CCIS

CSC 453 introduction to parallel processing

Midterm Exam 1st semester 1442

Duration: 60 Minutes. **Answer all questions.**

[2]Q1. Flynn proposed a four-way classification of computer systems based on **instruction streams and data streams**. What are the four types based on Flynn's classification.

1. SISD
2. SIMD
3. MISD
4. MIMD

[5]Q2. Answer with TRUE or FALSE:

The need for faster problem solving is one of the motivations for parallel processing	TRUE
DMMP is a Distributed Memory Multicomputer.	TRUE
The degree **d** of binary tree of p-processors is **p**.	FALSE
Randomization is decomposing the problem of size **n** into two or more "smaller" sub-problems.	FALSE
The degree **d** of a 2D mesh with **p** processors is 4.	TRUE
To find the maximum of a set of **p** values on p-processor 2D mesh, stored one per processor, we find the maximum of each row first and made available to every processor in the row. Then find the maximum of each column. This takes $4\sqrt{p} - 4$ steps.	TRUE
Under normal conditions the speedup is always greater than **p** number of processors.	FALSE
The diameter **D** of linear array of **p** processors is **2p-2**.	FALSE
On a linear array of p-processors, worst case number of communication steps for broadcasting is **p –1**.	TRUE
When we need more detailed & accurate results we use parallel processing to get higher computational power.	TRUE

[3]Q3. Complete the following table for a fixed problem size ***n*** and then answer the questions:

system	p	T1	Tp	Sp	Ep
A	2	600	300	**2**	**1**
B	4	600	200	**3**	**0.75**
C	8	600	100	**6**	**0.75**
D	16	800	100	**8**	**0.5**

What is the best system you recommend to use to solve the problem? Give explanation?

This is an open question and it explains how the student understand the purpose of the measure.

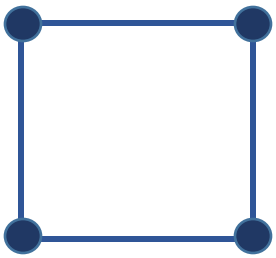
The best answer is C since it has the best parallel time with reasonable speedup and efficiency.[1]

If the answer is A since it has the best efficiency then the aim of using parallel machine is missed since A has the longest parallel run time. [0.5]

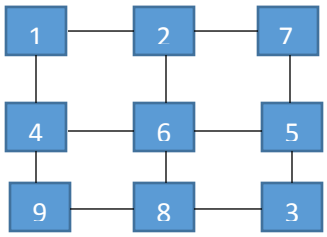
[2]Q.4. Draw a p=4 processor 2-D mesh, what is the diameter (D) of this parallel architecture? And what is the degree (d)?

D=2

d=2



[3]Q.5 Explain how to perform a semigroup computation on a 2D mesh. Show how to find the maximum in the 2D mesh below? Show all steps?

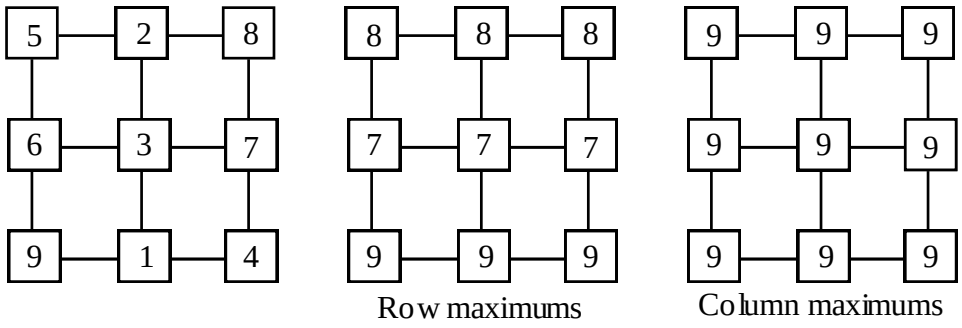


To perform a semigroup computation on a 2D mesh, do the semigroup computation in each row and then in each column.

To find the maximum of a set of p values, stored one per processor, find the row. ($2\sqrt{p} - 2$)

Then find column maximum for each column. ($2\sqrt{p} - 2$)

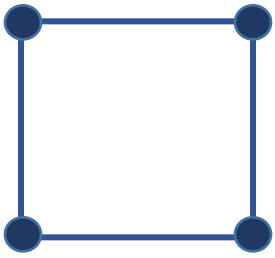
This takes $4\sqrt{p} - 4$ steps on a p-processor square mesh.

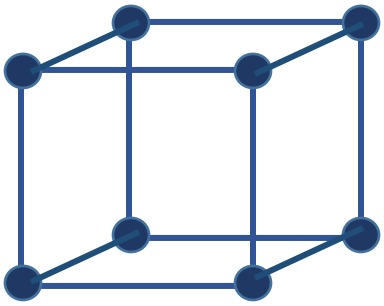


[2]Q6. Johnson 1988, proposed a further classification of **MIMD** machines based memory structure. What are the 4 types of his classification?

1. GMSV
2. GMMP
3. DMSV
4. DMMP

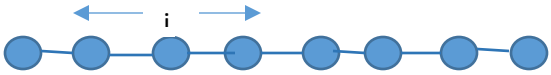
[3]Q7.Draw a 4-processor and an 8-processor hyper cube?





[5] Q8. Draw a linear array of 8 processors. Explain how broadcast works on this architecture?

[2]



[3] When processor *i* wants to broadcast a value (*a)* to all processors, it sends an rbcast(*a)* message to its right neighbor and lbcast(*a*) message to its left neighbor. Processor receiving an rbcast(a) message copies the value *(a)* and forwards the message to its right. The same with lbcast(a).

[3] Q9. Explain with example how to find the MAX value on a binary tree architecture assuming the values at leaf nodes. At the end all nodes must have the MAX value. Show all steps.