Parallel processing

Parallel processing

Parallel processing is a computing technique when multiple streams of calculations or data processing tasks co-occur through numerous central processing units (CPUs) working concurrently.

Parallel processing

- Parallel processing is used to increase the computational speed of computer systems by performing multiple data-processing operations simultaneously.

- For example, while an instruction is being executed in ALU, the next instruction can be read from memory.

Parallel processing

- The system can have two or more ALUs and be able to execute multiple instructions at the same time.
- In addition, two or more processing is also used to speed up computer processing capacity and increases with parallel processing, and with it, the cost of the system increases.
- But, technological development has reduced hardware costs to the point where parallel processing methods are economically possible.

Parallel processing

- Parallel processing derives from multiple levels of complexity. It is distinguished between parallel and serial operations by the type of registers used at the lowest level.

Parallel processing

Shift registers

- Shift registers work one bit at a time in a serial fashion, while parallel registers work simultaneously with all bits of the word.

- At high levels of complexity, parallel processing derives from having a plurality of functional units that perform separate or similar operations simultaneously. By distributing data among several functional units, parallel processing is installed.

Parallel processing

Shift registers

- As an example, arithmetic, shift and logic operations can be divided into three units and operations are transformed into a teach unit under the supervision of a control unit.

- One possible method of dividing the execution unit into eight functional units operating in parallel is shown in figure.

Parallel processing

Shift registers

- Depending on the operation specified by the instruction, operands in the registers are transferred to one of the units, associated with the operands.

- In each functional unit, the operation performed is denoted in each block of the diagram. The arithmetic operations with integer numbers are performed by the adder and integer multiplier.

Parallel processing

Floating-point operations

- Floating-point operations can be divided into three circuits operating in parallel.
- Logic, shift, and increment operations are performed concurrently on different data.
- All units are independent of each other, therefore one number is shifted while another number is being incremented.

Parallel processing

- Generally, a multi-functional organization is associated with a complex control unit to coordinate all the activities between the several components.

