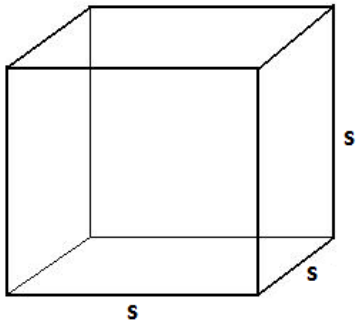
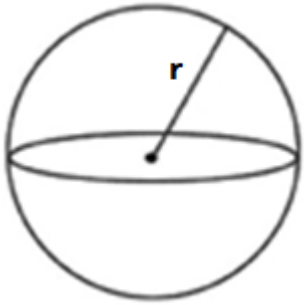
CSCI 1470 **Fall 2024** **Mr. Gustavo Dietrich**

Lab 7: Value-returning functions **Due:** 10/2/24

Problem: Suppose your geometry professor asks you to create a program that calculates the surface areas of a cube and a sphere.
In order to find these two values, your program needs to get the side of the cube and the radius of the sphere first and then, using them, calculate the corresponding areas using the formulas shown below.





Surface area of cube: $6 \times s^2$ **Surface area of sphere:** $4 \times \pi \times r^2$

The values corresponding to **s** (side of the cube), **r** (radius of the sphere), and the calculated areas must be **double precision real** numbers.

Your task: implement in C++ the algorithm solution shown below.

Algorithm solution (in pseudocode):

To solve this problem your program must perform the following tasks:

Declare a global constant variable named PI above main() that holds value 3.141592

Declare variables named side, radius, s_cube, and s_sphere that hold double precision real numbers
Prompt the user to "Enter side of cube : "
Read from keyboard the value entered by the user and assign it to side
Prompt the user to "Enter radius of sphere : "
Read from keyboard the value entered by the user and assign it to radius
Call cube_surf() to calculate the surface area of the cube and assign the result to s_cube
Call sphere_surf() to calculate the surface area of the sphere and assign the result to s_sphere
Clear the screen
Format the output to display the numbers in fixed format with two decimal digits
Display on the screen the message
"The surface of a cube of sides ", side, " is ", s_cube
"The surface of a sphere of radius ", radius, " is ", s_sphere

Note: use 39 columns for text and 6 columns for the values.

You need to define four value-returning functions to implement this solution:

1) To calculate the square of a number you **must** define a **value-returning** function named **square( )**. It receives a real number and returns its squared value (a real number). You must use it to calculate the squares of side and radius. ***Do NOT use pow() in THIS FUNCTION to determine the square of the value received.***

2) To calculate the surface area of the cube you **must** define a **value-returning** function named **cube_surf( )**. It receives the side of the cube (a real number) and returns the calculated area (a real number) rounded to the second decimal digit. To round this and next area use the round_off() function that you created for lab 6 (see below please).

3) To calculate the surface area of the sphere you **must** define a **value-returning** function named **sphere_surf( )**. It receives the radius of the sphere (a real number) and returns the calculated area (a real number) rounded to the second decimal digit.

4) To round a number define a **value-returning** function named **round_off( )**. It receives the number to be rounded (a real number) and the number of decimal digits that the number should be rounded to (a whole number), and returns the number rounded to the specified number of decimal digits.

The program must compile without errors or warnings.

Open **lab07.cpp** in your IDE and implement the above algorithm (already provided in the source code as comments).

Implement the above algorithm (already provided in the source code as comments).

Note:

- Do NOT remove or modify the statements that I use to test certain things in your program.
- Pay attention to the input and the output formats. Your solution must behave exactly like mine.
- Carefully analyze the following figure and use it as a reference to ensure you do the right things.

```
Enter side of cube: 2.12
Enter radius of sphere: 3.98

   The surface area of a cube of sides   2.12 is  26.97

The surface area of a sphere of radius   3.98 is 199.06


Testing your solution
```

- Test and compare your solution with mine for different values of side and radius to ensure they always produce the same outputs. Pay attention to the output format.
- Ensure your formulas do not use mixed data types.

To write your program, review the concepts learned in class (review examples discussed in class) and read the book (analyze the examples in it).

If you get an error message on the output, read the comment on the line specified in the message to find out what is wrong. If you have concerns or specific questions, post them on the Discussion Board of Blackboard.
Don't forget to include at the top of the program the comments shown below with your information (name, class and section number, etc.)

```
//////////////////////////////////////////////////////////////////
//
// Name: <Put your name here>
// Due date:
// Class: <Your class number and section number, like: CSCI 1470.02>
// Semester: <This semester, like: Fall 2012>
// CSCI 1470 Instructor: <Your lecture instructor's name>
//
// Program Description: Enter here your description of what the program does
//
//////////////////////////////////////////////////////////////////
```

When done, submit your solution through Blackboard using the "Assignments" tool. Do Not email it.

Paste the link to your final solution along with your source code in the textbox opened when you click on Create Submission before you click on Submit.

The following is the basic criteria to be used to grade your submission:

You start with 100 points and then lose points as you don't do something that is required.

-5: Minor mistakes
incorrect declaration of the constant
wrong variable names
wrong data types
no/too few comments
mixed data types in expression
did not display two decimal digits
incorrect way to round the value off
incorrect input format
incorrect output format
program does not pass test (each)
-10: Moderate mistakes
no declaration/use of the constant
didn't round the value off
incorrect implementation of the function (each)
incorrect function call (each)
missing libraries
-20: Major mistakes

didn't implement the required functions (each)
program does not implement the provided algorithm
Incorrect/missing source code
Incorrect/missing link to your solution
-50: program doesn't compile
-100: The code submitted is not your creation (you got it from a web site or another person)
Late

Important: more points may be lost for other reasons not specified here.

The following are sample runs of the program.

```
Enter side of cube: 3
Enter radius of sphere: 3.8

   The surface area of a cube of sides   3.00 is  54.00

The surface area of a sphere of radius   3.80 is 181.46


Testing your solution
```

```
Enter side of cube: 12.5
Enter radius of sphere: 10.11

   The surface area of a cube of sides  12.50 is 937.50

The surface area of a sphere of radius  10.11 is 1284.43


Testing your solution
```

Notice in this last example the results do not align because the number of columns reserved is not big enough to accommodate the surface area of the sphere.