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Enhance the Security of Cloud Computing Environment Using Semantic Segregation Techniques

تحسين الحماية في الحوسبة السحابية باستخدام تقنية الفصل المعنوي

by

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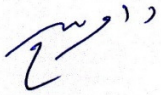
Signature: 

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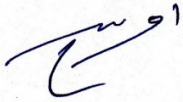
التوقيع: 

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LIST OF ABBREVIATIONS

CC	Cloud Computing
CIA	Confidentiality, Integrity and Availability
CSP	Cloud Service Provider
DLP	Data Leak Prevention
DUNS	Data Universal Numbering System
IaaS	Infrastructure as a Service
IC	Information Content
IT	Information Technology
LCS	Least Common Subsumer
NIST	National Institute of Standards and Technology
PaaS	Platform as a Service
SaaS	Software as a Service
SOAP	Simple Object Access protocol
UDDI	Universal Description, Discovery, and Integration
URL	Uniform Resource Locator
VB	Visual Basic
VM	Virtual Machine
WSDL	Web Services Description Language

Enhance the Security of Cloud Computing Environment Using Semantic Segregation Techniques

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ABSTRACT

Cloud computing can offer the business community higher reliability, security, higher availability and cost effective maintenance. These attractive benefits create the growing popularity of cloud computing.

The cloud service providers run multiple tenants' databases in the cloud computing environment; thus it needs an efficient resource sharing management technique in order to allow clients to keep lower overall costs without losing or degrading quality of their services. Thus, developing an efficient resource management for multi-tenant database system in cloud is essential for business community and cloud providers. In the cloud, most applications share memory, processors, disk spaces, and databases with other companies' applications to reduce the cost. There are many critical issues and challenges in the cloud computing security in multi-tenant environment; one of these challenges is how the businesses data will be segregated.

This research proposed new techniques to segregate data for enhance the security. This research built businesses taxonomy to classify the businesses depending on their type using the yellow pages, then use semantic similarity measurements in WordNet to calculate the similarity between the businesses in our taxonomy, which are Shortest Path Based measure, Wu-Palmer measure, Leakcock Chodorow's measure, Resnik's measure and Lin's measure.

The proposed techniques are evaluated by comparing between the results of segregation techniques. Experiments have been conducted in order to check the technique with least risk. The results demonstrated that using data segregation techniques will increase the information security in cloud computing.

Keywords: Cloud Computing, Multi-Tenant, Segregation Techniques, Semantic Similarity

تحسين الحماية في الحوسبة السحابية باستخدام تقنية الفصل المعنوي

إعداد: رامي المطارنة

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الملخص

الحوسبة السحابية تقدم لمجتمع الأعمال إنتاجية اعلى و درجة عالية من الموثوقية وتكلفة اقل وخدمة مضمونة هذه الميزات ادت الى اقبال اكثر على الحوسبة السحابية.

يعمل مزودي الخدمات السحابية على تشغيل عدة مستأجرين لقواعد البيانات في السحابة، وبالتالي يحتاج إلى أسلوب فعال لإدارة و تقاسم الموارد من أجل السماح للمستخدمين الحفاظ على انخفاض التكاليف الإجمالية دون فقدان الجودة .وبالتالي عملية تطوير إدارة الموارد للمستأجري قواعد البيانات عملية جوهرية لكل من مجتمع الاعمال ومزودي الخدمة.

معظم التطبيقات في الحوسبة السحابية تتشارك سعة التخزين والمعالجات وايضاً تتشارك قواعد البيانات من اجل تقليل التكلفة على مزودي الخدمات السحابية . يعتبر أمن انظمة المعلومات في الحوسبة السحابية من اهم التحديات وخصوصاً عند تشارك الموارد بين مستخدمي الحوسبة السحابية , ومن هذه التحديات كيف سيتم فصل بيانات المستخدمين عن بعضهم.

تقدم هذه الدارسة نموذج مقترح لفصل بيانات من اجل تحسين أمن انظمة المعلومات في الحوسبة السحابة. تقوم هذه الدارسة على بناء تصنيف للأعمال اعتماداً على طبيعة العمل وذلك باستخدام الورقة الصفراء, ثم استخدام مقاييس التشابة الدلالية لحساب نسبة التشابه بين هذه الاعمال وتحديد تقنية الفصل بين الأعمال.

التقنية المقترحة تم تقيمها من خلال مقارنة النتائج لعدة تجارب واستخدام اكثر من تقنية من خلال تحديد اقل نسبة خطورة على أمن انظمة المعلومات في الحوسبة السحابية . اظهرت النتائج انه باستخدام تقنية الفصل المعنوي لبيانات المستخدمين سوف تزيد من أمن انظمة المعلومات في الحوسبة السحابية.

كلمات البحث: سحابة الحوسبة، عدة مستأجرين ، تقنية الفصل، التشابة الدلالية.

1. CHAPTER ONE

1.1. INTRODUCTION

Recently, organizations and industries face many problems; doing certain office and business tasks, retrieving information and gaining services while paying huge amounts of money. Nowadays, using up-to-date technologies and computing services can help solving several problems by click of a button. One of the suggested solutions is designing a cloud full of services and resources.

Cloud Computing is a model that permits computing to be obtained as a service, thereby changing computing from a capital rigorous activity to an expense item. Cloud computing empowers consumers to focus on solving their specific business problems rather than on constructing and maintaining computing infrastructure. Cloud computing is likely to be one of the good solutions which has been found during hard times; where cloud has been proven to be a considerable benefit to any organization due to its flexibility and pay-as-you-go cost structure (Beik R. 2012).

The increasing demand on cloud computing services was empowered as a result of embracing features like convenience and on-demand access to shared resources by using several tenants. Many computing services moved to the cloud, and cloud computing had to scale-up dynamically to support new demands without losing quality of service (Beloglazov A & Buyya R. 2013).

A multi-tenant database is the primary characteristic of software as a service “SaaS”; it allows SaaS vendors to run a single instance application which supports multiple tenants on the same hardware, software and network infrastructure (Xiaohong. z.et al. 2012).

Public clouds are designed to store data from different organizations on same server which is cost-effective. Also, cloud services provider uses multi tenant environment for many reasons: high performance, low memory, optimum utilization for storage and low cost by using one engine (Sen j. 2013).

However; multiple clients store their own data using the applications that are provided by cloud service provider. In such cases, it would be a set of data for different clients in the same place that depends on cloud service provider. Data leakage from client to another may be possible through this environment. Therefore, the service provider should have techniques to segregate business’s data from each other at the physical level and database level (Rai.M et al., 2013).

One of the most challenges of cloud computing is how clients will be isolated from each others which may increase security effectively. The attention has received regarding the data segregation in a cloud computing model and there is recognition for the need of management to multi tenancy across the cloud computing (Sen. J, 2013).

Data is always exposed to be threaded through both internal and external. The less separation would increase the hacking of hypervisor, where a shared CPU can be attacked and the data can be manipulated, deleted or destroyed as a result of this attack. Any problem to segregate business’s data may cause the loss of data (Chandran S &Angepat M, 2010).

As previously mentioned, cloud services provider store several tenant in the same database and the same location. So, how cloud securely isolates users and differentiate between the memory and storage for each user. While, this failure could lead to leakage of data from one customer to another (Kurmus A .et al. 2011). Since the same set of tables has hosted multiple tenants' data, the term “Data Segregation” has been introduced.

Data segregation, in the simplest sense, is data isolation. In cloud environment the data is not specifically segregated. However, It is distributed throughout the cloud network (Chandran S & Angepat M, 2010).

Several studies were conducted to segregate the data in cloud environment. In this research performed different tests to gather information and results in order to find a solution for the management of multi-tenant and how to segregate the data depending on businesses type.

This research takes several techniques to find out that the best way to segregate clients’ data. These techniques are built to segregate the closer businesses type by constructing classification for businesses, depending on yellow pages that classify companies according to businesses type, and calculate the distance between these businesses by using semantic similarity measurement.

1.2. RESEARCH PROBLEM

In multi tenancy, data is stored in a shared environment where one customer's data is stored alongside another customer. This research takes in consideration that all safeguards use to save data from any possible leakage from user to other.

Cloud services provider stores several tenants in the same database and in the same servers for many reasons: performance, memory, size and cost. Data leakage from user to another is possible in this environment.

This research discusses how to ensure that the multiple users can not see each others data. Thus, data segregation is technique that is used to enhance tenant's data security. This thesis develops a technique to enhance the security in cloud computing by segregating business that has same domain businesses type.

In order to apply segregation as a technique, this thesis built taxonomy to classify the businesses depending on their types. Then use a semantic similarity measurement to calculate the similarity of businesses, in order to enhance the security in cloud.

The goal has been accomplished by answering the following questions:

1- How the company can be classified according to their businesses type?
2- How can calculate the similarityof businesses?
3- How can develop the techniques to segregate the data businesses that have the same businesses type?

1.3. RESEARCH OBJECTIVES

The main objective of this work is enhancing the security in the cloud. This research discusses how to ensure that the multiple clients cannot see each other, specially, the clients that have the same type of businesses. This will be accomplished by developing a technique. And to achieve the research objectives, this thesis are adopting the following steps:

1. Enhancing the security by developing new approach to manage several tenancy in cloud computing.

2. Finding new technique to classify the businesses according to their types.

3. Using the semantic similarity measurement to calculate the similarity between businesses.

4. Determining the best technique to segregate the businesses data, specially, the businesses which have similar type of businesses.

1.4. MOTIVATION

The main motivation to conduct this project is that scientist all through the years focuses on improving better services for end users and how to provide them with golden experiences of using the cloud. Recently, the main attention goes around the security of cloud computing.

Cloud computing is an evolving paradigm with lots of benefits. It can be seen as an integration of traditional computing and network technologies. The cloud computing security has become a hot topic in the industry and academic research works. In particular, the data security has been concerned by organizations and users which use cloud computing. So, that motivates us to propose a new approach to enhance the security by segregate the data in cloud computing.

1.5. RESEARCH METHODOLOGY

Security in cloud computing faces several challenges. One of these challenges is storing client's data because clients store their data in the same provider, and the provider uses multi tenancy to achieve cost effective.Research methodology as follow:

- The implementation and evaluation of the proposed techniques.
- How the data segregation will help to reducing the risks.
- Design and employ VB.NET software that can be used to evaluate the proposed algorithms.
- Draw the conclusion that clarifies and explains the process and the results briefly.

The methodology that is used to develop our model contains the following phases:

- Study and Analysis Phase.
- Design and Implementation Phase
- Test Phase

1.6. THESIS LAYOUT

The layout of the thesis is corresponded to the structure of the work, as undertaken throughout the study. In addition to the introductory chapter, the thesis includes four chapters, references and appendices. A brief content description for the four chapters is presented below:

Chapter 2 provides the summary of the literature review and related works. It details and analyses the project elements and identifies all of the factors for each element and their assessment techniques.

Chapter 3 provides the design of the proposed techniques and includes the experiments with their assessment techniques.

Chapter 4 presents the techniques and more of experiments and provides the main outcomes of these experiments. In order to determine the optimum techniques this will be used to enhancing the security.

Chapter 5 concludes the project and suggests future work in order to improve the final setup and lead to better implementation of the system.

2. CHAPTER TWO

BACKGROUND AND LITERATURE REVIEW

2.1. PREFACE

This chapter provides a background and literature review about the main concepts covered by this research. It is divided into three sections. Section 2.2 discusses the necessary background information that is needed for a better understanding for the embedded topics of the thesis. The Literature review and the related works are discussed in section 2.3. Finally, section 2.4 presents a summary.

2.2. BACKGROUND

CLOUD COMPUTING

Cloud computing is a subscription-based service where network storage space and computer resources can be gained by a subscription. And through using cloud, the information can be accessed from anywhere and at any time (Huth A& Cebula J. 2011). Figure 2.1 below shows the increase of using the cloud computing.

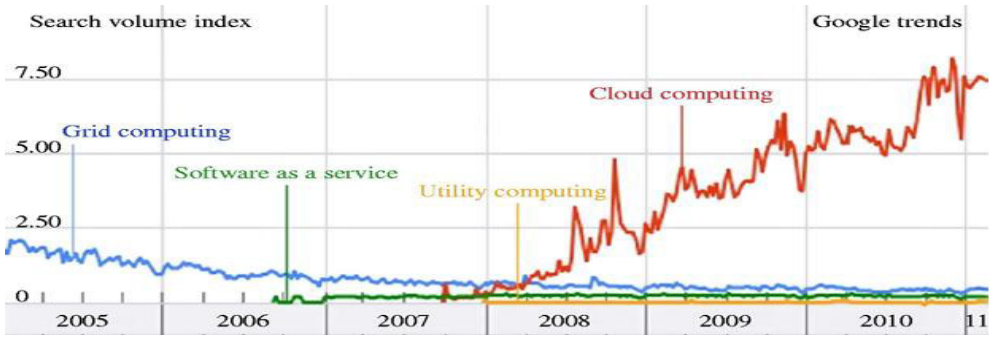

Figure 2.1: Growth of cloud and grid computing since 2005 (Patel et al., 2011).

In a traditional computer setup; it is required for a person to be in the same location where data storage device is. The cloud removes the need of person to be in the same physical location where data storage device is. Cloud providers can host the hardware and software which are necessary to run home or business applications (Lodha P & Wadhe A. 2013).

For small businesses that cannot afford the same amount of hardware and storage space as a bigger company; it is really helpful to use the cloud as a solution. Small companies can store their information in the cloud, removing the cost of purchasing and storing memory devices. Additionally, because you only need to buy the amount of storage space you will use, a business can purchase more space or reduce their subscription as their business grows or as they find they need less storage space (Taleen A .2013).

Having an internet connection is the only requirement that you need to access the cloud. This means that if you want to look at a specific file that has been stored in the cloud, you must, firstly, establish an internet connection either through a wireless, wired internet or a mobile broadband connection. One of the benefits of cloud is that you can access the file from wherever you are with any device. These devices could be a desktop, laptop, tablet, or phone. This can, also, help your business to work more smoothly because anyone, who can connect to the internet and your cloud, is able to work on documents, access the application, and store data (Taleen A .2013).

TYPES OF CLOUD

There are different types of clouds computing that you can subscribe to depending on what services and requirements a subscriber needs .Figure 2.2 below show the types of cloud deployment (Huth A & Cebula J. 2011).

1. Public Cloud - A public cloud can be accessed by any subscriber with an internet connection and access to the cloud space.

2. Private Cloud - A private cloud is established for a specific group or organization and limits access to just that group.

3. Community Cloud - A community cloud is shared among two or more organizations that have similar cloud requirements.

4. Hybrid Cloud - A hybrid cloud is essentially a combination of at least two clouds, where the clouds included are a mixture of public, private, or community.

Figure 2.2: Types of cloud deployment (Acutesys, 2011).

TYPES OF CLOUD PROVIDERS

A person can subscribe to any of the three types of cloud providers: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS), According to their needs.

These three types differ in the amount of control that a subscriber has over the information, and conversely, how much is expected from the provider to do for the subscriber. Briefly, here is what expected from each type (Huth A& Cebula J. 2011).

1. Software as a Service - A SaaS provider gives subscribers access to both resources and applications. SaaS makes it unnecessary for you to have a physical copy of software to install on your devices. SaaS also makes it easier to have the same software on all of your devices at once by accessing it on the cloud. In a SaaS agreement, you have the least control over the cloud.

2. Platform as a Service - A PaaS system goes a level above the Software as a Service setup. A PaaS provider gives subscribers access to the components that they require to develop and operate applications over the internet.

3. Infrastructure as a Service - An IaaS agreement, as the name states, deals primarily with computational infrastructure. In an IaaS agreement, the subscriber completely outsourced the storage and resources, such as hardware and software, which they need (Lawal B et al. 2013).

BENEFITS AND MOTIVATION OF CLOUD COMPUTING

Many organizations want to utilize clouds because they are low cost, scalable, provide easy remote access, higher performance and the list goes on and so on. When you consider that you do not need to invest in any type of infrastructure, hardware, technical support, and all users need in order to access information and data through Internet (Sahu B .et al. 2014). Also no need to worry about the storage in cloud since storage it is virtually limitless. Cloud computing additionally provides the scalability that many organizations need with just the click of a button (Greenwell R .et al. 2014).

SERVICE LEVEL AGREEMENT (SLA)

Cloud computing typically involves two organizations; the clients and the service provider. The security responsibilities of each party must be made clear. This is typically done by means of a service level agreement (SLA) which applies to the services provided, and the terms of the contract between the clients and the services provider (Kyriazis D.2013).

MULTI TENANCY

Multi tenancy is one of the main characteristics of cloud computing. Multiple clients store their own data using the applications provided by the cloud service provider. (Rai, M.et al. 2013).

Multi Tenant database architecture is where many users, typically unrelated when placed into the context of a cloud, make use of shared resources. In a cloud, this allows for multiple customer applications to be consolidated, removing the need for separate systems for each tenant. Multi-tenant database architectures can reduce the total cost of ownership

because multiple businesses are consolidating onto the same operational system and need one database engine (heng L. et al.2012).

