

Parallel Computing

Max. Marks: 60

Date: November 29th, 2006

Duration 3.00 Hrs.

Note: 1. Attempt any and only five questions.

2. Draw neat diagrams, if needed.

3. Please write answer to the sub sections in correct order.

Q.1 (A) If $n = 2^m$ numbers stored in an array A of dimension $(2n-1)$ from $A[n]$, $A[n+1], \dots, A[2n-1]$. Write a PRAM algorithm to compute prefix sum such that at the end $A[i]$ stores $A[1] \oplus A[2] \oplus \dots \oplus A[i]$. [6]

(B) Explain how do we achieve decentralize dynamic load balancing in a message passing program. [6]

Q.2 (A) Develop a row-oriented message passing parallel program to multiply two $n \times n$ matrices. Obtain its parallel time complexity. [8]

(B) Consider the following program segment of an Open_MP program and comment on the execution. [4]

```
#include <stdio.h>
int main(int argc, char *argv[])
{
    int i = 0, j = 0;
    int result = 0;
    #pragma omp parallel for private(i) reduction(+:result)
    for (i = 0; i < 3; i++) {
        for (j = i + 1; j < 4; j++) {
            printf("Hello.\n");
            #pragma omp critical
            result = result + 1;
        }
    }
    printf("Number of times printed Hello = %d\n", result);
}
```

Q.3 (A) What criteria are used to understand effectiveness in implementing efficient parallel algorithms on real architecture? [4]

(B) What are the qualifiers used to explicitly qualify variables in a parallel loop of an OpenMp program. Explain working of any two. [4]

(C) Explain theoretical W-RAM model of parallel computation. Which [4]

realistic parallel model is based on it?

Q.4 (A) Devise a parallel algorithm for finding factorial of ' n ' using doubling technique. What is the parallel time and processors complexity? [4]

(B) Consider the following program segment (assuming the syntax is correct) of a MPI program and comment on the execution. What if the buffer space is insufficient? [4]

```
if (rank == 0) then
    MPI_BSend(buf1, count, MPI_REAL, 1, tag1, comm, ierr)
    MPI_Ssend(buf2, count, MPI_REAL, 1, tag2, comm, ierr)
else
    MPI_Recv(buf1, count, MPI_REAL, 0, tag2, comm, status, ierr)
    MPI_Recv(buf2, count, MPI_REAL, 0, tag1, comm, status, ierr)
end if
```

(C) How do you classify clusters? [4]

Q. 5(A) Explain the shuffle exchange network of processors. [4]

(B) Propose a parallel algorithm for the bucket sort; discuss its parallel time and processor's complexity. [4]

(C) Explain Foster's design methodology with an example. [4]

Q.6 (A) Devise a parallel algorithm for finding x^n (x power n) using balanced binary tree technique. What is the parallel time and processors complexity? [4]

(B) Write schemes for static load balancing. What problems encountered in it and how do you solve them? [4]

(C) How do you compute the integration of a function using mean value theorem? Propose a multithreaded program for your algorithm. [4]

Q. 7(A) Propose a parallel algorithm for *Satisfiability problem* with k variables (or negation), represented in CNF or DNF formula. How many processors are needed to achieve k time parallel complexity. [6]

(B) List down advantages and disadvantages of using asymmetrical multi-computers. [4]

(C) Define: [2]
i. Efficient parallel algorithm
ii. Optimal parallel algorithm

-----Best of Luck-----