COMP4701: Web Application Development

Fall 2025

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1- .Net Framework and C# Basics

- .NET Frameworks
- .Net Programming Language
- Common Language Runtime (CLR)
- Intermediate Language (IL)
- .Net History

Web Pages

- **Static Web Pages:**
  - **Content doesn't change when requested by a user**
- **Dynamic Web Pages:**
  - **Content changes depending on the user's request and preferences**
    - **Client-Side: Executed in the browser**
    - **Server-Side: Executed in the server**

HTML

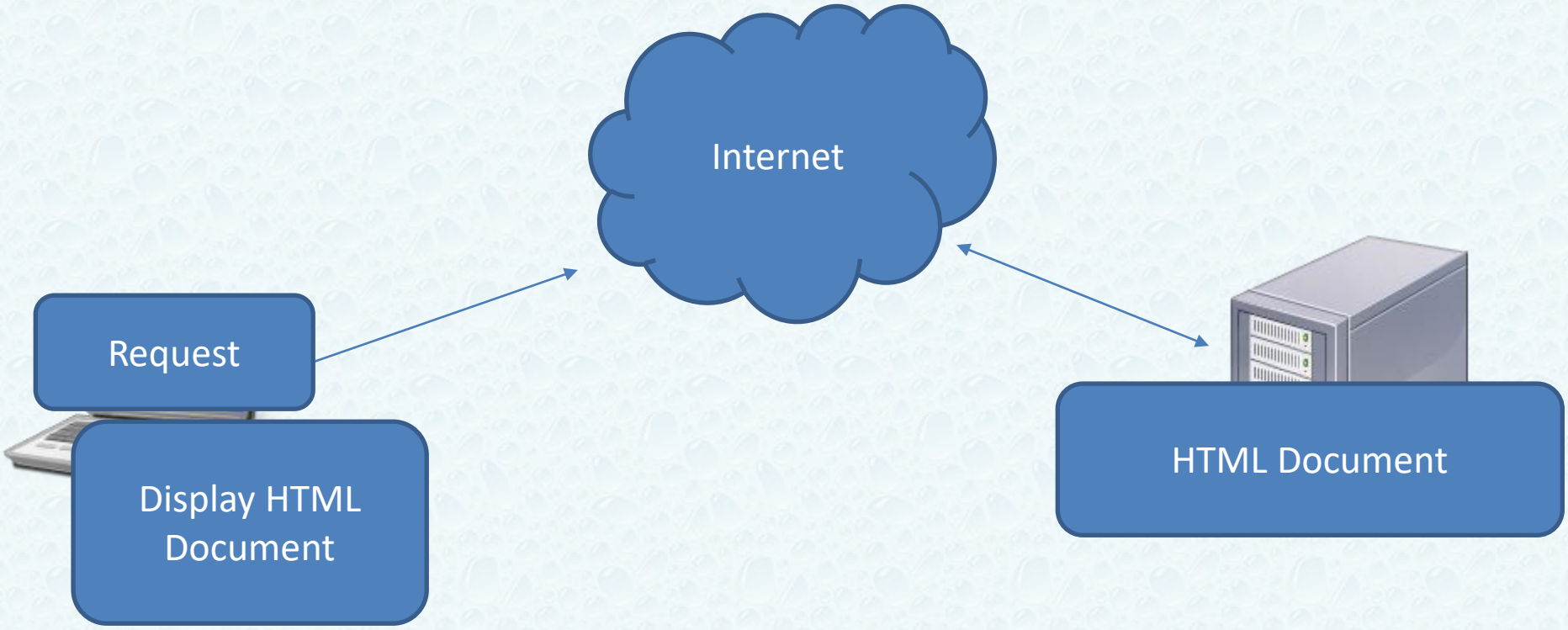
- Early websites were not *web applications*
- HTML only displays the information
- HTML has two types of contents: Text and Tags
- Saved in a fixed file (for example index.html)
- No interactivity – needed to be updated by hand
- Doesn’t require a web server

HTML Example

```
<html>
    <head>
        <title>Sample Web Page</title>
    </head>
    <body>
        <h1>Sample Web Page Heading</h1>
        <p>This is a sample web page.</p>
    </body>
</html>
```

