Master of Science in Technology Innovation
University of Washington

TECHIN 513, Winter 2025 — *Instructor*: Luyao Niu
Homework 3 — *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 results in a pdf file. If you use Python to solve the problem, submit your code in a separate file**.

Problems

1. Determine and plot the DTFS coefficients of a periodic signal whose period is $N = 6$. Within one period, the signal is given as $x[n] = \begin{cases} 1, & \text{if } n = 0, 1, 2, 3 \\ 0, & \text{if } n = 4, 5 \end{cases}$
Include your code as an attachment or comment on Canvas if you use program to compute the coefficients.

2. Write a Python program to verify your Fourier series in Problem 1 can be combined to reconstruct the original signal. Your program should use appropriate visualization to compare the original signal and the linear combination of all frequency components. *Hint:* You may need to round the values with very small coefficients, e.g., $0+10^{-17}j$ to 0, to prevent numerical errors.

3.**Optional.** Let $x[n] \overset{FS}{\longleftrightarrow} a_k$. Determine the DTFS coefficients of $x^*[-n]$.

4. **Optional.** Let N be an even number. Determine the DTFS coefficients of $(-1)^n x[n]$.

Answers

1.

$$a_0 = \frac{2}{3}$$
$$a_k = \frac{1}{6} e^{-jk\pi/2} \frac{\sin(2\pi k/3)}{\sin(k\pi/6)}$$