C++ Problem Set Worksheet 1.C CMPE 261 Large Scale Programming

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Problem 1: Classes and Encapsulation

Write a C++ program that defines a class named `Student`. The class should encapsulate the following attributes: name (string), student ID (integer), and GPA (double). Implement the following:

- A parameterized constructor that initializes all the attributes.

- Getter and setter methods for each attribute.

- A member function `printDetails()` that prints the student's information.

Sample Output:

```
Name:  Alice Johnson
Student ID: 1001
GPA: 3.85
```

Problem 2: Inheritance

Create a base class called `Tool` with a public member function `use()` that prints "Performing a generic task". Then, create a derived class named `Hammer` that overrides the `use()` function to print "Pounding a nail". Demonstrate the use of inheritance by creating an object of the `Hammer` class and calling the `use()` method.

Sample Output:

```
Pounding a nail
```

Problem 3: Operator Overloading

Create a class named `Vector` for representing a 3D vector (with components x,y,z). Implement the following:

- A parameterized constructor to initialize the vector components.

- Overload the - operator (binary minus) to subtract two vectors component-wise.

- A `print()` function to print the vector in the form: $< x, y, z >$.

Sample Output:

```
Result:  <1, 0, 5>
```

Problem 4: Function Overloading

Write a C++ program that demonstrates function overloading by creating a function named `findMax` that finds the maximum value among different sets of numbers: two integers, three integers, or two floating-point numbers. Implement different versions of the `findMax` function for each case.

Sample Output:

```
Maximum of two integers:  15
Maximum of three integers:  30
Maximum of two floats:  9.5
```

Problem 5: Function Overloading

Write a C++ program that demonstrates function overloading by creating a function named `printData`. This function should be able to handle and display different data types with appropriate formatting.

Instructions

Implement the following overloaded versions of the `printData` function:

- One that takes an `int` and prints it with the label "Integer: ".

- One that takes a `double` and prints it with the label "Double: ".

- One that takes a `std::string` and prints it with the label "String: ".

Sample Output

```
Integer:  42
Double:  3.14159
String:  Hello, C++!
```

Problem 6: Recursive Function (Power with Classes)

Write a C++ program that calculates the power (x^n) of a number using a class and a recursive method. The program should use a class to encapsulate the calculation and demonstrate basic object-oriented programming principles.

Instructions:

- Define a class named `PowerCalculator`.

- The class should have a public recursive method `double calculate(double base, int exponent)` that calculates the result.

- The class should also include a constructor and a destructor to demonstrate basic class structure.

Create an instance of the class in the `main()` function and call the recursive method to display the result.

Sample Output:

```
Enter the base number:  2
Enter the exponent:  4
2 raised to the power of 4 is 16
```