PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination: Semester 1 **Academic Year**: 2007

Date: 5 August 2007 **Time**: 1330-1630 (3 hours)

Subject Number: 240-631 **Room**: A203

Subject Title: Parallel and Distributed Simulation Systems

Exam Duration: 3 hours

This paper has 13 pages, 9 questions and 120 marks (30%).

Authorised Materials:

- Writing instruments (e.g. pens, pencils).
- Textbooks, a notebook, handouts, and dictionaries are permitted.

Instructions to Students:

- Scan all the questions before answering so that you can manage your time better.
- Attempt all questions in English.
- Write your name and ID on every page.
- Any unreadable parts will be considered wrong.

When drawing diagrams or coding, use good layout, and short comments; marks will not be deducted for minor syntax errors.

Cheating in the exam

Minimum punishment: Subject failed and study suspended for one semester.

Maximum punishment: Expelled.

Name_____ ID_____

Question 1 (38 marks; 90 minutes)

a) Explain the significance of time in a simulation? (1 marks)

b) What are the differences between *event-driven simulation* and *time-driven simulation* frameworks in terms of time advancement? (2 marks)

c) What is parallel or distributed simulation and why is it important? (2 marks)

d) Compare *virtual environments* and *analytic simulations*? (4 marks)

e) Compare *parallel computers* and *distributed computers*? (4 marks)

f) How do multiprocessors share memory? (1 marks)

g) Give the examples of *simulation time*, *physical time* and *wallclock time*. (3 marks)

h) Compare *real-time* and *as-fast-as-possible* modes of execution? (2 marks)

i) Compare *simulation executive* and *simulation application*? (2 marks)

j) Compare *broadcast* and *publish-and-subscribe* mechanism of message passing? (2 marks)

k) What technique is used in *callback* functions? (1 marks)

l) Compare *dynamic* and *static* data distribution? (2 marks)

m) Why data distribution prefers *region* to *point*? (1 marks)

n) Compare *push* and *pull* clock synchronization algorithms using a central time server? (2 marks)

o) What is the *local causality constraint* and why is it important? (2 marks)

p) What does the *Lower Bound on the Time Stamp* guarantee? (1 marks)

q) How *lookahead* can speed up a parallel and distributed simulation? What can *lookahead* be derived from? (2 marks)

r) What does a null message contain? And how can the null message algorithm help with deadlock avoidance? (2 marks)

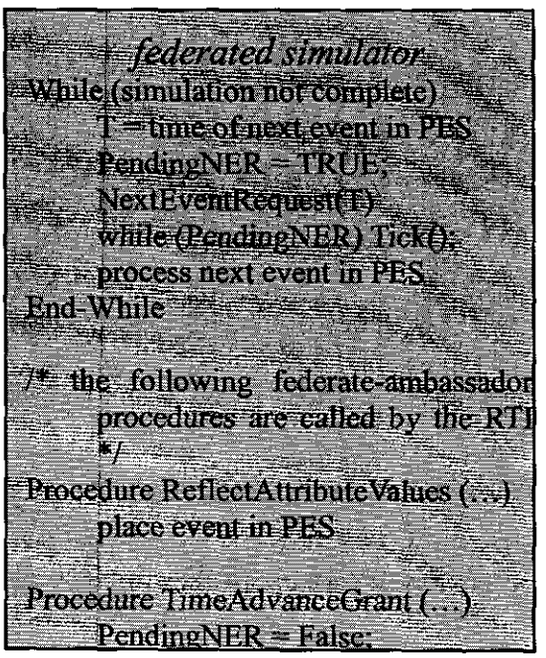
s) Give examples of how *livelock* and *deadlock* can occur? (2 marks)

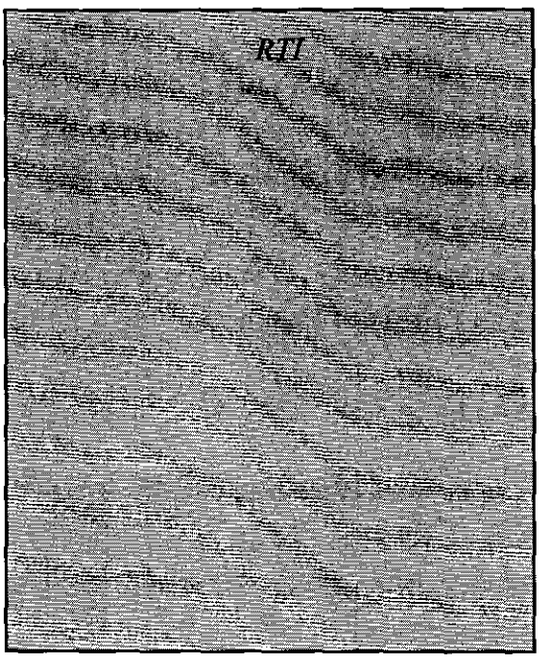
deadlock	livelock

Question 2 (12 marks; 15 minutes)

