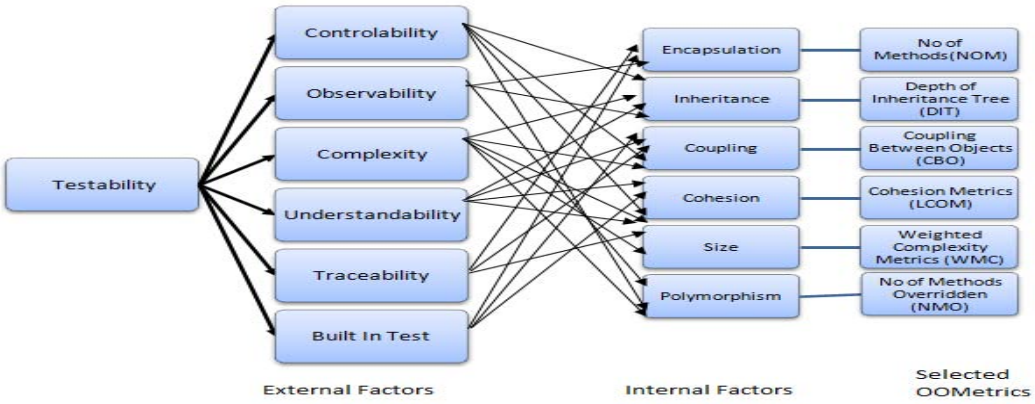


Figure 1 : Object Oriented Software Testability Assessment Model

V. Conclusion & Future Scope

In this paper an evaluation model for testability assessment during design and analysis phase based on external factors and their relation with internal object oriented programming features has been proposed. These factors directly or indirectly affect testability and can be used for software testability measurement. On the basis of detailed study we may say that Testability requires Low Coupling, Adequate Complexity, Good Understandability, High Traceability, Good observability, Adequate control and more Built in test.

The above proposed model requires to be evaluated using some technique which helps in validating these criteria's, sub-criteria's and their significant quantifiable role in testability assessment. We may use one of the formal Multi criteria decision making (MCDM) technique proposed by Satty [57] known as Analytic Hierarchy Process (AHP). The selected technique would be applied on the proposed model in our future research work. This would help the stake holders decision making more faster along with easing reducing testing effort.

References Références Referencias

1. J. Radatz, A. Geraci, and F. Katki, "IEEE Standard Glossary of Software Engineering Terminology (IEEE Std 610.12-1990)," 1990.
2. ISO, "ISO/IEC 9126: Software Engineering Product Quality," 2002.
3. A. P. Mathur, *Foundations of Software Testing*, Second. Pearson, 2013.
4. J. Fu, B. Liu, and M. Lu, "Present and future of software testability analysis," *ICCASM 2010 - 2010 Int. Conf. Comput. Appl. Syst. Model. Proc.*, vol. 15, no. Iccasm, 2010.
5. P. R. Suri and H. Singhani, "Object Oriented Software Testability Survey at Designing and Implementation Phase," *Int. J. Sci. Res.*, vol. 4, no. 4, pp. 3047–3053, 2015.
6. P. R. Suri and H. Singhani, "Object Oriented Software Testability (OOSTe) Metrics Analysis," *Int. J. Comput. Appl. Technol. Res.*, vol. 4, no. 5, pp. 359–367, 2015.
7. M. Patidar, R. Gupta, and G. Chandel, "Coupling and Cohesion Measures in Object Oriented Programming," *Int. J. Adv. Res. Comput. Sci. Softw. Eng.*, vol. 3, no. 3, pp. 517–521, 2013.
8. R. V Binder, "Design For Testabity in Object-Oriented Systems," *Commun. ACM*, vol. 37, pp. 87–100, 1994.
9. R. S. Freedman, "Testability of software components -Rewritten," *IEEE Trans. Softw. Eng.*, vol. 17, no. 6, pp. 553–564, 1991.
10. J. M. Voas and K. W. Miller, "Software Testability : The New Verification," *IEEE Softw.*, vol. 12, no. 3, pp. 17–28, 1995.
11. J. M. Voas and K. W. Miller, "Improving the software development process using testability research," *Softw. Reliab. Eng. 1992. …*, 1992.
12. D. Esposito, "Design Your Classes For Testbility." 2008.
13. S. Jungmayr, "Testability during Design," pp. 1–2, 2002.
14. B. Pettichord, "Design for Testability," *Pettichord.com*, pp. 1–28, 2002.
15. E. Mulo, "Design for testability in software systems," 2007.
16. R. A. Khan and K. Mustafa, "Metric based testability model for object oriented design (MTMOOD)," *ACM SIGSOFT Softw. Eng. Notes*, vol. 34, no. 2, p. 1, 2009.
17. M. Nazir, R. A. Khan, and K. Mustafa, "Testability Estimation Framework," *Int. J. Comput. Appl.*, vol. 2, no. 5, pp. 9–14, 2010.
18. J. E. Payne, R. T. Alexander, and C. D. Hutchinson, "Design-for-Testability for Object-Oriented Software," vol. 7, pp. 34–43, 1997.

