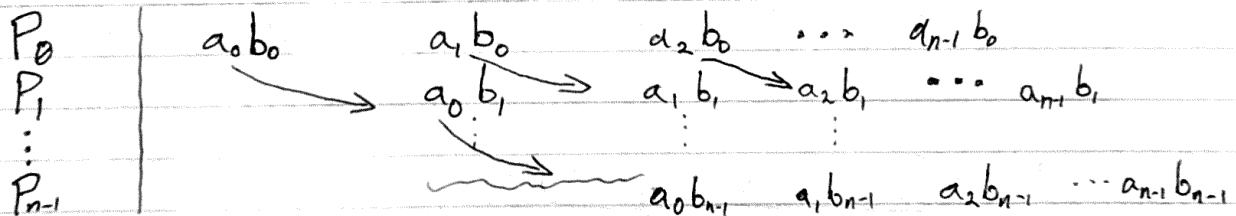


Assignment #3Darwin J GrosKleg  
20093596

## Section I: chapter 5 Pipelined computations

Q 5-10. Formulate a pipeline implementation for calculating the outer product of 2 vectors...For arrays of size  $n$ , create  $n+1$  processes:

- 1 master,  $n$  workers, ranked in that order.
- Each worker is initialized w/  $b$  set to the  $i$ th  $P_i: (P_0..P_{n-1})$  value in  $B^T$ , where  $i$  is index.
- Each process may receive from process who's rank is  $i-1$ , (the left) where (master-1) ==  $P_{n-1}$ .
- Each process shall send to process who's rank is  $i+1$ , where (master+1) ==  $P_0$ , (the right)  $(P_{n-1}+1) = \text{master}$ .

Each worker process will receive the values of  $A$ , in sequence, from the left as they are needed.Each process on completion of the sequence, will take any vectors ~~set~~ received and append the result to the set, sending this set to its right.Program completes when master receives the amalgamated  $N \times N$  matrix.

DJ

## Sorting

Q #2 Sort in sequence by hand.

### Merge Sort

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

### Quick Sort

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

### Quick Sort on Hypercube

- 000: 12 2 11 4 9 1 10 15 5 7 14 3 8 13 6 16
- 000: 2 4 1 5 7 3 6 8
- 000: 2 1 3 4 | 010: 5 7 6 8 | 100: 12 11 9 10 | 110: 15 14 13 16
- 000: 1 2 | 001: 3 4 | 101: 5, 6
- 100: 9 10 | 101: 11, 12 | 110: 13 14

## Q#2 Sorting, continued...

## Odd-Even Merge Sort

- MS1(12 2) MS2(11 4) MS3(9 1) MS4(10 15)  
MS5(5 7) MS6(14 3) MS7(8 13) MS8(6 16)
- 2 12 4 11 19 10 15  
5 7 3 14 8 13 6 16
- MS9(2 12 4 11) MS10(19 10 15)  
MS11(5 7 3 14) MS12(8 13 6 16)
- 2, 4, 11, 12 1, 9, 10, 15 3, 5, 7, 14 6, 8, 13, 16
- MS13( ) MS14( )
- 1, 2, 4, 9, 10, 11, 12, 15 3, 5, 6, 7, 8, 13, 14, 16
- MS15( )
- 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16.

# Numerical Algos

Q. 11-5 Dev a parallel program structure for convolution.

$$\mathbb{R}^{4 \times 5} \times \mathbb{R}^{5 \times 1} \rightarrow \mathbb{R}^{4 \times 1} : \vec{X} \cdot \vec{W} \mapsto \vec{Y}$$

5 processes : 1 master, 1 worker for each row in  $\vec{x}$ , 4,  
5 procs total.

Q 11-5 continued...

```
y-vector (int A[], int X[], int Y[]) {
```

```
    for (int i=0; i<n-1; i++)
```

```
        Y[i] = Y[i] + A[i][i] * X[i];
```

```
}
```

Each Process,  $n=5$ , indexed by  $i \in \{1, 2, 3, 4\}$  <sup>for slaves</sup>.

will have 4 elements of  $X$ :  $X_{5-\text{rank}} - X_{5-\text{rank}+4}$

will have  $w_{\text{rank}}$ .

will compute corresponding  $y_{\text{rank}}$ .

Do

$$\begin{array}{lclclclclclcl} y_1 & = & x_5 w_1 & + & x_4 w_2 & + & x_3 w_3 & + & x_2 w_4 & + & x_1 w_5 \\ y_2 & = & x_6 w_1 & + & x_5 w_2 & + & x_4 w_3 & + & x_3 w_4 & + & x_2 w_5 \\ y_3 & = & x_7 w_1 & + & x_6 w_2 & + & x_5 w_3 & + & x_4 w_4 & + & x_3 w_5 \\ y_4 & = & x_8 w_1 & + & x_7 w_2 & + & x_6 w_3 & + & x_5 w_4 & + & x_4 w_5 \end{array}$$

Then each process call y-vector.