HTML Example

An HTML Request



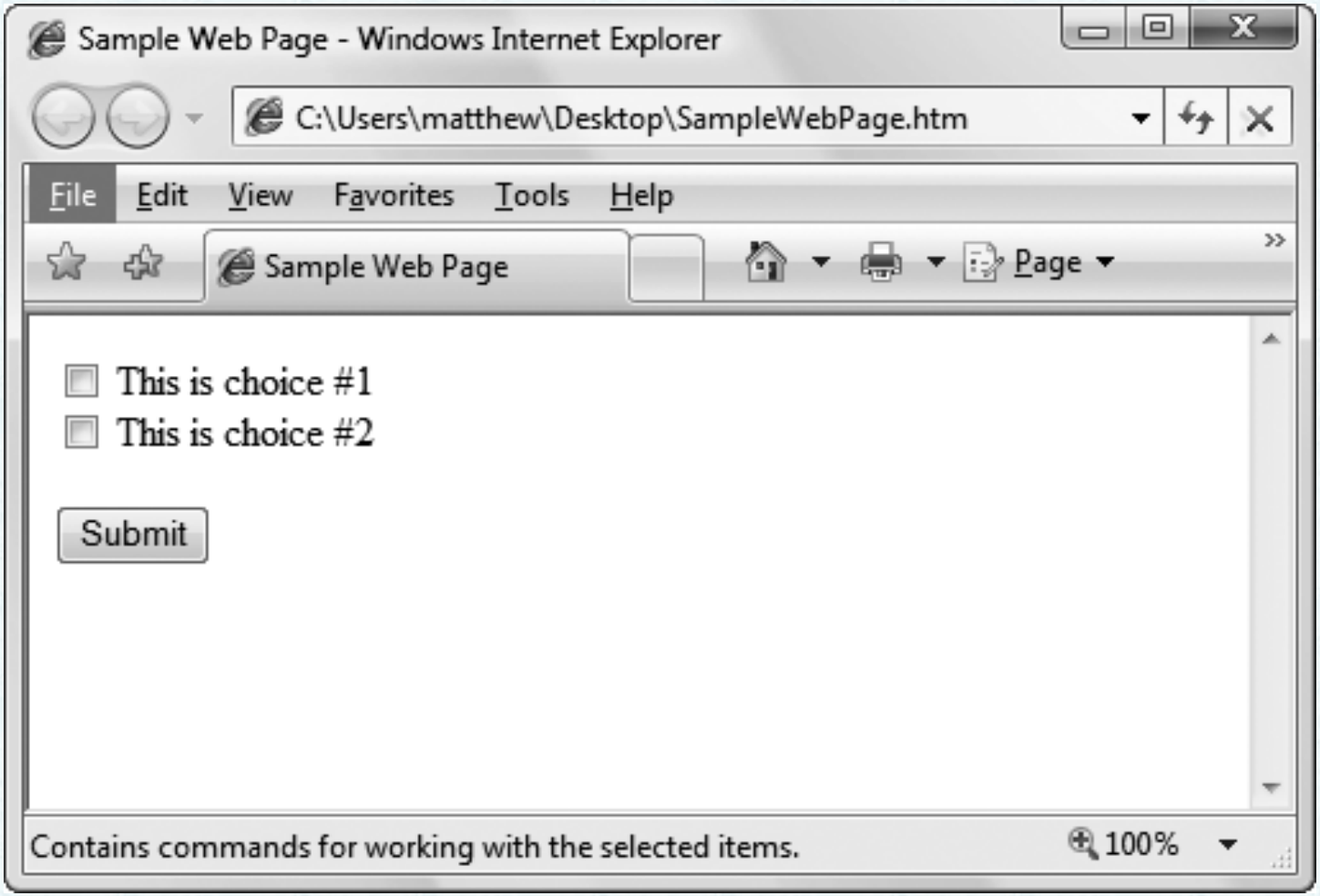
Browsers

- Examples: Internet Explorer, Firefox, Opera, Google Chrome, Safari, Netscape, Camino, etc.
- Browsers display HTML pages
- Different browsers display the same page differently
- Incorrect HTML may be displayed weirdly or not at all in some browsers
- There are different versions of browsers for mobile devices too

HTML Forms

- Introduced by HTML 2.0
- Graphical widgets or *controls* (text boxes, buttons, drop-down lists, etc.) are added
- These controls should be put between <form> and </form> tags
- Standard input pages can be designed
- Input data are sent to web server
- Web server processes the data

HTML Forms Example



HTML Forms Example

```
<html>
   <head>
      <title>Sample Web Page</title>
   </head>
   <body>
      <form>
         <input type="checkbox" /> This is choice #1<br />
         <input type="checkbox" /> This is choice #2<br /><br />
         <input type="submit" value="Submit" />
      </form>
   </body>
</html>
```

Methods of Sending Information

- The Form object may be used to send the data to another page using "action" attribute:

```
<form action="Another_Page.php">
  <input type="checkbox" /> This is choice #1<br />
  <input type="checkbox" /> This is choice #2<br /><br />
  <input type="submit" value="Submit" />
</form>
```

- Form object can send values in two separate methods: POST and GET:

