Indian Institute of Technology Patna

Department of Computer Science and Engineering

CS565- CLOUD COMPUTING

Mid-Semester Assignment

February 25, 2022

Time: 24 hours

All questions are compulsory. **Maximum Marks – 70**

Objectives: **(1x10= 10 Marks)**

1. A typical data center consists of

   (a) Compute Node (b) Network Topology

   (c) Software Services (d) All of the above

2. A _____ consists of multiple autonomous computers, having its own memory, communicating through _____.

   (a) Distributed System; Message Passing

   (b) Cloud Computing; Message Passing

   (c) Distributed System; Data Center

   (d) Cloud Computing; Data Center

3. Moore's law indicates that network bandwidth has doubled each year in the past.

   (a) True

   (b) False

4. _____ focuses on a business model in which customers receive computing resources from a paid service provider.

   (a) Utility Computing (b) Distributed computing

   (c) Grid Computing (d) Cluster Computing

5. An industry player wants to deploy its own cloud by using a webscale service provider's infrastructure. What type of cloud is this?

   (a) Private (b) Edge

   (c) Hybrid (d) Public

6. Which factors enable Network Slicing automation?

   (a) Network data analytics (b) Artificial intelligence

   (c) Machine learning (d) All of the above

7. Which of the following statements regarding the SDN Controller is correct?

   (a) It introduces a layer of network awareness needed for dynamic resource management.

   (b) It has end-to-end Overlay and Underlay network topology and latest devices information.

   (c) It can optimize cross-domain network resources.

   (d) All of the above

8. Which of the following enables 5G to have the capacity for adaptation?

   (a) Control / User Plane separation and the distributed UPF.

   (b) Network Slicing feature and the Network Slice Selection Function (NSSF).

   (c) Service Based Architecture (SBA) and the Network Exposure Function.

   (d) All of the above

9. Which of the following factors makes security such a major issue for 5G?

   (a) Massive amount of connected devices

   (b) Software-based technologies

   (c) Highly sensitive applications, such as distant surgery

   (d) All of the above

10. List out the components of the 5G core architecture.

    (a) Application Function (AF) (b) Network Slice Selection Function (NSSF)

    (c) Data network (DN) (d) All of the above

Short Answer Questions: **(3x10= 30 Marks)**

11. What are some problems with Tap-and-Emulate processor virtualization? How does Binary Translation improve upon these problems?

12. Briefly discuss the different models for Device Virtualization.

13. What is a Linux Container? Briefly discuss the advantages of using containerized applications over VM-based applications?

14. Why is Hotspot detection required in Data Centers? What is the role of Hotspot Mitigation?

15. Consider that an application running on a single cloud server is modeled using the G/G/1 queuing model. The SLA defines a desired mean response time of 1.5 seconds. The 10 most recent service times (in seconds) are obtained from server logs as –

1.1
0.9
1.2
0.8
1.3
0.7
1.4
0.6
1.2
0.8

Assuming the inter-arrival time of service request follow a Gamma Distribution with shape(a) = 2 and rate(b) = 1, find out the factor by which the current CPU capacity of the server should be scaled so as to service a peak request arrival time of 1 request per second.

16. List out the benefits of using Microservices based Architecture.

17. What are the factors you should consider while choosing a right cloud service provider.

18. Explain Grey-box and Black-box monitoring.

19. Compare the two approaches to address the problem of networking VMs.

20. Explain the stages of live VM Migration.

Long Answer Questions: **(30 Marks)**

21. Suppose you are running a start-up company and wishes to run a service for *M* months and requires following services: 128 servers (1024 cores) and 524 TB storage. Considering the cloud service provider costs: $0.12 per GB month $0.10 per CPU hour; and to own a system it will cost $349 K per *M* for storage and $7.5 K (includes 1 sys-admin/ 100 nodes). Explain the breakeven analysis and breakeven points in terms of cost and months; and which one would you prefer? **(5 marks)**

22. Consider a scenario where a company X wants to use a cloud service from a provider P. The service level agreement (SLA) guarantees negotiated between the two parties prior to initiating business are as follows:
    - Availability guarantee: 99.5% time over the service period
    - Service period: 30 days
    - Maximum service hours per day: 15 hours
    - Cost: INR 2500 per day

    Service credits are awarded to customers if availability guarantees are not satisfied. Monthly connectivity uptime service level are given as:

Monthly Uptime Percentage	**Service Credit**
<99.5%	15%
<99%	25%

    However, in reality in was found that over the service period, the cloud service suffered five outages of durations: 5hrs, 30mins, 1hr 30mins, 5mins, and 2hrs 30mins, each on different days, due to which normal service guarantees were violated. If SLA negotiations are honored, compute the effective cost payable towards buying the cloud service. **(5 marks)**

23. An organization ABC needs to support a spike in demand when it becomes popular followed potentially by a reduction once some of the visitors turn away. The company has two options to satisfy the requirements which are given in the following table:

(3 + 3 + 4 marks)

Expenditure	In-house server (INR)	Cloud servers (INR)
Purchase cost	70000	-
Cost/hour (over three year span)	-	7.00
Efficiency	40%	80%
Power and cooling (cost/hour)	30.00	-
Management cost (cost/hour)	20.00	1.00

(a) Calculate the total cost/effective-hour for both options.

(b) If the company wants to make its service available to the customers throughout the day (for over three years) and aims at earning daily revenue of INR 3000, calculate the expected profits if either of the approaches are followed.

(c) Calculate the modified efficiency of the in-house server, so that the in-house cost is equal to the cloud cost.

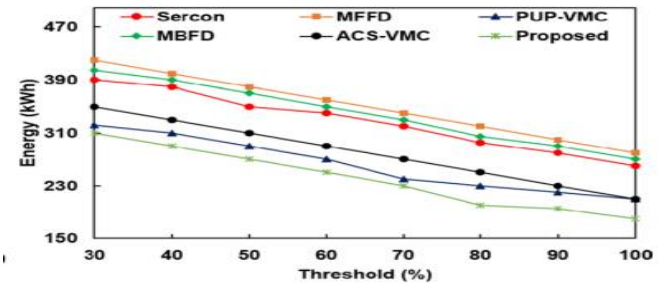
24. Energy consumption analysis in Data Center: (Refer to paper discussed in class titled Deep learning based multivariate resource utilization prediction for hotspots and coldspots mitigation in green cloud data centers) PMs' energy consumption relies on the utilization of resources mainly memory, network bandwidth, CPU, etc. However, existing researches reveal that the CPU utilizes more power than other resources. Hence, we represent the PM's resource usage by its CPU usage. **(2 + 2 + 3 + 3 marks)**

(a) Write the formula for estimating energy consumption in PM.

(b) As compared to the energy consumption caused by different algorithms, the best approach uses a lesser amount of energy, as represented in Fig shown below. State the heuristics for using less energy consumption.

(c) Explain how the energy consumption of PMs is further optimized via packing the VMs into the most loaded PMs

(d) Explain your own Deep Learning approach for reducing energy consumption



Comparison of the energy consumption