Q1

Parallel Prefix algorithm on an array of 8 elements

parallel-prefix algo —

for ($i=1$ to $n/2$) { // in parallel

$$b_i = a_{2i-1} + a_{2i}$$

}

find b_i recursively and store in C_i

for ($i=1$ to n) { // in parallel

if (i is even) {

$$s_i = C_{i/2}$$

}

~~else~~ if ($i=1$) $s_1 = C_1$

if (i is odd) {

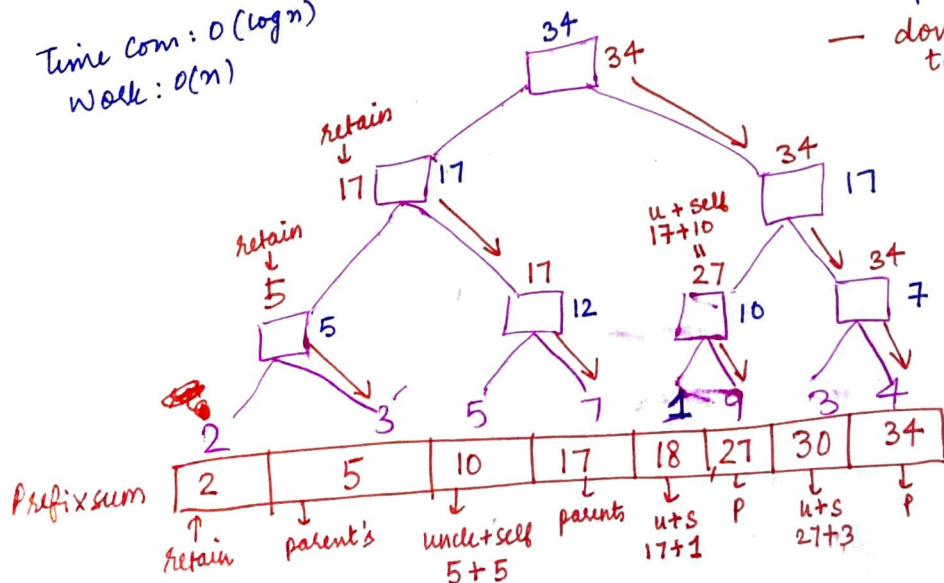$$s_i = ~~C_{i/2}~~ C_{i-1/2} + a_i$$

}

}

~~end~~ return s.

end ~~end~~

eg.

2	3	5	7	1	9	3	4

Time com: $O(\log n)$
Work: $O(n)$

— upward traversal
— downward traversal

Prefix sum

2	5	10	17	18	27	30	34

retain   parent's   uncle+self   parents   u+s   P   u+s   P
                       5+5   17+1   27+3

Harshita Sharma

② Parallel search algo

P = processors = 4 , no. to be searched = 10 = x

$n = 16$

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

1. divide array into p parts $[\ell = 0; r = n+1)$ $[r = 17]$

A₁

1	2	3	4

A₂

5	6	7	8

A₃

9	10	11	12

A₄

13	14	15	16

check x with first element of each part parallely

<u>Time : 1</u>
parallel
4 checks

$P_1 \quad x \to 1 ; \ x \not> 1 \ \infty$

$P_2 \quad x \to 5 ; \ x \not> 5$

$P_3 \quad x \to 9 ; \ x > 9$ ⎤

$P_4 \quad x \to 13 ; \ x < 13$ ⎦ — we know $x > 9$ & $x < 13$

So, x lies in A_3. here

2.

9	10	11	12

Divide (Recursive step) A_3 in p parts

<u>Time : 2</u>
parallel
4 checks

9		10		11		12

Check $x =$ ~~parallely~~ each part now that each part has only one elemen

$x - 9$

$\boxed{x - 10}$ ———— MATCH!.

$x - 11$

$x - 12$

p processors → Time : $O(\log_p n) = 2$

Work = $4 + 4 = 8$

(3)

$$2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 9 \rightarrow 6 \rightarrow 1 \rightarrow 7$$

Rank: 1   1   1   1   1   1   1   0
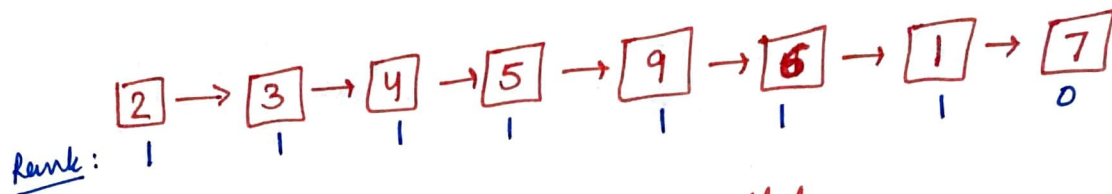
for $1 \le i \le n$ do in parallel
  $R[i] = 1$
  $R[i] = 0$ if node i is last
  while $S[i] \ne S[S[i]]$ do
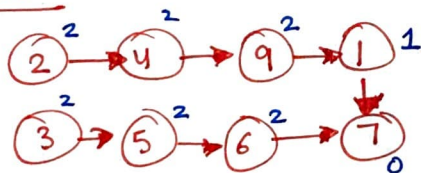 $R[i] = R[i] + R[S[i]]$
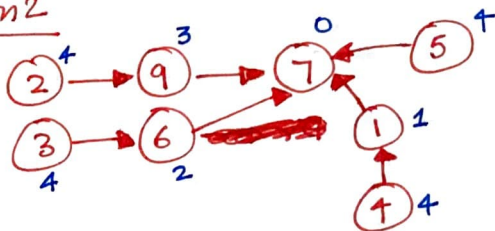 $S[i] = S[S[i]]$
  end
end

Iteration 1

Rank

$$\overset{2}{(2)} \rightarrow \overset{2}{(4)} \rightarrow \overset{2}{(9)} \rightarrow \overset{1}{(1)}$$

$$\overset{2}{(3)} \rightarrow \overset{2}{(5)} \rightarrow \overset{2}{(6)} \rightarrow \underset{0}{(7)}$$

Time: $O(\log n)$
W: $O(n \log n)$

Iteration 2

Rank

$$\overset{4}{(2)} \rightarrow \overset{3}{(9)} \rightarrow \overset{0}{(7)} \leftarrow \overset{4}{(5)}$$

$$\overset{3}{(3)} \rightarrow \underset{2}{(6)} \longrightarrow \overset{1}{(1)}$$
4

$$\underset{4}{(4)}$$

Iteration 3:

Rank

$$\overset{7}{(2)} \rightarrow \overset{0}{(7)} \leftarrow \overset{3}{(9)}$$
$$\overset{1}{(1)}$$

$$\underset{6}{(3)} \quad \underset{5}{(4)} \quad \underset{4}{(5)} \quad \underset{2}{(6)}$$