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Parallel Distributed
Computing.

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MTWTFSS

Q1:- What is pipeline bubble?

Ans:- Pipeline bubble refer to a situation where a system performance is limited by a bottleneck in a particular stage of a data processing pipeline.

In distributed systems, data is often processed through a series of stages, where each stage performs a specific task such as filtering, transformation or aggregation. A pipeline bubble can occur when the processing speed of one stage is significantly slower than the other stages, causing a backlog of data to accumulate and reducing overall efficiency of the pipeline.

Bottleneck can be caused by

1. Inefficient Algorithms
2. Slow Network Connections
3. Insufficient resources allocated to the stage

To overcome pipeline bubble, the bottle-neck stage must be identified and optimized to process data more efficiently, or additional resources may need to be allocated to the stage to handle the increased workload.

Q2:- How to calculate Branch Penalty? With Example.

Ans:- In computer architecture, the branch penalty refers to the delay or cost incurred when the processor encounters a conditional branch instruction that results in change of program flow.

$$\text{Branch Penalty} = P \times C$$

where

P = Probability of branch being taken

C = Number of cycles required to resolve the branch

For Example:

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if (x > y) {
    z = a + b;
} else {
    z = a - b;
}

```

Assume:-

if statement is taken 80% of the time, and not taken 20% of the time. The cost of taken branch is 3 cycle and not taken branch is 1 cycle.

$$\begin{aligned} \text{Branch Penalty} &= (0.8 \times 3) + (0.2 \times 1) \\ &= 2.6 \text{ cycles} \end{aligned}$$

This means on average, each execution of the 'if' statement will result in a delay of 2.6 cycles due to the branch penalty.