SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

COURSE CODE & NAME : 19IT301 COMPUTER ORGANIZATION AND ARCHITECTURE

II YEAR / III SEMESTER

Unit 1 : BASIC STRUCTURE OF COMPUTER

Topic : PERFORMANCE

Performance

- The most important measure of a computer is how quickly it can execute programs with high accuracy and efficiency.
- Three factors affect performance:

✓ Hardware design

✓ Instruction set

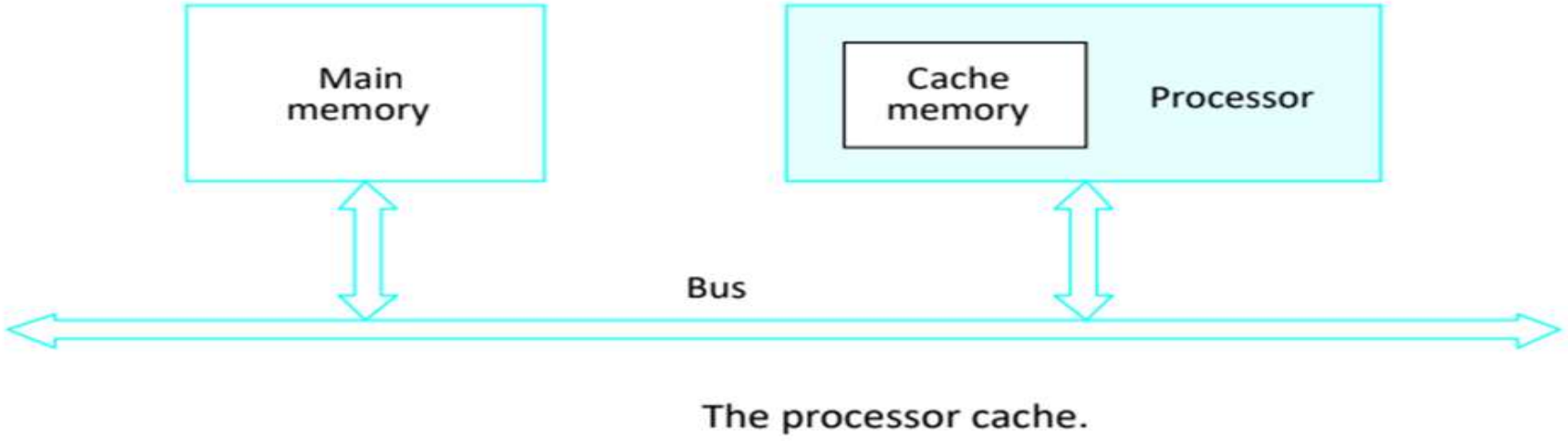
✓ Compiler

Performance

- The total time required to execute the program is elapsed time is a measure of the performance of the entire computer system.
- It is affected by the speed of the processor, the disk and the printer.
- The time needed to execute a instruction is called the processor time.

Performance

- Processor time to execute a program depends on the hardware involved in the execution of individual machine instructions.



The processor cache.

