Microprocessors & Microcontrollers
: Arm Cortex M0+
(Using RP2040)

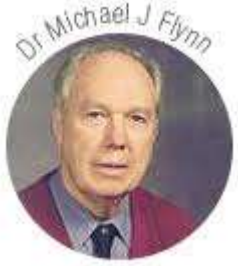
ES8

Flynn's Taxonomy

Focus

- Flynn's Taxonomy
  - Classification of Processors
  - SISD
  - SIMD
  - MISD
  - MIMD

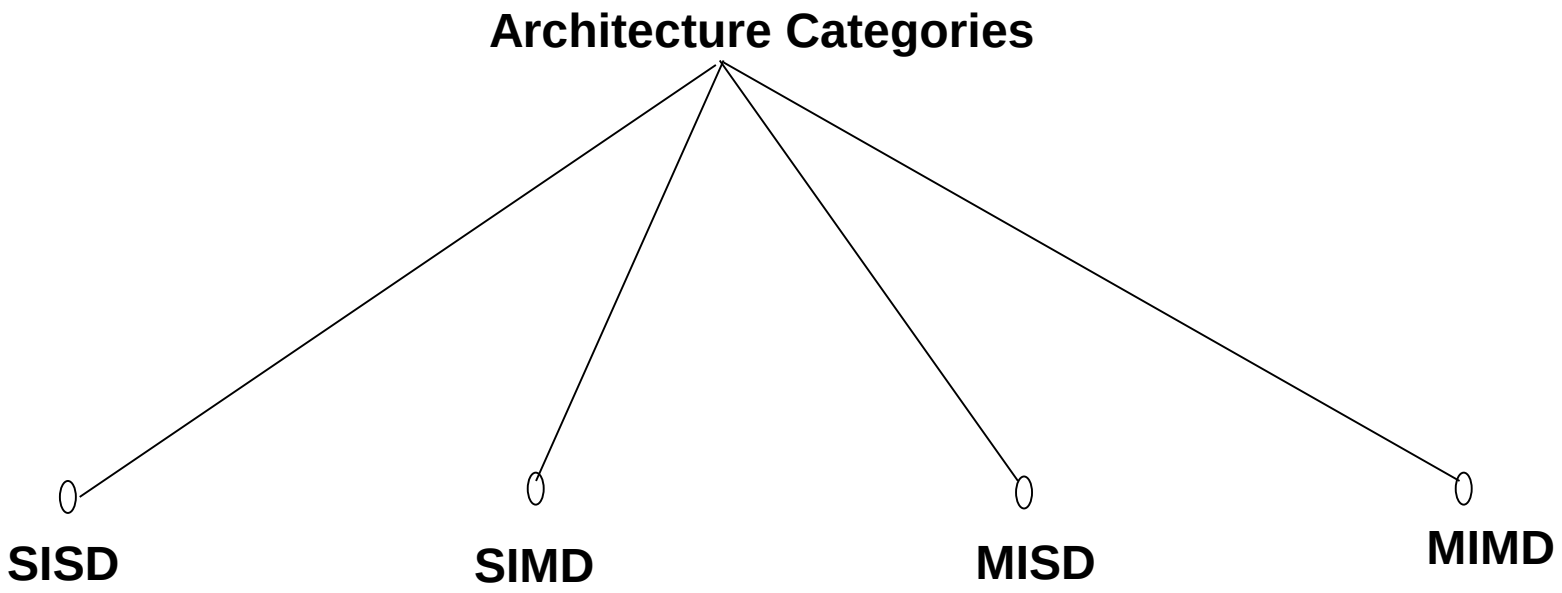
Flynn's Taxonomy



M.J. Flynn proposed a classification for the organization of a computer system by the number of instructions and data items that are manipulated simultaneously.

Taxonomy: The branch of science concerned with **classification**, especially of organisms.

