أنظمة التعلم الإلكتروني القائمة على أنظمة الوقت الحقيقي والحوسبة السحابية

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ملخص لما يتطرق اليه هذا البحث :

نظرًا لتطور الشبكة المعلوماتية والإنترنت، فإن توفر المعلومات ومشاركة هذه المعلومات ينموان بسرعة، كما أدى انتشار أجهزة الكمبيوتر والاتصالات عبر الإنترنت والمحتوى التعليمي الغني والميسور التكلفة إلى خلق ظاهرة عالمية يتم فيها استخدام تكنولوجيا المعلومات والاتصالات لتحويل أنظمة التعليم.

من الضروري أن يكون لديك نظام تعليم إلكتروني فعال لجعل عملية التعلم أكثر فعالية وتفاعلية. ستقدم هذه الورقة خصائص التعلم الإلكتروني الحالي، ثم تحلل مفهوم الحوسبة السحابية على التعلم الإلكتروني وتصف بنية منصة الحوسبة السحابية إلى جانب وظائف التعلم الإلكتروني. بالإضافة إلى ذلك، يحاول البحث إدخال أنظمة الوقت الحقيقي في التعليم الإلكتروني، وبناء سحابة التعليم الإلكتروني، وإجراء البحوث النشطة والاستكشاف من الهندسة المعمارية، وبناء طرق لأنظمة التعلم الإلكتروني على تطبيقات أنظمة الوقت الفعلي.

خلاصة البحث :

في هذا العمل، كشفنا المكونات الرئيسية للتعليم الإلكتروني، مع التركيز على الحوسبة السحابية ونظام التعليم الإلكتروني في الوقت الحقيقي. في هذه الطريقة يواجه نظام التعلم الإلكتروني تجارب لتحسين تنظيم الموارد على نطاق واسع والإمداد وفقًا للنمو الهائل في عدد المستخدمين والخدمات ومحتويات التعليم والموارد الإعلامية.

ومن خلال هذه الدراسة لقد توصلنا إلى جودة حلول الحوسبة السحابية ونظام التعلم الإلكتروني في الوقت الفعلي، ومن أهم ميزات منصة الحوسبة السحابية أنها مناسبة تمامًا لترحيل نظام التعلم الحالي حتى نتمكن من الاستفادة الكاملة من الإمكانات المقدمة والتي من خلالها يمكن إنشاء بيئة تعليمية فعالة توفر محتوى مخصصًا وتكييفًا سهلًا مع نموذج التعليم الحالي والتي تتمثل في مرونتها الجيدة وقابليها للتوسع من ناحية المصادر للموارد بما في ذلك التخزين والمتطلبات الحسابية والوصول إلى الشبكة، من ناحية

أخرى فإن نظام التعلم الإلكتروني في الوقت الحقيقي سهل الاستخدام للغاية وفعال من حيث التفاعل وتقديم المعرفة.

حيث يمكن من خلاله نشر النظام على الخوادم مما يجعله متاحًا لمئات الملايين من المستخدمين عبر مجموعة واسعة من الأجهزة من أجهزة الكمبيوتر الشخصية والهواتف والأجهزة اللوحية وغيرها، علاوة على ذلك أنه يمكن أن يتكيف تلقائيًا مع واجهة المستخدم لتبدو في أفضل حالاتها على كل جهاز مع منح المستخدم قدرًا كبيرًا من التحكم في أنواع الأجهزة المختلفة.

STUDY AN E-LEARNING SYSTEMS BASED ON REAL-TIME SYSTEMS AND CLOUD COMPUTING

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ABSTRACT

Today, due to the development of the network and the Internet, the information availability and sharing of this information are growing rapidly. The proliferation of computers, Internet communications, and rich and affordable educational content have created a global phenomenon in which information and communication technology [ICT] is being used to transform education. It is necessary to have an effective e-learning system to make the learning process more effective and interactive. This paper will introduce the characteristics of current e-learning, then analyzes the concept of cloud computing on e-learning and describes the architecture of the cloud computing platform along with the e-learning functions. In addition, the research tries to introduce Real-Time Systems into e-learning, build e-learning cloud, and conduct active research and exploration from the architecture, building methods of E-learning systems on real-time systems application.

Keywords Networks, education, Cloud Computing, Real-Time Systems, E-Learning, Computing Architecture, Information Technology.

