SIGNALS AND SYSTEMS I
Computer Assignment 4

Exercises

For this assignment, use the discrete system described by the difference equation,

$$y(n) - 2r\cos(\omega_0)y(n-1) + r^2 y(n-2) = r\sin(\omega_0)x(n-1)$$

where $x(n)$ is the system's input, $y(n)$ is the system's output and

$$\omega_0 = \pi / 7.$$

1. Draw a Direct Form I block diagram of the system, and determine the system's impulse response.

2. Determine the values of r for which this system stable?

3 Using a *for* loop or a *while* loop, write a program that implement your Direct Form I block diagram. Using this program, calculate the first 51 outputs of the system's impulse response when

   i) $r = 0.99$
   ii) $r = 1$
   iii) $r = 1.01$.

   Plot the input and the outputs using the **stem**, **title** and **subplot** functions. (You should generate 4 plots on 1 page.) Compare (**max**(**abs**(*difference*))) your results with your result in Exercise 1.

4. Using your program, calculate the first 51 outputs of the system's zero input response (ZIR) when the system's initial conditions are $y(-1) = -r^{-1}\sin(\omega_0)$, $y(-2) = -r^{-2}\sin(2\omega_0)$ and

   i) $r = 0.99$
   ii) $r = 1$
   iii) $r = 1.01$.

   Plot the outputs using the **stem**, **title** and **subplot** functions. (You should generate 3 plots on 1 page.)

5. Using your program, calculate the first 51 outputs of the system's impulse response when the system's initial conditions are $y(-1) = -r^{-1}\sin(\omega_0)$, $y(-2) = -r^{-2}\sin(2\omega_0)$ and

   i) $r = 0.99$
   ii) $r = 1$
   iii) $r = 1.01$.

   Plot the input and the outputs using the **stem**, **title** and **subplot** functions. (You should generate 4 plots on 1 page.)

6. Add your results from Exercises 3 and 4 and compare them to your results in Exercise 5. Comment on your comparison.