Midterm **Examination**: Semester 1   **Academic Year**: 2006-2007

Date: 20 December 2006   **Time**: 13.30-16.30 (3 hours)

Subject Number: 240-631   **Room**: R300

Subject Title: Parallel and Distributed Simulation Systems

Exam Duration: 3 hours

This paper has 11 pages, 8 questions and 110 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 <u>Thai</u>.

- 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.

ทุจริตในการสอบ

โทษขั้นต่ำ   ปรับตกในรายวิชานั้นและพักการเรียน 1 ภาคการศึกษา

โทษสูงสุด   ให้ออก

Question 1 (40 marks; 80 minutes)

a) Why time is important in simulation? (2 marks)

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b) What are the differences between _event-driven simulation_ and _time-driven simulation_ frameworks? (2 marks)

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c) What is parallel or distributed simulation and what are the benefits? (3 marks)

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d) What are the differences between _virtual environments_ and _analytic simulations_? (4 marks)

Virtual environments	Analytic simulations

e) What are the differences between *parallel computers* and *distributed computers*? (4 marks)

Parallel computers	Distributed computers

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

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

(3 marks)

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h) What are the differences between *real-time* and *as-fast-as-possible* modes of execution? (2 marks)

Real-time	As-fast-as-possible

i) What are the differences between *simulation executive* and *simulation application*? (2 marks)

Simulation executive	Simulation application

j) What are the tradeoffs of *broadcast* and *publish-and-subscribe* mechanism of message passing? (2 marks)

Broadcast	Publish-and-subscribe

k) What is a *callback* function. (2 marks)

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l) What are the differences between *dynamic* and *static* data distribution?

(2 marks)

Static data distribution	Dynamic data distribution

m) Why data distribution prefers *region* to *point*? (2 marks)

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n) What are the differences between *push* and *pull* clock synchronization algorithms using a central time server? (2 marks)

Push algorithm	Pull algorithm

o) What is *Lower Bound on the Time Stamp*? (2 marks)

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p) Why *lookahead* is important? What can *lookahead* be derived from?

(3 marks)

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q) What are the differences between *livelock* and *deadlock*? (2 marks)

livelock	deadlock

Question 2 (10 marks; 15 minutes)

a) What is the required scaling factor for a simulation to run 4-time slower in synchrony with an equivalent advance in wallclock time? (2 marks)

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b) Complete the connection between the RTI and the following federate program.

(4 marks)

federated simulator	*RTI*

While (simulation not complete)
    T = time of next event in PES
    PendingNER = TRUE;
    NextEventRequest(T)
    while (PendingNER) Tick();
    process next event in PES
End-While
 	
/* the following federate-ambassador
    procedures are called by the RTI
    */
Procedure ReflectAttributeValues (…)
    place event in PES
 	
Procedure TimeAdvanceGrant (…)
    PendingNER = False;	

c) Complete the connection between the RTI and the following federate program.

(4 marks)

federated simulator	*RTI*

While (simulation not complete)
    update local simulation state
    UpdateAttributeValues (…)
    PendingTAR = TRUE;
    TimeAdvanceRequest(T+ ΔT)
    while (PendingTAR) Tick(…);
    T = T + ΔT;
End-While
/ the following federate-defined
procedures are called by the RTI */*
    Procedure ReflectAttributeValues
(…)
    update local state
Procedure TimeAdvanceGrant (…)
    PendingTAR = False;	

Question 3 (10 marks; 20 minutes)

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

/* simulate aircraft arrival, circling, and landing */

Integer: InTheAir;

Integer: OnTheGround;

Boolean: RunwayFree;

