Assigned on 9/18/17 and to be due on 9/25/17
Do every questions with jupyter notebook. **Submit .ipynb file. Use jupyter notebook markdown to write text answer if needed.**

2.1) (1 point)

2.1a: Use for-loop to create a list of

[1, 2, 3, 10, 11, 12, 100, 101, 102, 1000, 1001, 1002, …, 10^8 + 1, 10^8 + 2, 10^8 + 3]

2.1b: Use list-comprehension to create the list in 2.1a.

2.1c: What is the length of list created in 2.1a

2.1d: What is the length of list created in 2.1b

2.2) (1 point)

Calculate the value of matrix C where

$$C = A^T A$$

by using only list and for-loop. You may use tuple/dictionary if needed. Nested list is fine too. Do not use numpy.

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \\ \vdots & \vdots & \vdots \\ 301 & 302 & 303 \end{bmatrix}$$

Please note that *A* is 101 by 3 matrix and A^T is 3 by 101 matrix. Therefore C should be 3 x 3 matrix.

2.3) Sorting dictionary by value (1 point)
Enter the following code into jupyter notebook. It will create list of 100 tuples.

```
import numpy as np
np.random.seed(10)
a = []
for i in range(100):
    a.append(tuple([i, np.random.random()]))
```

This should give

```
[('name 0', 0.771320643266746),
 ('name 1', 0.0207519493594015),
 ('name 2', 0.6336482349262754),
 ('name 3', 0.7488038825386119),
 ('name 4', 0.4985070123025904),
```

```
 ('name 5', 0.22479664553084766),
 ('name 6', 0.19806286475962398),
...
 ('name 97', 0.4407738249006665),
 ('name 98', 0.3182728054789512),
 ('name 99', 0.5197969858753801)]
```

Then create the dictionary by taking the first element in each tuple as key and the second element as value in dictionary. This dictionary can be created by

```
b = dict(a)
```

Now, sort this dictionary based on the value from high random number to low random number (descending order).
Hint: You may consider to sort `b.items()` with the lambda function pointing to the index 1 of each item.

2.3a) Show the list of the sorted dictionary based on the value (not key). This should be list of 100 tuples.

2.3b) At the highest value of the dictionary (first item shown in the sorted dictionary) the corresponding key is 'name xx' what is the number for that 'xx'

2.3c) what is the key for the lowest dictionary value (your answer should be name xx, replace xx with the actual value)?

2.4) **List of 2 random character (1 point)**
Create the list of 100 elements. Each element contain two characters. For example, the result may look like

```
['DP',
 'JU',
 'LW',
 'HC',
 'AW',
 'IV',
 'TQ',
 'GG',
...
 'CH',
 'AL',
 'WP',
 'SH',
 'LV',
 'HX']
```

Use `np.random.seed(20)` so that the result is repeatable. Use

```
np.random.seed(20)
asc = [tuple([np.random.randint(65,91),
              np.random.randint(65,91)]) for i in range(100)]
```

The above code will give list of 100 tuples. Each tuple has 2 number, each from 65 to 90.
ASCII code 65 is capital a or A. ASCII code 90 is 'Z'
Function chr take the input as the ASCII code and the output as the character. For example, chr(65) = 65.
Use chr function together with concatenation operator '+' to create 2 character from each tuple from list asc. Then, finally create list of 100 two character (only capital letter), as shown earlier.

2.5) Combination of 6 dices. (3 points)
Find the total combination of each summation of tossing 6 dices face value.
The answer must be given as a list of tuple.
Each tuple contain 2 number. The first number is the summation of the face value when tossing 6 dices together. The second number is the total number of combination for the summation event in the first value to occur.

The number of combination is defined as the possible number of way for a certain event to happen. Therefore, the combination number for the summation of the 6 dices face value to be 6 is only 1. There is only one way for the summation of 6 dices to be 6 that is each die has the face value of 1.

There are 6 ways (6 combination) for the 6 dices face value combination to be 7. These combinations are
2, 1, 1, 1, 1, 1 (only die 1 value is 2 and the rests are 1)
1, 2, 1, 1, 1, 1 (only die 2 value is 2 and the rests are 1)
1, 1, 2, 1, 1, 1 (only die 3 value is 2 and the rests are 1)
…
1, 1, 1, 1, 1, 2 (only die 6 value is 2 and the rests are 1)
Show the ANS list in jupyter notebook.
The result is expected to be

ANS = [(6,1), (7, 6), …, (35, 6), (36, 1)]

2.5a) show ANS list
2.5b) show the summation of the second value of all tuples in list ANS (it should equal 6^6 = 46656)

Hint: you may use 6 nested for-loop. Use count = count + 1 when the condition for counting is True. For example

```
if sum == 10:
    count[10] = count[10] + 1
```

You don't need to code it in a pythonic way, just get the correct answer is fine.
Advanced version, use recursive function if you can. Try to not have an exponential growth.

2.6: (3 points) At what times of the day that hour and minute hands of the clock will be

2.6a: pointing to the same number (0 degree between each other)
(multiple answers are expected)

2.6b: how many times that the condition in 2.6a occur in one day?

2.6c: pointing into the opposite direction (180 degree between each other)
(multiple answers are expected)

2.6d: how many times that the condition in 2.6b occur in one day?

Assume that both hour and minute hands can move freely and be at any location around the clock. For example, 1:14:01.23142523 AM is possible.

Note that two the obvious answers are 0:00:00 and 12:00:00 (this is 24 hours time format). At midnight and noon. Both hour and minute hands are at the number 12.

Note also that at 12:30:00.000000 pm, the hour and minute hands are not exactly opposite to each other, not 180 degree, because the minute hand will be at the number 6, but the hour hand will be at a half way between the number 12 and 1.

Picture is from http://sincerelysecondgrade.blogspot.com/2015/12/what-time-is-it.html

Hint: you may need to use gcd / lcm function(s) to do solve problem.