

Composition & Unit testing with MS test

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Agenda

- ❖ Composition vs Inheritance?
- ❖ Examples
- ❖ Unit testing
- ❖ TDD
- ❖ Creating MS Test project
- ❖ Assert class
- ❖ Examples



Composition vs Inheritance

- ❖ **Object Composition** is a way to combine simple objects or data types into more complex ones.
- ❖ **Inheritance** is a way to form new classes by using classes that have already been defined.
- ❖ **Composition** realizes "has a" relationship: A car "has an" engine, a person "has a" name, etc.
- ❖ **Inheritance** realizes "is a" relationship. A car "is a" vehicle, a student "is a" person, etc.

Example 1. Point and Triangle

```
public struct Point
{
    public int X, Y;
    3 references
    public Point(int x, int y) {this.X = x; this.Y = y; }
    0 references
    public void Distance(Point p) { }
}
3 references
public class Triangle
{
    private Point p1, p2, p3;
    1 reference
    public Triangle(Point a, Point b, Point c)
    { p1 = a; p2 = b; p3 = c; }
    0 references
    public void Perimeter() { }
    0 references
    public void Square() { }
    0 references
    public void Print() { }
}
```

```
static void Main(string[] args)
{
    Point p1, p2, p3;
    p1 = new Point(1, 5);
    p2 = new Point(4, 1);
    p3 = new Point(1, 1);
    Triangle tr1 = new Triangle(p1, p2, p3);

    Console.ReadKey();
}
```

Example 2. Slide, Presentation

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```
public class Slide
{
    private string text = "";
    private bool isanimation = false;
    1 reference
    public bool IsAnimation { get { return isanimation; } }
    3 references
    public string Text { get { return text; } set { text = value; } }
}
```

2 references

```
public class Presentation
{
    private List<Slide> slides = new List<Slide>();
    1 reference
    public void Add(Slide s) { slides.Add(s); }
    0 references
    public bool Delete(Slide s) { return slides.Remove(s); }
    1 reference
    public void Show()
    {
        foreach (Slide s in slides)
            Console.WriteLine("Slide text:{0} animation {1}", s.Text, s.IsAnimation);
    }
    0 references
    public void Show(int number)
    { Console.WriteLine(slides[number].Text); }
}
```

```
static void Main(string[] args)
{
    Presentation p = new Presentation();
    Slide s = new Slide();
    s.Text = "FirstSlide";
    p.Add(s);
    p.Show();

