The Z-plane

The purpose of this assignment is to learn about the system function of a discrete time system and its relationship to the Z-plane, and filtering of discrete signals. You will need the m-file `frevalz.m` and can get it from the web page.

The function you'll use, `frevalz.m`, is similar to `frevals.m` that you used on a prior lab. Like `frevals`, `frevalz` takes in a system function, then computes and plots the frequency and impulse responses. `frevalz` has the additional feature of plotting the pole/zero diagram. The syntax of the two functions are quite different so type help frevalz (in MATLAB) to learn more.

1. **First Order System**

   (a) Use `frevalz` to examine a first-order system that consists of a single pole on the real axis:

   $$H(z) = \frac{1}{1 - az^{-1}}$$

   How does the sign of the pole affect the frequency response of the system?
   What happens to the impulse response when the pole has absolute value greater than 1?

   (b) Compare the low pass system you can generate with the simple system above to the following improved system:

   $$H(z) = \frac{1 + z^{-1}}{1 - az^{-1}}$$

   Pick $a = 0.75$. How is this system an improvement over the system described in part (a)? Hand in a hard copy of the summary plot from the IMPROVED system.

2. **Second Order System**

   (a) Use `frevalz` to design a second-order low pass system.
   State where you placed your poles and zeros.
   Hand in a hardcopy of the summary plot of your system.

   (b) Use `frevalz` to design a second-order bandpass system. Try to design a system that passes frequencies around 0.25 and rejects all others.
   Explain where you chose to place your poles and zeros and why.
   Hand in a hardcopy of the summary plot of your system.