1- INTRODUCTION

At present, most forms of traditional education have not adapted to the requirements of social progress and educational development, and cannot keep pace with changes in learning needs promptly, so computer networks provide opportunities for this. However, in the traditional e-learning environment, the system is created and maintained within the educational institution, which causes many problems. The demand for education is increasing, and the number of students who choose this type of educational course continues to increase, so they sometimes prefer distance education. It was also noted that due to the increase in the number of students and the limited physical space available, the e-learning method is the preferred method for many educational institutions. Cloud computing has become an attractive technology due to its dynamic scalability and efficient use of resources. It can be used under conditions of limited resource availability. As cloud computing has become a hotspot of modern technology, researchers are paying great attention to its tools. For cloud computing applied in education, many problems, such as distance education technology [1], teaching system [2] [3], and educational resources [5], teaching systems development tests are presented in real-time [6]. The system consists of calculations that depend not only on its logical effect but also when the result is manufactured, "the system in real-time". Each information processing system can be categorized must meet the values created outside of a specified, defined system period in real-time. The correctness depends not only on the logical result but also on the time it was delivered. Failure to respond is as bad as the wrong response! This is a typical misconception: Real-time computing ≠ computes things as fast as possible.

1.1- Traditional e-learning

With a quick look at electronic or virtual education, it can be said that this type of education depends on the use of electronic media in communication, receiving information, acquiring skills, and the interaction between the student and the teacher and between the student and the school and perhaps between the school and the teacher. This type of education does not require the existence of school buildings or classrooms, but rather it eliminates all the

physical components of education, and to clarify the true picture of it, we see that it is that type of education.

The default by its means, the real with its results.

This type of education is linked to electronic resources, information, and communication networks, the most famous of which is the International Information Network (Internet), which has become a major point for e-learning.

1.2- E-learning development stages

- The era of traditional education in1983
- The era of multimedia after 1986
- The first wave of e-learning 1994-1999
- The second wave of e-learning 2000-2005
- The third wave of e-learning 2006, which is currently ongoing, depends on modern technologies and programs related to Cloud Computing and Real-Time System.

1.3- Characteristics of E-learning:

1- The ability to access it at any time and from anywhere without barriers represented by connecting it to the Internet.

2- Interactivity in the sense of the content of the educational material, the beneficiaries of students, teachers, and other beneficiaries, dealing with parts of the scientific material, and direct transmission from one part to another.

3- It is not limited to one group of people and not only that, but more than one learner in more than one place can deal and interact with the educational program at the same time.

4- Individualism in the sense that it corresponds to the needs of each learner, meets his desires, and is in line with his scientific level, which allows progress in the program or learning according to each individual's learning speed.

5- Complementarity in the sense of the integration of all its components of the elements with each other.

2- REAL-TIME SYSTEM COMPUTING

In the world of computer science, Real-Time Computing [RTC] is also known as ‘Sensitive Computing’. These constraints are well known in computer science by their general name ‘Deadlines’. The learning, research, and investigation of software and hardware systems that are subject to any 'Real-

Time Constraint' is termed as Real-Time Computing. These Real-time responses are each of the order of milliseconds. Significantly, all the Real-time programs show a guaranteed response within the given overhead of strict time constraints.

Fig 1, Real-Time System E-learning

The real-time system that controls a certain environment by receiving data, then processing it, and finally responding to results after applying some operations to it can be called, quickly enough i.e. immediately, to affect the particular environment at that specific time. Real-time programs may use the following:

1- Real-Time Operating System
2- Synchronous programming languages
3- Real-time networks

2.1- Real-Time Constraint

If the real-time constraint is not able to meet its time constraint parameters and the constraint is not met leads to a crash or fatal error, then the real-time constraint is called a hard true equalizer. All other time constraints are called soft. For example, a real-time computing system is the anti-lock brakes of a vehicle. The real-time limitation in this particular system is the "time the brake must be released to stop the wheel spinning from locking." [9].

2.2- Classification of Real-Time Cloud Application

An application or system can be categorized as follows:

• Non- Real-time system: In this type of system, there are no important deadlines for anything or any parameters; it won't make a difference even if all the deadlines are missing.

• Real-time: Real-time systems can be further divided into soft and hard real-time systems based on the severity of compliance with deadlines.

