Towards Cloud Computing at IS Department, King Abdulaziz University

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Abstract

Cloud computing has gained tremendous attention over the past few years both in academic circles and computing professionals. The cloud computing cost efficiency, facilitation of collaboration and sharing of data, and its aptitude to advance access, would play a vital role in the classrooms of tomorrow. This paper highlights the importance of cloud computing in the undergrad curriculum at the Department of Information Systems (IS), King Abdulaziz University. The course design data, including course objectives and major topics are presented.

Keywords

Cloud computing, Course Material, Cloud Services, Curriculum

Introduction

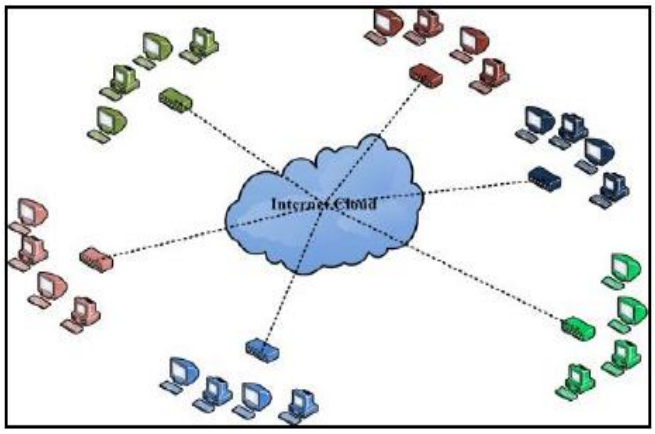
A Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically presented as one or more unified computing resource(s) based on service-level agreements established through negotiation between the service provider and consumers [1]. Cloud computing gets its name as a symbol for the Internet [6]. Usually, the Internet is symbolized in network diagrams as a cloud. In essence, cloud computing is created that permits a user to access applications that actually reside at a location other than user's computer or other Internet-connected device; most often, this will be a distant datacenter. Cloud computing course would play a vital role in the

curriculum of Information System (IS) Department due to its fast emergence in the field of computing and (Information Technology) IT. In this paper, we discuss the importance of the course and the material we may use while studying cloud computing.

Background

Cloud computing is an emerging field which enables convenient, on demand network access and allows for a shared pool of configurable computing resources (e.g. servers, storage, applications, and variety of computing services) that can be quickly provisioned and released with minimal management effort or provider interaction [2]. The basic idea of cloud computing is that the computing is "in the cloud". Usually, the Internet is symbolized in network diagrams as a cloud. The cloud icon stands for "all that other stuff" that put together the network to work. Figure 1 shows the cloud and accessed components. Cloud computing infrastructures comprise of services delivered throughout common centers and built on servers. Clouds usually appear as single points of access for user's computing needs and demands. As convenient as public services, once the client enter to the cloud, he/she can access any service from the Internet through any end devices like personal computers, personal digital assistants (PDA), 3G mobile phones or other terminal equipments [2]. The users generally do not need to worry about the problems related to the hardware/software upgrade to use the services. This shows that cloud computing will ultimately transform the traditional personal computer-based production model, and eventually revolutionize the information exchange mechanism. It is also convenient for telecommuters and traveling-remote users to simply login and utilize their applications and services, no matter wherever they are. Cloud computing topology consists of several basic elements: clients, the datacenter, and distributed servers [2]. Figure 2 depicts the elements this topology. Each element has a different

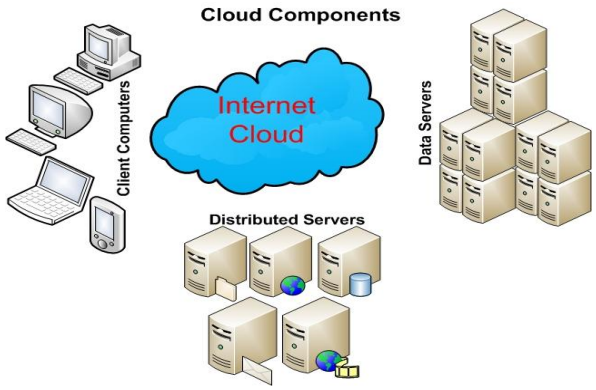
Figure1: Cloud Computing



functionality and plays a vital role in delivering a functional cloud based application. Clients in a cloud computing architecture play the same role that they might have in a common and plain network world. They are, in general, the computers (hosts) that just sit on your desk. But, they can be of any type, e.g. laptops, tablet computers, mobile phones, or PDAs. The cloud computing datacenter consists of a group of servers where the application to which

you subscribe is housed. Virtualizing servers are a growing and emerging trend in the IT world. They allow multiple virtual servers being run on one physical server.