Parallel processing

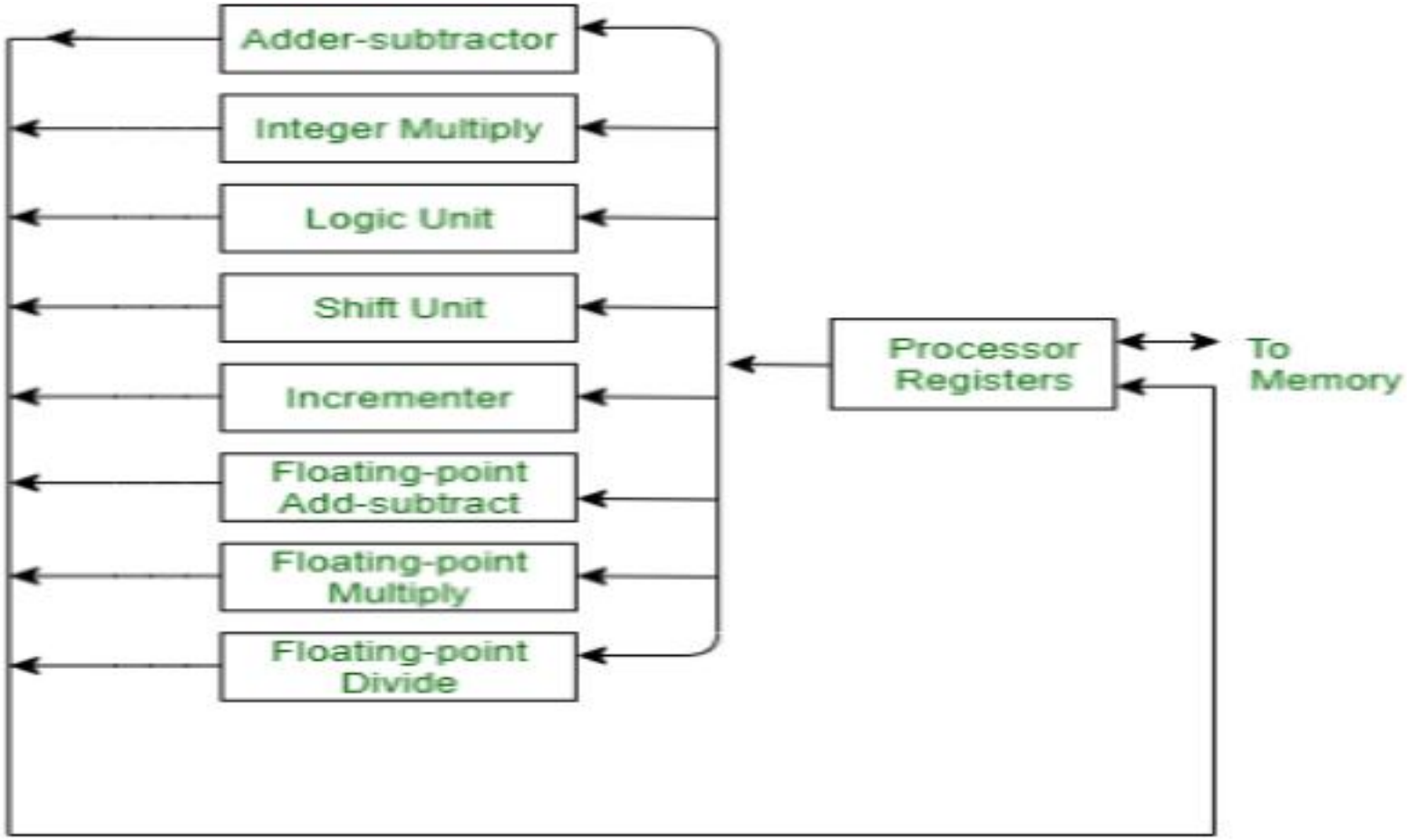

Figure - Processor with Multiple Functional Units

Parallel processing

- The main advantage of parallel processing is that it provides better utilization of system resources by increasing resource multiplicity which overall system throughput.

Parallel processing

- One classification introduced by M.J. Flynn **considers the organization of a computer system by the number of instructions and data items that are manipulated simultaneously**.

- The normal operation of a computer is to fetch instructions from memory and execute them in the processor.

- The sequence of instructions read from memory constitutes an instruction stream. The operations performed on the data in the processor constitutes a data stream.

Parallel processing

- Parallel processing may occur in the **instruction stream**, **in the data stream** or in **both**.

- Flynn's classification divides computers into four major group as follows:
- Single Instruction, Single Data (SISD)
- Single Instruction, Multiple Data (SIMD)
- Multiple Instruction, Single Data (MISD)
- Multiple Instruction, Multiple Data (MIMD)

Single Instruction, Single Data (SISD)

- In the type of computing called Single Instruction, Single Data (SISD), a single processor is responsible for simultaneously managing a single algorithm as a single data source.

- A computer organization having a control unit, a processing unit, and a memory unit is represented by SISD.

Single Instruction, Single Data (SISD)

- It is similar to the current serial computer. Instructions are carried out sequentially by SISD, which may or may not be capable of parallel processing, depending on its configuration.

- Sequentially carried-out instructions may cross over throughout their execution phases. There may be more than one functional unit inside a SISD computer.

- However, one control unit is in charge of all functional units. Such systems allow for pipeline processing or using numerous functional units to achieve parallel processing.

Single Instruction, Multiple Data (SIMD)

- Computers that use the Single Instruction, Multiple Data (SIMD) architecture have multiple processors that carry out identical instructions.
- However, each processor supplies the instructions with its unique collection of data.
- SIMD computers apply the same algorithm to several data sets. The SIMD architecture has numerous processing components.

Single Instruction, Multiple Data (SIMD)

- All of these components fall under the supervision of a single control unit.
- While processing numerous pieces of data, each processor receives the same instruction from the control unit.
- Multiple modules included in the shared subsystem aid in simultaneous communication with every CPU.
- This is further separated into organizations that use bit-slice and word-slice modes.

Multiple Instruction, Single Data (MISD)

- Multiple processors are standard in computers that use the Multiple Instruction, Single Data (MISD) instruction set.

While using several algorithms, all processors share the same input data. MISD computers can simultaneously perform many operations on the same batch of data.

As expected, the number of operations is impacted by the number of processors available.

Multiple Instruction, Single Data (MISD)

- The MISD structure consists of many processing units, each operating under its instructions and over a comparable data flow.
- One processor's output becomes the input for the following processor.
- This organization's debut garnered little notice and wasn't used in architecture.

Multiple Instruction, Multiple Data (MIMD)

Multiple Instruction, Multiple Data, or MIMD, computers are characterized by the presence of multiple processors, each capable of independently accepting its instruction stream.

These kinds of computers have many processors. Additionally, each CPU draws data from a different data stream.

A MIMD computer is capable of running many tasks simultaneously.

Multiple Instruction, Multiple Data (MIMD)

Although MIMD computers are more adaptable than SIMD or MIMD computers, developing the sophisticated algorithms that power these machines is more challenging.

Since all memory flows are changed from the shared data area transmitted by all processors, a MIMD computer organization incorporates interactions between the multiprocessors.

- The multiple SISD operation is equivalent to a collection of separate SISD systems if the many data streams come from various shared memories.

- Parallel processing is studied under the following topics :

- Pipeline processing
- Vector processing
- Array processors

Thank You