**Parallel Computing Exam**

**Hugo Marerua**

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**Part 1**

1. i.) Just like having 20 trains running simultaneously, parallel computing involves multiple processors or cores working on different parts of a problem at the same time. In this case each train can be seen as a thread or process. The more trains (threads) we have, the more people (tasks) we can move simultaneously among 4 rail ways, ensuring that each train (processor) is optimally loaded with passengers (tasks) to avoid bottlenecks we allocate them in a well-orchestrated and synchronized way.

Parts to Optimize:

1. Train Scheduling Logic: Optimize the algorithm that decides when each train departs and arrives.
2. Track Usage: Ensure efficient use of the four rail tracks.
3. Passenger Flow: Optimize passenger boarding and alighting processes.
4. Resource Allocation: Allocate trains and tracks effectively.

ii.) Best-Case Scenario:

- Maximum Efficiency: Ensuring that all trains run without any delays, breakdowns, or interruptions.

- Optimal Scheduling: Trains are scheduled to run at maximum capacity (1000 passengers) continuously and simultaneously.

Calculation

Each train can make multiple trips in a day. Assuming each trip takes 1 hour (including boarding, travel, and alighting), each train can make 24 trips in a day.

- Total capacity per train per day = 24 trips \* 1000 passengers = 24,000 passengers.

- With 20 trains, total capacity per day = 20 \* 24,000 = 480,000 passengers.

- To evacuate 900 million people, it would take approximately 1875 days (900,000,000 / 480,000).

1875 days in years =

1875/365 = 5.143651875​≈5.14 years

Hours=Days×24

1875×24 = 45,000 hours

To evacuate 900 million people, it would take approximately **45,000 hours**

Worst-Case Scenario:

- Delays and Breakdowns: Trains face delays, breakdowns, or other interruptions.

- Underutilization: Trains are not running at full capacity due to mismanagement or other issues.

Calculation

If trains run at 50% efficiency, it would take twice as long, so we hereby multiply

1875 x 2 = 3750 days.

3750 x 24 = 90 000 hours

**Part 2**

Phone Components for Efficiency and Optimization

1. Data Storage:

- Storage Type: SSDs (Solid State Drives) are faster and more efficient than traditional HDDs (Hard Disk Drives).

- File System: Efficient file systems like NTFS or ext4 can improve data retrieval speeds.

2. Data Transfer:

- RAM (Random Access Memory): More RAM allows for faster data access and transfer.

- Network Interface: High-speed network interfaces (5G, Wi-Fi 6) improve data transfer rates.

3. Connectivity:

- Modem and Antenna: Advanced modems and antennas ensure better connectivity and faster data transfer.

- Bluetooth and NFC: For short-range data transfer, efficient Bluetooth and NFC modules are crucial.

Processing of 1 Billion Transactions

1. Server Hardware:

- CPU: High-performance multi-core CPUs can handle multiple transactions simultaneously.

- RAM: Sufficient RAM ensures smooth processing without bottlenecks.

- Storage: Fast SSDs for quick data access and storage.

2. Phone Hardware:

- CPU: Modern smartphones have multi-core processors capable of handling multiple tasks.

- RAM: Adequate RAM to manage multiple transactions.

- Storage: Fast internal storage for quick data access.

Metrics for Processing 1 Billion Transactions

1. Server:

- Throughput: Number of transactions processed per second (TPS). High-performance servers can achieve thousands of TPS.

- Latency: Time taken to process a single transaction. Lower latency is better.

- Scalability: Ability to handle increased load by adding more resources.

2. Phone:

- Throughput: Modern smartphones can handle hundreds of TPS.

- Latency: Optimized software and hardware reduce latency.

- Battery Life: Efficient processing to ensure minimal battery drain.