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?

Ans:

Given, Cumulative Support Expense (CSE) equals that of the initial licensing fee (CSE = p).

CSE = p*c*m

where

P = Initial Licensing fee per user ($12,000 given value)

C = Support ratio coefficient (0.40 given value)

M = No. of years

Substituting the value of CSE with p, we get

- ⇨ p = p*c*m
- ⇨ c*m = p/p
- ⇨ c*m = 1
- ⇨ m = 1/c

Upon substituting the given value of c, we get

- ⇨ m = 1 / 0.40
- ⇨ **m = 2.5 years**

So, Cumulative support expense will be equal to initial licensing fee in 2.5 years.

Initial cost (**IC**) = p*n

Overall Expenditure (**OE**) = n*p(1+m*c)

No. of years when the initial cost of the software becomes 5% of the overall expenditure

IC = 5% of OE

- ⇨ IC = 0.05*OE
- ⇨ p*n = 0.05*n*p(1+m*c)
- ⇨ p*n / n*p = 0.05*(1+m*c)
- ⇨ 1+m*c = 1/0.05
- ⇨ 1+m*0.40 = 1/0.05
- ⇨ 1+m = 1/(0.05*0.40)
- ⇨ 1+m = 1/(0.02)
- ⇨ 1+m = 50
- ⇨ m = 50-1
- ⇨ **m = 49 years**

So, Initial cost of software would become 5% of the overall expenditure in 49 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.

Ans:

The mix of at least one public and private cloud condition is called a Hybrid cloud. Although public and private cloud situations make up a hybrid cloud, they are one of a kind but separate elements, changing between them is encouraged by encrypted application programming interfaces that help transmit assets and remaining tasks at hand. The design is isolated however yet associated, this permits numerous ventures to run critical tasks in the private cloud, remaining burdens that are less delicate to be in the public cloud and pull resources from either environment when needed. When there is a peak in IT requests, few configuration steps have been set-up between private cloud and public cloud.

The deployment model in which application runs in the private cloud, and later blasts into the public cloud when the demand in computing capacity increments is known as Cloud Blasting.

After reading a few articles on the internet, I came to the conclusion that Hybrid cloud and Cloud Bursting are related to each other.

(References: https://www.redhat.com/en/topics/cloud-computing/what-is-hybrid-cloud)

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.

Ans:

Shadow IT refers to Information Technology (IT) systems within an organization that is neither monitored or supported by the organization's IT department where as in case of a private cloud, all the tasks are monitored. It needs explicit approval from the IT department. Resources cannot be accessed with just permissions. The employees and the departments accessing the resources need to follow the set of rules and guidelines while accessing the resources over the cloud. Shadow IT can easily be compared to private cloud. Whereas in the case of a public cloud, each department and member can access the resources without any intervention from the IT department after the budget approval of the project in order to fulfil their requirements.

HIPAA is the acronym for the Health Insurance Portability and Accountability Act that was passed by Congress in 1996. The portion of HIPAA addressing the ability to retain health coverage is overseen by the California Department of Insurance and the California Department of Managed Health Care. HIPAA was established in order to privacy & security provisions for safeguarding medical data. HIPAA has 4 purposes:

- Provides the ability to transfer and continue health insurance coverage for millions of American workers and their families when they change or lose their jobs.
- Reduces health care fraud and abuse.
- Mandates industry-wide standards for health care information on electronic billing and other processes.
- Requires the protection and confidential handling of protected health information.

SOX is the acronym for the **Sarbanes–Oxley Act**, also known as the "Public Company Accounting Reform and Investor Protection Act" and "Corporate and Auditing Accountability, Responsibility, and Transparency Act". SOX bill contains eleven sections, was enacted as a reaction to several major corporate and accounting scandals. The sections of the bill cover responsibilities of public corporation's board of directors and add criminal penalties for certain misconduct.

(References: https://searchhealthit.techtarget.com/definition/HIPAA , https://www.dhcs.ca.gov/formsandpubs/laws/hipaa/Pages/1.00WhatisHIPAA.aspx & https://en.wikipedia.org/wiki/Sarbanes%E2%80%93Oxley_Act)

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?

