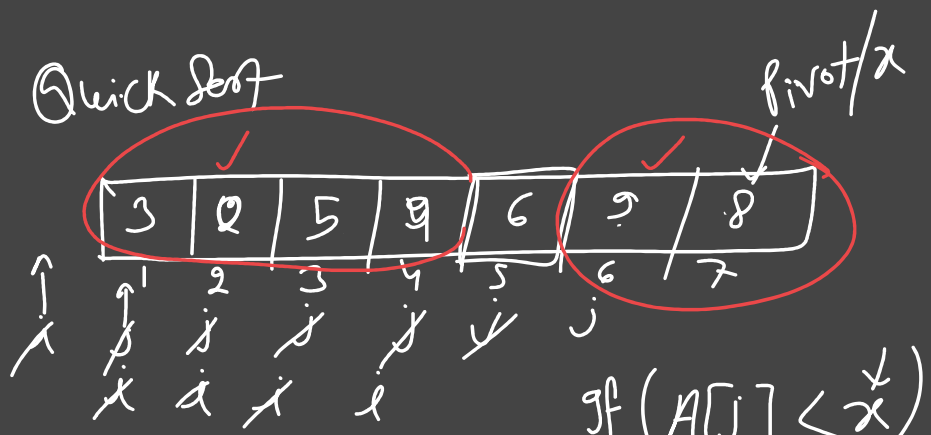
Date
13/02/2023

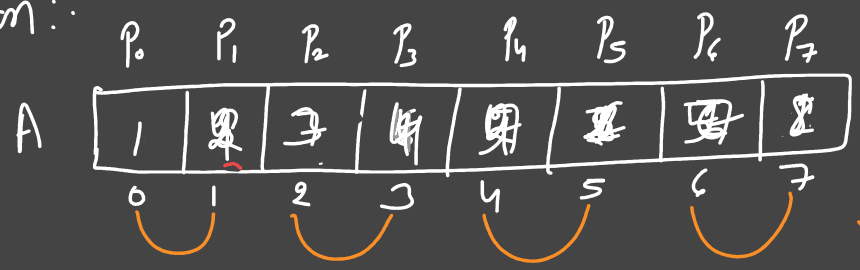
§ Parallel & Distributed Computing §

§ Sorting ::

Quick Sort



Odd-Even transposition:



Odd-Even
Even-Odd
Odd-Even
Even-Odd
Odd-Even
Even-Odd
Odd-Even

Algorithm:

```
for i=0 to n/2
{
    for all Pj where 0 ≤ j ≤ n-1
    if(j<n-1 and odd(j))
    {
        t=Successor(a)
        Successor(a)=max(a,t)
        a=min(a,t)
    }
    if(j<n-1 and Even(j)
        Copied.
}
if(j≤n-1)
→Copied
```

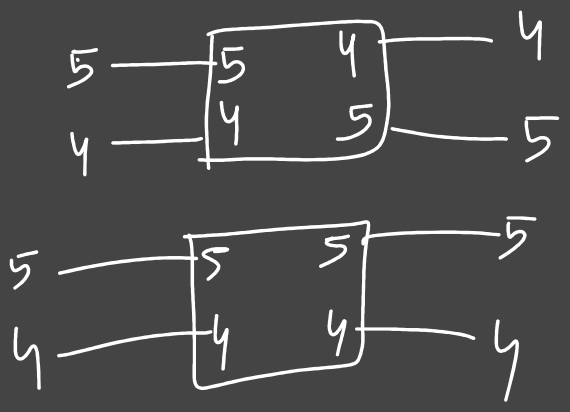
∀ P_j

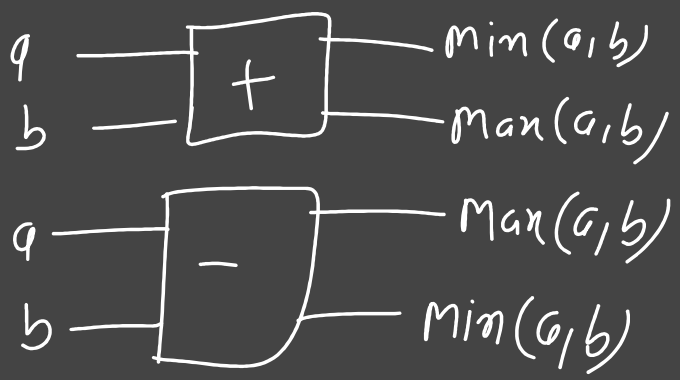
two local variables a & t

Mark

§ Bitonic Merge:

Two numbers are routed in Comparator.





A bitonic Sequence is a Sequence of values $a_0, a_1, \ldots, a_{n-1}$, with the property that (1) there EXISTS a Index i where $0 \le i \le n-1$, such that a_0 through a_i is monotonically increasing and a_{i+1} to a_{n-1} is monotonically decreasing or (2) there exists a Cyclic Shift of Indices So that first Condition is Satisfied.

