EECS 20. Midterm No. 1
October 8, 2001.

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 time below.

Name:
Lab time:

Problem 1:
Problem 2:
Problem 3:
Total:

1. **40 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) $[\{1, 2, 3\} \rightarrow \{a, b\}] \subset [Naturals \rightarrow \{a, b\}]$

   (b) $\{g \mid g = graph(f) \wedge f: X \rightarrow Y\} \subset X \times Y$

   (c) F: $[Reals \rightarrow Reals] \rightarrow [Reals \rightarrow Reals]$, such that $\forall t \in Reals$, $\forall x \in [Reals \rightarrow Reals]$,
   $(F(x))(t) = \sin(2\pi \cdot 440t)$
   is a memoryless system.

   (d) Let f: $Reals \rightarrow Reals$ and g: $Reals \rightarrow Reals$, where g is obtained by delaying f by $\tau \in Reals$. That is,
   $\forall\ t \in Reals$, $g(t) = f(t - \tau)$.
   Then $graph(g) \subset graph(f)$.

2. **30 points**. Consider a state machine where

Inputs = {1, *absent*},

Outputs = {0, 1, *absent*},

States = {*a*, *b*, *c*, *d*, *e*, *f*},

initialState = *a*,

and the *update* function is given by the following table (ignorring stuttering):

(*currentState*, *inputSymbol*)	(*nextState*, *outputSymbol*)
(*a*, 1)	(*b*, 1)
(*b*, 1)	(*c*, 0)
(*c*, 1)	(*d*, 0)
(*d*, 1)	(*e*, 1)
(*e*, 1)	(*f*, 0)
(*f*, 1)	(*a*, 0)

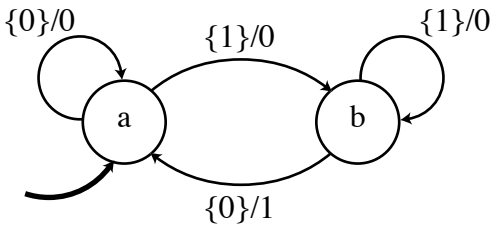
(a) Draw the state transition diagram for this machine.

(b) Ignoring stuttering, give the *Behaviors* relation for this machine.

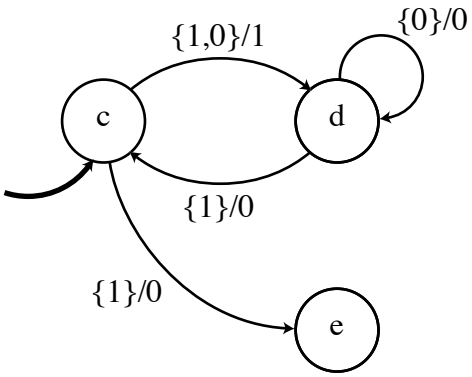
(c) Find a state machine with three states that is bisimilar to this one. Draw that state machine, and give the bisimulation relation.

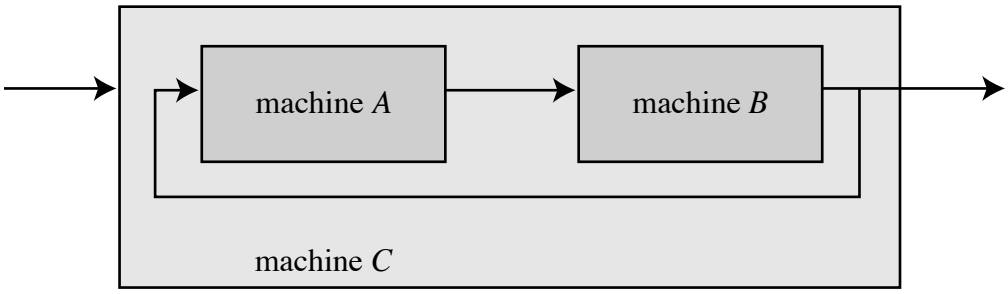
3. **30 points.** Consider the following three state machines:

machine *A*:



machine *B*:





Machines *A* and *B* have input and output alphabets

$$Inputs = Outputs = \{0, 1, absent\}.$$

Machine *C* has the same output alphabeet, but input alphabet $Inputs_C = \{react, stutter\}$.

(a) Which of these machines is deterministic?

(b) Draw the state transition diagram for the composition (machine C), showing only states that are reachable from the initial state.

(c) Give the $Behaviors_C$ relation for the composition of machine C, ignoring stuttering.