1. Using the formulae for the first software business model, find the year where the cumulative support expense equals that of the initial licensing fee *p*, where *p* = $12,000 per user, and *c = 0.40*. In how many years will the initial cost of software becomes 5% of the overall expenditure?

Answer:

Formulae for the first software business model:

Given,

p =one-time per-user license fee= $12,000 per user

c = support ratio coefficient = 0.40

m = years =?

Now,

CSE (Cumulative Support Expense) = p*c*m

we know that, CSE = p

Then, p =p*c*m

1 = 0.40*m

1/0.40 = m

m = 2.5 years.

Also, given IC (Initial Cost) =n*p= 5% of OE (Overall Expenditure)

OE = n*p(1+m*c),

IC = 0.05 * n*p(1+m*c)

n*p = 0.05*n*p(1+m*c)

1/0.05 = 1 +m*0.4

20 -1 =0.4*m

m = 19/0.4

m = 47.5 years.

2. In the definition of *Hybrid Cloud*, a term "Cloud bursting" is mentioned. Search the Web for its definitions. Do these definitions agree? If so, provide what you think is the best definition (you can rephrase it as you see fit). If not, explain the differences between the definitions.

Answer:

As per my Web searches, I definitely **agree** with the definitions. In cloud bursting we've got a one management environment or one version of application where we can deploy it into a private cloud or into public cloud through a one management interface, meaning that in a hybrid configuration where the web part can be deployed into a public cloud and database deployed into a private cloud which is important cause it makes simpler to manage ones or a company's IT infrastructure; and that basically means cloud bursting can be used for load balancing between clouds. For example, many sectors deal with spikes that can occur seasonally that can put more burden on private cloud, especially in case of Life sciences workflow or in financial sectors. (Faynberg, I., Lu, H.-L., & Skuler, D. (2016)).

Hybrid cloud to simply put it is a combination of two or more distinct clouds that have their unique entities that makes data and application movable and are constrained by standardized technology, or to simply put it, in order to take full advantage of the many cloud models in a way that optimizes cost and effectiveness companies and enterprises deploy a mix of public, private, or community clouds, known as hybrid cloud; and the most crucial step in realizing the full potential of a **hybrid cloud** is through the use of **cloud bursting**. (Irimia R, Gottschling M (2016)).

3. What are the essential differences between the *public* and *private* cloud that have made CIOs worry about legal consequences of Shadow IT? Read the original text of the US Government acts mentioned in the text (HIPAA and SOX) and summarize each in one paragraph.

Answer:

Shadow IT refers to applications that are in the company's IT network without the CIO's or IT department authorization for the application to be there. In Public cloud since it exists on the premises of the Cloud provider and the provider is responsible for the management and maintenance. Because these applications are often downloaded by employees to make their life easier as it is accessible over Public Cloud, and because the employees have begun using these apps directly without the knowledge of the IT department making the CIO more worried about not only the legal consequences of shadow IT but also the loss of control over personnel. ((Faynberg, I., Lu, H.-L., & Skuler, D. (2016)). There seems to be also notably security risks, as important datas are duplicated over in the Cloud. Since there is no need of approval of CIO as everything is

accessible in Public Cloud. A private cloud resides on company's intranet or data center where all of the company's data is exclusively used by a single organization. This can be great as private cloud offers increased level of security where everything can be monitored by CIO's or IT department making it easier to handle shadow IT. Taking these consideration CIO's can also been seen taking new approaches such as Virtual Private Cloud that helps the company to take advantages of Cloud but in a more controlled manner.
(Private vs. Public Cloud: What's the Difference? (2014, June 5)).
The U.S. Department of Health and Human Services ("HHS") issued the Privacy Rule to implement the requirement of the Health Insurance Portability and Accountability Act of 1996 ("HIPAA"). It was designed so as to improve the efficiency and effectiveness of health care by the use of electronic exchange of information with respect to financial and administrative transactions done by health plans, health care, and health care providers who transmit information electronically in connection with such transactions. The goal was to assure people that their individual information about their health is properly protected and not be used recklessly with the flow of information be it in electronic, oral, or written, and when needed be provided to promote high quality health care while protecting the public's health and wellbeing. (HHS Office of the Secretary, Office for Civil Rights, & Ocr. (2013, July 26).

