ECE 5530/6530 Digital Signal Processing
Matlab Exercise 3

Submission guidelines (READ CAREFULLY)

- All submissions must be done using Canvas.
- The submission should contain a single zip file which contains the report (html) and code (matlab files).
- Scanned hand written submissions will be accepted; however, it is the student's responsibility to ensure that the answers are easily legible. Otherwise, you may lose points.
- MATLAB code should be submitted as part of the code (zip) file. A brief description of the code and how to run it should be included in the html report.
- If a question asks for plots, these should be generated by MATLAB (not handdrawn) and included in the html report.
- For late policy refer to syllabus.
- Unless otherwise specified, all MATLAB exercise questions refer to the dataset described in the first MATLAB exercise. We will indicate questions which use other data explicitly with the text **Other dataset**.

Module 3: z-transforms

1. Consider the signal $x[n] = \alpha^n, \quad \alpha = 0.6, \quad n = 0 \ldots 999$. Numerically evaluate the z-transform of the signal at $z = 1$.
2. Let $h[n]$ be a finite, discrete-time signal, where $h[n] = \frac{1}{n}$, where $n \in [1, k], \quad k = 4$. Let $z = \exp(j\omega), \quad \omega \in [0, \pi]$. Compute the z-transform of the signal numerically. Then plot its absolute magnitude vs ω (use increments of $\Delta\omega = 0.01$ for the plots). Repeat the experiment for $k = 8$.
3. For the signal in (1), evaluate $X(z)$ using the definition $X(z) = \sum_{-\infty}^{\infty} x[n] z^{-n}$ over a uniform grid of values covering the z-plane from -2 to 2 and from -2j to +2j. Fill these $X(z)$ values into $\mathbb{X}$[rows, columns] (use increments of 0.01 over the range of z). Plot the ROC boundary at $|z| = \alpha$ and also plot the unit circle. Use the following script to visualize the results.

```
X(isnan(X(:))) = Inf
imagesc(zvals, zvals, abs(X))
axis xy; axis  square; grid
title('|X(z)|, Z-transform evaluation')
colormap('gray')
colorbar
caxis([-20 20 ])
```

4. Repeat Question 3 for the signal $x[n] = -\alpha^{-n}, \quad \alpha = 0.6, \quad n = [-999 \ldots -1]$. Plot the ROC boundary at $|z| = \alpha$ and also plot the unit circle.