19. Y. Wang, G. King, I. Court, M. Ross, and G. Staples, "On testable object-oriented programming," *ACM SIGSOFT Softw. Eng. Notes*, vol. 22, no. 4, pp. 84–90, 1997.
20. B. Baudry, Y. Le Traon, G. Sunye, and J. M. Jézéquel, "Towards a ' Safe ' Use of Design Patterns to Improve OO Software Testability," *Softw. Reliab. Eng. 2001. ISSRE 2001. Proceedings. 12th Int. Symp.*, pp. 324–329, 2001.
21. M. Harman, A. Baresel, D. Binkley, and R. Hierons, "Testability Transformation: Program Transformation to Improve Testability," in *Formal Method and Testing, LNCS*, 2011, pp. 320–344.
22. M. Badri, A. Kout, and F. Toure, "An empirical analysis of a testability model for object-oriented programs," *ACM SIGSOFT Softw. Eng. Notes*, vol. 36, no. 4, p. 1, 2011.
23. S. R. Chidamber and C. F. Kemerer, "A Metrics Suite for Object Oriented Design," *IEEE Trans. Softw. Eng.*, vol. 20, no. 6, pp. 476–493, 1994.
24. T. Mayer and T. Hall, "Measuring OO systems: a critical analysis of the MOOD metrics," *Proc. Technol. Object-Oriented Lang. Syst. TOOLS 29 (Cat. No.PR00275)*, 1999.
25. S. Mouchawrab, L. C. Briand, and Y. Labiche, "A measurement framework for object-oriented software testability," *Inf. Softw. Technol.*, vol. 47, no. April, pp. 979–997, 2005.
26. B. Henderson and Sellers, *Object-Oriented Metric*. New Jersey: Prentice Hall, 1996.
27. A. Fernando, "Design Metrics for OO software system," *ECOOP'95, Quant. Methods Work.*, 1995.
28. M. Badri, "Empirical Analysis of Object-Oriented Design Metrics for Predicting Unit Testing Effort of Classes," *J. Softw. Eng. Appl.*, vol. 05, no. July, pp. 513–526, 2012.
29. M. Bruntink and A. Vandeursen, "An empirical study into class testability," *J. Syst. Softw.*, vol. 79, pp. 1219–1232, 2006.
30. Y. Singh and A. Saha, "Predicting Testability of Eclipse: Case Study," *J. Softw. Eng.*, vol. 4, no. 2, pp. 122–136, 2010.
31. B. Baudry, Y. Le Traon, and G. Sunye, "Improving the testability of UML class diagrams," *First Int. Work. onTestability Assessment, 2004. IWoTA 2004. Proceedings.*, 2004.
32. M. Genero, M. Piattini, and C. Calero, "A survey of metrics for UML class diagrams," *J. Object Technol.*, vol. 4, no. 9, pp. 59–92, 2005.
33. B. Baudry and Y. Le Traon, "Measuring design testability of a UML class diagram," *Inf. Softw. Technol.*, vol. 47, no. 13, pp. 859–879, 2005.
34. B. Baudry, Y. Le Traon, and G. Sunye, "Testability analysis of a UML class diagram," *Proc. Eighth IEEE Symp. Softw. Metrics*, 2002.
35. J. W. Sheppard and M. Kaufman, "Formal specification of testability metrics in IEEE P1522," *2001 IEEE Autotestcon Proceedings. IEEE Syst. Readiness Technol. Conf. (Cat. No.01CH37237)*, no. 410, pp. 71–82, 2001.
36. G. Booch, R. a. Maksimchuk, M. W. Engle, B. J. Young, J. Conallen, and K. a. Houston, *Object-Oriented Analysis and Design with Applications*, vol. 1, no. 11. Addison Wesley, 2007.
37. L. C. Briand, J. Wust, S. V. Ikonomovski, and H. Lounis, "Investigating quality factors in object-oriented designs: an industrial case study," *Proc. 1999 Int. Conf. Softw. Eng. (IEEE Cat. No.99CB37002)*, 1999.
38. L. Rosenberg and L. Hyatt, "Software quality metrics for object-oriented environments," 1997.
39. R. G. Dromey, "A Model for Software Product Quality," *IEEE Transactions on Software Engineering*, vol. 21. pp. 146–162, 1995.
40. M. Nazir and R. A. Khan, "Software Design Testability Factors: A New Perspective," in *Proceddings of Naional Third Conference INDIACOM 2009*, 2009, pp. 1–6.
41. H. Singhani and P. R. Suri, "Object Oriented SoftwareTestability (OOSTe) Metrics Assessment Framework," *Int. J. Adv. Res. Comput. Sci. Softw. Eng.*, vol. 5, no. 4, pp. 1096–1106, 2015.
42. M. Nazir and K. Mustafa, "An Empirical Validation of Testability Estimation Model," *Int. J. Adv. Res. Comput. Sci. Softw. Eng.*, vol. 3, no. 9, pp. 1298–1301, 2013.
43. S. Khalid, S. Zehra, and F. Arif, "Analysis of object oriented complexity and testability using object oriented design metrics," in *Proceedings of the 2010 National Software Engineering Conference on - NSEC '10*, 2010, pp. 1–8.
44. M. Bruntink, "Testability of Object-Oriented Systems : a Metrics-based Approach," Universiy Van Amsterdam, 2003.
45. M. Genero, M. Piattini, and C. Calero, "An Empirical Study to Validate Metrics for Class Diagrams."
46. L. Badri, M. Badri, and F. Toure, "An empirical analysis of lack of cohesion metrics for predicting testability of classes," *Int. J. Softw. Eng. its Appl.*, vol. 5, no. 2, pp. 69–86, 2011.
47. T. B. Nguyen, M. Delaunay, and C. Robach, "Testability Analysis of Data-Flow Software," *Electron. Notes Theor. Comput. Sci.*, vol. 116, pp. 213–225, 2005.
48. A . Goel, S. C. Gupta, and S. K. Wasan, "COTT – A Testability Framework for Object- Oriented Software Testing," *Int. Jounal Comput. Sci.*, vol. 3, no. 1, pp. 813–820, 2008.
49. S. Kansomkeat, J. Offutt, and W. Rivepiboon, "INCREASING CLASS-COMPONENT TESTABILITY," in *Proceedings of 23rd IASTED International Multi-Conference*, 2005, pp. 15–17.
50. J. M. Voas, J. M. Voas, K. W. Miller, K. W. Miller, J. E. Payne, and J. E. Payne, "An Empirical

Comparison of a Dynamic Software Testability Metric to Static Cyclomatic Complexity," *Proc. 2nd Int'l. Conf. Softw. Qual. Manag.*, pp. 431–445, 1994.

51. S. A. Khan and R. A. Khan, "Object Oriented Design Complexity Quantification Model," *Procedia Technol.*, vol. 4, pp. 548–554, 2012.
52. M. Nazir, R. A. Khan, and K. Mustafa, "A Metrics Based Model for Understandability Quantification," *J. Comput.*, vol. 2, no. 4, pp. 90–94, 2010.
53. [53]J. Bach, "Test Plan Evaluation Model," no. c, pp. 1–5, 1999.
54. J. Bach, "Heuristics of Software Testability," p. 2003, 2003.
55. T. Jeon, "Increasing the Testability of Object-Oriented Frameworks with Built-in Tests," *Building*, pp. 169–182, 2002.
56. J. Vincent and G. King, "Principles of Built-In-Test for Run-Time-Testability in Component-Based Software Systems," pp. 115–133, 2002.
57. T. L. Saaty, "Decision making with the analytic hierarchy process," *Int. J. Serv. Sci.*, vol. 1, no. 1, p. 83, 2008.

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 15 Issue 5 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

System of Linear Equations, Guassian Elimination

By Suriya Gharib, Syeda Roshana Ali, Rabia Khan , Nargis Munir & Memoona Khanam

Fatima Jinnah Women University, Pakistan

Abstract- In this paper linear equations are discussed in detail along with elimination method. Guassian elimination and Guass Jordan schemes are carried out to solve the linear system of equation. This paper comprises of matrix introduction, and the direct methods for linear equations. The goal of this research was to analyze different elimination techniques of linear equations and measure the performance of Guassian elimination and Guass Jordan method, in order to find their relative importance and advantage in the field of symbolic and numeric computation. The purpose of this research is to revise an introductory concept of linear equations, matrix theorey and forms of Guassian elimination through which the performance of Guass Jordan and Guassian elimination can be measured.

