# Parallel & Distibuted Computing: Lecture 6

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October 17, 2017

# Concepts and Terminology

1. General concepts

# General concepts

# von Neumann Computer Architecture

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- Since then, virtually all computers have followed this basic design

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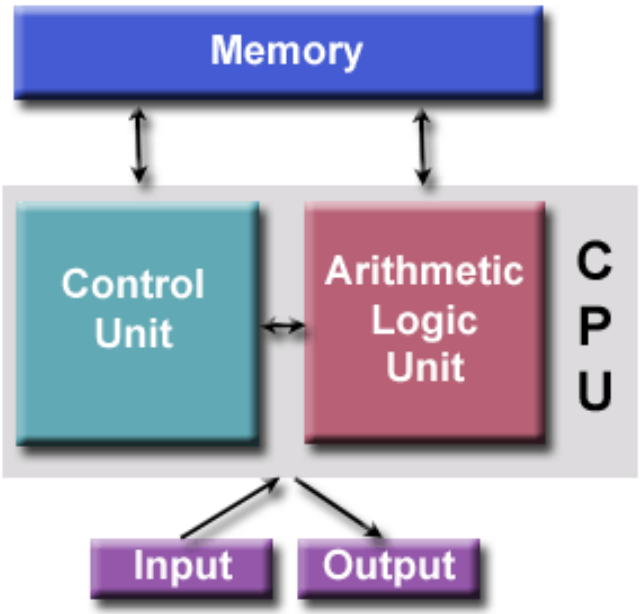
- Four main components:

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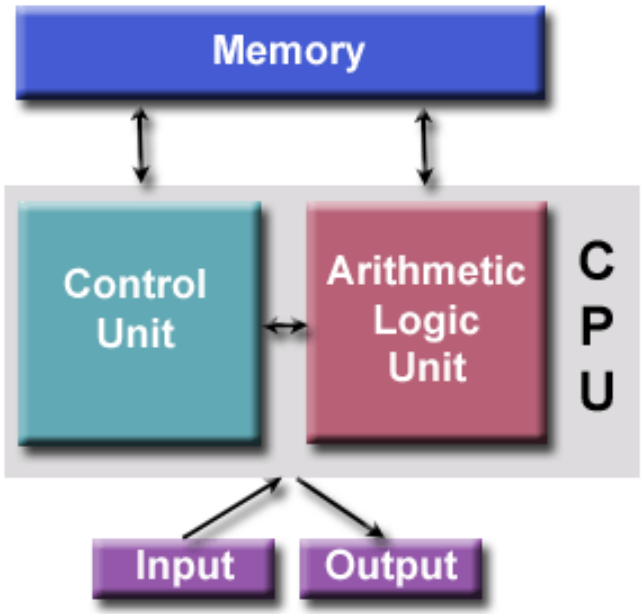


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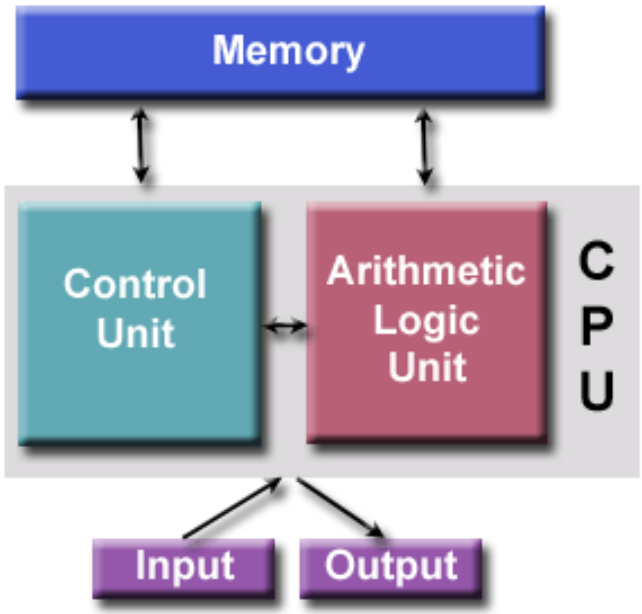