Figure2. Cloud Components



Cloud Services

Services in cloud computing is the idea of being capable to use reusable, fine-grained components across a provider's network. Below, the cloud services are explained in detail.

Storage-as-a-Service

Storage-as-a-service is the ability to leverage storage that physically exists remotely but is logically a local storage resource to any application that needs storage [3]. This is mainly a primitive component of cloud computing and is controlled by the other cloud computing parts.

Database-as-a-service

Database-as-a-service provides the ability to leverage the services of a remotely hosted database, sharing it with anyone disguising as if the database is local. This offers all functionality of a local database, including table creation, data loading and data access; however, all this is done via cloud. Database-as-a-service also provides access to the latest and emerging databases like Oracle, Sybase, and Microsoft.

Information as a Service

Information as a Service offers resources like software and enterprise data available virtually anywhere. Information-as-a-Service makes possible for Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems, business intelligence tools, mash-ups, and portals to interact with matching data in real time. Thus creating a single source of truth for key domains – Information-as-a-Service offers the facility to establish and keep one trusted source of data for explicit work flows; everyone is on the same location. Information-as-a-Service facilitates business processes and customers to utilize the up-to-date data in critical applications [1-3].

Process-as-a-service

Process-as-a-service is defined as a remote resource that is able to connect many resources together to build business processes [2]. Process-as-a-service facilitates a method to combine other resources together to form a solution. Whereas your information and (Application Programming Interface)APIs possibly will be hosted within a cloud provider, or maybe on-premise, you would control this service to abstract and unite these resources together to form a business solution. We can consider the processes as a series of events that are required to occur in a definite order, leveraging any number of services and segments of data.

Integration-as-a-service

Integration-as-a-service is the aptitude to convey an entire integration stack from the cloud, together with interfacing with applications, semantic mediation, flow control, and integration design. Fundamentally, integration-as-a-service comprises most of the features and functions found within conventional Enterprise Application Integration (EAI). Now a day's most enterprises typically utilize more than one kind of EAI technology.

Integration-as-a-Service is based on reliable and secure underlying enterprise services. However, this is challenging to employ due to the need to manage the governance of those services as they transfer from planning through development and finally operation.

Testing as a service

Testing-as-a-service is the ability to test local or cloud-delivered systems using remotely hosted testing software and services [7]. It should be noted that while a cloud service requires testing unto itself, testing-as-a-service systems have the ability to test other cloud applications, web sites, and internal enterprise systems. However, they do not require a hardware or software footprint within the enterprise.

Cloud Infrastructure

In this section, the cloud infrastructure is explained both in depth and breath.

Private Cloud

Private cloud, also called internal cloud or corporate cloud, is a computing term for a proprietary computing architecture that facilitates hosted services to a limited number of people behind a firewall [6]. Generally private clouds are hosted by third parties.

Public Cloud

Public cloud is the cloud infrastructure made available to the general public or a large industry group and is owned by an organization selling cloud services [1-4]. A public cloud depends on the standard cloud computing model. In the public cloud, service provider makes resources available, e.g. applications and storage, accessible to the general public over the Internet. The services offered by public cloud may be free or available on a pay-per-usage model.

Community Cloud

Community cloud might be set up where a number of organizations have similar requirements, needs and seek to share infrastructure so as to take some of the advantages of cloud computing. The cloud infrastructure joint by numerous organizations and supports a specific community that has shared concerns (e.g., mission, security requirements and policies). Community cloud may be controlled and managed by the organizations or a third party.

Hybrid Cloud

A hybrid cloud is a cloud infrastructure which is a composed of two or more clouds like private, community, or public [6]. The constituent clouds are remained unique entities; however, they are bound mutually by standardized or proprietary technology that permits data and application.