- If n is Even, then $n/2$ Comparators are Sufficient to transform a bitonic Sequence of n values,

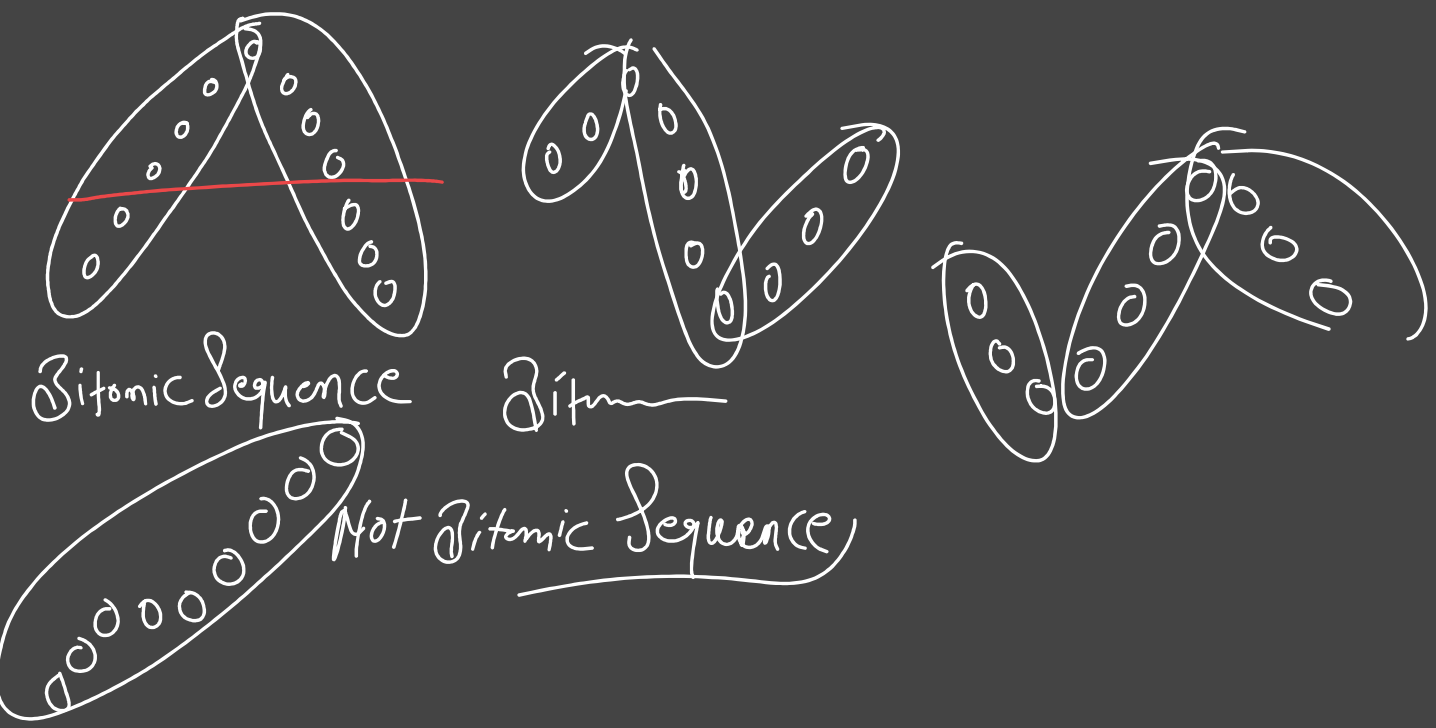
$$a_0, a_1, a_2, \ldots, a_{n-1}$$

into two bitonic Sequences of $n/2$ values.

