Module 2.2:
Automatic Testing

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Agenda

- Introducing Automatic Testing
- Testing in Visual Studio

Automatic Testing

- Automatic "white-box" testing of classes
  - Developers can run tests in Visual Studio
  - Tests can run automatically when code is checked in
- (Unit) Testing
  - Captures a code-based "specification" of functionality
  - Drives safe refactoring
  - Assists regression testing
- (Unit) Testing frameworks for C# include
  - MSTest
  - NUnit
  - MbUnit
  - xUnit.net
  - …

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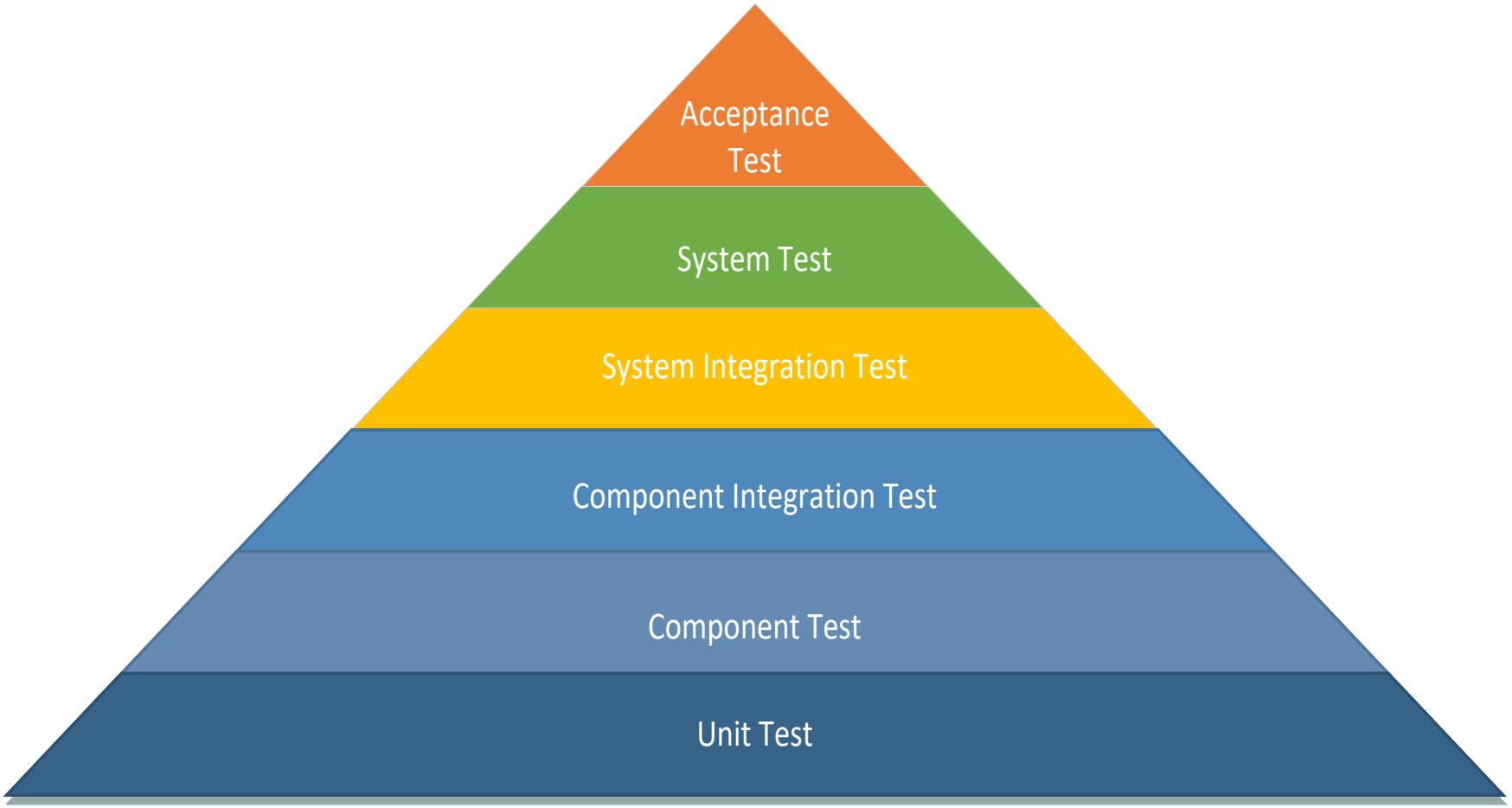
Various Kinds of Automatic Tests