BENEFITS OF MULTI-TENANT IN CLOUD COMPUTING

Multi tenant in a cloud can handle high traffic volumes at low cost. It can reduce the total cost of ownership by aggregating clients together. This includes money for hardware, software, operational expenditures for bandwidth, network and personnel. Multi tenancy allows for pooling of resources. This improves the utilization by eliminating need to provision each client for maximum load (Rai, M.et al. 2013).

The goal of a multi tenant in a cloud is to minimize the number of machines required while still maintaining query and application performance goals. Ultimately, multi tenant data platforms must minimize cost by efficient resource sharing (Martinez.C. 2012).

MULTI-TENANCY APPROACHES

Multi tenancy on the cloud, have three main approaches. These approaches are:

1. Separate databases

In the separate databases approach, each tenant has its own separate database. This makes it easy to extend the application's data model to meet tenant's individual needs and recovering the database in case of a required backup. But since each tenant has its own database, this approach leads to higher costs (Karaca. H, 2013). Figure 2.3 shows the separate databases architecture.

Figure 2.3: Separate Databases (Karaca. H, 2013. 2013)

2. Shared Database, Separate Schemas

Hosting multiple tenants in the same database, with each tenant having his own set of tables is the second approach. This approach is also relatively easier to implement compared to shared everything approach. The data model extension is also easier for each particular tenant.

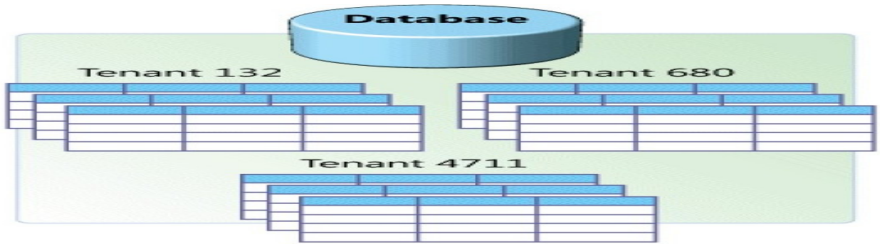

Figure 2.4 show the separate databases architecture (Karaca. H, 2013. 2013).

3. Shared Database, Shared Schema

The third approach uses the same database and the same tables to host multiple tenants' data. Since this approach allows serving the largest number of tenants per database instance, it has the lowest hardware and backup costs compared to the other two approaches. But it requires additional development effort to ensure the data isolation and security among tenants (Karaca. H. 2013) Figure 2.5 shows the shared database, shared schema architecture.

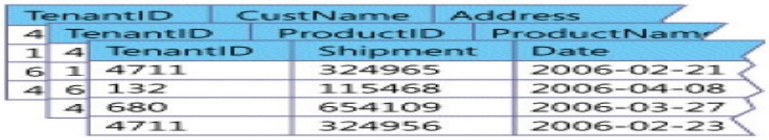

Figure 2.5: Shared Database, Shared Schemas (Karaca. H. 2013)

MULTI-TENANCY SECURITY ISSUES

The fundamental security issue with multi tenancy is that clients use cloud computing by employing single and the same computer hardware to share and process information. This presents a number of challenges in terms of compliance, security and privacy (Srinivas C et al. 2013).

In such case it would be a set of data for different client in the same server and same infrastructure depending on the cloud service provider, data leakage from client to another is possible through this environment. So, should be there a solution to avoid the data leakage, this solution service must be smart enough to segregation the data for each clients (Mahmood Z& Hill R. 2010).

SEGREGATION

Data segregation is the separations of data of one client of other clients (Figure 2.6). Consumer A, Consumer B, and Consumer C share the same commodity resources but due to segregation they have their own data separate from each other. In the cloud environment, the resources are shared by multiple clients this means the data for multiple customers may be stored or processed on the same physical servers (Kaur K & Vashisht S.2013).

Clients may not know where their data is being stored and there may be a risk of data being stored alongside other client's information, Data segregation and data location are of particular importance in the cloud computing, given the disparate physical location of data and shared computing resources (Sen J, 2013).

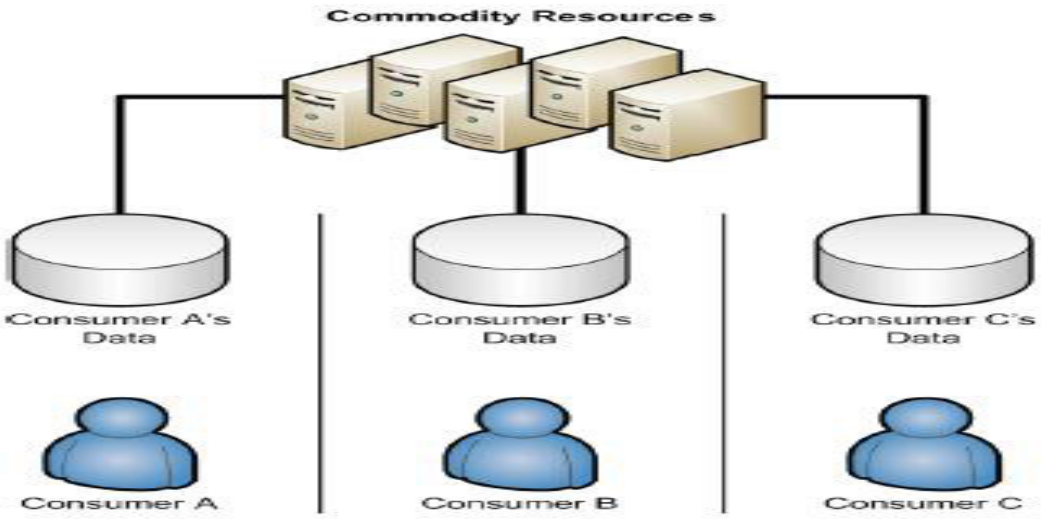

Figure 2.6: Segregation Consumer (Kaur K& Vashisht S.2013).

All the resources are shared in the cloud so every service shares resources such as space on the provider's servers and other parts of the provider's infrastructure. Hypervisor is used to create virtual containers on the provider's hardware for each of its clients, but still there is lack of security of data of the clients. Data is stored in a shared environment where one client's data is stored alongside another client's data (Kaur K& Vashisht S.2013).

IMPORTANCE OF DATA SEGREGATION

- Loss of Sensitive Information

In cloud all the resources are shared. To reduce the cost, data from different clients is stored in the same container, if there is aggregation of data done by the service under the control of cloud service provider. There is logical isolation between the data of each and every client, but the risk of data leakage from client to another is possible (Amar B .2012).

- Less Reliability

Data from many organizations is just logically separated from each other. It can be mixed. If your data is not secure or might be accessed by another person then you never prefer to store your data on the cloud. A disgruntled employee could alter or destroy the data using his or her own access credentials. If cloud storage system is not reliable, no one wants to save the data on an unreliable system (Sen J, 2013).

- Lack of Availability

As previously mentioned without data separation, one organization can access the data of another organization. It is also possible that data might be misused or get lost. You can't compromise your data only to reduce the cost. Organizations always need their data to run their businesses so we need to separate the data for high availability (Kaur K & Vashisht .2013).

This research aims to build businesses taxonomy to classify the companies depending on their business type. Yellow page is one of components of web service which

classifies the companies depending on their types. Thus, this research will use yellow pages to build the businesses taxonomy.

WEB SERVICE

According to Deng.F (2012) a web service is a method of communication between two electronic devices over a network. The web service contains three components:

1. Simple Object Access protocol (SOAP), which is the protocol for the exchange of XML messages via HTTP & HTTPS protocol.

2. Web Services Description Language (WSDL), which is the language of the XML format for describing Web services.

3. Universal Description, Discovery, and Integration (UDDI), which is an online directory of services provided by a Web server and allows them to get to know each other

UDDI information is often described as being divided into three main categories of business information:

White Pages: Business name, address, contact information, Web site, and Data Universal Numbering System (DUNS) or other identifying number.

Yellow Pages: Type of business, location, and products, including various categorization taxonomies for geo-graphical location, industry type, business ID.

Green Pages: Technical information about business services, such as how to interact with them, business process definitions, and so on. A pointer to the business's WSDL file, if any,

would be placed here. Information in this category describes a service's features/functionality, including a unique ID for the service. This category is quite new and specific to the internet.

WORDNET

WordNet is an online lexical database of english nouns, verbs, adjectives and adverbs that are grouped into sets of cognitive synonyms (synsets), each expressing distinct concept. Synsets are interlinked by means of conceptual-semantic and lexical relations. WordNet groups words together based on their meanings, so it superficially resembles a thesaurus (Ester, M .et al .1996).

WordNet divides words into nouns, verbs, adjectives, adverbs. However these four groups are organized in different ways. WordNet organizes the nouns depending on the hierarchy of subjects, verbs according to lexical collection relationship, adjectives and adverbs according to N-dimensional space. For example, we illustrate the 25 base classes from the nouns (Ester, M .et al .1996).

(Snasel et al., 2005) studied the WordNet ontology and semantic analysis mechanism in order to retrieve data from Internet to the user PC. The authors explained that despite of the big advantage of semantic there still several problems that need to be solved. When retrieving information, it is important to consider the dimensions of the desired document. The authors suggest a method for retrieving information called LSI (Latent Semantic Index) which is numerical method that discovers latent semantics. In this paper

authors present a basic method for mapping LSI concepts. The results of the test of the proposed method show that the method was strong enough in semantic retrieving data.

SEMANTIC SIMILARITY

Nagwani explained that the semantic similarity is a concept whereby a set of documents or terms within term lists assign a metric based on the likeness of their meaning / semantic content. Various semantic similarity techniques are available which can be used for measuring the semantic similarity between text documents (Nagwani N. 2011).

Described the different types of the semantic similarity:

1) Path Length Similarity Measures:
   - Path
   - Wu - Palmer
   - Leacock & Chodorow
2) Information Content Similarity Measures:
   - Resnik
   - Lin
   - Jiang &Conrath
3) Semantic Relatedness Measures
   - Extended Gloss Overlaps (Adapted Lesk)
   - Context Vectors
   - Hirst& St-Onge. Also define the WordNet as a machine readable dictionary created at the Cognitive Science Laboratory at Princeton University. Unlike most dictionaries, WordNet contains only open-class words (nouns, verbs, adjectives, and adverbs) (Nagwani N. 2011).

2.3. LITERATURE REVIEW & RELATED WORKS

(Curran K., 2011) provided an overview of the key aspects of cloud computing which has five key attributes which grant it some advantages over similar technologies and these attributes include:

1.Multi tenancy (shared resources): Unlike previous computing models, which assumed dedicated resources dedicated to a single user or owner, cloud computing Is based on a business model in which resources are shared at the network, host and application level.

2. Massive scalability: Cloud computing provides the ability to scale to tens of thousands of systems, as well as the ability to massively scale bandwidth and storage space.

3. Elasticity: Users can rapidly increase and decrease their computing resources as needed, as well as release resources for other uses when they are no longer required.

4. Pay as you go: Users pay for only the resources they actually use and for only the time they require them.

5. Self-provisioning of resources: Users self-provision resources, such as additional systems (processing capability, software & storage) and network resources.

Zhang. Z and Fu. S (2011) focus on the principle of cloud computing and define it as virtual pool of computing resources. They elaborate on the actual workings of cloud computing and asserts the presence of mandatory application environments, that enables the users to access and store data in a dynamic manner. Moreover, Zhang et al. (2010), identify the different cloud computing styles. They introduce SaaS, utility computing, network service, PaaS, Management service provider, commercial service platform and

integrating internet. They define SaaS as a type of cloud computing that transfer programs to its end users through a browser. Utility computing is defined as a service offered by cloud computing through its characteristic features such as virtualization, memory and data center pool. Network service is defined as a service closely linked with SaaS, which provides the developers the necessary platform to develop applications for the cloud (Zhang.Z et al, 2011).

With respect to the economics of cloud adoption and growth, Armbrust et al (2009) claim that cloud computing enables trade off decisions more fluid due to the elasticity feature of the cloud. In addition, they claim that hardware resource costs such as computing and storage are comparatively low in cloud computing. And, while adopting cloud computing, the organizations need to conduct appropriate analysis with respect to the demand and utility and operational costs. Spinola (2009) outlines the risks of cloud as potential challenges for the active deployment of services. Issues pertinent to data security, confidentiality, data segregation, SLAs and licensing and legal systems have questioned the credibility of cloud computing.

Subashin S, (2011) surveyed of the different security risks that posed a threat to the cloud. Also surveyed more specifically to the different security issues that has emanated due to the nature of the service delivery models of a cloud computing system and define the elements key for each. Security issues in SaaS: the following key security elements should be carefully considered as an integral part of the SaaS application development and deployment process: Data security, Network security, Data locality, Data integrity, Data segregation, Data access, Authentication and authorization, Data confidentiality, Web

application security, Data breaches, Virtualization vulnerability, Availability, Backup, Identity management and sign-on process. Security issues in PaaS: in the PaaS model, the provider might give some control to the people to build applications on top of the platform. Hackers are likely to attack visible code, including but not limited to code running in user context. They are likely to attack the infrastructure and perform extensive black box testing. Security issues in IaaS: the security responsibilities of both the provider and the consumer greatly differ between cloud service models (Subashin S., 2011).

Chen Z, (2010) discussed the evolvement of cloud computing paradigm and presents a framework for secure cloud computing through IT auditing. The research approach is to establish a general framework using checklists by following data flow and its lifecycle. The checklists are made based on the cloud deployment models and cloud service models. The contribution of the paper is to understand the implication of cloud computing and what is meant to secure cloud computing via IT auditing rather than propose a new methodology and new technology to secure cloud computing. Their checklist focuses on the following: Data location Aware, Data ownership aware, Data protection plan and best practice, data processing isolation, data lock-in, IaaS IT architecture, regulatory compliance (Chen Z, 2010).

Budanitsky .A, (2006) proposed to evaluate similarity measurements based on WordNet. However, the authors have evaluated five measurements lexical semantics distance. The authors mentioned that most of their work was limited to the narrower notion of similarity measures. These relationships include not just hyponymy and the non hyponymy relationships in WordNet such as meronymy but also associative and ad hoc

relationships. As the authors mentioned, these can include just about any kind of functional relation or frequent association in the world (Budanitsky.A, 2006).

Li et al., 2003 highlighted that the similarity between words and concepts had become difficult problem that face many applications and artificial intelligence. Tries to predict the determination of semantic similarity by a number of information resources that contain semantic information from lexical taxonomy. They also indicated how information sources could be used effectively by using variety of strategies for using various possible information resources. However, authors argued that all first-hand information sources need to be processed in similarity measure. Besides that, authors claimed that humans can compare word similarity with a finite interval between similar and non-similar (Li et al., 2003).

(Miller et al., 2006) proposed an introduction to Word Net. They highlighted on the difficulty differences between WordNet and standard dictionary is that WordNet divide word into five elements: nouns, verbs, adjectives, adverbs and function words, and in fact the WordNet contains only four elements: nouns, verbs, adjectives and adverbs. Also, authors have indicated the lexical matrix and explained the principle of this matrix and how it can be used in semantic analysis to find matches between concepts (Miller et al., 2006).

In summary there are limited studies which take into consideration the security in cloud computing around the world. Most of the previous studies emphasize on how to decrease the cost and increase the security. So, our thesis goes hand by hand with these works to find an optimal technique to achieve a suitable cost and security.

3. CHAPTER THREE

TAXONOMY BUILDING

3.1. PREFACE

Several research studies have been done to improve the security in cloud computing. This chapter develop a model to enhance the security of cloud by segregating businesses that have the same businesses type. This is done through building classification for the businesses according to their types. Finally, In Section 3.4 semantic similarity measurement is used to calculate the distance between businesses.

3.2. INTRODUCTION

This research develops a new technique to reduce the risks of using cloud by segregating the businesses which have the same type of business through the following steps:

- Building classification of businesses according to their type using UDDI component.
- Using semantic similarity measurement to calculate the distance between businesses.
- Applying several experiments to determine the most efficient technique.

3.3. YELLOW PAGE CLASSIFICATION

This section focuses on building classification of businesses depending on yellow pages. The yellow pages are one of UDDI components which are responsible for the registration of companies depending on their businesses type.

Companies register their contact information, including details such as phone, fax numbers, and web site. The Registration contains information categories for searching, such as industry type code, business type, and so on. Other businesses can search about the information, which has been registered in UDDI, to find suppliers for parts, helping services and marketplaces (Feng. D.2012).

BUSINESSES CLASSIFICATION

According to the yellow pages, this research built a classification of businesses as a first step to prepare the proposal model. As previously mentioned yellow pages are used to register companies depending on their businesses type. So, figure 3.1 shows the level of taxonomy.

