

# MATLAB Assignment 6

Spring 2017, Section B

This homework assignment will look at some simple examples of discrete systems.

1.  $Z^z$  This question involves a digital filter with the following transfer function:

$$H(z) = \frac{\frac{1}{2} + \frac{2}{3}z + \frac{3}{7}z^2}{2 + \frac{1}{3}z + \frac{1}{2}z^3}$$

- (a) Find the poles and zeros of H using *tf2zp*.
- (b) Plot the poles and zeros using *zplane*.
- (c) Obtain the first 50 points of the impulse response using *impz*. Plot them using the **appropriate** plotting function.
- (d) Let  $x = (-\frac{1}{2})^n$  where n ranges from 0 to 49. Apply the digital filter to x using *filter*. Plot the result using the appropriate plotting function.
- (e) Now apply the digital filter to x using *conv*. You will have to throw out some values to get the same result. Make another plot to show that the results are the same.

## 2. You Gotta be Fibbin Me!

The Fibonacci sequence is the sequence of numbers such that every number after the first two is the sum of the two preceding numbers. The first two numbers are both 1.

- (a) We are interested in thinking of the  $n^{th}$  number (starting at 0) in the sequence as the output of a discrete system at time  $n$ . Assume the input to the said system is an impulse at  $n = 0$ , that is, the Fibonacci sequence is the impulse response of this system. what is the difference equation governing the system? Use a for loop to generate the first 100 values of the impulse response of this system. Plot each point with semilogy, make the linetype dots (i.e. '.' is the third argument).
- (b) Use the Z-transform to determine the transfer function of the system—Don't use MATLAB to do this, just right it down. Calculate the exact poles and zeros by hand. Calculate the poles and zeros with MATLAB and generate a pole zero plot. Is the system causal? Is it stable? Explain why using the pole zero plot and the difference equation.