Indian Institute of Technology Guwahati
Department of Computer Science and Engineering
Course: CS528-HPC,   End Semester Examination,   Mode: Online,
Date: 8th June 2020, Timing: 10.00AM to 8.00P.M.

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- There are 100 data set for each questions. You need to use the data set Nth data set, where N is the last two digits of your Roll Number. As the answers will be evaluated by software, so don't use others data set.
- Calculation using other data set will not be evaluated. Data sets are available in **www.iitg.ac.in/asahu/cs528/ES-DataSet/**. You are allowed to use a calculator, internet, books and any other material. You should not talk with any of CS528 peers: expected.
- Write eight lines of numeric answers in plain text and send it to asahu@iitg.ac.in with the subject "HPC-ES-RollNo". Before 8.00 PM of 8th June 2020.
- Format of answers:
    Q1: <ANS1> <ANS2>
    Q2: <ANS1>..

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1. **[4 Marks, AC and Energy Minimization in Cloud]** Suppose N persons need to be transported from **Guwahati Airport to IIT Guwahati**. Due to **COVID-19 restriction**, only a 30% load to a vehicle is allowed [*which is similar to the scenario where 30% of cores of servers of a rack are switched on in hot summer to reduce huge AC power cost*]. There are two kinds of vehicles, and these are Mini-BUS (M) and BUS (B). The capacity of Mini-BUS and BUS is 30 and 60 respectively. The cost of hiring a Mini-BUS is Rs 1000 and Rs 50 per passenger. Similarly, the cost of hiring a BUS is Rs 1500 and Rs 50 per passenger. Calculate the minimum prices need to pay for the transportation of all the N persons with **COVID-19 restriction** and **without COVID-19 restriction** (both Mini-BUS and BUSs will operate with full capacity). The driver of a bus is not a passenger and capacity excludes the driver.

   [*Hint: N<=30 Sol is 1M, N>30&&N<=60 Sol is 1B, N>60&&N<=90 Sol is 1M+1B, N>90 && N<=120 Sol is 2B. But this need to generalized to N and calculate total cost*]

   <ANS1> <ANS2>

2. **[4 Marks, Profit Maximization in Cloud]** The airline **DHAKKAN** generally does 10% overbooking of tickets assuming that 10% of passengers will not turn up at the time of flight. The capacity of a **DHAKKAN** flight is 40 and the cost per ticket to **DHAKKAN** is Rs 2000/-. If a passenger does not get a seat in the flight then the airline arranges alternate flight and pays Rs 3000/- for that customer in arranging alternate flight. Given the number of tickets, prices of each ticket for each customer, and the number of people who turn up for that flight, calculate the profit of the **DHAKKAN** airline. The price paid for the ticket for all the passengers is given in the data set.

   <ANS1>

3. **[3 Marks, Resource Prediction in Cloud]** Suppose **Bejan Daruwalla** got contract to predict the number of daily customer for **PIZZA HUT Guwahti**. **Bejan Daruwalla** uses EWMA Prediction with **α=0.5** to predict the number of daily customer. Calculate the average prediction error for given observed data. Assume initial estimated as 0 values. The error for the first prediction is same as first observed value. Observed values of all the instants are given serially in the data set.

   <ANS1>

4. **[4 Marks, Interference Aware Scheduling in Cloud]** **Prajapati the God of Marriage** knows the efficient solution to the problem of marriage of couple. He chooses two persons, one male and one female in such way that they should live happily. Suppose there are 10 males and 10 females. Each person is associated with two characteristics (a) level of aggression (LA) and (d) level of spending (LS) attitude. **Prajapati** wants to **minimize the maximum of unhappiness** among all the couple. The unhappiness of a couple is calculated as simple sum of aggressions values and spending attitude values of both the persons. Calculate value of minimized maximum unhappiness for the given data in **doing the match making**.

    [Relation to HPC: Tasks with same execution time but with different CPU utilization (CPU bound level) and memory utilization (Memory/IO bound level) needs to be scheduled on server with two processors, such that there will be minimum interference]

    <ANS1>

5. **[6 Marks Scheduling in Cloud]** Given 10 independent tasks that need to be executed on three homogeneous processors using methods (a) List Scheduling (in given order in the data set, lower index processor is preferred if load is same), (b) LPT rules (lower index processor is preferred if load is same), and (c) Preemptive scheduling. Calculate C_{max} for all three methods of scheduling. The execution time of all the 10 tasks is given in the data set.

    <ANS1> <ANS2> <ANS3>

6. **[4 Marks, Server Problem of Energy Minimization]** Given twenty with tasks execution time and deadlines need to schedule on infinite set of the homogeneous processor. The processor power consumption is given by $P = P_s + \alpha.f^3$, where the value of f ranges from 0 to 1 continuously. We need to schedule all the tasks on the processors without missing their deadlines and minimize the total energy consumption. Calculate the total energy needed for the schedule for the given data. Data set consists of P_s, α, and execution times, deadlines of the twenty tasks. Specified execution time is the execution time when processor execute at frequency f=1.

    <ANS1>

7. **[3 Marks, Reliability in Scheduling Cloud Tasks]** Given an application with 10 independent tasks, and two homogeneous processors with different failure rate f_1 and f_2. The tasks are scheduled in processors using LPT rules. Calculate the reliability of the application for this schedule of the tasks on the given processor. The data set consists of f_1, f_2, and execution time of all the tasks.

    <ANS1>

8. **[4 Marks, Cost Aware Scheduling in Cloud]** Given an application represented in 7 nodes complete binary out-tree given in the Figure. We need to schedule the application with minimum cost with meeting the end to end deadline **D** on a Cloud with infinite number of VMs. Cost of VMs is characterized by $Cost(S)=200+50*S^2$, where S is the speed of VM and it ranges from 1 to 10 with the step of 1. The execution time of nodes is given with speed $S=1$ and execution time decrease with high speed with a multiplication factor of $1/S$. The data set consist of the execution time of nodes in serial order with $S=1$ and a common end to end deadline D.

    <ANS1>