Advantages

I. Cloud offers powerful computing and storage facility. It enables the support of a number of applications which are convenient and quick to retrieve the powerful computing and storage resources.

II. Cloud facilitates high resources availability. It allows real-time configuration, on demand resource allocation and efficient usage of accessible resources.

III. Cloud presents high security. It promises the users' data security to the maximum possible degree by depending on one or more data center.

IV. Cloud offers virtualization. Every application deployment environment and physical platform is administered, expensed, migrated, and backup through virtualization platform and practice.

Course design data

In this section, we present the course design data including course outline, course objectives and recommended books.

Course outline

The course outline has been designed carefully in order to cater the market trend, research trend and technology shift in information technology. We recommend the following main topics.

1) Fundamentals of cloud computing: definition, components, merits and demerits

2) Cloud services: storage, database, information, process, application, platform, integration, management/governance, testing and infrastructure

3) Cloud management and governance: people and processes, governance model and governance technology

4) Cloud design and deployment: platform selection, analysis and testing of the candidate platforms, the process of moving to the clouds, and deployment to the target platform

5) Selected topics

Course Material

Many books and reference guides are available on cloud computing. We recommend the following books, which broadly cover our course outline.

Text book: Cloud Computing and SOA Convergence in Your Enterprise by David S. Linthicum, Published by: Addison-Wesley

This comprehensive book helps define what cloud computing is and thoroughly explores the technologies, protocols, platforms and infrastructure that make it so desirable. It covers thorough technical information regarding the trend, supporting technology and methods, a step-by-step guide for doing a self-evaluation, and an approach to reinventing an enterprise.

Additional References

I. Cloud Computing: Principles, Systems and Applications, By Lee Gillam 1st Edition

II. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg, Andrzej Gościński , 1st Edition John Wiley & Sons

III. Pre-requisite : Fundamentals of Data Networks (CPIS-370)

This is an introductory course offered in the Department of IS, which provides a wide background of computer networks. This course is intended to provide basic knowledge of data communication, medium accessing protocols, local area networks, and an overview of the higher level protocols.

Course Objectives

The objectives and the goals of the course are:

I. Present the students with the basic knowledge, understanding, and skills necessary for designing, building, emerging and evolving IT systems and infrastructures to make use of cloud computing paradigm.

II. Enable the students to design and deploy cloud-enabled systems and deal with socio-technical problems involved in deploying innovative or migrating legacy systems on private, public, or hybrid Clouds.

III. Present the knowledge about the technical and non-technical features for developing Infrastructure-as-a-Service, Platform-as-a-Service, Software-as-a-Service, Storage-as-a-Service, Process-as-a-Service, Database-as-a-Service, Security-as-a-Service and Integration-as-a-Service.

Learning Outcome

Here we present the students learning outcomes in terms of application of subject, analysis and the knowledge learner will acquire in the completion of this course. We intend that by the completion of this course, the students will be able to:

I. Explain different concepts and mechanisms supporting Cloud computing and its possible impacts on businesses

II. Present a thorough description of technologies, advancement and approaches facilitating Cloud computing, e.g. service-orientation, Internet infrastructures, virtualization, distributed computing, multi-tenancy, resource provisioning techniques, and protocols.

III. Demonstrate and describe key aspects of building and migrating systems to Cloud, e.g. costs involved, potential profits, security concerns, regulatory issues and standards

IV. Formulate and implement a medium size system following the principles, ideology, practices, and methods for creating cloud-based systems.

V. Implement and apply architecture assessment approaches to thoroughly assess the designed solutions for required quality attributes for example security, privacy concerns, and performance.

VI. Assess and choose a suitable public cloud provider by applying the theoretical ideas and practical techniques from the course.

Conclusion

In this paper, we highlighted the importance of cloud computing in the curriculum of the IS Department at King Abdulaziz University. We designed the general course objectives, more specific course outcomes and course topics; reference books and other materials are also suggested. While designing this course it appeared to us that such a course might be offered as an elective course, rather than a core course because of its diversity. It is also suggested, however, that a separate specialisation track may be introduced in the IS curricula, focusing on a more in-depth knowledge in this area in cloud computing.

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