Laboratory 8

Topics

1. Reading and writing files
2. Data processing
3. Data structures and containers

Discussion

A. What is the difference between a tuple and a list?

Exercises

8.1 Computer graphics. In computer graphics, triangles are used to draw 3D models on screen. A triangle is composed of 3 vertices (points), each with a point “A”, “B” and “C”. One common way to provide triangles to the GPU is to have a list of vertices and a list of indices, where each index “points” to the corresponding vertex. 3 consecutive indices represent a triangle.
In this exercise you have 2 files: one with the vertices (“vertices.csv”) and one with the indices (“indices.txt”). Reproducing the work of a GPU, from both the lists reconstruct the corresponding triangles and write them to a file called “output.txt”. In “vertices.csv”, each line represents a vertex in a 2D space. In “indices.txt”, each line represents the indices of the vertices forming a triangle.

[PEER REVIEW EXERCISE]
8.2 Computer graphics 2. Another common way to represent the list of indices, in 3D graphics, is to perform a “sliding window” idea: once the first 3 indices are set, you can build the following vertices starting from the last 2 vertices read.
Build a tool that converts the previous format to the new one, writing it into a new file “indices_strips.txt” in one line. Assume that you can find the 2 vertices in common in the next line of the “indices.txt” file. As it may not always be possible to convert the format, in case it is not possible print an error.

8.3 Sparse vectors. A sparse vector is a sequence of numbers, most of which are 0s. A dictionary is an efficient structure to memorize a sparse vector; in such a dictionary, keys are positions in which there are only values different from zero and each value is the number itself. For instance, the sequence 0 0 0 0 0 4 0 0 0 2 9 can be represented by the dictionary {5:4, 9:2, 10:9}.
Write a function, sparse_array_sum(a, b), whose arguments are two sparse arrays represented as dictionaries, a and b. Without modifying the parameters, the function shall return their sum vector as a sparse vector, where each value in the i_{th} position is the sum of the values of a and b in each position i. [P8.22]

8.4 Sieve of Eratosthenes. The Sieve of Eratosthenes is an iterative algorithm, well known in Ancient Greece, computing all prime numbers before an integer number n. In each iteration, it deletes all values multiple of the lowest value present in the set, starting from 2 up to $\sqrt{n}$. After the last iteration, only prime numbers remain. Implement a function using the Sieve of Eratosthenes. First, insert all numbers from 2 to n. Then, eliminate all multiples of 2, except for 2 (as is: 4, 6, 8, 10, 12, and so on, up to n). As a second step, eliminate all multiples of 3, except for 3 (as is, 6, 9, 12, 15, and so on, up to n). Go on until only prime numbers remain. [P8.4]