1. Relative Performance

To compare how fast one computer is over another, we look at the time they take to complete the same task.

Example:

- Computer A takes 10 seconds
- Computer B takes 15 seconds

To find out how much faster A is than B, we use the formula:

$$\text{Relative Performance} = \frac{\text{Execution Time of B}}{\text{Execution Time of A}} = \frac{15}{10} = 1.5$$

Conclusion: Computer A is 1.5 times faster than Computer B.

2. Measuring Performance

Performance is generally measured by time, but there are different types:

Types of Time:

- **Elapsed Time:** Total time from start to finish (includes all delays like I/O, other processes, etc.)
- **CPU Time:** Time during which the CPU was actually working on the task.

3. Types of CPU Time

CPU time is further divided into:

- **User CPU Time:** Time spent executing your program code.
- **System CPU Time:** Time spent executing operating system tasks (e.g., file access, memory allocation).

These give you an idea of how efficiently the CPU was used for actual computation.

4. Example: Calculating CPU Utilization

Let's say, after running a program, we get the following times:

- User CPU Time: 90.7 seconds
- System CPU Time: 12.9 seconds

- Elapsed Time: 159 seconds

Then, we calculate the CPU Utilization as follows:

$$\text{CPU Utilization} = \frac{90.7 + 12.9}{159} = \frac{103.6}{159} = 0.652 = 65.2\%$$

Conclusion: This means the CPU was actively working on the task for about 65% of the time.

5. Key Terms Recap

Term	**Meaning**
Elapsed Time	Total wall-clock time (including waiting, I/O, etc.)
CPU Time	Actual time the CPU was working on the task
User CPU Time	Time CPU spent executing user code
System CPU Time	Time CPU spent executing OS services on behalf of the program
CPU Utilization	Percentage of time CPU was busy with your program