Semester - 8th (B. Tech.)   Full Marks - 30 16.5 / 30   Duration - 01:30 hours

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Answer all 3 (Three) Questions. All Questions carry same marks. $(3 \times 10 = 30$ Marks)

1. (a) Consider the peak computing demand for an organization is 120 units. The demand as a function of time can be expressed as:

$$D(t) = \begin{cases} 60sin(t), & 0 \le t < \frac{\pi}{4} \\ 50sin(t), & \frac{\pi}{4} \le t < \frac{\pi}{2} \\ 40sin(t), & \frac{\pi}{2} \le t < \frac{3\pi}{4} \\ 30sin(t), & \frac{3\pi}{4} \le t < \pi \end{cases} \qquad (1)$$

The resource provisioned by the cloud to satisfy current demand at time t is given as:

$$R(t) = D(t) + \delta\left(\frac{dD(t)}{dt}\right) \qquad (2)$$

where, δ is the delay in provisioning the extra computing resource on demand. The cost to provision unit cloud resource for unit time is 0.9 units. Calculate the penalty (Penalty: Either pay for unused resource or missing service delivery). Assume the delay in provisioning is $\frac{\pi}{12}$ time units and minimum demand is 0.

Hint: (1) Penalty cost $\propto \int_0^\pi |D(t) - R(t)| dt$, (2) $R[0,\pi] = \int_0^\pi D(t)dt + \delta \int_0^\pi \frac{dD(t)}{dt} dt$ (5 marks)

(b) Consider a scenario where a company X wants to use a cloud service from a provider P. The service level agreement (SLA) negotiated between the two parties prior to initiating business is as follows.

- Availability guarantee: 99.5% time over the service period
- Service period: 30 days
- Maximum service hours per day: 20 hours
- Cost: INR 100000 per day
- Service credits are awarded to customers if availability guarantees are not satisfied.

The monthly connectivity uptime service level is given as follows.

Monthly Uptime Percentage	Service Credit
<99.5%	15%
<99.0%	25%
<98.5%	35%
<98.0%	45%

In reality, it was found that over the service period, the cloud service suffered four outages of duration: 1 hour 35 minutes, 2 hours 20 minutes, 3 hours 45 minutes and 4 hours 45 minutes, each on different days, due to which normal service guarantees were violated. If SLA negotiations are honored (except Q. No. (iii)), calculate the following things.

(i) Total outages in minutes

(ii) Total availability in minutes

(iii) Total cost if SLA negotiations are not honored

(iv) SLA violation cost by taking the above table data

(v) Effective cost payable towards buying the cloud service. $(1 + 1 + 1 + 1 + 1 = 5$ marks)

× 2. (a) Define the different criteria to discriminate a normal service and the service delivered in the
4·5 cloud computing style. How can you say that interoperability and portability are the challenges

of cloud computing? What is the difference between elasticity and scalability in cloud computing? $(2 + 2 + 1 = 5$ marks$)$

3✗(b) Why standardization is essential in a SLA? If you are a policy maker, what are the criteria you will consider? Suppose you have startup company and you have just started the business. Specify the possible challenges when moving your business to the cloud? $(2.5 + 2.5 = 5$ marks$)$

3. (a) Let us assume that the base price for utilizing a resource at node j is \$10. The maximum units and the remaining free units of the resource at the same node j for the deadline duration of request i is 100 and 50, respectively.

(i) Determine the utilization price of a resource at the same node j for the required deadline of request i. (1 mark)

2✗(ii) Determine the price using Libra + \$Max, Libra + \$Min and Libra + \$Auto mechanisms. Assume that $\alpha = 2$ and $\beta = 5$. (3 marks)

1✗✗(iii) Determine the price using FixedMax and FixedMin mechanisms. (1 mark)

3✗(b) Discuss the cloud computing architecture with a suitable diagram. (5 marks)

Wishing you all the best on your exam!

National Institute of Technology Mizoram
End-Semester Examination, Even - 2022-23
Cloud Computing (CSL - 1801)
Full Marks: 50

B. Tech. 7th Sem CSE

Duration: 02:30 Hours

Answer All Questions.   (5 × 10 = 50 Marks)

1. (a) In a MapReduce framework, consider the HDFS block size is 64 MB. We have three files of size 64 KB, 65 MB and 127 MB. How many blocks will be created by Hadoop framework? Assume that the number of replicas is 3. Suppose there are four nodes in a cluster. The idle power consumption of each node is 105 watts. If a node hosts eight virtual machines (VMs), then the power consumption of that node is 170 watts. Similarly, if a node hosts two VMs, then the power consumption of that node is 138 watts. Consider the following scenarios. (i) The number of VMs in the four nodes is 8, 0, 0 and 0, respectively. (ii) The number of VMs in the four nodes is 2, 2, 2 and 2, respectively. Find the total power consumption in both scenarios and choose the best one. (2.5 + 2.5 = 5 marks)

   (b) Write the pseudo-codes (for map and reduce functions) for calculating the average of a set of integers in MapReduce. Suppose $A = (10, 20, 30, 40, 50)$ is a set of integers. Show the map and reduce outputs. (2.5 + 2.5 = 5 marks)

