Beamforming Bake-Off: Implement, compare, and analyze classical + advanced acoustic beamformers on a controlled synthetic scene.

Scene (free-field, no flow):

- **Array geometries:** (A) 32-mic Uniform Circular Array (UCA), radius 0.5 m; (B) 48-mic spiral (aperiodic) within 0.6 m radius.

- **Sources @ z=1.5 m:**
  S1: (x,y)=(0.20,0.00)(x,y)=(0.20, 0.00)(x,y)=(0.20,0.00) m, tonal @ 2 kHz
  S2: (x,y)=(0.26,0.00)(x,y)=(0.26, 0.00)(x,y)=(0.26,0.00) m, tonal @ 2 kHz (coherent with S1 → hard resolution test)
  S3: (x,y)=(−0.35,0.25)(x,y)=(-0.35, 0.25)(x,y)=(−0.35,0.25) m, broadband (1–4 kHz), **incoherent**

- **Frequencies evaluated:** 1, 2, 4, 8 kHz (8 kHz intentionally near/above spatial-aliasing for the UCA).

- **Snapshots:** default K=200K=200K=200; vary K∈{25,50,100,200}K\in\{25,50,100,200\}K∈{25,50,100,200}.

- **Noise:** spatially white, set by SNR (default 10 dB).

TO DO:

1. Implement: CB, MVDR (with diagonal loading), MUSIC, Functional BF (FB, parameter mmm), CLEAN-SC (simplified), and DAMAS (Gauss–Seidel, nonnegative).

2. Produce maps on a 2D scan grid and compare across methods, arrays, frequencies, and snapshots.

3. Report metrics: **localization error**, **resolution (FWHM)**, **MSR** (mainlobe-sidelobe ratio), **false positives**, **runtime**, and **robustness vs. snapshots**.

4. Discuss **spatial aliasing** effects (esp. @8 kHz), **coherent-source** behavior (S1/S2), and **array layout** trade-offs (UCA vs spiral).

5. (Bonus) Inject **steering-vector mismatch** (e.g., +2% speed-of-sound error) and show winners/losers.