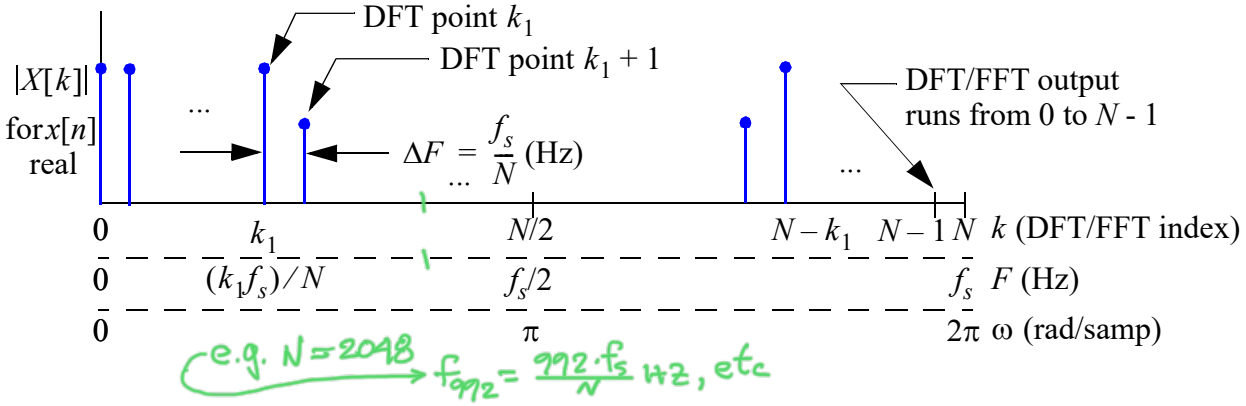
Final Exam Review Topics – Fall 2025 — Additions since class

1. The final will be comprehensive, but new material that you have not been tested on will be emphasized. The length will be about 5 pages, as the final time slot is just 2 hours.
2. The exam is **open book** and **open notes**.
3. The following is a list of topics relevant for the final:
   - Discrete-time signals and systems in the time domain, e.g., working with basic signal types, system properties, for LTI systems the convolution sum to get the output from input (something from this area likely)
   - LCCDEs; classical solution techniques (NO)
   - The discrete-time Fourier transform (DTFT); DTFT for LTI system gives the frequency response; for signals the spectrum; DTFT theorems and transform pairs (something from this area likely)
   - The z-transform; ROC, inverse transform using partial fraction expansions, transform theorems and transform pairs (fundamental, so a problem in this area for sure)
   - Lowpass sampling theory; aliasing, ideal reconstruction
   - Multirate sampling; upsampling, downsampling, rate conversion (almost certain)
   - Discrete-time random processes as applied to quantization noise issues when using $B+1$ bits in the A/D and D/A (possible) ← Keep to simple model in terms of 3 parameters
   - Transform analysis of LTI systems; working systems level problems using time-domain, frequency domain, and z-domain relationships (as needed)
   - Characterization in terms of magnitude, phase and group delay; stability, causality, and inverse systems ← replace with linear phase
   - ~~All-pass~~ systems, minimum phase systems, generalized linear phase systems (one problem in this area for sure; maybe in more than one problem)
   - Structures for LTI systems; direct form I and II, cascade, parallel, and transpose realizations; structure from $H(z)$ or get $H(z)$ for a given structure (one problem in this area for sure)
   - Structures for FIR; general and linear phase (not likely)
   - Finite precision effects – coefficient quantization, roundoff noise due to finite precision multiplication, the linear noise model (a short answer/ concept problem in this area possible)
   - The discrete Fourier transform (DFT); basics such as calculation and how it relates to the DTFT (basic spectral analysis), properties such as circular sequence shift and circular convolution (a problem from this area for sure)
   - Simple FFT applications, e.g., transform domain filtering with FFT/IFFT
   - Fast implementation via FFT algorithms; We briefly studied the radix-2 FFT, e.g., $(N/2)\log_2 N$ multiplies for N points (multiply count my be requested)
   - Basic FFT spectral analysis $\Delta F = F_s/N$ Hz (for sure)_

$$\text{SNR}_{dB} = 10\log_{10}\left(\frac{\sigma_x^2}{\sigma_e^2}\right) = 6.02B + 10.8 - 20\log_{10}\left(\frac{X_m}{\sigma_x}\right)$$

CHANGE X_m, σ_x, or B how does SNR change etc.



e.g. $N = 2048$ → $f_{\text{bin}2} = \frac{2 \cdot f_s}{N}$ Hz, etc