Summer Projects & Workshop 2017

Python - Assignment 2

May 2017

Functions

1. Write a function `filter_long_words()` that takes a list of words and an integer `n` and returns the list of words that are longer than `n`. (Solve the problem with and without using `filter()` function)

2. Write a function `add_time(t1, t2)` which takes as input two tuples (representing time) `t1 = (hour1, min1, sec1)` and `t2 = (hour2, min2, sec2)` and returns the tuple with value equal to the sum of `t1` and `t2`. The sum returned by your function should have values between 0 to 59 for minutes and seconds.

3. Write a function `pig_latin()` that takes in a single word, then converts the word to Pig Latin. To review, Pig Latin takes the first letter of a word, puts it at the end, and appends "ay". The only exception is if the first letter is a vowel, in which case we keep it as it is and append "hay" to the end.

4. Write a function `find_longest_word(lst)` that takes a list of words `lst` as input and returns the index of the longest word in the list (i.e. position of the longest word in the list).

5. Given a dictionary consisting of words from a document as keys and the frequency of the words in the document as values, write a function which takes as parameters this dictionary and a number `n`, and returns a list of top `n` most frequent words in the dictionary.

   For example, let `D = {'a':32, 'the':12, 'an':5}` and `func(dict,n)` be the function. Then `func(D,2)` should return `['a', 'the']`.

Higher-order Functions and List Comprehension

1. Using the higher order function `reduce()`, write a function `max_in_list()` that takes a list of numbers and returns the largest number.

2. Using higher order function `filter()`, define a function `filter_long_words()` that takes a list of words and an integer `n` and returns the list of words that are longer than `n`.

3. Using the higher order functions `map()`, `reduce()` and `filter()`, write a program to find the sum of squares of all even numbers in the range 0 to n.

4. Given a matrix (a list of lists) consisting of numbers. Using list comprehension write a python program to compute the trace of the matrix. Recall that the trace of the matrix is the sum of its diagonal elements.

5. Write a list comprehension which finds integral solutions of the equation $y = x^2 + 1$. Your solution should print out a list of (x, y) tuples; use the domain $x \in [-5, 5]$ and the range $y \in [0, 10]$.

6. Write a program using list comprehension which takes 2 numbers - m, n as input and generates a 2-dimensional array. The value of the element at i^{th} row and j^{th} column of the array should be $i * j$.

7. Using list comprehension write a program to find all Pythagorean triples in the range 0 to 50. Recall that the Pythagorean triplets are the numbers `(a,b,c)` such that $a^2 + b^2 = c^2$.

8. Write a python program to multiply two matrices using list comprehension. The matrices are input as list of lists. Your program should check that the dimensions of the matrices are compatible to allow matrix multiplication, if not it should print an error message.

File Management and Exception Handling

1. Using your code from last assignment to check if a string is a palindrome, write a program that accepts a file name from the user, reads each line, and prints the line to the screen if it is a palindrome. Use exception handling to handle IO errors like 'file not found' or 'invalid file'.

2. You are given a string `password`. Using the exception handling constructs, write a program which asks user to enter a password, terminate if the user enters the correct password, otherwise ask the user to reenter the password. Your program should terminate with an error message after three unsuccessful attempts.

3. You are given a text file containing English sentences.

   - Write a program that reads this text file and computes the frequency of length of words (i.e. how many one-letter words are there in the file, how many two-letter words, three-letter words, and so on. Save the result in an output file with format - {word length}, { frequency}.
   - Extend your program to calculates the average word length of the text in file (i.e the sum of all the lengths of the words in the text, divided by the number of words) and print the average word length.

4. In a document, a *'hapax legomenon'* is a word which occurs only once throughout the document. Write a function that takes the file name of a text and returns all its hapaxes. Ignores all capitalization in the document.

5. Substitution Cipher is a method of encoding text by which units of plaintext are replaced with ciphertext. Consider for example:

   Plaintext alphabet: abcdefghijklmnopqrstuvwxyz
   Ciphertext alphabet: zebrascdfghijklmnopqtuvwxy

   Let the text message be: 'flee at once. we are discovered!'
   Then in substitution cipher, every occurrence of 'a' is replaced with 'z', every occurrence of 'b' is replaced with 'e', and so on.
   Above message will encipher to: 'siaa zq lkba. va zoa rfpbluaoar!'.

   Now, you are given a text file and a cipher text for alphabets (ignore capitalization), write a program that enciphers the given text file and write the enciphered text to another file.