CISC 5800 – Machine Learning
Homework 0
Due September 11
Highly recommend you complete by September 11, 2017
Submit Parts A and B on paper at the start of class September 18;
Submit Part C on your erdos account by 11:00pm September 18 (see Part C instructions below).

Much of this homework should be review of concepts you have learned prior to this semester in algebra, probability, and programming.

A. Probability:
First probability table corrected below on Sept 11, 11pm.
Consider the following joint probability table:

A	B	P(A,B)
0	0	0.2
0	1	0.1
1	0	**0.3**
1	1	0.4

1. What is P(A=1,B=1)?
2. What is P(B=0)?
3. What is P(A=1|B=0)?
4. What is P(A=1 or B=0)?

Consider the following joint probability table:

A	B	C	P(A,B,C)
0	0	0	0.08
0	0	1	0.40
0	1	0	0.24
0	1	1	0.08
1	0	0	0.02
1	0	1	0.10
1	1	0	0.06
1	1	1	0.02

5. Are variables A and B independent?
6. Are variables B and C independent?

(Potentially **NEW** material)

Typo in Question 10 corrected on Sept 11, 11pm.

Consider the multi-valued random variables N and M, where N is an animal and M is the attitude of the animal.

- N can take on the values: cat, dog, zebra, pony
- M can take on the values: hostile, friendly, shy

Which of the following represent a single probability value, and which represent a function (specifically, a "probability density function")?

7. P(N)

10. P(M|N=pony)

9. P(M=shy)

10. P(M=friendly| N=zebra)

B. Algebra/Calculus

Express a as a function of b.

Example question: 2b=5a+3

Example answer: $a = \frac{2b-3}{5}$

1. $a^2=4b^2+2a+a^2$

2. $b^2+4a=4b+16$

3. 5a=4(b-6a)

Consider the function $f(x)=3x^2-7$.

4. What is the value of f(x) when x=4?

5. What is the derivative of f(x)?

Consider the function $g(z)=2(z^3-1)^2$

6. What is the value of g(z) when z=-2?

7. What is the value of g(z) when z=5?

C. Programming:

Use a programming language you know to perform the following tasks. Provide the code and tell me what language you are using. I most recommend you use Matlab, C++, or Python, if you already know one of these languages. If you do not, you must e-mail me for my approval to use another language. The code for questions 2 and 3 **each must use at least one loop**. You may not use the pre-defined Matlab trace function.

Matlab code is NOT required for this assignment, but is permitted if you wish.

Submission instructions for Part C: Log into your erdos account (erdos.dsm.fordham.edu) – you can use Terminal on Mac or Putty on Windows (see Resources section on our course web site). Inside your folder called "private"

Linux command: `cd private`

create a folder called "CIS5800".

Linux command: `mkdir CIS5800`

Save the three programs, hobbitDetector, runningProduct, and trace, inside private/CIS5800/. As course instructor, I will be able to access your files inside private/CIS5800/. You must have the necessary files in the proper directory by September 18 at 11:00pm.

You are welcome to write your programs on your local computer (or on erdos). To transfer files from your local computer to erdos, you may use a program such as FileZilla `https://filezilla-project.org/`. **Make sure you transfer your files into your private/CIS5800/ directory!**

If you have trouble accessing erdos for this assignment, you may e-mail me your programs by September 18, 11:00pm – however, we will use erdos for code submission throughout the rest of the semester, so you must resolve your erdos troubles by the time the next homework is due!

1. Write a function called **reasonableDetector** that takes in a real number. The function will return 1 (meaning "true, this number is reasonable") if number the height is between 10 and 100. The function will return 0 (meaning, "false, the number is NOT reasonable") if the input is less than 10 or greater than 100.

2. Write a function called **sumSquared** that takes in a list/array/vector of numbers and returns the sum of the squares of all the numbers. For example, if you provide the list {2, -2, 4, 5}, the output is $2^2+(-2)^2+4^2+5^2$ = 4+4+16+25 = **49** . For this question, **use a loop**.

3. Write a function called **trace** that takes in a two-dimensional array/list/matrix and returns the trace – the sum of the elements in the first row, first column; second row, second column; third row, third column; etc. For example, the trace of the list {{1, 2, 3}, {4, 5, 6}, {7, 8, 9}} is 15 (1+5+9=15). The trace of the list {{1, 2, 3, 4}, {5, 6, 7, 8}, {9, 10, 11, 12}, {13, 14, 15, 16}} is 34 (1+6+11+18=34).   *You may assume the maximum size of the input is 6 rows by 6 columns.*