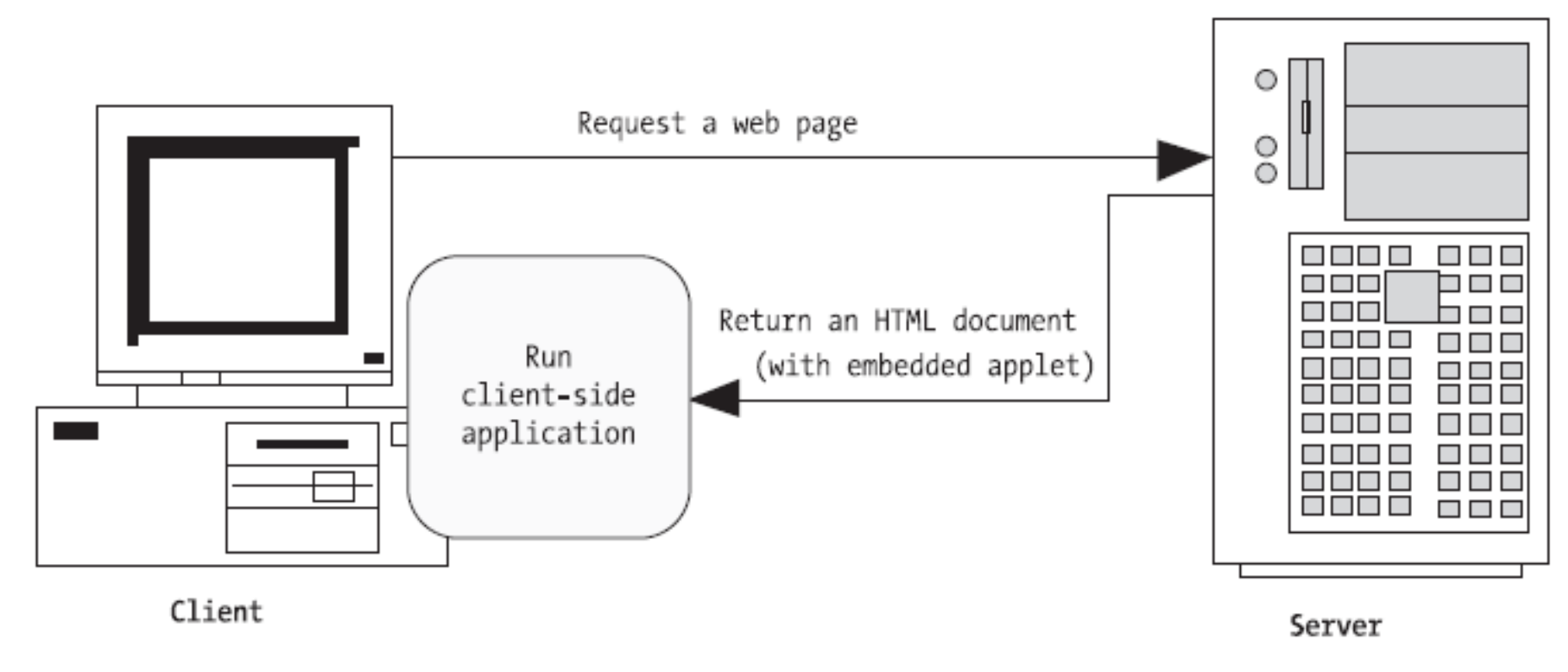
```
<form method="GET">...</form>
<form method="POST">...</form>
```

Methods of Sending Information

- **POST**
  - Default method
  - User data is combined in a special form and sent to the server
- **GET**
  - User data is added to the end of the URL address
  - Data is sent as an encoded stream
  - Example:

https://www.google.com/search?q=oman&hl=en

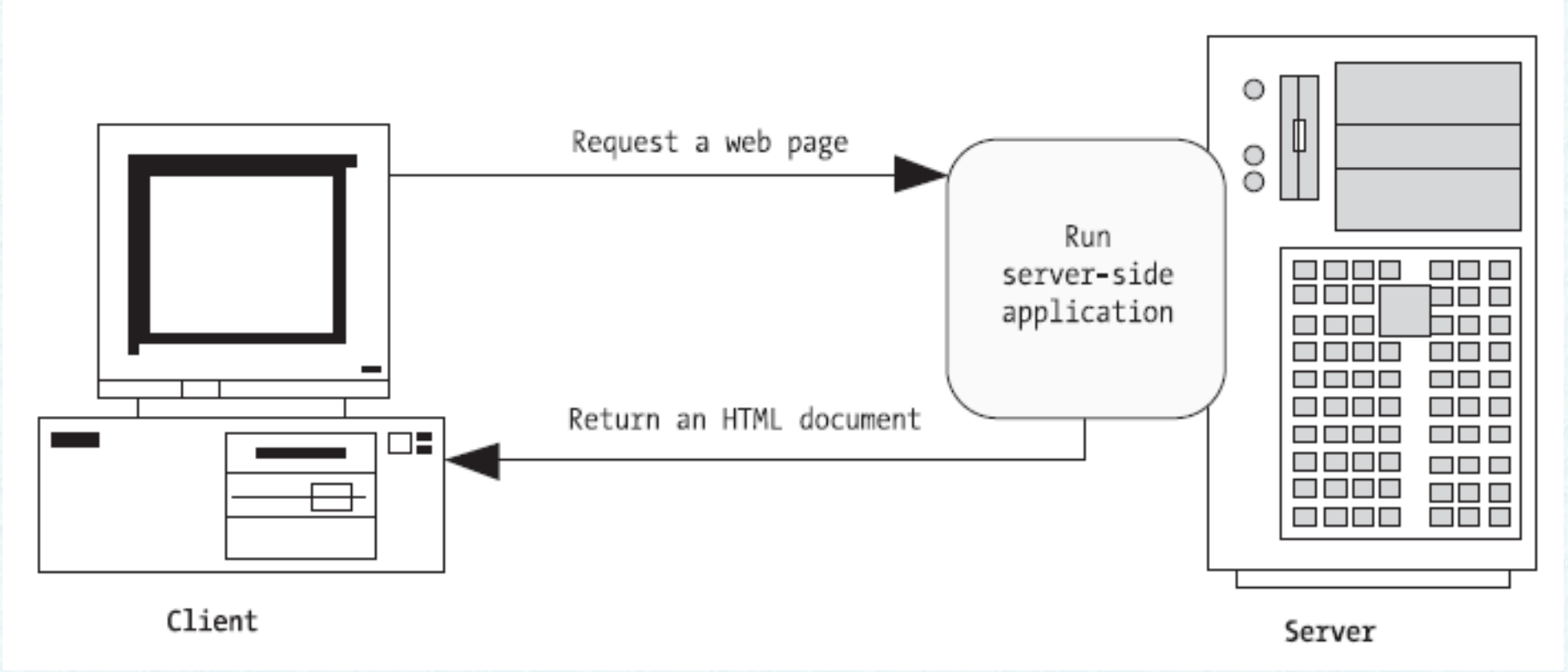
A Client-Side Web Application



Server-Side Programming

- Executed on the server side
- Early web development technologies used CGI
  - In CGI, web server launch a completely separate instance of the application for each web request
- If the website is popular, the web server may be down easily
- If higher-level features are needed (e.g. user authentication), the pages of codes should be written from scratch
- Building web Application, this way is boring and error-prone
- To counter these problems, high-level development platforms are created, such as PHP, JSP, ASP, ASP.NET and ASP.NET Core

A Server-Side Web Application



Classic ASP Example

```
<html>
  <body>

    <% Response.Write(“<p>Hello World!</p>") %>

    <% Response.Write("<p
    style='color:#0000ff'>Hello World!</p>") %>

  </body>
</html>
```

PHP Example

```
<html>
  <body>

    <?php echo “</p>Hello World!</p>"; ?>

    <?php echo "<p style='color:#0000ff'>Hello
    World!</p>"; ?>

  </body>
</html>
```

Classic ASP vs. ASP.NET

- ASP is a script-based programming language that requires a thorough understanding of HTML and a good deal of painful coding

- ASP.NET is an object-oriented programming model that lets developers to develop websites as easily as Windows applications

ASP.NET

- A server-side technology
- All ASP.NET codes are executed on the web server
- When the code is finished executing, the user receives an ordinary HTML page, which can be viewed in any browser

Why Use Server-Side Programming Instead of Client-Side?

- **Isolation:** Client-side code can't access server-side resources
- **Security:** End users can view client-side code
- **Thin clients:** Mobile phones, PDAs, etc. don't support all features of a traditional browser

Best Solution?

- Combining server-side and client-side programming is the best solution
- ASP.NET controls can detect capabilities of the client browser
- If browser supports JavaScript, these controls return a web page that incorporates JavaScript
- Ajax technology can be used with ASP.NET effectively
- However, ASP.NET codes are always executed on the server

The .NET Framework

- .NET Framework is composed of a cluster of several technologies:
  - .NET Languages:

    C#, Visual Basic.NET, JScript.NET, J#, C++, Java, ……
  - The Common Language Runtime (CLR):

    The engine that executes all .NET programs
  - The .NET Framework Class Library:

