CISC 5800 – Machine Learning
Homework 0
Due January 24
Submit Parts A and B on paper at the start of class January 24;
Submit Part C on your erdos account by 11:59pm January 24 (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:
Consider the following joint probability table:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>P(A,B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

1. What is $P(A=1|B=1)$?
2. What is $P(A=0)$?
3. What is $P(A=0,B=0)$?
4. What is $P(A=1 \text{ or } B=0)$?

Consider the following joint probability table:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>P(A,B,C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.08</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.40</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.24</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0.08</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.02</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.06</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.02</td>
</tr>
</tbody>
</table>

5. Are variables A and B independent?
6. Are variables B and C independent?
Consider the multi-valued random variables N and M, where N is an animal, M is the attitude of the animal, and C is the color of the animal.

- N can take on the values: cat, dog, zebra, pony
- M can take on the values: hostile, friendly, shy
- C can take on the values: red, blue, green, orange

Which of the following represent a single probability value, and which represent a function (e.g., a “probability density function” or a “probability table”)?

- 7. \( P(C=\text{orange}, M) \)
- 10. \( P(C=\text{red} | M=\text{shy}) \)
- 9. \( P(M) \)
- 10. \( P(M=\text{friendly}, N=\text{zebra}) \)

**B. Algebra/Calculus**

Express \( a \) as a function of \( b \).

Example question: \( 2b=5a+3 \)

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

1. \( 2a=3(b-4a) \)

2. \( 6b+3a = b^2+12 \)

3. \( a^2 = -4b^2+2a^2 \)

Consider the function \( f(x)=4x^3-1 \).

4. What is the value of \( f(x) \) when \( x=2 \)?

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

Consider the function \( g(z)=2(z^2-1)^4 \)

6. What is the value of \( g(z) \) when \( z=1 \)?

7. What is the value of the **derivative of** \( g(z) \) when \( z=-2 \)?
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.

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 website). Inside your folder called “private”

Linux command: cd private
create a folder called “CIS5800”.

Linux command: mkdir CIS5800
Save the three programs, reasonableDetector, numEven, and flip, 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 January 24 at 11:59pm.

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! Connect to erdos using port 22.

If you have trouble accessing erdos for this assignment, you may e-mail me your programs by January 24, 11:59pm – 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 numEven that takes in a list/array/vector of numbers and returns the number of even entries in the list/array/vector. (You can assume all entries are integers) For example, if you provide the list {2, -2, 4, 5}, the output is 3. Use a loop.

3. Write a function called flip that takes in a two-dimensional array/list/matrix with R rows, and returns a new two-dimensional array/list/matrix where the n\textsuperscript{th} row of the new matrix contains the entries of the (M-n+1)\textsuperscript{th} row of the original matrix. In other words, flip the row order. For example, the flip of A={\{1, 2, 3\}, {4, 5, 6}, {7, 8, 9}} is A\textsuperscript{F}={\{7,8,9\}, {4,5,6}, {1,2,3}} Use a loop.