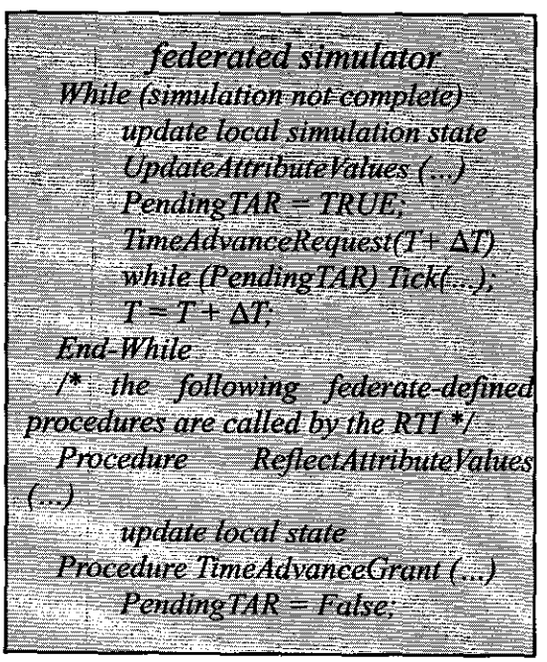
a) If we would like the simulation to run 3-time slower in synchrony with an equivalent advance in wallclock time, what is the required scaling factor and the transfer equation of the simulation time and wallclock time. (4 marks)

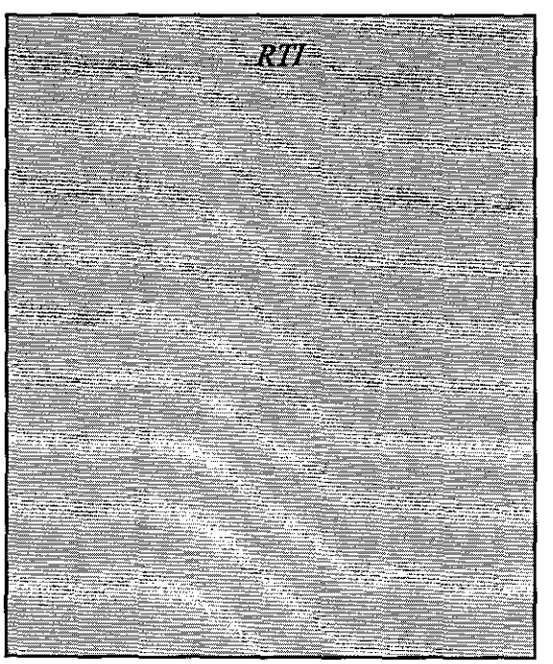
b) Show the call back functions between the RTI and the following federate program that *requests for next events to be processed.* (4 marks)





c) Show the call back functions between the RTI and the following federate program that requests for *time advancement.* (4 marks)