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- Four main components:
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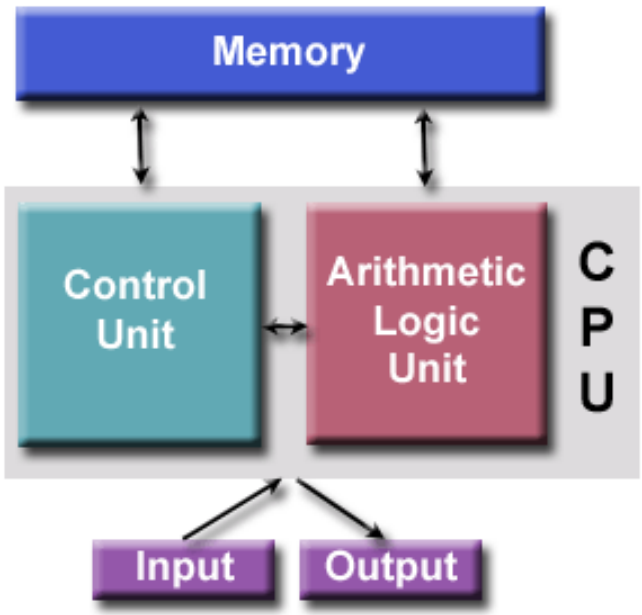


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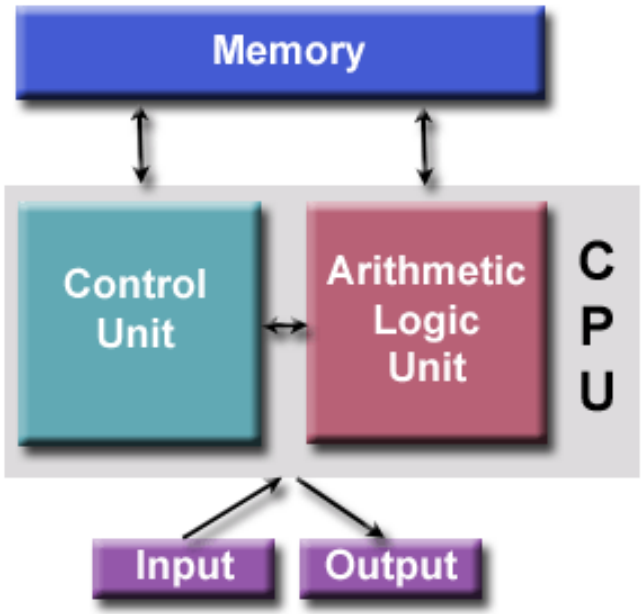


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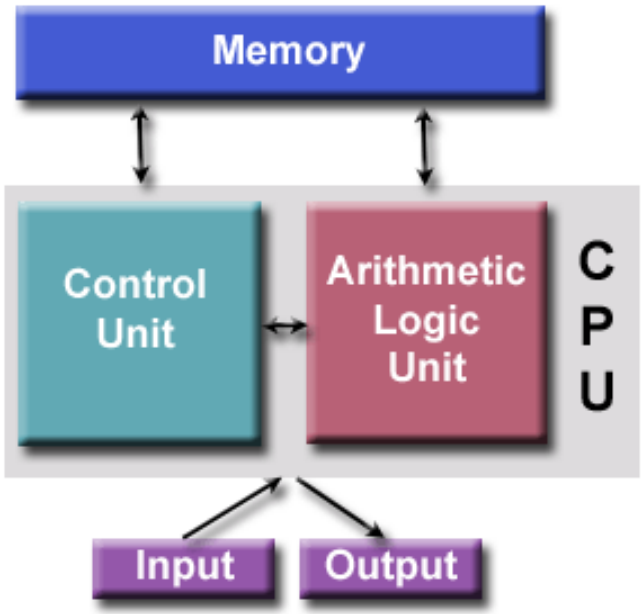


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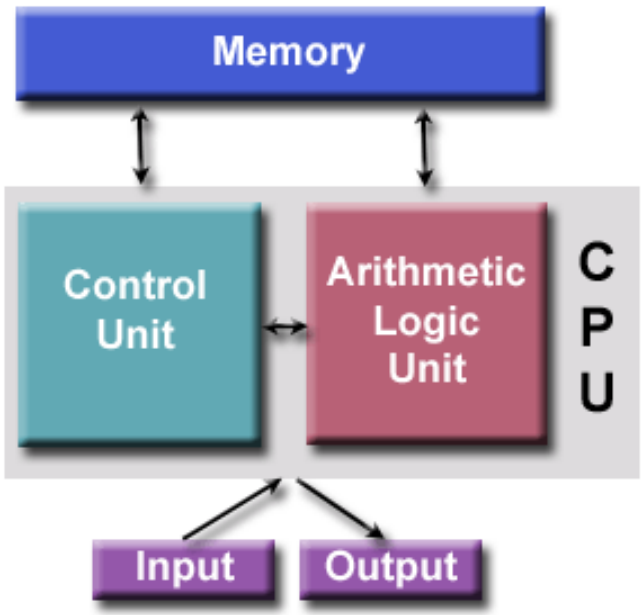


