

Nov 6

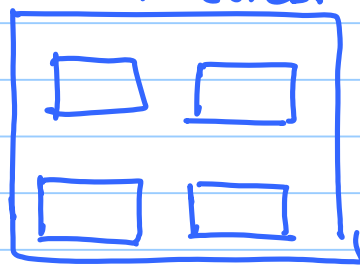
RAID-6

X Two parity blocks are mirrored

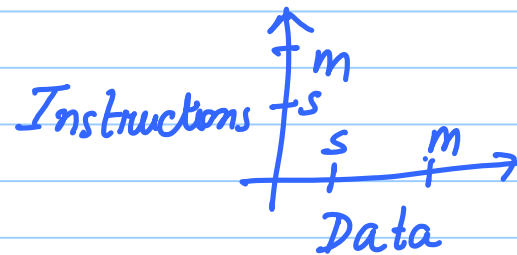
✓ syndrome based error-correction.

Multiprocessors

4-Cores.



Flynn's Taxonomy.



SISD: standard processor

MIMD: multiple unrelated programs running
parallelly.

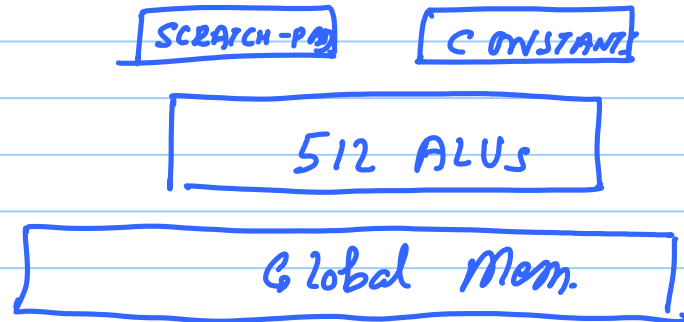
SIMD: 1) Vector processor.

```
for (i=0; i<n; i++)
```

```
    C[i] = A[i] + B[i];
```

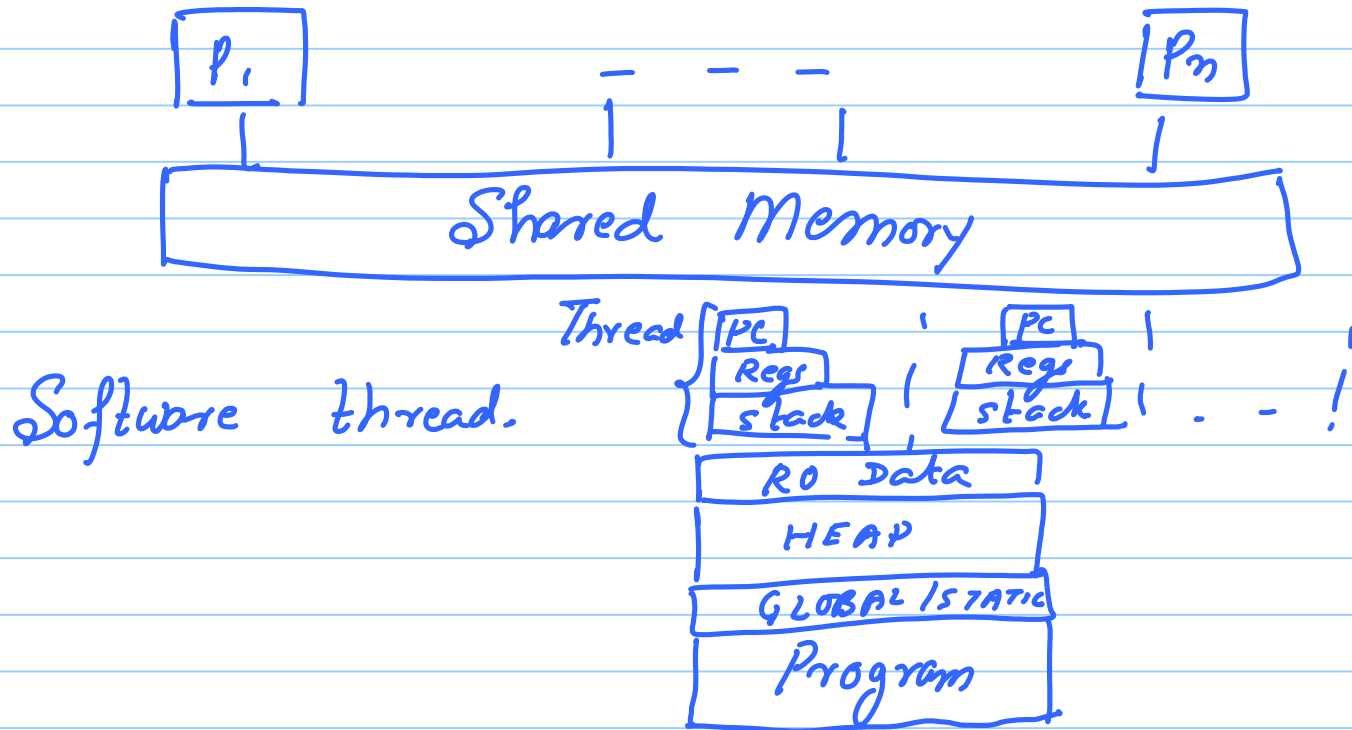
ADDVEC & C, RA, RB
vector Load-Store also.