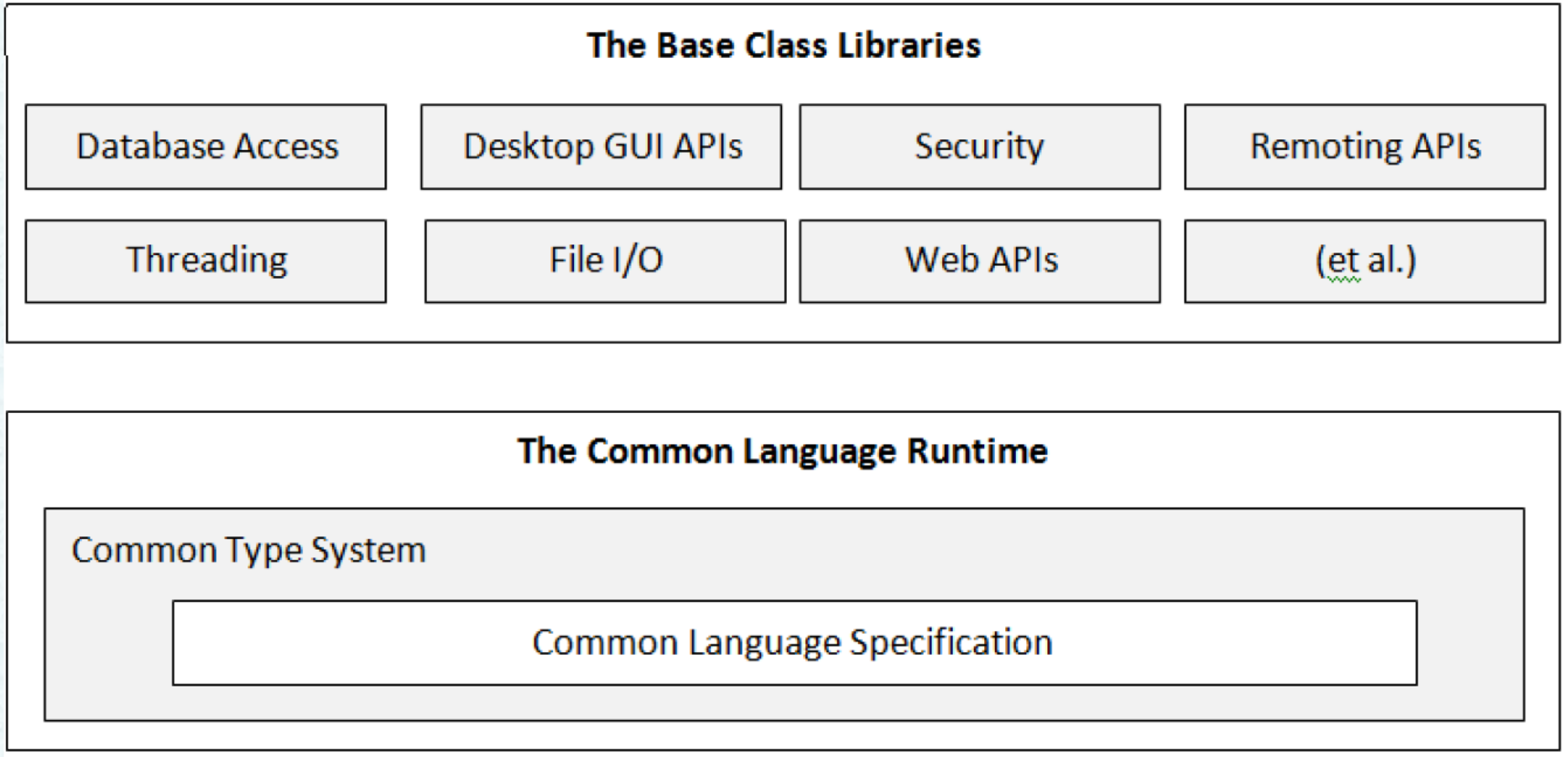
    The class library for thousands of prebuilt functionality (e.g. ADO.NET, Windows Forms, etc.) – 13000 classes
  - ASP.NET: engine that hosts web applications and includes a set of web specific services
  - Visual Studio.NET