Flynn's Classification



SISD: Single Instruction Single Data

SIMD: Single Instruction Multiple Data

MISD: Multiple Instruction Single Data

MIMD: Multiple Instruction Multiple Data

	Single Data	Multiple Data
Single Instruction	SISD	SIMD
Multiple Instruction	MISD	MIMD

Instruction stream & Data Stream

The sequence of instructions read from memory constitutes an **instruction stream**.

The operations performed on the data in the processor constitute a **data stream.**

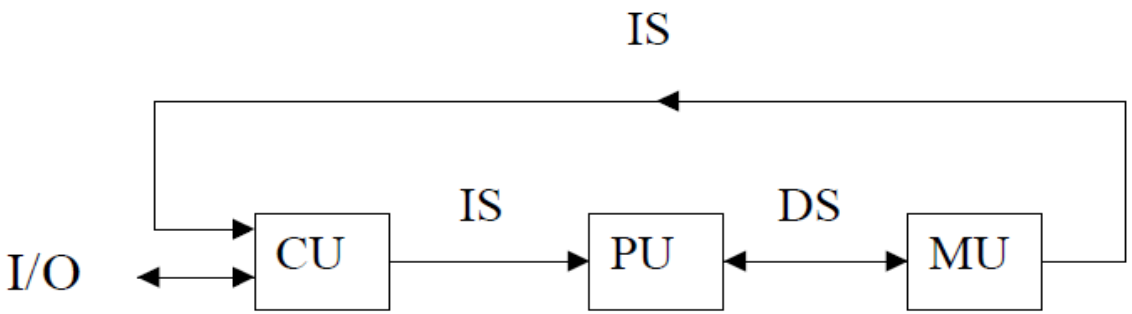
The term 'Stream' refers to the flow of instructions or data.

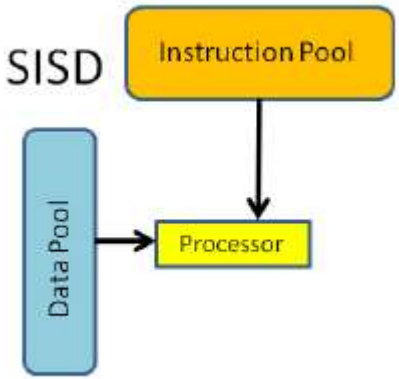
Parallel processing may occur in the instruction stream, in the data stream, or both.

SISD Uniprocessor
(Single Instruction and Single Datastream)

Flynn's Classification of Computer Architectures

(Derived from Michael Flynn, 1972)





(a) SISD Uniprocessor Architecture

Captions:

CU - Control Unit ; PU – Processing Unit

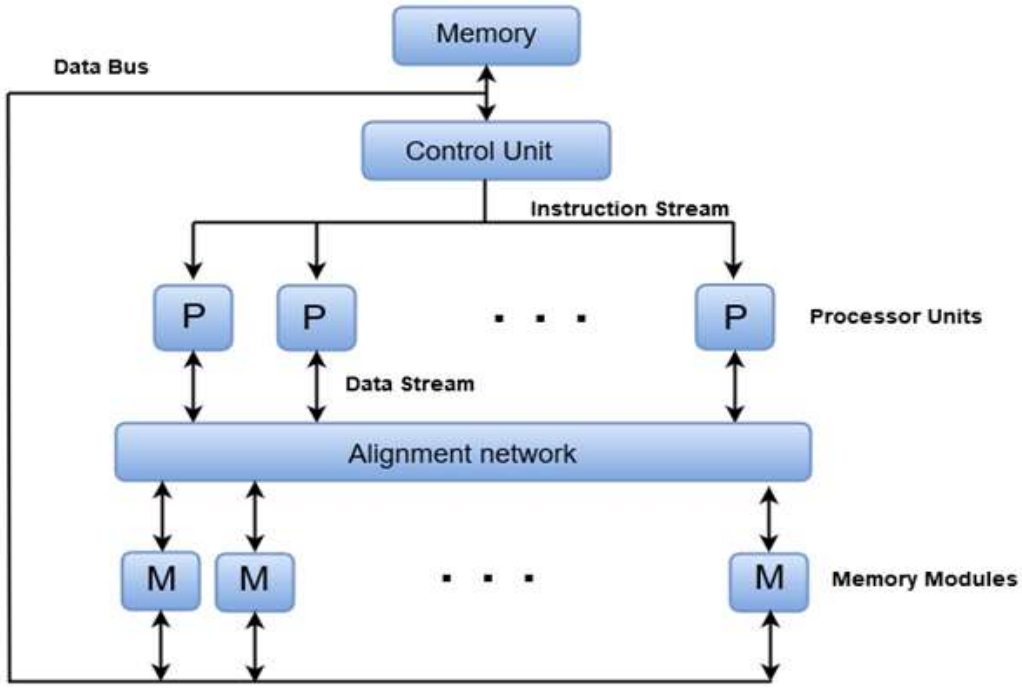
MU – Memory Unit ; IS – Instruction Stream