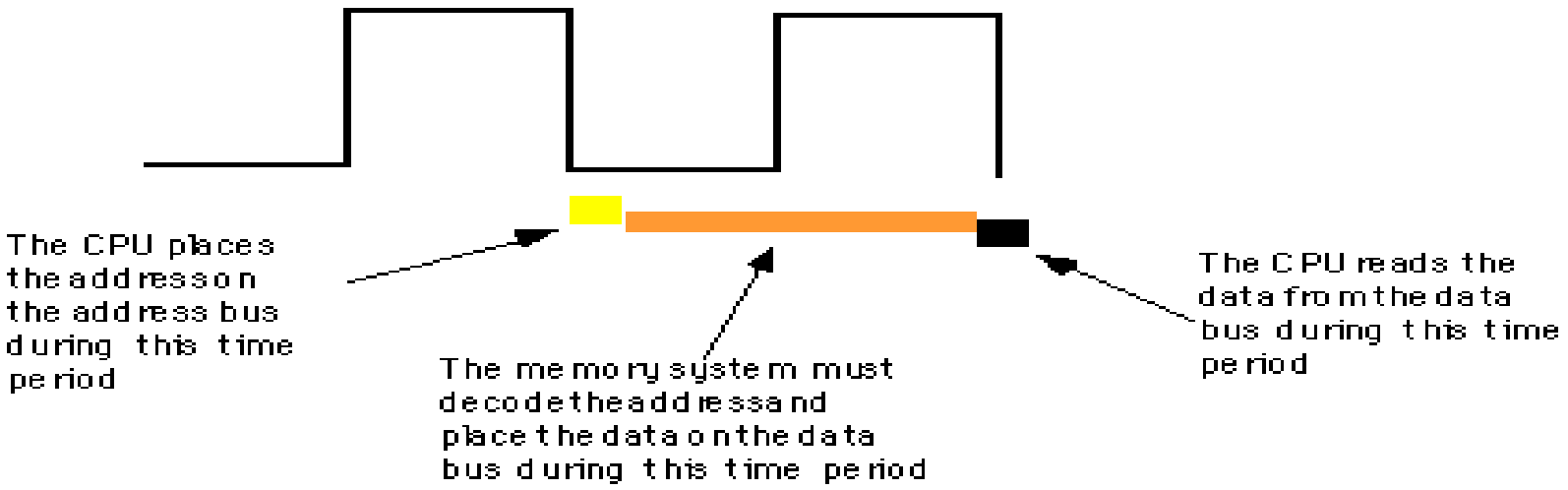
Processor clock

- Processor circuits are controlled by a timing signal called a **clock.**
- The clock defines regular time intervals called ***clock cycles***.
- To execute a machine instruction, the processor divides the action to be performed into a sequence of basic steps such that each step can be completed in one clock cycle.
- Let P=length of one clock cycle R=clock rate
- Relation between P and R is given by

$$R = \frac{1}{p}$$

- R is measured in cycles per second.
- Cycles per second is also called hertz(Hz)

Processor Clock



BASIC PERFORMANCE EQUATION

- Let T=processor time required to execute a program
- N=actual number of instruction executions
- S=average number of basic steps needed to execute one machine instruction
- R=clock rate in cycles per second
- • The program execution time is given by

$$T = \frac{N \times S}{R} \quad \text{----(1)}$$

- Equ1 red to as the basic performance equation.

Pipelining and Superscalar Operation

- Instructions are not necessarily executed one after another.
- Pipelining – overlapping the execution of successive instructions.
- Superscalar operation – multiple instruction pipelines are implemented in the processor.
- Goal – reduce S.

$$T=\frac{N\ X\ S}{R}$$

Compiler

- A compiler translates a high-level language program into a sequence of machine instructions.
- To reduce N, we need a suitable machine instruction set and a compiler that makes good use of it.
- Goal – reduce N×S
- A compiler may not be designed for a specific processor; however, a high-quality compiler is usually designed for, and with, a specific processor.

Performance Measurement

- T is difficult to compute.
- Measure computer performance using benchmark programs.
- System Performance Evaluation Corporation (SPEC) selects and publishes representative application programs for different application domains, together with test results for many commercially available computers.
- Compile and run (no simulation)

$$SPEC\ rating = \frac{\text{Running time on the reference computer}}{\text{Running time on the computer under test}}$$

$$SPEC\ rating = \left(\prod_{i=1}^{n} SPEC_i\right)^{\frac{1}{n}}$$

n= number of programs

- To achieve high performance, the computer designer must reduce the value of T, which means

reducing N and S, and increasing R.

- The value of N is reduced if source program is compiled into fewer machine instructions.
- The value of S is reduced if instructions have a smaller number of basic steps to perform.
- The value of R can be increased by using a higher frequency clock.
- while modifying the values since changes in one parameter may affect the other.

Performance Measurement

- If the SPEC rating = 50 means that computer under test is 50 times as fast as the reference computer.

1. What is pipelining?

Reference

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, McGraw-Hill, 6th Edition 2012.


Thank You!