

Final

October 8, 2021

Abstract

This final is to be accomplished by your individual work. Due to the high improbability of identical solutions, students turning in identical solutions will be suspected of violating academic integrity.

This exam has two parts: One is like a homework, worth 200 points, the other is questioning your understanding of important concepts treated by the course.

1 Programming Problem

The context of this problem is working with a three-dimensional space.

1.1 Data

There is a three-dimensional space. Thus locations within the space are of the form (x,y,z) . The space has distinct points, that is, it is a lattice. The distinct points are identified by integers. Thus, an example location in the space is $(0,2,1)$. At each location, also called a point, is a value. The value is taken from the set of real numbers, thus a computer approximation, such as float or double is appropriate.

1.2 Configuration

The shape of the space is cubical, so, the largest x coordinate and the largest y coordinate and the largest z coordinate are the same. Moreover, this number is an odd integer, such as three.

The space, and the values found at its points is provided in a file. The code must be able to work with a file containing different values as well. Do not use values you found in the provided sample file as defined constants in your code.

1.3 Calculations

It is possible to imagine lines in this space. These lines can be characterized by the amount of change the line undergoes in the y and z coordinates when the x

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coordinate is changed by 1. Thus a line whose changes are $\frac{\Delta y}{\Delta x} = 1$ and $\frac{\Delta z}{\Delta x} = 1$, and which intercepts the point (0,0,0) is well specified.

Consider a space of size $k \times k \times k$. It is possible to determine the entire set of lines that intercept the point (0,0,0) and also intercept a total of k points in the lattice.

It is possible to add up the values from each of the points intercepted by such a line. It is possible to determine that subset of such lines that accumulate the maximum value. It is possible to print that subset of lines onto the console.

1.4 Product

Show your work, including the artifacts from the process steps we studied in class.

1. Likely nouns for the sequence diagram
2. Sequence diagram
3. Function prototypes/stubs
4. Test cases (these are found within tests)
5. Evidence (screenshots) that you tested the stub and the test was able to detect that the implementation was inadequate.
6. Evidence (screenshots) that you tested the completed implementation of a function, and the test declared a pass.
7. Evidence of the programming running to completion (having printed specification of the line or lines in the console) with exit code 0, using the provided file.

2 Conceptual Questions

1. Why are sequence diagrams important and useful?
2. How is it that using test-driven development is better than using the debugger?
3. How is it that thinking about test cases helps with the implementation of the function being tested?
4. What is the purpose of using divide and conquer at the level of a function?
5. What does “traversing levels of abstraction” mean? Give an example.