EECS 20. Midterm No. 1
October 4, 2002.

Please use these sheets for your answer and your work. Use the backs if necessary. **Write clearly and put a box around your answer, and show your work.**

Print your name and lab day and time below

Name: _____

Lab time: _____

Problem 1:

Problem 2:

Problem 3:

Total:

1. **50 points.** Please indicate whether the following statements are true or false. There will be no partial credit. They are either true or false. So please be sure of your answer.

   (a) $\forall\, t \in Reals, \quad (t, t+1) \in Reals^2$

   (b) $\exists\, x \in Integers, \quad \{(x, x+1)\} \subset \{1, 2, 3\}^2$

   (c) If $A = \{1, 2\}$ and $B = \{1, 2, 3\}$, then $\exists\, x \in A$ such that $\forall y \in B, x <= y$.

   (d) $P(A \cup B) = P(A) \cup P(B)$, where P denotes the power set.

   (e) For any two functions $f: A \to A$ and $g: A \to A$, where A is a set, $f \circ g = g \circ f$.

   (f) Let $f: Reals \to Reals$ be a function where $\forall x \in Reals$, $f(x) = x \sin(x)$. Then f is onto.

(g) For the same function f in the previous part, f is one-to-one.

(h) Let $A = [-1, 1]$. Consider a function f where $\forall\ x \in A$, $f(x) = x \sin(2\pi x)$. Then $f \in [A \to A]$.

(i) $[\{1, 2, 3\} \to \{1, 2\}] \subset [\{1, 2, 3\} \to \mathit{Naturals}]$.

(j) $X \times Y \in \{g \mid g = \mathit{graph}(f) \wedge f \colon X \to Y\}$.

(k) Given two state machines A and B, if A simulates B and A is deterministic, then B simulates A.

(l) Consider two state machines A and B with state spaces States_A and States_B. If in each state machine, all states are reachable, then in the side-by-side composition, all states in $\mathit{States}_A \times \mathit{States}_B$ are reachable.

2. **35 points.** Consider the state transition diagram shown below.
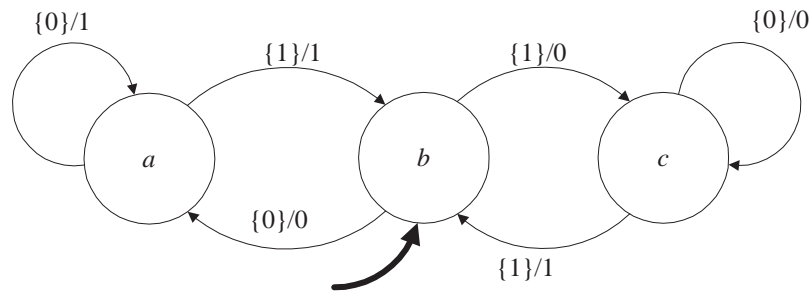
Give each of the following:

(a) *States* =

(b) *Inputs* =

(c) *Outputs* =

(d) Give the domain and range, and fill in the table for
    update:

current	(*next state, output symbol*) under specified input symbol		
state	0	1	*absent*
a			
b			
c			

(e) *initialState* =

(f) Compose this state machine in a feedback loop, where its output is connected to its input. Assume the output of the composition is the output of this state machine. Give the set *Behaviors* for the feedback composition. You may ignore stuttering reactions, and give only the behaviors with no stuttering reactions.

3. **15 points.** Consider the following two state machines:
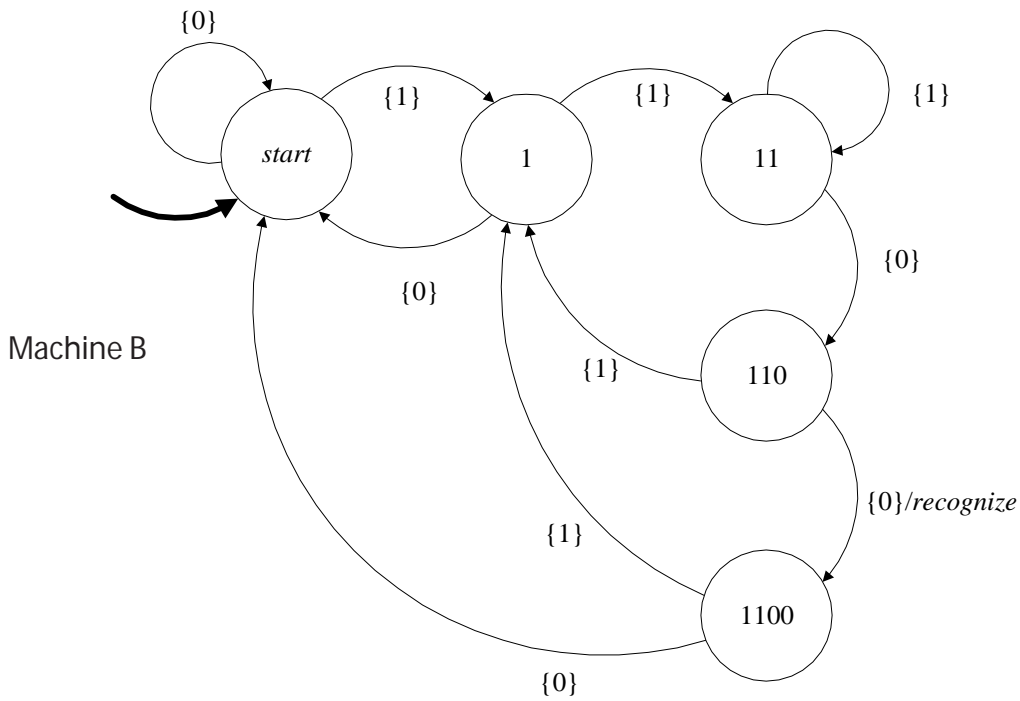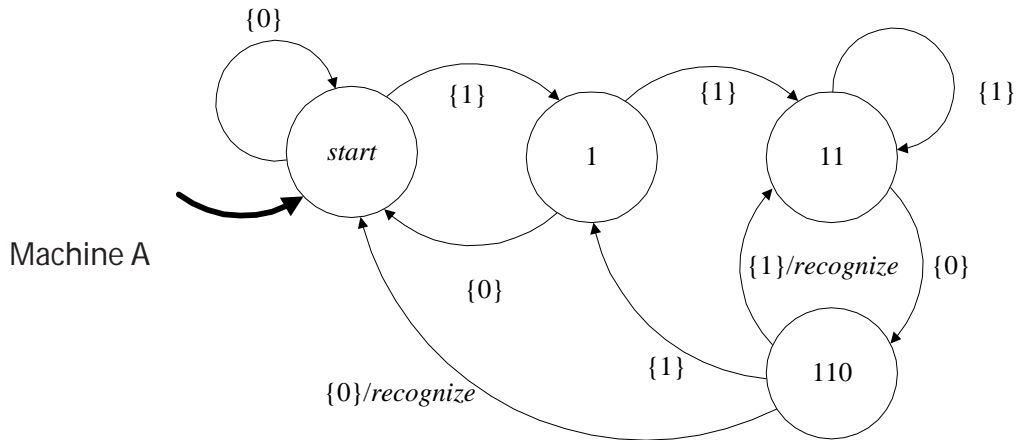
Machine A

Machine B

These are similar to the machine *CodeRecognizer* studied in the text and in the homework. Determine whether A simulates B, B simulates A, neither, or both. Give the relevant simulation relations, if any.

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