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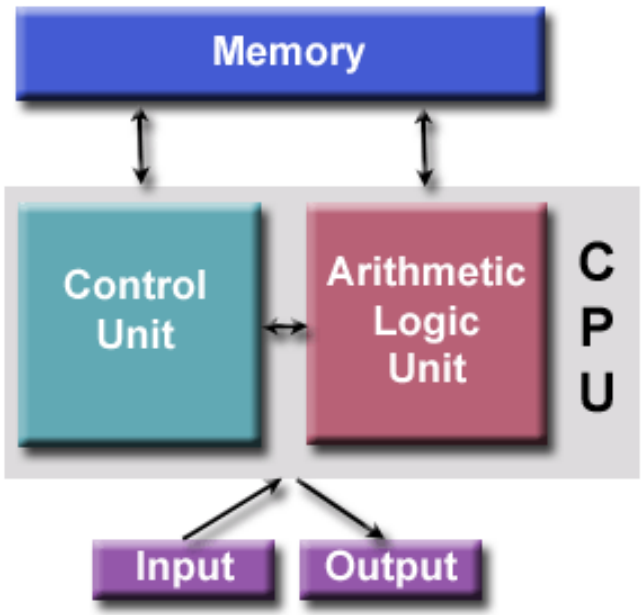


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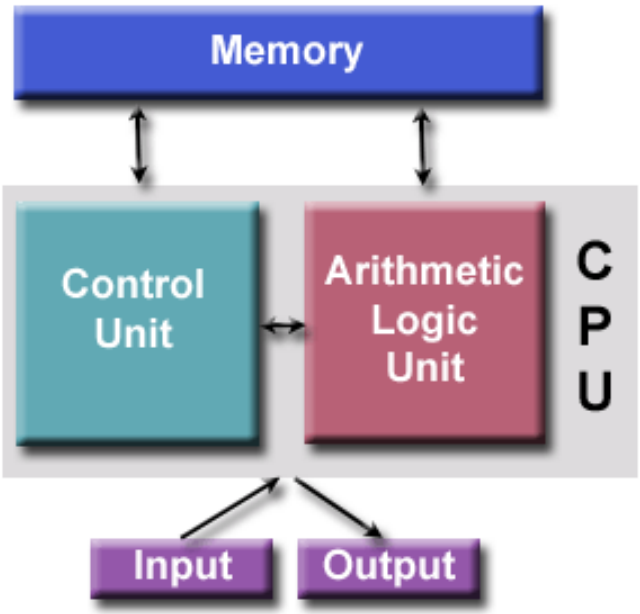


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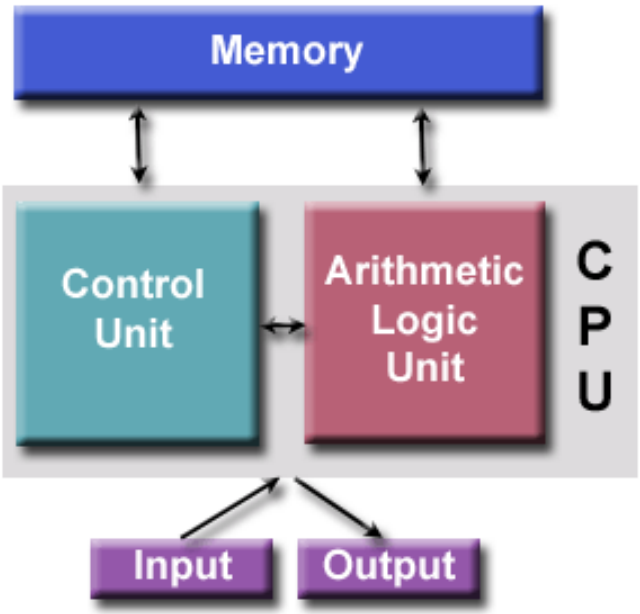


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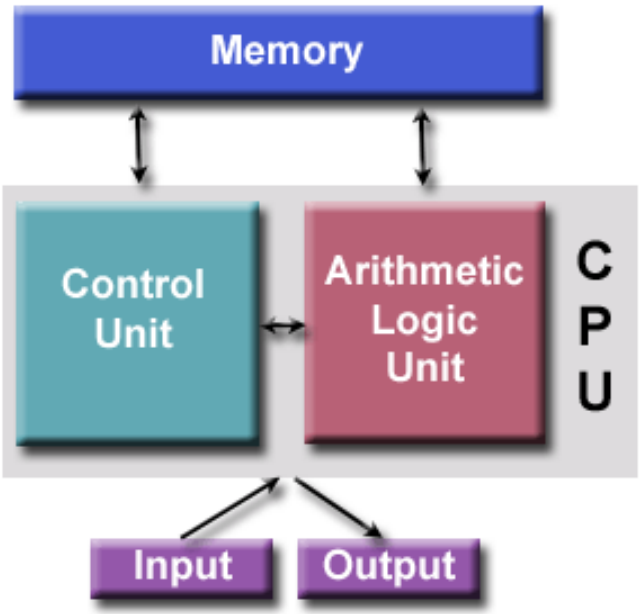


