Asynchronous Class Activity

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1. Basic 2D Line Plot
Problem:
A car accelerates from rest with an acceleration of $a = 2m/s^2$. Plot the velocity of the car over time for $t = 0\ to\ 10s$

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2. Multiple Plots
Problem:
Compare the growth of two plants. Plant A grows $y = 3x + 2\ cm/day$, and Plant B grows $y = 2x^2 + 1\ cm/day$. Plot both functions for $x = 0\ to\ 10\ days$.

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3. Subplots
Problem:
Analyze a pendulum's motion. Plot:

1. Displacement $x(t) = Asin(\omega t)$
2. Velocity $v(t) = A\omega\ cos(\omega t)$

Use $A = 5\ m$ and $\omega = 2\ rad/s$ for $t = 0\ to\ 10s$

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4. Stem Plot
Problem:
Plot the temperatures (∘C) recorded hourly from 6 AM to 6 PM:
[15,17,19,21,23,25,27,28,27,26,24,22,20]

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5. Logarithmic Plot
Problem:
Plot the growth of a bacterial colony that doubles every hour: $N(T) = N_0\ .2^t$, starting with $N_0 = 10$ bacteria for $t = 0\ to\ 10\ hours$.

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6. Histogram
Problem:
Simulate the test scores of 1000 students with a mean of 70 and standard deviation of 10. Plot a histogram.

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7. Box Plot
Problem:
Analyze the height (in cm) of two basketball teams.
Team A: mean=180, std = 6
Team B: mean=190, std=6.ds
Each team has 50 players.

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8. Scatter Box Plot

Problem:

Plot the weight (in kg) of 30 fruits with individual data points and a box plot. Use mean=1.2, std=0.2.

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9. Bode Plot

Problem:

Plot the magnitude and phase responses of an RC circuit $R = 10k\Omega$, $C = 1\mu F$ over frequencies $f = 1Hz\ to\ 10^4 Hz$.

Comprehensive Problem: "Earthquake Monitoring and Analysis"
Scenario:
You are part of a research team studying seismic activities. Over a 24-hour period, you collected the following data from a seismic station:

1. **Seismic signal amplitude (A)** recorded every second for 60 seconds during a minor earthquake.
2. **Energy released (E)** during 10 major tremors over the day.
3. **Sound intensity (L)** recorded hourly from ambient noise.
4. **Frequency response (f)** of the station's sensors to different frequencies.
5. **Magnitude distribution (M)** of 100 earthquakes in a simulated model.
6. **Sensor measurements (X)** from two regions (North and South).

You need to analyze and visualize this data using **all the plotting techniques** listed.

Data:

1. **Seismic signal amplitude (Stem Plot)**: A(t)=sin(0.1πt)A(t) = \sin(0.1\pi t), t=1,2,…,60t = 1, 2, ..., 60.
2. **Energy released (Logarithmic Plot)**: EE in J\text{J} = [10110^1, 10210^2, 10310^3, ..., 101010^{10}].
3. **Sound intensity (Logarithmic Plot)**: LL in dB\text{dB} = [30, 35, 50, 40, 45, 55, 50, 60, 65, 70, 75, 80, 85, 90, 95, 100, 95, 85, 80, 75, 70, 65, 60, 55].
4. **Frequency response (Bode Plot)**: Sensor transfer function H(f)=1/(1+j2πfRC)H(f) = 1 / (1 + j2\pi f R C) with R=10kΩR = 10k\Omega and C=1μFC = 1\mu F, f=1Hz to 10kHz (log-scale)f = \text{1Hz to 10kHz (log-scale)}.
5. **Magnitude distribution (Histogram)**: Generated using Normal Distribution\text{Normal Distribution} with μ=4,σ=0.5\mu = 4, \sigma = 0.5.
6. **Sensor measurements (Box Plot)**: North: Normal Distributionμ=10,σ=2\text{Normal Distribution} \mu = 10, \sigma = 2, South: μ=12,σ=3\mu = 12, \sigma = 3.

Instructions:

- **Step 1**: Use a **2D line plot** to visualize seismic amplitude over time.
- **Step 2**: Use a **stem plot** for discrete seismic amplitude values.
- **Step 3**: Compare **energy released** (normal plot vs log-log plot).
- **Step 4**: Analyze **hourly sound intensity** using log-log plot.
- **Step 5**: Create a **Bode plot** for frequency response.
- **Step 6**: Use a **histogram** to visualize the magnitude distribution.
- **Step 7**: Compare **North and South sensor measurements** with a box plot.
- Use subplots to organize your results effectively.