Keywords : *direct, indirect, backward stage, forward stage.*

GJCST-C Classification : *G.1.6*

Strictly as per the compliance and regulations of:

System of Linear Equations, Guassian Elimination

Suriya Gharib [α], Syeda Roshana Ali [σ], Rabia Khan [ρ], Nargis Munir [ω] & Memoona khanam [¥]

Abstract- In this paper linear equations are discussed in detail along with elimination method. Guassian elimination and Guass Jordan schemes are carried out to solve the linear system of equation. This paper comprises of matrix introduction, and the direct methods for linear equations. The goal of this research was to analyze different elimination techniques of linear equations and measure the performance of Guassian elimination and Guass Jordan method, in order to find their relative importance and advantage in the field of symbolic and numeric computation. The purpose of this research is to revise an introductory concept of linear equations, matrix theorey and forms of Guassian elimination through which the performance of Guass Jordan and Guassian elimination can be measured.

Keywords: direct, indirect, backward stage, forward stage.

I. Introduction

A system of equation is a set or collection of equations solved together. Collection of linear equations is termed as system of linear equations. They are often based on same set of variables. Various methods have been evolved to solve the linear equations but there is no best method yet proposed for solving system of linear equations[1]. Various methods are proposed by different mathematicians based on the speed and accuracy. However speed is an important factor for solving linear equations where volume of computation is so large. Linear equation methods are divided into two categories. Direct and Indirect. Each category comprises of several elimination methods used for solving equations. this paper deals with Guassian elimination method, a direct method for solving system of linear equations. An introductory portion of Guass Jordan elimination is also carried out in order to analyze the performance of both methods. Indirect methods are basically iterative methods and these methods have an advantage in a sense that they require fewer multiplication steps for large computations. Iterative methods can be implemented in smaller programs and are fast enough. With study of system of linear equation one must be familiar with matrix theory that howdifferent operations are performed on a desired matrix to calculate the result.

Author α σ ρ ω ¥ : Department of computer science Fatima Jinnah Women University, RWP. e-mails: rabia.khan1050@gmail.com, suriya_rehman@yahoo.com, r.ali_naqvi@yahoo.com, nargis.munir@yahoo.com, memoonakhanam@gmail.com

II. History of Guassian Elimination[2]

Classic books on the History of Mathematics, as well as recent studies on this subject, place the origins of Guassian Elimination in a variety of ancient texts from different places and times: China, Greece, Rome, India, medieval Arabic countries, and European Renaissance. However, it is not exact to say that these ancient texts describe what we understand today as the method of Guassian Elimination, since these texts mainly present some specific problems that are solved in a way that is accepted as Guassian Elimination, butthey do not include any explicit statement of the set of rules that constitute the method of GE. The schoolbook elimination period corresponds to the development of GE essentially as it is presented incurrent high school textbooks. This period started with Isaac Newton who lectured on Algebraas it appeared in Renaissance texts.

Isaac Newton established first the rules of Gaussian elimination as they are still presented in current high school textbooks. Carl Friedrich Gauss developed efficient methods for solving normal equations, i.e., the special type of linear equations that may arise in solutions of least square problems, via Gaussian elimination of linear equations via hand computations.

III. Guassian Elimination

Guassian elimination is the standard method for solving linear equations. As it is a ubiquitous algorithm and plays a fundamental role in scientific computation. Guassian elimination is a tool for obtaining the solution of equations, to compute the determinant, for deducing rank of coefficient matrix. However Guassian Elimination depends more on matrix analysis and computation. It emphasis on block pivoting, methods of iteration and a means to improve the computed solution quality. It involves two stages forward and backward stage.

Forward stage: Unknowns are eliminated in this stage by manipulation of equations and constitute an echelon form.

Backward stage: it is related with back substitution process on the reduced upper triangular method resulting in a solution of equation.

a) Steps to Solve Guassian Elimination

Guassian Eliminationis systematic application of elementary row operations in system of equations [2]. It converts the linear system of equations to upper triangular form, from which solution of equation is determined. Guassian elimination is summarized in the above mentioned steps[3]:

i. Augmented matrix must be written for the system of linear equations..
ii. Transform A to upper triangular form using row operations on{A/b}. diagonal elements may not be zero.
iii. Use back substitution for finding the solution of problem.

-Consider the system of linear equations with involving n variables[3].

$$a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n = a_1,n+1$$
$$a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n = a_2,n+1$$
$$a_{31}x_1 + a_{32}x_2 + \ldots + a_{3n}x_n = a_3,n+1$$
$$\ldots\ \ldots\ \ldots\ \ldots\ \ldots\ \ldots$$
$$a_{n1}x_1 + a_{n3}x_2 + \ldots + a_{nn}x_n = a_n,n+1$$

Where a_{ij} and $a_{i,j+1}$are constants, xi's are variables. The system becomes equal to:
AX=B

$$\begin{bmatrix} a_{11}a_{12}a_{13}\ldots a_{1n} \\ a_{21}\ a_{22}a_{23}\ldots a_{2n} \\ a_{31}a_{32}a_{33}\ldots a_{3n} \\ \vdots \quad\quad \vdots \quad\quad \vdots \\ a_{1n}a_{2n}a_{3n}\ldots a_{nn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} a_{1,n+1} \\ a\ _{2,n+1} \\ a\ _{3,n+1} \\ \vdots \\ a_{n,n+1} \end{bmatrix}$$

Step 1: Store the coefficients in an augmented matrix. The superscript on a_{ij} means that this is the first time that a number is stored in location (i, j).

$$\left[\begin{array}{cccc|c} a_{11} & a_{12}a_{13}\ldots a_{1n} & & & a_{1,n+1} \\ a_{21} & a_{22}a_{23}\ldots a_{2n} & & & a_{2,n+1} \\ a_{31} & a_{32}a_{33}\ldots a_{3n} & & & a_{3,n+1} \\ \vdots & \vdots & & & \vdots \\ a_{1n} & a_{2n} & a_{3n} & \ldots\ a_{nn} & a_{n,n+1} \end{array}\right]$$

Step 2 : If necessary, shift rows so that $a_{11} \neq 0$, theneliminate x1 in row2 through n .The new elements are written aij to indicate that this is thesecond time that a number has been stored in the matrix atlocation (i , j).

