Sofia University
Department of Mathematics and Informatics

Course : OO Programming C#.NET
Date:
Student Name:

Lab No. 8

Submit the all C# .NET files developed to solve the problems listed below. Use comments and Modified-Hungarian notation.

Problem No. 1

Use **Explicit Interface Member Name Qualification** to implement interfaces in the following problems:

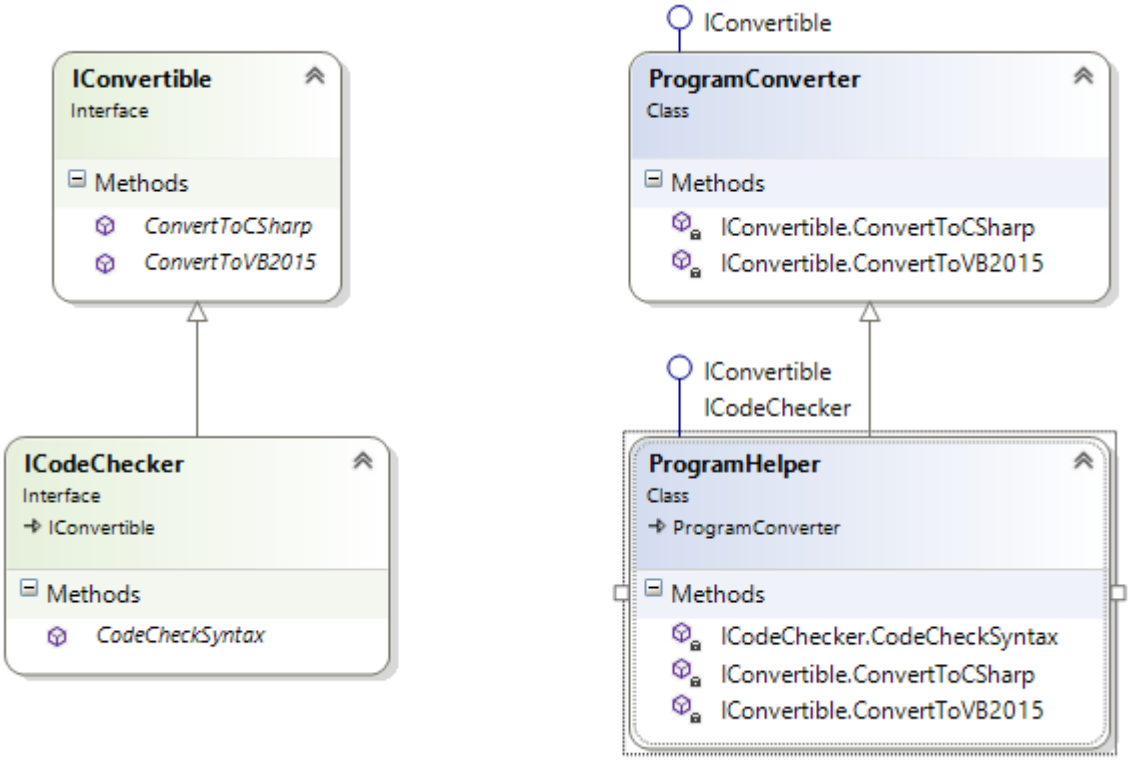
A) Define an `interface IConvertible` that indicates that the `class` can convert a `string` to `C#` or `VB2015`. The interface should have two methods: `ConvertToCSharp` and `ConvertToVB2015`. Each method should take a `string`, and return a `string`.

B) Implement that `interface` and test it by creating a `class ProgramHelper` that implements `IConvertible`. You can use simple `string` messages to simulate the conversion.

C) Extend the `interface IConvertible` by creating a new interface, **ICodeChecker**. The new interface should implement one new method, `CodeCheckSyntax`, which takes two strings: the `string` to check, and the language to use. The method should return a `bool`. Revise the `ProgramHelper` class from `Problem B` to use the new `interface`.

D) Demonstrate the use of `is` and `as`. Create a `new class`, `ProgramConverter`, that `implements IConvertible`. `ProgramConverter` should `implement` the `ConvertToC-Sharp`( ) and `ConvertToVB`( ) methods.

E) Revise `ProgramHelper` so that it derives from `ProgramConverter`, and implements `ICodeChecker`.



Problem No. 2

Create a **`struct Point`** which has coordinates ***`(double x, double y, double z)`***.