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- Input/Output is the interface to the human operator

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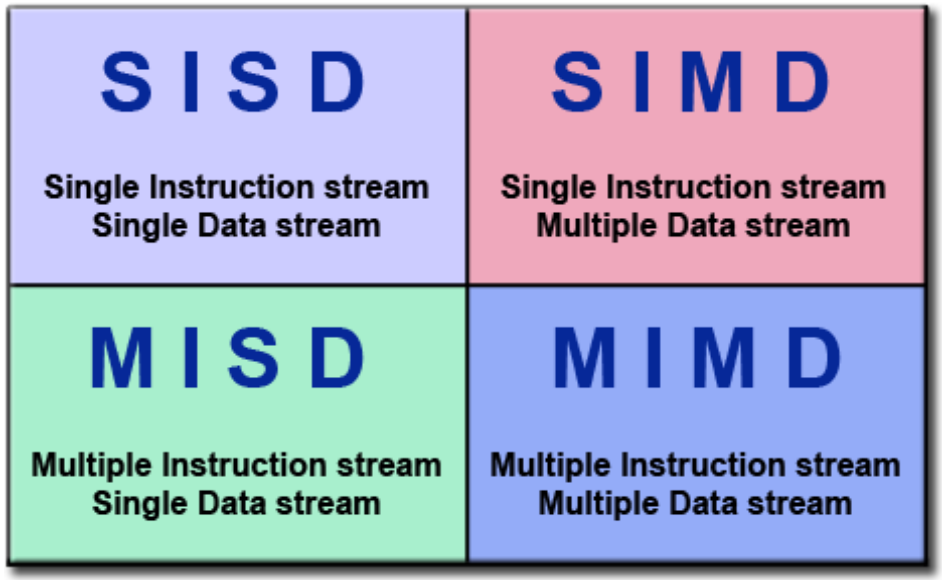


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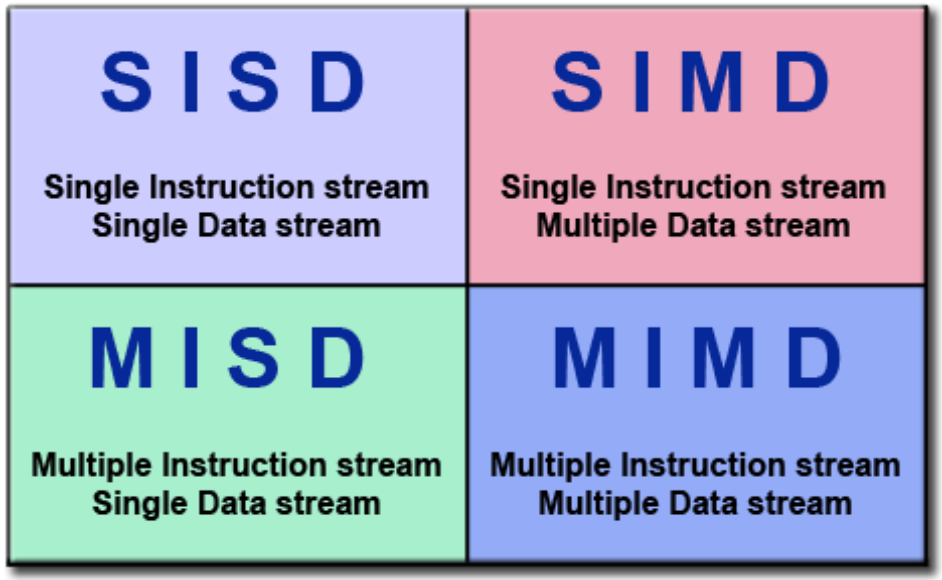