$$\left[\begin{array}{cccc|c} a_{11} & a_{12}a_{13}\ldots a_{1n} & & & a_{1,n+1} \\ 0 & a_{22}a_{23}\ldots a_{2n} & & & a_{2,n+1} \\ 0 & a_{32}a_{33}\ldots a_{3n} & & & a_{3,n+1} \\ \vdots & \vdots & & & \vdots \\ 0 & a_{2n} & a_{3n} & \ldots\ a_{nn} & a_{n,n+1} \end{array}\right]$$

Step 3 : New elements are written aij indicate that this is thethird time that a number has been stored in the matrix at location (i , j) .

$$\left[\begin{array}{cccc|c} a_{11} & a_{12}a_{13}\ldots a_{1n} & & & a_{1,n+1} \\ 0 & 0\ a_{23}\ldots a_{2n} & & & a_{2,n+1} \\ 0 & 0\ a_{33}\ldots a_{3n} & & & a_{3,n+1} \\ \vdots & \vdots & & & \vdots \\ 0 & 0\ a_{3n} & \ldots & a_{nn} & a_{n,n+1} \end{array}\right]$$

Final result after the row operation may result in above form:

$$\left[\begin{array}{cccc|c} a_{11} & a_{12}a_{13}\ldots a_{1n} & & & a_{1,n+1} \\ 0 & 0\ a_{23}\ldots a_{2n} & & & a_{2,n+1} \\ 0 & 0\ a_{33}\ldots a_{3n} & & & a_{3,n+1} \\ \vdots & \vdots & & & \vdots \\ 0 & 0 & 0\ldots & a_{nn} & a_{n,n+1} \end{array}\right]$$

b) Sequential Algorithm – Gauss Elimination Method[4]

Input : Given Matrix a[1 : n, 1: n+1]

Output : x[1 : n]

1. for k = 1 to n-1
2. for i = k+1 to n
3. u = a_{ik}/a_{kk}
4. for j = k to n+1
5. aij = a_{ij} – u * ak_j
6. next j
7. next i
8. next k
9. x_n = a_n,n+1/ann
10. for i = n to 1 step -1
11. sum = 0
12. for j = i+1 to n
13. sum = sum + a_{ij} * x_j
14. next j
15. xi = (a_i,n+1 - sum)/a_{ii}
16. next i
17. end

c) Guassian Elimination Through Partial Pivoting

In actual computational practice, it is necessary to permute the rows of the matrix A (equivalently, the equations of the system Ax = b) for obtaining a reliable algorithm.

The permutations are performed on line as GE proceeds and several permutation (or pivoting). Partial pivoting involves the following steps:

Step 1: Select the equation having the larger 1st coefficient in system of equation and place it at the 1st entity of matrix.

$$\begin{bmatrix} 2 & 3 & -1 & 1 \\ 2 & 5 & 1 & 3 \\ 6 & 4 & 1 & 9 \end{bmatrix} > \begin{bmatrix} 6 & 4 & 1 & 9 \\ 2 & 5 & 1 & 3 \\ 2 & 3 & -1 & 1 \end{bmatrix}$$

Step 2 : Now perform the elementary row operations and convert the matrix into upper triangular form by using the pivot equation. The resultant matrix after operations may result in the form:

$$\begin{bmatrix} 6 & 4 & 1 & 9 \\ 0 & 5 & 1 & 3 \\ 0 & 0 & -1 & 1 \end{bmatrix}$$

Step 3 : Make the equation equal to the number of variables and determine the solution of equation.

d) LU Factorization Guassian Elimination

LU factorization is the most important mathematical concept used in Guassian Elimination method. It plays a key role in the implementation of GE in modern computers, and, finally, it is essential to facilitate the rounding error analysis of the algorithm. LU factorization method is performed in three steps [5]:

i. A=LU, compute the LU factorization.
ii. For y solve the lower triangular matrix as Ly=b by using forward substitution method(i.e, start by computing the first unknown as y1=b1 from the first equation, after that compute the second unknown using the value of previous variable and so on.
iii. Compute x for the upper triangular matrix using the relation Ux=y by using backward substitution method.

Consider the following matrix of the form
Ax=b :

$$A=\begin{bmatrix} a_{11}a_{12}a_{13}a_{14} \\ a_{21}a_{22}a_{23}a_{24} \\ a_{31}a_{32}a_{33}a_{34} \\ a_{41}a_{42}a_{43}a_{44} \end{bmatrix}, x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}, b=\begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \end{bmatrix}$$

Transform the matrix A into lower and upper triangular matrix for the further computations. Let lower triangular matrix be L and upper triangular matrix be U.

$$L=\begin{bmatrix} a_{11} & 0 & 0 & 0 \\ a_{21}a_{22} & 0 & 0 & \\ a_{31} & a_{32}a_{33} & 0 & \\ a_{41} & a_{42}a_{43}a_{44} & & \end{bmatrix}$$

$$U=\begin{bmatrix} a_{11}a_{12}a_{13}a_{14} & & & \\ 0 & a_{22}a_{23}a_{24} & & \\ 0 & 0 & a_{33}a_{34} & \\ 0 & 0 & 0 & a_{44} \end{bmatrix}$$

From these upper and lower triangular matrix perform the computations for both equations listed in step ii. Calculate the values of unknown.

IV. Guassian Elimination as Computational Pardigm[6]

Sparse Guassian Elimination was studied in the early 70's. For the vertex elimination on the undirected graphs a graph model was proposed. The structural properties of the vertices has been a major research in the last decades. Also work on optimal elimination tree was carried out, which proved of no importance in sparsity preserving elimination trees, looking towards optimal elimination trees could result in non linear fill. There has been minimum use of tree related graphs elimination outside the sparse Guassian Elimination. Cholesky factor is described in terms of different set of vertices: sets of predecessor and successor, chain elimination and elimination sets. The model of Guassian Elimination gives a precise description of interaction between master, sub problems which are hidden in formulation of dynamic programming. In case of solving blocked linear equations with PDS matrices, proposed model of computation is a straightforward extension of Guassian Elimination (point wise).

Transformation associated with elimination of vertex is simply block elimination using submatrix of block diagonal as block pivot.

One application regarding computational model is in the context of solution of asymmetric blocked structural system of linear system of equations which demonstrates an indirect use in process of solution, rules of assignments of columns to block for block elimination process. These rules provide a new concept of pivoting. Consider zero subcolumn in original data and non zero in partially reduced matrix. Computed subcolumn remains in the column space of some subcolumn in the original data. Substituting one of these subcolumn to the considered subcolumn is appealing. It is complementary to sparse preserving elimination. Cholesky Factorization method is motivated by solution of so called normal equations that come from linearalized KKT system in the context of Newton method.

