

CSci 1113: Introduction to C/C++
Programming for Scientists and Engineers
Homework 9
Spring 2020

Due Date: Friday, May 1, 2020 before 11:55pm.

Instructions: This is an individual homework assignment. There are two problem worth 20 points each. Solve the problem below by yourself (unlike the labs, where you work collaboratively), and submit the solution as a C++ source code file. Here are a few more important details:

1. Unlike the computer lab exercises, this **is not** a collaborative assignment. You must design, implement, and test the solution to each problem on your own without the assistance of anyone other than the course instructor or TAs. In addition, you may not include solutions or portions of solutions obtained from any source other than those provided in class: examples from the textbook, lectures, or code you and your partner write to solve lab problems. Otherwise obtaining or providing solutions to any homework problems for this class is considered academic misconduct. See the “collaboration rules” file on the class website page for more details, and ask the instructor if you have questions.
2. Because all homework assignments are submitted and tested electronically, the following are important:
 - You follow the naming conventions mentioned at the end of the problems.
 - You submit the correct file(s) on gradescope (<https://www.gradescope.com/>) by the due deadline.
 - You follow the example input and output formats exactly given in each problem description.
 - **Regardless of how or where you develop your solutions, your programs compile and execute on gradescope computers (which run Linux/Ubuntu operating system like the cselabs machines).**
3. The problem descriptions will usually show at least one test case and the resulting correct output. However, you should test your program on other test cases (that you make up) as well. Making up good test cases is a valuable programming skill, and is part of ensuring your code solution is correct.

Problem A: Shapes (20 points)

Just like last time, I am providing a main() function that you have to work with (what fun!):
<http://www-users.cselabs.umn.edu/classes/Spring-2020/csci1113/assignments/part9A.cpp>

Make the “shape” class to work with the main to compute the area and perimeter of each of the four shapes (the math is done for you already). You should be able to add as many shapes as you want, then display the area and perimeter of each (in the order they were entered).

You cannot modify main.

Example 1 (user input is underlined):

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or

(q)uit?

c

What is the radius of the circle?

2

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

t

What are the lengths of the triangle sides?

4 5 6

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

h

What is the side length of the regular hexagon?

2

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

r

What are the width and height of the rectangle?

4 5

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

q

Shape 1:

Area: 12.5664

Perimeter: 12.5664

Shape 2:

Area: 9.92157

Perimeter: 15

Shape 3:

Area: 10.3923

Perimeter: 12

Shape 4:

Area: 20

Perimeter: 18

Totals:

Area: 52.8802

Perimeter: 57.5664

When you are done, name the source code file hw9A.cpp. Then log into gradescope and upload your file for the “Homework 9A” submission. **If you name your file incorrectly it will be unable to compile and run your code, so you will fail all test cases.** You may submit cpp files as many times as you want until the deadline to try and fix the code if you fail a test case. Following rigorous naming conventions and using test cases are something computer programmers often must do in “real life” programming , and so submitting your program with the correct name and functionality is part of doing this assignment correctly.

Problem B: Classes... classes everywhere (20 points)

Yet again, I give you a main()... but this time it is slightly different. Achieve the same results as part A. (See the example above.)

<http://www-users.cselabs.umn.edu/classes/Spring-2020/csci1113/assignments/part9B.cpp>

You cannot modify main.

Hint: you will have to use inheritance.

When you are done, name the source code file hw9B.cpp. Then log into gradescope and upload your file for the “Homework 9B” submission. **If you name your file incorrectly it will be unable to compile and run your code, so you will fail all test cases.** You may submit cpp files as many times as you want until the deadline to try and fix the code if you fail a test case. Following rigorous naming conventions and using test cases are something computer programmers often must do in “real life” programming, and so submitting your program with the correct name and functionality is part of doing this assignment correctly.

Problem C: ASCII Art (5 points extra credit)

Once again use this main() (which you cannot modify):

<http://www-users.cselabs.umn.edu/classes/Spring-2020/csci1113/assignments/part9C.cpp>

This is basically the same as part B, except in the loop that displays the information after you hit ‘q’. Now this line:

```
cout << "Shape " << i+1 << ":\n" << *list[i] << endl;
```

... should display a visualization of the shape (of the appropriate size assuming each character is 1 unit).