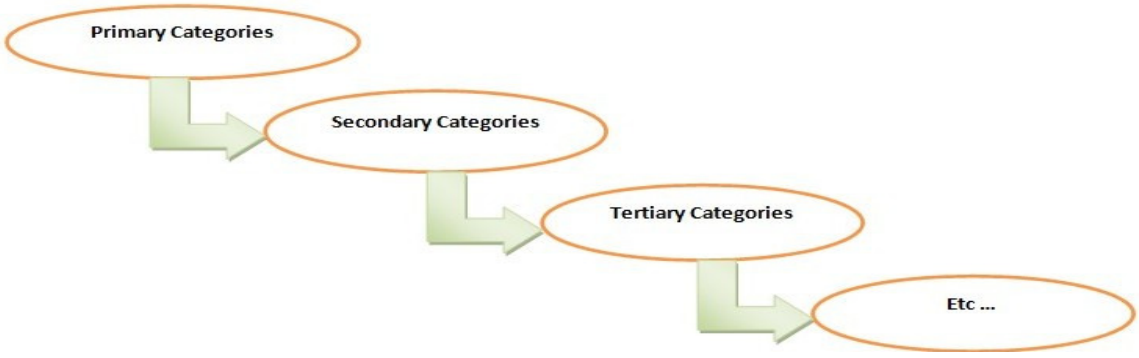

Figure 3.1: Level of taxonomy (Feng. D.2012).

To build the taxonomy, choose three main businesses which are education, financial services and medical services. These businesses are chosen because they are the most popular companies using in yellow pages. And can expand this taxonomy to include more businesses in future works.

- **Education businesses**

According to the yellow pages, education businesses contain three main categories schools, colleges and universities. Then, these main categories are divided into several categories, as shown in Figure 3.2.

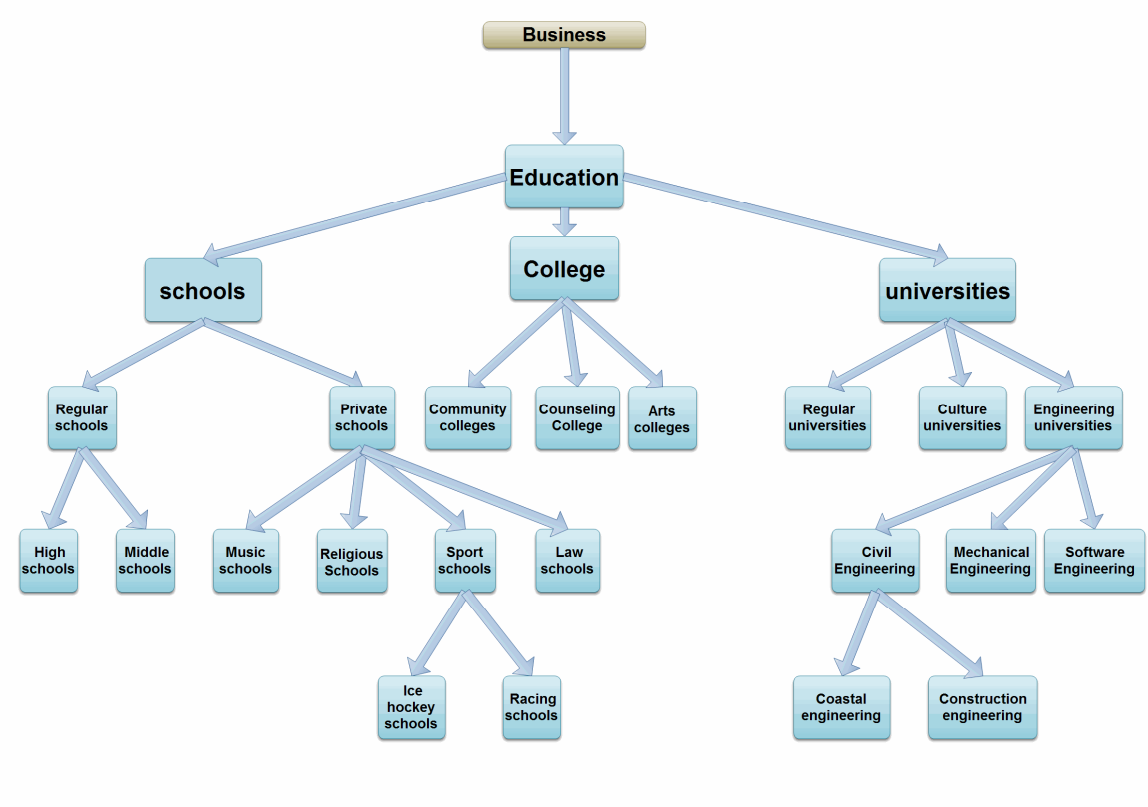

Figure 3.2: Education Taxonomy (Perrigne. I. 2010).

❖ **Financial services**

The Yellow pages, also, classify the financial services to three main categories bank, insurance and investment. And as what happened in the previous process, the main categories are divided into other categories, as shown in Figure 3.3.

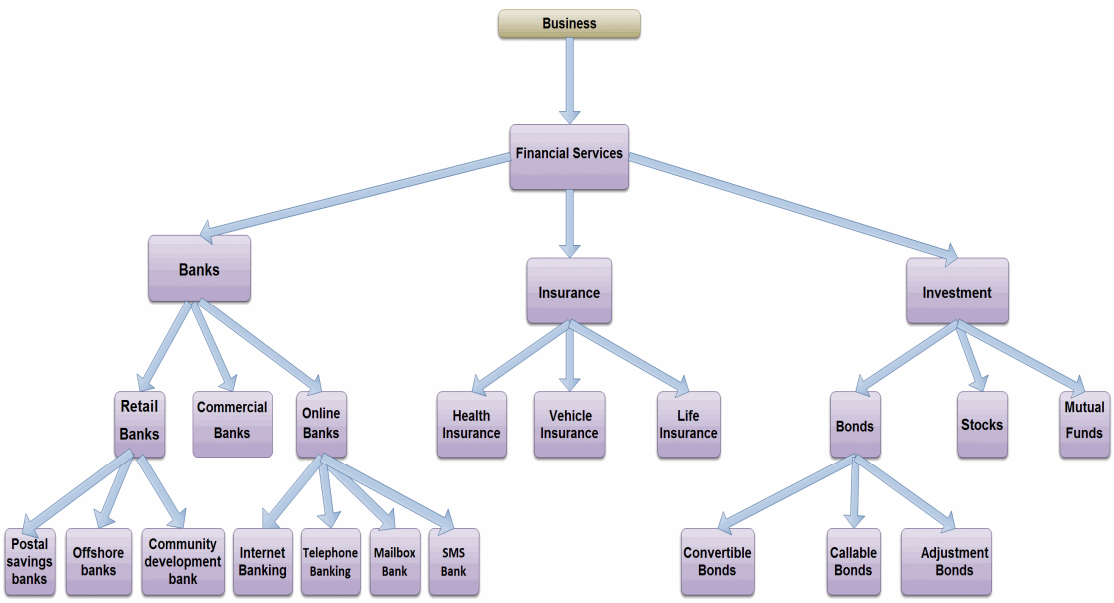

Figure 3.3: Financial Services Taxonomy (Perrigne. I.2010).

❖ **Medical services**

Medical services face the same stages. That started by dividing it into categories dentists, diagnosis and doctors. After that, these categories are divided into several types. Figure 3.4 shows these stages

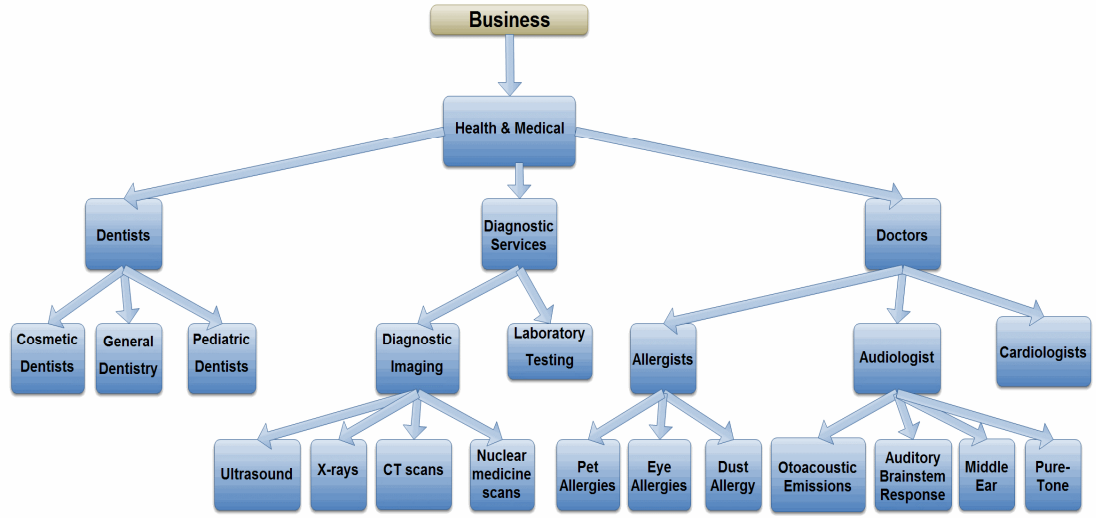

Figure 3.4: Health & Medical Taxonomy (Perrigne. I.2010).

- **Businesses category**

In the last, make a businesses category, named with businesses taxonomy, to include the three main types. Figure 3.5 shows these stages:

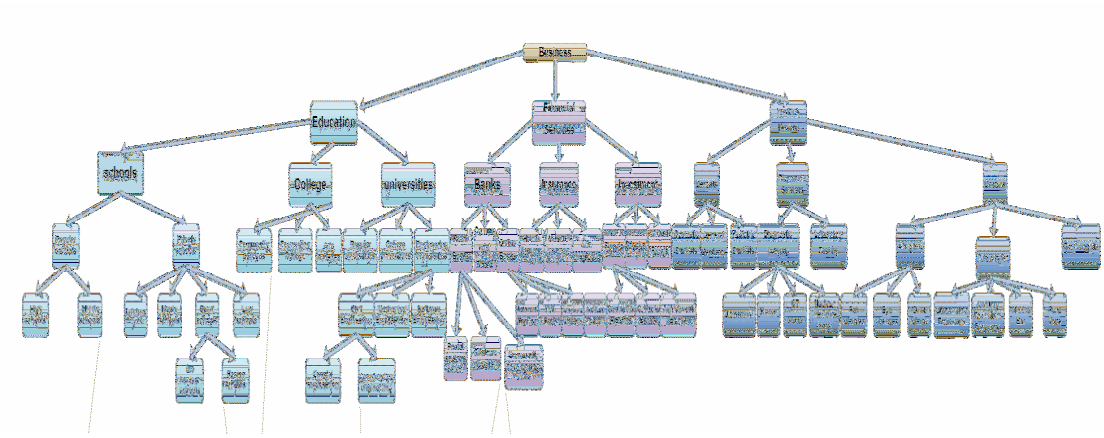

Figure 3.5: Taxonomy of Businesses (Perrigne. I.2010).

As previously mentioned, calculating the similarity between businesses type is one of the most methodologies in this thesis. WordNet use semantic similarity measurement to compute the similarity between concepts. This thesis will use this measurement to find the similarity between businesses in businesses taxonomy.

3.4. WORDNET AND SEMANTIC SIMILARITY MEASURES

WordNet is a large lexical database of English. WordNet Nouns, verbs, adverbs and adjectives are organized by a variety of semantic relations into synonym sets (synsets), which represent one concept. Some of the Examples of semantic relations, used by WordNet, are synonymy, autonomy, hyponymy, member, similar, domain and cause and so on (Meng L et al., 2014-A).

WordNet uses several measurements to calculate the similarity between concepts. This research will apply these measurements to calculate the similarity between businesses in the businesses taxonomy shown in Figure 3.3. These measurements they are:

1-The Shortest Path based Measure

This measure computes the semantic relationship of word senses by counting the number of nodes to get the shortest path between the senses in the WordNet (Miller et al., 2006).

Formal:

$$\textbf{Sim path}\ (\textbf{C1}, \textbf{C2}) = \textbf{2} \times \textbf{Deep\_Max} - \textbf{Len} \ \ldots\ \textbf{(3.1)}$$

Where is:

- Sim (C_1, C_2): Semantic similarity between concept C_1 and concept C_2.
- C1: Concept 1, C2: Concept 2.

- Deep_Max: The max depth of the taxonomy.
- Len: The shortest path between concepts.

2-Wu and Palmer's Measure

Wu and Palmer is the measurement which calculates relatedness by considering the depths of the two synsets in the WordNet (Meng L et al., 2014-A).

❖ **Formal :**

$$\boldsymbol{Sim\ wu-p(C1,C2)=\frac{2\times \mathbf{Depth}(\mathbf{LCS}(\mathbf{C1},\mathbf{C2}))}{\mathbf{len}(\mathbf{C1},\mathbf{C2})+2\times \mathbf{Depth}(\mathbf{LCS}(\mathbf{C1},\mathbf{C2}))}\ \ldots (3.2)}$$

Where is:

- Sim (C1, C2): Semantic similarity between concept C1 and concept C2.
- C1: Concept 1, C2: Concept 2.
- Len: The shortest path between concepts.
- LCS: Least Common Subsumers of C1 and C2.
- Depth (C): The length of the path to synset C from the global root entity, and depth (root) =1.

3-Leacock and Chodorow's Measure

Leacock and Chodorow adopted the concept of information content (Resnik1995) in part to evaluate the relatedness of two words (Meng L et al., 2014-A).

❖ **Formal :**

$$\mathbf{Sim\ lch(C1,C2)=-\log\frac{len(C1,C2)}{2\times Deep\_Max}\ \ldots (3.3)}$$

Where is:

- Sim (C1, C2): Semantic similarity between concept C1 and concept C2.
- C1: Concept 1, C2: Concept 2.
- Len: The shortest path between concepts.

- Deep_Max: The max depth of the taxonomy.

4-Resnik's Measure

Resnik is defined as the measurement for calculating the similarity between two synsets to be the information content of their lowest super-ordinate, last specific common subsumer (Meng L et al., 2014-A).

❖ **Formal :**

$$\mathbf{SimResnik(C1, C2) = IC(LCS(C1, C2))} \ldots \mathbf{(3.4)}$$

Where is:

- Sim (C1, C2): Semantic similarity between concept C1 and concept C2.
- C1: Concept 1, C2: Concept 2.
- Deep_Max: The max depth of the taxonomy.
- Depth (C): The length of the path to synset C from the global root entity.
- LCS: Least Common Subsumers of C1 and C2.
- IC: Information Content

$$\boldsymbol{IC(C) = \frac{\log(\mathbf{Depth(C)})}{\log(\mathbf{Deep\_Max})}} \ldots \mathbf{(3.5)}$$

5-Lin's Measure

Lin introduces another way of computing the similarity to distinguish among word senses (Meng L et al., 2014-A).

❖ **Formal :**

$$\mathbf{Sim\ lin(C1, C2) = \frac{2 \times IC(LCS\ (C1,C2))}{IC(C1)+IC(C2)}} \ldots \mathbf{(3.6)}$$

Where is:

- Sim (C1, C2): Semantic similarity between concept C1 and concept C2.

- C1: Concept 1, C2: Concept 2.
- Deep_Max: The max depth of the taxonomy.
- Depth (C): The length of the path to synset C from the global root entity.
- LCS: Least Common Subsumers of C1 and C2.
- IC: Information content

The related concepts in the measurements, here, are important to be defined. An example figure 3.6 explains these concepts.

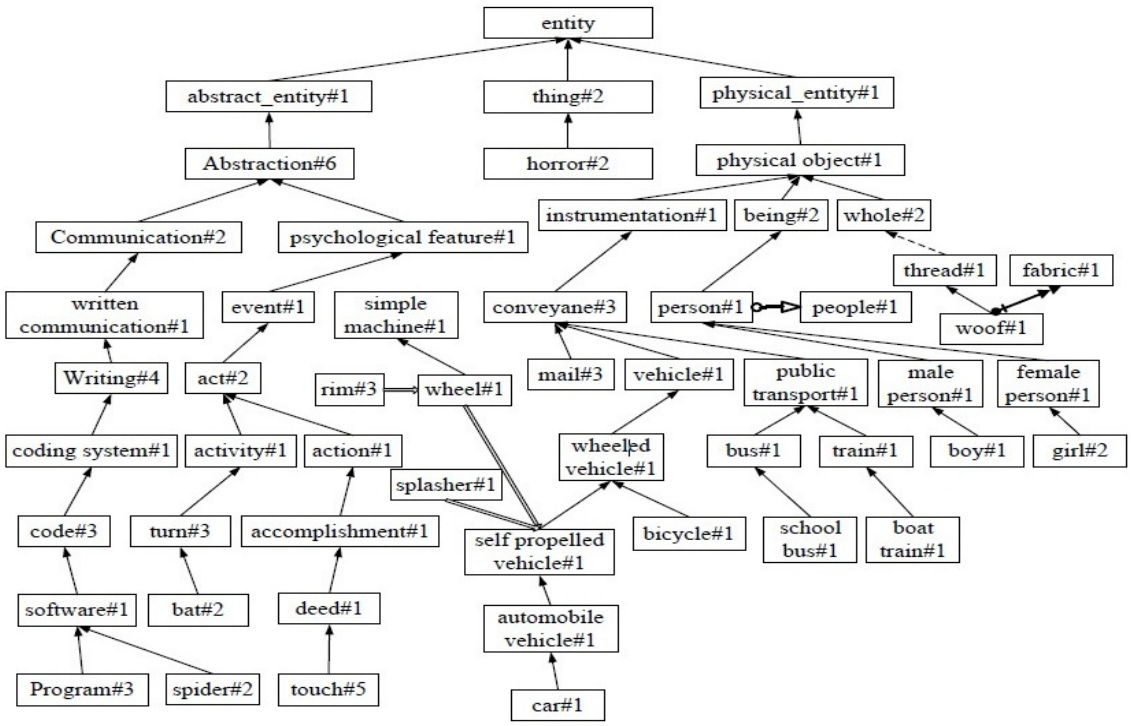

Figure 3.6: Example of WordNet (Meng L .2014).

