**CS 121 Week 9 Worksheet - Classes**

**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.
* Methods defined inside of a class are called **inline** functions.
* 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)
    - Destructor (will call any destructors of any objects in the class if they exist)

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**Syntax Work:**

Complete the following (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 (I added

//this solely to show how it looks)

~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 is the default value of 1.

// If setHeight does not work, then height is 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;

}

//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 (you can use '=' or getters)

//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. An inline function is a function created outside of a class

**Concept Questions:**

1. Give an example of an inline function (you can use *FCylinder*, 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?