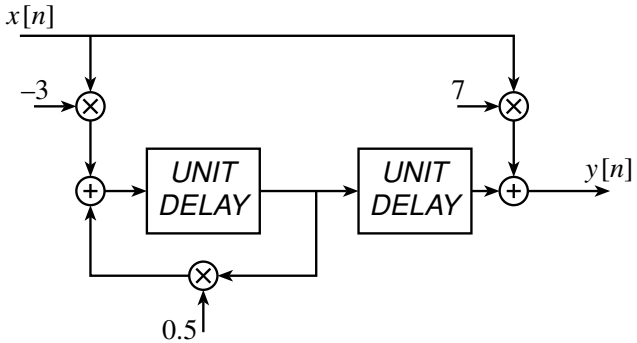
## PROBLEM:

The following signal flow graph structure defines a linear time-invariant system:



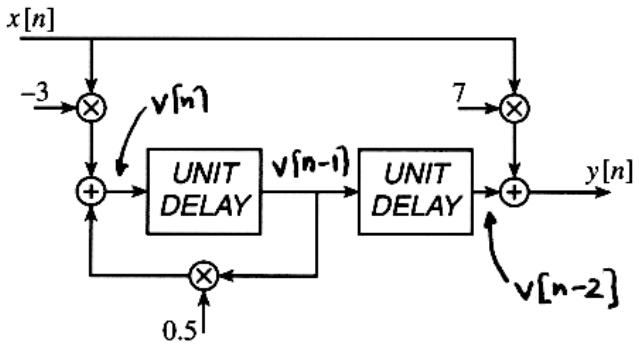

(a) Write a simple formula for the difference equation defined by the signal flow graph. Since this is not a standard form, you must write the equations for signals at each node of the signal flow graph.

(b) Write a few lines of MATLAB code that will generate the first 20 values of the impulse response of the system.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458. 

SOLUTION

The following signal flow graph structure defines a linear time-invariant system:




(a) Write a simple formula for the difference equation defined by the signal flow graph. Since this is not a standard form, you must write the equations for signals at each node of the signal flow graph.

$v[n] = -3x[n] + \frac{1}{2}v[n-1]$ & $y[n] = 7x[n] + v[n-2]$

$V(z) = -3X(z) + \frac{1}{2}z^{-1}V(z)$ $\qquad Y(z) = 7X(z) + z^{-2}V(z)$

$\Rightarrow V(z) = \frac{-3}{1-\frac{1}{2}z^{-1}}X(z) \longrightarrow Y(z) = 7X(z) + z^{-2}\left(\frac{-3}{1-\frac{1}{2}z^{-1}}\right)X(z)$

$\therefore Y(z) = \left(7 - \frac{3z^{-2}}{1-\frac{1}{2}z^{-1}}\right)X(z) = \left(\frac{7-\frac{7}{2}z^{-1}-3z^{-2}}{1-\frac{1}{2}z^{-1}}\right)X(z)$

$\longleftarrow H(z)$

$\Rightarrow$

$y[n] = \frac{1}{2}y[n-1] + 7x[n] - \frac{7}{2}x[n-1] - 3x[n-2]$

(b) Write a few lines of MATLAB code that will generate the first 20 values of the impulse response of the system.

```
bb = [7  -7/2  -3];
aa = [1  -1/2];
nn = 0:19;
impulse = (nn==0);
hh = filter(bb, aa, impulse);
```