

Divide and Conquer Strategies

10/8/03

Parimala Thulasiraman

1

Add—sequential

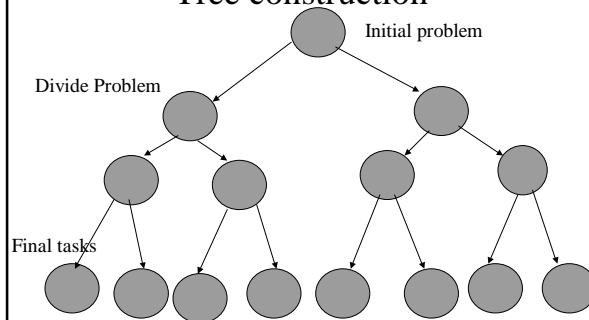
```
int add(int* s){
  if (number(s) <= 2) return (n1+n2);
  else{
    Divide(s,s1,s2);
    part_sum1 = add(s1);
    part_sum2 = add(s2);
    return(part_sum1+part_sum2);
  }
}
```

10/8/03

Parimala Thulasiraman

2

Tree construction



If powers of 2, exactly balanced.

10/8/03

Parimala Thulasiraman

3

Parallel implementation

- In seq. impl. Only one node of the tree can be visited at a time
- Parallel Solution:
 - Can traverse several parts of the tree simultaneously
 - Once a division is made, both parts can be traversed simultaneously
 - Key: construction of a tree.

10/8/03

Parimala Thulasiraman

4

Computation

- $T_{\text{comp}} = T_{\text{divide}} + T_{\text{combine}}$
- $T_{\text{divide}} = n/P$
- $T_{\text{combine}} = \log P$ (only one addition)
- $T_{\text{comp}} = n/P + \log P$

10/8/03

Parimala Thulasiraman

9

Total parallel execution time

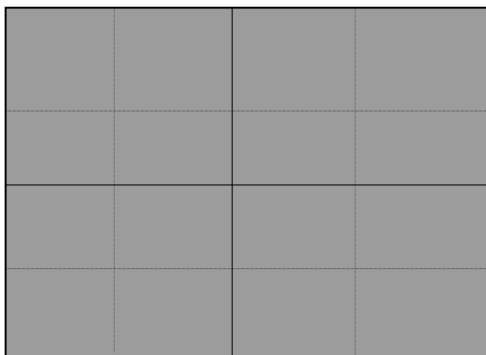
- $T_{\text{total}} = T_{\text{comm}} + T_{\text{comp}}$
- $= n(P-1)/P * t_{\text{data}} + t_{\text{data}} * \log P + n/P + \log P$

10/8/03

Parimala Thulasiraman

10

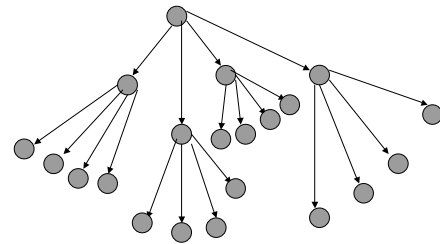
Image



10/8/03

Parimala Thulasiraman

11



M-ary Divide and Conquer

Example of a quadtree

10/8/03

Parimala Thulasiraman

12

Bin (Bucket) Sort

- Given n numbers
- Sort the n numbers
- Idea:
 - create m buckets.
 - the numbers are uniformly distributed within an interval, say 0 to $a-1$.
 - Divide the interval into m equal regions: $0..a/m-1, a/m$ to $2a/m-1, \dots, 3a/m-1$.
 - One bucket is assigned to hold the numbers that fall within each region.
 - Sort the buckets which are stored in a linked list
 - Concatenate the results in the buckets.

10/8/03

Parimala Thulasiraman

13

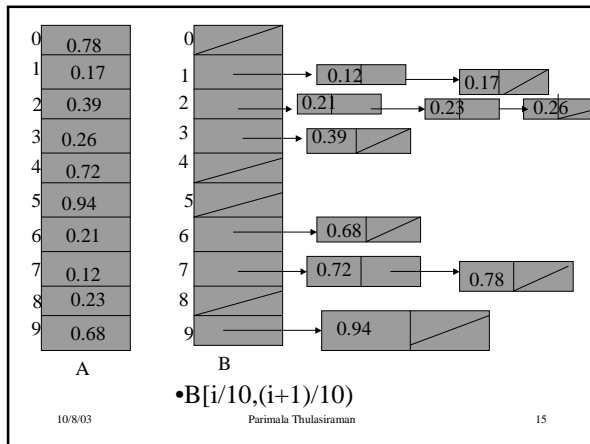
Example

- A is a list with 10 numbers
- B contains 10 buckets and each bucket i holds values that lie in the range $B[i/10, (i+1)/10)$
- For example bucket 5 can hold numbers that lie within $B[0.5, 0.6)$

10/8/03

Parimala Thulasiraman

14



10/8/03

Parimala Thulasiraman

15

Bucket_Sort(A)

- $N \leftarrow \text{length}(A)$
- For $I \leftarrow 1$ to N
 - Do insert $A[I]$ into list $B[I/N, (I+1)/N)$
- For $I \leftarrow 0$ to $N-1$
 - Do sort list $B[I]$ with insertion sort
- Concatenate the lists $B[0], \dots, B[n-1]$ together in order

10/8/03

Parimala Thulasiraman

16