1. Hard real-time system: This kind of real-time system cannot miss a single deadline i.e. it has to comply with all deadlines for it to be a hard real-time system. Let's take an example of a flight controller; If the action in response to upcoming events is pending within a certain time, the result could be an unstable plane or even a disaster for that matter [9].

2. Soft Real-Time System: The concept of a Soft Real-Time System falls between the non-real-time system and the hard real-time system i.e. it allows missing deadlines at times. Let's take an example of a cruise control system; Let's assume the program is not able to measure the current speed in a certain period for the control algorithm to use. In this case, the algorithm can fetch the previous value [9].

2.3- Advantages and Benefits of Real-Time E-learning System using Cloud

1- Enables Ubiquitous Computing since it acts as a common platform for students, professors, administrators, etc.

2- Another key advantage of online study is that it encourages and enables students to collaborate and communicate with their fellow students as well as their tutors.

3- The most implicit benefit of online study is that students can utilize their time efficiently to learn or take a course through e-learning at any time convenient to them.

4- No backup or copying of data required while signing off or when you are buying a new device.

5- Data remains intact even if the system crashes.

6- It provides universal portability to students so that they can work from any place at any time using any device; the only internet is required.

7- Cloud computing allows users to dynamically scale as demands fluctuate.

8- It thus provides a lot of flexibility to the students and is quite affordable.

3- BASIC CONCEPTS ON CLOUD COMPUTING

We may define SOA [10] as an integration platform based on a mix of logic and technology-oriented architecture to support and integrate all types of services. In general, "service" in the cloud computing framework is a mission that has been encapsulated in a way that it can be automated and made available to customers consistently and consistently. Any component can be considered as a service, from entities closest to hardware such as storage space or computational time, for software components intended to authenticate a user, manage mail, manage database, or monitor system resource usage. In this section, we will provide a brief introduction to the cloud computing environment, and first describe its main features[10]. next by presenting the layers in which this platform is built, and finally pointing out several technological difficulties that should still be addressed to improve the quality of this paradigm.

3.1- Introduction to Cloud Computing

Cloud computing refers to the applications and services that operate on a distributed network using virtual resources and accessing them through common internet protocols and network standards. It is characterized by the idea that the resources are virtual and it has no limits and details of the physical systems on which the software is run are extracted from the user. [1][3] Cloud computing takes technology, services, and applications similar to those found on the Internet and turns it into a self-service utility. The use of the word “cloud” guides the two basic concepts which are:

1- Abstraction: Cloud computing summarizes the details of the system implementation from users and developers. Applications run on unspecified physical systems, data is stored in unknown locations, systems management is outsourced to others, and users' access is ubiquitous.

2- Virtualization: Cloud computing virtualizes systems by clustering and sharing Resources. Systems and storage can be provided as needed from central infrastructure, costs are evaluated based on metrics, multiple leases are enabled, and resources are scalable with flexibility [1].

3.2- Service Models of Cloud Computing

There exist different categories of Service Models of Cloud Computing

Cloud Computing has various service models such as Infrastructure as a Service [IAAS], Platform as a Service [PAAS], and Software as a Service [SAAS] [10] as shown in fig 2.

1- The very first and basic layer of cloud computing is Infrastructure as a service [Iaas]. Infrastructure as a Service means that you rent IT infrastructure from a cloud provider, such as Microsoft Azure or Amazon Web Services, on a pay-as-you-go term.
2- The second layer of the cloud is the platform – the PaaS [Platform as a service]. This layer is a development and deployment environment in the cloud and provides the resources to build applications.
3- The third cloud level is the definite Software the SaaS [Software As A Service]. This is the layer that provides a complete software solution, meaning that organizations rent the use of an app, and the users connect to it via the internet, usually with a web browser.

