27/2/24

Thread safeness :-

It refers to an application's ability to execute multiple threads simultaneously without clobbering shared data or creating race condition while accessing shared global memory.
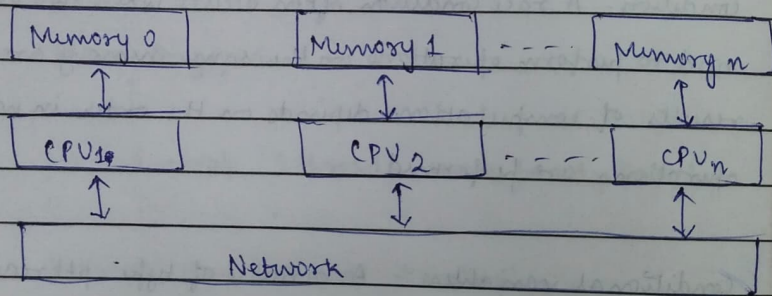
Limitations of pthreads :-

Because of pthreads, a program that runs fine on one platform may fail or produce wrong results on another platform. eg :-
The maximum no. of threads permitted and the default thread stacksize are two important limits to consider when designing your program.

⇒ **SPMD Mode (Single Program Multiple data Model)**

It is a special case of MIMD model.

Tasks are split up and run simultaneously on multiple processors with different inputs in order to obtain results faster.


```
┌──────────┐    ┌──────────┐           ┌──────────┐
│ Memory 0 │    │ Memory 1 │  - - -    │ Memory n │
└──────────┘    └──────────┘           └──────────┘
     ↕               ↕                      ↕
┌──────────┐    ┌──────────┐           ┌──────────┐
│  CPU 1   │    │  CPU 2   │  - - - -  │  CPU n   │
└──────────┘    └──────────┘           └──────────┘
     ↕               ↕                      ↕
┌──────────────────────────────────────────────────┐
│                   Network                         │
└──────────────────────────────────────────────────┘
```

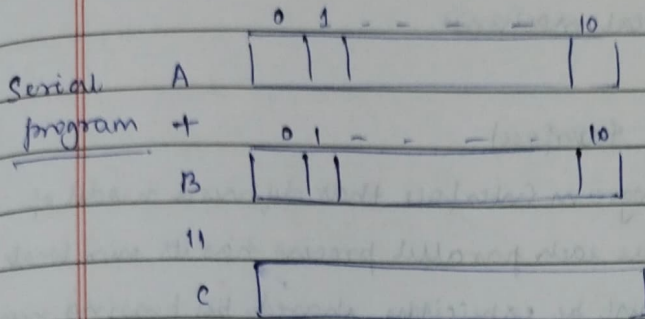# SIMD V/S SPMD → on your own

Execution process :-

The program is written once but replicated many times with each processing element executing the same program but with different data elements. The processing elements (PE) operate independently of each other and can execute conditional branches or loops differently depending on their assigned data elements.
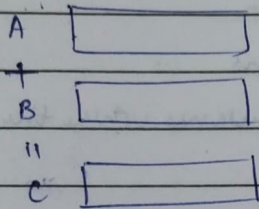
Good Write

```
for (i=0:11) {
    C[i] = A[i] + B[i]
}
```

Serial program

A +

SPMD :-   for (i=0:3)   (4:7)   (8:11)

(for loop ko
parts
~~mein~~
divide
kr diya)

A +
B
"
C

Applications :- used where there is massive data processing
Vector multiplication, weather forecasting, scientific simulations

Advantages

(i) Locality :- Data locality is essential to achieving good performance on large scale machines where communication across the network is very expensive.

(ii) structured parallelism :- The set of threads is fixed throughout computation. It is easier for compiler to reason about SPMD code resulting in more efficient program analysis than in other models.

(iii) Simple runtime implementation :- It has a local view of execution and parallelism is exposed directly to the users. Compilers and runtime systems require less effort to implement than any other MIMD model.

Good Write

Disadvantages

(i) SPMD is a flat model which makes it difficult to write hierarchical code such as divide and conquer algorithms as well as programs optimized for hierarchical machines.

⇒ **MPI** (Message Passing Interface)

It is an application program interface that defines a model of parallel computing where each parallel process has its own local memory and data must be explicitly shared by passing messages between processes.

MPI communication functions :-

(i) **Blocking communication functions**

Blocking communications are routines where the completion of the call is dependent on certain events.

MPI_send (void * buf, int count, MPI_Datatype datatype, int dist, int tag, MPI_Comm comm)

MPI_Recv (void * buf, int count, MPI_Datatype datatype, int source, int tag, MPI_Comm comm, MPI_Status * status)

for sends, the data must be successfully sent or safely copied to system buffer space and for receives, the data must be safely stored in the receive buffer.