**Part 1: Basic Numpy**

For this assignment we are going to turn our attention away from Visual Studio and work with Jupyter Notebook. The easiest way to install it is by installing Anaconda. (https://conda.io/docs/user-guide/install/index.html). It will also install many of the other packages we are going use in this assignment. Using NumPy in your Jupyter Notebook…

1. Import NumPy
2. Use *arange* to create a NumPy array with 100 equally spaced values in the range 0 through 100 (not including 100). Name this NumPy array *a*.
3. Use *arange* to create a NumPy array with 10 equally spaced values in the range 0 through 100 (not including 100). Name this NumPy array *b*.
4. Use *linspace* to create a NumPy array in the range 0 through 10 (inclusive) with values spaced at 0.1. Call this NumPy array *c*.
5. Create a random two-dimensional array with the dimensions 10 by 10. Call this NumPy array *d*.
6. Reshape *a* so that it is a two-dimensional array with the dimensions 10 by 10.
7. Show the results of “a[4,5]” and explain the results in a comment.
8. Show the results of “a[4]” and explain the results in a comment.
9. Show the sum of *d*.
10. Show the max of *a*.
11. Show the transpose of *b*.
12. Show the results of adding *a* and *d.*
13. Show the results of multiplying *a* and *d*.
14. Show the results of computing the dot product of *a* and *d*.

Submission: Submit a single **.ipynb** file containing all the code to the D2L. Do not zip or archive the file. Your code must include comments at the top including your name, date and the honor statement, “I have not given or received any unauthorized assistance on this assignment.”

**Part 2: Life**

Read the Wikipedia article on Conway’s Game of Life. We will implement this simulation in a Jupyter Notebook using NumPy.

We will work on a torus because it will make the code easier and we won't need to deal with boundaries. This means that cells on the top are adjacent to cells on the bottom and the same is true for the left and right sides.

Write a function called conway(s, p) that generates a board, which is a square two dimensional NumPy array of size s. The board should be randomly populated with probability p. If p is set to 0, all cells should be 0 (dead). If p is set to 1, all cells should be 1 (alive). Start with p=0.1; about 10 percent of cells should 1.

Write a function advance(b,t) that accepts a Conway board and advances it t time steps according to the rules:

* Any live cell (marked as 1) with fewer than two live neighbors dies, as if by underpopulation.
* Any live cell (marked as 1) with two or three live neighbors lives on to the next generation.
* Any live cell (marked as 1) with more than three live neighbors dies, as if by overpopulation.
* Any dead cell (marked as 0) with exactly three live neighbors becomes a live cell, as if by reproduction.

Write a function to pleasantly display the board.

Demonstrate your code for different values of s, p and t.

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**Part 3: Housing**

Using NumPy and MatPlotLib:

1. Import MatPlotLib.
2. Import NumPy.
3. Read about the California Housing Dataset:
   1. www.kaggle.com/camnugent/california-housing-prices
4. Use this code to download the California Housing dataset:

from io import BytesIO  
import tarfile  
from urllib.request import urlopen  
url = 'http://www.dcc.fc.up.pt/~ltorgo/Regression/cal\_housing.tgz'  
b = BytesIO(urlopen(url).read())  
fpath = 'CaliforniaHousing/cal\_housing.data'  
with tarfile.open(mode='r', fileobj=b) as archive:  
 housing = np.loadtxt(archive.extractfile(fpath), delimiter=',')

1. Write code to get the size of housing.
2. Write code to get the data type of the data in housing.
3. Write code to get the dimensions of housing.
4. You can get prices from the dataset with:

price = housing[:, -1]

1. You can get pop and age from the dataset with:

pop, age = housing[:, [4, 7]].T

1. Create a labeled histogram of pop.
2. Create a labeled histogram of age.
3. Create a labeled scatter plot of age (x-axis) and pop(y-axis). Color the points in the scatterplot based on price.
4. Write a brief analysis of the scatterplot.

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**Part 4: Pay it forward**

I can use your help preparing for next quarter:

1. List three things you learned this quarter that were useful.
2. List three topics you would like added to the class.
3. List three pieces of advice for future students.
4. Identify a dataset you think would be interesting for future students.
5. Identify an interesting game or puzzle you think would be interesting for future students (e.g. something along the lines of overlapping squares).
6. Enjoy you break!

Submission: Submit a single **.doc or .pdf** file containing all the code to the D2L. Do not zip or archive the file.