

## EECS 360 Lab 12

### Z-Transform

The bilateral or two-sided Z-transform of a discrete-time signal  $x[n]$  is the function  $X(z)$  defined as

$$X(z) = Z\{x[n]\} = \sum_{n=-\infty}^{\infty} x[n]z^{-n}$$

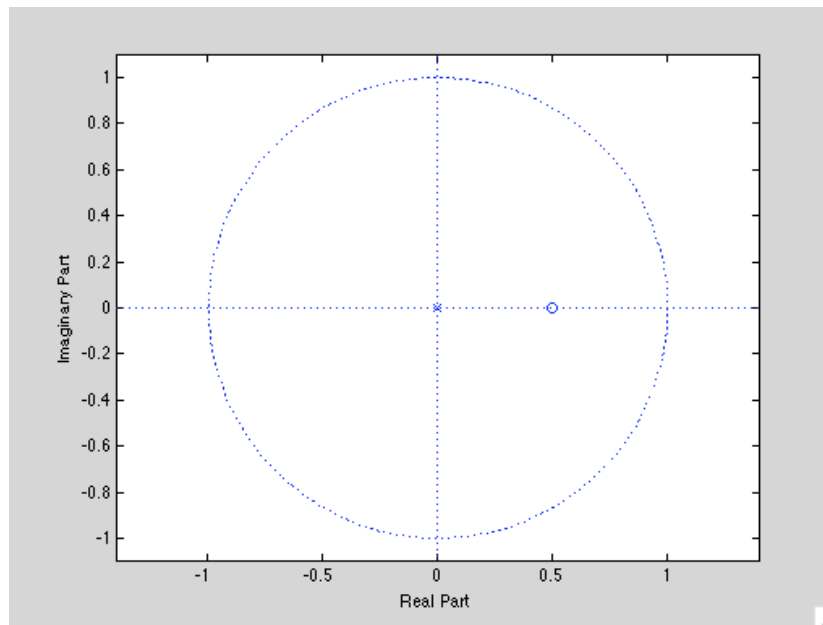
Let  $x[n] = 0.5^n u[n]$ . Expanding on the interval  $(-\infty, \infty)$ , it becomes

$$x[n] = \{\dots, 0.5^{-3}, 0.5^{-2}, 0.5^{-1}, 1, 0.5^1, 0.5^2, 0.5^3, \dots\}$$

Looking at the sum

$$\sum_{n=-\infty}^{\infty} x[n]z^{-n} = \sum_{n=0}^{\infty} 0.5^n z^{-n} = \sum_{n=0}^{\infty} \left(\frac{0.5}{z}\right)^n = \frac{1}{1 - 0.5z^{-1}}$$

Using Matlab function `zplane` to generate the pole-zero diagram



First, follow the same procedure as lab 11 (Laplace transform) to generate the pole-zero diagram, and then plot the magnitude and phase of the system using `freqz` function for the following system functions:

1.  $H(z) = \frac{z + 1}{z^2 - 0.9z + 0.81}$

2.  $H(z) = \frac{2z^2 + 5z + 12}{z^2 + 2z + 10}$

$$3. H(z) = \frac{2z^2 + 5z + 12}{(z^2 + 2z + 10)(z + 2)}$$

$$4. H(z) = \frac{s^2 + 0.49s + 0.7}{(s + 0.4)(s + 0.33)(s - 0.75)}$$

**Note:** for your lab report, you only have to provide your Matlab code and figures generated for those four system functions (4 pole-zero diagrams and 4 frequency responses).