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Class Work, HPDS

Question 2-1

We know,

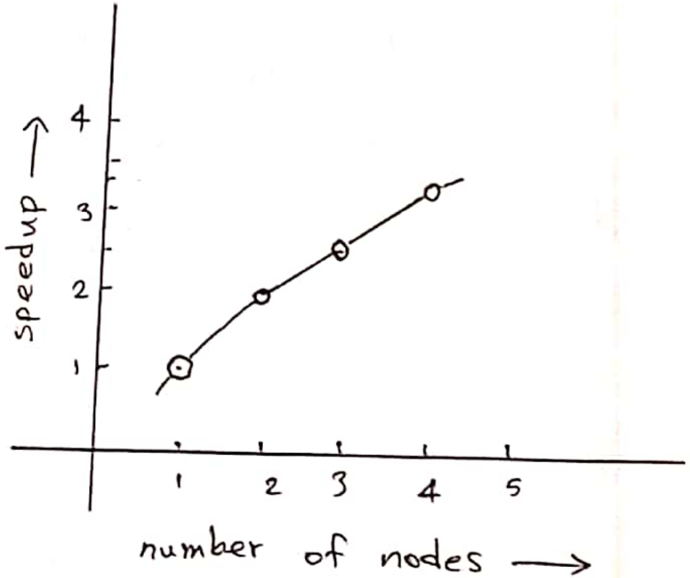
$$\text{speedup} = \frac{\text{small system elapsed time}}{\text{large system elapsed time}}$$

We calculate speedup for the three cases.

$$\text{speedup}_1 = \frac{10}{5} = 2$$

$$\text{speedup}_2 = \frac{10}{4} = 2.5$$

$$\text{speedup}_3 = \frac{10}{3} = 3.3$$



From the graph we see that the speedup is sub-linear, since ~~as we increase resources,~~ increase in speedup isn't proportional to increase in resources.

Question 2-2

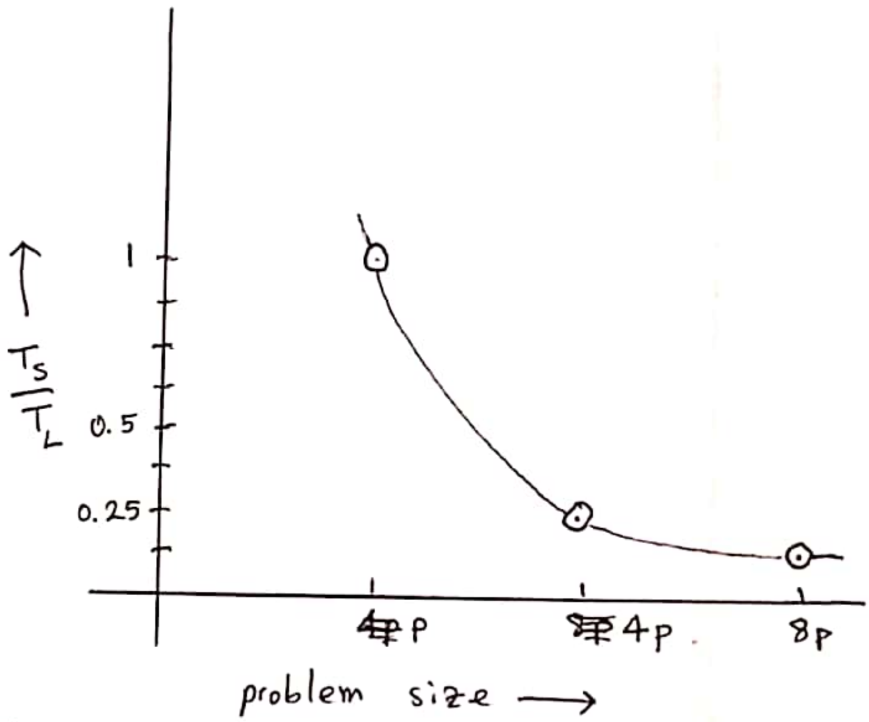
We know,

$$\text{scaleup} = \frac{\text{small system small problem elapsed time } (T_s)}{\text{large system large problem elapsed time } (T_L)}$$

We calculate scaleup for the two cases.

$$\text{scaleup}_{4p} = \frac{10}{40} = 0.25$$

$$\text{scaleup}_{8p} = \frac{10}{80} = 0.125$$



Since scaleup in these two cases is not equal to 1, we're not dealing with a linear scaleup.

Again, from the graph, we see that decrease in scaleup is proportional to the increase in problem size.

Therefore, we can say that there is no scaleup for the system.

Question 2-3

Amdahl's law: speedup $= \dfrac{1}{1-p+\dfrac{p}{n}}$

Case 1: Since $p=1$, we get speedup $= \dfrac{1}{\frac{1}{n}} = n$

Since speedup is equal to resource size, it is linear.

Case 2: Since $p=0$, we get speedup $= 1$

There is no speedup for this case.

Case 3: In this case,

$$\text{speedup}_{0<p<1} = \frac{1}{1-p+\dfrac{p}{n}}$$

This speedup is greater than one but smaller than n, which mean's there is some speedup which is not linear.

Hence, the speedup is sub-linear.

Question 2-4

Gustafson's law: $scaleup = \dfrac{1}{(1-p)n + p}$

Case 1: Since $p=1$, we get $scaleup = 1$

By definition, it's a linear scaleup.

Case 2: Since $p=0$, we get $scaleup = \dfrac{1}{n}$

Since decrease in scaleup is proportional to increase in problem size (n), we can say that there is no scale up.

Question 3-1

Bus:

Advantages:

1. Low cost
2. Easy to set up, handle, and implement
3. Best-suited for small networks.

Disadvantages:

1. A fault in the bus leads to network failure.
2. Not easy to isolate faults in the network nodes.
3. High traffic decreases network efficiency.

