Types of Microprocessors

Vector Processors

A **vector processor** is designed for vector computations. A vector is an array of operands of the same type. Consider the following vectors:

Vector A (a1, a2, a3, ......., an)

Vector B (b1, b2, b3,......., bn)

Vector C = Vector A + Vector B

         = C(c1, c2, c3, .......,cn), where c1 = a1+ b1, c2 = a2 + b2, .....,Cn= an + bn.

A vector processor adds all the elements of vector A and Vector B using a single vector instruction with **hardware approach**.

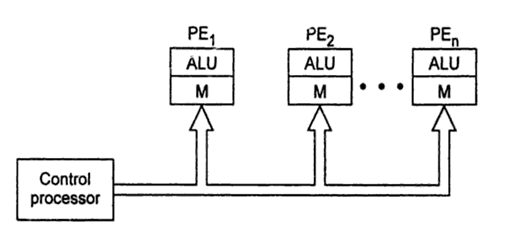
**Examples of vector processors are:**

* DEC's VAX 9000,
* IBM 390/VF,
* CRAY Research Y-MP family,
* Hitachi's S-810/20, etc.

Array Processors or SIMD Processors

**Array processors** are also designed for vector computations. The difference between an array processor and a vector processor is that a vector processor uses multiple vector pipelines whereas an array processor employs a number of processing elements to operate in parallel.

An array processor contains multiple numbers of ALUs. Each ALU is provided with the local memory. The ALU together with the local memory is called a Processing Element (PE). An array processor is a **SIMD (Single Instruction Multiple Data)** processor. Thus using a single instruction, the same operation can be performed on an array of data which makes it suitable for vector computations.



**Fig:- Schematic Diagram of an Array Processor or SIMD Processor**

Scalar and Superscalar Processors

A processor that executes scalar data is called scalar processor. The simplest scalar processor makes processing of only integer instruction using fixed-points operands. A powerful scalar processor makes processing of both integer as well floating- point numbers. It contains an integer ALU and a **Floating Point Unit (FPU)** on the same CPU chip.

**A scalar processor may be RISC processor or CISC processor**.

**Examples of CISC processors are:**

* Intel 386, 486; Motorola's 68030, 68040; etc.

**Examples of RISC scalar processors are:**

* Intel i860, Motorola MC8810, SUN's SPARC CY7C601, etc.

A **superscalar processor** has multiple pipelines and executes more than one instruction per clock cycle.

Examples of superscalar processors are:

* Pentium, Pentium Pro, Pentium II, Pentium III, etc.

RISC and CISC Processors

RISC stands for **Reduced Instruction Set Computer and**

CISC stands for **Complex Instruction Set Computer**.

There are two approaches of the design of the control unit of a microprocessor i.e.-

* Hardware approach and
* Software approach.

**RISC Processors:-** To execute an instruction, a number of steps are required. By the control unit of the processor, a number of control signals are generated for each step. To execute each instruction, if there is a separate electronic circuitry in the control unit, which produces all the necessary signals, this approach of the design of the control section of the processor is called **RISC** design. It is hardware approach. It is also called hard-wired approach.

**Examples of RISC processors are:**

* DEC's Alpha 21064, 21164 and 21264 processors;
* SUN's SPARC and ULTRA SPARC;
* PowerPC processors etc.

**CISC Processors:-** If the control unit contains a number of micro electronic circuitry to generate a set of control signals and each micro circuitry is activated by a microcode, this design approach is called CISC design. This is a software approach of designing a control unit of the processor.

**Examples of CISC processors are:**

* Intel 386, 486;
* Pentium Pro, Pentium, Pentium II, Pentium III, Pentium 4;
* Motorola's 68000, 68020, 68030, 68040, etc.

**Difference between RISC and CISC**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **RISC** | **CISC** |
| 1. | Simple instruction set | Complex instruction set |
| 2. | Consists of Large number of registers. | Less number of registers |
| 3. | Larger Program | Smaller program |
| 4. | Simple processor circuitry (small number of transistors) | Complex processor circuitry (more number of transistors) |
| 5. | More RAM usage | Little Ram usage |
| 6. | Simple addressing modes | Variety of addressing modes |
| 7. | Fixed length instructions | Variable length instructions |
| 8. | Fixed number of clock cycles for executing one instruction | Variable number of clock cycles for each instructions |

Digital Signal Processors (DSP)

**DSP** microprocessors specifically designed to process signals. They receive some digitized signal information, perform some mathematical operations on the information and give the result to an output device. They implement integration, differentiation, complex fast Fourier transform, etc. using hardware.

**Examples of digital signal processors are:**

* Texas instruments' TMS 320C25,
* Motorola 56000,
* National LM 32900,
* Fujitsu MBB 8764, etc.

Symbolic Processors

**Symbolic processors** are designed for expert system, machine intelligence, knowledge based system, pattern-recognition, text retrieval, etc.

**The basic operations which are performed for artificial intelligence are:**

Logic interference, compare, search, pattern matching, filtering, unification, retrieval, reasoning, etc. This type of processing does not require floating point operations. Symbolic processors are also called **LISP processors or PROLOG processors**.

Bit-Slice Processors

The processor of desired word length is developed using the building blocks. The basic building block is called Bit-Slice where the building blocks include 4-bit ALUs, micro programs sequencers, carry look-ahead generators, etc. The word 'slice' was used because the desired number of ALUs and other components were used to build an 8-bit, 16-bit or 32-bit CPU.

**Examples of Bit-Slice Processors were:**

* AMD-2900, AMD 2909, AMD 2910, AMD 29300 series,
* Texas instrument's SN-74AS88XX series, etc.

Transputers

In a multiprocessor system, a transputer is a specially designed microprocessor to operate as a component processor.

Transputers were introduced in late 1980's. They were built on VLSI chip and contained a processor, memory and communication links. The communication link was to provide point-to-point connection between transputers.

A transputer contains FPU, on-chip RAM, high-speed serial link, etc.

**Examples of transputers are:**

* INMOS T414, INMOS T800, etc.

Where, T414 was a 32-bit processor with 2 KB memory. The T800 was FPU version of 32-bit transputer with 4 KB memory.

Graphic Processors

Graphics Processors are specially designed processors for graphics. Intel has developed Intel 740-3D graphics chip. It is optimized for Pentium II PCs, using a hyper pipelined 3D architecture with additional 2D acceleration. Like most 3D graphics chips, the I-740 will be marketed in performance, not the main stream category. It is designed mostly for such heavy multimedia uses as games and movies.

**Examples of Graphic Processors are:**

* Intel 82786 graphics coprocessor
* IBM's 8514/A,
* Texas Instruments' TMS34010 and TMS34020,
* Intel i860 and Intel i750, etc.