In the following, this research introduces a metric amount as an example to each concept:

- Len (Bus, Train) is (2).
- LCS (Bus, Train) public transport.

- Depth (Bus) is (7).
- Deep_Max is (10).

After the explanation of the measurements, this research chased (19) companies from our taxonomy, to calculate the similarity between businesses.

1. The Shortest Path Based Measurement

The similarity between high schools and middle schools in the shortest path measure, depending on businesses taxonomy the len between high schools & middle schools is (2), and the Deep_Max of businesses taxonomy is (6). So, according to equation (3.1) the similarity in shortest path based measure is:

$$\textbf{Sim path}\ (\textbf{C1}, \textbf{C2}) = \textbf{2} \times \textbf{Deep\_Max} - \textbf{Len}$$

$$\textbf{Sim path}\ (\textbf{High Schools}\ , \textbf{Middle schools}) = \textbf{2} \times \textbf{6} - \textbf{2}$$

$$\textbf{Sim path}\ (\textbf{High Schools}\ , \textbf{Middle schools}) = \textbf{10}$$

Calculate the outcome value (sim $_{\text{Path}}$) which are (10) in percentage value. Therefore, this research chooses two companies with the same business domain (Adjustment Bonds). We have found that the len is (0) and the output of the similarity is (12). Thus, 12 is the maximum value which represents in (100%), according to our example, (10) will represent$\frac{100\times10}{12} = 83.3$.

Table 3.1, shows the similarity between some businesses by the shortest path measure.

Table 3.1: The Shortest Path Measure

No	C_1:concept $_1$	C_2: concept $_2$	sim_{path}	%
1	High schools	Middle schools	10	83.3%
2	Ice hockey schools	Racing schools	10	83.3%
3	Middle schools	Racing schools	7	58.3%
4	Racing schools	Arts colleges	6	50%
5	Community colleges	Counselling College	10	83.3%
6	Arts colleges	Coastal engineering	6	50%
7	Coastal engineering	Construction engineering	10	83.3%
8	Construction engineering	Software Engineering	9	75%
9	Software Engineering	Postal savings banks	4	33.3%
10	Community development bank	Coastal engineering	3	25%
11	Offshore banks	Law schools	4	33.3%
12	Callable Bonds	Offshore banks	6	50%
13	Callable Bonds	Racing schools	3	25%
14	Convertible Bonds	X-rays	4	33.3%
15	Ultrasound	Nuclear medicine scans	10	83.3%
16	Eye Allergies	Middle Ear	8	66.6%
17	Middle Ear	Middle schools	4	33.3%
18	Cardiologists	Software Engineering	5	41.6%
19	Adjustment Bonds	Adjustment Bonds	12	100%

2. Wu- Palmer's Measure

The similarity among high schools and middle schools by Wu & Palmer's measure, depending on businesses taxonomy the len between high schools & middle schools is (2) , the LCS(High schools and Middle schools) is regular school, thus, the Depth LCS(High schools and Middle schools) is (4).So, according to equation (3.2) the similarity in Wu-P measure is:

$$\boldsymbol{Sim\ wu-p(C1,C2)=\frac{2\times Depth(LCS(C1,C2))}{len(C1,C2)+2\times Depth(LCS(C1,C2))}}$$

$$\boldsymbol{Sim\ wu-p(High\ schools\ ,Middle\ schools)=\frac{2\times 4}{2+2\times 4}}$$

$$\boldsymbol{Sim\ wu-p(High\ schools\ ,Middle\ schools)=0.8}$$

Table 3.2, shows the similarity between some businesses by the Wu-p measure.

Table 3.2: The Wu-P Measurement.

No.	C_1:concept $_1$	C_2: concept $_2$	Sim $_{wu-p}$	%
1	High schools	Middle schools	0.8	80%
2	Ice hockey schools	Racing schools	0.83	83%
3	Middle schools	Racing schools	0.54	54%
4	Racing schools	Arts colleges	0.4	40%
5	Community colleges	Counselling College	0.6	60%
6	Arts colleges	Coastal engineering	0.4	40%
7	Coastal engineering	Construction engineering	0.83	83%
8	Construction engineering	Software Engineering	0.72	72%
9	Software Engineering	Postal savings banks	0.2	20%

No.	C_1:concept $_1$	C_2: concept $_2$	Sim $_{wu-p}$	%
10	Community development bank	Coastal engineering	0.18	18%
11	Offshore banks	Law schools	0.2	20%
12	Callable Bonds	Offshore banks	0.4	40%
13	Callable Bonds	Racing schools	0.18	18%
14	Convertible Bonds	X-rays	0.2	20%
15	Ultrasound	Nuclear medicine scans	0.8	80%
16	Eye Allergies	Middle Ear	0.6	60%
17	Middle Ear	Middle schools	0.2	20%
18	Cardiologists	Software Engineering	0.22	22%
19	Adjustment Bonds	Adjustment Bonds	1	100%

3. Leakcock & Chodorow's Measure

The similarity between High Schools and Middle Schools by Leakcock & Chodorow's measure, depending on businesses taxonomy the len between high schools and middle schools is (2) , and the Deep_Max of businesses taxonomy is (6).So, according to equation (3.3) the similarity in Lch measure is :

$$\mathbf{Sim\ lch(C1, C2)} = -\mathbf{log}\frac{\mathbf{len(C1, C2)}}{\mathbf{2 \times Deep\_Max}}$$

$$\mathbf{Sim\ lch(High\ schools\ , Middle\ schools)} = -\mathbf{log}\frac{\mathbf{2}}{\mathbf{2 \times 6}}$$

$$\mathbf{Sim\ lch(High\ schools\ , Middle\ schools)} = \mathbf{0.77}$$

Table 3.3, shows the similarity between some businesses by the Lch measure.

Table 3.3: The Leakcock & Chodorow's Measure

No.	C_1:concept $_1$	C_2: concept $_2$	$Sim_{l\&ch}$	%
1	High schools	Middle schools	0.77	77%
2	Ice hockey schools	Racing schools	0.77	77%
3	Middle schools	Racing schools	0.38	38%
4	Racing schools	Arts colleges	0.30	30%
5	Community colleges	Counselling College	0.77	77%
6	Arts colleges	Coastal engineering	0.30	30%
7	Coastal engineering	Construction engineering	0.77	77%
8	Construction engineering	Software Engineering	0.60	60%
9	Software Engineering	Postal savings banks	0.17	17%
10	Community development bank	Coastal engineering	0.12	12%
11	Offshore banks	Law schools	0.17	17%
12	Callable Bonds	Offshore banks	0.30	30%
13	Callable Bonds	Racing schools	0.12	12%
14	Convertible Bonds	X-rays	0.17	17%
15	Ultrasound	Nuclear medicine scans	0.77	77%
16	Eye Allergies	Middle Ear	0.47	47%
17	Middle Ear	Middle schools	0.17	17%
18	Cardiologists	Software Engineering	0.23	23%
19	Adjustment Bonds	Adjustment Bonds	0	100%

4. Resnik's Measure

The similarity between high schools & middle schools by Resnik's measure, depending on businesses taxonomy, the LCS(High schools and Middle schools) is regular school, thus, the Depth regular school is (4), and the Deep_Max of businesses taxonomy is (6).So, according to equation (3.5) the similarity in resnik's measure is :

$$\mathbf{SimResnik(C1, C2) = IC(LCS(C1, C2))}$$

$$\mathbf{SimResnik(High\ schools\ , Middle\ schools) = IC(Regular\ School)}$$

$$\boldsymbol{IC}\mathbf{(Regular\ School) = \frac{log\ (Depth(Regular\ School)}{log\ (Deep\_Max)}}$$

$$\boldsymbol{IC}\mathbf{(Regular\ School) = \frac{log\ (4)}{log\ (6)}}$$

$$\mathbf{SimResnik(High\ schools\ , Middle\ schools) = 0.77}$$

Table 3.4, shows the similarity between some businesses by the resnik's measure.

Table 3.4: The Resnik's Measure

No.	C_1:concept $_1$	C_2: concept $_2$	Sim_{Resnik}	%
1	High schools	Middle schools	0.77	77%
2	Ice hockey schools	Racing schools	0.89	89%
3	Middle schools	Racing schools	0.61	61%
4	Racing schools	Arts colleges	0.38	38%
5	Community colleges	Counselling College	0.61	61%
6	Arts colleges	Coastal engineering	0.38	38%
7	Coastal engineering	Construction engineering	0.88	88%

No.	C_1:concept $_1$	C_2: concept $_2$	Sim_{Resnik}	%
8	Construction engineering	Software Engineering	0.77	77%
9	Software Engineering	Postal savings banks	0	0%
10	Community development bank	Coastal engineering	0	0%
11	Offshore banks	Law schools	0	0%
12	Callable Bonds	Offshore banks	0.38	38%
13	Callable Bonds	Racing schools	0	0%
14	Convertible Bonds	X-rays	0	0%
15	Ultrasound	Nuclear medicine scans	0.77	77%
16	Eye Allergies	Middle Ear	0.61	61%
17	Middle Ear	Middle schools	0	0%
18	Cardiologists	Software Engineering	0	0%
19	Adjustment Bonds	Adjustment Bonds	0.89	89%

5. Lin's Measure

The similarity among high schools & middle schools by Lin's measure, depending on businesses taxonomy, the LCS(High schools and Middle schools) is regular school, thus, the Depth of regular school is (4), and the Deep_Max of businesses taxonomy is (6).So, according to equation (5) the similarity in lin's measure is :

$$\mathbf{Sim\ lin(C1, C2)} = \frac{\mathbf{2 \times IC(LCS\ (C1, C2))}}{\mathbf{IC(C1) + IC(C2)}}$$

$$\mathbf{Sim\ lin(High\ schools\ , Middle\ schools)} = \frac{\mathbf{2 \times IC(Regular\ School)}}{\mathbf{IC(High\ schools) + IC(Middle\ Schools)}}$$

$$\boldsymbol{IC}\mathbf{(Regular\ School)} = \frac{\mathbf{log\ (4)}}{\mathbf{log\ (6)}} = \mathbf{0.77}$$

$$\boldsymbol{IC}\mathbf{(High\ Schools)} = \frac{\mathbf{log\ (5)}}{\mathbf{log\ (6)}} = \mathbf{0.89}$$

$$\boldsymbol{IC}\mathbf{(Middle\ Schools)} = \frac{\mathbf{log\ (5)}}{\mathbf{log\ (6)}} = \mathbf{0.89}$$

$$\mathbf{Sim\ lin(High\ schools\ , Middle\ schools)} = \frac{\mathbf{2 \times 0.77}}{\mathbf{0.89 + 0.89}}$$

$$\mathbf{Sim\ lin(High\ schools\ , Middle\ schools)} = \mathbf{0.86}$$

Table 5, shows the similarity between some businesses by the lin's measure.

Table 3.5: The Lin's Measure

No.	**C_1:concept $_1$**	**C_2: concept $_2$**	Sim_{lin}	**%**
1	High schools	Middle schools	0.86	86%
2	Ice hockey schools	Racing schools	0.89	89%
3	Middle schools	Racing schools	0.64	64%
4	Racing schools	Arts colleges	0.42	42%
5	Community colleges	Counselling College	0.79	79%
6	Arts colleges	Coastal engineering	0.42	42%
7	Coastal engineering	Construction engineering	0.88	88%
8	Construction engineering	Software Engineering	0.81	81%
9	Software Engineering	Postal savings banks	0	0%

No.	**C_1:concept $_1$**	**C_2: concept $_2$**	Sim_{lin}	**%**
10	Community development bank	Coastal engineering	0	0%
11	Offshore banks	Law schools	0	0%
12	Callable Bonds	Offshore banks	0.42	42%
13	Callable Bonds	Racing schools	0	0%
14	Convertible Bonds	X-rays	0	0%
15	Ultrasound	Nuclear medicine scans	0.86	86%
16	Eye Allergies	Middle Ear	0.68	68%
17	Middle Ear	Middle schools	0	0%
18	Cardiologists	Software Engineering	0	0%
19	Adjustment Bonds	Adjustment Bonds	1	100%

Table 3.6: The LCS for Some Companies in Business Taxonomy

No.	**C_1:concept $_1$**	**C_2: concept $_2$**	LCS(C1,C2)
1	High schools	Middle schools	Regular schools
2	Ice hockey schools	Racing schools	Sport schools
3	Middle schools	Racing schools	Schools
4	Racing schools	Arts colleges	Education
5	Community colleges	Counselling College	College
6	Arts colleges	Coastal engineering	Education
7	Coastal engineering	Construction engineering	Civil Engineering
8	Construction engineering	Software Engineering	Engineering universities

No.	C_1:concept $_1$	C_2: concept $_2$	LCS(C1,C2)
9	Software Engineering	Postal savings banks	Business
10	Community development bank	Coastal engineering	Business
11	Offshore banks	Law schools	Business
12	Callable Bonds	Offshore banks	Financial Services
13	Callable Bonds	Racing schools	Business
14	Convertible Bonds	X-rays	Business
15	Ultrasound	Nuclear medicine scans	Diagnostic Imaging
16	Eye Allergies	Middle Ear	Doctors
17	Middle Ear	Middle schools	Business
18	Cardiologists	Software Engineering	Business
19	Adjustment Bonds	Adjustment Bonds	Adjustment Bonds

3.5. SEMANTIC SIMILARITY MEASUREMENT EVALUATION

This classification is done according to the yellow pages depending on their businesses type. Then, the semantic similarity measurement is applied to calculate the similarity between businesses. So now, this thesis is evaluating the measurements, by two approaches, to get the suitable one for our proposed model.

3.5.1. PREVIOUS STUDIES

Michelizzi J. (2005) illustrated Wu-p measurement by calculating the similarity between two concepts using the depth of the two concepts, Michelizzi J refer to use the

Wu-P measurement (Michelizzi J. 2005). Table 3.7 shows some advantages and disadvantages of Semantic Similarity measurement according to Meng et al (2014-B).

Table 3.7.Advantages and Disadvantages Semantic Similarity (Meng et al, 2014-B)

Measure	Features	Advantages	Disadvantages
Shortest path	count of edges between concepts	Simple	two pairs with equal lengths of shortest path will have the same similarity
Wu-P	path length to subsumer, scaled by subsumer path to root	Simple	two pairs with the same LCS and equal lengths of shortest path will have the same similarity
L&C	count of edges between and log smoothing	Simple	two pairs with equal lengths of shortest path will have the same similarity
Resnik	IC of LCS	Simple	two pairs with the same LSC will have the same similarity
Lin	IC of LCS and the compared concepts	take the IC of compared concepts into considerate	two pairs with the same summation of IC(c1) and IC(c2) will have the same similarity

The results of this step present that Wu-P (similarity measurement which is based on path lengths between the concepts to calculate the similarity between them) is the best measurement to work with.

3.5.2. QUESTIONNAIRES

The study is conducted to investigate the best measurement tools depending on the advertisement company "Yellow Pages Jordan for advertising Company". The data is collected quantitatively by questionnaire prepared by the researcher from 18 participants.

The Population is taken by stratified sampling method as the following:-

- Sales: 33.3%
- Marketing: 44.4%

- IT: 22.2 %

All survey participants are between 23years-40years. Questionnaire questions included in appendix Table (15).

Out of the whole distributed questionnaires, 18 were returned. Two questionnaires in marketing department are rejected because they miss some answers for important fields.

After the deletion of the invalid responses, 16 valid questionnaire papers have been retrieved: Sales: 6 Marketing: 6 ` IT: 4

And the results are shown in Table 3.8:

Table 3.8:The Questionnaire Results. Full table in appendix Table (16).

