

Roll No: CS23E001
Collaborators (if any):
References/sources (if any):

Name: Shuvrajeet Das

- Use \LaTeX to write-up your solutions (in the solution blocks of the source \LaTeX file of this assignment), and submit the resulting pdf files (one per question) at Crowdmark by the due date. (Note: **No late submissions** will be allowed, other than one-day late submission with 10% penalty or four-day late submission with 30% penalty! Instructions to join Crowdmark and submit your solution to each question within Crowdmark TBA later).
- For the programming question, please submit your code (rollno.ipynb file and rollno.py file in rollno.zip) directly in moodle, but provide your results/answers (including Jupyter notebook **with output**) in the pdf file you upload to Crowdmark.
- Collaboration is encouraged, but all write-ups must be done individually and independently, and mention your collaborator(s) if any. Same rules apply for codes written for any programming assignments (i.e., write your own code; we will run plagiarism checks on codes).
- If you have referred a book or any other online material or LLMs (Large Language Models like ChatGPT) for obtaining a solution, please cite the source. Again don't copy the source *as is* - you may use the source to understand the solution, but write-up the solution in your own words (this also means that you cannot copy-paste the solution from LLMs!). Please be advised that *the lesser your reliance on online materials or LLMs for answering the questions, the more your understanding of the concepts will be and the more prepared you will be for the course exams.*
- Points will be awarded based on how clear, concise and rigorous your solutions are, and how correct your answer is. The weightage of this assignment is 12% towards the overall course grade.

The solution to question (c)

Let's assume the dataset $D = \{\{1, 1, 1\}, \{1, 1, 0\}, \{0, 0, 1\}, \{1, 0, 0\}, \{0, 0, 0\}, \{0, 1, 1\}\}$ and $Y = \{\{1, 1, 1, 0, 0, 0\}\}$ where '+' denotes 1 and '-' denotes 0

we know posterior \propto likelihood \times prior,

Assuming the priors for each class 0 is 0.5 and class 1 is 0.5 (since both classes are in the same quantities)

Now, likelihood is,

$$\mathcal{L}_n(X_1, X_2, X_3, X_4, X_5, X_6, \theta) = \prod_{i=1}^6 p_{\theta}(x_i)$$

i.e. for class 1, the likelihood is 0.5, and for class 0 is 0.5

Now from the Bayes rule, the desired class is argmax of the posterior of the 2 classes but in this, the posterior probability is the same so we can choose any 1 or 0.

(i) The classified point is 1 or 0 for anyone whom you chose.

(ii) The Naive Bayes assumption is that prior is $\frac{N_{\text{samples}-C_i}}{N_{\text{samples}}}$ where $i \in \{0, 1\}$

(iii) The Naive Bayes Classifier $P(\theta|X) = \frac{P(X|\theta)P(\theta)}{P(X)}$

(iv) The Distribution is assumed to be Bernoulli.