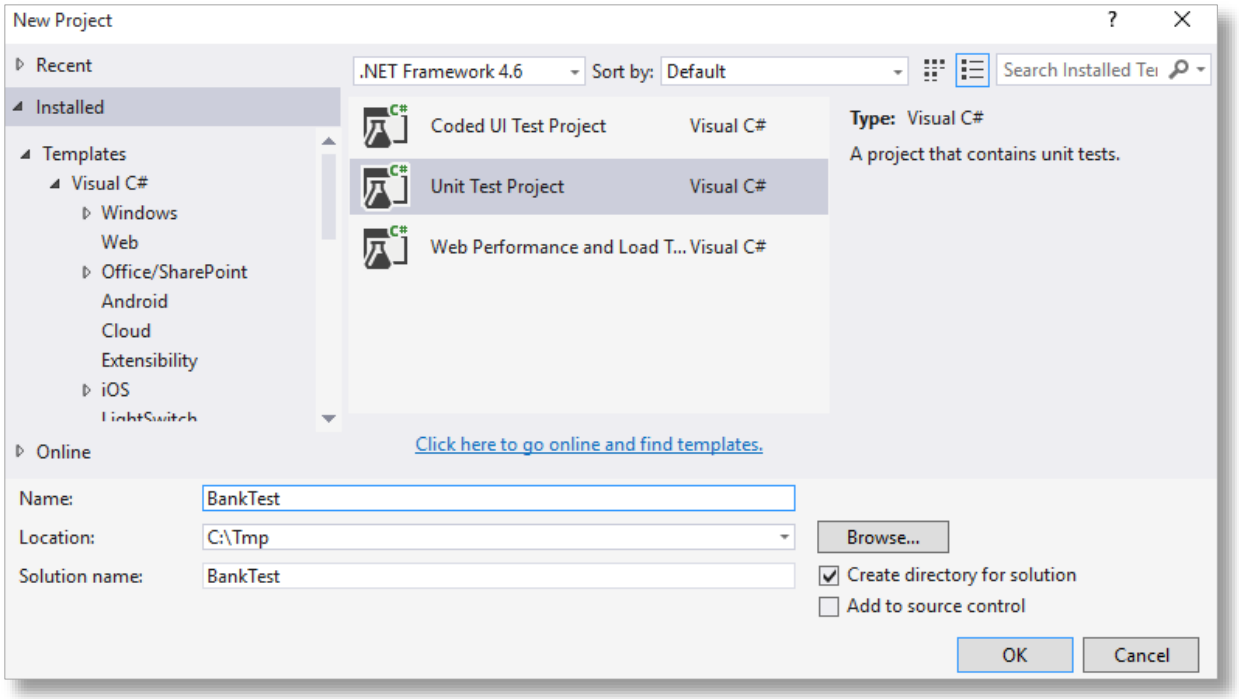


Agenda

- Introducing Automatic Testing
- **Testing in Visual Studio**

Unit Testing in Visual Studio

- Visual Studio includes MSTest (but can install other testrunners!)
  - Unit Test Project



- Create business logic project(s) "as usual"
- Create Unit Test Project with a reference to business logic project(s)
- Author test classes and methods in test project

Test Classes and Test Methods

- Test methods must be marked with the **`[TestMethod]`** attribute
  - Cannot have parameters and returns **`void`**, **`Task`**, or **`Task<T>`**

```
[TestClass]
public class BankAccountTest
{
    [TestMethod]
    public void TestDeposit()
    {
        BankAccount account = new BankAccount();
        account.Deposit(87);
        Assert.AreEqual(87, account.Balance);
    }
}
```

- Test classes must be marked with the **`[TestClass]`** attribute

Using the **Assert** Class and Attributes

- The `Microsoft.VisualStudio.TestTools.UnitTesting` namespaces includes e.g.
  - `Assert.`
    - `AreEqual()`
    - `AreNotEqual()`
    - `Fail()` …
  - `[ExpectedException]` attribute

```
[TestMethod]
[ExpectedException(typeof(ArgumentOutOfRangeException))]
public void TestWithdraw()
{
    BankAccount account = new BankAccount();
    account.Withdraw(87);
}
```