Ans:

Instagram had 11 employees & 30 million customers at the time of the purchase by Facebook. Facebook paid an amount of 1 Billion dollars. Instagram generated a value of 1 Billion dollars in the first two years after the purchase was made. The factors that made generating this value possible are as follows:

1. Having no physical infrastructure
2. A total of 11 employees
3. Just 3 employees employed to manage the infrastructure within Amazon Cloud
4. No capital expense required
5. No physical servers needed to be procured and maintained and no technician paid to administer them.

Most of the company expenses were towards the customer acquisition and retention. The cloud Allowed Instagram to scale automatically as more users came on board without the service crashing the growth.

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

Ans:

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides secure, resizable compute capacity in the cloud. It is designed to make web-scale cloud computing easier for developers using simple web service interface.

Amazon Elastic Cloud Computing provides Infrastructure as a service (IaaS) model, than Platform as a Service.

Amazon EC2 has the following benefits:

Bare Metal instances: Amazon EC2 bare metal instances provide your applications with direct access to the processor and memory of the underlying server. These instances are ideal for workloads that require access to hardware feature sets (such as Intel® VT-x), or for applications that need to run in non-virtualized environments for licensing or support requirements.

Pause and Resume Your Instances: You can hibernate your Amazon EC2 instances backed by Amazon EBS, and resume them from this state at a later time. Applications that take a while to bootstrap and persist state into memory (RAM) can benefit from this feature.

GPU Compute Instances: Customers requiring massive floating point processing power will benefit from the next-generation of general-purpose GPU compute instances from AWS, Amazon EC2 P3 instances with up to 8 NVIDIA® V100 Tensor Core GPUs. P3 instances provide up to 1 petaFLOPS of mixed-precision, 125 teraFLOPS of single-precision and 62 teraFLOPS of double-precision floating point performance.

GPU Graphics Instances: Customers requiring high graphics capability will benefit from GPU graphics instances. The current generation GPU graphics instance, G3 instance, provides access to NVIDIA Tesla M60 GPUs, each with up to 2,048 parallel processing cores, 8 GiB of GPU memory and a hardware encoder supporting up to 10 H.265 (HEVC) 1080p30 streams and up to 18 H.264 1080p30 streams.

High I/O Instances: Customers requiring very high, low latency, random I/O access to their data can benefit from High I/O instances. High I/O instances are an Amazon EC2 instance type that can provide customers with random I/O rates over 3 million IOPS.

Dense HDD Storage Instances: Customers requiring very high storage density per instance, and high sequential I/O for data-intensive applications like Massively Parallel Processing (MPP) data warehouse, MapReduce and Hadoop distributed computing, and log and data processing can benefit from Dense Storage instances.

Optimized CPU Configurations: The Optimize CPUs feature gives you greater control of your Amazon EC2 instances on two fronts. First, you can specify a custom number of vCPUs when launching new instances to save on vCPU-based licensing costs.

Flexible Storage Options: Amazon EBS provides persistent, highly available, consistent, low-latency block storage volumes for use with Amazon EC2 instances. Each Amazon EBS volume is automatically replicated within its Availability Zone to protect you from component failure, offering high availability and durability.

Flexible Scaling: Amazon EC2 enables you to scale resources up/down within minimal timelines via the web service that the API calls depending on the application requirements.

Full control: Root access to each and every instance enables you to have complete control over them.

Flexible hosting: Amazon EC2 allows you to choose your configurations so that are optimal to your configurations. You can pick from a wide range of instance types, operating systems and software packages.

Compatible with other AWS: Amazon EC2 in conjunction with other AWS such as S3 or RDS will shape up a complete computing solution around different areas.

Reliable: The environments are highly reliable with 99.95 percent availability commitment.

Secure: The environments are highly secure and robust. The inbound/outbound network access is controllable via the network ACLs and security groups.

