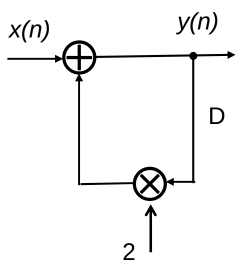
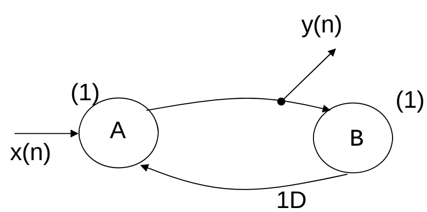
Chapter 7

Activities

Activity 1

Given an IIR filter, y(n)=2*y(n-1)+x(n), as shown below. The input x(n)=1 for all n.





(1) Find y(n) for n=0,1, ….8, assume y(n)=0 for n<0. What is minimum clock period? What is iteration time?

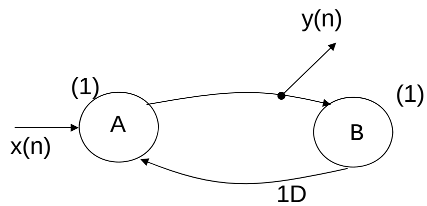
(2) Apply 2-slow transformation, find y(n) for n=0,1,…,8. What is minimum clock period? What is iteration time?

Solution to Activity 1

Given y(n)=2*y(n-1)+x(n) and y(n)=0 for n<0

We have:

n	y(n)
0	y(0)=2*y(-1)+x(0)=2*0+1=1
1	y(1)=2*y(0)+x(1)=2*1+1=3
2	y(2)=2*y(1)+x(2)=2*3+1=7
3	y(3)=2*y(2)+x(3)=2*7+1=15
4	y(4)=2*y(3)+x(4)=2*15+1=31
5	y(5)=2*y(4)+x(5)=2*31+1=63
6	y(6)=2*y(5)+x(6)=2*63+1=127
7	y(7)=2*y(6)+x(7)=2*127+1=255
8	y(8)=2*y(7)+x(8)=2*255+1=511



T_{clk}=2ut

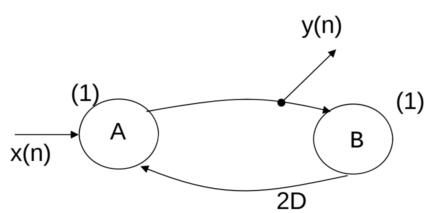
T_{iter}=2ut

Solution to Activity 1

For 2-slow, y(n)=2*y(n-2)+x(n) and x(n)=1,0,1,0,10,…

We have:

n	y(n)
0	y(0)=2*y(-2)+x(0)=2*0+1=1
1	y(1)=2*y(-1)+x(1)=2*0+0=0
2	y(2)=2*y(0)+x(2)=2*1+1=3
3	y(3)=2*y(1)+x(3)=2*0+0=0
4	y(4)=2*y(2)+x(4)=2*3+1=7
5	y(5)=2*y(3)+x(5)=2*0+0=0
6	y(6)=2*y(4)+x(6)=2*7+1=15
7	y(7)=2*y(5)+x(7)=2*0+0=0
8	y(8)=2*y(6)+x(8)=2*15+1=31



T_{clk}=2ut

T_{iter}=2*2ut=4ut

Activity 2

- Given the following inequalities, draw the constraint graph.

$r_1 - r_2 \leq 0$

$r_3 - r_1 \leq 5$

$r_4 - r_1 \leq 4$

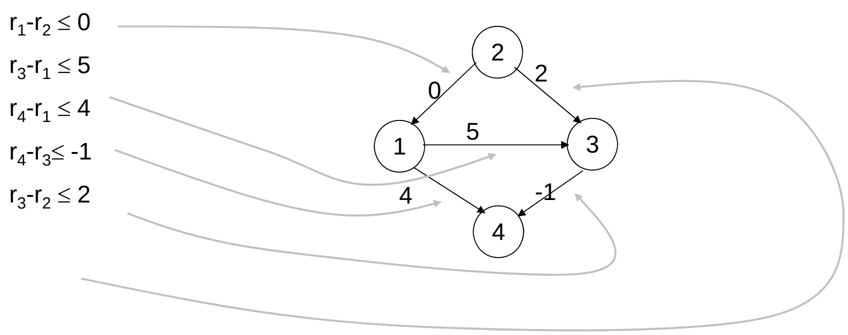
$r_4 - r_3 \leq -1$

$r_3 - r_2 \leq 2$

Solution to Activity 2

There are 4 variables in 5 inequalities, so N=4

We first draw 4 nodes, e.g. nodes 1 to 4, based on given inequalities



Solution to Activity

Next, we draw the node N+1, e.g. node 5

Connect node 5 to other nodes with length 0

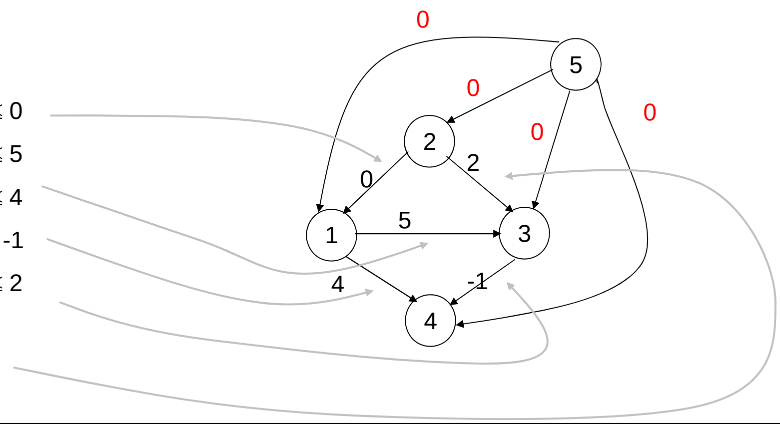
$r_1 - r_2 \leq 0$

$r_3 - r_1 \leq 5$

$r_4 - r_1 \leq 4$

$r_4 - r_3 \leq -1$

$r_3 - r_2 \leq 2$



Solution to Activity

No negative cycles in the constraint graph. This can be verified by Bellman-Ford algorithm in Appendix A.

A solution can be found: r(1)=r(2)=r(3)=0, r(4)=-1

$r_1 - r_2 \leq 0$

$r_3 - r_1 \leq 5$

$r_4 - r_1 \leq 4$

$r_4 - r_3 \leq -1$

$r_3 - r_2 \leq 2$

W=[0 inf 5 4
0 0 2 inf
inf inf 0 -1
inf inf inf 0]