Respondent	1	2	3	4	5	…	14	15	16	17	18	19
Sales												
Sales manager	80	85	60	45	60	…	20	80	60	15	20	100
Sales Promotion Manager	80	85	60	50	60	…	15	80	65	15	20	100
Sales Trainee	90	90	65	55	60	…	20	75	60	15	20	100
Sales Person 1	85	85	60	50	60	…	20	80	65	15	20	100
Sales Person 2	80	85	60	45	60	…	20	80	65	20	20	100
Sales Person 3	80	85	65	40	55	…	15	75	65	20	15	100
Marketing												
Marketing Director	85	90	70	55	50	…	15	85	70	15	15	100
Marketing Manager	90	90	70	55	60	…	15	85	70	15	15	100
MarketingPerson1	80	85	60	45	60	…	20	80	65	20	20	100
MarketingPerson2	80	80	55	40	60	…	20	80	60	20	20	100
Product Manager	80	85	65	50	60	…	20	85	60	15	15	100
Marketing Consultant	80	90	55	45	55	…	20	85	60	20	20	100
IT												
IT Administrator	85	85	60	40	60	…	15	90	70	15	15	100
System Administrator	90	90	65	40	65	…	20	85	65	20	20	100
Network Administrator	85	80	55	40	60	…	20	85	60	15	15	100
Technical IT	85	80	60	40	65	…	20	90	60	20	20	100
Average	83	86	62	46	59	…	18	83	64	17	18	100

After getting the results of questionnaire, we compare these results with the semantic similarity measurements to find the optimal measure through calculating the average of errors according to the measurements. Since the |80-83|=3 which (80) is the result of Wu-P measurements, calculated in table 3.2 and (83) in the questionnaire table 3.8 the result is (-3), then tacking absolute value of (-3) to get the (3) as result of error between Wu-P and expert person. The results are shown in Table 3.9:

Table 3.9:The Evaluation of Semantic Similarity Measurements. Full Table in Appendix Table (2)

No	Path	Error	W u- P	Error	L&Ch	Error	Resnik	Error	Lin	Error	Expert person
1	83%	0	80%	3	77%	6	77%	6	86%	3	83%
2	83%	3	83%	3	77%	9	89%	3	89%	3	86%
3	58%	4	54%	8	38%	24	61%	1	64%	2	62%
4	50%	4	40%	6	30%	16	38%	8	42%	4	46%
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
13	25%	6	18%	1	12%	7	0%	19	0%	19	19%
14	33%	15	20%	2	17%	1	0%	18	0%	18	18%
15	83%	0	80%	3	77%	6	77%	6	86%	3	83%
16	67%	3	60%	4	47%	17	61%	3	68%	4	64%
17	33%	16	20%	3	17%	0	0%	17	0%	17	17%
18	41%	23	22%	4	23%	5	0%	18	0%	18	18%
19	100 %	0	100%	0	100%	0	89%	11	100 %	0	100%
Error		8%		3.1%		9.1%		9.7%		9.2%	

3.6. ACCEPTED CUTTING POINT OF WU-P MEASURE

After the above experiment finished and refer to use Wu-P measure in our research. However, the range of Wu-P measure between zeros to one. So, there are many cutting point threshold available in the Wu-P similarity measure. Thus, we need to determine which threshold to use in this research. Our experiments depending on expert human and using score value (0.6, 0.5 and 0.4). According to expert opinion this experiment selects value (1) if the companies can't stay together, and select value (0) if the companies can stay together. If Wu-P higher than cutting points then their will be conformity with expert opinion so the error will be (0) as shown below.

1. Cutting point = 0.6

The similarity between Callable Bonds and Offshore banks depending on Wu-P measure is (0.4), which is lower than the cutting point (0.6). So; the error is (1), this result is rejected because these companies have the same type of businesses and should not be together, as shown in columns (12) in Table 3.10 . And so on.

Table 3.10: Results When Use the Cutting Point (0.6). Full Table in Appendix Table (6).

No	Company 1	Company 2	Wu-P	Wu-P>0.6	Error	E.P
1	High schools	Middle schools	0.8	1	0	1
2	Ice hockey schools	Racing schools	0.83	1	0	1
3	Middle schools	Racing schools	0.54	0	1	1
4	Racing schools	Arts colleges	0.4	0	1	1
5	Community colleges	Counselling College	0.6	1	0	1
.	.	.	.	.	.	.

.	.	.	.	.	.	.
11	Offshore banks	Law schools	0.2	0	0	0
12	Callable Bonds	Offshore banks	0.4	0	1	1
13	Callable Bonds	Racing schools	0.18	0	0	0
14	Convertible Bonds	X-rays	0.2	0	0	0
15	Ultrasound	Nuclear medicine	0.8	1	0	1
16	Eye Allergies	Middle Ear	0.6	1	0	1
17	Middle Ear	Middle schools	0.2	0	0	0
18	Cardiologists	Software Engineering	0.22	0	0	0
19	Adjustment Bonds	Adjustment Bonds	1	1	0	1
	Average Error				21%	

2. Cutting point = 0.5

The similarity between Callable Bonds and Offshore banks depending on Wu-P measure is (0.4), which is lower than the cutting point (0.5). So; the error is (1), this result is rejected because these companies have the same type of businesses and should not be together, as shown in columns (12) in below table and so on. See Table 3.11.

Table 3.11: Results When Use the Cutting Point (0.5). Full Table in Appendix Table (7).

No	Company 1	Company 2	Wu-P	Wu-P>0.5	Error	E.P
1	High schools	Middle schools	0.8	1	0	1
2	Ice hockey schools	Racing schools	0.83	1	0	1
3	Middle schools	Racing schools	0.54	0	1	1

4	Racing schools	Arts colleges	0.4	0	1	1
5	Community colleges	Counselling College	0.6	1	0	1
. .	. .	. .	. .	. .	. .	. .
11	Offshore banks	Law schools	0.2	0	0	0
12	Callable Bonds	Offshore banks	0.4	0	1	1
13	Callable Bonds	Racing schools	0.18	0	0	0
14	Convertible Bonds	X-rays	0.2	0	0	0
15	Ultrasound	Nuclear medicine	0.8	1	0	1
16	Eye Allergies	Middle Ear	0.6	1	0	1
17	Middle Ear	Middle schools	0.2	0	0	0
18	Cardiologists	Software Engineering	0.22	0	0	0
19	Adjustment Bonds	Adjustment Bonds	1	1	0	1
	Average Error				15%	

3. Cutting point = 0.4

The similarity between Callable Bonds and Offshore banks depending on Wu-P measure is (0.4), which is equal than the cutting point (0.4). So; the error is (0), this result is acceptable because these companies have the same type of businesses and should not be together, as shown in columns (12) in below table and so on. See Table 3.12.

Table 3.12: Results When Use the Cutting Point (0.4). Full Table in Appendix Table (8).

No	Company 1	Company 2	Wu-P	Wu-P>0.4	Error	E.P
1	High schools	Middle schools	0.8	1	0	1
2	Ice hockey schools	Racing schools	0.83	1	0	1
3	Middle schools	Racing schools	0.54	1	0	1
4	Racing schools	Arts colleges	0.4	1	0	1
5	Community colleges	Counselling College	0.6	1	0	1
. .	. .	. .	. .	. .	. .	. .
11	Offshore banks	Law schools	0.2	0	0	0
12	Callable Bonds	Offshore banks	0.4	1	0	1
13	Callable Bonds	Racing schools	0.18	0	0	0
14	Convertible Bonds	X-rays	0.2	0	0	0
15	Ultrasound	Nuclear medicine	0.8	1	0	1
16	Eye Allergies	Middle Ear	0.6	1	0	1
17	Middle Ear	Middle schools	0.2	0	0	0
18	Cardiologists	Software Engineering	0.22	0	0	0
19	Adjustment Bonds	Adjustment Bonds	1	1	0	1
	Average Error				10%	

SUMMARY

This research depends on using the Wu-Palmer measure (Wu-P) to calculate the similarity between businesses type. From Table: 3.10, 3.11 and 3.12, the average error is 21%, 15% and, 10% sequentially. Thus, we consider cutting point 0.4 with the minimum average error (10%).

4. CHAPTER FOUR

SEGREGATION TECHNIQUES

4.1. INTRODUCTION

In this section, the research shows several techniques to segregate the clients' data depending on size and similarity of business type, these techniques are:

1- Available Zones Technique

2-Businesses Randomly

3-- Businesses Sequential Server Technique

4- Businesses Neighbourhood

A) Businesses Neighbourhood with (3) Servers

B) Businesses Neighbourhood with (5) Servers

4.2. DATASET OVERVIEW

This part presents a brief idea about data that is used in our thesis where the data varies depending on the needs. In this thesis, we assume that the dataset contains (48) companies and (50) servers. These companies are classified according to our taxonomy which is found in figure 3.5 that is explained in Chapter Three.

4.3. EXPERIMENTS ENVIRONMENT AND PROCEDURES

The experiment is a simplified approach for presentation and evaluation of techniques. This thesis develops a set of techniques to achieve its main objective. This objective is defined by enhancing the security through segregating the businesses which have the same scope of companies' data. These techniques need to be built on real software. So, it is necessary to develop our model through a software platform. Is achieved by using Microsoft VB.NET software. Finally, compare the results of techniques after segregation.

4.4. SEGREGATION USING AVAILABLE ZONES TECHNIQUES

This experiment presents distribution for businesses' data over servers, depending on the size of businesses' data. This technique, available zones technique, is proposed by San j. (2013). We use the Microsoft VB.NET to implement this technique. Figure 4.1 shows the model.

4.4.1. THE MODEL

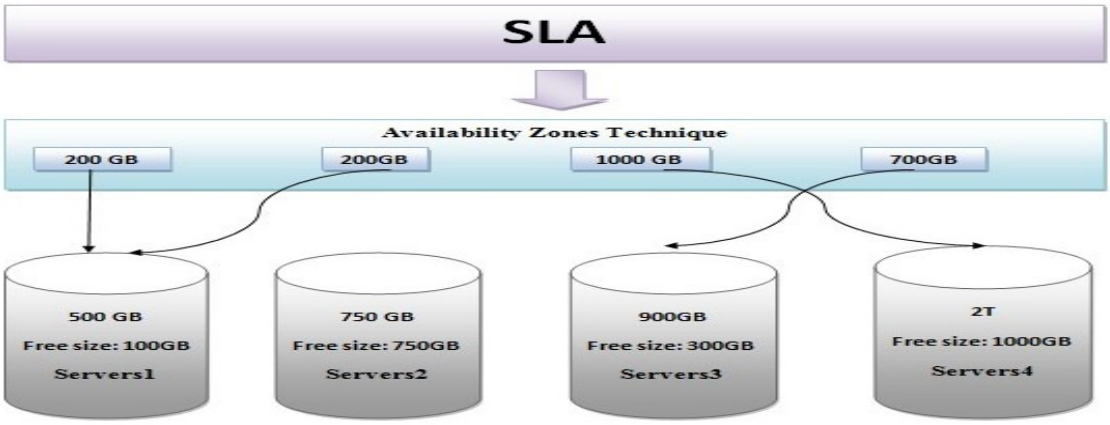

Figure 4.1: Available Zones Technique

4.4.2. THE PROCEDURE

In this experiment, the algorithm is designed to determine which server will be selected depending on businesses data size. To determine the server, (48) companies have been chosen from the businesses taxonomy, Figure 3.5. Also, it is assumed (50) servers which refer to the same service provider, each server capacity are (1000) GB.

- The data come from the companies through SLA to cloud service provider. Then the proposed model by San J. (2013) determines which server will be selected through the following algorithms to store the data:
  1- Select server from the data set randomly.
  2- Check the server size if there is available size to insert the data.
  3- If there isn't available size, select other server randomly, and follow the same procedure until finding the server with the available size.

4.4.3. THE RESULTS:

After the implementation of this technique by using Microsoft VB.NET, we have found that some companies which have the same type of businesses share the same server. And the red colours as shown in Table 4.1, identifies these companies

Table 4.1: Results of Available Zones Technique

No	Company Name	Size	Server ID	No	Company Name	Size	Server ID
1	High schools	500	32	25	Commercial Banks	100	20
2	Middle schools	600	35	26	Community bank	100	48
3	Religious Schools	150	1	27	Vehicle Insurance	150	27
4	Music schools	50	3	28	Life Insurance	200	28
5	Ice hockey schools	500	3	29	Mailbox Bank	350	4
6	Racing schools	400	6	30	Telephone Banking	600	2
7	Law schools	350	40	31	Internet Banking	100	27

No	Company Name	Size	Server ID	No	Company Name	Size	Server ID
8	Community colleges	850	8	32	SMS Bank	150	32
9	Counselling College	950	9	33	General Dentistry	50	33
10	Arts colleges	1000	10	34	Paediatric Dentists	100	34
11	Regular universities	100	32	35	Ultrasound	50	36
12	Culture universities	250	45	36	X-rays	50	36
13	Coastal engineering	650	16	37	CT scans	100	10
14	Construction engineering	750	1	38	Nuclear medicine scans	50	38
15	Mechanical Engineering	350	15	39	Laboratory Testing	150	50
16	Software Engineering	550	16	40	Pet Allergies	50	40
17	Convertible Bonds	1000	17	41	Eye Allergies	50	2
18	Callable Bonds	150	23	42	Dust Allergy	150	11
19	Adjustment Bonds	700	48	43	Otoacoustic Emissions	100	22
20	Stocks	600	20	44	Auditory Brainstem	200	37
21	Mutual Funds	550	21	45	Middle Ear	50	5
22	Health Insurance	200	20	46	Pure-Tone	200	16
23	Offshore banks	850	23	47	Cosmetic Dentists	100	12
24	Postal savings banks	900	24	48	Cardiologists	50	48

4.5. SEGREGATION OF BUSINESSES RANDOMLY

This experiment focuses on the segregation of businesses depending on businesses type. We will use businesses taxonomy. Figure3.5, and use the Wu-P as measurement to calculate the similarity between businesses type. The experiment was implemented on a VB.NET.

4.5.1. THE MODEL

The proposed model, which is shown in Figure 4.2, includes four main components: company, servers, SLA and tasks.

SLA: Data size and scope of company business.

Task1: similarity between businesses type.

Task 2: Size of company data.

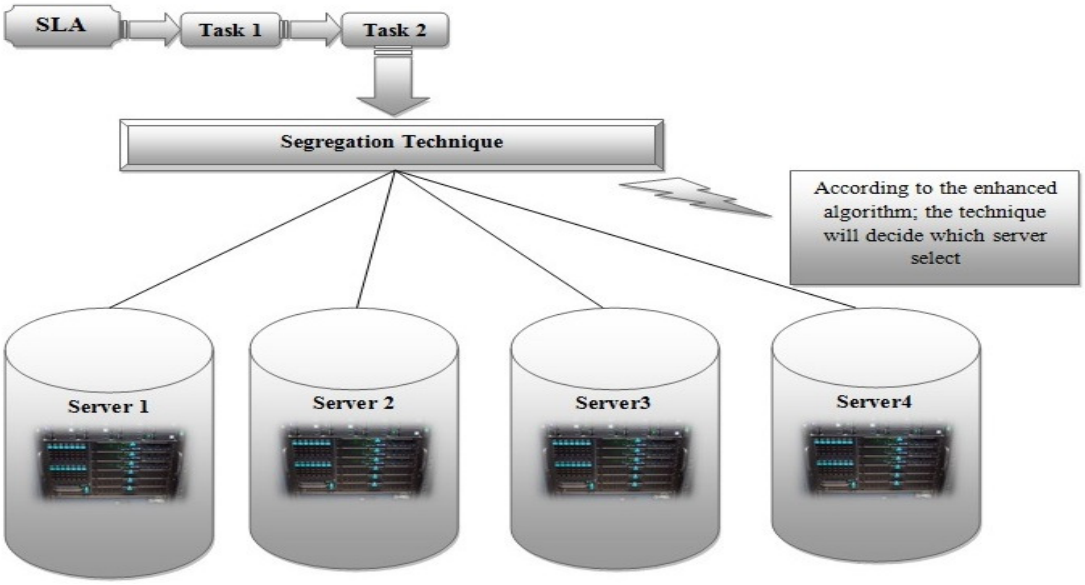

Figure 4.2: The Proposed Model

4.5.2. THE PROCEDURE

The data come from the companies (X) through SLA to cloud service provider. Then the proposed model determines which server will be selected through the following algorithms to store the data into servers:

1-Select server from the data set randomly.

2-After choosing (0.4) a cutting point value, if the result of similarity between company (X) and company (Y) more than (0.4), it means that company(X) and company (Y) are too close of businesses type. Therefore, company (Y) can't stay on the same server with company (X) as security procedure. Thus, search to find optimal server, by using the same previous algorithms, to store the (Y) company's data where the result of formal is less than 0.4.

3- This research take in consideration that the company data size is the other parameter in our algorithm. So we have two parameters: the similarity of the company(X) and company (Y) businesses and the available zone. This research suppose that the maximum server size is (1000) GB, as mentioned in the dataset part. If the zone can not accept the size of data company, there will be a message:" the remaining size in the selected server is not enough for the new company", but if the zone is available this message appears: "the remaining size in the selected server is enough for the new company".

4.5.3. THE RESULTS

The result in table 4.5 shows that, there isn't any business with same type in the same server.

Table 4.5 The Result of Segregation Using Businesses Randomly Technique.

NO	Company Name	Size	Server ID	NO	Company Name	Size	Server ID
1	High schools	500	50	25	Commercial Banks	100	48
2	Middle schools	600	45	26	Community bank	100	14
3	Religious Schools	150	29	27	Vehicle Insurance	150	2
4	Music schools	50	10	28	Life Insurance	200	10
5	Ice hockey schools	500	48	29	Mailbox Bank	350	7
6	Racing schools	400	12	30	Telephone Banking	600	14
7	Law schools	350	21	31	Internet Banking	100	4
8	Community colleges	850	32	32	SMS Bank	150	10
9	Counselling College	950	29	33	General Dentistry	50	18
10	Arts colleges	1000	18	34	Paediatric Dentists	100	42
11	Regular universities	100	28	35	Ultrasound	50	27
12	Culture universities	250	43	36	X-rays	50	47
13	Coastal engineering	650	1	37	CT scans	100	21
14	Construction engineering	750	5	38	Nuclear medicine scans	50	29
15	Mechanical Engineering	350	36	39	Laboratory Testing	150	6
16	Software Engineering	550	22	40	Pet Allergies	50	50
17	Convertible Bonds	1000	28	41	Eye Allergies	50	7

NO	Company Name	Size	Server ID	NO	Company Name	Size	Server ID
18	Callable Bonds	150	45	42	Dust Allergy	150	30
19	Adjustment Bonds	700	12	43	Otoacoustic Emissions	100	15
20	Stocks	600	9	44	Auditory Brainstem	200	12
21	Mutual Funds	550	4	45	Middle Ear	50	3
22	Health Insurance	200	21	46	Pure-Tone	200	38
23	Offshore banks	850	15	47	Cosmetic Dentists	100	39
24	Postal savings banks	900	43	48	Cardiologists	50	47

4.6. SEGREGATION USING SEQUENTIAL SERVERS

In this experiment, the study designs an algorithm to determinate which server will be selected sequentially. Then, This research use Microsoft Visual Studio VB.NET to apply this technique. See this experiment in the appendix.

