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**CMP 321 - Programming languages Laboratory**

**Lab 3 – Python Data Structures**

**Objectives:**

* Understand and practice with Python functions, lists, tuples, and dictionaries.

**Please explore and make use of Python features as much as possible. Code that does not follow this note will be penalized.**

**Exercise 1**

1. Arrays in Python are lists and so matrices can be represented using nested lists, e.g.

Matrix A = [ [1,  2,  3,  4],

    [5,  6,  7,  8],

    [9, 10, 11, 12] ]

Write a function that takes 2 matrices (of MxN and NxP sizes) and returns the product. Your function should check that matrix sizes are compatible for multiplication. Test your code with the following matrices.

A = [ [1,3,5] , [2,4,6] ] B = [ [10,3] , [6,7] , [4,9] ]

**Exercise 2**

1. Write a script that defines a list of (5 or more) 3D points, where the coordinates of each point are stored in a tuple. The script should then:

* Remove the last point
* Insert a new point before the last one in the list (do not assume the length is known)
* Print the points in the following format (where all columns are right-aligned):

|  |  |  |
| --- | --- | --- |
| X | Y | Z |
| 10 | 8 | 12 |
| 111 | 64 | 45 |
| … | … | … |

**Exercise 3**

Write a script that defines a string containing the following text:

The best programs are written so that computing machines can perform them quickly and so that human beings can understand them clearly. A programmer is ideally an essayist who works with traditional aesthetic and literary forms as well as mathematical concepts, to communicate the way that an algorithm works and to convince a reader that the results will be correct...

The script uses a dictionary to count letter frequencies, where the key is a letter and the value is the number of times it appears. Your script will have to traverse the text character by character to update the dictionary appropriately. Once done it should print the letter frequencies.

**Exercise 4**

Computer users’ information ID’s, user names, surnames, and roles are recorded as a list of strings, as follows:

                serverInfo = ( "id=0;role=admin;username=joe;surname=naysmith",

                         "surname=suffi;username=sam;role=guest;id=421",

                        "id=33;surname=lee;username=mia;role=staff"  )

A “user database” is a dictionary of computer user records: the key will be an ID and the value another (nested) dictionary, which comprises the key/value pairs of the user’s info. Write a function that takes server info as input and returns the corresponding “database”, as per the example below. Hint: Use string functions such as split/partition/join, etc. as needed.

                db = { 0 : { 'username': "joe", 'surname': "naysmith", 'role': "admin" },

          33 : { 'username': "mia", 'surname': "lee", 'role': "staff" },

          421 : { 'username': "sam", 'surname': "suffi", 'role': "guest" } }

Perform a “database query” that retrieves and print all user names and surnames (all capitalized) as well as their roles:

            Naysmith, Joe - admin

Lee, Mia - staff

Suffi, Sam - guest

Repeat the above “query” but this time users should be printed in ascending order of ID.