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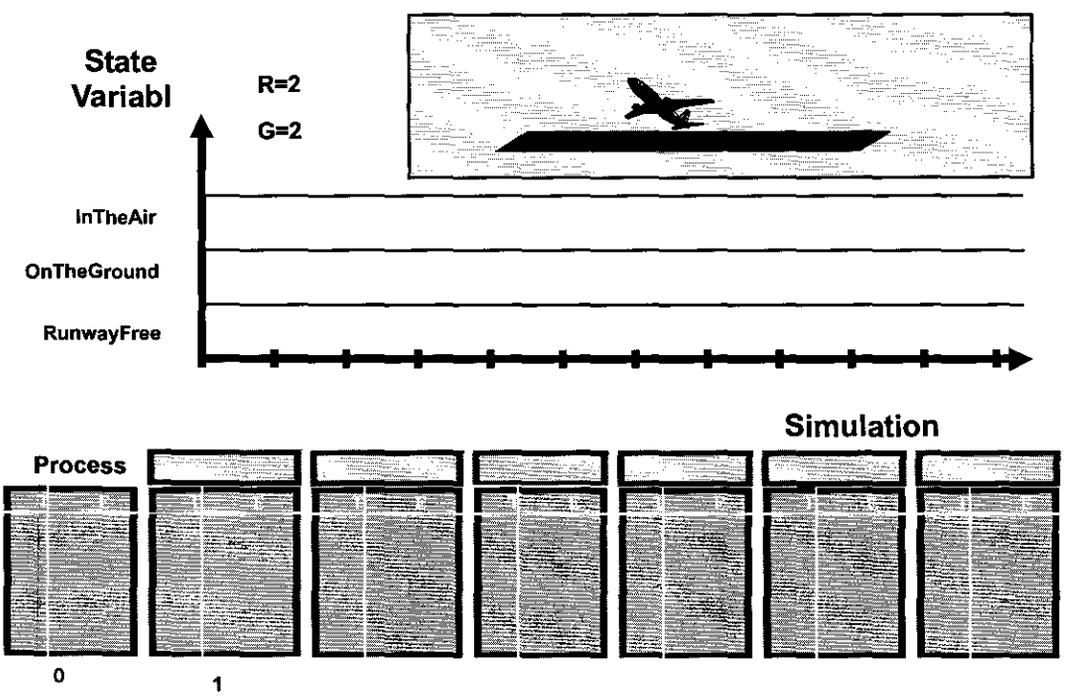
Question 3 (10 marks; 15 minutes)

From the following process program, show the relationship between state variables and time when R = 2 and G = 2, and airplanes F1 and F2 are scheduled to arrive at 1 time unit and 3 time units consecutively.

```
/* simulate aircraft arrival, circling, and landing */
Integer: InTheAir;
Integer: OnTheGround;
Boolean: RunwayFree;
1       InTheAir := InTheAir + 1;
2       WaitUntil (RunwayFree);                 /* circle */
3       RunwayFree := FALSE;                    /* land */
4       AdvanceTime(R);
5       RunwayFree := TRUE;
        /* simulate aircraft on the ground */
6       InTheAir := InTheAir - 1;
7       OnTheGround := OnTheGround + 1;
8       AdvanceTime(G);
        /* simulate aircraft departure */
9       OnTheGround := OnTheGround - 1;
```



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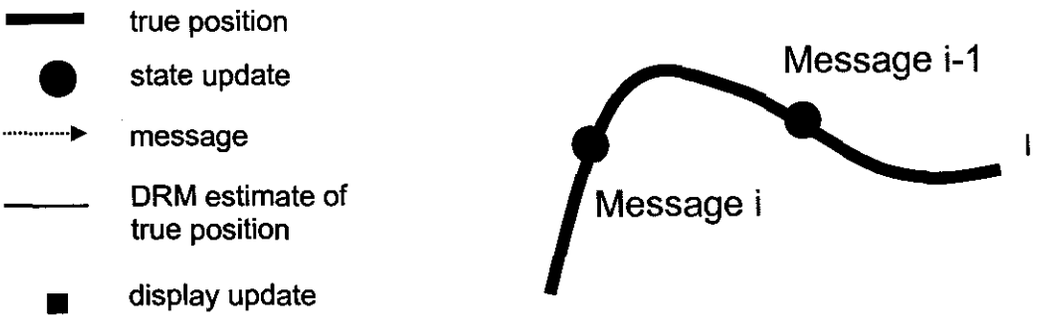
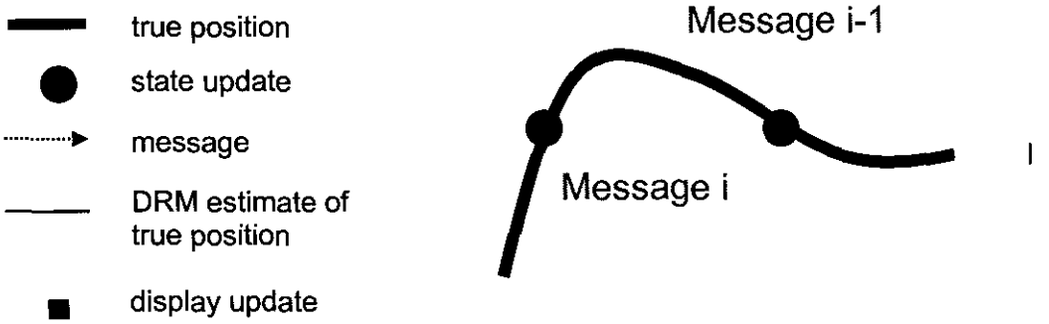
Question 4 (10 marks; 20 minutes)