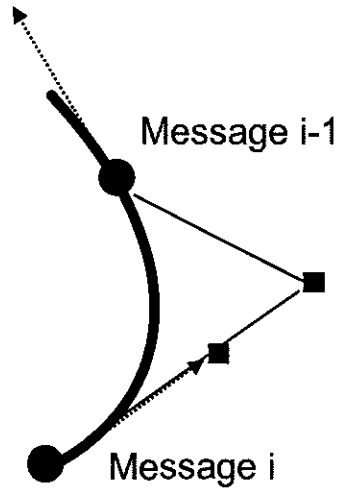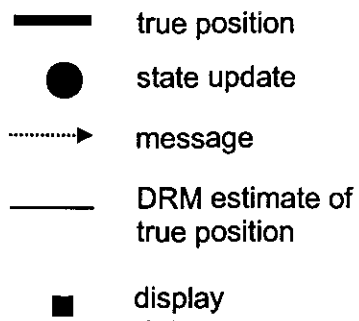|		
1	InTheAir := InTheAir + 1;	
2	WaitUntil (RunwayFree);	/* circle */
3	RunwayFree := FALSE;	/* land */
4	AdvanceTime(R);	
5	RunwayFree := TRUE;	
	/* simulate aircraft on the ground */	
6	InTheAir := InTheAir - 1;	
7	OnTheGround := OnTheGround + 1;	
8	AdvanceTime(G);	
	/* simulate aircraft departure */	
9	OnTheGround := OnTheGround - 1;	
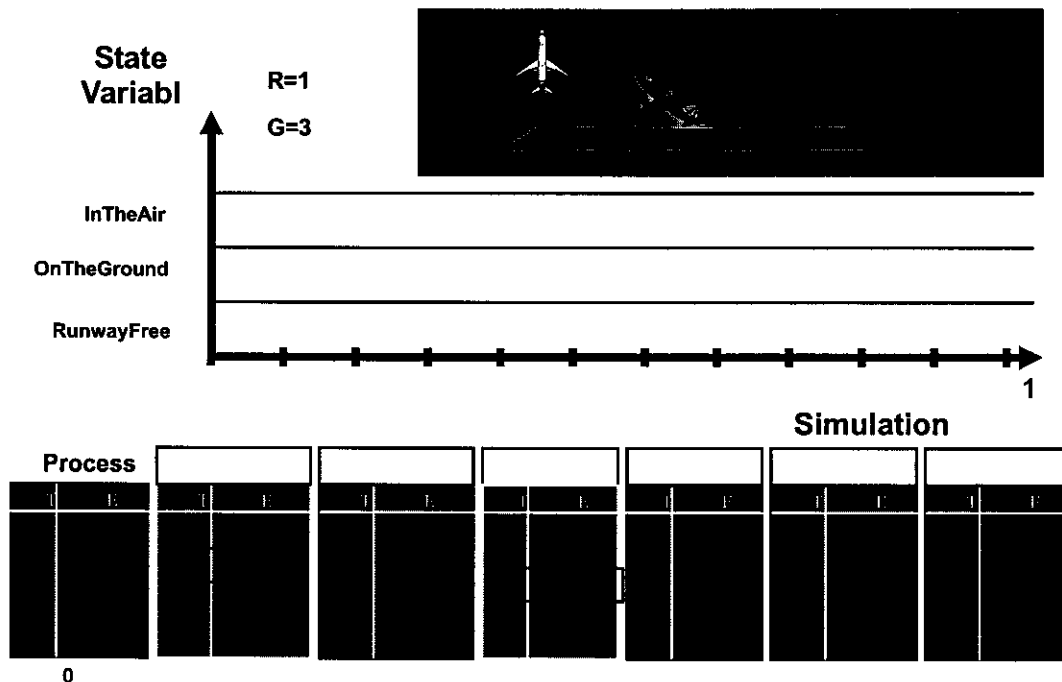
Question 4 (10 marks; 20 minutes)
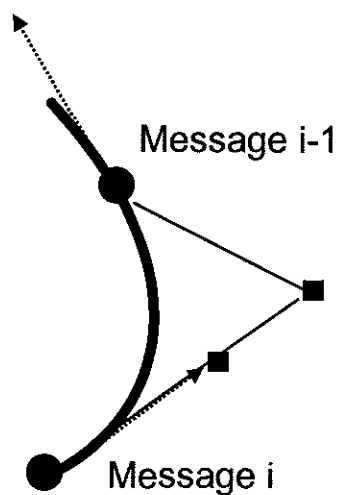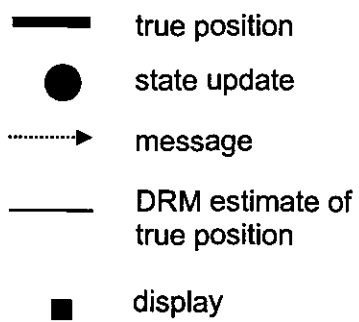
From the following disjointed graph below, show how *time compensation* and *smoothing* algorithms change the display.

a) Time Compensation   (1 mark)

	true position
●	state update
·········▶	message
_____	DRM estimate of true position
■	display

Message i-1

Message i

b) Smoothing

	true position
●	state update
·········▶	message
_____	DRM estimate of true position
■	display

Message i-1

Message i

Question 5   (10 marks; 10 minutes)