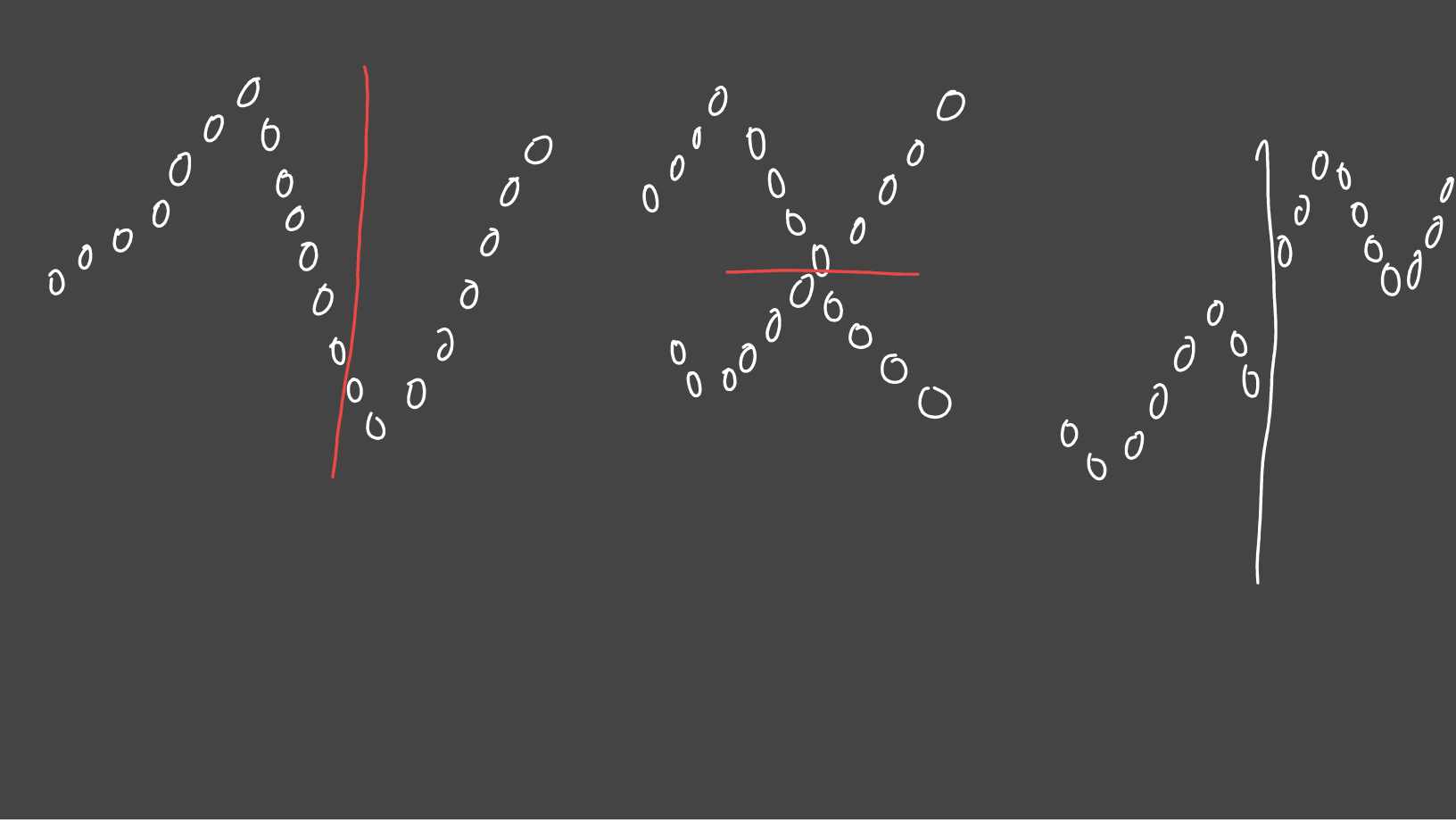
$$\min(a_0, a_{n/2}), \min(a_1, a_{n/2+1}), \ldots, (a_{n/2-1}, a_{n-1})$$