From the following disjointed graph below, show how *time compensation* and *smoothing* algorithms change the display.

a) Time Compensation (5 marks)



b) Smoothing (5 marks)



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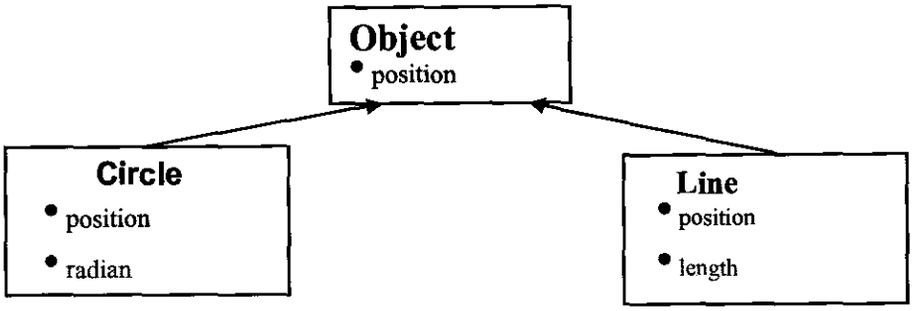
Question 5 (10 marks; 10 minutes)



From the above diagram,

a) add class *Sphere* into the diagram. (2 marks)

b) explain how other federates can receive updates from the newly added class even though the added class was not in the publication information. Use class *Sphere* in a) as an example. (4 marks)

b) list possible expressions from the name space. (4 marks)

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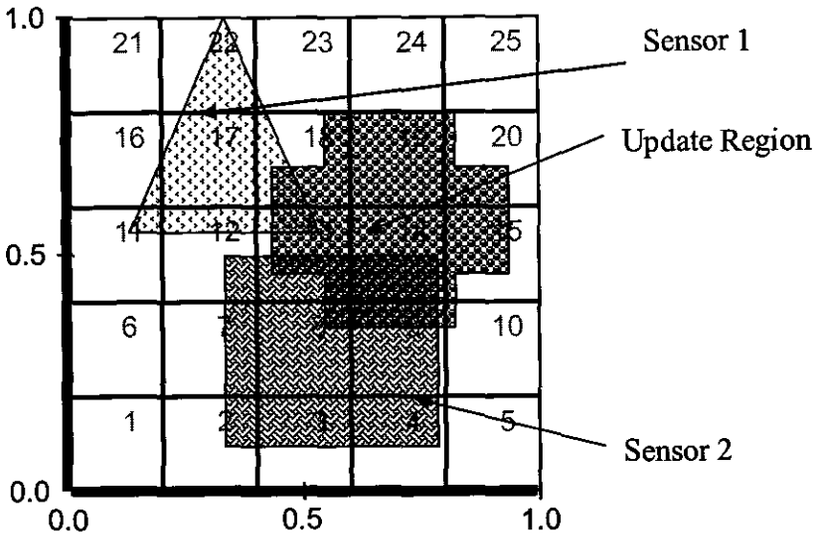
Question 6 (10 marks; 10 minutes)

From the following picture, show *duplicate* and *unwanted* updates at Sensor 1 and Sensor 2.



Question 7 (10 marks; 10 minutes)

a) According to the Network Time Protocol Latency and Offset Estimation, explain how to estimate *latency* and *offset*. (6 marks)

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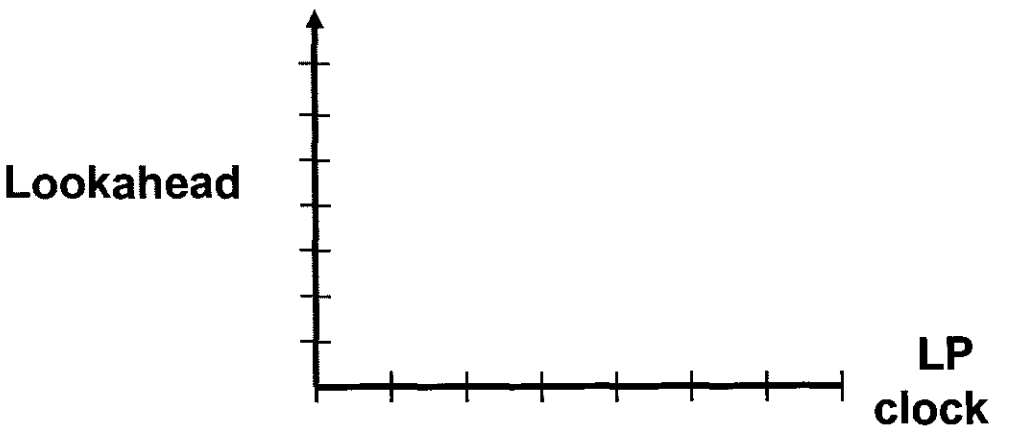
b) Suppose clock is 10 milliseconds ahead, interrupt generated every 15 milliseconds, show how to *phase in clock change* when correct or re-synchronizing clocks.

