Master of Science in Technology Innovation
University of Washington

TECHIN 513, Winter 2025 — *Instructor*: Luyao Niu
Homework 4 — *Due Jan. 31st 11:59pm* **on Canvas**

Instructions:

1. If a problem involves plotting/ sketching a graph, please make sure that the **axes of the graph are labeled clearly**. You will lose points for every graph axis that is not clearly labeled.

2. You can discuss the homework assignment with peers in the class. However, your submission must be written in your own words.

3. Show your **thought process** and **intermediate steps**. Simply giving the final answer will not earn points. Incorrect final answer with intermediate steps may earn partial credits.

4. **Submit your Jupyter Notebook with all results and discussion included**.

Problems

1. Consider a sequence $x[n] = (-1)^n$ obtained by sampling $x(t) = \cos(\omega_0 t)$ with sampling interval being $1ms$. List three distinct possible values of ω_0.

2. Generate a $x(t) = \sin(2\pi f_1 t) + \sin(2\pi f_2 t)$, where $f_1 = 5Hz$, $f_2 = 20Hz$. Use three distinct sampling rates: 50Hz, 25Hz, and 15Hz to sample $x(t)$. Plot the sampled signals, and compare the sampled signal with the original one. Explain your observations using the sampling theorem. Include your plot to the submission. Submit your code as an attachment or comment on Canavs.

3. (**Bonus: 1 point**) Can $2\sin(0.4\omega) + 3\cos(2\omega)$ be the DTFT of a DT signal. Why or why not?

4. (**Bonus: 1 point**) Consider a causal and stable LTI system given by $y[n] - \frac{1}{6}y[n-1] - \frac{1}{6}y[n-2] = x[n]$.

   (a) Determine the impulse response $h[n]$ using DTFT.

   (b) If the input to the system is $(\frac{1}{4})^n u[n]$, what is the output? Use the DTFT.

Answer

Problem 1: $\omega = \pi \times 10^3, 3\pi \times 10^3, 5\pi \times 10^3$
Problem 2-4: Left to you as an exercise.