Name: _____

CSSE 373—Formal Methods in Specification and Design

Exam 3, May 15, 2009

This exam is open book and open notes. You may also use your laptop if you wish to review past homework, slides, or reference manuals, though you should budget your time very carefully. You may *only* use your laptop to access data on your local hard drive or directly accessible from the course ANGEL or web pages.

Problem	**Poss. Pts.**	**Earned**
1	9	_____
2	18	_____
3	18	_____
4	18	_____
5	55	_____
Total	100	_____

Questions 1–4 involve simulating the behavior of several different statecharts. For each statechart a particular system state and a sequence of external events is given. Your task is to determine the final state of the system.

It's possible that internal events might be generated in the course of processing an external event. Assume that all such internal events are processed before processing the next external event. That is, assume the system settles into a *steady state* before processing the next external event.

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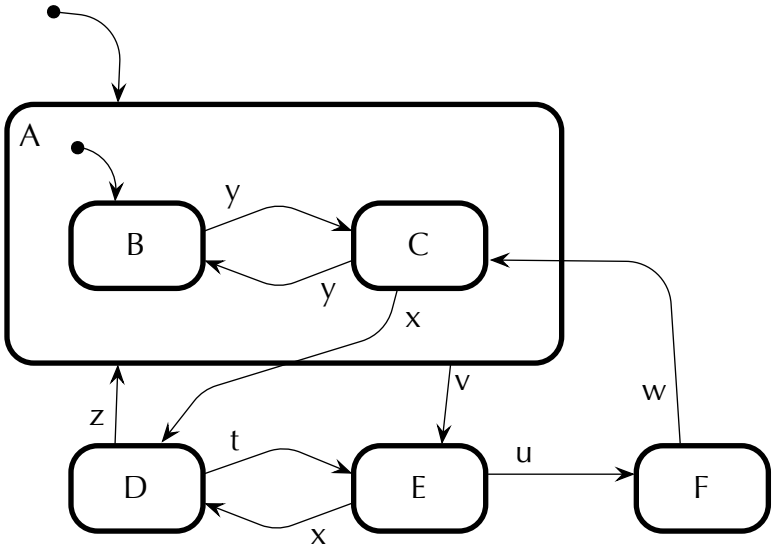
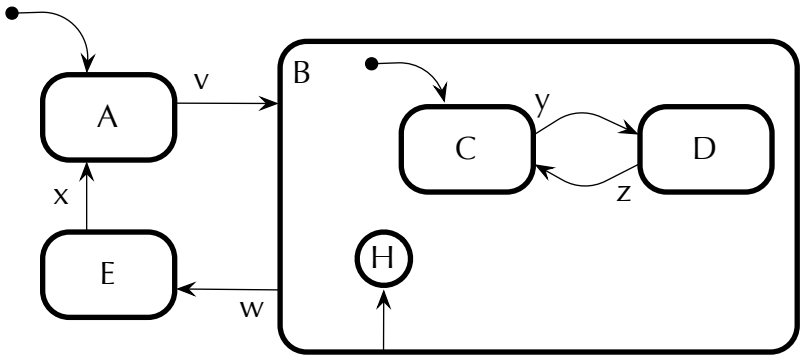
1. (9 points) Consider the statechart below. Suppose the system is in its initial state and then receives the external events listed below in order. Indicate the steady state of the system after each external event.

Event	State
v	_____
t	_____
u	_____
z	_____
w	_____
y	_____
y	_____
x	_____
z	_____



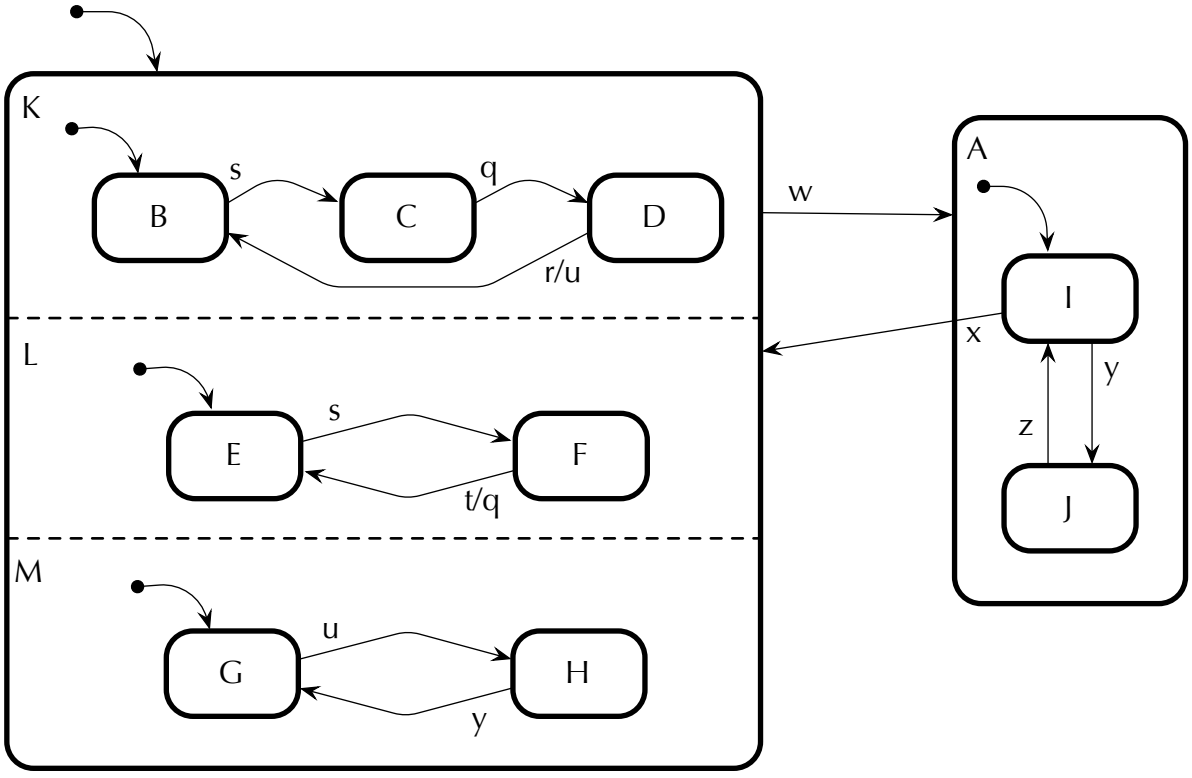
2. (18 points) Consider the statechart below. Suppose the system is in its initial state and then receives the external events listed below in order. Indicate the steady state of the system after each external event.