(4 marks)

Question 8 (10 marks; 10 minutes)

If a logical process is at simulation time 4 and *lookahead* is 3, use the below graph to help with answering the following questions.



a) The logical process has promised subsequent messages will have a time stamp of at least _____.

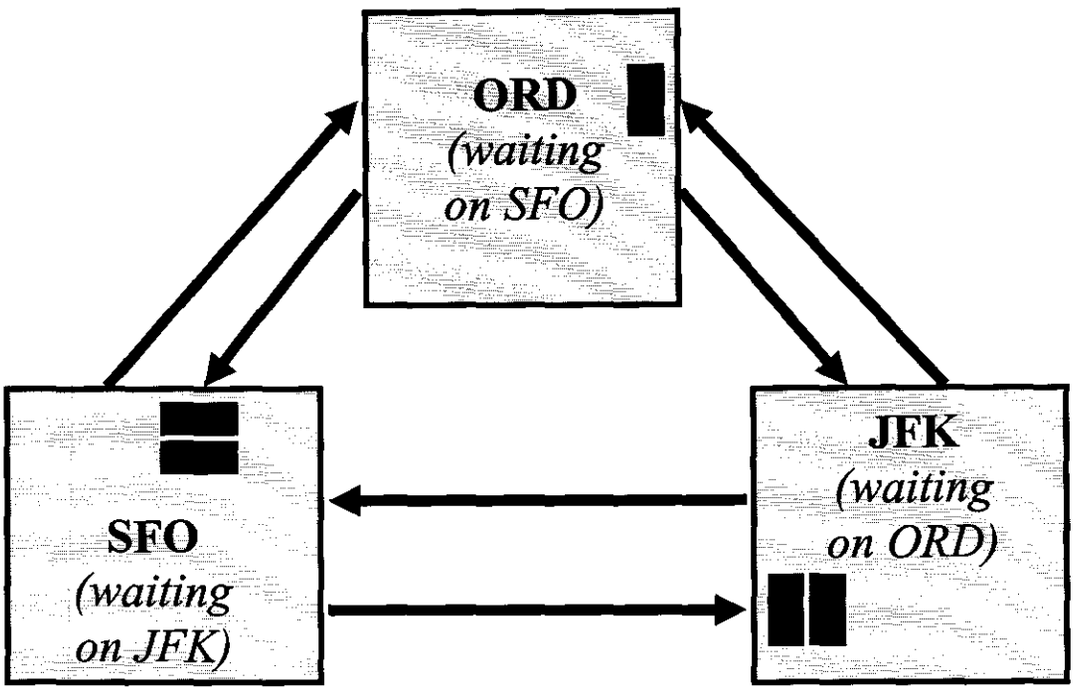
b) If *lookahead* were to increase to 10, what should be done?

c) If *lookahead* were to decrease to 1, what should be done?

Question 9 (10 marks; 10 minutes)

The below Parallel Discrete Event Simulation that represents a collection of airports (ORD, SFO, and JFK) is facing a deadlock. In order to recover from the deadlock, find which processes are *safe* to be processed if we do not use null messages and:

1) At ORD, there is a message from JFK and it is time stamped for the simulation time 4. It is waiting for a message from SFO.
2) At SFO, there are two messages from ORD and it is time stamped for the simulation time 8 and 6. It is waiting for a message from JFK.
3) At JFK, there are two messages from SFO and it is time stamped for the simulation time 6 and 5. It is waiting for a message from ORD.



----End of Examination----

Pichaya Tandayya Lecturer

"We can't solve problems by using the same kind of thinking we used when we created them."

-- Albert Einstein

"Some men see things as they are and ask why.
Others dream things that never were and ask why not."

-- George Bernard Shaw

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