While considering interior point for solving large scale block problems, from a numerical point of view to solve linear system of equations is of great consideration. Smallest height elimination trees tend to have maximum number of leaves. Block Cholesky includes block LU factorizations, the coefficients of submatrix that correspond to the leaves is the original data. Incomplete factorization consists of factorization from leaves up to the level where data is to be transformed several times by preceding block eliminations.

V. Algorithms

a) Guassian Elimination[7]

1. {*begin Reduction to Triangular form*}

for i= 1 to N- 1 do

f o r k = i + 1 t o N do

a_{ki} =fl(a_{ki}/a_{11})

for j = i + 1 to N+ 1 do

a_{kj}= fl(a_{kj} – a_{ki}* a_{ij})

2. { *begin back-Substitution*}

$x_N = fl(a_{N,N+1}/ a_{NN})$

for i= N-1 downto 1 do

for j = N downto *i* + 1do

$a_{i,N+1} = fl(a_{1,N+1}-a_{ij}*x_j)$

$x_i=fl(a_{1,N+1}/a_{ij})$

b) Guass Jordan

1. {*begin Reduction to Diagonal Form*}

fori = 1 to Ndo

fork = 1 to N(except i) do

forj= i + 1 to N+1 do

$a_{ki} = fl(a_{ki}/a_{ij})$

for j= i+1 to N+1 do

$a_{kj} = fl(a_{kj}-a_{kj}*a_{ij})$

2. {*beginSolving Diagonal System*}

fori = 1 to N do

VI. Performance Comparison of Guassian Elimination with Guass Jordan

Guassian elimination and Guass Jordan methods are compared and analyzed on the basis of execution time explained in the following table

No of variables	Time of Guassian Elimination (millisecond)	Time of Guass Jordan (millisecond)
2	14	25
3	16	31
4	20	36
5	26	39
6	29	56
7	46	76

Comparison through execution time

From the above mentioned results its clear that Guassian elimination is more faster than Guass Jordan method. Therefore, an efficient technique for solving linear system of equations, determining the values of unknowns in less time and less complicated procedure.

VII. Conclusion

There are different direct and indirect methods which are used to compute the linear system of equations. Guassian Elimination is a type of direct method used to calculate the unknown variables. Many scientific and engineering domains of computation may take the form of linear equations. The equations in this field may contain large number of variables and hence it is important to solve these equations in an efficient manner. This paper comprises of Guassian Elimination method an efficient method to solve these equations. Although the comparison on the basis of execution time is carried out along with the Guass Jordan method and it has been concluded that Guassian Elimination is faster than the other elimination methods and it is used in various scientific fields where large number of computations are performed by elimination of variables. Our future directions are to use and develop the simple and efficient method for non linear system of equations.

References Références Referencias

1. Noreen Jamil," direct and indirect solvers for linear system equations", june 2012.
2. Froilán M. Dopico, "Alan Turing and the origins of modern Gaussian elimination", Instituto de Ciencias Matemáticas CSIC-UAM-UC3M-UCM, December 14, 2012.
3. Yadanar Mon, Lai lai win kyi, "performance comparison of guassian elimination and guass Jordan", International Journal of Computer & Communication Engineering Research (IJCCER), Information Technology Department, Volume 2,02-march-2014.
4. Luke Smith and Joan Powell: "An Alternative Method to Gauss-Jordan Elimination: Minimizin g Fraction Arithmetic", The Mathematics Educator, 2011
5. J. F. Grcar, "How ordinary elimination became Gaussian elimination". Historia Math., 38(2):163_218, 2011.
6. Etienne Loute, "guassian elimination as computational paradigm", August 2003.
7. Nae Kaun Tsao, Ditroit Michigan, "On the Equivalence of Gaussian Eliminatio and Gauss-Jordan Reduction in Solving Linear Equations", February 1989.

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 15 Issue 5 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Streaming Analytics over Real-Time Big Data

By Ranjitha P

Abstract- A portal is developed using open source tool called Liferay for water management and city management using data acquired from sensors deployed in overhead water tanks and across the city at different locations. The parameters captured from sensors are water level and parameters captured sensors deployed across the city include dust, UV, temperature, light, humidity, sound and air quality. Data generated by these sensors amounts nearly megabytes of data per day and gigabytes on an annual rate. Real time analytics help in monitoring and management of water resources and rate of pollution across the city. Visualizations are provided in the form of a time series graph. The visual representations are plotted using d3.js graphs in real-time, hence allowing the users to take corrective decisions with respect to water usage and managing pollution across the city.

Index Terms : *D3.js, stream processing, siddhi CEP, big data analytics, liferay.*

GJCST-C Classification : *D.4.7*

Streaming Analytics over Real-Time Big Data

Ranjitha P

Abstract- A portal is developed using open source tool called Liferay for water management and city management using data acquired from sensors deployed in overhead water tanks and across the city at different locations. The parameters captured from sensors are water level and parameters captured sensors deployed across the city include dust, UV, temperature, light, humidity, sound and air quality. Data generated by these sensors amounts nearly megabytes of data per day and gigabytes on an annual rate. Real time analytics help in monitoring and management of water resources and rate of pollution across the city. Visualizations are provided in the form of a time series graph. The visual representations are plotted using d3.js graphs in real-time, hence allowing the users to take corrective decisions with respect to water usage and managing pollution across the city.

Index Terms: D3.js, stream processing, siddhi CEP, big data analytics, liferay.

I. Introduction

Sensing elements are growing rapidly in all areas of day-to-day life leading to large volumes of data generation. Data generated in this manner is considered as streaming data which is continuous in nature. This leads to the notion of Big Data as it refers to the velocity aspect of Big Data. Though a large amount of data is generated, extracting meaningful and useful contents from such streams is highly motivated in order to make timely decisions. These timely decisions can be achieved only when the data obtained is processed, analyzed and visualized as and when it arrives (i.e., in real-time). Visualizing and analyzing such huge streams is referred to as Big Data Visualization and Analytics.

a) *Big Data Processing*

There are two types of Big Data processing – 1. Batch based stored data processing 2. Real-time data stream processing [6]. Batch based processing handles historical data while the Real-time stream processing handles on-the-fly data. Batch based processing is used when we first store the data and then perform analytics as a later part, while real-time data stream processing performs analytics as and when the data arrives irrespective of whether the data is stored or not.

The key data processing approach for handling real-time streaming data is Complex Event Processing (CEP) [5]. It infers events or patterns from multiple sources of data and identifies meaningful events among them and responds with possible quick decisions. In this paper, we are considering events to be the flow of water in various overhead water tanks within a campus and data generated from sensors which capture dust, light, sound, humidity, air quality, UV and temperature that are deployed across the city. Events here refer to the change of state in generation of data.