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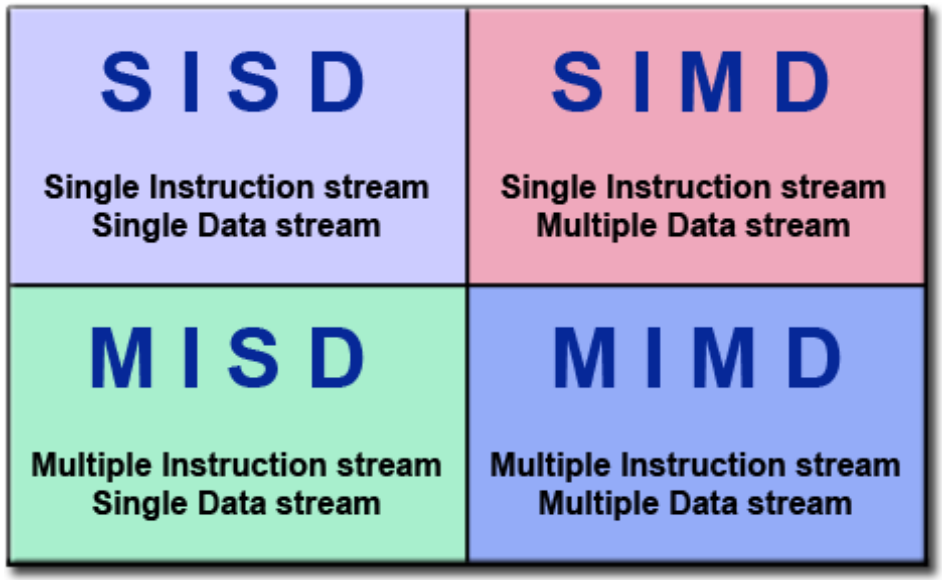


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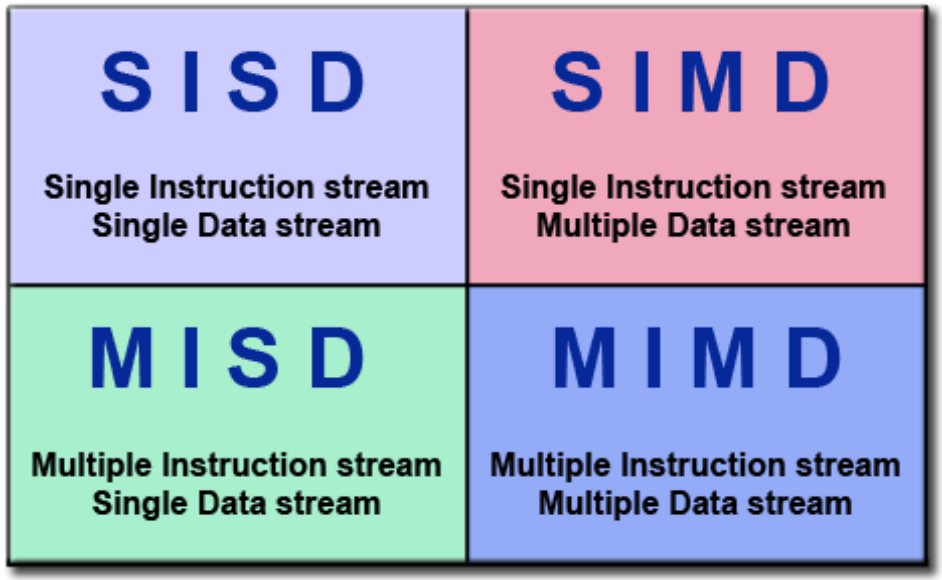
- Each dimension can have only two possible states: Single or Multiple.

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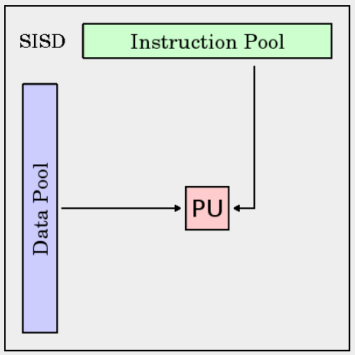


