# CSE 587 FA2024: Parallel Computing
# Assignment 1

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## 1 completely connected computer

### 1.1 Program in pseudo-code

**Algorithm 1** scan(A,0,p-1,min)

**Require:** The total processor p, the current process p_id and the current value v_id
**Ensure:** The min value from V_0 to V_p-1

```
1:  int step = 1
2:  while step < p - 1 do
3:     start_id = p_id + step
4:     end_id = p_id - step
5:     if end_id < p then
6:        send(end_id, v_id)
7:     end if
8:     if start_id >= 0 then
9:        receive(start_id, min_id)
10:       v_id = min(v_id, min_id)
11:    end if
12:    step = step * 2
13: end while
```

### 1.2 Analysis

The while loop will continue until step is larger than p. Thus, the loop time should be $\log p$. In every loop, the statement will decide to either send the value or receive the value to the min operation. So the time complexity is $O(1)$. Totally, the time complexity is $O(\log p)$

## 2 2-dimensional mesh

### 2.1 Program in pseudo-code

In the second page.

### 2.2 Analysis

Each loop will take $\sqrt{p} - 1$ times. Thus, the time complexity of the algorithm is $O(3 * (\sqrt{p} - 1)) = O(\sqrt{p})$

**Algorithm 2** scan(A, 0, p-1, min)

**Require:** The total number of processors p, the current processor id p_id, and the current value v_id
**Ensure:** The minimum value from v_0 to v_p-1

```
1: int sqrtp = sqrt(p)
2: int row_id = p_id / sqrtp
3: int col_id = p_id - row_id * sqrtp
4: for int step = 1; step < sqrtp - 1; step *= 2 do
5:    if col_id > 0 and col_id < sqrtp - 1 then
6:       send(p_id + 1, v_id)
7:       receive(p_id - 1, min_id)
8:       v_id = min(v_id, min_id)
9:    end if
10: end for
11: int global_min = 0
12: for int step = 1; step < sqrtp - 1; step *= 2 do
13:    if row_id > 0 and row_id < sqrtp - 1 then
14:       send(p_id + sqrtp, v_id)
15:       receive(p_id - sqrtp, min_id)
16:       v_id = min(v_id, min_id)
17:       global_min = v_id
18:    end if
19: end for
20: for int step = 1; step < sqrtp - 1; step *= 2 do
21:    if row_id > 0 and row_id < sqrtp - 1 then
22:       send(p_id - 1, global_min)
23:       receive(p_id + 1, min_id)
24:       v_id = min(v_id, min_id)
25:    end if
26: end for
```