FINAL EXAM IN INF-3201

Exam in	:	**INF-3201**
Date	:	**December 10, 2010**
Time	:	**09:00 – 13:00**
Place	:	**Åsgårdveien 9**

Approved remedies :

- English dictionary

- English-Norwegian/Norwegian-English dictionary

The exam contains 3 pages including this cover page

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Please give short and concise answers. State explicitly any assumptions you do.

1) Message-passing computing (20%)

a) What is the difference between ***synchronous*** message passing routines and ***asynchronous*** message passing routines?

b) What is the difference between ***blocking*** routines and ***non-blocking*** routines in MPI? When does a blocking send routine in MPI behave as a synchronous routine?

c) What is collective communication in MPI?

d) A master process divides a sequence of n numbers into p non-overlapping parts of n/p numbers each (assuming that n is divisible by p). It then distributes the p different parts to p slave processes using:

i) Case 1: p send() routines

ii) Case 2: one scatter() routine

Let the communication time of a message with m data words be $T^{comm} = T^{startup} + m.T^{data}$, where $T^{startup}$ is the startup time and T^{data} is the transmission time to send one data word. Which case (1 or 2) will have shorter communication time? Explain your answer using $T^{startup}$ and T^{data}.

2) Programming with shared memory (15%)

a) What is "determinacy race"?

b) What is Amdahl's law? If the serial fraction of an application is 25%, what is the maximum speed-up of the application?

c) Let T^P be the execution time of an application on P processors. Using Cilk++ to analyze an application, we get $T^1 = 24$ (i.e. work) and $T^\infty = 8$ (i.e. span). What is the maximum speed-up of the application on 4 processors? Explain your answer using the work law and the span law.

3) Parallelization strategies (10%)

a) Give a short description of divide-and-conquer strategy.

b) Give a short description of pipelined strategy.

c) Present three types of computations under which pipelined strategy can provide increased execution speed.

4) Data-parallel computations (15%)

In data-parallel computations, segmented scan operations are useful building blocks. Let A and F be a data vector and a flag vector, respectively. Values 1 in the flag vector indicate the beginning of each segment.

a) We execute the segmented scan operation with addition operator on vectors A and F given below. Write correct values to the result vector *Segmented +-scan*.

A	=	[5	2	3	1	4	5	4	8]
F	=	[1	0	1	0	0	0	1	0]
Segmented +-scan	=	[?	?	?	?	?	?	?	?]

b) How do we distribute the first element of each segment, given by vectors A and F above, to all other elements in the same segment using the segmented +-scan? Illustrate your answer by drawing relevant vectors.

5) Load balancing and Termination detection (10%)

a) What are fundamental disadvantages of ***static*** load balancing compared with ***dynamic*** load balancing?

b) Present the distributed termination conditions for a distributed computation at time t.

6) Distributed shared memory (15%)

a) What is "distributed shared memory" (DSM)?

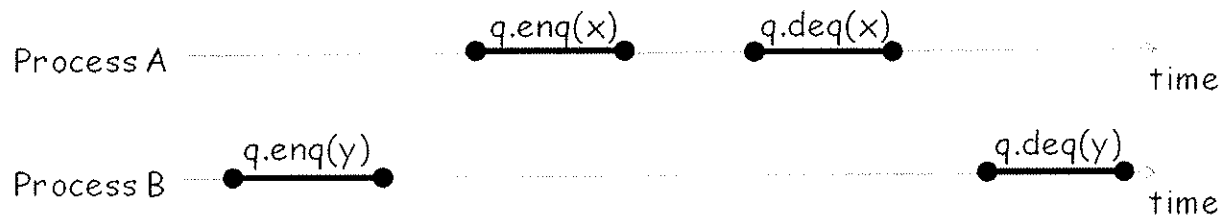
b) In a page-based DSM using write-invalidation, one of the problems is to locate the owner of a given page p. Present concisely ***four*** solutions to the owner location problem, including their advantages/disadvantages.

7) Concurrent objects (15%)

Two processes A and B access a shared first-in first-out (FIFO) queue q as shown in the figure below. In the execution, process B enqueues y before process A enqueues x, and process A dequeues x before process B dequeues y.

a) Is this execution sequentially consistent? Explain.

b) Is this execution linearizable? Explain.



Good luck!