The primary functionality is to match queries with events and generate response immediately. In this methodology, stored queries are run over dynamic data streams. In general, it is just the reverse procedure of traditional databases. Hence such a processing plays a crucial role in Big Data analytics. Siddhi – CEP, an open source complex event processing engine which is under Apache license is used [7].

b) *Big Data Analytics*

Applying Big Data analytics on such large data sets enables to uncover hidden patterns, correlations and preferences. Such an analysis improves the performance and efficiency. It thus brings real value to the data. It deals with what attributes of real-time data has to be captured for analyzing and visualizing. The critical parameters are given utmost importance. It deals with collecting, organizing and analyzing large data sets to discover patterns.

c) *Big Data Visualization*

Visualizations are always more understandable and appealing to the end users than continuous raw data streams. Smarter visualizations result in smarter and quicker decisions. These data visualizations can be in the form of charts, graphs, maps, etc. which can be placed within a portal or a web page. In this paper, we have considered the visualizations for parameters captured from the sensors such as water level, salt/chlorine content, PH, dissolved salts and temperature which are plotted through d3.js graphs in real-time within a Liferay portal based on the location of the buildings.

II. Related Works

The prevalent use of sensors has led to Big Data which traverses enterprise data processing pipelines in a streaming fashion leading to online analytic capabilities. Statistical anlysis and data mining can be used for real-time systems by implementing over the same system [1]. Timely analytics over Big Data made up of huge data sets is the key factor. Sensors that generate Big Data are from various fields such as intelligent transportation with road and vehicle sensors, financial market trading and surveillance, crowd control,

Author: Department of CSE, MSRIT, Bangalore, India.
e-mail: ranjithaph@gmail.com

military decision making, large scale emergency response and early warning of natural disasters [2].

To handle such a huge data, visual analytics is important because humans have the ability to gain quick insight and take quicker decisions. Computation of results obtained from such huge data has to be precise [3]. Dynamic Visual Analytics is the process of integrating knowledge discovery and interactive visual interfaces to facilitate data stream analysis and provide situational awareness in real-time [8].

D3.js is a web visual presentation tool for big data that provides graphical statistics of data flow. D3 achieves visualization through data loading, data binding, analytic transformation elements and excessive element. D3 uses CSS3, HTML and SVG (Scalable Vector Graphics) on the web. Data visualization technology views each data item as a single pixel element and hence large number of data sets constitute image of the data. Data visualization conveys information by using graphical tools and zoom features [9].

III. Methodology

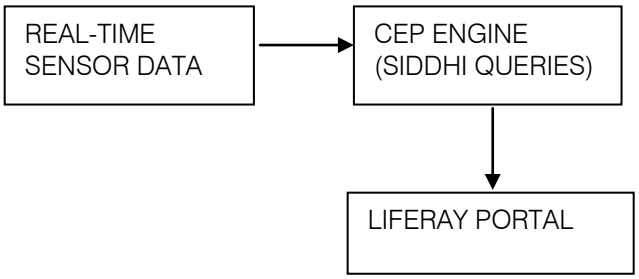


Figure 1 : High Level Design

In order to sense the usage of water and pollution level within a city, water level sensors and sensors that capture dust, light, sound, humidity, air quality, UV and temperature are deployed into water tanks and across the city.

Constant power supply and stable WIFI connection are made available for the duration of the project. These sensors use less bandwidth and electricity.

An API is created for these time-series data streams. At first, a source is created using POST method. POST can be empty or have an application/JSON body. Then the source info is fetched using the GET method. Data is sent after authorization modeled after Heroku's token based authorization. Later data is read in pages either in ascending chronological order or descending chronological order with latest results or entries being visualized. Also an option to visualize historical data is provided through the facility to choose from calendar option.

Figure 2 : Flow Design of Methodology

Figure 2. shows the flow of data along the different portlets.

According to the high level design in Figure 1, sensors generate real-time data which serves as the input to the CEP over which the data is processed and executed. After processing, the outcomes of the various queries are visualized in the form of D3.js graphs within a portal technology called Liferay.

IV. Input

The input to obtain the data visualization is a stream of data which can be either in CSV (Comma Separated values) or JSON format. And data can be either offline (Stored or historical data) or online (real-time data). The timestamps chosen are 1/min for a data generated from water level sensors and 1/10secs for data generated from sensors deployed across the city to counter pollution. Based on the location of the sensor selected, the visualizations are made available to the end users. These visualizations should be compatible on desktops, tablets and mobile phones.

V. Processing

Siddhi CEP queries reside in the CEP engine. The incoming data stream is run against appropriate Siddhi queries and the results are generated and the same queries can be visualized in D3.js graphs. These queries process event patterns. Based on the event that arises in the incoming data stream, that particular query gets executed for the visualization.

Sample Siddhi Query –

From DataStream #window. External

Time (timeStamp,200)

insert into Window Stream

In this query, we are detecting the rate drop based on time window where rate drop > 200.

VI. Output

The output will be a graph plotted against time stamp and water level. These graphs are plotted using D3.js which is a javascript library for manipulating documents [4]. The streaming data is captured in real-time and the graph also moves/changes along with time as the new data arrives. This graph will be a part of the portal technology called as Liferay which is a web based technology that provides personalization, single sign on, responsive and content management. Within a portlet, there will be a group of associated portlets. In this scenario, the various portlets are login portlet, Google

map portlet for location selection, chart portlet for graph visualization.

The user logs in through the login portlet and selects a location in a Google map portlet as well as the chart settings he wants to visualize. Based on the selection made in the Google map portlet, the water usage or the level of dust, sound, light, UV, humidity, air quality or temperature of that particular location will be visualized in the graph portlet.

Sample output –

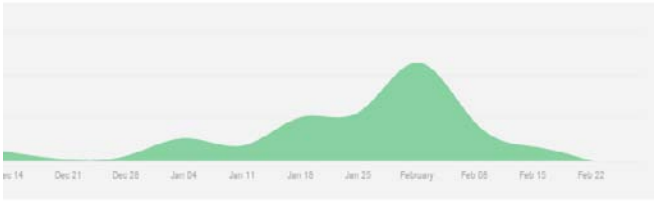


Figure 3 : Sample Graph

Time series graph plays a prominent role in these visualizations. The graph visualization gets highlighted with a spot at a particular point in the graph when aggregate queries are run.

