BRAC UNIVERSITY
CSE422 : Artificial Intelligence
Assignment 3

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1. Consider the following probabilities involving the events A, B, and C:

- $P(A, B, C) = 0.2$
- $P(A, \neg B, C) = 0.15$
- $P(A, \neg B, \neg C) = 0.05$
- $P(\neg A, B, C) = 0.05$
- $P(\neg A, B, \neg C) = 0.05$
- $P(\neg A, \neg B, C) = 0.35$
- $P(A) = 0.5$
- $P(\neg C) = 0.25$

Now solve the following problems:
a. Create a joint probability distribution table for the events.
b. Calculate $P(\neg B)$.
c. Calculate $P(A \mid \neg B, C)$ and $P(\neg A \mid B, \neg C)$.
d. Determine whether A, B, and C are independent or not.

2. Consider that 1 in 1000 people have a particular disease and a test for that disease has 1% false positive rate and 3% false negative rate.

a. What is the probability of the patient having that disease given the patient tests positive once?
b. What is the probability of the patient having that disease given the patient tests positive twice?

3. Consider the following datasets in the form $\{(x_i, y_i)\}^5$:

$D_1 = \{(8,\ 1.2),\ (9,\ 1.3),\ (10,\ 1.5),\ (12,\ 1.8),\ (15,\ 2.3)\}$

$D_2 = \{(10,\ 1),\ (13,\ 1),\ (5,\ 0),\ (15,\ 1),\ (7,\ 0)\}$

Let, the initial value of parameters $\Theta_i = i$, and learning rate $\eta = \frac{100}{100 * 10t}$, where t is the iteration number.

a. Perform two gradient descent update steps of linear regression on D_1.
b. Perform two gradient descent update steps of logistic regression on D_2.
c. Derive the closed-form solution for the weight matrix in linear regression.