Create a **`struct Vector`** which has a starting **`Point`** and an end **`Point`**.

Create a **`struct Triangle`** which has sides **`Vector a`** and **`Vector b.`**

Define **an** **`interface Comparable`** and implement it with explicit name qualification in **`structs Point, Vector`** and **`Triangle`**.

Include in **`interface Comparable`** the following:

- -method ***`double SizeOf`***();

  // the *`SizeOf()`* a *`Point`* is the absolute value of the total of its coordinates

  // the *`SizeOf()`* a *`Vector`* is the *length* of the *`Vector`*

  // the *`SizeOf()`* a *`Triangle`* is the absolute value of its area

- **an `indexer` get and set `property using a string to access the datamemebers of` *`Point, Vector`* and *`Triangle`***

Provide **general purpose constructor** for the above **`structs`** and override the inherited ***`ToString()`*** method that displays the data members and the **`SizeOf`**() the respective object (*properly formatted with 2 digits after the decimal point*). Override method ***`Equals()`*** inherited from class ***`object.`***

Define a public **`delegate`**

bool ***`GreaterThan(Comparable obj1, Comparable obj2)`*** // obj1 is greater than obj2

to compare **`Comparable`** objects in terms of ***`SizeOf();`***

For each of the **`structs`** ***`Point, Vector`*** and ***`Triangle`*** define a ***private*** static method **`GetSizeOf`***`(Comparable obj1, Comparable obj2)`* to implement the delegate ***`GreaterThan`*** for the respective ***struct***. Return ***`true`*** when ***`obj1.SizeOf()`*** is greater than ***`obj2.SizeOf()`*** and ***`false`*** otherwise.

Define a static *get* **property** returning the instance of ***`GreaterThan`*** for ***`GetSizeOf()`***.

For structs ***`Vector`*** and ***`Triangle`*** **overload the operators** :

a) **`operator +`**

For struct ***`Vector`***- add the coordinates of the two vectors in addition; For struct ***`Triangle`***- add the areas of the ***`Triangles`*** in addition

b) **`operator *`**

For **`struct`** ***`Vector`***- the **vector** product of two vectors in multiplication; as **well as**, **the product of a** ***`Vector`*** **by an** **`Integer`** number. For ***`Triangle`***- a product of a ***`Triangle`*** and an **integer number** (***`zoom factor`***)- each of the **`Vector`** sides of the ***`Triangle`*** are multiplied by the *zoom factor*

Define a ***`BubbleSort( Comparable[],GreaterThan g)`*** **method** to sort an array of ***`Comparable`*** objects, where the **delegate** ***`GreaterThan`*** determines the ordering sequence (Assume the elements of ***`Comparable[]`*** are all Points, Vectors or Triangles only)

Write a Windows application that defines ***`Points`***, ***`Vectors`***, and ***`Triangles`*** and ***sorts*** them by clicking respective buttons, ***adds*** ***`Vector`*** objects, ***adds*** ***`Triangle`*** objects and ***`zooms Triangle`*** objects by a user defined **factor**.

Problem No. 3

Create a ***`class InvoiceDetails`*** (it has a ***`double lineTotal`*** member with a ***`get property, constructors`***).

Create a ***`class Invoice.`*** Every ***`Invoice`*** has a (**unique**) sequential long number (***`invoiceNumber`*** member with a ***`get`*** property, constructors) and an ***`ArrrayList`*** (named ***`detailLines`***) of ***`InvoiceDetails`*** objects. It also has a method ***`PrintInvoice`*** () (prints out on the Console the ***`invoiceNumber`*** and the ***`LineTotals`*** of the ***`InvoiceDetails`*** objects in ***`detailLines`***). Overload the ***`operator+`*** for ***`class Invoice`***, allowing you to add the ***`LineTotals`*** of the ***`InvoiceDetails`*** objects comprising two Invoice objects given as arguments for the operator into the ***`detailLines`*** of a new ***`Invoice`*** object that has to be returned.

Overload the ***`operator>`*** **and** ***`operator<`*** for class Invoice, allowing you to compare two Invoice objects provided as arguments (by comparing the ***`total`*** amount of the ***`lineTotals`*** of their ***`detailLines`***)

Overload the ***`operator*`*** so that it takes as a second argument a ***`double`*** number (***`discount`***). As a result return a ***`new Invoice`*** object having the ***`lineTotal`*** of all the ***`InvoiceDetails`*** objects of the first argument of the ***`operator*`*** multiplied by ***`discount`*** *(*a discounted ***`Invoice`*** object*)*

Write a Console application to test the above classes.- create two Invoices with different sets of InvoiceDetails and apply the overloaded operators to them, run the ***PrintInvoice*** () method.

