# THROUGHPUT AND SPEEDUP

# PARAMETERS OF PIPELINING PERFORMANCE

- In computer architecture and pipelining, throughput and speedup are two important performance metrics used to evaluate the effectiveness and efficiency of a pipelined system.

# THROUGHPUT

- **Throughput refers to the amount of work completed per unit of time in a pipelined system.** It measures the overall system performance and is usually expressed in terms of tasks completed per second or instructions executed per cycle. Higher throughput indicates that more work is being accomplished in a given time frame.

- Pipelining improves throughput by allowing multiple tasks or instructions to be processed simultaneously at different stages of the pipeline.

- Each stage performs a specific operation on a different instruction or data, enabling parallelism and increasing overall throughput. As a result, the system can handle a higher number of tasks or instructions per unit of time.

# THROUGHPUT FORMULA

- **Throughput = Total Work / Execution Time**

- Throughput measures the amount of work completed per unit of time. The formula calculates it by dividing the total work accomplished by the execution time of the system. The unit of measurement for throughput can vary based on the context, such as tasks completed per second or instructions executed per cycle. A higher throughput indicates that more work is being completed within a given time frame.

# SPEEDUP

- **Speedup is a measure of performance improvement achieved by using pipelining compared to a nonpipelined system.** It quantifies how much faster a pipelined system can execute a given workload compared to a sequential or non-pipelined implementation of the same workload. Speedup is typically calculated as the ratio of the execution time in the non-pipelined system to the execution time in the pipelined system.

- The speedup achieved by pipelining depends on several factors, including the depth of the pipeline (the number of stages), the number of tasks or instructions being processed simultaneously. Ideally, a deeper pipeline with more tasks in progress and minimal hazards can result in higher speedup.

# SPEEDUP FORMULA

- **Speedup = Execution Time (Non-pipelined) / Execution Time (Pipelined)**
- It represents how much faster the pipelined system executes a given workload compared to non-pipelined implementation of the same workload. The formula calculates the speedup by dividing the execution time of the non-pipelined system by the execution time of the pipelined system. **A speedup greater than 1 indicates that the pipelined system is faster than the non-pipelined system.**

- In both formulas, the execution time is a crucial component. It represents the time taken for the system to complete the given workload. The execution time can be measured in seconds, cycles, or any other appropriate unit. **Lower execution time values indicate faster system performance.**

## Problem on Throughput:

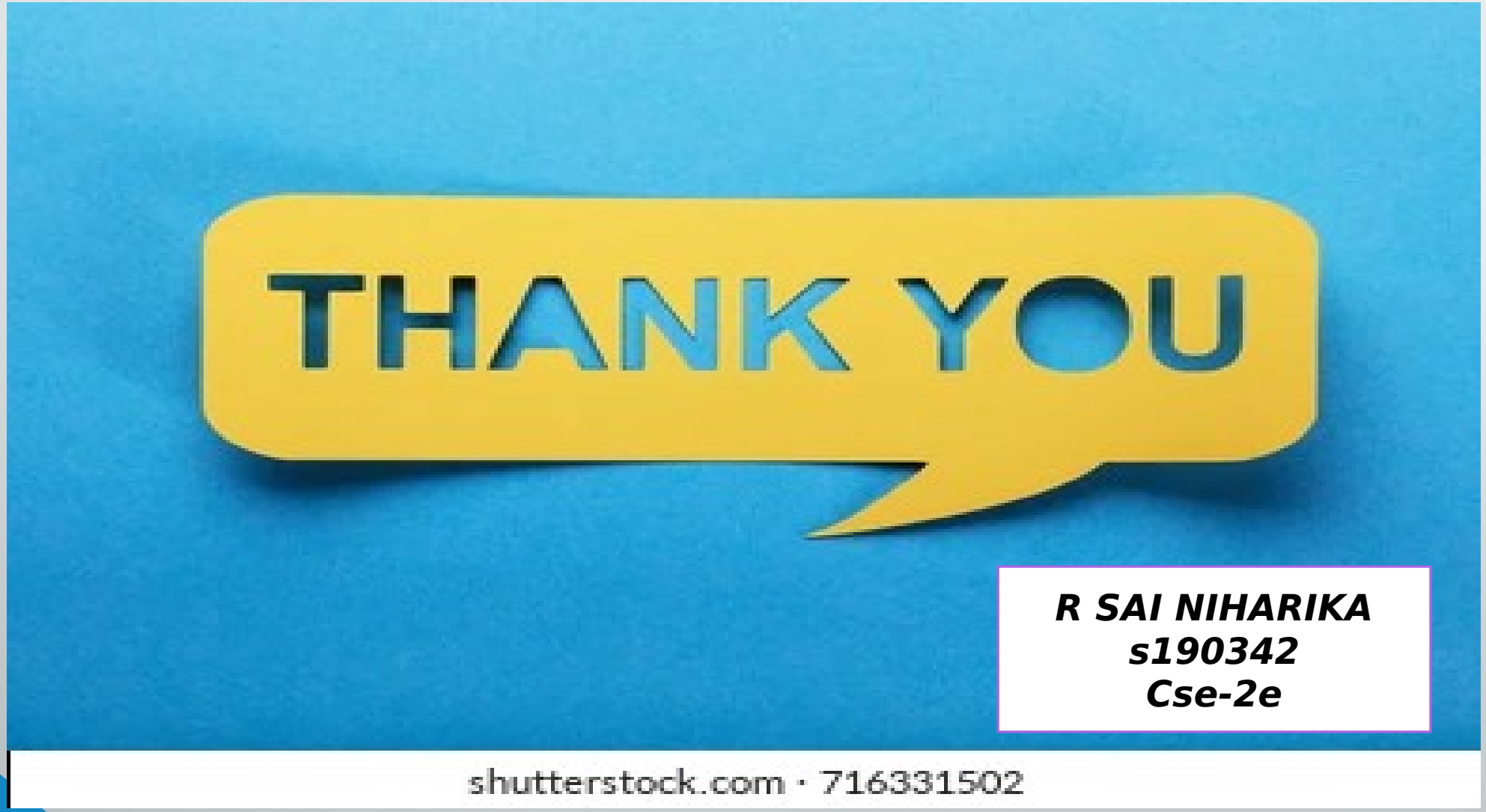
***A computer system can execute 1000 instructions in 5 milliseconds. What is the throughput of the system in instructions per second?***

- To calculate the throughput, we need to determine the number of instructions completed per unit of time.
- Given: **Number of instructions = 1000**
- **Execution time = 5 milliseconds** First, we need to convert the execution time to seconds since throughput is typically measured in ***instructions per second.***
- Throughput = Total Work / Execution Time
- Throughput = 1000 instructions / (5 * 10^(-3) seconds)
- Throughput = 1000 / 0.005 = 200,000 instructions per second

# Problem on speed up:

***A non-pipelined system takes 200 milliseconds to execute a workload. A pipelined version of the same system takes 50 milliseconds to executethe same workload. What is the speedup achieved by the pipelined system?***

- To calculate the speedup, we need to compare the execution time of the non-pipelined system to the execution time of the pipelined system.
- Given: **Execution time (Non-pipelined) = 200 milliseconds**
- **Execution time (Pipelined) = 50 milliseconds**
- **Speedup = Execution Time (Non-pipelined) / Execution Time (Pipelined)**
- Speedup = 200 milliseconds / 50 milliseconds Speedup **= 4**
- Therefore, the speedup achieved by the pipelined system is 4.

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