The Sarbanes-Oxley Act created the Public Company Accounting Oversight Board to oversee the accounting industry on 07/24/2002 comprising of XI Titles stating rules about the audits, accountants responsibility, corporate responsibility, corporate fraud accountability and many more which is responsible for making United States a more attractive place to do business. From internal controls to protecting whistleblower, it required companies to publish a prospect about public traded stocks and the investment bank and company were legally responsible that also included audited financial statements. (Amadeo, K. (2019, October 27). (Oxley, & G., M. (2002, July 30).

4. Consider the case of the *Instagram* as described in the textbook. How many employees and customers did it have at the time of the purchase by Facebook? How much did Facebook pay for it? What was the value that the purchased business has generated in the first two years, and what were the factors that enabled generating this value?

Answer:

Facebook had bought Instagram that had 11 employees who were managing 30 million users for one billion dollars. Since, the company had no capital expense, no physical servers needed to be maintained or cared for as it had no physical infrastructure and only three people managed the infrastructure within the Amazon Cloud it garnered one billion dollars value in two years with little to no upfront investment in infrastructure or employees. ((Faynberg, I., Lu, H.-L., & Skuler, D. (2016)).

5. Familiarize yourself with the description of the *Amazon Elastic Cloud Computing* (http://aws.amazon.com/ec2/). What kind of a service model does it provide (i.e., SaaS, PaaS, IaaS, or a combination of these)? Please list the features that support your answer.

Answer:

Amazon Elastic Compute Cloud (Amazon EC2) is designed to make web-scale cloud computing easier for developers making web service providing secure, resizable compute capacity in the cloud. Amazon EC2 also provides with complete control of computing resources letting it run on Amazon's proven computing environment.

Generally, Infrastructure as a Service (IaaS) give users more controls and flexibility and Platform as a Service (PaaS) tend to be more opinionated but has less things to maintain and support, and given those characteristics, believing AWS deliberately avoid labeling their services with either IaaS or PaaS to prevent getting pigeonholed into a certain category . You can get virtual machines of any size and configuration and run variants of Linux or Windows on it. EC2 is typically billed by the hour and you pay for the time your virtual machine is up and running.

After searching in their documentation, finding very few references to those terms. Having said that, EC2 is IaaS and is probably the only AWS offering that falls into the IaaS category. Using EC2, AWS users can provision computer, networking and storage just by calling various APIs. Users can access the EC2 instances and their volumes as if they were provisioned in a non-cloud environment. The rest of AWS offerings are a mixture between PaaS (e.g. Elastic Beanstalk) or just "AWS Services' is IaaS (Infrastructure as a Service). A category of cloud services which provides

-capability to provision processing,
-storage,
-intra-cloud network connectivity services,
-and other fundamental computing resources of the cloud infrastructure.
This is because Amazon takes the responsibility of networking, storage, server and virtualization and the user is responsible for managing the Operating System, middleware, runtime, data and application. In PaaS aka Platform as a Service the user only needs to take care of data and application, the management of rest of the layers lies in hands of the service provider. AWS Elastic BeanStalk is PaaS. (Daly, D. J., & Daly, D. J. (1987)).

6. Read the article on Fog Computing provided in the lecture. Familiarize yourself with the OpenFog Consortium (www.openfogconsortium.org) and answer the following questions:

a. How many members does the consortium have?
Answer: The consortium has 57 members, founded in 2015 by **Cisco Systems, Intel, Microsoft, Princeton University, Dell, and ARM Holdings**. It has members across the North America, Asia, and Europe, including Forbes 500 companies and noteworthy academic institution

b. What is the definition (one sentence) of Fog computing according to the consortium?
Answer: A system-level horizontal architecture that distributes computing, storage, and networking closer to users, and anywhere along the Cloud-to-Thing continuum.

c. What is the goal of the consortium?
Answer: Goal of the consortium are:

- Technology: Develop, Solve, Identify and Create.
- Innovation: Foster, Initiate, Provide and Influence.
- Education: Gain, Promote, Evangelize and Educate.

More detailly the goals of OpenFog consortium are:

- Create customer-validated requirements for the development of holistic solutions for industry
- Initiate technical validation projects for these requirements

- Initiate new industry standards to help harmonize the technology landscape
- Provide an efficient platform for vendors, suppliers and industry organizations to jointly shape the future of Industrial IoT (IIoT) solutions

(Introduction and Overview at W3C Open Day. (n.d))
(Industrial Internet Consortium. (n.d.)).

7. Consider the example of the *Zing Interactive Media* and explain how you would launch the same service today using Amazon EC2. Specifically list the steps (and costs) you would avoid by doing so.