.NET Framework

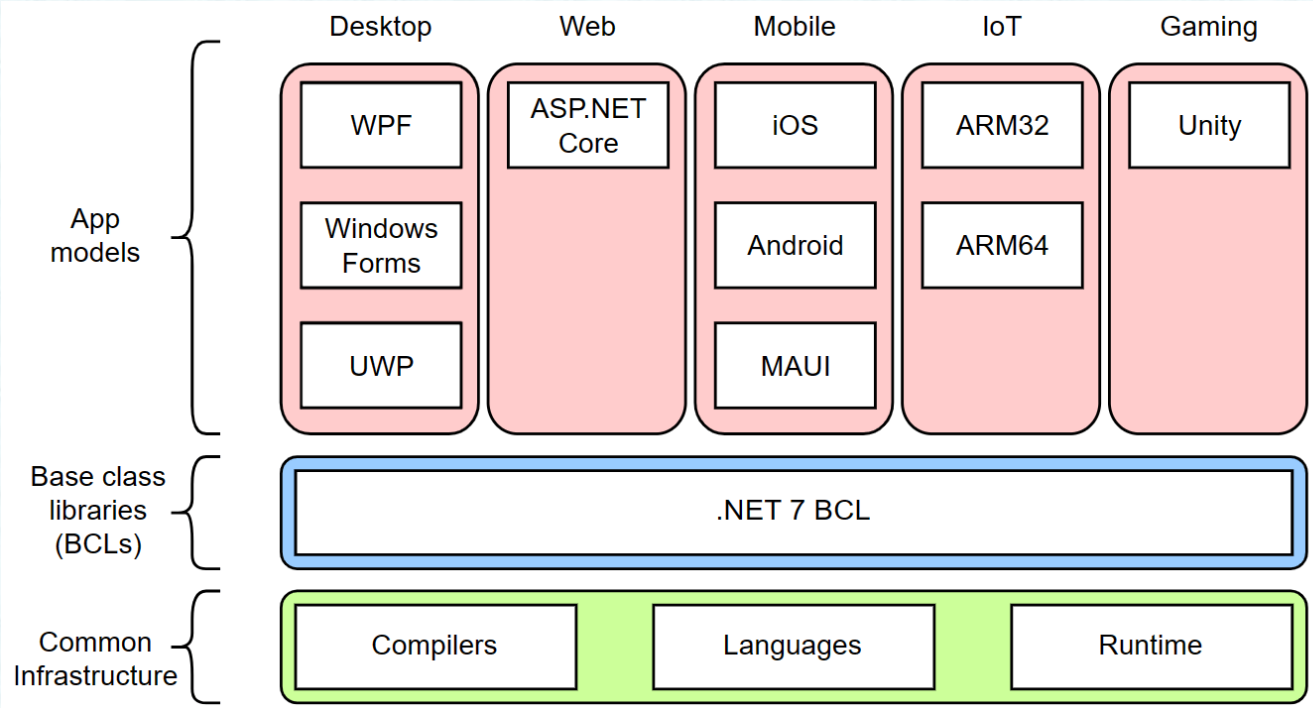
- The .NET Framework Class Library provides many capabilities that you can use to build substantial C# applications quickly and easily.
- It contains *thousands* of valuable *prebuilt* classes that have been tested and tuned to maximize performance.
- You should *re-use* the .NET Framework classes whenever possible to speed up the software-development process, while enhancing the quality and performance of the software you develop.

.NET Framework

- In addition to the CLR and CTS/CLS specifications, the .NET platform provides a base class library that is available to all .NET programming languages.

