Homework 1: CS 524

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,

p = $12,000 per user, and *c* = *0.40*

a. find the year where the cumulative support expense equals that of the initial licensing fee *p:*

Thus, CSE = p i.

Also, CSE= p * c * m ii. where p = Initial Licensing Fee
c = Support Ratio Coefficient
m = Number of years

Equating i. and ii.

p = pcm
m = 1/c
m= 1/0.4
m= 2.5 years

b. how many years will the initial cost of software becomes 5% of the overall expenditure:

Initial Cost = 0.05 * Overall Expenditure
n * p = 0.05 * n * p * (1 + m * c) where p = Initial Licensing Fee
c = Support Ratio Coefficient
n = Number of Licenses
m = Number of years

Therefore,
1 = 0.05 * 1(1 + m * c)
20 = 1 + m * 0.4
m = 19/0.4
m = 47.5 years

2. Give three examples of each, SaaS, PaaS, and IaaS.

ANS.

The examples for SaaS are:

1. Google Workspace
2. Dropbox
3. Salesforce

The examples for PaaS are:

1. Windows Azure
2. Google App Engine
3. Force.com

The examples for IaaS are:

1. Rackspace
2. Amazon Web Services (AWS)
3. Microsoft Azure

3. 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.

A Hybrid Cloud infrastructure is a composition of two or more distinct Cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., Cloud bursting for load balancing between Clouds).

In cloud computing, cloud bursting is a configuration that is set up between a private cloud and a public cloud to deal with peaks in IT demand. If an organization using a private cloud reaches 100 percent of its resource capacity, the overflow traffic is directed to a public cloud so there is no interruption of services.

In addition to flexibility and self-service functionality, the key advantage to cloud bursting is economical savings. You only pay for the additional resources when there is a demand for those resources - no more spending on extra capacity you're not using or trying to predict demand peaks and fluctuations. An application can be applied to the private cloud, then burst to the public cloud only when necessary to meet peak demands. Plus, cloud bursting can also be used to shoulder processing burdens by moving basic applications to the public cloud to free up local resources

for business-critical applications. When using cloud bursting, you should consider security and compliance requirements, latency, load balancing, and platform compatibility.

I entirely agree with the above statement and Cloud Bursting is an integral part of Hybrid Cloud since Hybrid Cloud is a combination of multiple cloud infrastructure and Cloud Bursting allows to set up the environment in a way which when requires more resources than available in the private space, in such situations, it can expand into Public cloud infrastructure like AWS which can give extra capacity when required and flexibility to use it whenever needed. Also, economically, it makes more efficient use of resources and thus saving on costs.

(References : https://azure.microsoft.com/en-us/overview/what-is-cloud-bursting/#:~:text=In%20cloud%20computing%2C%20cloud%20bursting,with%20peaks%20in%20IT%20demand.&text=An%20application%20can%20be%20applied,necessary%20to%20meet%20peak%20demands, Textbook: Cloud Computing: Business Trends and Technologies)

4. **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.

Each department of an organization has members accessing the cloud in a Public Cloud scenario to meet their own demands. The IT department does not intervene. When the department has an authorized budget, what equipment they choose is up to them. They no longer need the IT department or the CIO to authorize them. Over a public cloud, everything is available and open. In the case of a public cloud, Shadow IT can also not be stopped easily.

Whereas everything is monitored in a Private Cloud setup and needs formal IT department approval. Private Cloud services are monitored and cannot be accessed with permission. When accessing resources through the cloud, departments and staff need to adhere to the rules and regulations set by their IT departments. In the case of a Private Cloud, Shadow IT can also easily be challenged.

The Health Insurance Portability and Accountability Act of 1996 (HIPAA or the Kennedy–Kassebaum Act) is a United States federal statute. It was created primarily to modernize the flow of healthcare information, stipulate how personally identifiable information maintained by the healthcare and healthcare insurance industries should be protected from fraud and theft, and address limitations on healthcare insurance coverage. HIPAA preserves the rights and provide protections

to the individual's medical records and health plans, whether electronic, written, or oral. The security rule specifies a series of administrative, technical, and physical security to assure the integrity, availability, and confidentiality of information.

SOX stands for Sarbanes Oxley Act and known as "Public Company Accounting Reform and Investor Protection Act" and "Corporate and Auditing Accountability and Responsibility Act". SOX was introduced to protect investors from the possibility of fraudulent accounting activities by corporations. The SOX Act mandated strict reforms to improve financial disclosures from corporations and prevent accounting fraud. The new law set out reforms and additions in four principal areas:

1. Corporate responsibility
2. Increased criminal punishment
3. Accounting regulation
4. New protections

(References:https://en.wikipedia.org/wiki/Health_Insurance_Portability_and_Accountability_Act, Health Information Privacy | HHS.gov, Sarbanes–Oxley Act - Wikipedia, https://www.soxlaw.com/, https://www.investopedia.com/terms/s/sarbanesoxleyact.asp)

5. **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.

Facebook bought Instagram for one billion dollars. At the time of the purchase, Instagram had 11 employees managing 30 million customers. Instagram had no physical infrastructure, and only three individuals were employed to manage the infrastructure within the Amazon Cloud. There was no capital expense required, no physical servers needed to be procured and maintained, no technicians paid to administer them, and so on. This enabled the company to generate one billion dollars in value in two years, with little or no upfront investment in people or infrastructure.

