ELEG 4603/5173L Lab # 4
Z-Transform Part II

1. A discrete-time LTI system is given by the feedback connection shown below. The transfer functions of the subsystems are given by $H_1(z) = z/(z+1)$, and $H_2(z) = 9/(z-8)$.

   (a) Manually find the difference equation for the subsystems with transfer function $H_1(z)$.

   (b) Manually find the difference equation for the subsystems with transfer function $H_2(z)$.

   (c) Use Matlab to find the impulse response of the system by iteratively following the signal flow with difference equations of the two subsystems. Setting the input as $x(n) = \delta(n)$. The system is initially relaxed with $y(0) = 0$.

   (d) Plot the impulse response of the system.

2. Consider the LTI system defined in the previous problem.

   (a) Manually find the overall transfer function of the entire system.

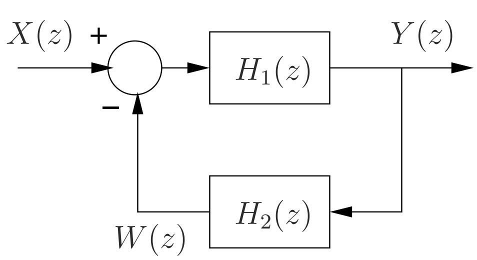

Figure 1: Block diagram of a discrete-time LTI system.

(b) Use the Matlab function `zplane()` to plot the poles and zeros. Is the system stable?

(c) Find the impulse response of the system by using the filtering method.

(d) Plot the impulse response and compare it with the results from the previous problem.

3. Consider a second-order discrete-time system represented by the difference equation

$$y(n) - 2r\cos(\omega_0)y(n-1) + r^2 y(n-2) = x(n), n \geq 0 \qquad (1)$$

where $r > 0$ and $0 \leq \omega_0 \leq 2\pi$, $y(n)$ is the output and $x(n)$ is the input.

(a) Manually find the transfer function of the system.

(b) Use the Matlab function `zplane()` to plot the poles and zeros for $r = 0.5$ and $\omega_0 = \pi/2$ radians.

(c) Manually find the value of ω_0 and determine the vlaues of r that would make the system stable.