4.6.1. THE PROCEDURE

1-Select a server sequentially. Start with server (1) to insert the (X) company data.

2-Check the size of server

3-Check the selected server:

4-If the server is empty, inserts company (X)

5-If the server contains a company ($Y_1 \ldots Y_n$) check the similarity between the company (X) and the other companies in the selected server: if the similarities between these companies are less than (0.4) store the company (X) in this server. Otherwise, search sequentially fro another server to find the similarity between companies less than (0.4).

4.6.2. THE RESULT

Table 4.6 shows the result of the segregation through sequential server technique. The result shows that there aren't any businesses with same type in the same server.

Table 4.6 Result of Segregation Technique Using Businesses Sequential Server.

No	Company Name	Size	Server ID	No	Company Name	Size	Server ID
1	High schools	500	1	25	Commercial Banks	100	5
2	Middle schools	600	2	26	Community bank	100	7
3	Religious Schools	150	3	27	Vehicle Insurance	150	8
4	Music schools	50	4	28	Life Insurance	200	12
5	Ice hockey schools	500	5	29	Mailbox Bank	350	13
6	Racing schools	400	6	30	Telephone Banking	600	15
7	Law schools	350	7	31	Internet Banking	100	14
8	Community colleges	850	8	32	SMS Bank	150	16
9	Counselling College	950	9	33	General Dentistry	50	1
10	Arts colleges	1000	10	34	Paediatric Dentists	100	2
11	Regular universities	100	11	35	Ultrasound	50	3
12	Culture universities	250	12	36	X-rays	50	4
13	Coastal engineering	650	13	37	CT scans	100	5
14	Construction engineering	750	14	38	Nuclear medicine scans	50	7
15	Mechanical Engineering	350	15	39	Laboratory Testing	150	12
16	Software Engineering	550	16	40	Pet Allergies	50	11
17	Convertible Bonds	1000	17	41	Eye Allergies	50	14
18	Callable Bonds	150	1	42	Dust Allergy	150	16
19	Adjustment Bonds	700	3	43	Otoacoustic Emissions	100	18
20	Stocks	600	6	44	Auditory Brainstem	200	19
21	Mutual Funds	550	4	45	Middle Ear	50	15
22	Health Insurance	200	2	46	Pure-Tone	200	20
23	Offshore banks	850	11	47	Cosmetic Dentists	100	21
24	Postal savings banks	900	18	48	Cardiologists	50	22

4.7. NEIGHBOURHOOD'S SEGREGATION

As mentioned, the segregation must be in the database level and in the physical level. And in the previous experiments, this research gets a succeeded in businesses segregation at the database level.

Neighbourhood's segregation technique is chosen in this study because it focuses on the database level and on the physical level. All that happen to enhance the security of cloud computing. This technique takes three factors:

1- Size of company data.

2- Similarity between businesses.

3- Location of selected server.

4.7.1. THE PROCEDURE

1-The thesis uses two experiments to work with. These experiments design the algorithm to determinate which server will be selected depending on businesses type, server location and company data size.

2-Apply size algorithm and similarity between businesses techniques.

3-Apply server location algorithm as the following:

- Select server ID randomly.
- Check the similarity of the new company with the other companies in the selected server if there are.
- Check the similarity between the new and the other companies which are found in the servers that occur alongside the selected server.

This research derived from this technique two approaches:

1- Segregation Neighbourhood Businesses with 3 Servers.

This approach designs technique to determine which server will be selected in order to insert companies' data. This is done by checking the similarity of new company with other

companies in a selected server. Then, the checking arrives to the servers which occur after and before the selected server. Finally, choose the server which includes the least similarity to store the new company's data in, depending on (0.4) as a cutting point value. See Figure 4.3. And the results are shown in Table 4.7.

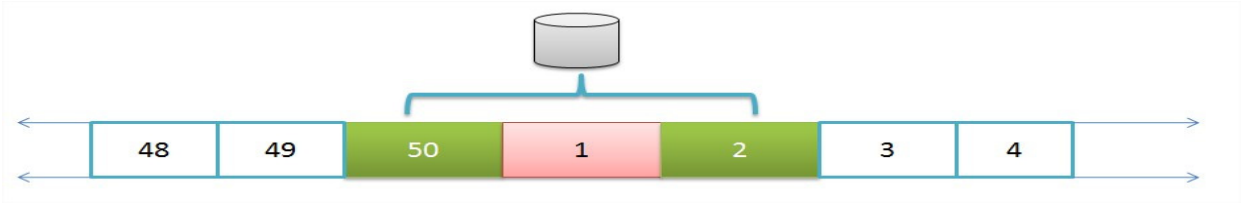

Figure 4.3 Segregation Using Neighbourhood Businesses with 3 servers.

4.7.2. THE RESULT

Table 4.7: The Results of Neighbourhood Segregation Technique With (3) Servers

No	Company Name	Size	Server ID	No	Company Name	Size	Server ID
1	High schools	500	42	25	Commercial Banks	100	18
2	Middle schools	600	10	26	Community bank	100	45
3	Religious Schools	150	17	27	Vehicle Insurance	150	50
4	Music schools	50	1	28	Life Insurance	200	37
5	Ice hockey schools	500	37	29	Mailbox Bank	350	24
6	Racing schools	400	12	30	Telephone Banking	600	7
7	Law schools	350	34	31	Internet Banking	100	5
8	Community colleges	850	23	32	SMS Bank	150	43
9	Counselling College	950	44	33	General Dentistry	50	12
10	Arts colleges	1000	14	34	Paediatric Dentists	100	2
11	Regular universities	100	27	35	Ultrasound	50	23
12	Culture universities	250	7	36	X-rays	50	9
13	Coastal engineering	650	29	37	CT scans	100	7
14	Construction engineering	750	47	38	Nuclear medicine scans	50	50
15	Mechanical Engineering	350	30	39	Laboratory Testing	150	5
16	Software Engineering	550	21	40	Pet Allergies	50	34
17	Convertible Bonds	1000	28	41	Eye Allergies	50	48
18	Callable Bonds	150	41	42	Dust Allergy	150	5
19	Adjustment Bonds	700	36	43	Otoacoustic Emissions	100	13
20	Stocks	600	31	44	Auditory Brainstem	200	25

21	Mutual Funds	550	6	45	Middle Ear	50	38
22	Health Insurance	200	10	46	Pure-Tone	200	36
23	Offshore banks	850	33	47	Cosmetic Dentists	100	45
24	Postal savings banks	900	16	48	Cardiologists	50	11

2- Segregation Neighbourhood Businesses with (5) Servers.

This approach designs algorithm to determine which server will be selected in order to insert companies' data. That will happen by checking the similarity of new company with other companies in a selected server. Then, the checking arrives to four servers: two servers in the lift side and two in the right. Finally, choose the server which includes the least similarity to store the new company's data in, depending on (0.4) as a cutting point value. But if the value (0.4) of cutting point isn't suitable, you can increase the value up to (0.6). See figure 4.4. And the results are shown in Table 4.8.

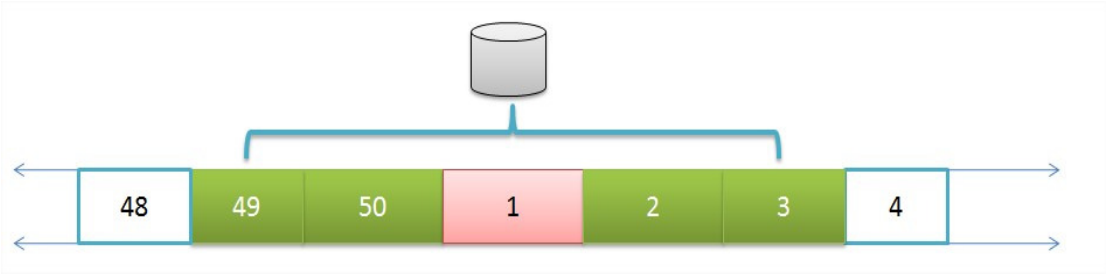

Figure 4.4: Segregation Using Neighbourhood Businesses with 5 Servers.

4.7.3. THE RESULT

Table 4.8: The Results of Neighbourhood Segregation Technique With (5) Servers.

No	Company Name	Size	Server ID	No	Company Name	Size	Server ID
1	High schools	500	4	25	Commercial Banks	100	50
2	Middle schools	600	14	26	Community bank	100	4
3	Religious Schools	150	24	27	Vehicle Insurance	150	39
4	Music schools	50	34	28	Life Insurance	200	46
5	Ice hockey schools	500	44	29	Mailbox Bank	350	30
6	Racing schools	400	50	30	Telephone Banking	600	11
7	Law schools	350	10	31	Internet Banking	100	25
8	Community colleges	850	20	32	SMS Bank	150	33
9	Counseling College	950	29	33	General Dentistry	50	1
10	Arts colleges	1000	40	34	Pediatric Dentists	100	10
11	Regular universities	100	7	35	Ultrasound	50	5
12	Culture universities	250	17	36	X-rays	50	30
13	Coastal engineering	650	36	37	CT scans	100	39
14	Construction engineering	750	24	38	Nuclear medicine scans	50	50
15	Mechanical Engineering	350	34	39	Laboratory Testing	150	20
16	Software Engineering	550	10	40	Pet Allergies	50	35
17	Convertible Bonds	1000	8	41	Eye Allergies	50	25
18	Callable Bonds	150	19	42	Dust Allergy	150	30
19	Adjustment Bonds	700	12	43	Otoacoustic Emissions	100	15
20	Stocks	600	15	44	Auditory Brainstem	200	45
21	Mutual Funds	550	28	45	Middle Ear	50	1
22	Health Insurance	200	30	46	Pure-Tone	200	9
23	Offshore banks	850	43	47	Cosmetic Dentists	100	19
24	Postal savings banks	900	35	48	Cardiologists	50	30

4.8. SEGREGATION USING EXPERT HUMAN

In this stage, this research distributes the companies to the servers depending on Yellow Pages Jordan Company for Advertising. Table 4.10 shows the results, and for more details see the questionnaire Table 3.9.

Table 4.9: The Results of Segregation According to Experts Human.

No	Company Name	Size	Server ID	No	Company Name	Size	Server ID
1	High schools	500	1	25	Commercial Banks	100	24
2	Middle schools	600	10	26	Community bank	100	35
3	Religious Schools	150	20	27	Vehicle Insurance	150	45
4	Music schools	50	30	28	Life Insurance	200	7
5	Ice hockey schools	500	40	29	Mailbox Bank	350	21
6	Racing schools	400	50	30	Telephone Banking	600	27
7	Law schools	350	5	31	Internet Banking	100	35
8	Community colleges	850	15	32	SMS Bank	150	42
9	Counselling College	950	25	33	General Dentistry	50	1
10	Arts colleges	1000	34	34	Paediatric Dentists	100	10
11	Regular universities	100	45	35	Ultrasound	50	20
12	Culture universities	250	7	36	X-rays	50	30
13	Coastal engineering	650	21	37	CT scans	100	40
14	Construction engineering	750	28	38	Nuclear medicine	50	50
15	Mechanical Engineering	350	42	39	Laboratory Testing	150	5
16	Software Engineering	550	39	40	Pet Allergies	50	15
17	Convertible Bonds	1000	2	41	Eye Allergies	50	25
18	Callable Bonds	150	10	42	Dust Allergy	150	35
19	Adjustment Bonds	700	20	43	Otoacoustic Emissions	100	45
20	Stocks	600	30	44	Auditory Brainstem	200	7
21	Mutual Funds	550	39	45	Middle Ear	50	20
22	Health Insurance	200	50	46	Pure-Tone	200	28
23	Offshore banks	850	6	47	Cosmetic Dentists	100	35
24	Postal savings banks	900	14	48	Cardiologists	50	42

4.9. RESULTS AND EVALUATION

Gathered results from these experiments are analysed and formulates techniques for enhancement of the security. This Techniques is developed to find the optimal location for companies' data in the cloud computing.

As a result, this research succeeded to enhance the security in cloud computing environment by using businesses segregation with (5) servers technique. The evaluation is shown in Table 4.10 and the comparison of the results is in Table 4.11.

Table 4.10: Evaluate Proposed Model. Full Evaluation in Appendix Table (9,10,11,12,13,14)

Company Name	Server ID By availably zone	Error	Server ID By SEGREGATION BUSINESSES	Error	Server ID By Businesses Sequential	Error	Server ID By Businesses Segregation with 3 Servers	Error	Server ID By Businesses Segregation with 5 Servers	Error	Server ID By human
High schools	32	31	50	49	1	0	42	41	4	3	1
Middle schools	35	25	45	35	2	8	10	0	14	4	10
Religious Schools	1	19	29	9	3	17	17	3	24	4	20
Music schools	40	35	10	20	4	26	1	29	34	4	30
Ice hockey schools	3	37	48	8	5	35	37	3	44	4	40
Racing schools	6	44	12	38	6	44	12	38	50	0	50
Law schools	3	2	21	16	7	2	34	29	10	5	5
X-rays	36	6	47	17	4	26	9	21	30	0	30
CT scans	46	6	21	19	5	35	7	33	39	1	40
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Laboratory Testing	50	45	6	1	12	7	5	0	20	15	5
Pet Allergies	40	25	50	35	11	4	34	19	35	20	15
Eye Allergies	2	23	7	18	14	11	48	23	25	0	25
Dust Allergy	11	24	30	5	16	19	5	30	30	5	35
Otoacoustic Emissions	22	23	15	30	18	27	13	32	15	30	45
Auditory Response	37	30	12	5	19	12	25	18	45	38	7
Middle Ear	5	15	3	17	15	5	38	18	1	19	20
Pure-Tone	16	12	38	10	20	8	36	8	9	19	28
Cosmetic Dentists	12	23	39	4	21	14	45	10	19	16	35
Cardiologists	48	6	47	5	22	20	11	31	30	12	42
Average Error:%		20.8		19.7		17.8		16.8		12.6	

4.1. SUMMARY

Table 4.11: The Comparison the Results

Techniques	Error
Segregation Using Availability zones	20.8%
Segregation Using Businesses Randomly	19.7%
Segregation Using Businesses Sequential	17.8%
Segregation Using Neighbourhood Businesses	
(3) Servers	16.8%
(5) Servers	12.6%

Our work is summarised by five steps: firstly, draw the taxonomy of businesses type depending on yellow pages; then, applying the semantic similarity measurements to calculate the similarity between businesses type. And choose the Wu-P measurement to find the similarity between businesses. After that, design techniques to distribute businesses data's over servers. Finally, this research made evaluation to these techniques in order to find the optimal technique. From that, we arrive to the optimal technique which is segregation using Neighbourhood Businesses with 5 servers. However by applying this technique and comparing it with the others, this research achieved enhancing for the security.

5. CHAPTER FIVE

CONCLUSION

5.1. OVERVIEW

This chapter contains future works and summarizes the work which our thesis has done. This research discussed the future work that will indicate how can exploit this thesis to build new idea and resolve new problems. And the conclusion of the thesis is based on practical results of experiments conducted in order to check and analyse the system efficiency.

5.2. CONCLUSION

Cloud computing is on-demand access to the shared resources. It helps to reduce costs, reduce management responsibilities and increase efficiency of organizations. And it is found, there are many advantages but, also, we have challenges. These challenges are related to the loss of sensitive information, price, reliability, outages, data mobility etc. This thesis focuses on and discusses the security issues, data separation and the methods by which we can separate the data for security purposes, availability and cost.

The general purpose of this research is to use certain techniques to decreasing the risk. This project shows the greatest technique for enhancing the security through a number of experiments. However, it has been recommended that further research is necessary to be conducted to make the technique more suitable to cloud computing security.

This study builds techniques in order to achieve the main goal. The proposed techniques were built to distribute the companies over the servers efficiently with minimum risk to avoid the leakage. This study included a literature review, which indicated that there is still a need to use different techniques.

In summary, the overall information was presented in this research work related to the critical analysis and previous studies in cloud computing, in order to afford opportunity for researchers to enhancing the security in the cloud computing as well as to help those who have the potential to implement this work in the future. Furthermore, the findings of our thesis can be beneficial for the other research works, as well as being a milestone on the way to further progress.

5.4 FUTURE WORK

Further works need to be conducted. So, this research suggests few ideas to be studied in the future:

1. Taking other factor to improve security in multi tenancy.
2. Enhancing the semantic similarity measurement.
3. Expand businesses taxonomy to include more businesses.
4. Use other way to evaluate our techniques.