(References: Textbook: Cloud Computing: Business Trends and Technologies)

6. **Familiarize yourself with the description of the *Amazon Elastic Cloud Computing* (http://aws.amazon.com/ec2/ (Links to an external site.)). 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. Amazon EC2's simple web service interface allows you to obtain and configure capacity with minimal friction.

Amazon Web Services is known primarily as an IaaS (infrastructure as a service), and with good reason: The Amazon cloud is practically synonymous with public cloud computing in general and with IaaS in particular. Yet, many of the services available in AWS are comparable to PaaS (platform as a service) offerings. The key distinguishing feature between an IaaS and a PaaS is the type of service. In an IaaS, customers typically work with virtual machines that they configure themselves. In a PaaS, customers work with services created and maintained by the PaaS provider. AWS has a mix of both. Its features are:

- Distributed Services:
  Like in IaaS, the resources are distributed like servers, storage, network, operating systems, etc. It provides the user with very strong working environment by combining all these resources. The client need not to purchase any of these but can have full control to use and deploy these resources.

- Elastic Scaling:
  The web service manages the resources more efficiently for high performance. Means, the resources capacity can be scaled both up and down according to the requirement. If there is a high demand of the resources, the web service scales up the resources quickly to fulfill the demand and vice versa.

- Complete Control:
  Amazon EC2 provides the complete computing control to customer. Like in IaaS, user have the control processing, storage, networks and other fundamental computing resources and the user can deploy and run arbitrary software, which can include operating systems. The user does not have to manage the underlying cloud infrastructure but has control over the resources.

- Multiple Users:
  Like IaaS, Amazon EC2 allows multiple users means all the computing resources (like computing power, memory size, etc.), servers or storages, maintaining the privacy and security, and other instances are available to many users at the same time. This feature allows the economical use of the resources.

- Varied Pricing:
  The price of using the resources in an IaaS is not fixed. The customer must pay depending upon the usage. There are no minimum charges; the prices are varied according to the use of the resources. This leads to controlled expenditure whenever the services are not in demand. This makes it well suited for workloads that are temporary, experimental or changes unexpectedly.

(References: Amazon EC2, https://www.investopedia.com/articles/investing/011316/what-amazon-web-services-and-why-it-so-successful.asp, https://www.business.com/reviews/amazon-web-services-paas/, https://en.wikipedia.org/wiki/Amazon_Web_Services)

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.

If we were to launch the *Zing Interactive Media* service today using Amazon EC2, we would avoid:

a. Renting/Buying server or “Cage”
b. Renting/Buying hosting space
c. Anticipating peak use and make redundant resource setup and associated costs also while going over capacity in some cases.
d. Buying associated hardware/software and equipments like servers, racks etc.
e. Making Vendor and support contracts and also hiring an IT Team
f. Leasing T1 lines

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

ANS.

CPU pinning is the ability to run specific virtual machine’s CPU on specific physical CPU in a specific host. Processor affinity, or CPU pinning or "cache affinity", enables

the binding and unbinding of a process or a thread to a central processing unit or a range of CPUs, so that the process or thread will execute only on the designated CPU or CPUs rather than any CPU. This can be advantageous if the task has a significant cache utilization because changing cores on different scheduling passes would cause numerous cache misses. With a pinned task, those turn into cache hits.In some implementations, CPU pinning also precludes other tasks from being assigned to the core, further guaranteeing performance.

Intel is providing API that allows the host to guarantee a certain percentage of the CPU to a given virtual machine. This capability, affected by assigning a virtual machine to a given processor or a range of processes is exposed via the hypervisor and the Cloud provider's systems, and it can be consumed by the application.

(References: https://www.quora.com/What-is-CPU-pinning, https://en.wikipedia.org/wiki/Processor_affinity, https://networkbuilders.intel.com/docs/CPU_Pinning_With_Openstack_nova.pdf)

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.

This Amazon Compute Service Level Agreement (this "SLA") is a policy governing the use of its Services and applies separately to each account using its Services. 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 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.

Monthly Uptime Percentage	Service Credit Percentage
Less than 99.99% but equal to or greater than 99.0%	10%
Less than 99.0% but equal to or greater than 95.0%	30%
Less than 95.0%	100%

The bound on the downtime in a year is 0.01% that is 0.876 hours or 52.56 minutes

(References: Amazon Compute Service Level Agreement)

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

(1) specifically engineered for running in telecommunications networks,

(2) designed to live in the network for over 15 years, and

(3) functional 99.999% (the "five nines") of the time (i.e., with about 5 minutes of downtime per year).

This comes with a high cost of installation and maintenance of customized equipment. Solving this problem requires a new operational model that reduces costs and speeds up the introduction of new services for revenue growth.

To tackle this, 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 12, 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. Soon after that, 52 other network operators—along with telecom equipment, IT vendors, and technology consultants—formed the ETSI NFV Industry Specifications Group (ISG).

The areas of action are as following:

a. Operational improvements

b. Cost reductions

c. Streamlining high touch processes

d. Reduction of development time

e. Reduction of replacement costs

f. Reduction of equipment costs

(References: Textbook: Cloud Computing: Business Trends and Technologies)