Designing Parallel Algorithms: Parallel Sum example

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piazza.com

Example: Sum of n numbers.

Input: An array $A[0..n-1]$ containing integers

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

Algorithm: (serial)

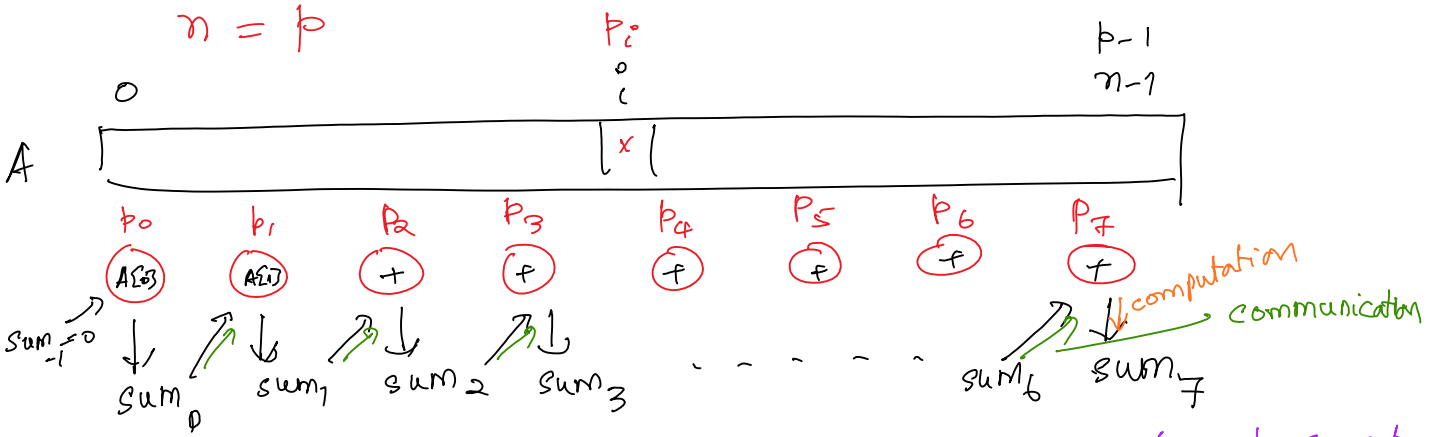
```
int sum(A[0..n-1])
{
    s = 0
    for (i = 0 to n-1)
        sum_i = sum_{i-1} + A[i]
    return s;
}
```

$T(n) = \Theta(n)$ ↓ $C = \Theta(n)$

Assume: Distributed Memory Model

p : # processes $\{P_0, P_1, \ldots P_{p-1}\}$

$n = p$



$T(n, p) =$ time steps spent waiting + time to compute

$= \Theta(p-1) + \Theta(1)$

$= \Theta(p)$

Communication Comp.

time steps

Parallel Sum

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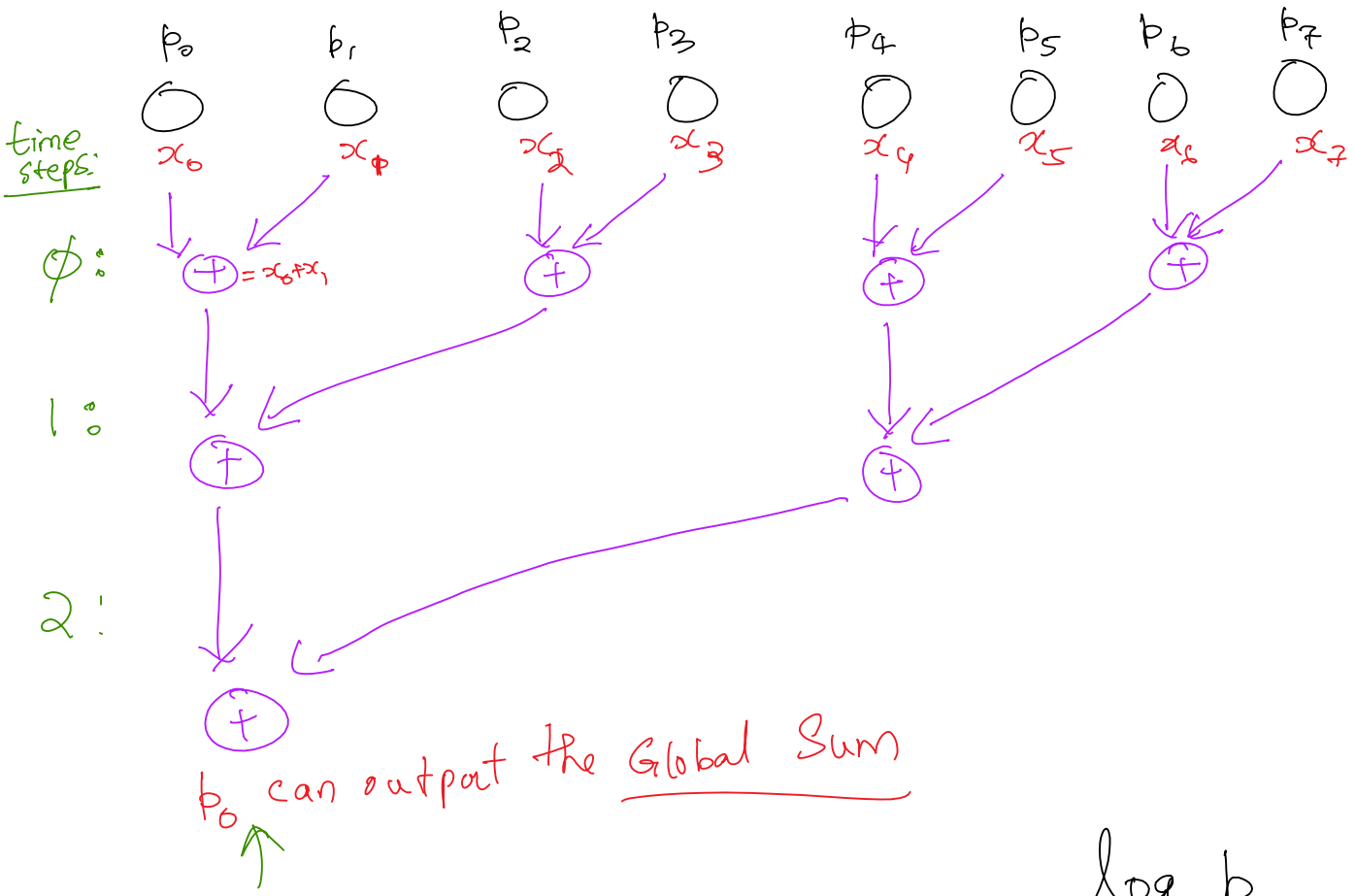
PRAM model (