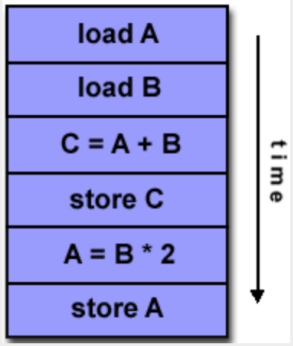



UNIVAC1


IBM 360


CRAY1


CDC 7600


PDP1


Dell Laptop

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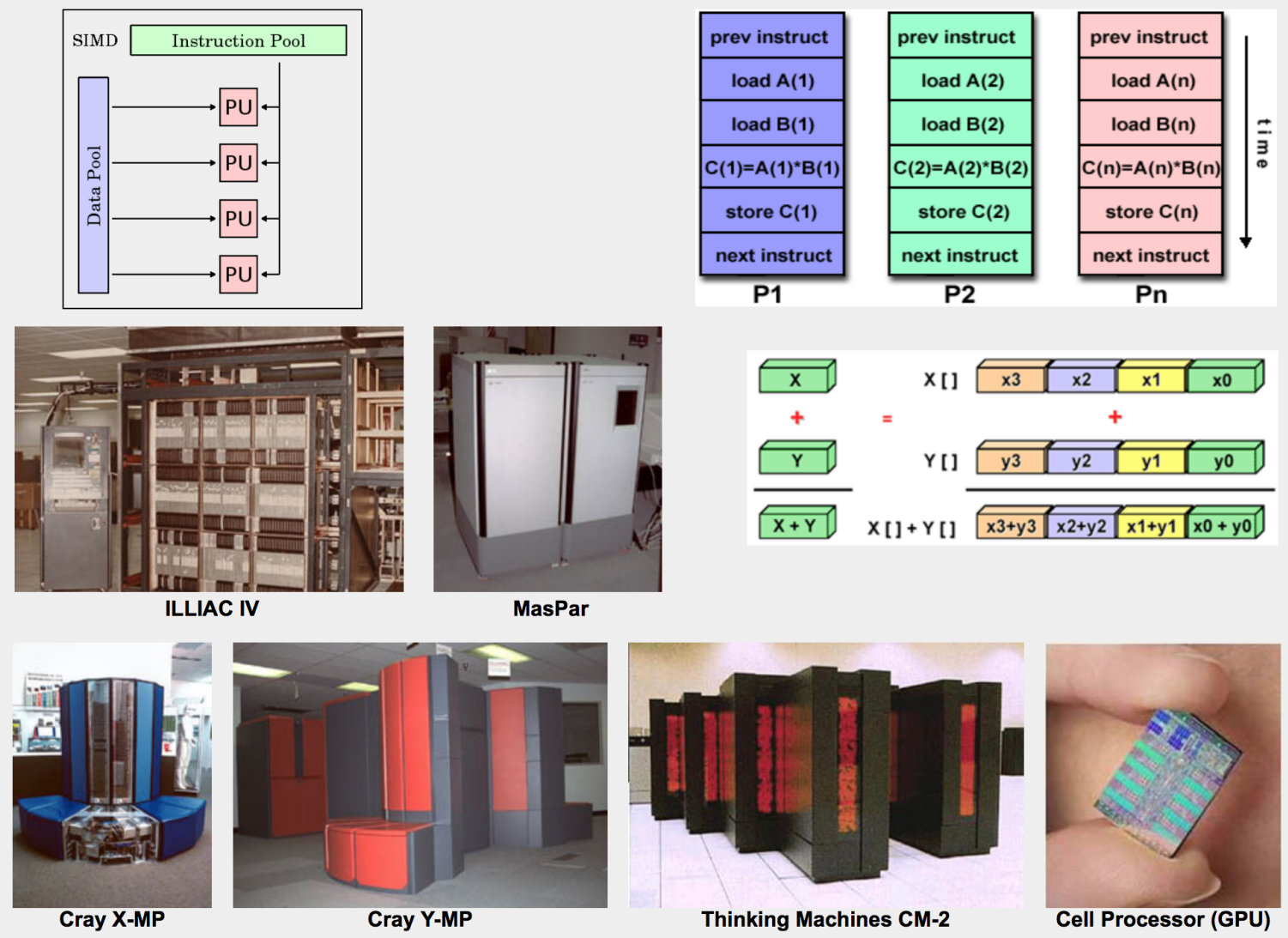


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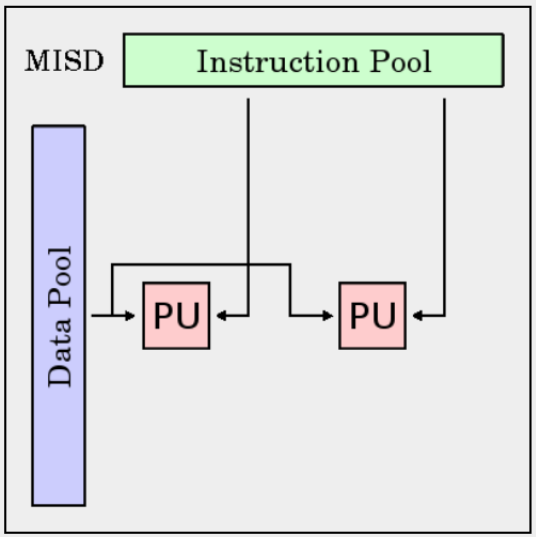


