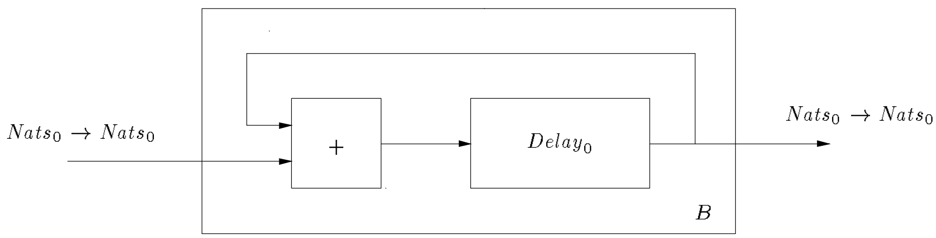
EECS 20, First Midterm Exam

February 23, 2001

Last name:	First name:
Student ID:	Lab user ID:
Email:	Lab section:

Problem 1. (20 points)



If the first four inputs are 3, 3, 0, 1, what are the first four outputs of B?

0, 3, 6, 6

Which of the following terms characterize the system B (answer Yes or No for each):

reactive Yes

discrete-time Yes

memory-free No

causal Yes

finite-state No

deterministic Yes

Complete the following:

B: $[Nats_0 \to Nats_0] \to [Nats_0 \to Nats_0]$ such that $\forall\, x \in [Nats_0 \to Nats_0]$, $\forall\, y \in Nats_0$, $(B(x))(y) \;=\; \sum_{0 \le z < y} x(z)$.

Problem 2. (30 points)

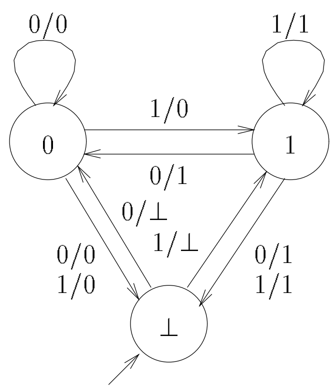
Draw the transition diagram of a state machine that implements the nondeterministic system $A \subseteq [Nats_0 \to Bins] \times [Nats_0 \to Bins_\perp]$ such that $\forall\, x \in [Nats_0 \to Bins]$, $\forall\, y \in [Nats_0 \to Bins_\perp]$, $(x, y) \in A$ iff

(1) $y(0) = \perp$;
(2) $\forall\, z \in Nats$, either $y(z) = x(z-1)$ or $y(z) = \perp$; and
(3) $\forall\, z \in Nats$, if $y(z) = \perp$ then $y(z-1) \neq \perp$.

Note that A is a lossy channel with unit delay that never drops two inputs in a row.

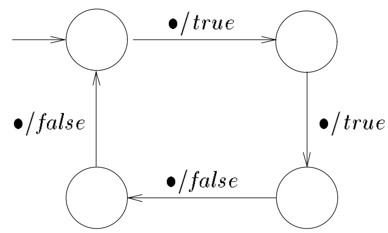
States:

0	previous input was 0
1	previous input was 1
$\perp$	previous input was dropped

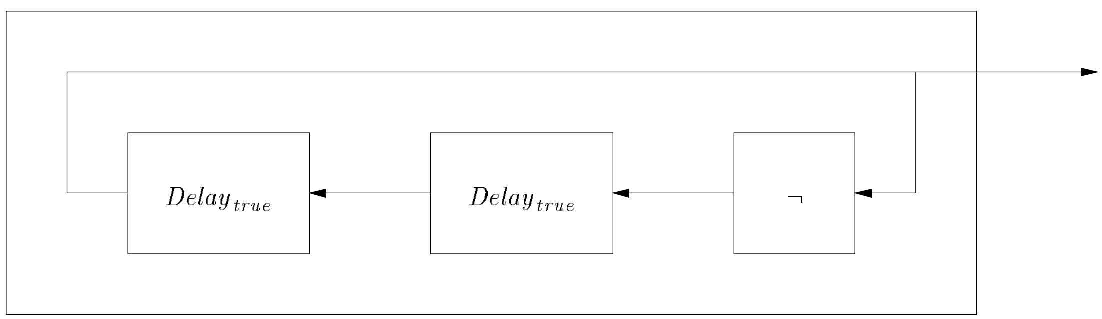


Problem 3. (30 points)

Draw a block diagram consisting of *and*, *or*, *not*, and *Delay* systems to implement the following state machine:

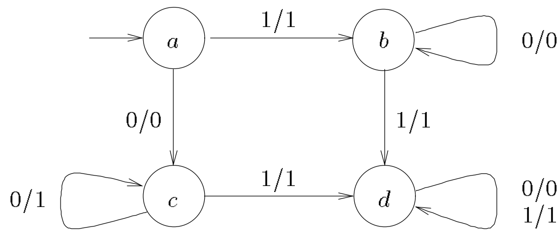


Solution:



Problem 4. (20 points)

Use minimization to find the transition diagram of the smallest state machine that is equivalent to the following state machine:



Splitting:

$\{\{a, b, c, d\}\}$
$\{\{c\}, \{a, b, d\}\}$
$\{\{c\}, \{a\}, \{b, d\}\}$