University of Uppsala

Department of Computer Systems (DoCS)

Repeat Examination

IT3 (Datorsystem II : Realtid System)

Distribuerade och Realtid Systems

INSTRUCTIONS TO CANDIDATES

- This is a SIX (6) hour examination
- Answer all questions
- All questions to be answered in English
- Dictionaries are Permitted
- The exam has 11 questions on 6 pages
- Marks total 85, 55 is a pass grade.

Section A: Distributed Systems

Question 1

What feature of a program makes it inherently sequential? Give an example of an inherently sequential program using C style code.

[4]

Question 2

Explain the difference between synchronous and asynchronous computer communication. Describe a commonly used approach to writing programs using an asynchronous communication model.

[6]

Question 3

What is the Flynn taxonomy? Why is the Flynn taxonomy not adequate for the classification of modern parallel computer architecture designs? Indicate how the Flynn taxonomy might be expanded to be more useful as a means for classifiying modern parallel computer architectures.

[5]

Question 4

Given that you can create 1..N parallel copies of a procedure using the command

$$ProcName(1..N, ...);$$

in a C program, write a parallel procedure which will update all the values in an array A to be double their original value.

Each procedure can assume the interface

Double (int Id, int_array A, int N, int k);

Where Id, is the identity of the copy of the procedure and A, N, and k are the Array to be modified, the number of entries in the array, and the number of procedure copies respectively.

[12]

Question 5

Explain the concept of the Linda "Tuple-Space" and comment on the two key properties that have been claimed for it "time decoupled" and "space decoupled" behaviour. Explain what each of these ideas refers to in terms of the execution of code in the Linda model. Comment on how these features of Linda can be useful.

[6]

Question 6

Describe an approach to computing the largest square of 1's in an array of 1's and 0's of size N by N. Explain how the data should be divided among the K processes in order to discover the largest square in parallel. Draw a diagram if you feel this will be the most clear way to represent the division of data among the processes.

Comment on the level of synchronisation required to implement the approach that you have outlined. What impact would you predict that this synchronisation might have of the final performance of the parallel algorithm.

[10]

Section B: Real Time Systems

Question 7

Discuss the Liu and Leyland bound for schedulability. Discuss its strengths and weaknesses, and then explain why it is not a sufficient analysis for most real time applications. What type of analysis replaces utilisation bounds, and why?

[8]

Question 8

Assume the following equation

(a). Given the following system of 4 tasks (without blocking) prove whether or not this system is schedulable using a rate monotonic priority ordering of processes.

Task	T	D	C	B
1	25	10	50	4
2	50	19	75	3
3	20	3	100	5
4	125	50	125	0

[6]

(b). Can the system be scheduled using any other priority allocation scheme.

[2]

Question 9

Given the following information related to execution costs for assembler program instructions compute a value for C for the following code segment.

Instruction	Cost
MOV	16
ADD SUB	4
DIV	32
CMP JMP	8
BGT	16

```
MOV (_S), D0
CMP D0, #5
BGT L2
DIV D0, #4
```

```
    ADD D0, #12
    MOV D0, (_S)
    JMP L3
L2: SUB D0, #2
    MOV D0, (_S)
L3: ....
```

[6]

Question 10

Given the following task set assign rate monotonic priorities to the tasks and then determine the blocking time for each task due to the semaphores (assume priority inheritance).

Finally compute the worst case response time for each task and determine if the system is schedulable using rate monotonic scheduling.

Task	T	D	C	S1	S2
1	60	45	8	2	
2	70	60	15		1
3	20	15	3	1	1
4	85	80	10		

[7]

Question 11

(a). Discuss message transmission on the CAN bus. What feature of the CAN bus makes it suitable for use in real time systems? Why is this feature necessary in a real time communication environment?

[5]

(b). Construct a simple scheduling example consisting of 3 CAN messages that demonstrates blocking delays for access to a CAN bus which result in a message missing its deadline. Give details of the message parameters in a table. Draw a diagram which shows the activity of the messages on the CAN bus.

[8]