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                        ┌─────────────────┐
                        │   Vehicle       │
                        │ • position      │
                        └─────────────────┘
                          ↗             ↖
        ┌─────────────────┐           ┌─────────────────┐
        │   Aircraft      │           │   Submarine     │
        │ • position      │           │ • position      │
        │ • altitude      │           │ • depth         │
        └─────────────────┘           └─────────────────┘
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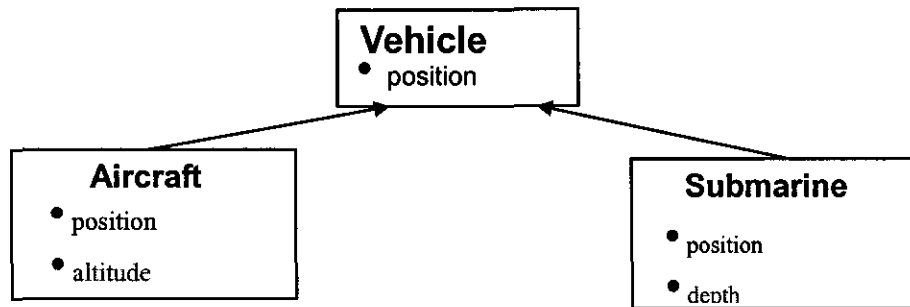
From the above diagram,

a) explain how other federates can receive updates from the newly added class

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b) list possible expressions from the name space

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c) add class *Ship* into the diagram

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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.
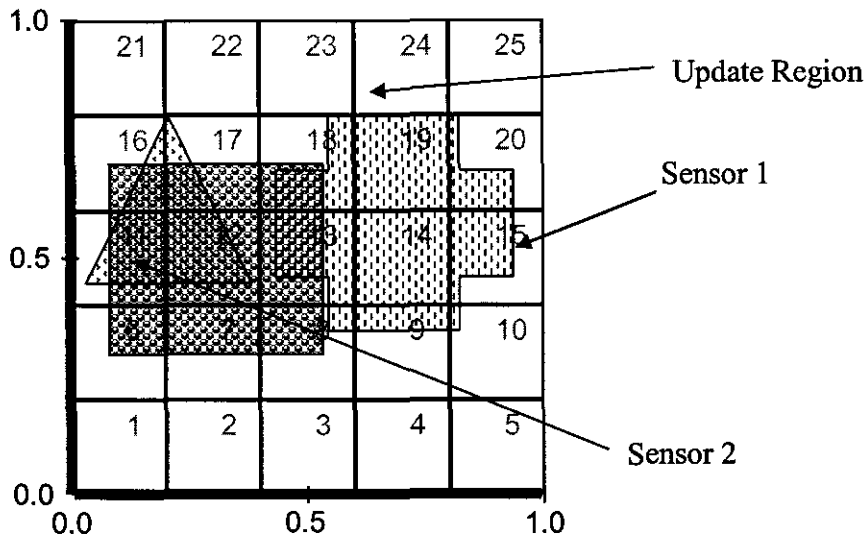
## Question 7
(10 marks; 15 minutes)

a) According to the Network Time Protocol Latency and Offset Estimation, explain how to estimate *latency* and *offset*.   (5 marks)

b) Suppose clock is 10 milliseconds ahead, interrupt generated every 20 milliseconds, show how to phase in clock change when correct or re-synchronizing clocks. Draw a diagram that shows the transition.   (5 marks)

Question 8   (10 marks; 10 minutes)

If a logical process is at simulation time 2 and *lookahead* is 4, use the below graph to help with answering the following questions.
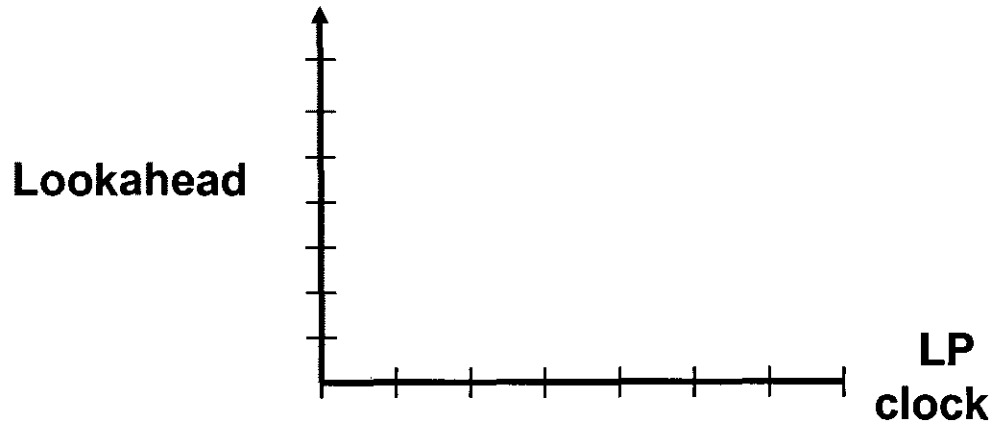
a) The logical process has promised subsequent messages will have a time stamp of at least _____ .

b) If *lookahead* were to increase to 6, what should be done?

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_____

c) If *lookahead* were to decrease to 2, what should be done?

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----End of Examination----

Pichaya Tandayya   Lecturer