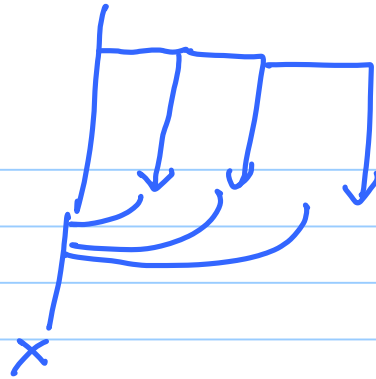
2) Graphics.



MISD: X

Parallel Programs

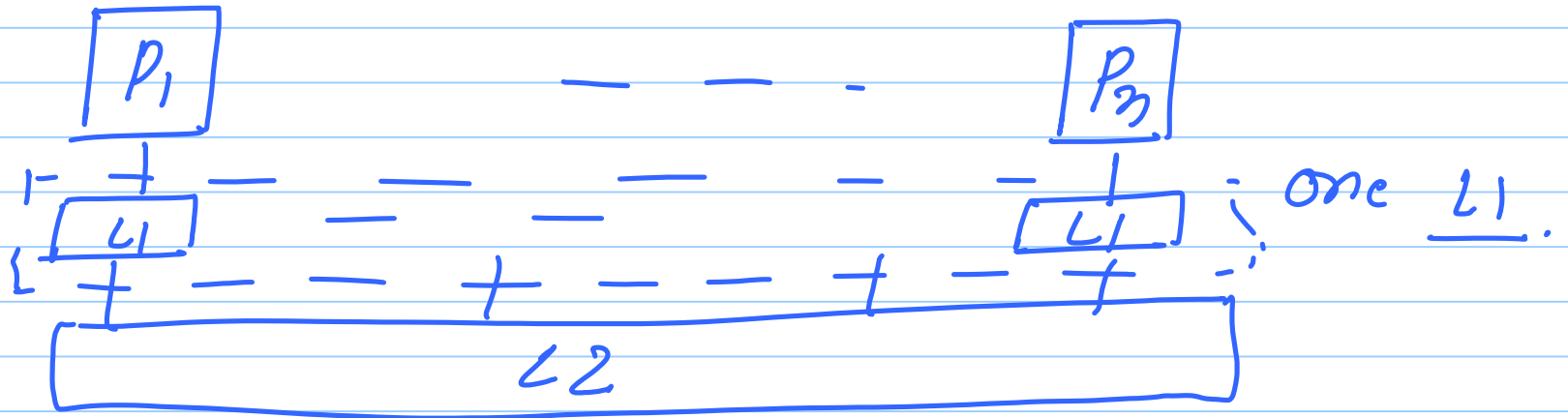




Java
→ extends Thread
→ implements Runnable.

C/C++
→ pthreads.
→ OpenMP

Shared Memory



→ cache coherence
→ memory consistency
(allowable orderings)

$$x=0, y=0$$

r_1 r_2
 0 0
 allowed on
 x86
 processors.

$$\begin{array}{l}
 x=1 \\
 r_1 = y \\
 T_1
 \end{array}$$

$$\begin{array}{l}
 y=1 \\
 r_2 = x \\
 T_2
 \end{array}$$

$$\begin{array}{l}
 r_1, r_2 \\
 0, 1 \\
 \left. \vphantom{\begin{array}{l} r_1, r_2 \\ 0, 1 \end{array}} \right\}
 \end{array}$$

$$\begin{array}{l}
 r_1 \quad r_2 \\
 1 \quad 1 \\
 x=1 \\
 y=1 \\
 r_1 = y \\
 r_2 = x
 \end{array}$$

$$\begin{array}{l}
 r_1 \quad r_2 \\
 1 \quad 0 \\
 y=1 \\
 r_2 = x \\
 x=1 \\
 r_1 = y
 \end{array}$$

You can
 check for
 yourself

Topologies.



MPI
(Message Passing
Interface).

1) Chain



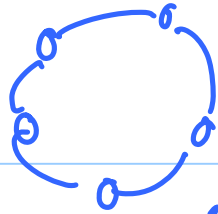
BB: 1

$D: O(n)$

Bisection Bandwidth: Minimum number of links that need to be cut to partition the network into two equal parts.