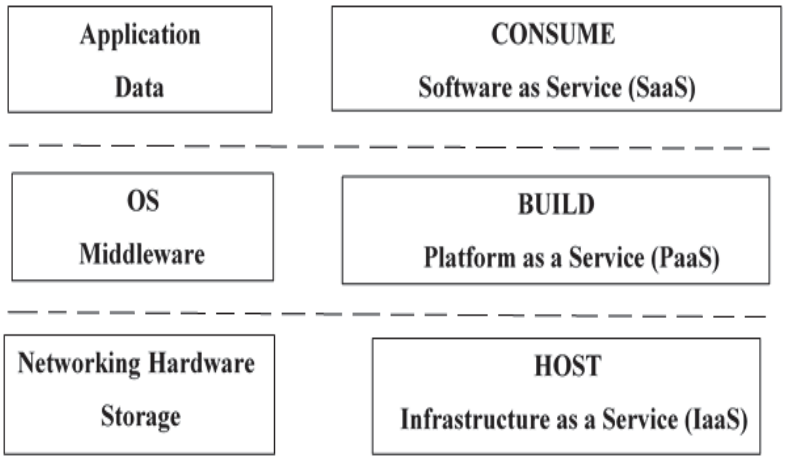

Fig 2. Service Models of Cloud Computing

3.3- Architectural layers of cloud computing

The cloud computing architecture can be classified into four layers: the infrastructure layers, the Physical layer, the platform layer, and the application layer, as indicated in Fig 3.

1- The hardware layer is responsible for dealing with the physical assets of the cloud, including routers, switches, servers, cooling systems, and power.

2- The infrastructure layer is also called a virtualization layer. It makes a pool of storage capacity and computing resources by partitioning the physical properties using virtualization technology
3- The platform layer based on the top of the infrastructure layer, and this layer comprises requisition structures and operating systems.
4- The application layer comprises the actual cloud provisions like Applications, Web Services, and Business Multimedia [4].

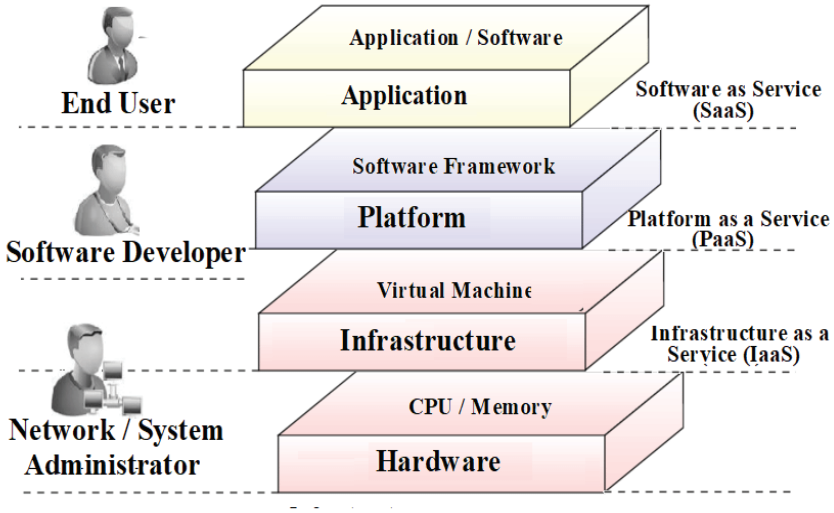

Fig 3. Architecture layers of cloud computing [4]

4- REAL-TIME SYSTEMS AND CLOUD COMPUTING FOR E-LEARNING TASKS

As we mentioned in the introduction to this work, with the tremendous growth in the number of students, the content of education, the services that can be provided, and the resources available, the dimensions of the e-learning system are growing at an exponential rate. Related challenges arise around optimizing resource accounting, storage, and communication requirements, handling dynamic concurrency requests, and the necessity to use a platform that meets scalable and cost-controlled requirements. This environment is cloud computing. In this section, we will present the main advantages and disadvantages that must be addressed for e-learning systems [12].

4.1- Current Challenges of E-Learning Systems

Among the learning pieces of knowledge, web-based learning suggests several benefits over conventional classroom-based E-learning. Its biggest compensations are the reduced costs since a physical environment is no longer required and so it can be used at any time and place for the convenience of the student. Furthermore, the learning material is easy to keep reorganized and the educator may also incorporate multimedia content to afford a friendly background and to ease the understanding of the concepts. Finally, it can be viewed as a learner-centered approach that can address differences between educators, so that they can all verify confidence in their materials to evaluate and reuse shared areas of knowledge [2]. However, some drawbacks must be addressed before e-learning is fully integrated into the academic framework. At present, e-learning systems remain weak in terms of infrastructure scalability. Many resources can be deployed and assigned to specific tasks only so that when receiving high workloads, the system needs to add and configure new resources of the same type, which makes cost and resource management very expensive. This major issue is also related to the efficient use of these resources. For example, in a typical college scenario, PC labs and servers are used inadequately during night breaks and the semester. Additionally, there is a high demand for these resources at the end of the semester, according to the dynamic use rule. Physical machines are suspended even at idle, wasting their full potential. Finally, we must understand that there is a cost related to the maintenance of the computer [and the building], but the educational center must pay for the site license, installation, and technical support for individual software packages [10].