    Console.ReadKey();
}
```

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Task-Homework 1

Create struct Point:

- fields x and y,
- method Distance() to calculate distance between points
- method ToString(), which return the Point in format "(x,y)"

Create class Triangle:

- fields vertex1, vertex2, vertex3 of type Point
- constructors
- methods Perimeter(), Square(), Print()

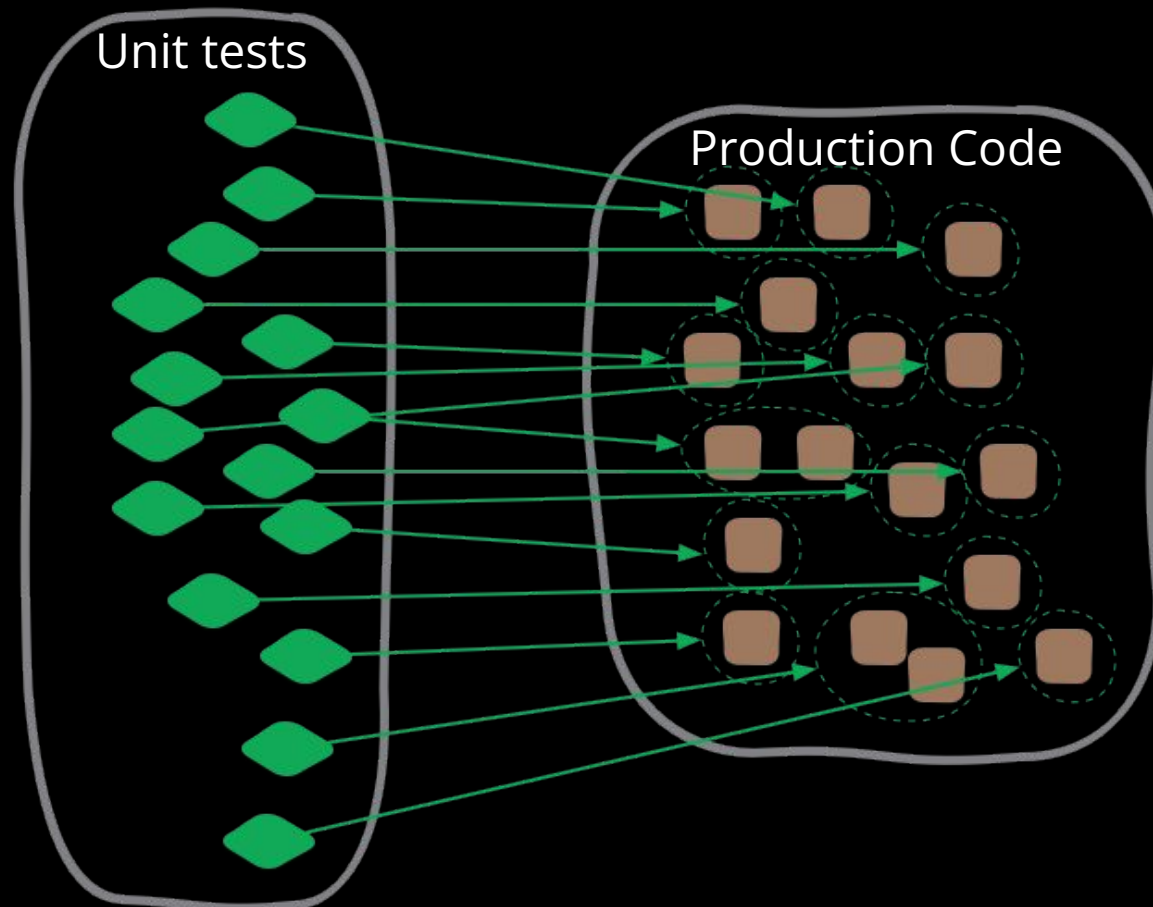
In the Main() create list of 3 triangles and write into console the information about these shapes.

*Print the triangle with vertex which is the closest to origin (0,0)

Unit testing with MS test

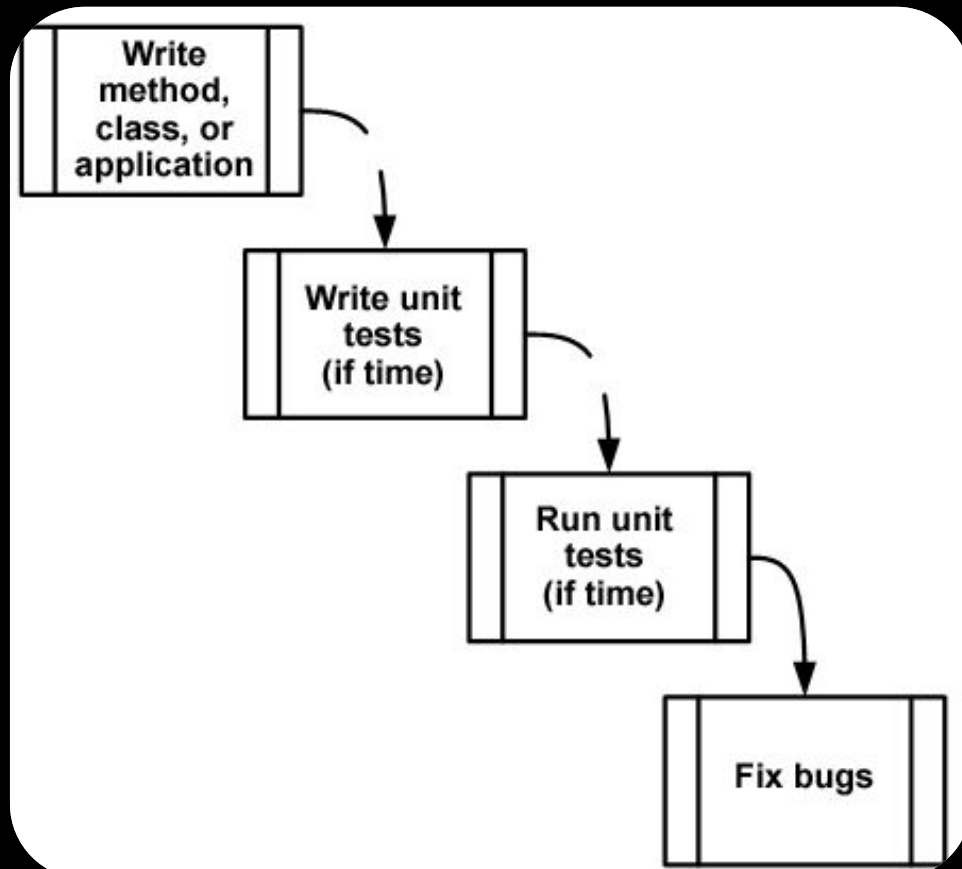
Unit Testing

- ◆ **Unit testing** is a procedure used to validate that individual