

Computational Management Science 1

Final

registration number:
(Do not write your name on the test - just the 7 digit student id number.)

1. (6 points) Writing Code

(a) (3 points, ≤5 minutes) Functions

Write a function `sumproduct(first_iterable, second_iterable)` in Python that takes a two sequences of numbers with equal length and returns the sum of the product of the numbers. [e.g. `sumproduct((1, 3, 4), (9, 2, 3)) ⇒ 27`;
`sumproduct([3, 5], [2, 4]) ⇒ 26`]. Add a proper docstring to receive full points.

(b) (3 points, ≤5 minutes) Classes and data structures

Implement a simple data structure in Python. The data structure must be capable of storing a node of a doubly linked list (i.e. a data field and a link to a potential predecessor as well as a potential successor). Write a **minimalistic** class (`__init__(.)`). You don't need to implement any functionality, just a class that stores the required data. Don't forget to write docstrings in order to receive full points.

2. (6 points, ≤ 10 minutes) Correct Mistakes

The following code contains 6 syntax errors/ typos. Clearly mark and correct the mistakes. (hint: you don't need to understand what the function does to correct the mistakes as there are no logical errors; assume that all required classes are available \rightarrow just look for syntax errors)

```
def __objective_function(index, p: Problem, milp**,
                        x_ns, y_sm, **kwargs)
    """The objective function."""
    milp += (lpSum(x_ns[n][] * s.unit_costs[n]
                  for n in p. fulfillment_centers
                  for s in p.sortation_centers) +
            lpSum(y_sm[s][m] * s.shipping_costs[m]
                  for s in p.sortation_centers
                  for m element p.customers),
            '{}) objective function'.format(index))
```

3. (9 points, ≤ 10 minutes) 3rd Party Libraries

(a) (3 points)

What is the purpose of pandas? What are its two central classes?

(b) Name (in total) two advantages and / or disadvantages of pandas over common spreadsheet programs or other professional data analysis tools (2p).

(c) Name (in total) two advantages and / or disadvantages of PuLP over other modeling languages (2p).

(d) Finally, name one thing you like about this course and one thing that should be improved in the future (be honest!) (2p).

4. (12 points, ≤10 minutes) Reading and Understanding Code

What is the output of the following code snippets? Write exactly what the output of each snippet is if the snippet is the sole content of a Python file. If the output is an error message, it is enough to write "ERROR". If there is no output, write "-"

(a) Simple calculation

```
print(5 ** 2 * 2)
```

(b) Loop

```
prices = (4.2, 5.8, 2.9)
total = 0.0
for price in prices:
    total += price
print("Total:", total)
```

(c) Function

```
import math
c1 = 3
c2 = 4
def perimeter_right_triangle(c1, c2):
    print('calculating the perimeter')
    return c1 + c2 + math.hypot(c1, c2)
perimeter_right_triangle(c1, c2)
```

(d) List

```
l = [5, 3, 2]
l.append(1)
print(sum(l))
```

(e) Numpy

```
import numpy as np
m = np.arange(4).reshape(2,2)
print(m[0,1])
```

(f) Lists

```
l = [2, 4, 3]
print(l.average())
```

5. (6 points, ≤5 minutes) Various

(a) (2 points)

Describe at least two debugging strategies or tools.

(b) (2 points)

Name at least one advantage and one disadvantage of Python?

(c) (2 points)

Name the two most popular Python web frameworks?

6. (6 points, ≤5 minutes) Writing Files

Write a Python function `write_matrix(filename, matrix)` => None that takes a filename string and a list of lists (matrix) of numbers. The function should write the contents of the matrix to a file with the given name. Any representation of the data is ok that as long as it allows to read the data back in from the file (but you don't need to implement the reading function, just the writing function). Don't forget to document the function in order to receive full points.

7. (3 points) Version Control

Name at least one (distributed) version control system. What are key benefits of such a system (list at least two)?