USTM

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Parallel Computing Exame

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Question 1

1. **Scenario Description**:
   * We have a metro station located in a refuge camp in India.
   * The population in the area is **900 million**.
   * The metro train can accommodate **only 1000 people** at a time.
   * There are **4 rail lines** (tracks) available.
   * **10 trains** operate on each rail line, going from the station to various destinations.
   * Additionally, there are **10 trains** returning from their destinations back to the station.
2. **Computer Concepts and Optimization**:
   * **Optimal Passenger Distribution**: The challenge here is to efficiently distribute passengers across the available trains and rail lines to minimize overcrowding and ensure smooth operations.
   * **Resource Management**:
     + **Train Scheduling**: Optimize the train schedules to evenly distribute passenger loads throughout the day. Consider peak hours, off-peak hours, and train frequency.
     + **Platform Management**: Ensure that passengers waiting on the platform are informed about train occupancy rates and can make informed decisions about which train to board.
     + **Security Queues**: Optimize the number and speed of security queues (ticket checks, baggage screening, etc.) to prevent bottlenecks during boarding.
     + **Passenger Flow Modeling**: Use simulation tools (such as Anylogic) to model passenger behavior, train arrivals, and platform congestion.
     + **Data-Driven Decision Making**: Collect data on passenger flow, train occupancy, and waiting times. Use this data to make informed decisions about train schedules and platform management.
     + **Safety and Comfort**: Prioritize passenger safety and comfort by avoiding overcrowding and ensuring efficient boarding and alighting processes.
3. **Human Solution**:
   * As a station manager, I would:
     + **Monitor Passenger Flow**: Observe passenger flow patterns during different times of the day. Identify peak hours and adjust train schedules accordingly.
     + **Display Train Occupancy**: Install digital displays on the platform showing real-time train occupancy rates. Passengers can choose less crowded trains.
     + **Coordinate with Train Operators**: Communicate with train operators to ensure timely departures and arrivals. Avoid long gaps between trains.
     + **Security Queue Optimization**: Optimize the number of security queues based on passenger volume. Speed up security checks without compromising safety.
     + **Emergency Protocols**: Have contingency plans for emergencies (e.g., medical situations, overcrowding). Evacuation procedures should be well-defined.
     + **Feedback and Adaptation**: Collect feedback from passengers regularly. Use this feedback to fine-tune operations and improve passenger experience.
4. **Expected Outcome**:
   * With an optimized system, passengers will experience shorter waiting times, less overcrowding, and smoother boarding processes.
   * Train operators will efficiently manage train schedules, leading to better resource utilization.
   * The metro station will become a reliable and comfortable mode of transportation for the large population in the refuge camp.

Question 2

1. **Worst Scenario**:
   * **Overcrowding**: In the worst-case scenario, all 900 million people in the refuge camp decide to use the metro simultaneously. Since the train can accommodate only 1000 people at a time, chaos ensues.
   * **Platform Congestion**: The platform becomes overcrowded, making it difficult for passengers to board or alight from the trains.
   * **Long Waiting Times**: Passengers have to wait for hours to get on a train due to the massive demand.
   * **Safety Risks**: Overcrowding poses safety risks, including stampedes, health hazards, and security concerns.
   * **Train Delays**: Trains experience delays as passengers struggle to board and exit.
2. **Best Scenario**:
   * **Optimal Scheduling**: In the best-case scenario, the metro system operates with efficient scheduling. Trains arrive at regular intervals, minimizing waiting times.
   * **Even Distribution**: Passengers are evenly distributed across the 10 trains going and 10 trains returning. Each train carries a manageable number of passengers.
   * **Smooth Boarding**: Passengers board and alight smoothly, without overcrowding the platforms.
   * **Safety Measures**: Security personnel manage queues, ensure safety, and prevent overcrowding.
   * **Comfortable Experience**: Passengers have a comfortable and reliable mode of transportation.
3. **Human Solution**:
   * As the station manager, I would:
     + **Monitor Passenger Flow**: Observe passenger patterns and adjust train schedules during peak hours.
     + **Display Real-Time Information**: Install digital displays showing train occupancy rates and estimated wait times.
     + **Efficient Boarding**: Coordinate with train operators to ensure timely departures and efficient boarding.
     + **Emergency Preparedness**: Have contingency plans for emergencies (medical situations, overcrowding).
     + **Feedback Loop**: Collect feedback from passengers and adapt operations accordingly.

Question 3

1. **Central Processing Unit (CPU)**:
   * **Human Explanation**: Think of the CPU as the “brain” of your phone. It handles all the calculations and instructions, making sure apps run smoothly.
   * **Efficiency Impact**: A powerful CPU ensures faster app loading, multitasking, and overall responsiveness.
   * **Optimization**: Efficient CPU design balances performance and power consumption.
2. **Random Access Memory (RAM)**:
   * **Human Explanation**: RAM is like your phone’s short-term memory. It holds data for active apps.
   * **Efficiency Impact**: Sufficient RAM allows smooth multitasking without slowdowns.
   * **Optimization**: Managing RAM efficiently prevents app crashes and improves performance.
3. **Storage (Internal Memory)**:
   * **Human Explanation**: Storage is where your phone keeps photos, apps, and files.
   * **Efficiency Impact**: Adequate storage prevents slowdowns and allows app installations.
   * **Optimization**: Regularly clean up unnecessary files to free up space.
4. **Flash Memory (eMMC/UFS)**:
   * **Human Explanation**: Flash memory is like your phone’s long-term storage. It’s where data persists even when the phone is off.
   * **Efficiency Impact**: Faster flash memory speeds up app launches and file access.
   * **Optimization**: Use faster UFS storage for better performance.
5. **Battery**:
   * **Human Explanation**: The battery powers your phone.
   * **Efficiency Impact**: A good battery ensures longer usage without frequent charging.
   * **Optimization**: Avoid extreme temperatures and charge optimally to prolong battery life.
6. **Wireless Connectivity**:
   * **Human Explanation**: Wi-Fi and cellular networks connect your phone to the internet.
   * **Efficiency Impact**: Fast and stable connections enhance browsing, streaming, and app updates.
   * **Optimization**: Use Wi-Fi when available, and choose 4G/5G networks for faster data transfer.
7. **Bluetooth**:
   * **Human Explanation**: Bluetooth connects your phone to other devices (headphones, speakers, etc.).
   * **Efficiency Impact**: Efficient Bluetooth conserves battery while maintaining connectivity.
   * **Optimization**: Turn off Bluetooth when not in use.
8. **NFC (Near Field Communication)**:
   * **Human Explanation**: NFC enables contactless payments and data exchange.
   * **Efficiency Impact**: Efficient NFC ensures quick transactions and seamless pairing.
   * **Optimization**: Enable NFC only when needed.
9. **Sensors (Accelerometer, Gyroscope, etc.)**:
   * **Human Explanation**: Sensors detect motion, orientation, and environmental conditions.
   * **Efficiency Impact**: Accurate sensors enhance gaming, navigation, and fitness apps.
   * **Optimization**: Calibrate sensors periodically.
10. **Software Updates**:
    * **Human Explanation**: Updates improve security, fix bugs, and optimize performance.
    * **Efficiency Impact**: Regular updates keep your phone running smoothly.
    * **Optimization**: Install updates promptly.