

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

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

(c) $F: [\text{Reals} \rightarrow \text{Reals}] \rightarrow [\text{Reals} \rightarrow \text{Reals}]$, such that $\forall t \in \text{Reals}$, and $\forall x \in [\text{Reals} \rightarrow \text{Reals}]$,

$$(F(x))(t) = \sin(2\pi \cdot 440t)$$

is a memoryless system.

(d) Let $f: \text{Reals} \rightarrow \text{Reals}$ and $g: \text{Reals} \rightarrow \text{Reals}$, where g is obtained by delaying f by $\tau \in \text{Reals}$. That is,

$$\forall t \in \text{Reals}, \quad g(t) = f(t - \tau).$$

Then $\text{graph}(g) \subset \text{graph}(f)$.

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

$$\text{Inputs} = \{1, \text{absent}\},$$

$$\text{Outputs} = \{0, 1, \text{absent}\},$$

$$\text{States} = \{a, b, c, d, e, f\},$$

$$\text{initialState} = a,$$

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

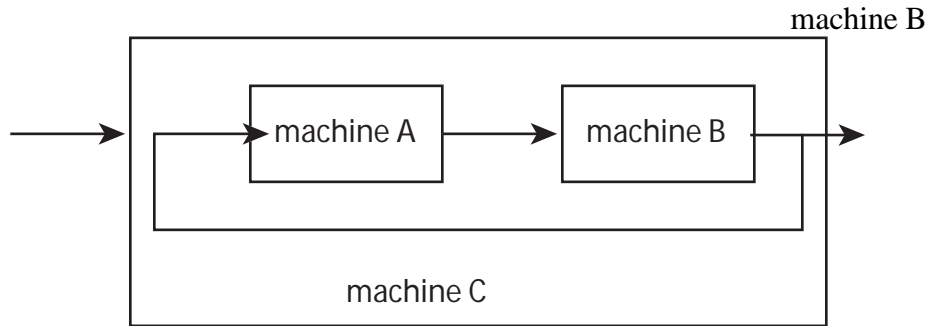
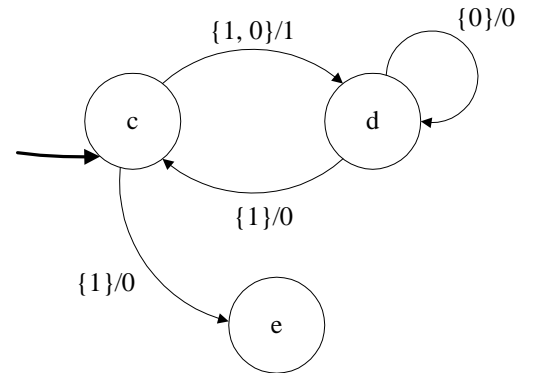
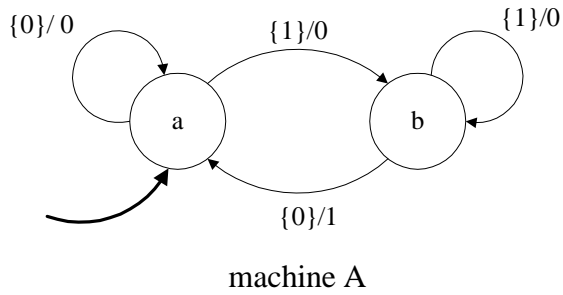
| $(\text{currentState}, \text{inputSymbol})$ | $(\text{nextState}, \text{outputSymbol})$ |
|---|---|
| $(a, 1)$ | $(b, 1)$ |
| $(b, 1)$ | $(c, 0)$ |
| $(c, 1)$ | $(d, 0)$ |
| $(d, 1)$ | $(e, 1)$ |
| $(e, 1)$ | $(f, 0)$ |
| $(f, 1)$ | $(a, 0)$ |

(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:



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

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

Machine *C* has the same output alphabet, 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.

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