units of source code (methods, properties, classes) are working properly.

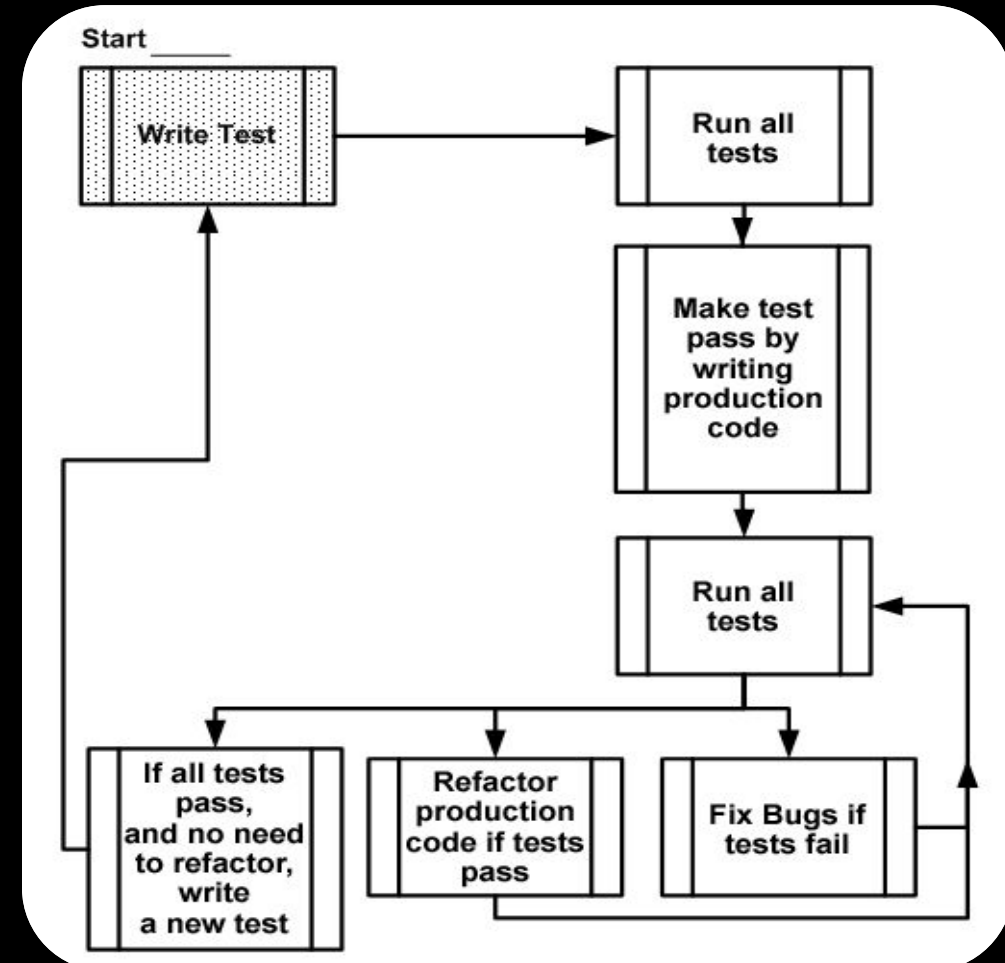


Test-Driven Development (TDD)

❖ The traditional way of writing unit tests



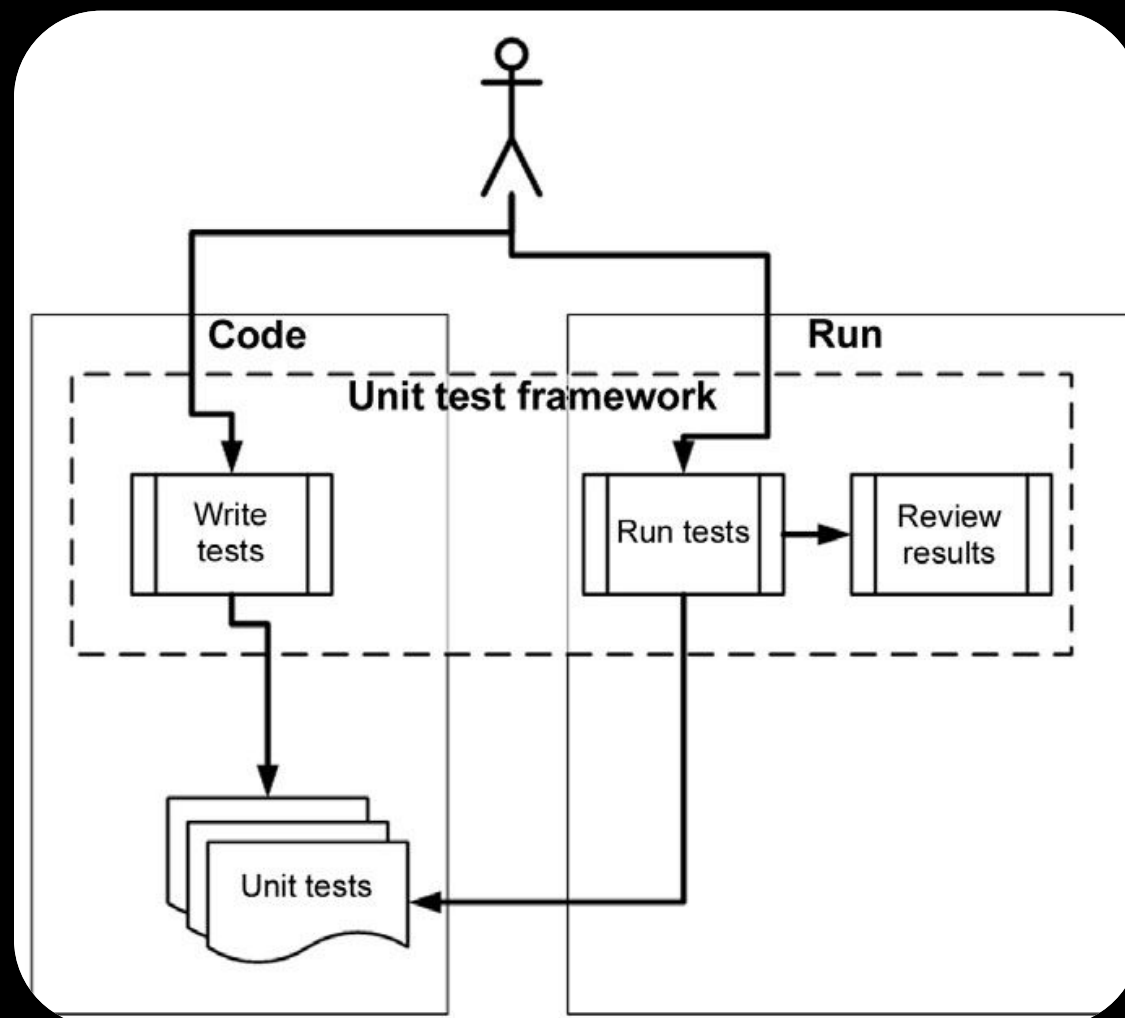
❖ Test-driven development



Unit-testing frameworks

◆ UTF for .NET:

- ✓ MSTest
- ✓ NUnit
- ✓ XUnit
- ✓ ...



Creating Unit Tests

