Practices in visual computing 1

Lab1: Python Basics

Simon Fraser University
Fall 2024

Subjects

1. Intro and Logistics
2. Basic Python
3. Intermediate Python
4. Basic Numpy

TAs

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Assignments

1. Classical image processing (16 Sep)
2. Image segmentation (7 Oct)
3. Object detection (15 Oct)
4. 3D computer vision (4 Nov)

The assignment release dates may be subject to change.

Tips for the course

- Preferably, use VSCode (or other IDEs) for projects and Notebooks for snippets
- Use conda to manage environments and packages
- Avoid using ChatGPT for assignments. But definitely use it as a learning tool!
- You may be asked to write code snippets during project demos
- Avoid loops whenever possible
- Stick to Python best practices:
  - Proper namings, PEP8, Docstrings, etc
  - Try to seek optimal yet clean and easy-to-understand solutions

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Question #1

String Reversal

❖ Write a Python function that takes a string as input and returns the string reversed.

❖ Follow-up: How can you do this without using slicing?

Question #2

Fibonacci Sequence

❖ Write a Python function that returns the nth Fibonacci number.

❖ Follow-up: How can you optimize this function to avoid recalculating previously computed Fibonacci numbers?

Question #3

Palindrome Check

❖ Write a function that checks whether a given string is a palindrome (reads the same forwards and backwards).

❖ Follow-up: How would you modify this function to ignore spaces and capitalization?

Question #4

Sum of Two Numbers

❖   Given a list of numbers and a target number, write a function that finds two numbers in the list that add up to the target number. If no such pair exists, return None.

❖   Follow-up: What's the time complexity of your solution? Can you improve it?

Question #5

Prime Number Check

❖ Write a Python function to check whether a given number is prime.

❖ Follow-up: Can you optimize your solution to make it more efficient for large numbers?

Question #6

Calculating Weighted Sums

❖ Write a Python function to calculate the weighted sum of two lists (weights and values), using random.uniform(0, 1) for lists with 1 million elements.

❖ Follow-up: Redo the calculation using list comprehension and experiment with different random seeds to observe the effect on the results.

Question #7

Merge Sorted Lists

❖ Write a Python function that merges two sorted lists into one sorted list.

❖ Follow-up: What is the time complexity of this function?

Question #8

Anagram Detection

❖ Write a Python function that checks if two strings are anagrams (i.e., contain the same characters in a different order).

❖ Follow-up: How would you account for case sensitivity and spaces?

Question #9

Longest Substring Without Repeating Characters

❖   Write a Python function that finds the length of the longest substring in a given string that does not contain repeating characters.

❖   Follow-up: What is the time complexity of your solution? How can it be improved?

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Question #10

Dictionaries

❖ You are given a dictionary with student IDs as keys and their assignment grades (e.g., "a1": 95) as values. Write a function that calculates the average grade for each student and adds it to their dictionary as "avg".

Question #11

CSV and JSON

❖ For the previous question, construct the input dictionary from a .csv file.

    ➢ Example format: std_id, a1, a2, a3, a4

❖ After calculating the averages, write them into a new .csv file.

    ➢ Output format: std_id, a1, a2, a3, a4, avg

Question #12

Create a class Student that gets std_id, name, age, gender, and major as constructor.

It should also create a list of dictionaries, called courses.

A method add_course will receive a course_name: grade key-value pair and will append it to the courses list.

A method get_gpa will return the student's GPA by calculating the average for all courses.

A method export_info will create a .txt file containing human-readable information about the student.

◎ Advanced tip: Use __str__ for custom string representation of the class.

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Question #13

Matrix Multiplication

Create the following two ndarrays

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{pmatrix} \qquad B = \begin{pmatrix} 1 & 1 \\ 2 & 2 \\ 3 & 3 \end{pmatrix}$$

And calculate the following:

$$AB \qquad BA$$

Question #14

Slicing

First create a random 10x10 matrix, then using array slicing, change it to the following format:

$$
\begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & x & x & x & x & x & x & 0 & 0 \\
0 & 0 & x & x & x & x & x & x & 0 & 0 \\
0 & 0 & x & x & x & x & x & x & 0 & 0 \\
0 & 0 & x & x & x & x & x & x & 0 & 0 \\
0 & 0 & x & x & x & x & x & x & 0 & 0 \\
0 & 0 & x & x & x & x & x & x & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
$$

Question #15

Calculating Weighted Sums with Numpy

Redo the question six, this time using Numpy arrays. Use time module to compare the speedup between list and ndarrays.