The area and perimeter are displaying using two new functions (if you didn’t make them before):

```
cout << "Area: " << list[i]->getArea() << endl;
cout << "Perimeter: " << list[i]->getPerimeter() << endl;
```

Some notes on the visualizations.

- All shapes: You need exactly one blank line between the end of your shape and the area (from the endl after *list[i]). You can assume all double to integer conversions are truncations (i.e. $\text{double } x = 7.6; \text{int } y = x;$), as you cannot display half a character. We will be somewhat lenient on the format, but the degree depends on the shape in quest.
- Circle: The general radius needs to be correct, but we will not be picky on specifically where you put the periods. (You do need to use periods...)
- Triangle: This is probably the hardest to display. The largest side should be at the top (the “width” or “base” of the triangle). The height of the triangle also needs to be correct (based on what is input). We will be quite lenient on the other aspects (if you want to assume it is a right triangle, that should be fine... but it still needs to have the correct height input numbers).
- Hexagon: This you should be able to get exactly. (You can highlight the text to see where spaces are exactly if it is unclear in the example.)
- Rectangle: Also needs to be shown exactly. You can assume the first number entered is the width and the second is the height. Be sure you follow the usage of ‘_’ and ‘|’ exactly as shown.

Example 1 (user input is underlined):

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or

(q)uit?

c

What is the radius of the circle?

9

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

t

What are the lengths of the triangle sides?

5

6

7

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

h

What is the side length of the regular hexagon?

5

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

r

What are the width and height of the rectangle?

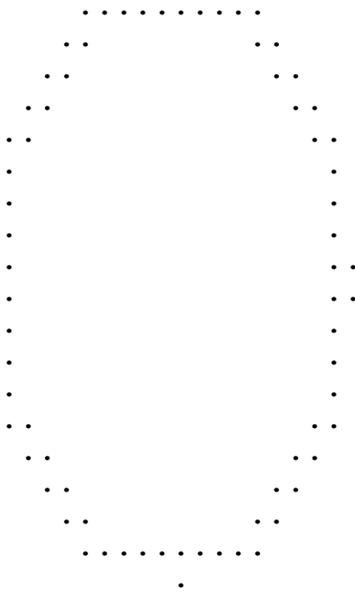
6

7

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

q

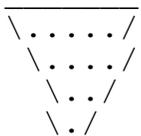
Shape 1:



Area: 254.469

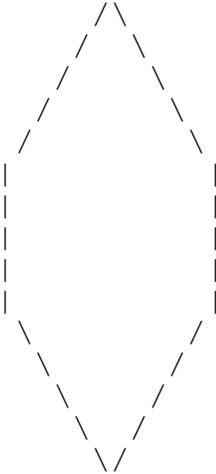
Perimeter: 56.5487

Shape 2:



Area: 14.6969

Perimeter: 18
Shape 3:



Area: 64.9519
Perimeter: 30
Shape 4:



Area: 42
Perimeter: 26
Totals:
Area: 376.118
Perimeter: 130.549

Example 2 (user input is underlined):

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

c

What is the radius of the circle?

5

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

t

What are the lengths of the triangle sides?

9 3 7

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

h

What is the side length of the regular hexagon?

2

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

r

What are the width and height of the rectangle?

3_3

Do you want to add a (c)ircle, (t)riangle, (h)exagon, (r)ectangle or (q)uit?

q

Shape 1:

```
.....
.      .
.      .
.      .
.      .
.      .
.      .
.      .
.....
.
```

Area: 78.5398

Perimeter: 31.4159

Shape 2:

```
-----
\...../
```

Area: 8.78564

Perimeter: 19

Shape 3:

```
  / \
 /   \
|     |
|     |
 \   /
  \ /
```

Area: 10.3923

Perimeter: 12

Shape 4:

```
-----
| |
| |
|_|
```

Area: 9

Perimeter: 12

Totals:

Area: 106.718

Perimeter: 74.4159

When you are done, name the source code file hw9C.cpp. Then log into gradescope and upload your file for the “Homework 9C” submission. **If you name your file incorrectly it will be unable to compile and run your code, so you will fail all test cases.** You may submit cpp files as many times as you want until the deadline to try and fix the code if you fail a test case. Following rigorous naming conventions and using test cases are something computer programmers often must do in “real life” programming, and so submitting your program with the correct name and functionality is part of doing this assignment correctly.