Answer:

Zing Interactive Media had a fresh idea back in 2000 about interacting with the content the audience would hear in radio through a simple voice command. Now, since it was 20 years back, they had to do a lot of things unlike today where it can be achieved through a classic Cloud-based SaaS solution. If I had to launch the same service in today's world through the service provided using Amazon EC2 I would:

- ➔ Not lease a secure space "cage", buy a server, rent T1 lines, or go through the hoops as Zing Media did,
- ➔ Only be able to focus on the interactive radio application,
- ➔ Also need not to hire a DBA or database administrator since our application could consume a database-as-a-service function,
- ➔ And lastly, would hire fewer developers like Instagram did, as building a robust scalable application would be as simple as defining the life cycle management rules in the relevant service of the Cloud provider.

((Faynberg, I., Lu, H.-L., & Skuler, D. (2016)).

8. Explain what *CPU pinning* is and how *Intel* supports it with API.

Answer:

The general concept of CPU pinning is that there is a physical CPU on the server and we want to exclusively assign this CPU to the VM (Virtual Machines). CPU pinning makes a VM only get a

CPU time from a specific CPU or a set of CPUs. Pinning is performed on each logical CPU of guest VM against each core ID in the host system. The CPU pinning information will be lost every time VM instance is shut down and restarted. CPU pinning is one of the best solutions to gain VM's performance.

Intel is providing API allowing the host to guarantee a certain percentage of CPU to a given virtual machine and this capability is effected by assigning a virtual machine to a given processor of so called CPU pinning as explained above and is exposed via the hypervisor and the Cloud provider's systems and can be utilized by the application. ((Faynberg, I., Lu, H.-L., & Skuler, D. (2016)).

9. Study the Amazon EC2 SLA. What service commitment (in percentage) does it guarantee? What is the bound on the downtime in a year?

Answer:

Amazon Compute Service Level Agreement (this "SLA") is a policy governing the use of the Included Services and applies separately to each account using the Included Services. Also, in the event of a conflict between the terms of the given SLA and the terms of the AWS_Customer Agreement or other agreement with the Amazon governing the use of their Services "Agreement", the terms and conditions of the given SLA apply, but only to the extent of such conflict. SLA guarantees a Monthly uptime percentage of at least 99.99% for Amazon EC2.

Amazon EC2 SLA is defined on a per data center (region in Amazon speak) basis instead of per instance. EC2 offers a 99.95% region availability rate (service guarantee). If a user is unable to access her instances in one region during a contiguous period of **five** minutes or launch replacement instances, the region is deemed to be unavailable during those five minutes. Bound downtime is around four and half hours and is half percentage in a year. A customer can claim a service credit anytime the service falls below the availability SLA in the last 365 days or since the last time a service credit claim was filed by the customer. The service credit is up to 10% of a customer's bill (excluding any one-time costs) for the instances affected by the outage.

(Compute. (n.d.)).

(of Australasia).?Dr. discussing varying points, burgs ... (n.d))

10. What is the "telecom-grade" service commitment? Who were the ETSI NFV Industry Specifications Group founders? List the areas where the NFV is expected to act. (Optional recommended reading: the ETSI NFV White Papers.)

Answer:

Telecom grade comes with a high cost of installation and maintenance of customized equipment which is a hardware engineered specifically for running in telecommunication network which is designed to live for over 15 years that will function 99.999% which is also known as nine of the times with not even 5 minute downtime a year.

There was a problem arising with the increasing competition and it was not only from within the telecom industry but also from web bases service providers and to address the problem seven of the world's leading telecom network operators joined together to create a set of standards that were to become the framework for the advancement of virtualizing network services, which included representatives of network operators worldwide who published a White paper, 52 other network operators along with telecom equipment, IT vendors, and technology consultants formed the ETSI NFV Industry Specifications Group (ISG).

The areas where the NFV is expected to act are:

- Operational Improvements: Network run with many vendors and spare parts are complex and is difficult to manage.
- Cost Reductions: The number of workers in telecom is larger than in the Cloud operator for managing and maintaining the infrastructure.
- Streamlining high-touch processes: The provisioning and scaling services required months while Cloud offering instant scaling.
- Reduction of development time: New services introduction happens instantly in the Cloud rather in telecom that would take 16 to 25 months.
- Reduction of replacement costs
- Reduction of equipment costs: Comparing prices with the related vendors to low the costs of replacing the parts.

((Faynberg, I., Lu, H.-L., & Skuler, D. (2016)).

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