**CS 121 Week 7 Worksheet - Classes (Defined in Multiple Files)**

**Syntax Work:**

**Notes:** All parts needed to be completed are marked with *TO-DO* in the below syntax:

*FCylinder.h* and *FCylinder.cpp:*

* Method *getHeight* (needs prototype and definition); mimic *getRadius*
* Method *computeVolume* (needs prototype and definition); mimic *computeSurfaceArea*
* Method *printSelf* (needs prototype and definition); **HINT:** Read the comment on what this does

*main.cpp:*

* Fill in the areas that have comments (with no code below). Should all be in sequential order.

------------------------------------------------------------------------------------------------------------------------------------------FCylinder.h:

#include <iostream>

using namespace std;

// required for volume and area methods

const double PI = 3.141592;

class FCylinder

{

private:

// member variables

double radius, height; // doubles for radius & height

public:

FCylinder(); // default constructor

FCylinder(double r, double h); // overloaded constructor

FCylinder(const FCylinder& fc); // copy constructor; optional as C++

// defines this automatically (good to make)

~FCylinder(); // deconstructor

// getter Methods

double getRadius(); // return radius

// return height (TO-DO)

// setter Methods

void setRadius(double r); // set radius (with bounds-checking)

void setHeight(double h); // set height (with bounds-checking; TO-DO)

// misc. Methods

double computeSurfaceArea(); // returns surface area of FCylinder

// returns volume of FCylinder (TO-DO)

// print member variables of FCylinder (TO-DO)

};

FCylinder.cpp:

#include "FCylinder.h"

// default constructor

FCylinder::FCylinder()

{

// default initialization

radius = height = 1;

}

// overloaded constructor

FCylinder::FCylinder(double r, double h)

{

// first assign default value

radius = height = 1;

// afterwards, attempt to assign the values of r, h to radius, height

setRadius(r);

setHeight(h);

// NOTE: If setRadius does not work, then radius retains the default value of 1.

// If setHeight does not work, then height retains the default value of 1.

}

// copy constructor; I included this to show what a copy constructor does

FCylinder::FCylinder(const FCylinder& fc)

{

// we're allowed to use the dot operator here because we're within

// the "same" class

radius = fc.radius;

height = fc.height;

}

// deconstructor

FCylinder::~FCylinder()

{

cout << "Destroyed a FCylinder.\n";

}

//---------------------Getter Methods---------------------//

// returns radius

double FCylinder::getRadius()

{

return radius;

}

// returns height (TO-DO)

//---------------------Setter Methods---------------------//

// set radius (as long as r > 0, else keep original)

void FCylinder::setRadius(double r)

{

if(r > 0)

{

radius = r;

}

else

{

cout << "Attempted to assign invalid radius size! Retaining current radius value.\n";

}

}

// set height (as long as h > 0, else keep original)

void FCylinder::setHeight(double h)

{

//TO-DO

}

//----------------------Misc. Methods---------------------//

// returns surface area of FCylinder

double FCylinder::computeSurfaceArea()

{

return (2 \* PI \* radius \* height) + (2 \* PI \* radius \* radius);

}

// returns volume of FCylinder (TO-DO)

// prints member variables of FCylinder class to console output (TO-DO)

main.cpp:

/\*

NOTE: When we include "FCylinder.h", we're also including the libraries and namespaces it includes (that is: the library "iostream" and the namespace "std")

\*/

#include "FCylinder.h"

void class\_area();

int main()

{

cout << "Start of program.";

cout << "\n-------------------------\n";

// function made solely to show when the deconstructor is called

class\_area();

cout << "\n-------------------------\n";

// custom exit prompt

cout << "End of program. Press ENTER to continue.";

cin.ignore(1000, '\n');

return 0;

}

void class\_area()

{

// example of each type of constructor in use

FCylinder first\_cyl; //default constructor

FCylinder second\_cyl(7.5, 4.0); //overloaded constructor

FCylinder third\_cyl(first\_cyl); //copy constructor

// print out each cylinder (before operations)

first\_cyl.printSelf();

second\_cyl.printSelf();

third\_cyl.printSelf();

// assign first\_cyl's radius and height equal to second\_cyl's (use either method)

// set the radius of third\_cyl equal to 14 and height to 13

//print out each cylinder's surface area and volume (NOTE: Each method returns doubles)

// print out each cylinder again (after operations)

}

**Questions (True/False):**

1. An object is an instance of a class
2. Classes and structures are exactly the same
3. A deconstructor is called when creating an object
4. You can only have one constructor in a class
5. Constructors and deconstructors do not need to have the same name as the class they belong to
6. Constructors can be called at any given time like a method
7. Member variables in a class are normally public
8. Member variables in a structure are normally public
9. An accessor/getter method of a class should allow an instance of a class change its member variables
10. A mutator/setter method of a class should allow an instance of a class change its member variables
11. Inline functions are good to use for any type of function, be it big or used very often.

**Concept Questions:**

1. Give an example of an inline function (you can use *FCylinder* with your example, however there are no inline functions in there).
2. When passing an object through a function or method, why should it be called by reference (or const reference)? Give two reasons.
3. Why, do you think, I named the class (from the example I gave) *FCylinder* and not just *Cylinder*?
4. What is the difference between *public* and *private* in a class/structure? Give an example supporting yourself (you can use *FCylinder* for this if you want).
5. When would someone prefer using a structure over a class? What about a class over a structure?

**Bunch of notes I came up with on classes/structures and general OOP:**

* Classes and structures are grouped in a category of programming called Object-Oriented Programming (OOP in short). Here are some major parts to OOP:
  + - **Abstraction:** A definition that captures general characteristics without details
    - **Data Hiding:** Restricting access to certain members of an object. The intent is to allow only member functions to directly access and modify the object's data (think of the purpose of *public* and *private*).
    - **Encapsulation:** The bundling of an object's data and procedures into a single entity
* Classes are equivalent to structures in the sense that you can make objects from them
* In a more formal approach: A **class** is a programmer-defined data type used to define objects
* An **object** is an instance of a class. Formally, an object is a software entity that combines data and functions that act on the data in a single unit. The "data in a single unit" part can be described as a class.
* When a function is declared as **inline**, it means the compiler will replace all instances of the function call with the code's body (instead of usually referring to an address).
  + - Typically, this works well with small functions/methods used frequently (e.g. getters/setters)
    - Also, whenever you define a method inside of a class, the method is automatically seen as being inline (this means methods made outside of the class cannot be inline)
* To **instantiate** a class/structure means to create an object/instance of it.
* **Method** is a synonym for **class function**
* When stating a member variable or function of a class/structure as *public*, that means that the member variable or method can be accessed by dot operator **outside of the class/structure**.
* When stating a member variable or function of a class/structure as *private*, that means the member variable or method can only be used **within the class/structure**.
* Although there are other differences between structures and classes, the primary difference you must concern yourself with is that structures are **public on default**, whereas classes are **private on default**.
  + - This means that, if you were not to specifically type *public* or *private* in the structure/class you're working with, the member variables and methods will be either **public** or **private** (depending on what you're working with)
    - This is the reason we're able to use the dot operator when working with structures (without having to specify that the member variable or method is private/public).
* Although it's typically better to implement your own, C++ implicitly makes the following in a class/structure:
  + - Default constructor (NOTE: This **DOES NOT** mean that all member variables will be initialized; only objects inside of the class will be initialized if they exist)
    - Copy constructor (will copy every member variable from one class to another)
    - Assignment operator (same as above except after declaration)
    - Deconstructor (will call any deconstructors of any objects in the class if they exist)