and

$$\max(a_0, a_{n/2}), \max(a_1, a_{n/2+1}), \ldots, (a_{n/2-1}, a_{n-1})$$


Bitonic Sequence
Bitonic Sequence

Not Bitonic Sequence



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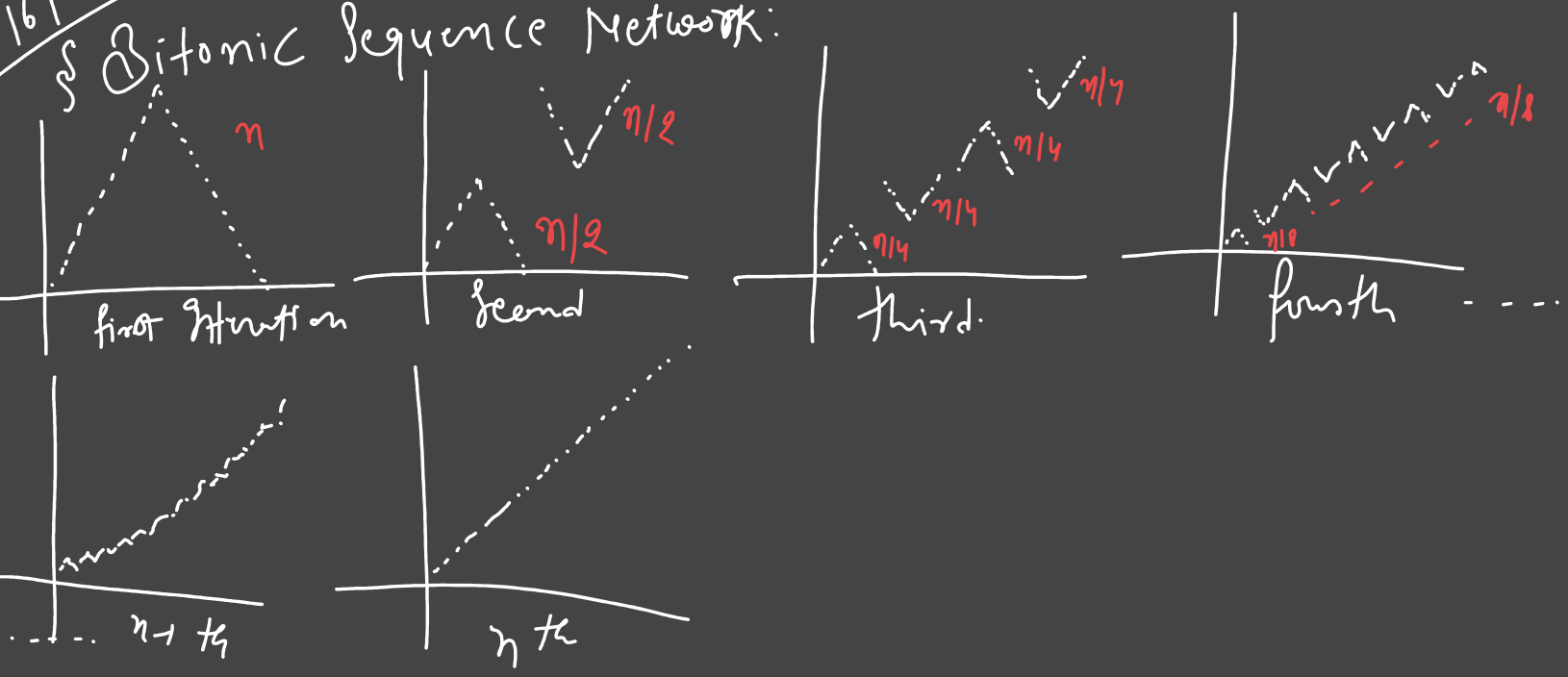
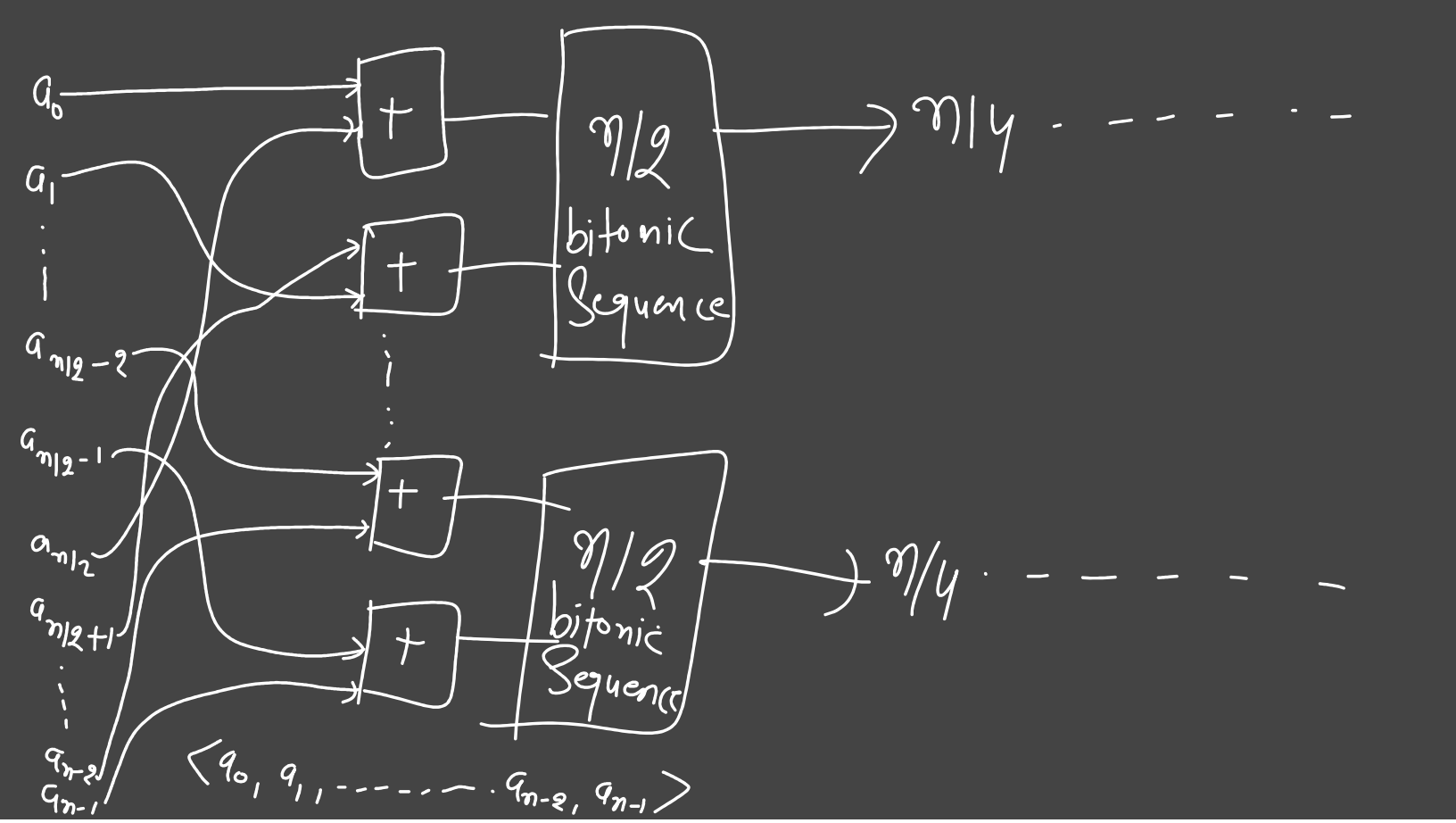
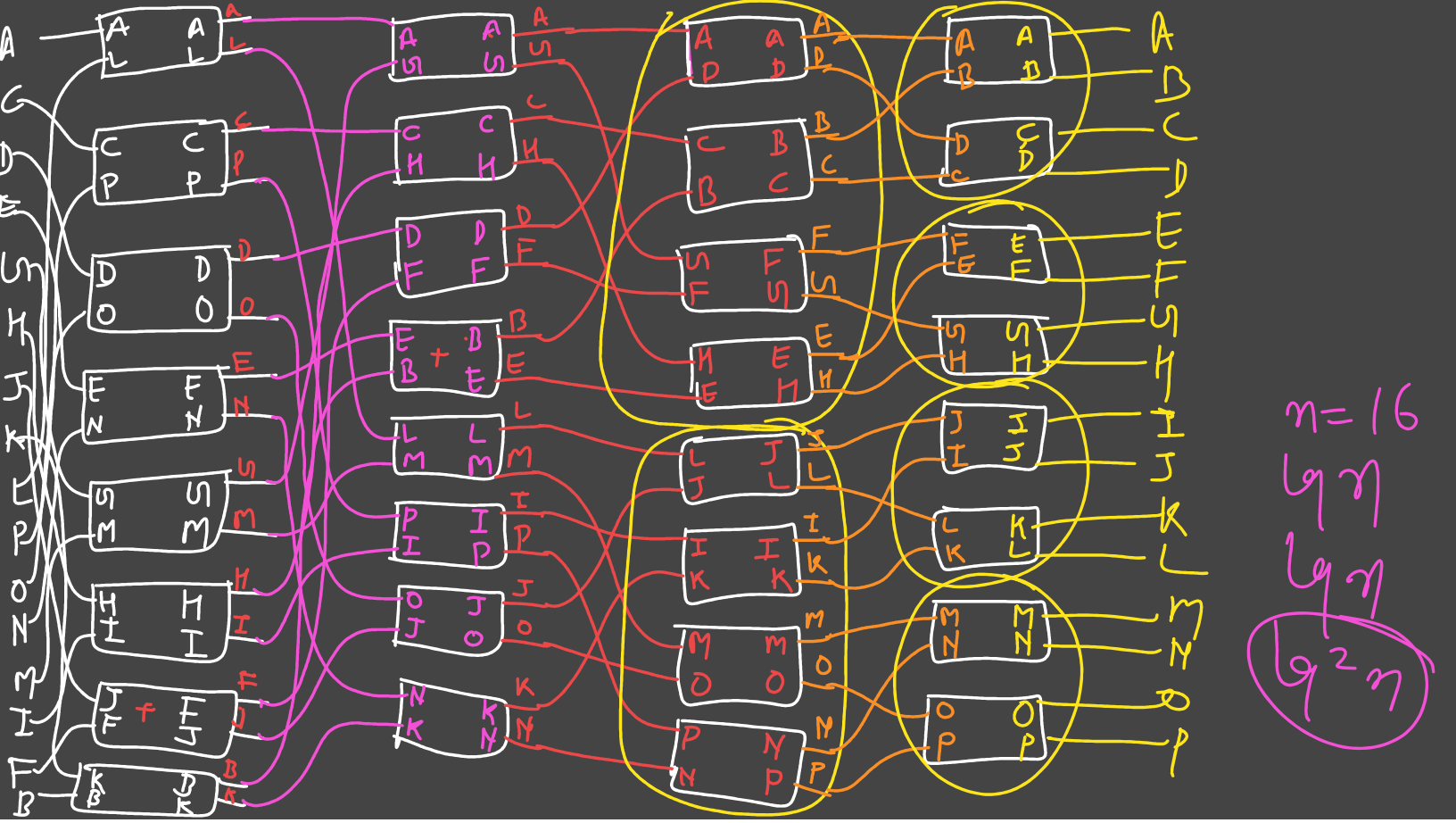
§ Parallel & Distributed Computing §

