

# CSE 5522 Homework 1: Math + Python Review

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## Problem 1 (2 points)

Consider the following function:

$$f(x) = \frac{1}{1 + e^{-x}}$$

**(a)**

Draw a plot of  $f(x)$  - what are the minimum and maximum values of  $f$ .  
What values of  $x$  result in the largest or smallest values of  $f(x)$ ?

**(b)**

Show that the derivative of  $f(x)$  can be written simply in terms of the function's value like so:

$$\frac{df(x)}{dx} = f(x)(1 - f(x))$$

*Hint: start by computing the derivative of  $f(x)$  using the chain rule, then re-arrange terms to get the result into the form of the answer.*

## Problem 2 (1 point)

Assume the following joint distribution for  $P(A, B)$ :

$$P(A = 0, B = 0) = 0.2$$

$$P(A = 0, B = 1) = 0.2$$

$$P(A = 1, B = 0) = 0.6$$

$$P(A = 1, B = 1) = 0.0$$

- (a) What is the marginal probability of  $P(B = 0)$ ?
- (b) What is  $P(A = 1|B = 0)$ ?
- (c) What is  $P(A = B)$ ?

## Problem 3 (1 point)

Assume  $X$  is conditionally independent of  $Y$  given  $Z$ . Which of the following statements are always true?

- (a)  $P(X, Y) = P(X) + P(Y) - P(Z)$
- (b)  $P(X, Y, Z) = P(X) + P(Y) + P(Z)$
- (c)  $P(X, Y) = \sum_{c \in \mathcal{X}_Z} P(X, Y, Z = c)$
- (d)  $P(X, Y|Z) = P(X|Z)P(Y|Z)$
- (e)  $P(X, Y) = P(X)P(Y)$

## Problem 5 (1 point)

Consider the following matrix,  $M$  and vector,  $v$ :

$$M = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 0 \\ 1 & 3 & 3 \end{bmatrix}, v = \begin{bmatrix} 3 \\ 0 \\ 2 \end{bmatrix}$$

Compute the following matrix-vector and vector-vector products explaining how you arrived at each answer (show your work):

(a)

$$M \cdot v =$$

(b)

$$v^T \cdot M =$$

(c)

$$v^T \cdot v =$$

## Problem 6 (5 points)

Install Python (<https://www.python.org/>) on your machine and complete the Unix / Python / Autograder tutorial available here: <http://ai.berkeley.edu/tutorial.html>. Print out your files (`addition.py`, `buyLotsOfFruit.py` and `shopSmart.py`), in addition to a log of your shell session running the autograder to turn in with answers to the written questions above.

## Survey

- (a) What is your favorite programming language?
- (b) What programming languages do you feel comfortable using?
- (c) Are there any specific topics you would like to see covered in the class?