```
[TestClass]
public class PointUnitTest
{
    [TestMethod]
    public void DistanceTest()
    {
        //Arrange
        Point p1 = new Point(0, 0);
        Point p2 = new Point(1, 0);
        double expected = 1;

        //Act
        double result = p1.Distance(p2);

        //Assert
        Assert.AreEqual(expected, result);
    }
}
```

Kinds of Assert Classes

Microsoft.VisualStudio.TestTools.UnitTesting namespace:

❖ class **Assert**

In your test method, you can call any number of methods of the Assert class, such as `Assert.AreEqual()`. The Assert class has many methods to choose from, and many of those methods have several overloads.

❖ class **CollectionAssert**

Use the CollectionAssert class to compare collections of objects, and to verify the state of one or more collections.

❖ class **StringAssert**

Use the StringAssert class to compare strings. This class contains a variety of useful methods such as `StringAssert.Contains`, `StringAssert.Matches`, and `StringAssert.StartsWith`.

public static class Assert


Name	Description
AreEqual(Object, Object)	Verifies that two specified objects are equal. The assertion fails if the objects are not equal.
AreNotEqual(Object, Object)	Verifies that two specified objects are not equal. The assertion fails if the objects are equal.
AreNotSame(Object, Object)	Verifies that two specified object variables refer to different objects. The assertion fails if they refer to the same object.
AreSame(Object, Object)	Verifies that two specified object variables refer to the same object. The assertion fails if they refer to different objects.
Fail()	Fails the assertion without checking any conditions.
Inconclusive()	Indicates that the assertion cannot be verified.
IsFalse(Boolean)	Verifies that the specified condition is false. The assertion fails if the condition is true.
IsTrue(Boolean)	Verifies that the specified condition is true. The assertion fails if the condition is false.
IsInstanceOfType(Object, Type)	Verifies that the specified object is an instance of the specified type. The assertion fails if the type is not found in the inheritance hierarchy of the object.
IsNotInstanceOfType(Object, Type)	Verifies that the specified object is not an instance of the specified type. The assertion fails if the type is found in the inheritance hierarchy of the object.
IsNull(Object)	Verifies that the specified object is null. The assertion fails if it is not null.
IsNotNull(Object)	Verifies that the specified object is not null. The assertion fails if it is null.

Example 1. Testing Bank project

```
public void Debit(double amount)
{
    if (m_frozen)
    {
        throw new Exception("Account frozen");
    }
    if (amount > m_balance)
    {
        throw new ArgumentOutOfRangeException("amount");
    }
    if (amount < 0)
    {
        throw new ArgumentOutOfRangeException("amount");
    }
    m_balance -= amount;
}
```

```
[TestMethod()]
public void DebitTest()
{
    BankAccount target = new BankAccount("Mr. Bryan Walton", 11.99);
    double amount = 11.22;
    target.Debit(amount);
    Assert.AreEqual((System.Convert.ToDouble(0.77)), target.Balance, 0.05);
}
```

```
[TestMethod()]
[ExpectedException(typeof(ArgumentOutOfRangeException))]
public void DebitTest()
{
    BankAccount target = new BankAccount("Mr. Bryan Walton", 10);
    double amount = 20;
    target.Debit(amount);
    Assert.AreEqual(10, target.Balance);
}
```

	Result	Test Name	Project	Error Message
<input type="checkbox"/>	 Passed	DebitTest	TestProject1	

Create project and Unit test example

1. Create project *MyCalcLib*

```
namespace MyCalcLib
{
    public class MyCalc
    {
        public int Sum(int x, int y)
        {
            return x + y;
        }
        static void Main(string[] args)
        {
            //...
        }
    }
}
```

2. Right click on *Solution*
Add →
Test “MyCalcTests”

3. Right click on *References*
Add References →
project “MyCalcLib”

Create project and Unit test example

```
namespace MyCalcLib.Tests
{
    [TestClass]
    public class MyCalcTests
    {
        [TestMethod]
        public void Sum_10and20_30returned()
        {
            //arrange налаштувати
            int x = 10;
            int y = 20;
            int expected = 30;

            //actual
            MyCalc c = new MyCalc();
            int actual = c.Sum(x, y);

            //assert
            Assert.AreEqual(expected, actual);
        }
    }
}
```

❖ After this click ***Build Solution***

Task & Homework 10

- ❖ Add Test project to your solution and write unit tests for Point and Triangle classes.
- ❖ Add Unit tests to one of your previous class – Person, Car ...