VII. Implementation

The following results in Figure 3 and Figure 4 represent the time series visualizations. Here the graph is plotted against timestamp and data. The data can be water level or data from dust sensor, sound sensor, humidity sensor, light sensor, temperature sensor, air quality sensor or UV sensor.

Different visualizations can be realized based on what parameters of the data are captured by the sensors thus helping the users to smartly manage water and pollution level within the city. The main goal is to perform analytics on data-in-motion.

The challenges include fault-tolerance in the cluster where application is deployed, handling continuous data flow in mission critical applications with very minute disruption and resource wastage when the data input rate is non-uniform.

The most appropriate visualization is made available to the end users as part of the portal. The visualization obtained should be easily understandable so as to take quicker decisions.

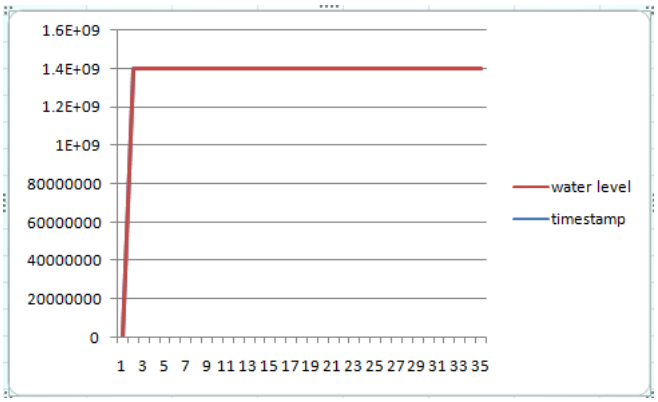


Figure 3 : Results for Smart Water Management

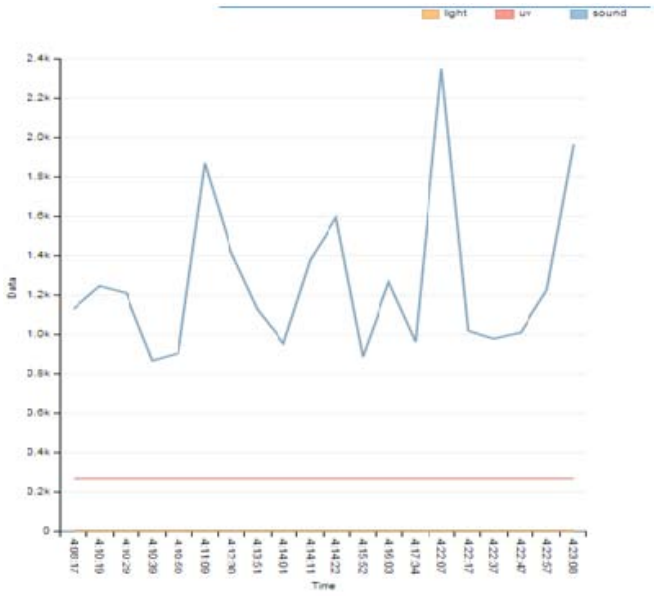


Figure 5 : Results for Sense City

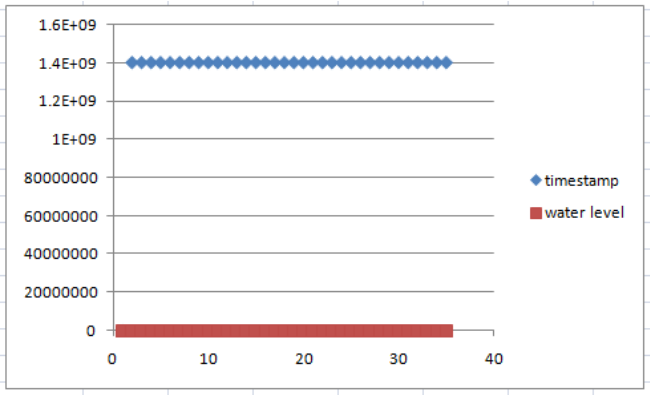


Figure 6 : Scatter Plot Results

VIII. Future Work

As part of future work, we extend the Big Data visualization techniques to different formats.

a) ARIMA Algorithm

Autoregressive Integrated Moving Average is a model that understands the data and predicts the future

points in series which is known as forecasting. It is referred to as ARIMA (p, d, q) or ARIMA (AR, I, MA).

Where p – auto regression

d - Integration

q – Moving average

This concept is used to predict what the future water levels will be based on the current water levels for a particular time series of data.

b) Scatter plot representation of water usage at different buildings within the campus. These are plots of data points on a horizontal and a vertical axis to show the usage of water at different buildings. At the same time building with isomorphic water usage can be grouped under the same cluster on the scatter plot.

c) To implement a similar Big Data analysis for different sensors that capture dust, airquality, sound, light, temperature and humidity.

IX. Conclusion

As the sensors generate huge amount of data, it is considered as Big Data by the velocity aspect of it. It is very important to analyze, process and visualize Big Data as it help in making meaningful and quicker decisions. This is very important in mission critical applications. Processing the data on-the-fly is achieved with the help of Siddhi CEP. Visualizations are more appealing and understandable. D3 graphs serve the purpose of visualization. As per the case of smart water management within a campus, allows us to make better usage of water and thus avoid wastage.

References Références Referencias

1. Ismail Ari, Erdi Olmezogullari, Omer Faruk Celebi, Cloud Computing Research Group and Avea Labs, Computer Science Department, Ozyegin University, Istanbul, TURKEY. “Data Stream Analytics and Mining in the Cloud.” 2012 IEEE 4th International Conference on Cloud Computing Technology and Science.
2. Nader Mohamed, UAE University, UAE, Jameela Al-Jaroodi, University of Pittsburgh, USA. “Real-Time Big Data Analytics: Applications and Challenges.” 2014 IEEE International Conference On High Performance Computing and Simulation (HPCS).K. Elissa, “Title of paper if known,” unpublished.
3. Jaegul Choo and Haesun Park , Georgia Tech. “Customizing Computational Methods For Visual Analytics With Big Data.” 2013 IEEE Computer Graphics and Applications.
4. “D3-Data Driven Documents.” Internet: http://d3js.org/
5. ”Siddhi”, https://github.com/wso2/siddhi
6. http://www.nec.com/en/global/rd/research/cl/bdpt.html [Big Data Processing].
7. Sriskandarajah Suhothayan, Isuru Loku Narangoda, Subash Chaturanga, Siddhi: A Second Look at Complex Event Processing Architectures, ACM GCE Workshop 2011.
8. Sabri Hassan, Johannes S¨anger, G¨unther Pernul, Department of Information Systems, University of Regensburg, Regensburg, Germany. “SoDA: Dynamic Visual Analytics of Big Social Data.” Big Data and Smart Computing (BIGCOMP), 2014 International Conference.
9. Fan Bao, Dalian Maritime University, Dalian, China , Jia Chen. “Visual framework for big data in d3.js.” Electronics, Computer and Applications, 2014 IEEE Workshop.

