Lab 7 – Thursday June 28, 2018

This lab covers:

- arrays
- functions
- input
- exception handling

Question 1

The purpose of this question is to write a python program (script) that manipulates arrays using vector arithmetic. You will compute the values of points on an ellipse. The ellipse has a major axis whose length is **a** and a minor axis whose length is **b**. For any point (x,y) on the ellipse the following should be true.

$$1 = \frac{x^2}{a^2} + \frac{y^2}{b^2}$$

Write a function that begins with the header:

```
def getNumber(prompt):
```

The function repeatedly asks for a number (either a float or an int), by displaying the prompt, until the user enters a valid number. The function returns the number entered by the user.

Hint: Strip the leading and trailing whitespace from the input from the user.

If *value* is the value returned by *input* the function must perform the following tests:

- if *value* is not a float or an int display the value of *value* and the message 'is not a number!'.
- if *eval(value, {}, {})* causes an exception display the message 'Invalid input!'.
- if *value* is an empty string (that is the user did not type anything in and pressed return/enter) display the message 'Missing input!'

Note: You should be able to modify a function from lab 6 to do this.

Write a function that begins with the header:

```
def yOnEllipse(a, b, xValues):
```

This function is given the lengths of the major and minor axes and an array of X values. It must compute and return a new array of Y values using vector arithmetic where each element in the new array is computed using the formula

$$y = b\sqrt{1-\frac{x^2}{a^2}}$$

where **a** is the length of the major axis, **b** is the length of the minor axis and **x** is an element of the array of x values. Each value of (x,y) is a point on the ellipse.

Note: You must NOT use *for* or *while* in this function.

Write a function that begins with the header:

```
def verifyPoints(a, b, xValues, yValues):
```

This function uses vector arithmetic to compute and return an array where each element is True if

$$1 = \frac{x^2}{a^2} + \frac{y^2}{b^2}$$

for each corresponding pair of x and y values in the arrays xValues and yValues, otherwise the element is False.

Note: You must NOT use *for* or *while* in this function.

Write a function that begins with the header:

```
def main():
```

This function calls *getNumber* three times to get the length of the major axis (a), the length of the minor axis (b), and the number of points along the major axis. The array of x values is created using the *linspace* function. For example if a = 10.0 and the number of points along the major axis is 6 the array of x values is [0., 2., 4., 6., 8., 10.]. Call *yOnEllipse* and *verifyPoints* to create two new arrays. Display the corresponding values of the arrays in three columns under an appropriate heading as shown in the sample output.

The main program (not to be confused with the function **main**) should contain any import statements needed, the definitions of the functions and the statement *main()*.

A sample run of the program is shown on the next page. In the column labeled 'On Ellipse all of the values should be True, why are some of them False?

```
Enter the length of the major axis:
Missing input!

Enter the length of the major axis: 'hello'
hello is not a number!

Enter the length of the major axis: stuff
Invalid input!

Enter the length of the major axis: 10

Enter the length of the minor axis: 5

Enter the number of points along the major axis: 20

     X                    Y              On Ellipse
  0.00            5.0000000000         True
  0.53            4.9930699897         True
  1.05            4.9722220073         False
  1.58            4.9372797472         False
  2.11            4.8879409529         True
  2.63            4.8237638894         False
  3.16            4.7441464151         False
  3.68            4.6482951928         True
  4.21            4.5351810367         True
  4.74            4.4034738239         True
  5.26            4.2514459004         False
  5.79            4.0768245750         False
  6.32            3.8765578586         True
  6.84            3.6464227528         True
  7.37            3.3803243628         True
  7.89            3.0689220499         True
  8.42            2.6965659910         True
  8.95            2.2329687827         True
  9.47            1.6007269817         True
 10.00            0.0000000000         True

Programmed by Stew Dent.
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End of processing.
```