**Assignment 2**

Due date : 24th Feb, 8 pm.

1. Work out the PRAM EREW parallel sum (see chapter 2, slide 54 onwards) and CREW prefix sum algorithms for an array containing 16 numbers :1, 2, 3, 4, 5, 6, 9, 7, 5, 4, 3, 0, 4, 8, 8, 2

Answer: a[n]={1, 2, 3, 4, 5, 6, 9, 7, 5, 4, 3, 0, 4, 8, 8, 2};

Suppose there are four processors to calculate the prefix of 16 integers, and the 4 groups of integers are as follows:

{1, 2, 3, 4}{ 5, 6, 9, 7}{ 5, 4, 3, 0}{ 4, 8, 8, 2} ;

Each processor computing prefix and a set of number, as shown below

{1,3,6,10}{ 5, 11, 20, 27}{ 5, 9, 12, 12}{ 4, 12, 20, 22} ;

Select each group number of the last number, for this a few prefix and data calculation, as shown below

{1,3,6,10}{ 5, 11, 20, 37}{ 5, 9, 12, 49}{ 4, 12, 20, 71} ;

After this step of calculation, the end of each set of values has became the raw number before it the location all of the number’s sum.so ,count from group 2, will the number of each group (except the last number) plus it before the end of a group of several number, can get the number of all the prefix and. As shown below.

{1,3,6,10}{ 5+10, 11+10, 20+10, 37}{ 5+37, 9+37, 12+37, 49}{ 4+49, 12+49, 20+49, 71}

Sequence S [n] is the prefix and a [n]

S[n]={1,3,6,10, 15, 21, 30, 37, 42, 46, 49, 49, 53, 61, 69, 71}

1. A cycle in a graph is defined as a path originating and terminating at the same node. The length of a cycle is the number of edges in the cycle. Show that there are no odd-length cycles in a d-dimensional hypercube.

Answer：For each n-digit binary number where two vertices are adjacent to each other when the binary representation of both vertices differ by a single digital cycle from vertex V1,V2,… Vx within a hypercube，computing the hamming distance while traversing from each vertex V1-Vx, with every change in the bit at every alternative vertex will compute to 1.Also the vertex V1 === Vx as it is mention that it is a cycle the starting and the ending vertex will be same.Thus in order to travel back around the whole cycle,There will be no cycle with odd number of length in a cycle.

1. Chapter 2, (Text book) 2.17

Calculate diameter, bisection width and number of switches in a mesh of tree topology.

**Answer:2 dimensional mesh; Diameter = 2 \* (sqrt( n ) – 1); Bisection bandwidth = sqrt(n).**

So,the mesh have two independent processes.There are sqrt(q) node and 2 dimensional. Therefore, the bisection width of a mesh of trees is √p.The dimensional mesh diameter is 2√p-2. The processors require the most number of solution links to communicate. There are 2√p trees, each tree has √p − 1 switches. Thus the total number of switches is 2√p( √p − 1).

1. Given a matrix as an input, write an MPI program to add the elements of the matrix in parallel. The basic idea is to divide the rows among processes. In phase I, local sum of the local rows is produced by an individual process. In phase II, perform a global reduction on local sums.

You can start with the program matrix\_partition.c which is provided. It contains a 10 by 10 matrix.

e.g. 3 by 3 matrix.

|  |  |  |
| --- | --- | --- |
| 1 | 2 | 3 |
| 5 | 1 | 2 |
| 3 | 3 | 3 |

If number of processes = 3, then

Process 0 adds elements in one of the rows let us say 1st row = 3+3+3 = 9

Process 1 adds elements in the middle row = 5+1+2 = 8

Process 2 adds elements in the third row = 1+2+3 = 6

Then, do a reduction to three local sums to produce 23

If number of processes = 2, then you can assign two rows to one of the processes and the remaining row is assigned to the other process. Assuming process 0 gets 2 rows:

Process 0 produces 9 + 8 = 17

Process 2 adds the elements in remaining row = 6

Then, do a reduction on two local sums to produce 23.

In the qsub script, as shown below, use a single node (nodes=1:ppn=2), so that your job will finish faster. You can vary the ppn which means number of cores. Here ppn is 2. You can also change this string “yourname\_programname” to distinguish your job on PERE.

#!/bin/sh

#PBS -N yourname\_programname

#PBS -l nodes=1:ppn=2,walltime=00:10:00

#PBS -q dev

#PBS -j oe

#PBS -o $PBS\_JOBNAME-$PBS\_JOBID.log

cat $PBS\_NODEFILE

cd $PBS\_O\_WORKDIR

module purge mpich2/intel/1.4.1

module load openmpi/gcc/1.4.2

mpiexec -np 4 ./hello