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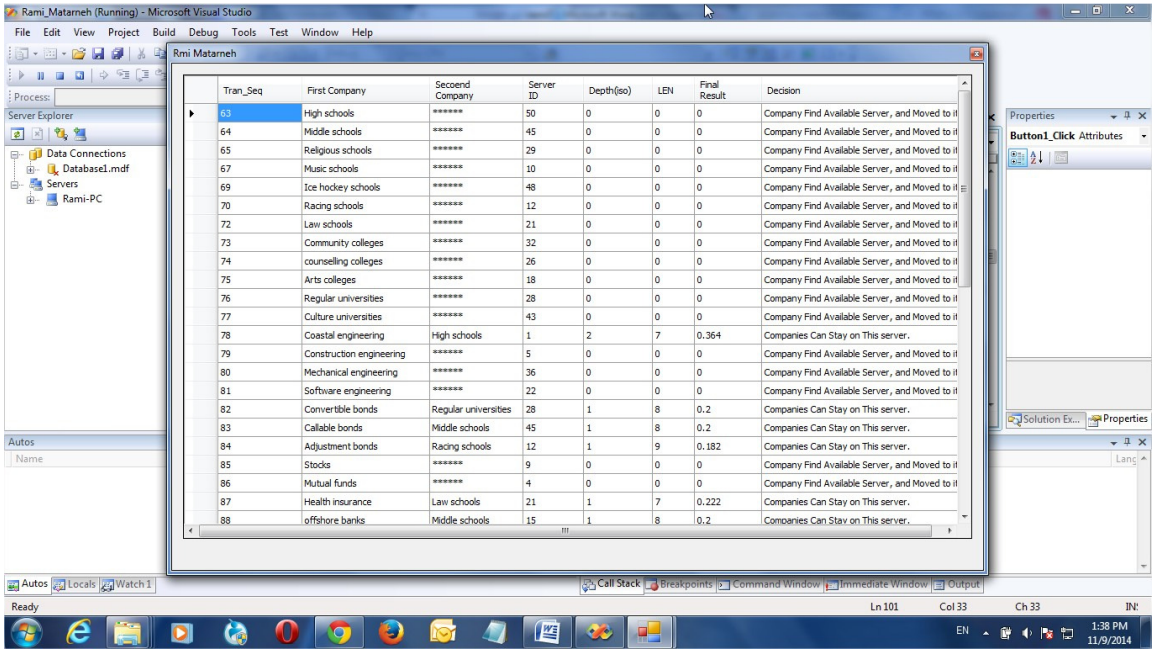
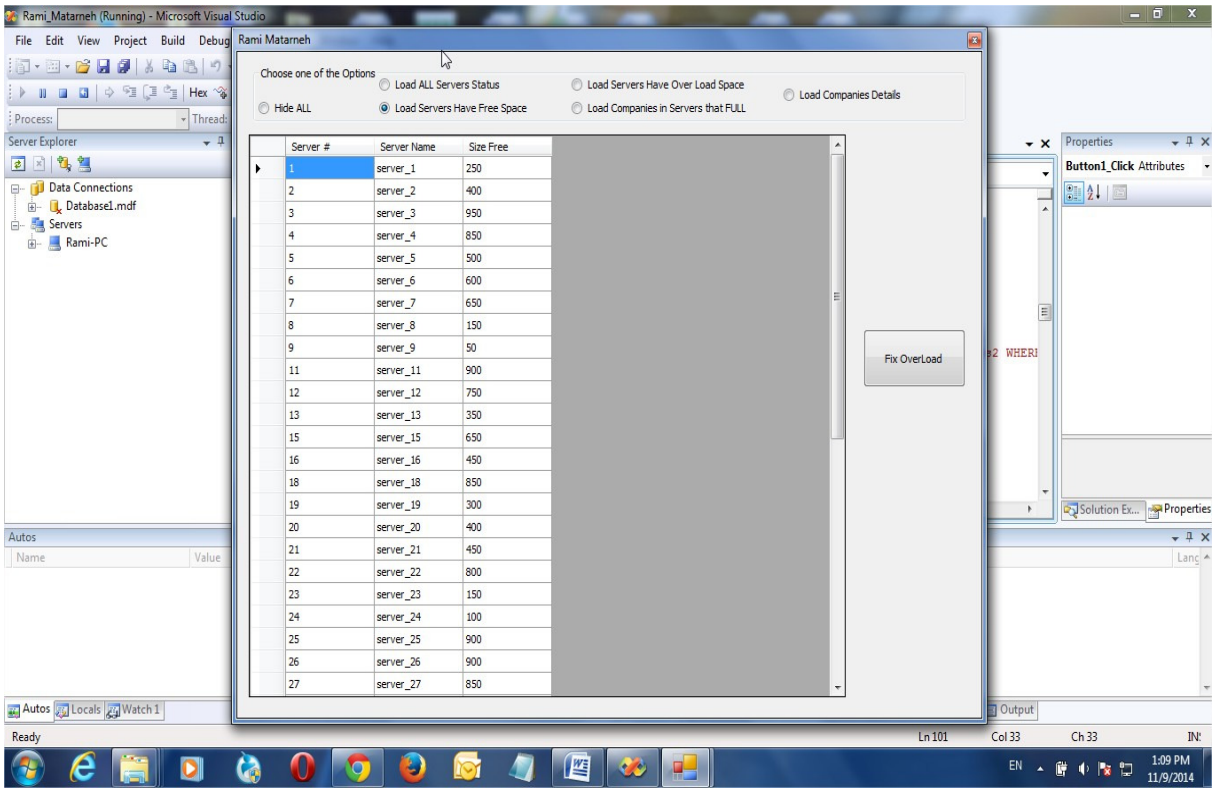
APPENDIX

1- Figure of Software





2-Evaluation of semantic similarity measurement

No.	Path	Error	W & P	Error	L&Ch	Error	Resnik	Error	Lin	Error	Expert person
1	83%	0	80%	3	77%	6	77%	6	86%	3	83%
2	83%	3	83%	3	77%	9	89%	3	89%	3	86%
3	58%	4	54%	8	38%	24	61%	1	64%	2	62%
4	50%	4	40%	6	30%	16	38%	8	42%	4	46%
5	83%	24	60%	1	77%	18	61%	2	79%	20	59%
6	50%	6	40%	4	30%	14	38%	6	42%	2	44%
7	83%	1	83%	1	77%	7	88%	4	88%	4	84%
8	75%	5	72%	8	60%	20	77%	3	81%	1	80%
9	33%	15	20%	2	17%	1	0%	18	0%	18	18%
10	25%	7	18%	0	12%	6	0%	18	0%	18	18%
11	33%	15	20%	2	17%	1	0%	18	0%	18	18%
12	50%	5	40%	5	30%	15	38%	7	42%	3	45%
13	25%	6	18%	1	12%	7	0%	19	0%	19	19%
14	33%	15	20%	2	17%	1	0%	18	0%	18	18%
15	83%	0	80%	3	77%	6	77%	6	86%	3	83%
16	67%	3	60%	4	47%	17	61%	3	68%	4	64%
17	33%	16	20%	3	17%	0	0%	17	0%	17	17%
18	41%	23	22%	4	23%	5	0%	18	0%	18	18%
19	100%	0	100%	0	100%	0	89%	11	100%	0	100%
Error	8%		3.1%		9.1%		9.7%		9.2%		

3. Available Zone

Company –ID	Company Name	Company Data Size	Server – ID
1	High schools	500	32
2	Middle schools	600	2
3	Religious Schools	150	4
4	Music schools	50	3
5	Ice hockey schools	500	5
6	Racing schools	400	6
7	Law schools	350	7
8	Community colleges	850	8
9	Counseling College	950	9
10	Arts colleges	1000	10
11	Regular universities	100	11
12	Culture universities	250	12
13	Coastal engineering	650	13
14	Construction engineering	750	1
15	Mechanical Engineering	350	15
16	Software Engineering	550	16
17	Convertible Bonds	1000	17
18	Callable Bonds	150	18
19	Adjustment Bonds	700	19
20	Stocks	600	20
21	Mutual Funds	550	21
22	Health Insurance	200	22
23	Offshore banks	850	23
24	Postal savings banks	900	24
25	Commercial Banks	100	25
26	Community development bank	100	26
27	Vehicle Insurance	150	27
28	Life Insurance	200	28
29	Mailbox Bank (Online Bank)	350	29
30	Telephone Banking	600	30
31	Internet Banking (Online Bank)	650	31
32	SMS Bank (Online Bank)	300	32
33	General Dentistry	750	33
34	Pediatric Dentists	1000	34
35	Ultrasound	100	35
36	X-rays	250	36
37	CT scans	850	37
38	Nuclear medicine scans	800	38
39	Laboratory Testing	400	39
40	Pet Allergies	700	40

Company –ID	Company Name	Company Data Size	Server – ID
41	Eye Allergies	450	41
42	Dust Allergy	300	42
43	Otoacoustic Emissions	100	43
44	Auditory Brainstem Response	200	44
45	Middle Ear	750	45
46	Pure-Tone	600	46
47	Cosmetic Dentists	100	47
48	Cardiologists	500	48

4. Business segregation

First Company	Scorned Company	Server - ID	Depth LCS	LEN	Result	Decision
High schools	******	32	0	0	0	Company Find Available Server, and Moved to it.
Middle schools	******	17	0	0	0	Company Find Available Server, and Moved to it.
Religious Schools	******	14	0	0	0	Company Find Available Server, and Moved to it.
Music schools	******	22	0	0	0	Company Find Available Server, and Moved to it.
Ice hockey schools	******	30	0	0	0	Company Find Available Server, and Moved to it.
Racing schools	******	34	0	0	0	Company Find Available Server, and Moved to it.
Law schools	******	9	0	0	0	Company Find Available Server, and Moved to it.
Community colleges	******	48	0	0	0	Company Find Available Server, and Moved to it.
Counselling College	******	4	0	0	0	Company Find Available Server, and Moved to it.
Arts colleges	Community colleges	48	3	2	0.75	Companies Can NOT Stay on This.

First Company	Scorned Company	Server - ID	Depth LCS	LEN	Result	Decision
Regular universities	******	33	0	0	0	Company Find Available Server, and Moved to it.
Culture universities	******	12	0	0	0	Company Find Available Server, and Moved to it.
Coastal engineering	******	28	0	0	0	Company Find Available Server, and Moved to it.
Mechanical Engineering	******	31	0	0	0	Company Find Available Server, and Moved to it.
Software Engineering	******	27	0	0	0	Company Find Available Server, and Moved to it.
Convertible Bonds	******	2	0	0	0	Company Find Available Server, and Moved to it.
Callable Bonds	High schools	32	1	8	0.2	Companies Can Stay on This server.
Adjustment Bonds	******	41	0	0	0	Company Find Available Server, and Moved to it.
Stocks	******	44	0	0	0	Company Find Available Server, and Moved to it.
Mutual Funds	******	13	0	0	0	Company Find Available Server, and Moved to it.
Health Insurance	******	36	0	0	0	Company Find Available Server, and Moved to it.
Offshore banks	******	19	0	0	0	Company Find Available Server, and Moved to it.
Postal savings banks	******	5	0	0	0	Company Find Available Server, and Moved to it.
Commercial Banks	******	37	0	0	0	Company Find Available Server, and Moved to it.

First Company	Scorned Company	Server - ID	Depth LCS	LEN	Result	Decision
Vehicle Insurance	Stocks	44	2	4	0.5	Companies Can NOT Stay on This server.
Vehicle Insurance	Ice hockey schools	30	1	8	0.2	Companies Can Stay on This server.
Life Insurance	******	6	0	0	0	Company Find Available Server, and Moved to it.
Mailbox Bank (Online Bank)	******	1	0	0	0	Company Find Available Server, and Moved to it.
Telephone Banking (Online Bank)	Community colleges	48	1	7	0.222	Companies Can Stay on This server.
Internet Banking (Online Bank)	******	10	0	0	0	Company Find Available Server, and Moved to it.
SMS Bank (Online Bank)	Community development bank	20	3	3	0.667	Companies Can NOT Stay on This server.
SMS Bank (Online Bank)	******	40	0	0	0	Company Find Available Server, and Moved to it.
General Dentistry	******	42	0	0	0	Company Find Available Server, and Moved to it.
Paediatric Dentists	Software Engineering	27	1	7	0.222	Companies Can Stay on This server.
Ultrasound	******	24	0	0	0	Company Find Available Server, and Moved to it.
X-rays	Health Insurance	36	1	7	0.222	Companies Can Stay on This server.
CT scans	******	25	0	0	0	Company Find Available Server, and Moved to it.

First Company	Scorned Company	Server - ID	Depth LCS	LEN	Result	Decision
Laboratory Testing	Postal savings banks	5	1	7	0.222	Companies Can Stay on This server.
Pet Allergies	Music schools	22	1	8	0.2	Companies Can Stay on This server.
Eye Allergies	******	26	0	0	0	Company Find Available Server, and Moved to it.
Dust Allergy	Counselling College	4	1	7	0.222	Companies Can Stay on This server.
Otoacoustic Emissions	Racing schools	34	1	8	0.2	Companies Can Stay on This server.
Auditory Brainstem Response	Middle schools	17	1	8	0.2	Companies Can Stay on This server.
Middle Ear	Ice hockey schools	30	1	9	0.182	Companies Can Stay on This server.
Pure-Tone	Ice hockey schools	30	1	9	0.182	Companies Can Stay on This server.
Cosmetic Dentists	Counselling College	4	1	6	0.25	Companies Can Stay on This server.
Cardiologists	Counselling College	4	1	6	0.25	Companies Can Stay on This server.
Construction engineering	******	49	0	0	0	Company Find Available Server, and Moved to it.

5. Sequential Segregation

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
******	High schools	1	0	0	0	Direct Inserted to the Server because it does not have any company to compare with
High schools	Middle schools	1	4	2	0.8	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
******	Middle schools	2	0	0	0	Direct Inserted to the Server because it does not have any company to compare with
High schools	Religious Schools	1	3	4	0.6	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Middle schools	Religious Schools	2	3	4	0.6	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
******	Religious Schools	3	0	0	0	Direct Inserted to the Server because it does not have any company to compare with

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
Middle schools	Music schools	2	3	4	0.6	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Religious Schools	Music schools	3	4	2	0.8	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
******	Music schools	4	0	0	0	Direct Inserted to the Server because it does not have any company to compare with
High schools	Ice hockey schools	1	3	5	0.545	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Middle schools	Ice hockey schools	2	3	5	0.545	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Religious Schools	Ice hockey schools	3	4	3	0.727	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
******	Ice hockey schools	5	0	0	0	Direct Inserted to the Server because it does not have any company to compare with
High schools	Racing schools	1	3	5	0.545	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Middle schools	Racing schools	2	3	5	0.545	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Religious Schools	Racing schools	3	4	3	0.727	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Music schools	Racing schools	4	4	3	0.727	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Ice hockey schools	Racing schools	5	5	2	0.833	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
High schools	Law schools	1	3	4	0.6	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Middle schools	Law schools	2	3	4	0.6	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Religious Schools	Law schools	3	4	2	0.8	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Music schools	Law schools	4	4	2	0.8	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Ice hockey schools	Law schools	5	4	3	0.727	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Racing schools	Law schools	6	4	3	0.727	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
High schools	Community colleges	1	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Middle schools	Community colleges	2	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Religious Schools	Community colleges	3	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Music schools	Community colleges	4	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Ice hockey schools	Community colleges	5	2	6	0.4	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
Law schools	Community colleges	7	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
******	Community colleges	8	0	0	0	Direct Inserted to the Server because it does not have any company to compare with
High schools	Counselling College	1	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Middle schools	Counselling College	2	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Religious Schools	Counselling College	3	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Music schools	Counselling College	4	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
Racing schools	Counselling College	6	2	6	0.4	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Law schools	Counselling College	7	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Community colleges	Counselling College	8	3	2	0.75	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
******	Counselling College	9	0	0	0	Direct Inserted to the Server because it does not have any company to compare with
High schools	Arts colleges	1	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Middle schools	Arts colleges	2	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
Music schools	Arts colleges	4	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Ice hockey schools	Arts colleges	5	2	6	0.4	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Racing schools	Arts colleges	6	2	6	0.4	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Law schools	Arts colleges	7	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Community colleges	Arts colleges	8	3	2	0.75	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
******	Arts colleges	10	0	0	0	Direct Inserted to the Server because it does not have any company to compare with
High schools	Regular universities	1	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Middle schools	Regular universities	2	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Religious Schools	Regular universities	3	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Music schools	Regular universities	4	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Ice hockey schools	Regular universities	5	2	6	0.4	This server is Perfect for this Company because it have a free size and the WU & P is Lower than Tested Value (50)

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
Middle schools	Culture universities	2	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Religious Schools	Culture universities	3	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Music schools	Culture universities	4	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
High schools	Culture universities	1	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Middle schools	Culture universities	2	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company
Religious Schools	Culture universities	3	2	5	0.444	The distance is greater than the test value (40) >>> the remaining size in the Selected Server is enough for the New company