2. Find the makespan and average resource utilization of the following algorithms using the expected time to compute (ETC) matrix (in seconds) as given below. (1) Minimum execution time (2) Minimum completion time (3) Min-Min (4) Max-Min (5) Sufferage. Note that if there is a tie, then the task is assigned to cloud 1. (2 + 2 + 2 + 2 + 2 = 10 marks)

Table 1: An ETC matrix with 7 tasks and 2 clouds

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7
Cloud 1	23	24	12	24	20	11	14
Cloud 2	18	25	25	12	25	25	17

3. (a) Find the t-level, b-level, s-level, critical path, and ALAP of the below application. Note that each task's computation time is shown at the top of the node. (1 + 1 + 1 + 1 + 1 = 5 marks)
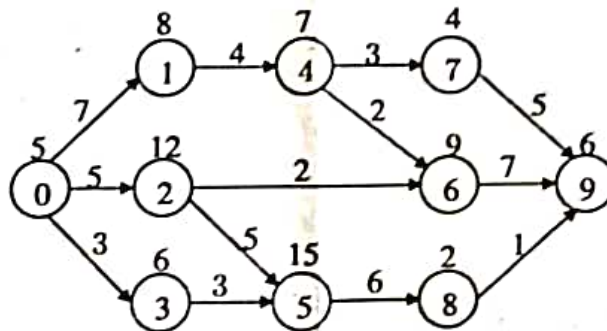

Figure 1: An application with 10 tasks.

   (b) Consider a scenario where a company X wants to use a cloud service from a provider P. The service level agreement (SLA) negotiated between the two parties prior to initiating business is as follows.

   - Availability guarantee: 98.5% time over the service period
   - Service period: 30 days
   - Maximum service hours per day: 22 hours
   - Cost: INR 12500 per day
   - Service credits are awarded to customers if availability guarantees are not satisfied.

   The monthly connectivity uptime service level is given as follows.

Monthly Uptime Percentage	Service Credit
<98.5%	5%
<98.0%	15%
<97.5%	25%
<97.0%	35%

In reality, it was found that over the service period, the cloud service suffered five outages of duration: 3 hours 35 minutes, 1 hour 15 minutes, 5 hours 20 minutes, 35 minutes and 3 hours 45 minutes, each on different days, due to which normal service guarantees were violated. If SLA negotiations are honored (except Q. No. (iii)), calculate the following things.

    (i) Total outages in minutes

    (ii) Total availability in minutes

    (iii) Total cost if SLA negotiations are not honored

    (iv) SLA violation cost by taking the above table data

    (v) Effective cost payable towards buying the cloud service. $(1 + 1 + 1 + 1 + 1 = 5$ marks$)$

4. Consider the following applications with their ETC matrix that are submitted to three different clouds. The first and third applications are submitted in best-effort (BE) mode, whereas the second application is submitted in advance reservation (AR) mode. Find the Gantt chart, makespan and average resource utilization by applying the round-robin algorithm (follow numeric order in each application) and the cloud list scheduling algorithm. $((3 + 1 + 1) \times 2 = 10$ marks$)$
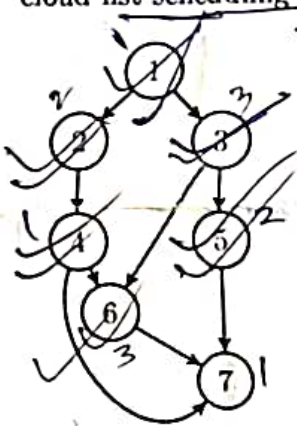
93.44%

89.79%.
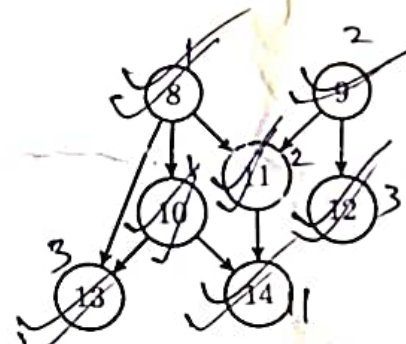
Figure 2: Application 1 (BE),
Arrival Time 0

Figure 3: Application 2 (AR),
Arrival Time 10
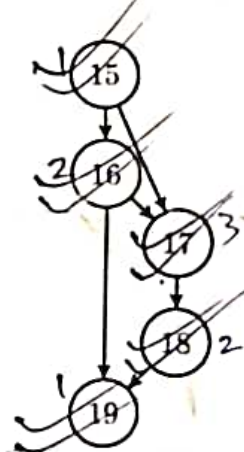
Figure 4: Application 3 (BE),
Arrival Time 15

Table 2: An ETC matrix with 19 tasks and 3 clouds

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Cloud 1	5	8	4	10	2	9	3	8	6	2	8	7	7	8	6	5	6	2	5
Cloud 2	7	3	2	7	3	3	2	3	5	4	10	4	6	4	4	8	7	3	2
Cloud 3	9	7	3	6	5	7	4	5	9	8	5	9	4	8	7	10	5	4	

5. (a) Describe with the help of examples the various service models and deployment models of cloud computing. (Given one real example of each type of service model and one example situation where each type of deployment models could be used.) $(2.5 + 2.5 = 5$ marks$)$

(b) Compare between cloud computing, cluster computing and grid computing. What is meant by "economies of scale" and how it plays an important role in determining whether an organization should move towards a cloud-based solution instead of an in-house solution? $(2.5 + 2.5 = 5$ marks$)$

Wishing you all the best on your exam!