Global Journals Inc. (US) Guidelines Handbook 2015

www.GlobalJournals.org

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN COMPUTING (FARSC)

Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards "FARSC" title to individuals. The 'FARSC' title is accorded to a selected professional after the approval of the Editor-in-Chief/Editorial Board Members/Dean.

- The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

FARSC accrediting is an honor. It authenticates your research activities. After recognition as FARSC, you can add 'FARSC' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSC designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.

Once FARSC title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA).The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSC can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSC, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.

The FARSC will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSC member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSC, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSC members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSC member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

The FARSC is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSC can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSC member can decide its price and we can help in making the right decision.

The FARSC member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN COMPUTING (MARSC)

The ' MARSC ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.
The “MARSC” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSC or William Walldroff, M.S., MARSC.

MARSC accrediting is an honor. It authenticates your research activities. After becoming MARSC, you can add 'MARSC' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSC designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSC, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSC member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSC, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

AUXILIARY MEMBERSHIPS

Institutional Fellow of Open Association of Research Society (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not convenient, and then email the paper directly to dean@globaljournals.org.

Offline Submission: Author can send the typed form of paper by Post. However, online submission should be preferred.

Preferred Author Guidelines

MANUSCRIPT STYLE INSTRUCTION (Must be strictly followed)

Page Size: 8.27" X 11'"

- Left Margin: 0.65
- Right Margin: 0.65
- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, "Abstract" word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

The Global Journals Inc. (US) welcome the submission of original paper, review paper, survey article relevant to the all the streams of Philosophy and knowledge. The Global Journals Inc. (US) is parental platform for Global Journal of Computer Science and Technology, Researches in Engineering, Medical Research, Science Frontier Research, Human Social Science, Management, and Business organization. The choice of specific field can be done otherwise as following in Abstracting and Indexing Page on this Website. As the all Global

Journals Inc. (US) are being abstracted and indexed (in process) by most of the reputed organizations. Topics of only narrow interest will not be accepted unless they have wider potential or consequences.

2. ETHICAL GUIDELINES

Authors should follow the ethical guidelines as mentioned below for publication of research paper and research activities.

Papers are accepted on strict understanding that the material in whole or in part has not been, nor is being, considered for publication elsewhere. If the paper once accepted by Global Journals Inc. (US) and Editorial Board, will become the copyright of the Global Journals Inc. (US).

Authorship: The authors and coauthors should have active contribution to conception design, analysis and interpretation of findings. They should critically review the contents and drafting of the paper. All should approve the final version of the paper before submission

The Global Journals Inc. (US) follows the definition of authorship set up by the Global Academy of Research and Development. According to the Global Academy of R&D authorship, criteria must be based on:

1) Substantial contributions to conception and acquisition of data, analysis and interpretation of the findings.

2) Drafting the paper and revising it critically regarding important academic content.

3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board's decision on publication of the paper is final and cannot be appealed elsewhere.

Permissions: It is the author's responsibility to have prior permission if all or parts of earlier published illustrations are used in this paper.

Please mention proper reference and appropriate acknowledgements wherever expected.

If all or parts of previously published illustrations are used, permission must be taken from the copyright holder concerned. It is the author's responsibility to take these in writing.

Approval for reproduction/modification of any information (including figures and tables) published elsewhere must be obtained by the authors/copyright holders before submission of the manuscript. Contributors (Authors) are responsible for any copyright fee involved.

3. SUBMISSION OF MANUSCRIPTS

Manuscripts should be uploaded via this online submission page. The online submission is most efficient method for submission of papers, as it enables rapid distribution of manuscripts and consequently speeds up the review procedure. It also enables authors to know the status of their own manuscripts by emailing us. Complete instructions for submitting a paper is available below.

Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications.

Research letters: The letters are small and concise comments on previously published matters.

5. STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(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, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

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

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

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive 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) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

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

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin 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 research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, 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. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. 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.

Color Charges: It is the rule of the Global Journals Inc. (US) for authors to pay the full cost for the reproduction of their color artwork. Hence, please note that, if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a color work agreement form before your paper can be published.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

6.2 Early View of Global Journals Inc. (US) (Publication Prior to Print)

The Global Journals Inc. (US) are enclosed by our publishing's Early View service. Early View articles are complete full-text articles sent in advance of their publication. Early View articles are absolute and final. They have been completely reviewed, revised and edited for publication, and the authors' final corrections have been incorporated. Because they are in final form, no changes can be made after sending them. The nature of Early View articles means that they do not yet have volume, issue or page numbers, so Early View articles cannot be cited in the conventional way.

6.3 Author Services

Online production tracking is available for your article through Author Services. Author Services enables authors to track their article - once it has been accepted - through the production process to publication online and in print. Authors can check the status of their articles online and choose to receive automated e-mails at key stages of production. The authors will receive an e-mail with a unique link that enables them to register and have their article automatically added to the system. Please ensure that a complete e-mail address is provided when submitting the manuscript.

6.4 Author Material Archive Policy

Please note that if not specifically requested, publisher will dispose off hardcopy & electronic information submitted, after the two months of publication. If you require the return of any information submitted, please inform the Editorial Board or dean as soon as possible.

6.5 Offprint and Extra Copies

A PDF offprint of the online-published article will be provided free of charge to the related author, and may be distributed according to the Publisher's terms and conditions. Additional paper offprint may be ordered by emailing us at: editor@globaljournals.org .

You must strictly follow above Author Guidelines before submitting your paper or else we will not at all be responsible for any corrections in future in any of the way.

Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. 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.

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

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

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

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

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. 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 to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

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

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

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

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After 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 though which your research is going to be in print to 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 in 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 criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of 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 the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

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

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing 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 approach 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. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than 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 maintain the initial two items to no more than one ruling each.

- Reason of the study - 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 quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness 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 to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled 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 with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose 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 sound written Procedures segment allows a capable scientist to replacement 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 for the least amount of information that would permit another capable scientist to spare 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 object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text 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:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not 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 - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in 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 a 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. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise 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 in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to 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 part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a 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 implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly 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 with prospect, and let it drop at that.

- Make a decision if each premise is supported, 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 the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One 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 available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

save our planet

Global Journal of Computer Science and Technology

Visit us on the Web at www.GlobalJournals.org | www.ComputerResearch.org
or email us at helpdesk@globaljournals.org

ISSN 9754350