§ Bitonic Sequence Network:




a_0
a_1
$a_{n/2-2}$
$a_{n/2-1}$
$a_{n/2}$
$a_{n/2+1}$
a_{n-2}
a_{n-1}
+
+
+
+
n/2 bitonic Sequence
n/2 bitonic Sequence
n/4 - - - - - -
n/4 - - - - - -
$\langle a_0, a_1, \ldots, a_{n-2}, a_{n-1} \rangle$


n=16
log n
log n
log² n

$\Rightarrow n = 2^k$ Elements.

$n = 16$

$2^k = 2^4$ Comparators at Each

total no. of levels $= 2^{k-1} = 2^{4-1} = 2^3 = 8$

time Complexity =

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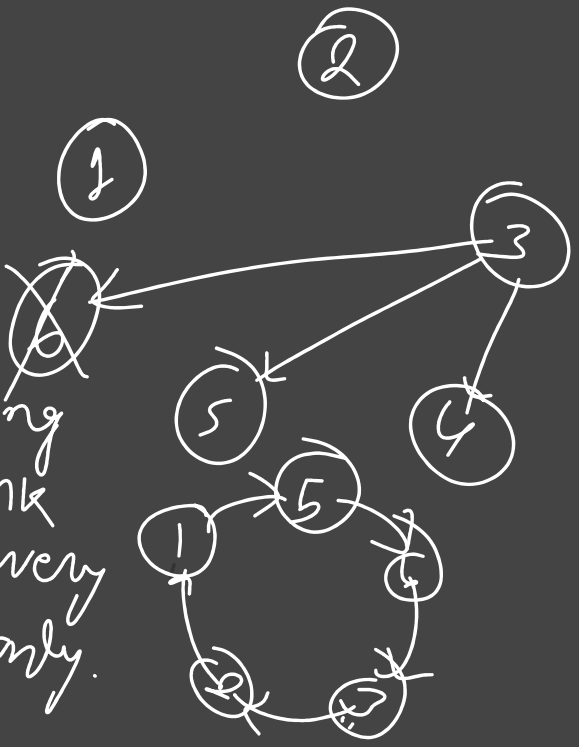
§ Parallel & Distributed Computing §

Bully Algorithm :: last class.

Ring Algorithm ::

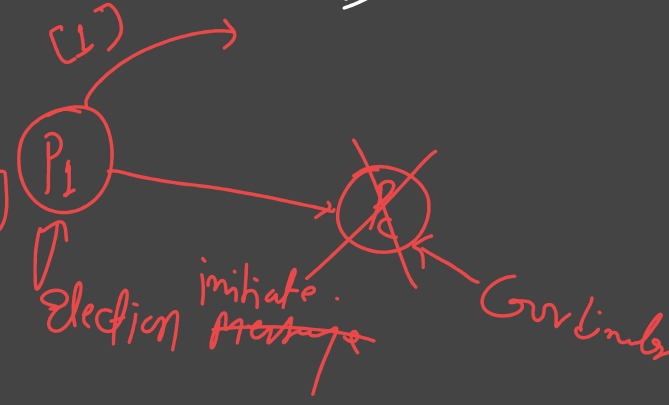
Approach :: This Algorithm applies to the system organized as a ring

- In this algorithm we assume that the link b/w processes are unidirectional and every process can manage to the its right only.
- Active link data structure.



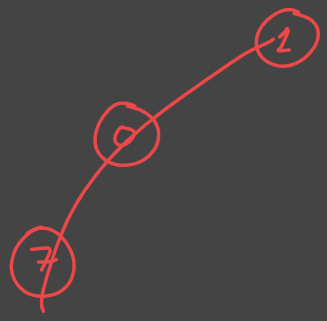
Algorithm::

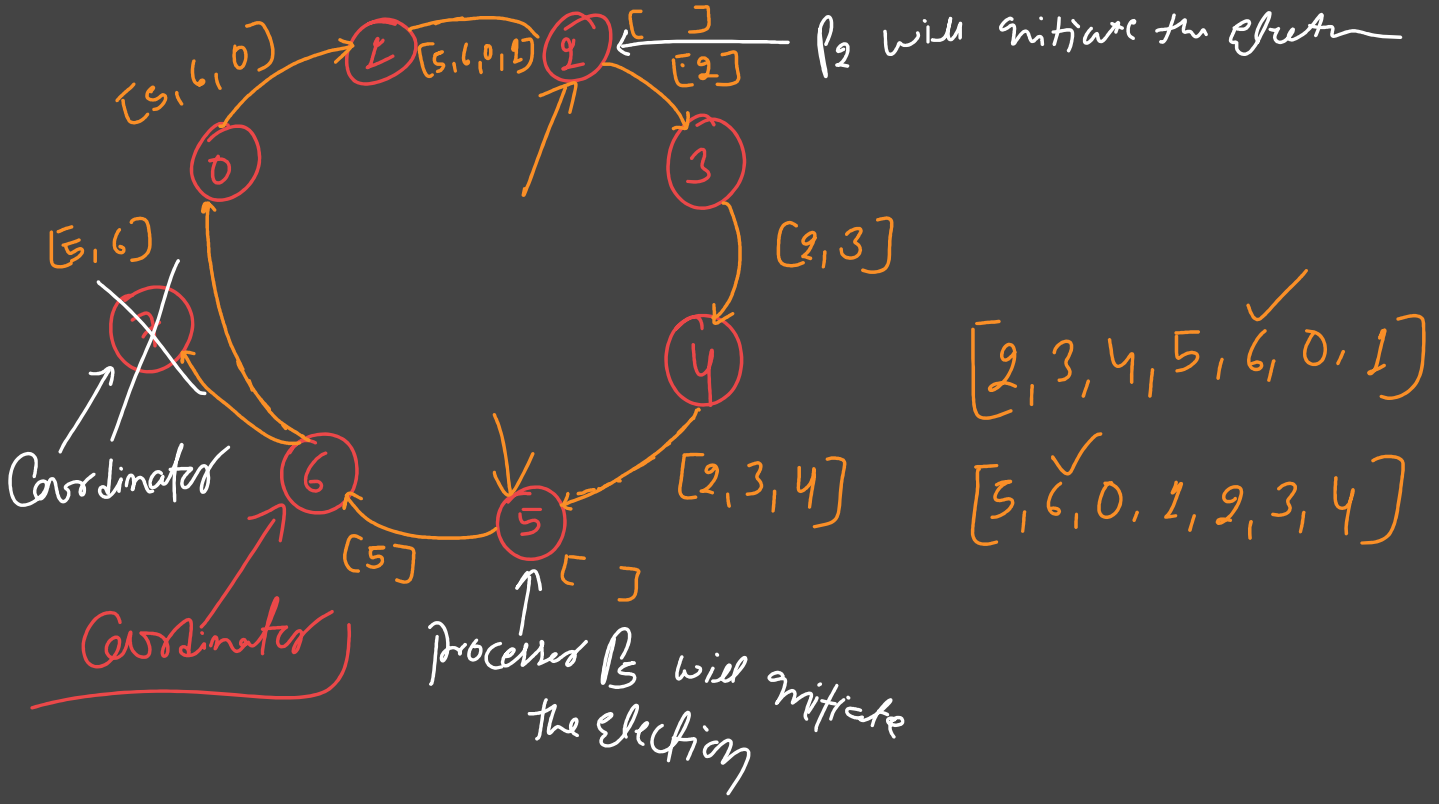
- If process P_2 detects a coordinator failure, it create a new active list which is Empty. It sends the Election message to its neighbour on right and adds number "1" to its active list.
- If process P_2 receives a message elect from the processes of the left.