First Company	Second Company	Server ID	Depth LCS	LEN	Result	Decision
High schools	Coastal engineering	1	2	7	0.364	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Middle schools	Coastal engineering	2	2	7	0.364	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Religious Schools	Coastal engineering	3	2	7	0.364	This server is Perfect for this Company because it have a free size and the WU & P is Lower than Tested Value (50)
High schools	Construction engineering	1	2	7	0.364	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company
Middle schools	Construction engineering	2	2	7	0.364	The distance is Lower or Equal than the test value (40) >>> the remaining size in the Selected Server is NOT enough for the New company

6-cutting point 60

Company 1	Company 2	Wu-P	Wu-P>60	Error	E.P
High schools	Middle schools	0.8	1	0	1
Ice hockey schools	Racing schools	0.83	1	0	1
Middle schools	Racing schools	0.54	0	1	1
Racing schools	Arts colleges	0.4	0	1	1
Community colleges	Counselling College	0.6	1	0	1
Arts colleges	Coastal engineering	0.4	0	1	1
Coastal engineering	Construction engineering	0.83	1	0	1
Construction engineering	Software Engineering	0.72	1	0	1
Software Engineering	Postal savings banks	0.2	0	0	0
development bank	Coastal engineering	0.18	0	0	0
Offshore banks	Law schools	0.2	0	0	0
Callable Bonds	Offshore banks	0.4	0	1	1
Callable Bonds	Racing schools	0.18	0	0	0
Convertible Bonds	X-rays	0.2	0	0	0
Ultrasound	Nuclear medicine	0.8	1	0	1
Eye Allergies	Middle Ear	0.6	1	0	1
Middle Ear	Middle schools	0.2	0	0	0
Cardiologists	Software Engineering	0.22	0	0	0
Adjustment Bonds	Adjustment Bonds	1	1	0	1
Error				21%	

7-cutting point 0.5

Company 1	Company 2	Wu-P	Wu-P>50	Error	E.P
High schools	Middle schools	0.8	1	0	1
Ice hockey schools	Racing schools	0.83	1	0	1
Middle schools	Racing schools	0.54	1	0	1
Racing schools	Arts colleges	0.4	0	1	1
Community colleges	Counselling College	0.6	1	0	1
Arts colleges	Coastal engineering	0.4	0	1	1
Coastal engineering	Construction engineering	0.83	1	0	1
Construction engineering	Software Engineering	0.72	1	0	1
Software Engineering	Postal savings banks	0.2	0	0	0
development bank	Coastal engineering	0.18	0	0	0
Offshore banks	Law schools	0.2	0	0	0
Callable Bonds	Offshore banks	0.4	0	1	1
Callable Bonds	Racing schools	0.18	0	0	0
Convertible Bonds	X-rays	0.2	0	0	0
Ultrasound	Nuclear medicine	0.8	1	0	1
Eye Allergies	Middle Ear	0.6	1	0	1
Middle Ear	Middle schools	0.2	0	0	0
Cardiologists	Software Engineering	0.22	0	0	0
Adjustment Bonds	Adjustment Bonds	1	1	0	1
Error				15%	

8-cutting point 0.4

Company 1	Company 2	Wu-P	Wu-P>40	Error	E.P
High schools	Middle schools	0.8	1	0	1
Ice hockey schools	Racing schools	0.83	1	0	1
Middle schools	Racing schools	0.54	1	0	1
Racing schools	Arts colleges	0.4	1	0	1
Community colleges	Counselling College	0.6	1	0	1
Arts colleges	Coastal engineering	0.4	0	1	1
Coastal engineering	Construction engineering	0.83	1	0	1
Construction engineering	Software Engineering	0.72	1	0	1
Software Engineering	Postal savings banks	0.2	0	0	0
development bank	Coastal engineering	0.18	0	0	0
Offshore banks	Law schools	0.2	0	0	0
Callable Bonds	Offshore banks	0.4	1	0	1
Callable Bonds	Racing schools	0.18	0	0	0
Convertible Bonds	X-rays	0.2	0	0	0
Ultrasound	Nuclear medicine	0.8	1	0	1
Eye Allergies	Middle Ear	0.6	0	1	1
Middle Ear	Middle schools	0.2	0	0	0
Cardiologists	Software Engineering	0.22	0	0	0
Adjustment Bonds	Adjustment Bonds	1	1	0	1
Error				**10%**	

9-Evaluation available zone

Company Name	Server ID By human	Server ID By Available zone	Error
High schools	1	32	31
Middle schools	10	35	25
Religious Schools	20	1	19
Music schools	30	3	27
Ice hockey schools	40	3	37
Racing schools	50	6	44
Law schools	5	40	35
Community colleges	15	8	7
Counselling College	25	9	16
Arts colleges	34	10	24
Regular universities	45	32	13
Culture universities	7	45	38
Coastal engineering	21	16	5
Construction engineering	28	1	27
Mechanical Engineering	42	15	27
Software Engineering	39	16	23
Convertible Bonds	2	17	15
Callable Bonds	10	23	13
Adjustment Bonds	20	48	28
Stocks	30	20	10
Mutual Funds	39	21	18
Health Insurance	50	20	30
Offshore banks	6	23	17
Postal savings banks	14	24	10
Commercial Banks	24	20	4
development bank	35	23	12
Vehicle Insurance	45	27	18
Life Insurance	7	28	21
Mailbox Bank	21	4	17
Telephone Banking	27	2	25
Internet Banking	35	27	8
SMS Bank	42	32	10
General Dentistry	1	33	32
Paediatric Dentists	10	34	24
Ultrasound	20	36	16
X-rays	30	36	6
CT scans	40	10	30
Nuclear medicine scans	50	38	12
Laboratory Testing	5	50	45

Company Name	Server ID By human	Server ID By Available zone	Error
Pet Allergies	15	40	25
Eye Allergies	25	2	23
Dust Allergy	35	11	24
Otoacoustic Emissions	45	22	23
Auditory Response	7	37	30
Middle Ear	20	5	15
Pure-Tone	28	16	12
Cosmetic Dentists	35	12	23
Cardiologists	42	48	6
Average Error :20.8%			

10 –Evaluation businesses randomly

Company Name	Server ID By Human	Server ID By businesses Randomly	Error
High schools	1	50	49
Middle schools	10	45	35
Religious Schools	20	29	9
Music schools	30	10	20
Ice hockey schools	40	48	8
Racing schools	50	12	38
Law schools	5	21	16
Community colleges	15	32	17
Counselling College	25	29	4
Arts colleges	34	18	16
Regular universities	45	28	17
Culture universities	7	43	36
Coastal engineering	21	1	20
Construction engineering	28	5	23
Mechanical Engineering	42	36	6
Software Engineering	39	22	17
Convertible Bonds	2	28	26
Callable Bonds	10	45	35
Adjustment Bonds	20	12	8
Stocks	30	9	21
Mutual Funds	39	4	35
Health Insurance	50	21	29
Offshore banks	6	15	9
Postal savings banks	14	43	29
Commercial Banks	24	48	24

Company Name	Server ID By Human	Server ID By businesses Randomly	Error
development bank	35	14	21
Vehicle Insurance	45	2	43
Life Insurance	7	10	3
Mailbox Bank	21	7	14
Telephone Banking	27	14	13
Internet Banking	35	4	31
SMS Bank	42	10	32
General Dentistry	1	18	17
Paediatric Dentists	10	42	32
Ultrasound	20	27	7
X-rays	30	47	17
CT scans	40	21	19
Nuclear medicine scans	50	29	21
Laboratory Testing	5	6	1
Pet Allergies	15	50	35
Eye Allergies	25	7	18
Dust Allergy	35	30	5
Otoacoustic Emissions	45	15	30
Auditory Response	7	12	5
Middle Ear	20	3	17
Pure-Tone	28	38	10
Cosmetic Dentists	35	39	4
Cardiologists	42	47	5
Average Error :19.7%			

11 –Evaluation businesses Sequential

Company Name	Server ID By Human	Server ID By businesses Sequential	Error
High schools	1	1	0
Middle schools	10	2	8
Religious Schools	20	3	17
Music schools	30	4	26
Ice hockey schools	40	5	35
Racing schools	50	6	44
Law schools	5	7	2
Community colleges	15	8	7
Counselling College	25	9	16
Arts colleges	34	10	24
Regular universities	45	11	34
Culture universities	7	12	5
Coastal engineering	21	13	8

Company Name	Server ID By Human	Server ID By businesses Sequential	Error
Construction engineering	28	14	14
Mechanical Engineering	42	15	27
Software Engineering	39	16	23
Convertible Bonds	2	17	15
Callable Bonds	10	1	9
Adjustment Bonds	20	3	17
Stocks	30	6	24
Mutual Funds	39	4	35
Health Insurance	50	2	48
Offshore banks	6	11	5
Postal savings banks	14	18	4
Commercial Banks	24	5	19
development bank	35	7	28
Vehicle Insurance	45	8	37
Life Insurance	7	12	5
Mailbox Bank	21	13	8
Telephone Banking	27	15	12
Internet Banking	35	14	21
SMS Bank	42	16	26
General Dentistry	1	1	0
Paediatric Dentists	10	2	8
Ultrasound	20	3	17
X-rays	30	4	26
CT scans	40	5	35
Nuclear medicine scans	50	7	43
Laboratory Testing	5	12	7
Pet Allergies	15	11	4
Eye Allergies	25	14	11
Dust Allergy	35	16	19
Otoacoustic Emissions	45	18	27
Auditory Response	7	19	12
Middle Ear	20	15	5
Pure-Tone	28	20	8
Cosmetic Dentists	35	21	14
Cardiologists	42	22	20
Average Error :17.8%			

12 –Evaluation Businesses Segregation with 3 Servers

Company Name	Server ID By Human	Server ID By businesses segregation with 3 servers	Error
High schools	1	42	41
Middle schools	10	10	0
Religious Schools	20	17	3
Music schools	30	1	29
Ice hockey schools	40	37	3
Racing schools	50	12	38
Law schools	5	34	29
Community colleges	15	23	8
Counselling College	25	44	19
Arts colleges	34	14	20
Regular universities	45	27	18
Culture universities	7	7	0
Coastal engineering	21	29	8
Construction engineering	28	47	19
Mechanical Engineering	42	30	12
Software Engineering	39	21	18
Convertible Bonds	2	28	26
Callable Bonds	10	41	31
Adjustment Bonds	20	36	16
Stocks	30	31	1
Mutual Funds	39	6	33
Health Insurance	50	10	40
Offshore banks	6	33	27
Postal savings banks	14	16	2
Commercial Banks	24	18	6
development bank	35	45	10
Vehicle Insurance	45	50	5
Life Insurance	7	37	30
Mailbox Bank	21	24	3
Telephone Banking	27	7	20
Internet Banking	35	5	30
SMS Bank	42	43	1
General Dentistry	1	12	11

Company Name	Server ID By Human	Server ID By businesses segregation with 3 servers	Error
Paediatric Dentists	10	2	8
Ultrasound	20	23	3
X-rays	30	9	21
CT scans	40	7	33
Nuclear medicine scans	50	50	0
Laboratory Testing	5	5	0
Pet Allergies	15	34	19
Eye Allergies	25	48	23
Dust Allergy	35	5	30
Otoacoustic Emissions	45	13	32
Auditory Response	7	25	18
Middle Ear	20	38	18
Pure-Tone	28	36	8
Cosmetic Dentists	35	45	10
Cardiologists	42	11	31
Average Error :16.8%			

14 –Evaluation businesses segregation with 5 servers

Company Name	Server ID By Human	Server ID By businesses segregation with5 servers	Error
High schools	1	4	3
Middle schools	10	14	4
Religious Schools	20	24	4
Music schools	30	34	4
Ice hockey schools	40	44	4
Racing schools	50	50	0
Law schools	5	10	5
Community colleges	15	20	5
Counselling College	25	29	4
Arts colleges	34	40	6
Regular universities	45	7	38
Culture universities	7	17	10
Coastal engineering	21	36	15
Construction engineering	28	24	4
Mechanical Engineering	42	34	8
Software Engineering	39	10	29
Convertible Bonds	2	8	6

Company Name	Server ID By Human	Server ID By businesses segregation with5 servers	Error
Callable Bonds	10	19	9
Adjustment Bonds	20	12	8
Stocks	30	15	15
Mutual Funds	39	28	11
Health Insurance	50	30	20
Offshore banks	6	43	37
Postal savings banks	14	35	21
Commercial Banks	24	50	26
development bank	35	4	31
Vehicle Insurance	45	39	6
Life Insurance	7	46	39
Mailbox Bank	21	30	9
Telephone Banking	27	11	16
Internet Banking	35	25	10
SMS Bank	42	33	9
General Dentistry	1	1	0
Paediatric Dentists	10	10	0
Ultrasound	20	5	15
X-rays	30	30	0
CT scans	40	39	1
Nuclear medicine scans	50	50	0
Laboratory Testing	5	20	15
Pet Allergies	15	35	20
Eye Allergies	25	25	0
Dust Allergy	35	30	5
Otoacoustic Emissions	45	15	30
Auditory Response	7	45	38
Middle Ear	20	1	19
Pure-Tone	28	9	19
Cosmetic Dentists	35	19	16
Cardiologists	42	30	12
Average Error :12.6%			

15. Questionnaire

Question One

A) How much the similarity between High schools& Middle schools:

1)80 2)85 3)90

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question two

A) How much the similarity between Ice hockey schools&Racing schools:

1)80 2)85 3)90

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Three

A) How much the similarity between Middle schools &Racing schools:

1)60 2)65 3)70

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Four

A) How much the similarity between Racing schools& Arts colleges:

1)45 2)50 3)55

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Five

A) How much the similarity between Community colleges&Counseling College:

1)50 2)55 3)60

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Six:

A) How much the similarity between Arts colleges &Coastal engineering:

1)40 2)45 3)50

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question seven:

A) How much the similarity between Coastal engineering &Construction engineering:

1)80 2)85 3)90

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Eight:

A) How much the similarity between Constructions engineering& Software Engineering:

1)80 2)85 3)90

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Nine:

A) How much the similarity between Software Engineering &Postal savings banks:

1)10 2)15 3)20

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Ten:

A) How much the similarity between Community development bank& Coastal engineering:

1)10 2)15 3)20

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Eleventh:

A) How much the similarity between Off shore banks& Law schools:

1)10 2)15 3)20

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Twelfth:

A) How much the similarity between Callable Bonds& Offshore banks:

1)40 2)45 3)50

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Thirteenth:

A) How much the similarity between Callable Bonds&Racing schools:

1)10 2)15 3)20

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Fourteenth:

A) How much the similarity between Convertible Bonds&X-rays:

1)10 2)15 3)20

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Fifteenth:

A) How much the similarity between Ultrasound&Nuclear medicine scans:

1)75 2)80 3)85

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Sixteenth:

A) How much the similarity between Eye Allergies&Middle Ear:

1)75 2)80 3)85

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Seventeenth:

A) How much the similarity between Middle Ear&Middle schools:

1)10 2)15 3)20

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Eighteenth:

A) How much the similarity between Cardiologists&Software Engineering:

1)10 2)15 3)20

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

Question Nineteenth:

A) How much the similarity between Adjustment Bonds&Adjustment Bonds:

1)90 2)95 3)100

B) Could these businesses stay on same server :(if yes choose1, if no choose0)

1)1 2)0

15. Questionnaire

Respondent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Sales																			
Sales Manager	80	85	60	45	60	45	85	80	15	15	15	45	20	20	80	60	15	20	100
Sales Promotion Manager	80	85	60	50	60	40	80	80	15	15	15	40	20	15	80	65	15	20	100
Sales Trainee	90	90	65	55	60	50	85	80	20	15	20	45	15	20	75	60	15	20	100
Sales Person 1	85	85	60	50	60	45	80	85	15	20	15	45	20	20	80	65	15	20	100
Sales Person 2	80	85	60	45	60	45	85	80	15	15	15	45	20	20	80	65	20	20	100
Sales Person 3	80	85	65	40	55	50	85	85	20	20	15	45	20	15	75	65	20	15	100
Marketing																			
Marketing Director	85	90	70	55	50	50	80	90	15	15	15	50	15	15	85	70	15	15	100
Marketing Manager	90	90	70	55	60	50	90	85	20	20	20	50	15	15	85	70	15	15	100
MarketingPerson1	80	85	60	45	60	45	85	80	15	15	15	40	20	20	80	65	20	20	100
MarketingPerson2	80	80	55	40	60	40	85	75	20	20	20	40	20	20	80	60	20	20	100
Product Manager	80	85	65	50	60	45	85	75	20	20	20	50	20	20	85	60	15	15	100
Marketing Consultant	80	90	55	45	55	40	90	80	20	20	20	45	20	20	85	60	20	20	100
IT																			
IT Administrator	85	85	60	40	60	40	80	80	15	15	15	40	15	15	90	70	15	15	100
System Administrator	90	90	65	40	65	45	85	75	20	20	20	45	20	20	85	65	20	20	100
Network Administrator	85	80	55	40	60	40	85	75	20	20	20	40	20	20	85	60	15	15	100
Technical IT	85	80	60	40	65	40	85	75	20	20	20	50	20	20	90	60	20	20	100
Average	83	86	62	46	59	44	84	80	18	18	18	45	19	18	83	64	17	18	100

For the more results, you can contact with author at:ramim2012@yahoo.com