Basic Concepts

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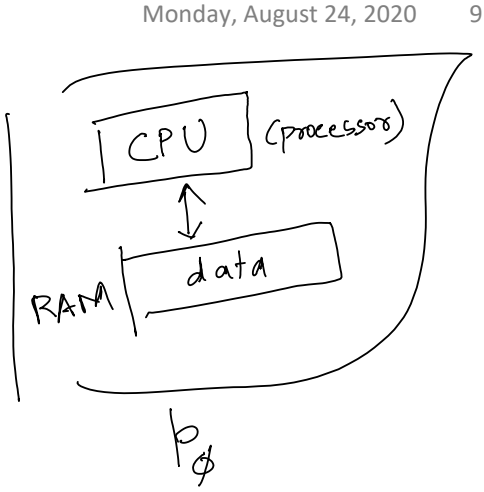
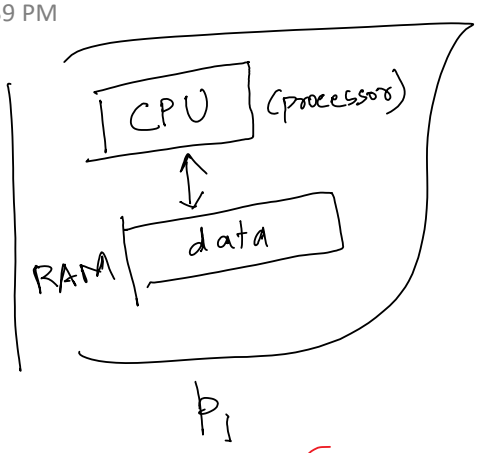
"Sequential" ≡ "Serial"

($p=1$)





. . .

Serial Program:

A: [0 . . $n-1$]

sum ← 0

for (i = 0 to $p-1$)

{ local data

sum ← sum + x_i

{ send recv

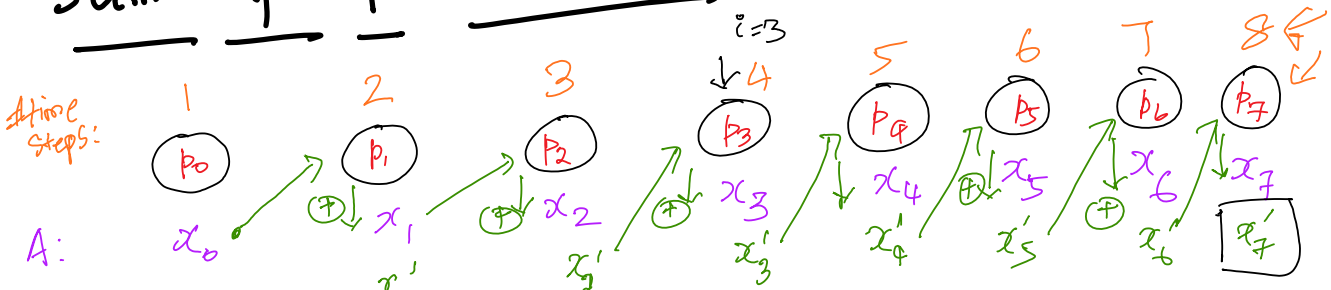
Output sum

opt.

O(p) time

(Address Space)

Sum of p numbers:



p ← # processes

// from pov: p_i

Init: load x_i ; temp ← 0

Comp: (p_i executes ith iteration)

my "rank" ← i

if rank > 0 {

temp ← Receive from p_{i-1} // Communication

}

x_i' ← x_i + temp // local computation

if (rank < $p-1$) {

Send x_i' to p_{i+1} // Communication

}

else {

Output x_i' // from rank ($p-1$)

}

Homogeneous processing system

Problem:

Input: A[0 . . $p-1$]

Output: $sum = \sum_{i=0}^{p-1} A[i]$

Parallel time complexity:

$= \max\{T_i(n)\}$

$= O(p)$ time

Parallel Work

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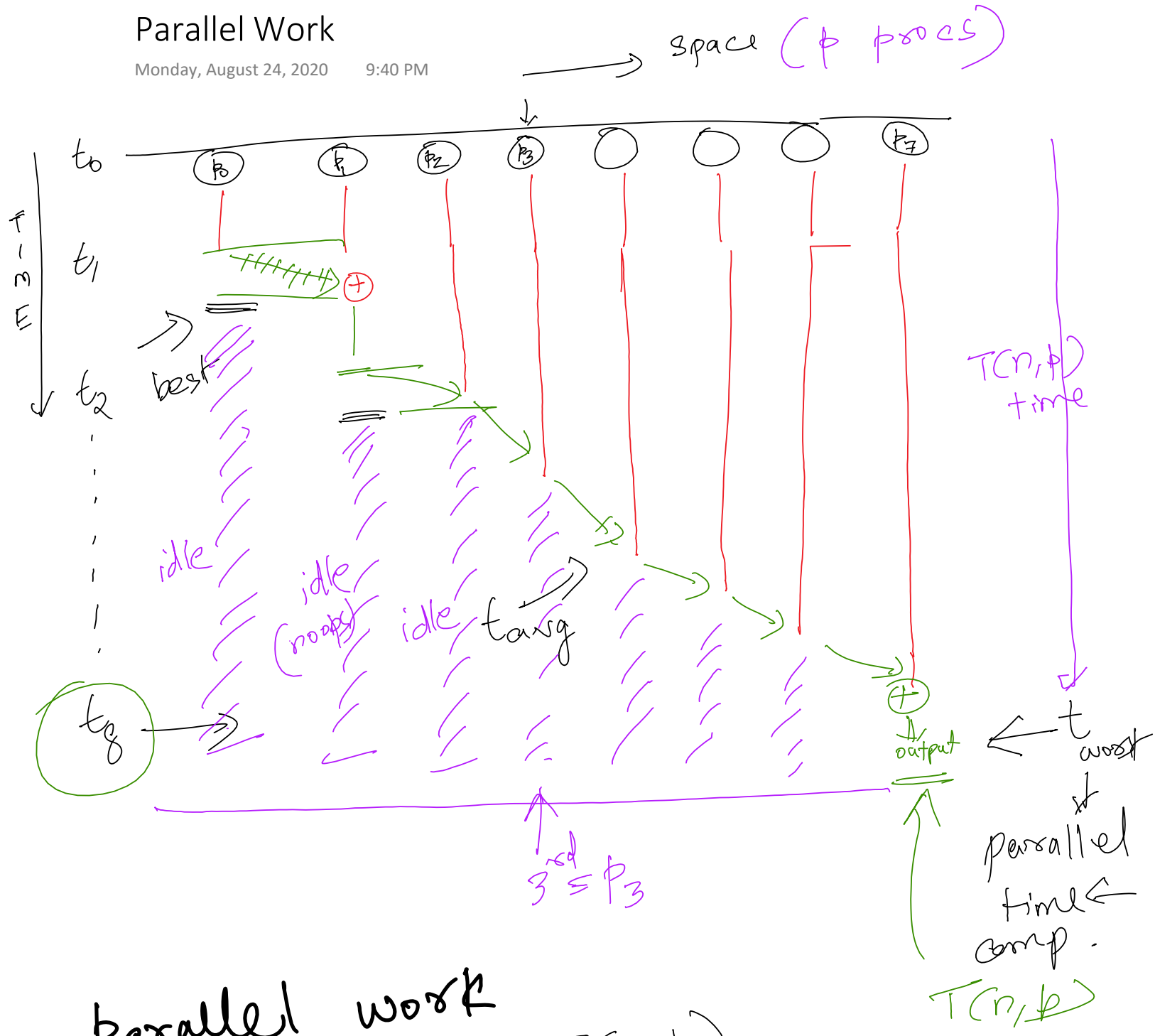

Parallel work $= p \times T(n,p)$

Parallel Overhead = parallel work − Serial work

$n \leftarrow$ input size
$p \leftarrow$ #processes

Definitions

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Serial time: Time taken by a "best" serial algorithm

$T(n) = O(n+p)$

Serial work: amount of work computed by the serial algorithm

$w = O(n+p)$

parallel time: time taken by the longest running process of the parallel program.

$T(n,p) = O(p)$

parallel work: volume of computation performed by the parallel program