ECP2046 COMPUTER ORGANIZATION AND ARCHITECTURE
SESSION: 2001/2002
TUTORIAL 1B SOLUTION

Chapter-1

Q1. Illustrate the Flynn's classification of computer architecture.

Flynn's Classification

- ✓ **SISD: single instruction stream, single data stream**
- ✓ **MISD: multiple instruction stream, single data stream**
- ✓ **SIMD: single instruction stream, multiple data stream**
- ✓ **MIMD: multiple instruction stream, multiple data stream**

MISD: multiple instruction stream, single data stream

- This implies that several instructions are operating on a single piece of data. The same data flows through a linear array of processors executing different instruction streams. This architecture is also known as ***systolic array*** for pipelined execution of specific algorithms.
- Not much used in practice.

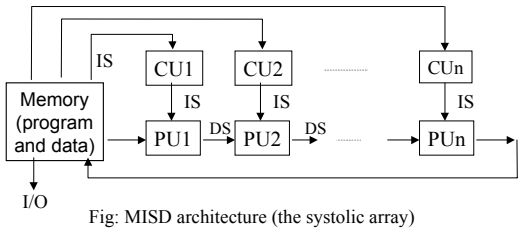
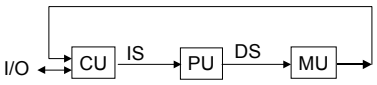


Fig: MISD architecture (the systolic array)

SISD: single instruction stream, single data stream

- In this architecture, only one instruction is executed at any one time. Often, SISD is referred to as a serial scalar computer.



CU:control unit
PU: processing unit
IS: instruction stream
DS: data stream

Fig: SISD uniprocessor architecture

SIMD: single instruction stream, multiple data stream

- In this category, a single instruction is applied to different data simultaneously. SIMD machines have more than one processing element (PE).
- General characteristics of SIMD computers are:
  - They distribute processing over a large amount of hardware
  - They operate concurrently on many different data elements
  - They perform the same computation on the all data elements

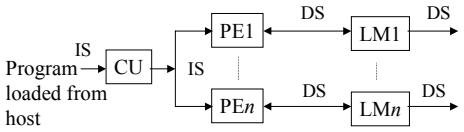


Fig: SIMD architecture (with distributed memory)

MIMD: multiple instruction stream, multiple data stream

These machines have several processing units in which multiple instructions can be applied to different data simultaneously. These machines are also called *multiprocessors*.

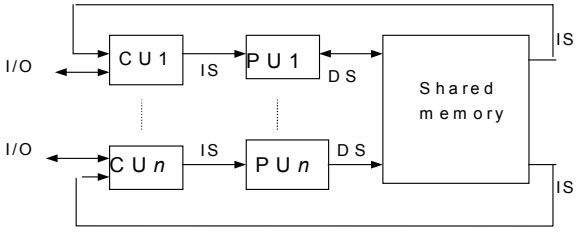


Fig: MIMD architecture with shared memory

Q2. State the general characteristics of MIMD processors. Illustrate a simple MIMD architecture with shared memory system.

General characteristic of MIMD machines:

- They distribute processing over a number of independent processors
- They share resources, including memory, among the component processors
- Each processor operates independently and concurrently
- Each processor runs its own program

(The architecture : shown as in Q1)

Q3. Briefly describe the main structural of the following components:
a) Computer b) Central processing unit (CPU) c) Control Unit

Four main structural components of computer:

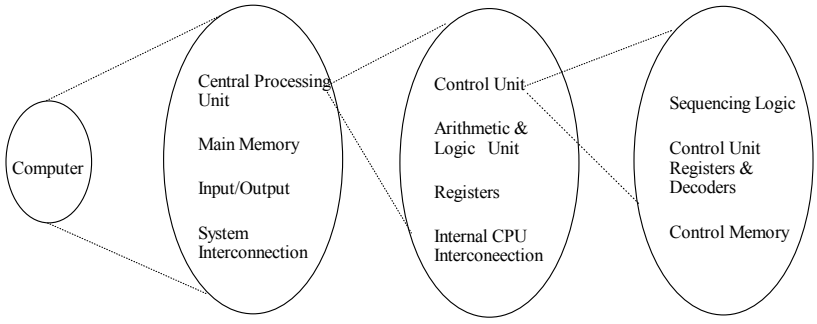
- Central Processing Unit (CPU): Controls the operation of the computer and performs its data processing functions.
- Main Memory: Stores and retrieves data.
- I/O: Moves data between the computer and its external environment.
- System Interconnection: Provides communication among CPU, main memory and I/O.

And major structural components of CPU are:

- Control Unit: Controls the operation of the CPU.
- Arithmetic and Logic Unit (ALU): Performs the computer's data processing functions.
- Registers: Provides fast storage internal to the CPU.
- CPU interconnection :It provides communication among the control unit, ALU, and registers.

And major structural components of control unit are:

- Sequencing Logic
- Control Unit Registers and Decoders
- Control Memory



4. What is the difference between RISC and CISC architecture?

RISC : Reduced Instruction Set Computer
CISC : Complex Instruction Set Computer

RISC architectures have the following characteristics that distinguish them from CISC.

1) All instructions are of fixed length, one machine word in size (simple instruction format)
2) All instructions perform simple operation (one machine instruction per machine cycle)
3) All operands must be in register before being operated upon (register-to-register)
4) Addressing modes are limited to simple ones.
5) There should be a large number of general registers for arithmetic operations so that the temporary variables can be stored in registers rather than on a stack in memory

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