EECS20n, Quiz 3, 3/14/05

The quiz will take 15 minutes. Write your response on the sheet.

Please print your name and lab time here:

Last Name Solution First _____ Lab time _____

1. [10 points] Give the zero-input state response (response if input = 0) of the state machine:

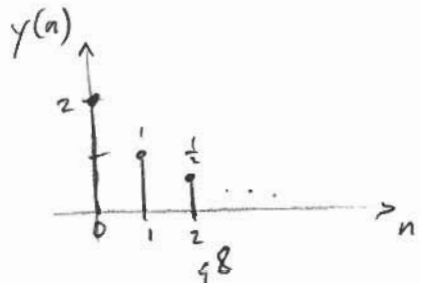
$$\begin{aligned} s(n+1) &= as(n) + bx(n) \\ y(n) &= cs(n) + dx(n) \qquad n \in \text{Naturals}_0 \end{aligned}$$

Here x is the input, y is the output and s is the state trajectory.

Sketch the response for $a = 1/2, b = c = d = 1$, and for $a = 2, b = c = d = 1$. For the sketches assume an initial state of $s(0) = 2$.

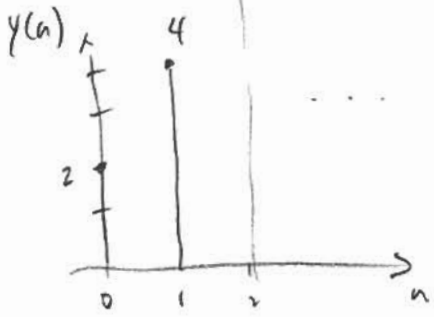
2/10 $s(n+1) = a\,s(n)$ zero input state response

4/10 $a = \frac{1}{2}$



$y(n) = s(n)$

4/10 $a = 2$



$y(n) = s(n)$

$s(n) = a^n s(0)$

2. [20 points] Consider the system given by the difference equations:

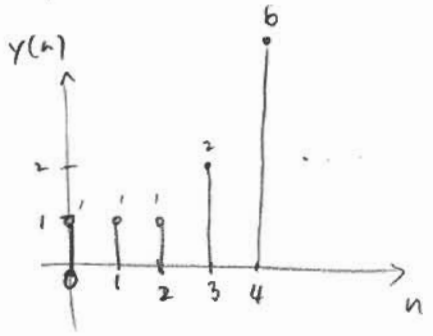
$$\begin{aligned} s(n+1) &= \beta n s(n) + x(n) \\ y(n) &= s(n) + x(n) \qquad n \in \text{Naturals}_0 \end{aligned}$$

with $s(0) = 0$. Here x is the input, y is the output and s is the state trajectory.

(a) [5 points] Assume $\beta = 1$. Compute and plot the first few values of the output if (i) the input is an impulse: $x(n) = \delta(n)$ for all $n \in \text{Naturals}_0$. (ii) if the input is $x(n) = \delta(n-1)$ for all $n \in \text{Naturals}_0$.

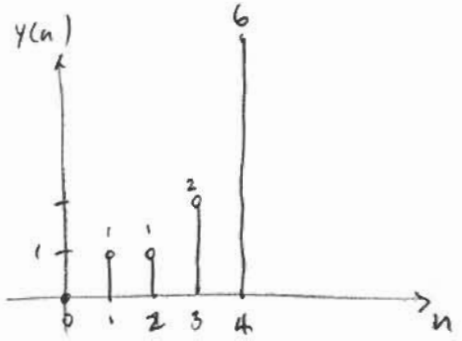
3/5 (i)

$y(0) = 1$
$y(1) = 1$
$y(2) = 1$
$y(3) = 2$
$y(4) = 6$



2/5 (ii)

$y(0) = 0$
$y(1) = 1$
$y(2) = 1$
$y(3) = 2$
$y(4) = 6$



5/5

(b) [5 points] Is the system linear? Circle the right answer below.

A) No, for all values of $\beta \in$ Reals.

B) Yes, for all values of $\beta \in$ Reals.

C) Yes, for some but not all values of $\beta \in$ Reals.

D) Depends on the input sequence.

5/5

(c) [5 points] Is the system time-invariant? Circle the right answer below.

A) No, for all values of $\beta \in$ Reals.

B) Yes, for all values of $\beta \in$ Reals.

(C) Yes, for some but not all values of $\beta \in$ Reals.

$\beta = 0 \Rightarrow$ time invariant

D) Depends on the input sequence.

5/5

(d) [5 points] Assume again $\beta = 1$. Compute and plot the first few values of the output if the input sequence is $x(0) = 1, x(1) = 3$ and $x(n) = 0$ for $n \geq 2$.

[partial credit (2/5)]

$x(n) = \underbrace{\delta(n)}_{2a(i)} + \underbrace{3\delta(n-1)}_{2a(ii)}$