  - `[TestInitialize]` + `[TestCleanup]` attributes

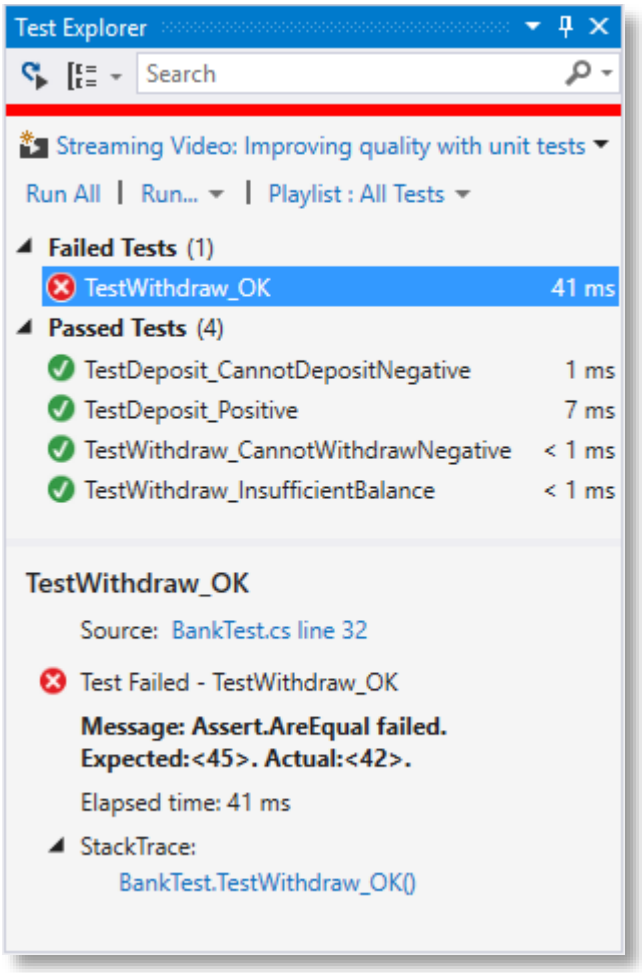
Async Test Methods and Tasks

- Test methods using await should always return `Task` or `Task<T>`
  - Never **`void`**!!

```
[TestClass]
public class BankAccountTest
{
    [TestMethod]
    public async Task TestDepositAsync()
    {
        BankAccount account = new BankAccount();
        await account.DepositAsync(87);
        Assert.AreEqual(87, account.Balance);
    }
}
```

Running the Tests

- Test Explorer
  - `Test` -> `Windows` -> `Test Explorer`
- Status annotations in source code in editor



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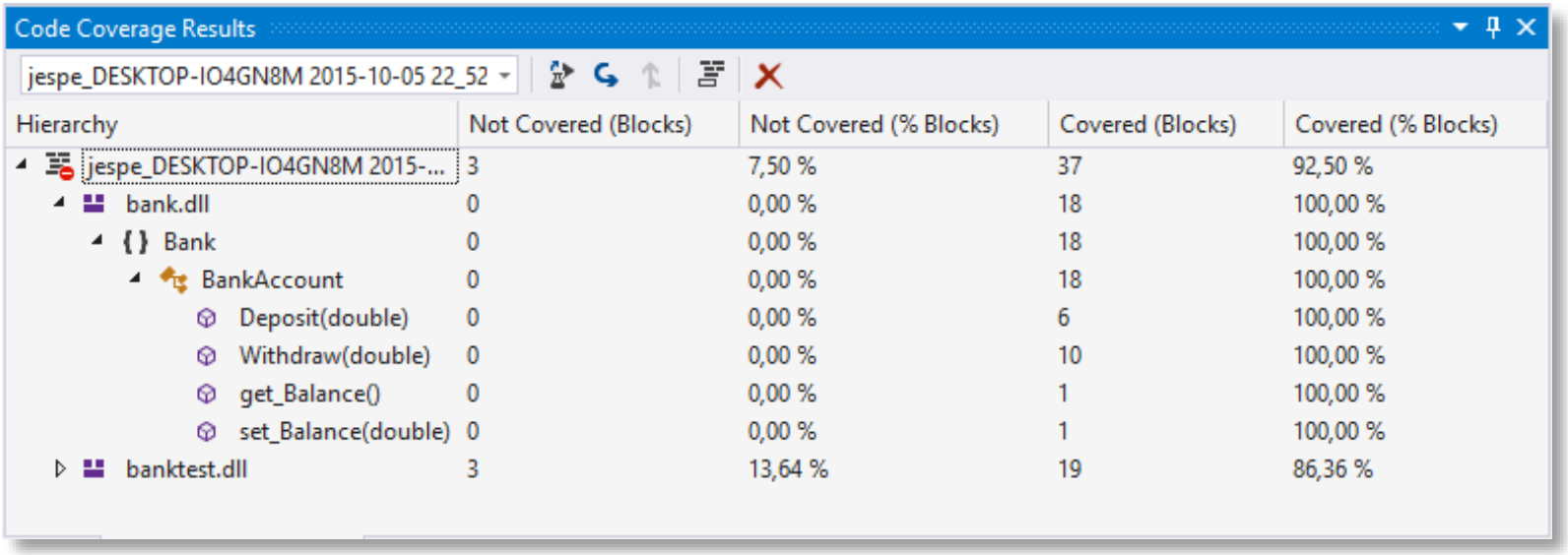
Code Coverage Analyzer

- Some versions of Visual Studio have additional testing tools
  - `Test > Analyze Code Coverage > All Tests`
  - …



Test-Driven Development (TDD)

- Test-Driven Development (TTD)
  - Write unit tests before class itself
  - Class is complete when all units tests pass
  - Additional features and/or bug fixes incur yet more unit tests etc.

- Visual Studio has "TDD-friendly" IntelliSense mode
  - **CTRL-ALT-Space** toggles between modes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