

Assignment 3

CS329e - Elements of Software Design
Solid Geometry
(100 points)

Due Date on Canvas and Gradescope

1 Description

This assignment is on object oriented programming. You will be developing several classes that are fundamental in Solid Geometry - Point, Sphere, Cube, and Cylinder. In `main()` you will test the various functions that you have written for the classes.

The file (**Geometry.py**) that you will be submitting will have the following structure. You will follow the standard coding conventions in Python¹.

You can find a template for your implementation in file **Geometry.py**.

You may not change the names of the functions listed in file Geometry.py. They must have the functionality as given in the specifications. You can always add more functions than those listed.

Note that in this program you will be checking for the equality of two floating point numbers. Since there is a finite precision in the representation of floating point numbers, it is not always possible to determine exact equality. A working solution is to determine equality is to take the difference of the floating point numbers and see if the difference is less than a pre-determined tolerance. This tolerance is arbitrary and is often dictated by the problem that you are trying to solve. Here is a function that tests for equality of two floating point numbers.

```
1 def is_equal (a, b):
2     tol = 1.0e-6
3     return (abs (x - y) < tol)
```

Input:

You will be reading your input from standard input in the following format [geometry.in](#). You can find the file [geometry.in](#) on Canvas.

The content of the input file will be the following

```
1 -3.0 2.0 1.0           # coordinates of p
2 2.0 -1.0 3.0           # coordinates of q
3 2.0 1.0 3.0 4.0        # center and radius of sphereA
4 -1.0 -2.0 -3.0 5.0     # center and radius of sphereB
5 2.0 1.0 -3.0 4.0       # center and side of cubeA
6 3.0 2.0 -4.0 3.0       # center and side of cubeB
7 -2.0 1.0 -3.0 5.0 4.0  # center, radius, and height of cylA
8 1.0 5.0 3.0 4.0 2.0    # center, radius, and height of cylB
```

¹PEP 8 Style Guide for Python Code <https://www.python.org/dev/peps/pep-0008/>

Mac: python3 Geometry.py < geometry.in
Windows: python Geometry.py < geometry.in

Output:

You will print your output to standard out in the following format **geometry.out**:

```
1 Point p (is / is not) inside sphereA
2 sphereB (is / is not) inside sphereA
3 cubeA (is / is not) inside sphereA
4 cylA (is / is not) inside sphereA
5 sphereA (does / does not) intersect sphereB
6 cubeB (does / does not) intersect sphereB
7 Volume of the largest Cube that is circumscribed by sphereA (is / is not) greater
  than the volume of cylA
8
9 Point p (is / is not ) inside cubeA
10 sphereA (is / is not) inside cubeA
11 cubeB (is / is not) inside cubeA
12 cylA (is / is not) inside cubeA
13 cubeA (does / does not) intersect cubeB
14 Intersection volume of cubeA and cubeB (is / is not) greater than the volume of
  sphereA
15 Surface area of the largest Sphere object inscribed by cubeA (is / is not) greater
  than the surface area of cylA
16
17 Point p (is / is not) inside cylA
18 sphereA (is / is not) inside cylA
19 cubeA (is / is not) inside cylA
20 cylB (is / is not) inside cylA
21 cylB (does / does not) intersect cylA
22
```

You may not change the names of the functions listed. They must have the functionality as given in the specifications. You can always add more functions than those listed.

For this assignment you may work with a partner. Both of you must read the paper on Pair Programming² and abide by the ground rules as stated in that paper. If you are working with a partner then only one of you will be submitting the code. But make sure that your partner's name and UT EID is in the header. If you are working alone then remove the partner's name and eid from the header.

1.1 Turnin

Turn in your assignment on time on Gradescope system on Canvas. For the due date of the assignments, please see the Gradescope and Canvas systems.

1.2 Academic Misconduct Regarding Programming

In a programming class like our class, there is sometimes a very fine line between "cheating" and acceptable and beneficial interaction between students (In different assignment groups). Thus, it is very important that you fully understand what is and what is not allowed in terms of collaboration with your classmates. We want to be 100% precise, so that there can be no confusion.

²Read this paper about Pair Programming <https://collaboration.csc.ncsu.edu/laurie/Papers/Kindergarten.PDF>

The rule on collaboration and communication with your classmates is very simple: you cannot transmit or receive code from or to anyone in the class in any way – visually (by showing someone your code), electronically (by emailing, posting, or otherwise sending someone your code), verbally (by reading code to someone) or in any other way we have not yet imagined. Any other collaboration is acceptable.

The rule on collaboration and communication with people who are not your classmates (or your TAs or instructor) is also very simple: it is not allowed in any way, period. This disallows (for example) posting any questions of any nature to programming forums such as **StackOverflow**. As far as going to the web and using Google, we will apply the **"two line rule"**. Go to any web page you like and do any search that you like. But you cannot take more than two lines of code from an external resource and actually include it in your assignment in any form. Note that changing variable names or otherwise transforming or obfuscating code you found on the web does not render the "two line rule" inapplicable. It is still a violation to obtain more than two lines of code from an external resource and turn it in, whatever you do to those two lines after you first obtain them.

Furthermore, you should cite your sources. Add a comment to your code that includes the URL(s) that you consulted when constructing your solution. This turns out to be very helpful when you're looking at something you wrote a while ago and you need to remind yourself what you were thinking.

We will use the following Code plagiarism Detection Software to automatically detect plagiarism.

- **Stanford MOSS**

<https://theory.stanford.edu/~aiken/moss/>

- **Jplag - Detecting Software Plagiarism**

<https://github.com/jplag/jplag> and <https://jplag.ipd.kit.edu/>