CS445/CS645 Midterm Exam
Winter 2000
Closed-Book Exam

Instructor: J.M. Atlee

March 2, 2000
2:30-4:30 p.m.

1	10	
2	10	
3	40	
4	40	
Total	100	

Name:_____

ID number:_____

Read each question in its entirety before answering. Show ALL of your work on the pages of the midterm exam. If you make any assumptions while solving a problem, state the assumptions clearly in your answer.

1. **(10 marks) Software Engineering**

This question tests how well you can express your (serious) opinions about the discipline of software engineering.

(a) How would you describe *software engineering* to a 3B computer science student?

(b) How would you describe *software engineering* to a technically-incompetent relative of yours?

Comparison of Engineering Discplines

Mechanical Engineering is like looking for a black cat in a lighted room.

Chemical Engineering is like looking for a black cat in a dark room.

Software Engineering is like looking for a black cat in a dark room in which there is no cat.

Systems Design is like looking for a black cat in a dark room in which there is no cat, and someone yells, "I got it!"

http://shemesh.larc.nasa.gov/fm/fm-humor.html

1(c) Do you think that *software engineering* has matured into a true engineering discipline? Briefly defend your answer.

2. **(10 marks) Requirements Elicitation**
This question tests how well you can perform (on-the-fly) certain requirements elicitation tasks.

(a) Suppose you have been asked to help develop a new student-transcript system for the university. The system will record students' course marks and (if appropriate) co-op evaluations; will calculate and report each student's major and overall averages, their standing in their programs, their class rank, and other statistical information; and will present a record of a student's academic record as a written transcript.

- Give a complete a list of the system's stakeholders (e.g., registrar's office), and the role (e.g., customer, user, etc.) that each stakeholder plays.

- Who is the most important stakeholder?

(b) Identify and discuss how the different categories within PIECES might apply in the following situation.

- We're producing fewer products than we're accepting orders for.

3. **(40 marks) UML**
This question asks you to model in UML the process for selecting articles to be published in a scientific journal.

Every scientific journal has an editorial board that consists of an editor-in-chief and several associate editors. The editorial board, under the guidance of the editor-in-chief, is responsible for setting the journal's agenda and for selecting for publication articles that meet that agenda. While the editors make the final decisions about whether or not to publish an article, they solicit the views of other scientists who have the expertise to critically review the article's scientific contributions.

The review process works as follows. If an author wants to publish an article in the journal, she submits the article to the journal's editor-in-chief. The editor-in-chief assigns it a unique tracking number. Then, based on the topic of the article, the editor-in-chief chooses an associate editor who has the expertise to sheppard the paper through the reviewing process and to make a final decision on whether or not to publish the paper. The associate editor selects from the scientific community three reviewers who will read the paper and comment on the novelty and significance of the article's scientific results. Each reviewer writes a lengthy review and sends it back to the associate editor, along with a recommendation about whether to accept the paper for publication, reject the paper, or to ask the author to submit a revised article to be re-reviewed. (If the article being reviewed has already been revised and resubmitted, then the reviewers must recommend either to accept or reject the paper.) When the associate editor has received reviews from all three reviewers, he makes a decision about whether to accept the paper, reject the paper, or to ask the author to revise the paper and re-submit it. The associate editor sends his final decision to the editor-in-chief. He also sends his decision plus the three reviews, with the names of the reviewers removed, to the author.

(a) Draw a sequence diagram depicting the scenario where an author submits an article for publication and the article is accepted.

(b) Draw a class diagram that models all of the classes and associations that contribute to a description of this problem. Use generalization, aggregation, association names, roles, qualifiers, multiplicity classes, etc. to make your model as complete and precise as possible.

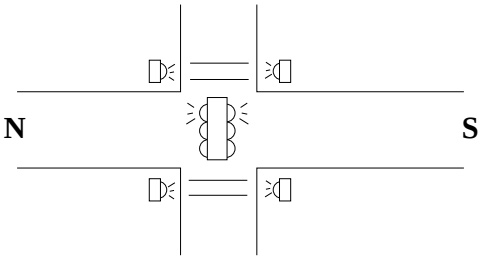
(c) Draw the state diagram for an associate editor that describes an editor's behaviour in the above process. You may assume that an editor only sheppards one paper through the review process at a time. Also, you needn't model exceptional cases – that is, you can assume that the editor is always able to find three reviewers, that the reviewers always write their reviews in a timely manner, that the editor is able to make a decision based on the reviewers recommendations, etc.

Write your answer to question 3 on this page

Continue your answer to question 3 on this page

4. **(40 marks) SDL**

This question asks you to model in SDL the behaviour of a traffic light controller that controls a traffic light and its corresponding crosswalk lights.



The traffic light is at an intersection of a north-south (NS) road and an east-west (EW) road. Each road has a crosswalk light for pedestrians crossing the other road at the intersection. The figure shows the traffic and crosswalk lights for NS road; the EW road has a similar set of lights.

Whenever the traffic light for either road is green or yellow, the traffic light for the other road is red. Whenever the traffic light for a road is yellow or red, its corresponding crosswalk light is red (indicating that it is illegal to start crossing the street). If the traffic light for a road is green, its crosswalk light might be green (indicating it is safe to cross the street), yellow (indicating it unsafe to start crossing the street), or red – depending on whether or not a pedestrian triggered the crosswalk signal.

The following describes how the lights for the NS road should change over time. The lights for the EW road behave similarly.

If there are no pedestrians, then when the traffic light turns green it stays green for 27 seconds or until an EW car or any pedestrian arrives at the intersection – which ever occurs *latest*. Thus, if there is no traffic on the EW road, the traffic light for the NS road will continuously stay green. When the light changes, it first changes to yellow for 3 seconds, then it changes to red. Since there were no pedestrians, the crosswalk light for north- and south-bound pedestrians is red.

A pedestrian triggers the crosswalk signal if he triggers a sensor (presumably by pressing a button) when the crosswalk light is *not* green. If an NS pedestrian has triggered the crosswalk signal, then the next time the NS traffic light turns green, the NS crosswalk light will also turn green. Also, the traffic light will stay green for at least 55 seconds, to allow pedestrians time to cross the road. After the traffic and crosswalk lights have been green for 40 seconds, the crosswalk light turns yellow. After 17 seconds of being yellow the crosswalk light turns red. If in the meantime an EW car or a pedestrian has arrived and is waiting, then the traffic light will turn yellow when the crosswalk light turns red; and after 3 seconds the traffic light will also turn red. Otherwise, the traffic light stays green until an EW car or a pedestrian arrives.

You are to draw an SDL ***process*** diagram for a controller that gets inputs from sensors (that detect the presence of cars and pedestrians) and sends output commands to actuators to change the traffic and crosswalk lights.

You may assume that the system and block diagrams declare the following signals and that there is a signal-route carrying the input signals from the sensors to the process and another signal-route carrying the output signals from the process to the actuators.

```
/* input signals */
SIGNAL
   NScar, EWcar,  /* sense cars */
   NSped, EWped;  /* sense pedestrians */
```

```
/* output signals */
NEWTYPE  color
    LITERALS  red, yellow, green;
ENDNEWTYPE color;

SIGNAL
   NSlight(color), /* traffic lights */
   EWlight(color),
   NSwalk (color), /* crosswalk lights */
   EWwalk (color);
```

Continue your answer to question 4 on this page