4.2- Organization of the Cloud Computing Environment

The Cloud Computing architecture platform is usually common to most e-Learning methods on the Cloud. In the first layer, we can observe the interface with the Cloud environment, which consists of several management subsystems for responsible the current requirements of the user in terms of computational properties, being these the organizer for storage services, the management for the distribution of the execution load among the virtual machines, a system administrator to monitor and to initiate activities of each layer, and a security component to ensure the privacy, recovery, integrity, and

security of user data and transactions, among others. The second layer signifies the virtual machines affected within the system. Finally, the third layer includes all the physical architecture of the system [6].

4.3- Applications of Cloud Computing for E-Learning

We must emphasize the necessity of setting the basis for an educational information infrastructure to alleviate the issues enumerated in the previous section as we indicated during this contribution, cloud computing may promote a new era of learning, taking advantage of hosting e-learning applications on the cloud and following the features of virtualization of devices, because it reduces the cost of building and maintaining learning resources. Nowadays, a combination of cloud technologies and e-learning is rarely explored. Some relevant efforts to use IaaS cloud technologies in education focuses on the reservation of Virtual Machines to students for a specific time frame [8]. Another example of an application that can be found in the specialized literature is BlueSky [9], whose architecture has several components aimed at providing and managing e-learning services efficiently, the ability to pre-schedule resources for hot content and applications before they are needed, to safeguard the performance in concurrent access, although no details have been found concerning how this is achieved. On the other hand, Claudia [12] is a framework that provides on-demand creation and configuring of VM images so that students can get their own Java servlet environment to try, which includes MySQL, Tomcat, PHP, and the Apache webserver. By this style, learners can focus more on deploying, developing, and testing their applications. In [5], the authors present a new service model that enhances the efficiency within a virtual personalized learning environment. Aimed at subscribing to specific learning resources as well as creating a custom virtual classroom, this system allows learning content providers to register their applications to the server and learners integrate other online learning resources into their learning application pools. Other proposals for in-person and virtual learning interact with cloud-based services, such as YouTube or GoogleDocs [1]. Lastly, we may find some cloud-related works for performance comparison on the proficiency of online prototypes versus traditional models [7]. The most representative work in this area is developed in [10], where the authors focused on the impact of

supporting technology or the perceived ease of acceleration and use of the learning process. In addition, they investigate the suitable level of abstraction [i.e., IaaS or PaaS] that should be delivered to students to enable them to focus on the course topics.

4.4- Applications of Real-Time System for E-Learning

Many schools, colleges, and other educational institutions have adopted online educational platforms due to the COVID-19 outbreak. By using real-time e-learning web applications, you can provide an effective virtual learning experience for learners. An E-learning web application is an interactive web page that allows learners to enter their data and achieve expected results through interactions. Your students can access the app from a web browser with an active internet connection from remote locations [13]. Regarding SmallBiz Trends, 90% of learners consider real-time e-learning applications better than traditional learning. By using e-learning web applications, Additionally, E-learning real-time learning environment web apps are stored on the webserver. Unlike e-learning websites, web applications allow students to perform interactive activities like attending a test, presenting a seminar, submitting a response, working on a math problem, and more in a virtually connected classroom [7]. And there are some features for e-learning real-time application:

- Responsive designs and learner-centric
- Appreciations, reminders, and other relevant push notifications
- Variety of different learning materials like videos, visuals, podcasts.
- Holistic micro-learning theories
- Downloadable online content for future reviews
- Multiple quiz forms

