

FE-520 Assignment 2

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Submission Requirement:

For all the problems in this assignment you need to design and use Python 3, output and present the results in nicely format.

Please submit a written report (pdf), where you detail your results and copy your code into an Appendix. You are required to submit a single python file and a brief report. Your grade will be evaluated by combination of report and code.

You are strongly encouraged to write comment for your code, because it is a convention to have your code documented all the time.

Python script must be a executable '.py' script (please test your .py file in terminal before submitting to canvas, otherwise you will be deducted 5 points), Jupyter notebook '.ipynb' is not allowed.

Do NOT copy and paste from others, all homework will be firstly checked by plagiarism detection tool.

1 Loop Condition Practice(25 pts)

A ball falls freely from a certain height. After each landing, it bounces back to 1/4 of its original height, then it falls again. Define a function with two arguments, one is the original height, another one is the number of landing (Set this is a default value with 5). Print how many total distance the ball traveled. Return the meters it bounces after the number of specific landing.

Example:

Input:

OriginalHeight = 100

NumLanding = 2

Output: (Total traveling distance = $100+25+25+6.25=156.25$)

Print: after twice landing, the ball bounces 156.25 meters.

Return: 6.25

2 String Practice (35 Pts)

Define a function to clean text:

1. Convert the string to single words as list.
2. if a token starts with or ends with a punctuation, remove the punctuation, e.g. "world!" to "world", "'hello'" to "hello". However, if there is a punctuation in the middle of word, e.g. It's, we don't remove it. (Hint: you may need to use string.punctuation method by importing string)
3. Replace \n to space
4. Convert all chars to low case.
5. creates a dictionary (Name: Token) containing the count of every unique token, e.g. 'it's':5, 'hello':1,...
6. print the most frequent word and its frequency by string formatting, e.g. "The most frequent word is "the", its frequency is 3".

Hint: You don't need to finish the requirement with the order.

You need to test the function with following string:

String = "" "He has indicated he is prepared to sign the bill. He will also be issuing a national emergency declaration at the same time," McConnell said. "I've indicated to him that I'm going to support the national emergency declaration. So for all of my colleagues, the President will sign the bill. We will be voting on it shortly." ""

Please see the example below:

```
>>> myString = '''
This course is designed for those students have no experience or
limited experience on Python. This course will cover the basis
syntax rules, modules, importing packages (Numpy, pandas), data
visualization, and Intro for machine learning on Python. You will
need to implement what you learn from this course to do a finance
related project. This course aims to get you familiar with Python
language, and can finish a simple project with Python.
'''
```

```
>>> ret = myFun(myString)
The most frequent key is 'this', its frequency is 4.
>>> print(ret)
{'this': 4, 'course': 4, 'is': 1, 'designed': 1, 'for': 2,
'those': 1, 'students': 1, 'have': 1, 'no': 1, 'experience': 2,
'or': 1, 'limited': 1, 'on': 2, 'python': 4, 'will': 2,
'cover': 1, 'the': 1, 'basis': 1, 'syntax': 1, 'rules': 1,
'modules': 1, 'importing': 1, 'packages': 1, 'numpy': 1,
'pandas': 1, 'data': 1, 'visualization': 1, 'and': 2,
'intro': 1, 'machine': 1, 'learning': 1, 'you': 3, 'need': 1,
'to': 3, 'implement': 1, 'what': 1, 'learn': 1, 'from': 1,
'do': 1, 'finance': 1, 'related': 1, 'project': 2, 'aims': 1,
'get': 1, 'familiar': 1, 'with': 2, 'language': 1, 'can': 1,
'finish': 1, 'simple': 1}
```

Hint: You can replace all punctuation with blank space before splitting this string.

3 Find Zero of Function. (40pts)

Definition: Here we define if we could find a x^* , let $f(x^*) = 0$, we say x^* is the zero point of this function.

In this question, we are going to use Euler method to find the zero point of function.

Forward Euler Method: If we have a function $f(x)$, then given an initial condition of w_0 and δ (δ small constant), the forward Euler algorithm is described as

$$w_{n+1} = w_n - \delta \cdot f(w_n) \quad (1)$$

We see that the Forward Euler method is a straight forward application of linear approximation.

How to find this zero point?

Solution: with n increase, we might (or might not, figure out why?) observe $|w_{n+1} - w_n| < \epsilon$, here we define $\epsilon = 0.001$. Thus, we say w_n is converged, and $x^* = w_n$ or $f(x^*) = 0$

3.1 20 pts

Consider the function f

$$f(x) = 2x + 4 \quad (2)$$

1. define a lambda function with $f(x) = 2x + 4$
2. define a function to find the zero point of $f(x)$. Be careful that in this function, your parameters with this function need to at least contain lambda function $f(x)$, initial value of x_0 , constant δ , and ϵ .

Hint: The stop condition of this function should be $|w_{n+1} - w_n| < \epsilon$.

3. Test your function with $x_0 = -5$ and $x_0 = 0$

3.2 20 pts

Consider another function g :

$$g(x) = x \cdot \sin(x) - 1 \quad (3)$$

1. Use the function you define in question 3.1, try to find the zero point of $g(x)$, with $x \in [-4; 4]$.
2. Plot this function $g(x)$ in google, and see how many zero point you can find in $x \in [-4; 4]$. Think about why you cannot get all zero points with Euler method.
3. Modify your Euler method, and try other zero point in $g(x)$, with $x \in [-4; 4]$.