Mesh

Advantages:

1. The failure of a singe node does not cause the entire network to fail.
2. It can handle heavy traffic.
3. Easy to isolate faults in the network nodes.

Disadvantages:

1. High setup and maintenance cost.
2. Administration is difficult.
3. Many connections serve no major purpose. This leads to redundancy of many network connections.

Hypercube

Advantages:

1. Low Degree of Node: Each of the n ~~nodes~~ nodes are connected to log n other nodes.
2. Low Diameter: Each node can reach any other node via at most log n links.
2. Less communication delay.

Disadvantages:

1. The number of edges per node is a (logarithmic) function of network size, making it difficult to scale up.
2. The maximum edge length increases as network size increases.

Fat Tree

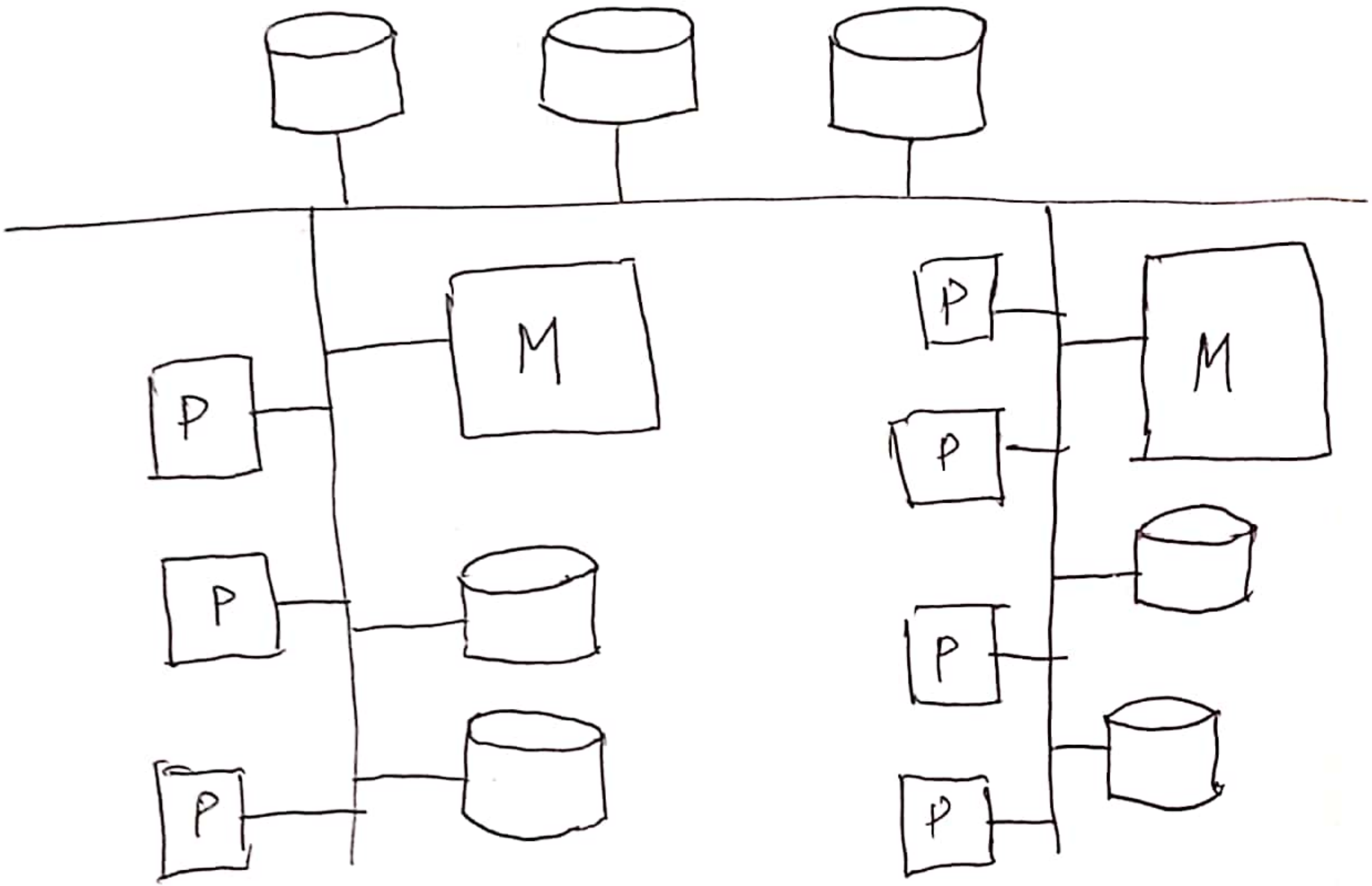
Advantages:

1. Bandwidth remains constant at each level.
2. High fault tolerance.
3. Low congestion.

Disadvantages:

1. Network performance depends on routing mechanism.

Question 3-2



Question 1-1

Main Memory DBMS

1. All data stored in main memory, no need to perform disk I/O to query or update data.
2. Data is persistent or volatile depending on the in-memory database product.
3. Specialized data structures and index structures assume data is always in main memory.
4. Database size limited by the amount of main memory.
5. Optimized for specialized workloads; i.e. communication industry-specific HLR/HSS workloads.

Disk-Based DBMS

1. All data stored on disk, disk I/O needed to move data into main memory when needed.
2. Data is ~~always~~ ~~persisted.~~ persistent.
3. Traditional data structures like B-Trees are designed to store tables and indices ~~of~~ on disk.
4. Virtually unlimited database size.
5. Supports very broad set of workloads, i.e. OLTP, data warehousing, mixed workloads, etc.