Concurrent Read
Concurrent Write

→ CRCW
CREW
ERCW
EREW



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

p

$\log_2 p = \lg p$

↑ # time steps

Parallel Sum

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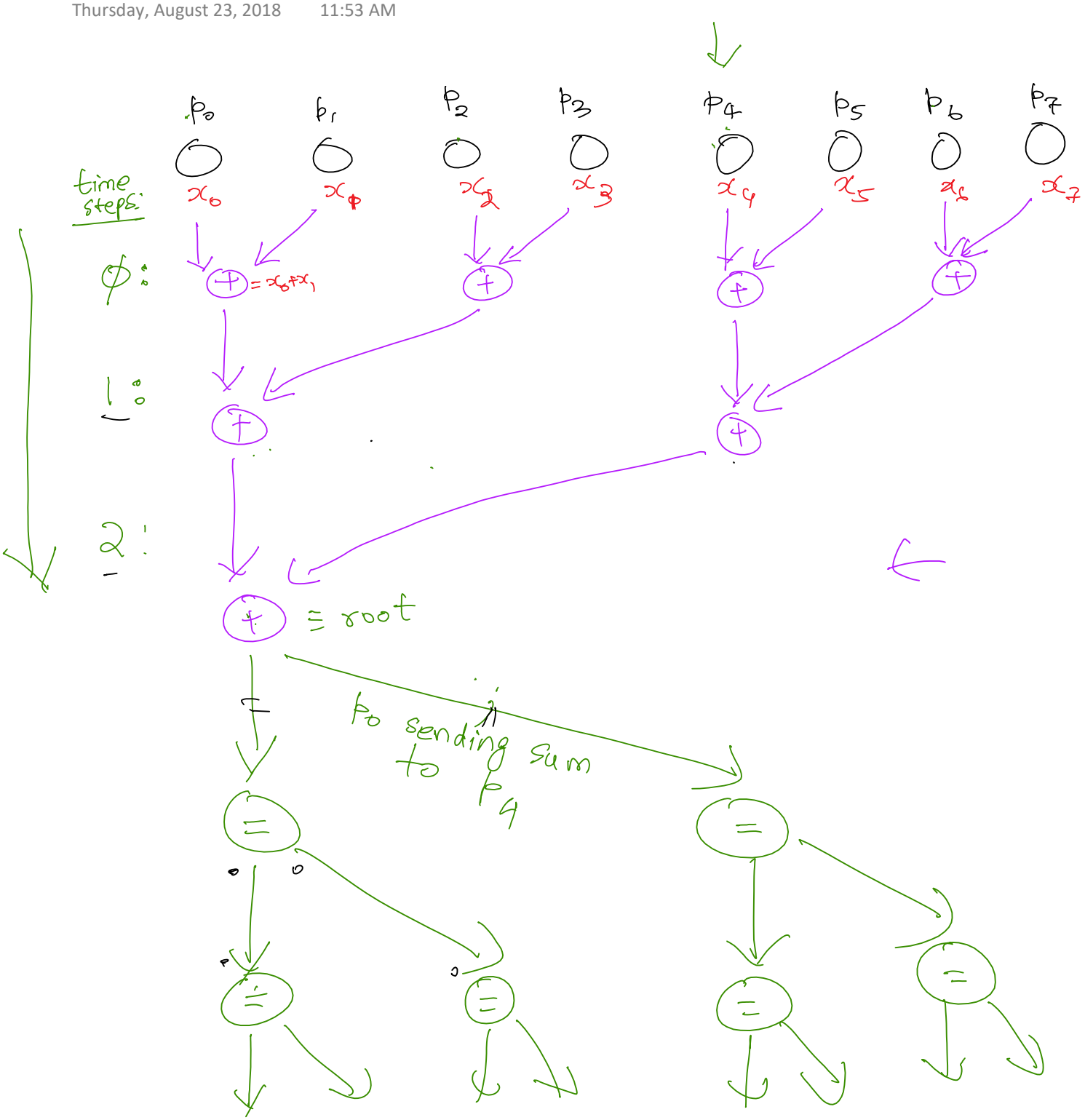

$$T(n, p) = \Theta(\lg p)$$

n

p