Event	State
v	_____
z	_____
y	_____
w	_____
x	_____
v	_____



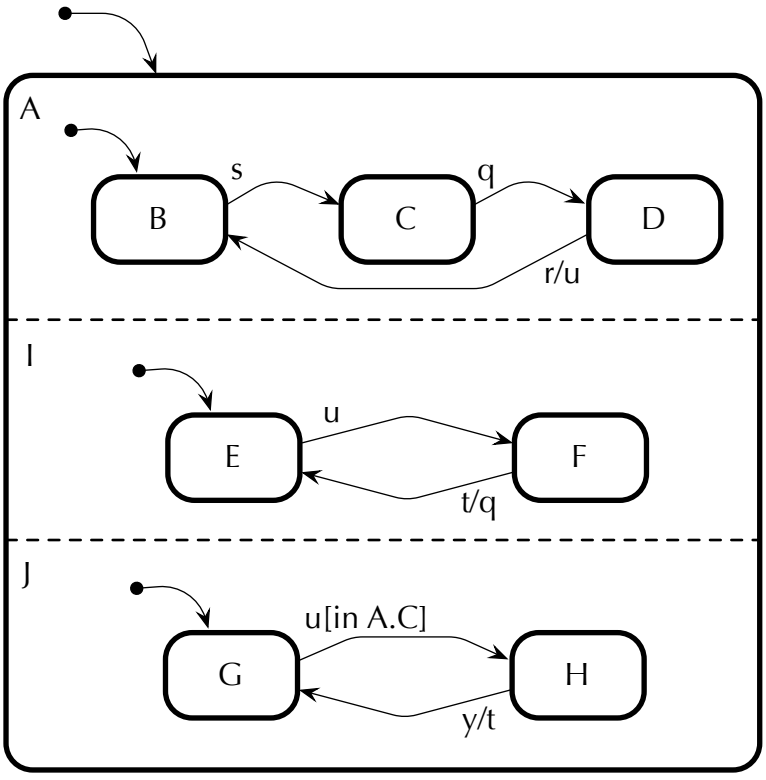
3. (18 points) Consider the statechart below. Suppose the system begins in state **B, E, G** and then receives the external events listed below in order. Indicate the steady state of the system after each external event.

Event	**State**
s	_____
t	_____
r	_____
w	_____
y	_____
x	_____



4. (18 points) Consider the statechart below. Suppose the system begins in state **B, E, G** and then receives the external events listed below in order. Indicate the steady state of the system after each external event.

Event	**State**
s	_____
q	_____
r	_____
s	_____
u	_____
y	_____



5. (55 points) Design a statechart to model a portion of an Automated Teller Machine.

The system allows the user to insert their card and attempt to enter their Personal Identification Number (PIN). The user is considered "logged in" if they enter a correct PIN.

If the user enters an incorrect PIN three times in a row, the machine should display an error message for 10 seconds, then return to the Welcome screen **without returning the user's card**. Anytime before that, the user can choose to cancel entering of their PIN, in which case the machine should return their card and display the Welcome screen.

Once logged in, the user may choose to log out, in which case the machine should return their card and display the Welcome screen.

In your design:

- Include at least a *Welcome* state and a *Logged In* state. Presumably while logged in the user could execute a variety of actions; you do **not** need to model those.
- Assume the following external events are available:
  - *cardInserted*
  - *pinEntered*
  - *pinCancelled*
  - *loggedOut*
- Assume a guard predicate *pinOK* is available.
- Assume the following actions are available:
  - *returnCard*, which will cause the machine to release the user's card, and
  - *consumeCard*, which will cause the machine to capture the user's card for return to their bank.
- For full credit, your design should include at least one feature of higher order statecharts.
- Be sure to indicate all initial states.

Please use the following page(s) for your design.

For instructor use only

	5	3	1	S
Cl				
Co				
D				
N				

Q5 solution:

Q5 solution (continued, if needed):