Cost-effectiveness: Amazon EC2 allows you to pay as you go, thereby reducing upfront investments.

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?

b. What is the definition (one sentence) of Fog computing according to the consortium?

c. What is the goal of the consortium?

Ans:

a.The consortium was founded by Cisco Systems, Intel, Microsoft and others in 2015 and now has 180 members across the North America, Asia, and Europe, including Forbes 500 companies.

b. Fog computing is a system-level horizontal architecture that distributes resources and services of computing, storage, control and networking anywhere along the continuum from Cloud to Things.

c. The goal of the OpenFog architecture is to facilitate deployments which highlight interoperability, performance, security, scalability, programmability, reliability, availability, serviceability, and agility.

The goal of the OpenFog Consortium is to create an open reference architecture for fog computing, build operational models and testbeds, define and advance technology, educate the market and promote business development through a thriving OpenFog ecosystem.

(References: https://www.iiconsortium.org/members.htm)

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.

Ans:

These are the steps I would have totally avoided if I were to launch Zing media today.

1. Rent space on hosting site.
2. Purchase and install server
3. Lease dedicated T1 lines.
4. Purchase networking gear
5. Purchase and install software (OS, DB, etc)
6. Purchase networking gear for installation in the **CAGE**
7. Purchase and install load balancer
8. Hire an IT team of networking experts, system administrators, database administrator in order to maintain the same.

I would have deployed the product on AWS.

(References: Cloud Computing Business Trends and Technologies)

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

Ans:

CPU pinning otherwise known as Processor affinity enables the binding and unbinding of a certain process or thread to a particular CPU or a range of CPUs as a result of which the tasks will be executed on the designated CPU.

This modifies the native queue scheduling algorithm in a symmetric multiprocessing operating system. A preemptive multitasking operating system consistently reschedules jobs on a multicore processor for optimal system performance. Intel is providing API that allows the host to guarantee a certain percentage of the CPU to a given virtual machine. The range of processes are exposed via the hypervisor and the Cloud provider's systems, and it can be consumed by the application.

(References: Cloud Computing Business Trends and Technologies, https://en.wikipedia.org/wiki/Processor_affinity)

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

Ans:

Amazon Compute Service Level Agreement is a policy governing the use of the Included Services and applies separately to each account using the Included Services. In the event of a conflict between the terms of this SLA and the terms of the AWS Customer Agreement or other agreement with us governing your use of our Services (the "Agreement"), the terms and conditions of this SLA apply, but only to the extent of such conflict. Capitalized terms used herein but not defined herein shall have the meanings set forth in the Agreement.

AWS will use commercially reasonable efforts to make the Included Services each available for each AWS region with a Monthly Uptime Percentage of at least 99.99%, in each case during any monthly billing cycle (the "Service Commitment"). In the event any of the Included Services do not meet the Service Commitment, you will be eligible to receive a Service Credit as described below.

The included services are EC2, EBS, ECS & Amazon fargate for ECS.

"Monthly Uptime Percentage" is calculated by subtracting from 100% the percentage of minutes during the month in which any of the Included Services, as applicable, was in the state of Unavailability. Monthly Uptime Percentage measurements exclude Unavailability resulting directly or indirectly from any Amazon Compute SLA Exclusion.

The bound on the downtime in a year is 5 minutes.

(References: Cloud Computing Business Trends and Technologies, https://aws.amazon.com/compute/sla/)

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.)

Ans:

Telecom grade means that the hardware is specifically engineered for running in telecommunications networks, designed to live in the network for over 15 years, and functional

99.999% of the time. Solving the issues required a new operational model that reduces costs and speeds up the introduction of new services of growth.

In order to intercept 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. On October 12th 2012 the representatives of 13 network operators worldwide published a white paper outlining the benefits and challenges of doing so and issuing a call for action.

The NFV is assumed to act in the following areas:

- Operational Improvements
- Cost Reductions
- Streaming high-touch processes
- Reduction of development time
- Reduction of replacement costs
- Reduction of equipment costs

(References: Cloud Computing Business Trends and Technologies)