

CHAPMAN University
 Department of Computational and Data Sciences
 CS501 Introductory Computation for Scientists
 Fall 2019
 Homework#4

Date Given: Sep 11, 2019

Due Date: Sep 17, 2019

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There are 4 problems in this homework assignment. Write a program in Python to solve these problems.

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Book: Learning Scientific Programming with Python: By: Christian Hill
 Publisher: Cambridge University Press

Chapter 2: Page82-83

- Problem# 2.7.1
- Problem# 2.7.2
- Problem# 2.7.3
- Problem# 2.7.4

P2.7.1 The word game Scrabble is played on a 15×15 grid of squares referred to by a row index letter (A – O) and a column index number (1 – 15). Write a function to determine whether a word will fit in the grid, given the position of its first letter as a string (e.g., 'G7') a variable indicating whether the word is placed to read *across* or *down* the grid and the word itself.

P2.7.2 Write a program to find the smallest positive integer, n , whose factorial is *not* divisible by the sum of its digits. For example, 6 is not such a number because $6! = 720$ and $7 + 2 + 0 = 9$ divides 720.

P2.7.3 Write two functions which, given two lists of length 3 representing three-dimensional vectors \mathbf{a} and \mathbf{b} , calculate the dot product, $\mathbf{a} \cdot \mathbf{b}$ and the vector (cross) product, $\mathbf{a} \times \mathbf{b}$.

Write two more functions to return the scalar triple product, $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$ and the vector triple product, $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$.

P2.7.4 A right regular pyramid with height h and a base consisting of a regular n -sided polygon of side length s has a volume, $V = \frac{1}{3}Ah$ and total surface area, $S = A + \frac{1}{2}nsl$ where A is the base area and l the slant height, which may be calculated from the *apothem* of the base polygon, $a = \frac{1}{2}s \cot \frac{\pi}{n}$ as $A = \frac{1}{2}nsa$ and $l = \sqrt{h^2 + a^2}$.

Use these formulas to define a function, `pyramid_AV`, returning V and S when passed values for n , s and h .

P2.7.1

The goal is to write the 'word_fits' function. Test your function with the following data.

```
In [20]: def test(word, position, across):
        across_down = 'across' if across else 'down'
        mod = 'not' if not word_fits(word, position, across) else ''
        return "{}" "{} at {} does {} fit".format(word, across_down, position, mod)

In [21]: test('CHAPMAN', 'B13', across=True)

Out[21]: "CHAPMAN" across at B13 does not fit'

In [22]: test('DATASCIENCE', 'D6', across=False)

Out[22]: "DATASCIENCE" down at D6 does fit'
```

P2.7.2

Answer = 432

Sum of digits = $4+3+2 = 9$

Remainder of $(\text{Factorial}(432)/9) \neq 0$

P2.7.3

Test your function with the following data.

```
In [12]: a, b, c = [1, -2, 1], [2, -0.5, -1], [0.5, 1, -1.5]

        print('a . b =', dot(a, b))
        print('a x b =', cross(a, b))
        print('a . (b x c) =', scalar3(a, b, c))
        print('a x (b x c) =', vector3(a, b, c))

a . b = 2.0
a x b = [2.5, 3, 3.5]
a . (b x c) = -1.0
a x (b x c) = [-7.0, -0.5, 6.0]
```

P2.7.4

Test your function with the following data.

```
In [18]: n = 5
        s = 36.5
        h = 12

        volume, area = pyramid_AV(n, s, h)
        print("Volume = ", volume)
        print("Area = ", area)

Volume = 9168.424067738606
Area = 4832.337304213042
```