DS - Data Stream

Example: Non-pipelined Uniprocessors

SIMD
(Single Instruction Multiple Datastreams)

SIMD:



SIMD represents an organization that includes many processing units under the supervision of a common control unit.

All processors receive the same instruction from the control unit but operate on different items of data.

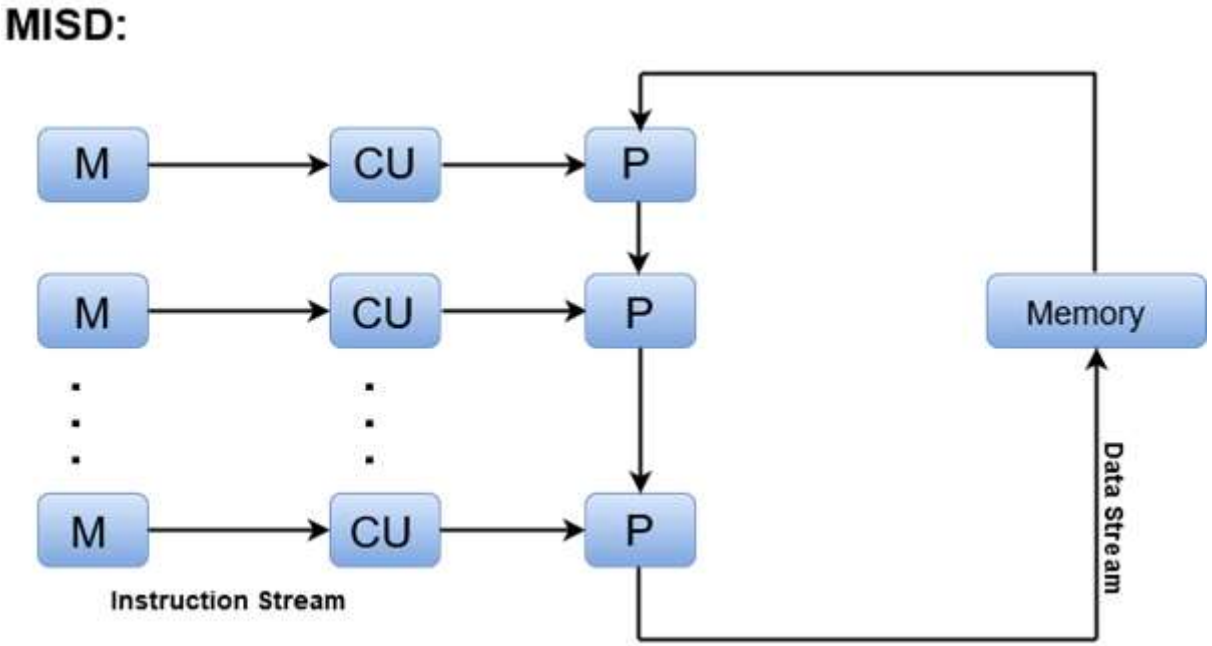
The shared memory unit must contain multiple modules so that it can communicate with all the processors simultaneously.