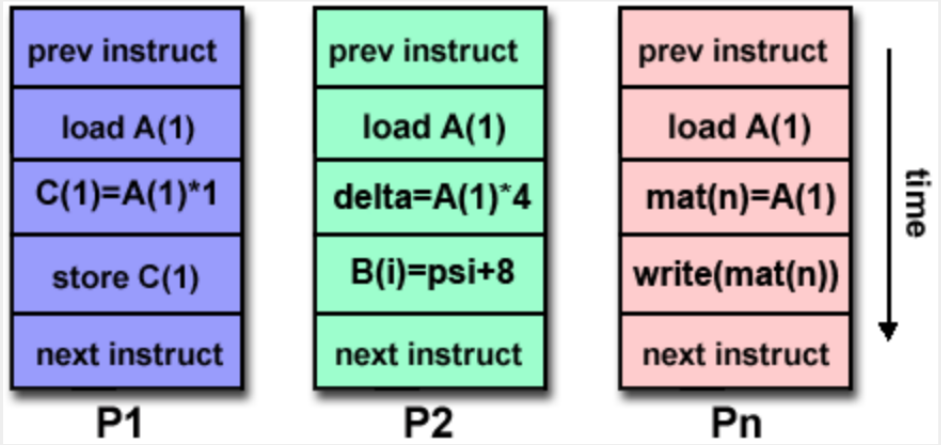


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- Note: many MIMD architectures also include SIMD execution sub-components

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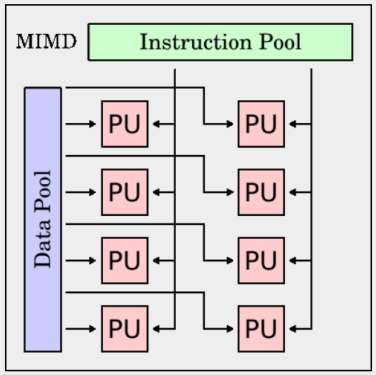


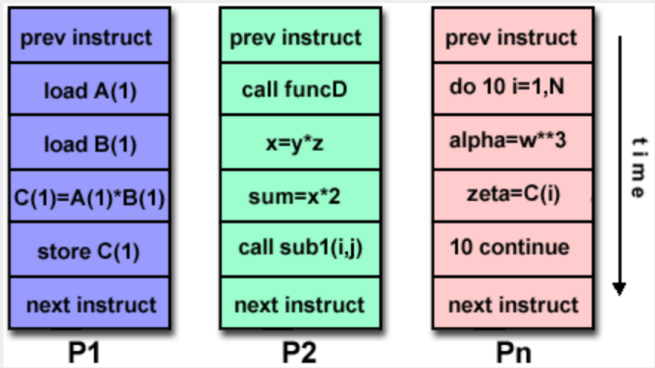


IBM POWER5

HP/Compaq Alphaserver

Intel IA32

AMD Opteron

Cray XT3

IBM BG/L

Figure 7: Multiple Instruction, Multiple Data (SIMD)

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**Node** A standalone "computer in a box". Usually comprised of multiple CPUs/processors/cores, memory, network interfaces, etc.
Nodes are networked together to produce a supercomputer.

# Some General Parallel Terminology

**CPU / Socket / Processor / Core** This varies, depending upon who you talk to.

In the past, a CPU (Central Processing Unit) was a singular execution component for a computer.

Then, multiple CPUs were incorporated into a node.

Then, individual CPUs were subdivided into multiple "cores", each being a unique execution unit. CPUs with multiple cores are sometimes called "sockets" - vendor dependent.

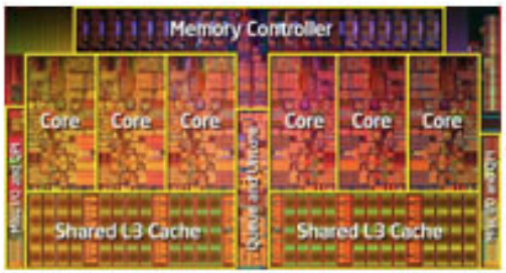
The result is a node with multiple CPUs, each containing multiple cores. The nomenclature is confused at times. Wonder why?

# Some General Parallel Terminology

Supercomputer - each blue light is a node

Node - standalone Von Neumann computer

CPU / Processor / Socket - each has multiple cores / processors.



