Total No. of Questions : 8]

SEAT No. :

P2366

[Total No. of Pages : 3

[4937]-4001

M.Sc.

COMPUTER SCIENCE

CS - 402 : Parallel Computing

(2013 Pattern) (Semester - IV)

Time : 3 Hours]　　　　　　　　　　　　　　　　　　　　　　*[Max. Marks : 50*

Instructions to the candidates:

　1)　Attempt any five questions out of eight.

　2)　All questions carry equal marks.

　3)　Figures to the right indicate full marks.

　4)　Neat diagrams must be drawn wherever necessary.

Q1) a)　Explain Amdahl's law in parallel processing.　　　　　　　**[2]**

　　b)　Explain in brief data parallel model (partitioned global address space model).　　　　　　　　　　　　　　　　　　　　　　**[4]**

　　c)　Explain what is meant by deadlock, and blocking & non- blocking communications.　　　　　　　　　　　　　　　　　　　　　**[4]**

Q2) a)　Define speedup and efficiency of a parallel program.　　　　**[2]**

　　b)　What is scalability of parallel program? What is super - linear speedup?**[4]**

　　c)　Explain UMA and NUMA computer architectures. Draw block diagram of each architecture.　　　　　　　　　　　　　　　　　　　　**[4]**

Q3) a)　Draw a schematic of a mesh-connected parallel computer.　　**[2]**

　　b)　Define total network bandwidth and bisection bandwidth of an interconnection network.　　　　　　　　　　　　　　　　　　　**[4]**

　　　　What are the values of these parameters for a ring of n computing elements (processors with own memory)? Assume B to be the bandwidth of an individual link.

　　c)　Explain in brief MPI_Comm_size, MPI_Comm_rank and MPI_COMM_WORLD.　　　　　　　　　　　　　　　　　　　　**[4]**

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Q4) a) Explain in brief MPI_Init and MPT_Finalize. **[2]**

b) The pipeline given below consists of four stages and it is synchronous, i.e., each cell finishes its operation in one clock cycle and the (input/output) data advances one step forward **[3]**
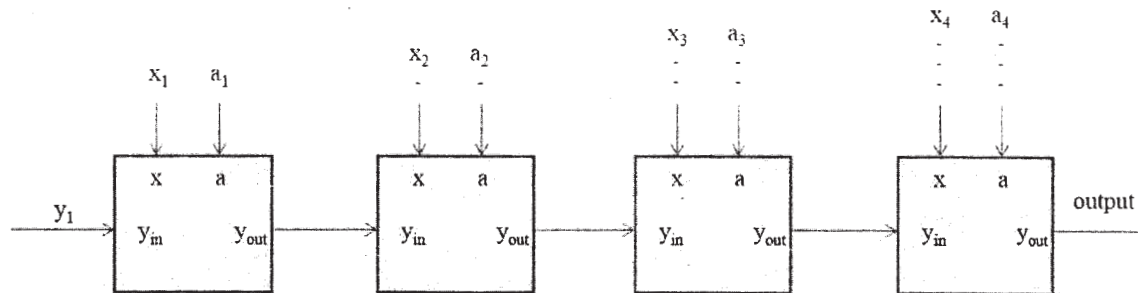
If each stage performs the operation

$y_{out} = y_{in} + a.x$

What will be the final output after four clock cycles?

c) Describe packet switching, virtual cut through routing, and wormhole routing in direct interconnection networks. **[5]**

Q5) a) Explain single and master directives in OpenMP. **[2]**

b) Does the following code snippet lead to a deadlock? Is so, give at least two methods that you can use to avoid this deadlock. **[3]**

```
if (myrank == 0){

    MPI_Send (in,  10,  MPI_INT,  1,  1,  MPI_COMM_WORLD);

    MPI_Send (out,  10,  MPI_INT,  1,  2,  MPI_COMM_WORLD);

}

else if (myrank == 1){

    MPI_Recv (out,  10,  MPI_INT,  0,  2,  MPI_COMM_WORLD);

    MPI_Recv (in,  10,  MPI_INT,  0,  1,  MPI_COMM_WORLD);

}
```

Note: The parameters in the above functions represent: buffer, count of data type to be sent/received, data-type, destination/source process-id, message-tag, and communicator, respectively.

c) What is shared memory parallel programming paradigm? Describe with schematic the OpenMP shared parallel programming model. **[5]**

Q6) a) Distinguish between MPI_Bcast and MPI_Send. **[2]**

b) What is a thread? Why are the advantages of using threads? Describe different methods in Open MP to create threads. **[4]**

c) What is a critical section in parallel program? Which OpenMP directive can be used to implement a critical section? **[4]**

Q7) a) Explain any two scheduling strategies of a for directive in OpenMP. **[5]**

b) Explain task parallelism using spawn and sync keywords in Cilk++ with an example. **[5]**

Q8) a) Explain the concepts of grids, thread blocks, threads, and warps in CUDA programming. **[5]**

b) What is the purpose of GPU and how does it differ form CPU? **[5]**

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