5- CONCLUSION AND FUTURE WORK

In this work we have exposed the main components of e-Learning, focusing on cloud computing and a real-time e-learning system. In this method, an E-learning system is facing experiments of optimizing large-scale resource organization. And provisioning, according to the explosive growth of users, services, education contents, and media resources. We have settled the goodness of Cloud Computing and Real-Time e-learning system solutions. The features of the cloud computing platform are well suited to migrating this

learning system so that we can take full advantage of the potential offered by creating an effective learning environment that provides customized content and easy adaptation to the current education model. Specifically, the benefits considering the integration of an e-Learning system into the cloud can be highlighted as good flexibility and scalability for the resources, including storage, computational requirements, and network access. On the other hand, a Real-Time e-learning system is very user-friendly and effective in terms of interaction and knowledge delivery. The system can be deployed on servers thus making it available to hundreds of millions of users across a wide range of devices from personal computers, phones to tablets and beyond. It automatically adapts UI to look its best on each device, while giving the user as much control on different device types. Our work aimed to identify an architecture that will be using Cloud Computing within higher education. Mainly, we have considered the benefits of cloud architecture and real-time systems in E-learning. Future research will include a study regarding the attitude and strategy for research and exploitation of real-time systems on e-learning and cloud computing platforms.

REFERENCES

[1] F. Jian, "Cloud computing-based distance education outlook", China electronic education, 2009.10, Totally 273, pp.39-42.

[2] R. Hua, “Teaching Information System Based on Cloud Computing”, Computer and Telecommunications, 2010.02, pp. 42-43.

[3] Krupali Shah and Jayant Gadge," Semantic Web Services for e-Learning: Engineering and Technology Domain", International Journal of Computer Theory and Engineering", pp. 727-731, December 2011.

[4] Y. Juan, S. Yi-Xiang, “The Initial Idea of New Learning Society which Based on Cloud Computing”, Modern Educational Technology, Vol.20, No.1, 2010, pp.14-17.

[5] Jarle Hansen, Tor-Morten Gronli & Gheorghita Ghinea, "Towards Cloud to Device Push Messaging on Andriod: Technologies, Possibilities, and Challenges", International Journal of Communications, Network and System Sciences, pp. 839-849, December 2012.

[6] T. Jian, F. Lijian, G. Tao, “Cloud computing-based Design of Network Teaching System”, Journal of Taiyuan Urban Vocational College, Mar. 2010, pp.159-160.

[7] Y. Zhongze, “The basic principles of cloud computing and its impact on education”, Satellite TV and Broadband Multimedia, 2010.6, pp.67-70.

[8] W. Xiaomei, J. Xiaoqiang, “Cloud computing on the Impact of Higher Education”, Science & Technology Information, 2010.10, pp.397-398.

[9] Malgaonkar, S., Shah, P., Jhaveri, R. and Hirave, T., 2015. Real-Time e-Learning System using Cloud Computing. International Journal of Computer Applications, 123[3].

[10] PAUL POCATILU, FELICIAN ALECU, MARIUS VETRICI [2018], Measuring the Efficiency of Cloud Computing for E-learning Systems, wseas.us/elibrary/transactions/computers/2019/89-159.pdf.

[11] Patidar, S., Rane, D. and Jain, P., 2012, January. A survey paper on cloud computing. In 2012 Second International Conference on Advanced Computing & Communication Technologies [pp. 394-398]. IEEE.

[12] Fernandez, A., Peralta, D., Herrera, F. and Benítez, J.M., 2012. An overview of e-learning in cloud computing. In Workshop on Learning

Technology for Education in Cloud [LTEC'12] [pp. 35-46]. Springer, Berlin, Heidelberg.

[13] K. Chitra and R. Umamaheswari, "A real-time application for e-learning system using similarity measurement and visiting frequency," 2017 4th International Conference on Advanced Computing and Communication Systems [ICACCS], 2017, pp. 1-6, DOI: 10.1109/ICACCS.2017.8014650.

[14] Masud, M.A.H., Yong, J. and Huang, X., 2012, May. Cloud computing for higher education: a roadmap. In Proceedings of the 2012 IEEE 16th International Conference on Computer Supported Cooperative Work in Design [CSCWD] [pp. 552-557]. IEEE.

APPENDIX A

List of abbreviations used in this study:

No	abbreviations	The meaning of the abbreviation
1	ICT	Information and Communication Technology
2	RTC	Real-Time Computing
3	IAAS	Infrastructure As A Service
4	PAAS	Platform As A Service
5	SAAS	Software As A Service
6	OS	Operating System
7	PC	Personal Computer
8	PHP	Personal Home Page
9	MySQL	My Structured Query Language (database management system)