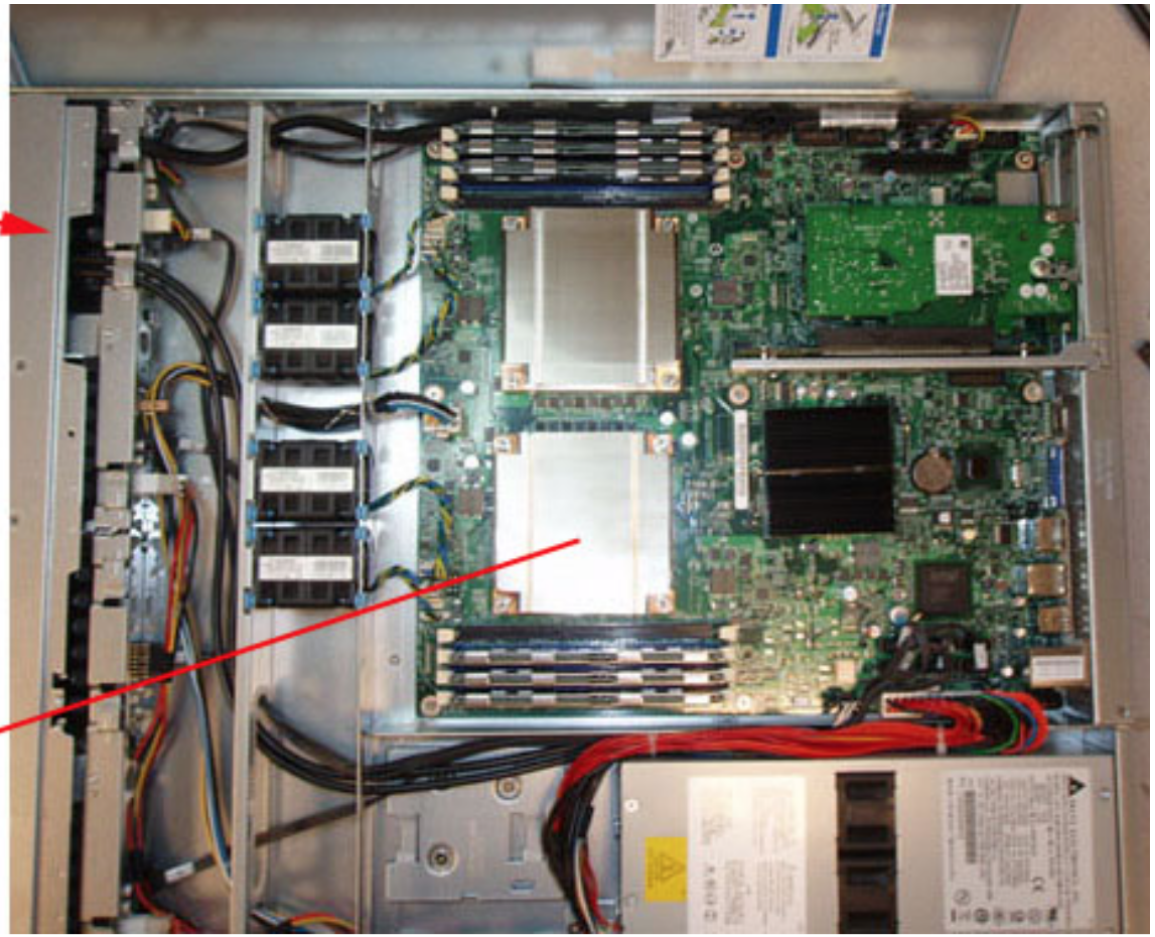



Figure 8: CPU / Socket / Processor / Core

# Some General Parallel Terminology

**Task** A logically discrete section of computational work. A task is typically a program or program-like set of instructions that is executed by a processor. A parallel program consists of multiple tasks running on multiple processors.

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**Pipelining** Breaking a task into steps performed by different processor units, with inputs streaming through, much like an assembly line; a type of parallel computing.

# Some General Parallel Terminology

**Shared Memory** From a strictly hardware point of view, describes a computer architecture where all processors have direct (usually bus based) access to common physical memory. In a programming sense, it describes a model where parallel tasks all have the same "picture" of memory and can directly address and access the same logical memory locations regardless of where the physical memory actually exists.

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**Symmetric Multi-Processor (SMP)** Shared memory hardware architecture where multiple processors share a single address space and have equal access to all resources.

# Some General Parallel Terminology

**Distributed Memory** In hardware, refers to network based memory access for physical memory that is not common.
As a programming model, tasks can only logically "see" local machine memory and must use communications to access memory on other machines where other tasks are executing.

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**Communications** Parallel tasks typically need to exchange data.
There are several ways this can be accomplished, such as through a shared memory bus or over a network, however the actual event of data exchange is commonly referred to as communications regardless of the method employed.