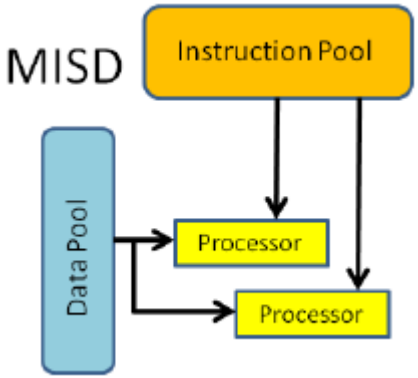
Where, M = Memory Modules, CU = Control Unit, P = Processor Units

Example: Vector processors (VIRAM)

VIRAM: Scalable Vector Processor for Embedded Systems.

MISD
(Multiple Instructions and Single Datastream)





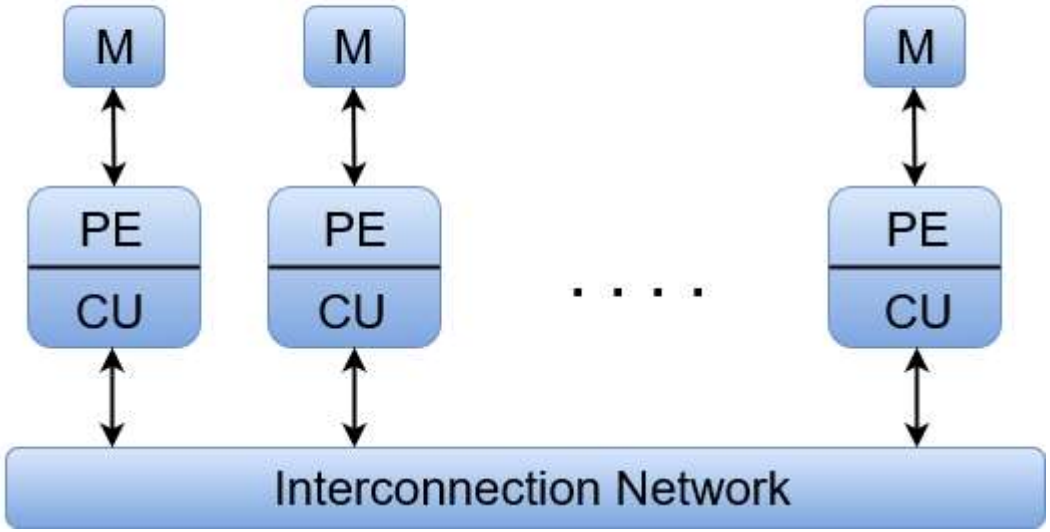
MISD structure is only of theoretical interest since no practical system has been constructed using this organization.

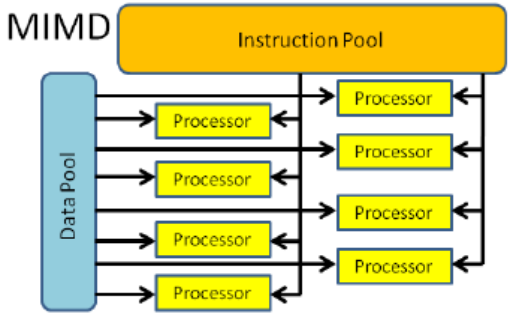
In MISD, multiple processing units operate on one single-data stream. Each processing unit operates on the data independently via separate instruction stream.