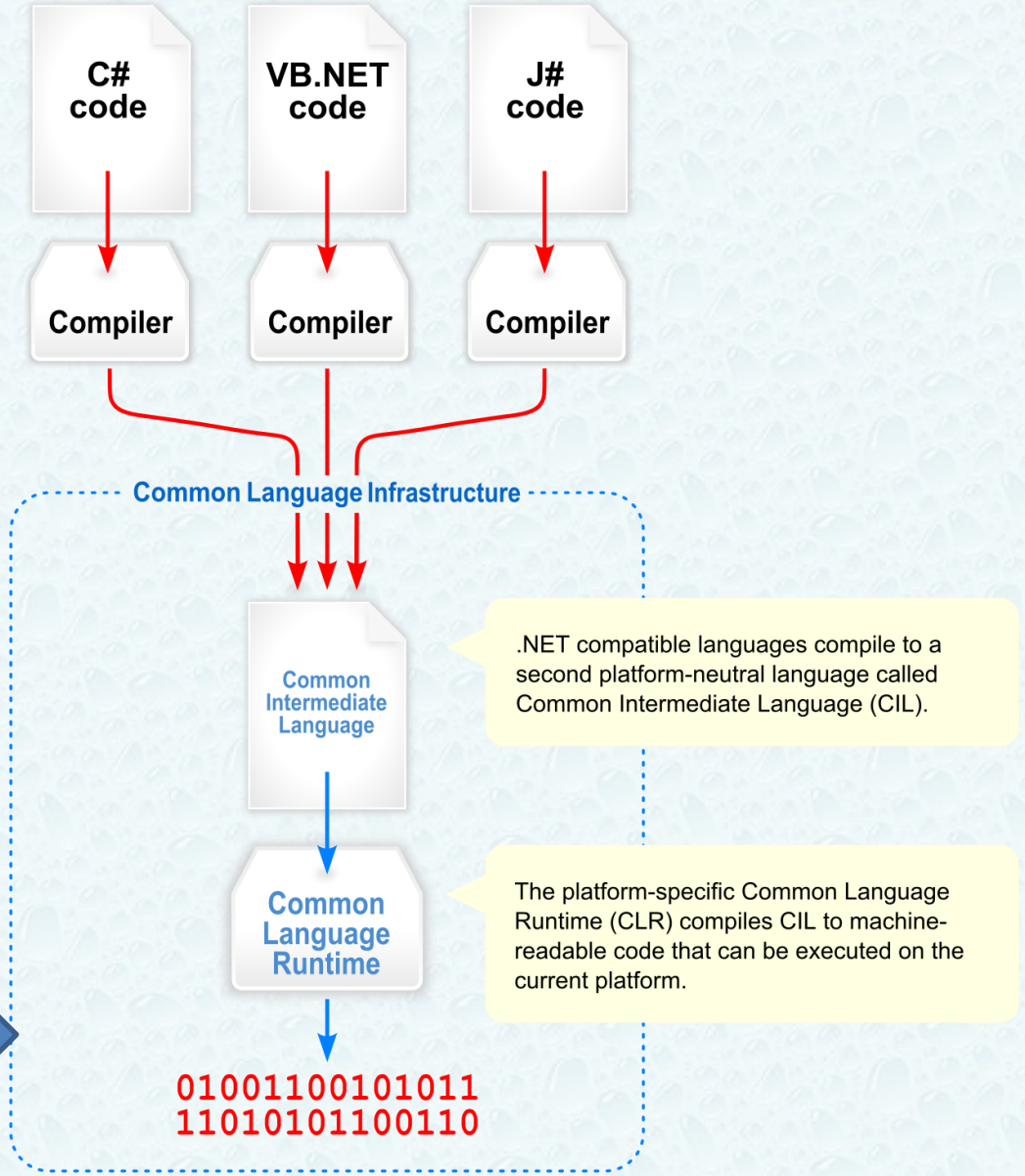


.NET Core Framework



Starting with .NET 5 and continuing in .NET 7 there is a single .NET platform which provides the BCL across all app models. All app models are based on the same underlying BCL.

Common Language Infrastructure (CLI)



