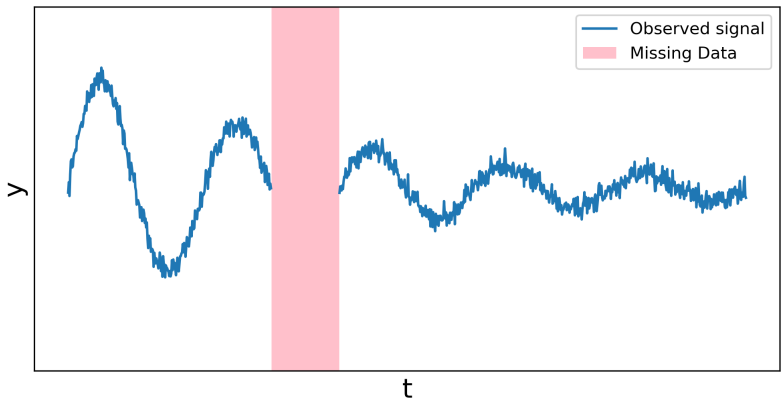
ICPE 637 DSPS - Spring 2022

HW 2

Please show your work for each problem, even if it does not completely solve the problem.

Problem 1 [50 points] - Missing Data

No programming is needed for this problem. Justify your response for all the answers you provide.



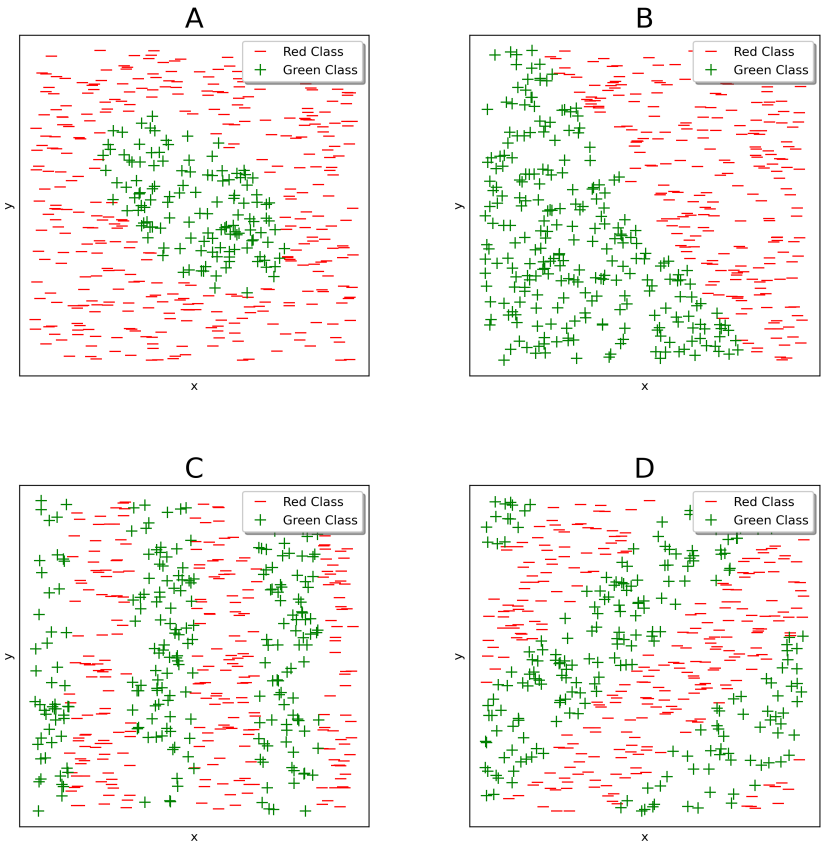
Let's say you're given a signal with some missing data, as shown in the figure above, and your goal is to fill in the blanks.

1. Would you say that this is a supervised learning, or an unsupervised learning problem?
2. Which of the following models do you think fits the data above?
    - $y = A\cos(\omega t + \phi)$
    - $y = A_1\cos(\omega_1 t + \phi_1) + A_2\cos(\omega_2 t + \phi_2)$
    - $y = Ae^{-kt}\cos(\omega t + \phi)$
3. Describe how you would proceed to solve it if you were given such a problem.

Problem 2 [50 points] - Decision boundaries

No programming is needed for this problem. Justify your response for all the answers you provide.

Let's say you're given four different datasets, (labelled A, B, C and D in the figures below), each with two-dimensional points, labelled either as members of a "Red Class" or a "Green Class". For each dataset, you'd like to come up with a decision boundary that splits the two classes.



You express the decision boundary as the set of points (x, y) such that $f(x, y) = 0$, and let's call f the decision function.

For example, let's say you determine whether a point (x, y) is Red or Green by adopting the following rule:

$$\begin{aligned} 3x + 2y \geq 0 \quad &\Rightarrow \quad \text{Green} \\ 3x + 2y < 0 \quad &\Rightarrow \quad \text{Red} \end{aligned}$$

then, you'd select a decision function $f(x, y) = 3x + 2y$.

Question:

For each of the 4 datasets given above, which of the following decision functions would you use?

1. $f(x, y) = \sin(c_1 x)$
2. $f(x, y) = c_1 x^2 + c_2 y^2 + c_3 xy + c_4 x + c_5 y + c_6$
3. $f(x, y) = c_1 x + c_2 y$
4. $f(x, y) = \sin(c_1 x + c_2 y)$

Hint: You might find Desmos Graphing Calculator helpful for this problem, to give you an idea of what $f(x, y) = 0$ looks like for each of these cases.

BONUS [25 points] - Choosing a Retail Electricity Provider

Knowing your experience in retail electricity markets, your friend, who resides in ZIP code 77478 near Houston, seeks your help in choosing the best electric plan for them. Using powertochoose.com, select the top three plans to present to them, and justify why they should consider those. Consider the following priorities:

1. Estimated consumption of 500 kWh per month.
2. Not willing to pay more than 11 cents per kWh.
3. A preference of at least 15% of their energy to be from renewables.