PROBLEM:

An LTI system has the following system function:

$$H(z) = \frac{1 - z^{-2}}{1 + 0.5z^{-1}}.$$

The following questions cover most of the ways available for analyzing IIR discrete-time systems.

(a) Plot the poles and zeros of $H(z)$ in the z-plane.

(b) Determine the difference equation that is satisfied by the general input $x[n]$ and the corresponding output $y[n]$ of the system.

(c) Use z-transforms to determine the impulse response $h[n]$ of the system; i.e., the output of the system when the input is $x[n] = \delta[n]$.

(d) Determine an expression for the frequency response $H(e^{j\hat{\omega}})$ of the system.

(e) Use the frequency response function to determine the output $y_1[n]$ of the system when the input is

$$x_1[n] = 2\cos(\pi n) \qquad -\infty < n < \infty.$$

(f) Use the z-transform to determine the output $y_2[n]$ when the input is

$$x_2[n] = 2\cos(\pi n)u[n] = \begin{cases} 2(-1)^n & n \geq 0 \\ 0 & n < 0. \end{cases}$$