Hint: **Create** an instance of ***ArrayList*** as follows:

```
private  ArrayList  detailLines;
..>>,,,,>>
detailLines= new ArrayList();
```

Add elements to an `ArrayList` as follows:

```
detailLines.Add(new InvoiceDetailLine(intInvoiceDetailTotal);
```

Problem No. 4

A ***RationalNumber*** is any number that could be represented as the division of two integer numbers- a numerator and a denominator. Thus, any ***RationalNumber*** has a numerator and a denominator. For instance, the numbers $-5,\ \frac{3}{4},\ -\frac{1}{2}$ etc are rational numbers (*the numerator and denominator of **-5** are respectively, the integer numbers **-5** and **1***). Write a ***RationalNumber*** class in ***C#.NET*** with the following capabilities:

a) Create a general purpose constructor that **prevents a 0 (zero) denominator**, **reduces or simplifies** fractions that are not in reduced form (for instance, $2/4$ and $1/2$ represent the same ***RationalNumber***) and **avoids negative denominators**. (for instance, $2/(-4)$ and $-1/2$ represent the same ***RationalNumber***)

b) Create a **default constructor** (the default rational number is ***1/1***) and **a copy constructor**

c) Define ***set/get*** properties for the ***nominator*** and ***denominator*** **- prevents a 0 (zero) denominator**, **reduces or simplifies** fractions that are not in reduced form (for instance, $2/4$ and $1/2$ represent the same ***RationalNumber***) and **avoids negative denominators**. (for instance, $2/(-4)$ and $-1/2$ represent the same ***RationalNumber***)

d) Create an ***int*** to ***RationalNumber*** constructor (the result should be a rational number with the given ***int*** as ***nominator*** and ***denominator*** equal to ***1***)

e) Overload the **addition (+)**, **subtraction(-)**, **multiplication(*)** and **division(/)** operators for this class, as well as, (the corresponding ***+=, -=, /=, *=*** operators will be evaluated on the basis of **addition (+)**, **subtraction(-)**, **multiplication(*)** and **division(/)**).

f) Catch ***DivideByZeroException*** with the operator **/**

g) Overload the **relational** (***<,>***) and **equality** ***(==, !=)*** operators. (override the virtual ***Equals(), GetHashCode()*** methods, as well)

h) Overload the virtual ***ToString()*** method (display the ***numerator*** and the ***denominator*** separated by a slash)

i) Overload the **explicit** type conversion operator ***(int)*** from ***Rationalnumber*** objects to ***int***. (the result should be an ***int*** number equal to the integer division of the ***numerator***

over the ***denominator***), as well as, **implicit** type conversion from ***int*** to ***RationalNumber*** ***(***thus, it must be possible to add a ***RationalNumber*** to an ***int***, divide ***RationalNumber*** by an ***int*** etc, by means of the operators defined in (e)***)***

j) Write a **C#.NET** Windows application, which tests **completely** each one of the capabilities *a) – i)* (use textboxes and labels to manage the input and output, use buttons to manage the overloaded operators.

Problem No. 5a

Modify the **payroll system** of Employees (*see the sample code Fig12.rar*) to include private instance variable ***birthDate*** in ***class Employee***. Use ***class Date*** (*see the sample code Fig12.rar)* to represent an employee's birthday. **Assume that payroll is processed once per month. Create an array** of ***Employee*** variables to store references to the various employee objects. In a loop, calculate the payroll for each ***Employee*** (polymorphically), and add a **$100.00** bonus to the person's payroll amount if the current month is the month in which the ***Employee's*** birthday occurs.

Problem No. 5b

Modify the **payroll system** Employee- SalariedEmployee in **Figs. 12.4–12.11** (*see the sample code Fig12.rar*) to include private instance variable ***birthDate*** in ***class Employee***. Use ***class Date*** (*see the sample code Fig12.rar)* to represent an employee's birthday. **Assume that payroll is processed once per month. Create an array** of ***Employee*** variables to store references to the various employee objects. In a loop, calculate the payroll for each ***Employee*** (polymorphically), and add a **$100.00** bonus to the person's payroll amount if the current month is the month in which the ***Employee's*** birthday occurs.