Example:: Ring Algorithm

- Process P observed the coordinator has crashed. then it will create an election message which contain its own id no.
- It will send the message to live successor.
- Each process adds its own number and forward to the next.
- At a time more than one elections are possible.





[2, 3, 4, 5, 6, 0, 1]

[5, 6, 0, 1, 2, 3, 4]

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§ Parallel & Distributed Computing §

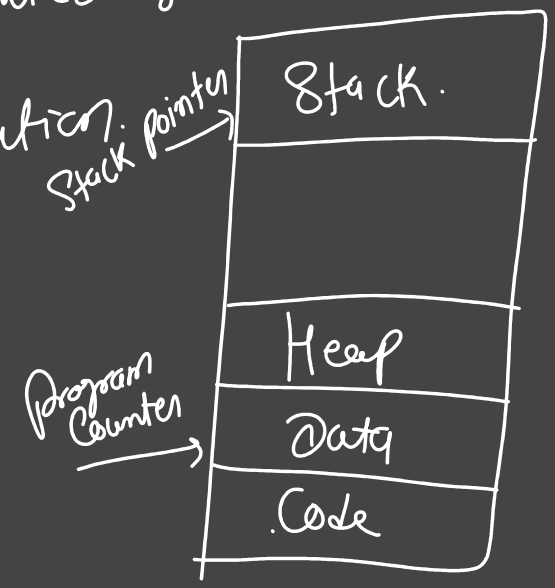
§ Process & threads in Distributed Systems.