Diameter: Largest shortest path between two nodes.

2)



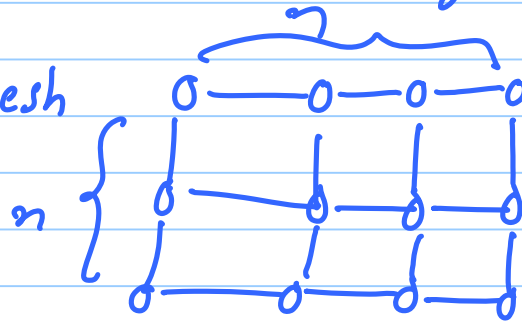
Ring

$$BB : 2$$

$$D : n/2$$

3)

Mesh

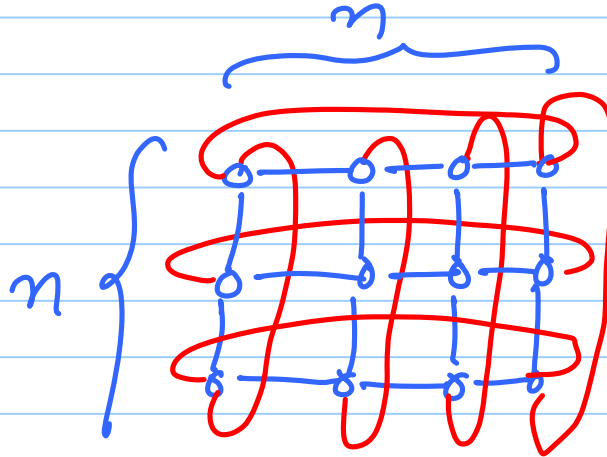


$$BB : n$$

$$D : 2n$$

4)

Torus

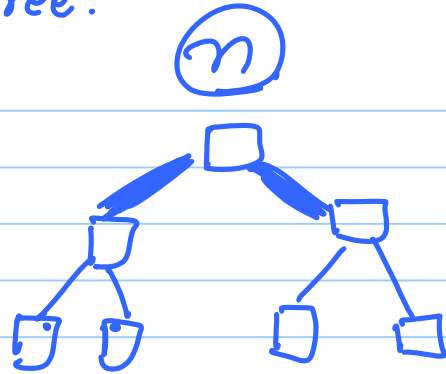


$$BB : 2n$$

$$D : n$$

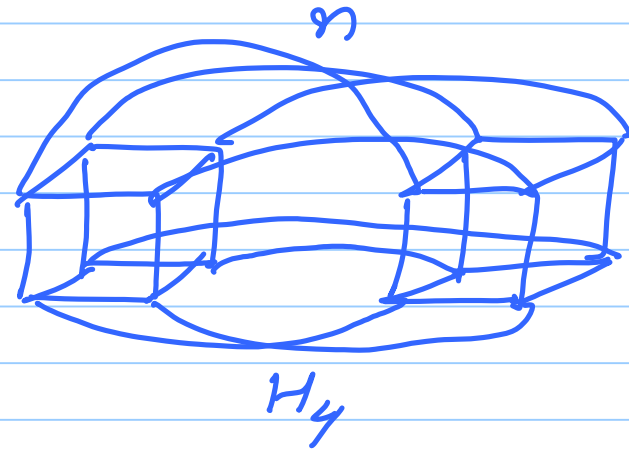
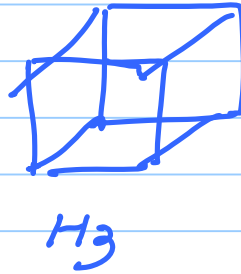
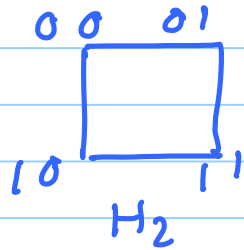
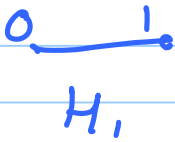
5)

Fat-Tree:



$$D: 2 \log_2(n)$$

6) Hypercube:



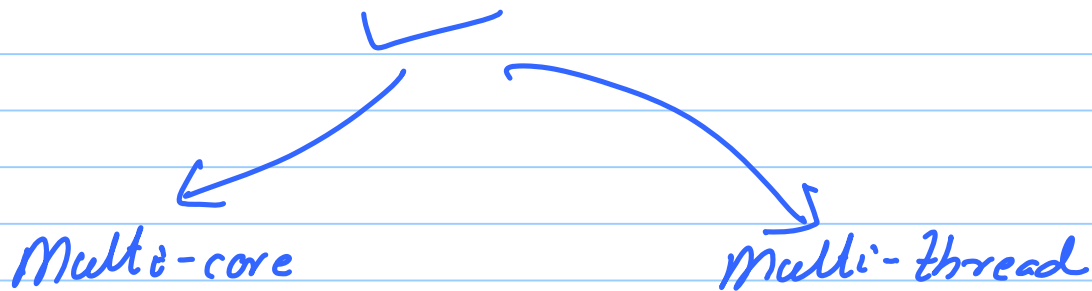
H_k
 H_{k-1} H_{k-1}

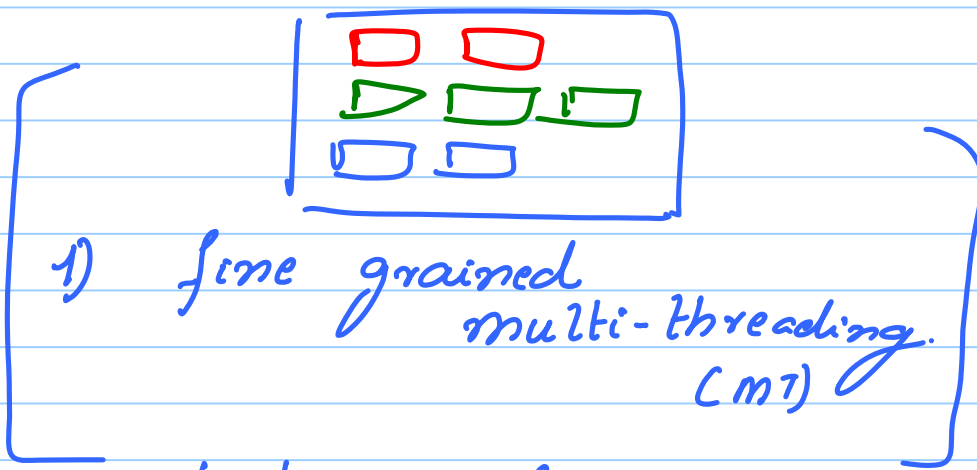
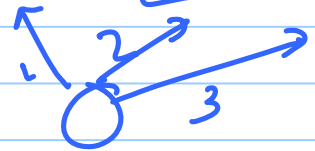
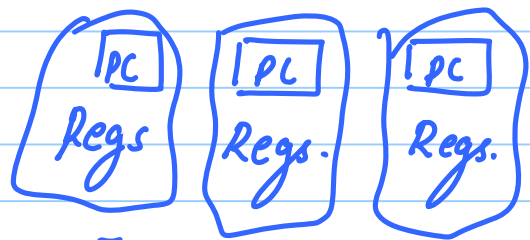
BB: $n/2$
D: $\log(n)$

Paradigms.

Shared Memory

Distributed Memory



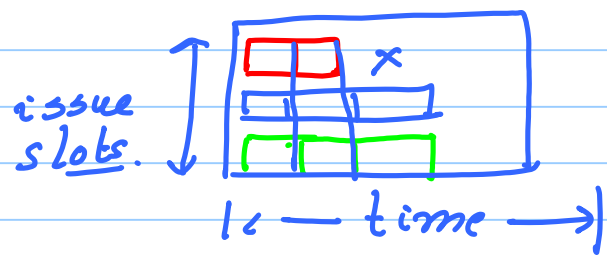
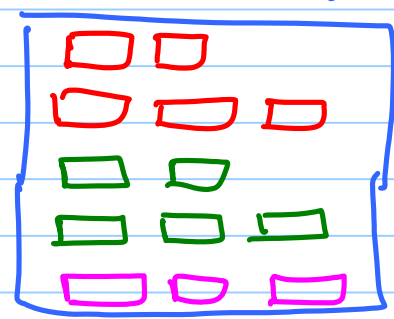


1) fine grained multi-threading (fMT)

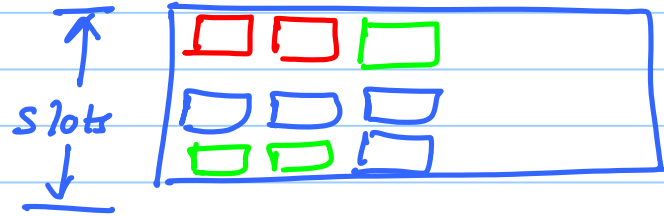
hyper threading.

1.5) Coarse-grain (mT)

2)

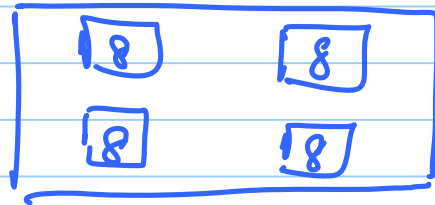


3) Simultaneous Multi-Threading (SMT)



Server:

Kalindi . cse.



Each core can support 2 HW Threads.

Total: 64 HW Thds.

(Shared Mem.)