Example: Fault tolerant systems and Network processors (Intel IXP1200, LSI PayloadPlus)

MIMD
(Multiple Instructions and Multiple Datastreams)

MIMD:



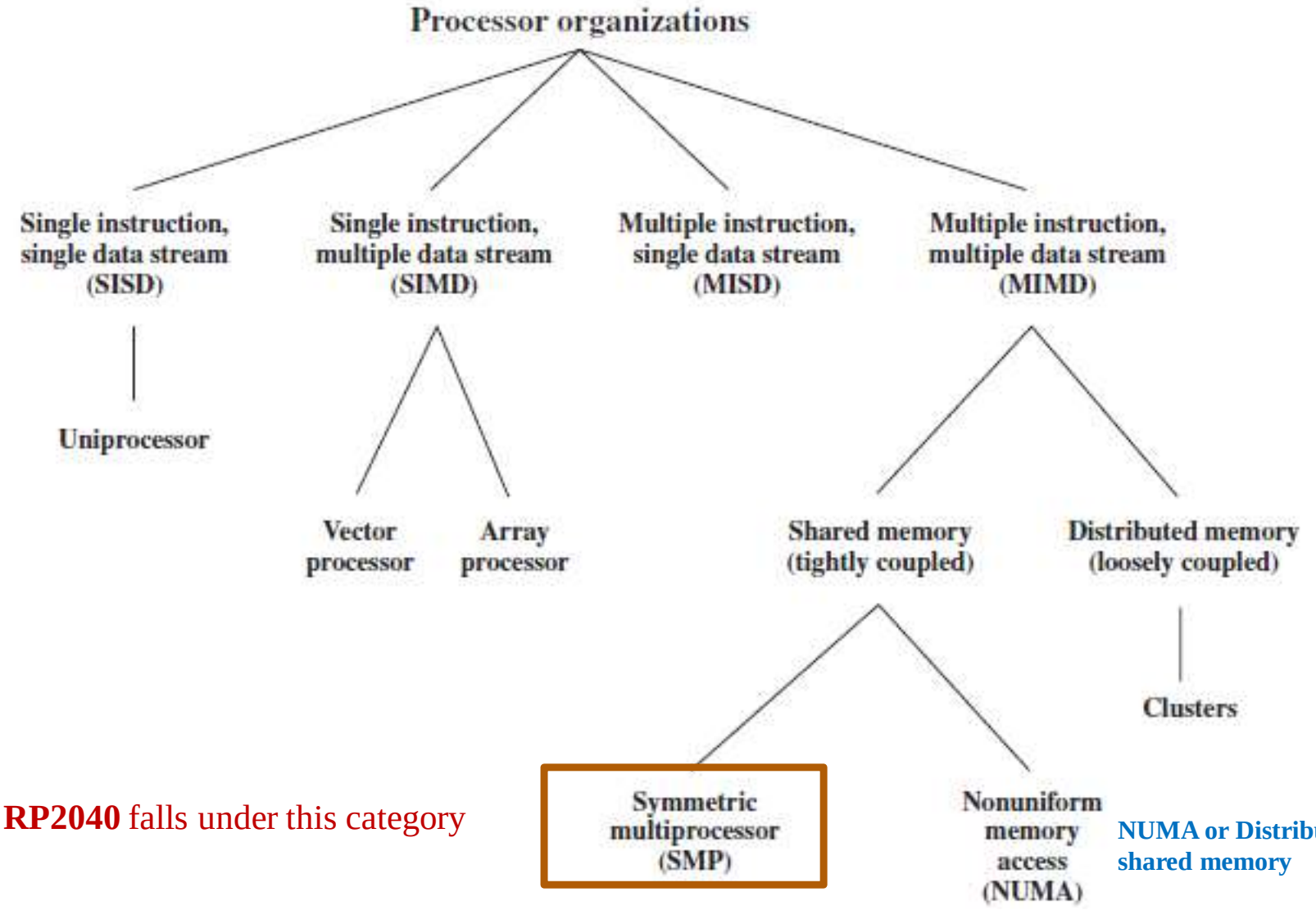


In this organization, all processors in a parallel computer can execute different instructions and operate on various data at the same time.

In MIMD, each processor has a separate program and an instruction stream is generated from each program

Example: Network of workstations

Flynn's Classification: Summary



Note: **RP2040** falls under this category

NUMA or Distributed shared memory

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