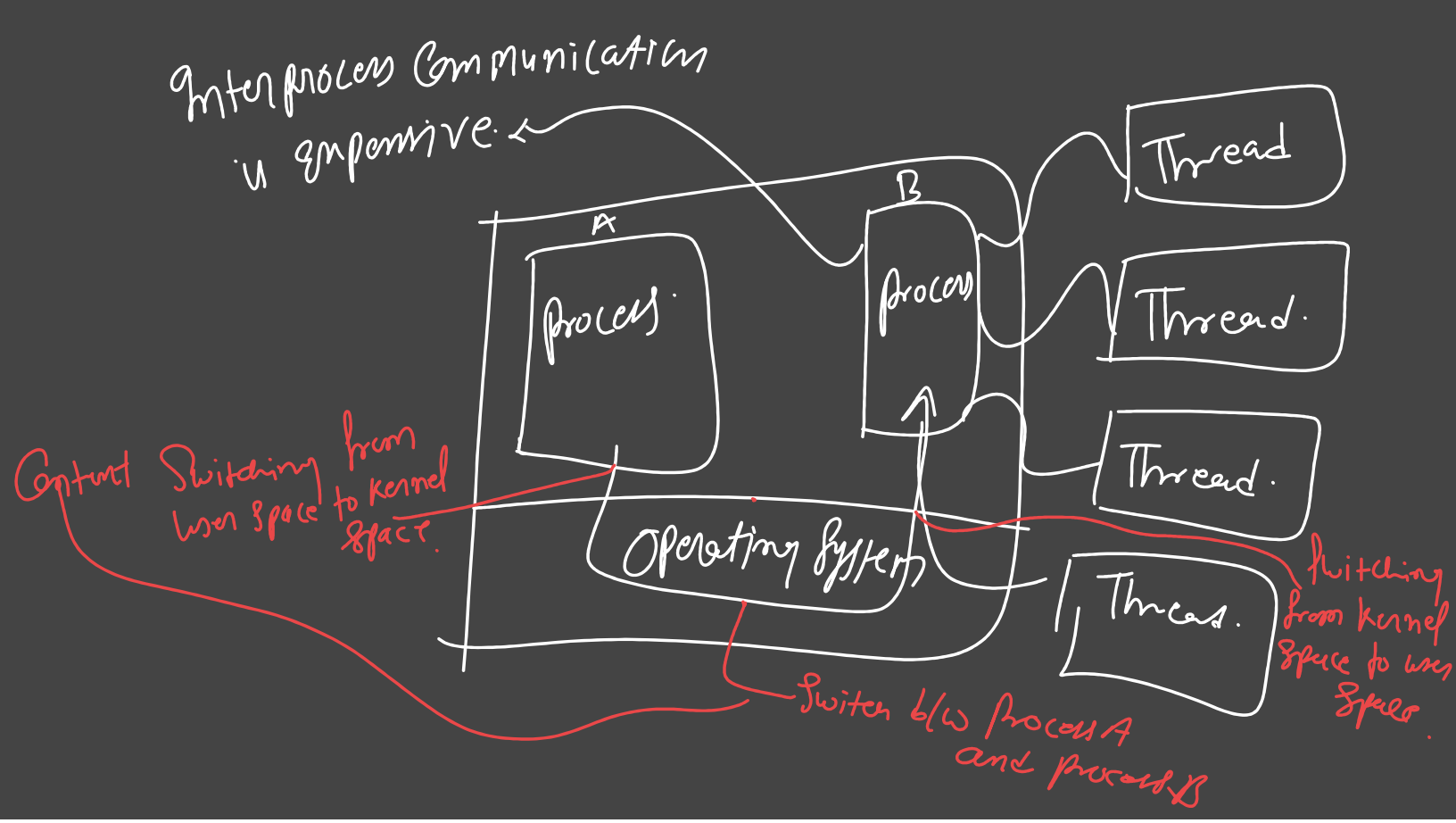
Process ?

Process is a program in Execution.

→ Execution Context
- Program Counter
- Stack pointer
- Data Registers.

→ Code
→ Data
→ Stack.

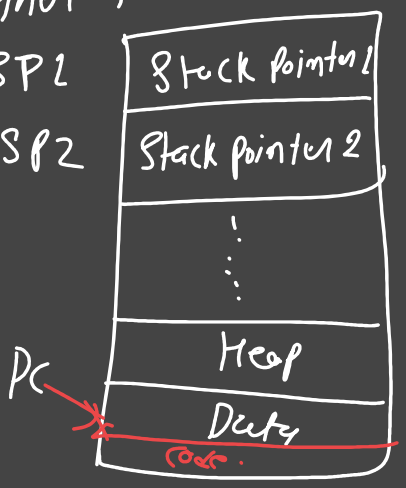


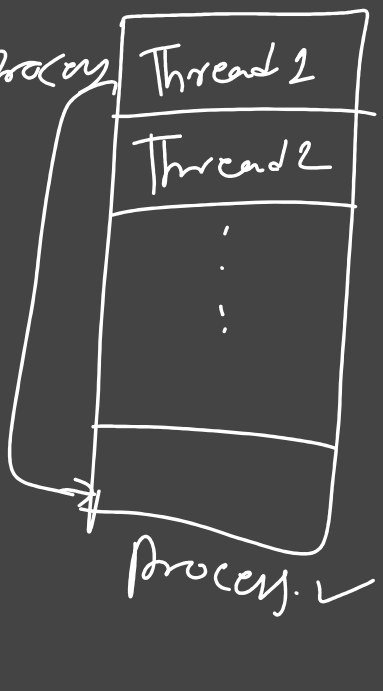

Interprocess Communication is expensive.
A
B
Process
Process
Thread
Thread
Thread
Thread
Operating System
Context Switching from user space to kernel space.
Switching from kernel space to user space.
Switch b/w Process A and Process B

Thread ?

Thread is a light weight process.

A thread is a path of execution within a process.
A thread executes its own piece of code independently from other threads.



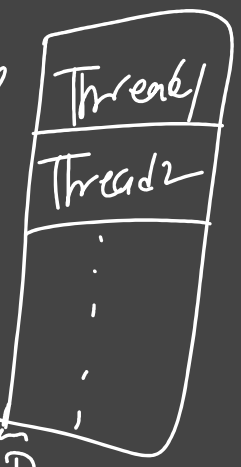


Threads: Interprocess Communication is cheap and it is not secure.

→ memory ~~Data~~ is shared in thread.

→ memory doesn't share in process.

A thread can write the memory used by another thread.



- Threads are allowed to blocking the system call without blocking Entire process.
- The main contribution of a thread in Distributed System is that they allow clients and servers to be constructed such that local processing can overlap, resulting the high level of processing

§ Threads can be used in D.S.

1) multithreaded client → web browser
2) " " server → web server

§ It can be used to hide the delay/latency in network communication by initiating by multithreading