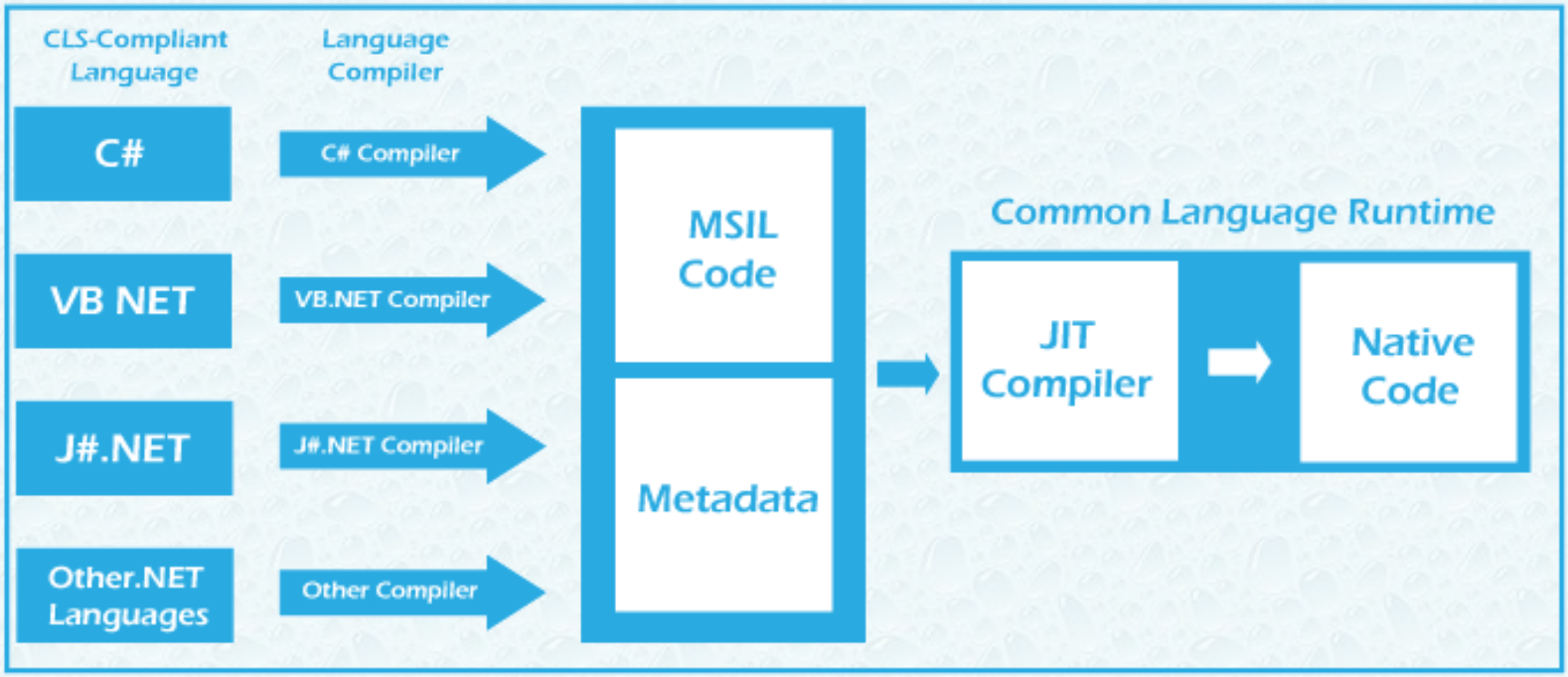
.Net:
Windows only

.Net Core:
any OS

Common Language Runtime

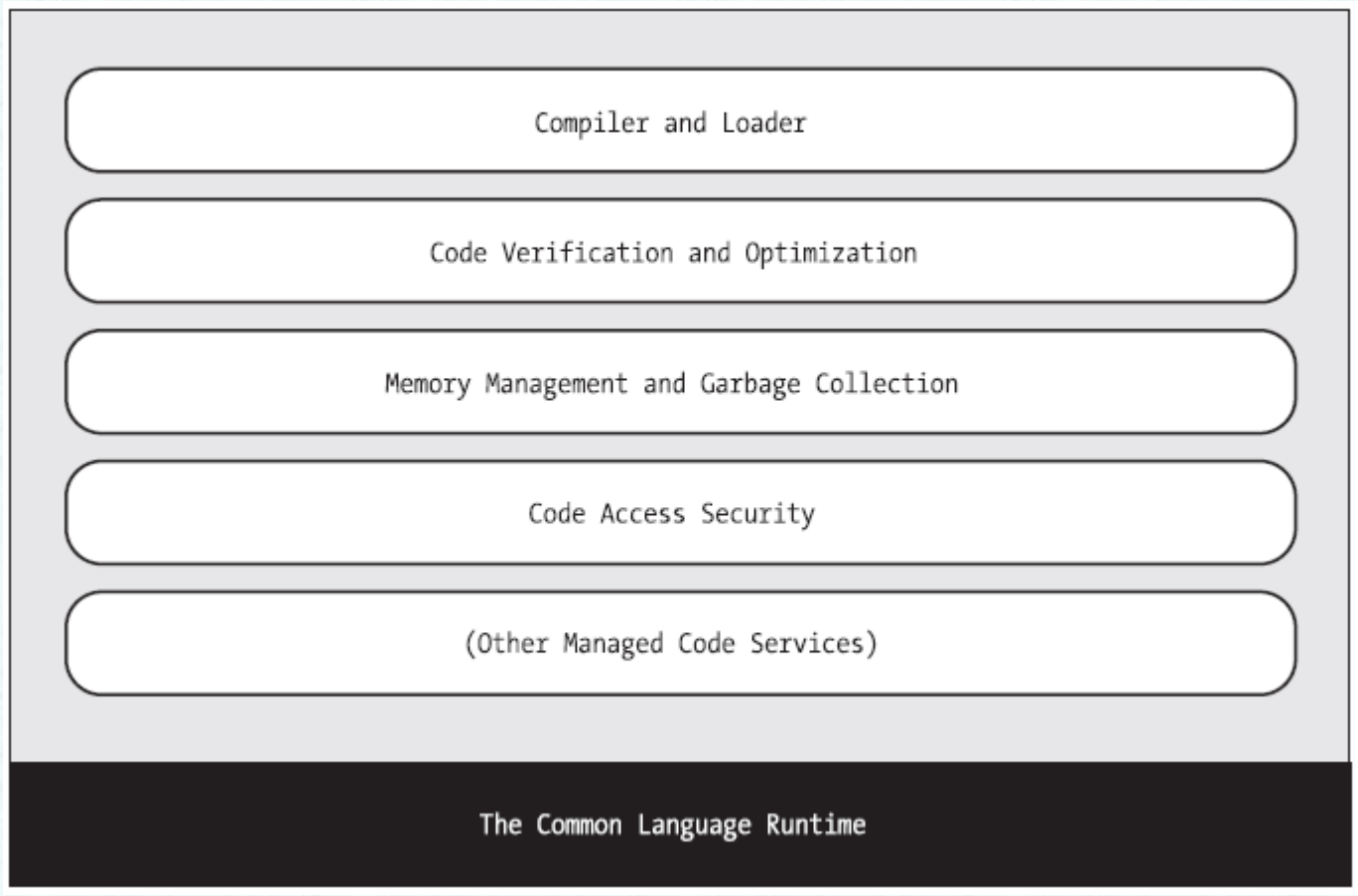
- The Common Language Runtime (CLR) executes .NET programs and provides functionality to make them easier to develop and debug.
- The CLR is a virtual machine (VM)—software that manages the execution of programs and hides from them the underlying operating system and hardware.
- The source code for programs that are executed and managed by the CLR is called managed code.

Common Language Infrastructure (CLI) - .Net Core Framework



Exceution of a .NET Application

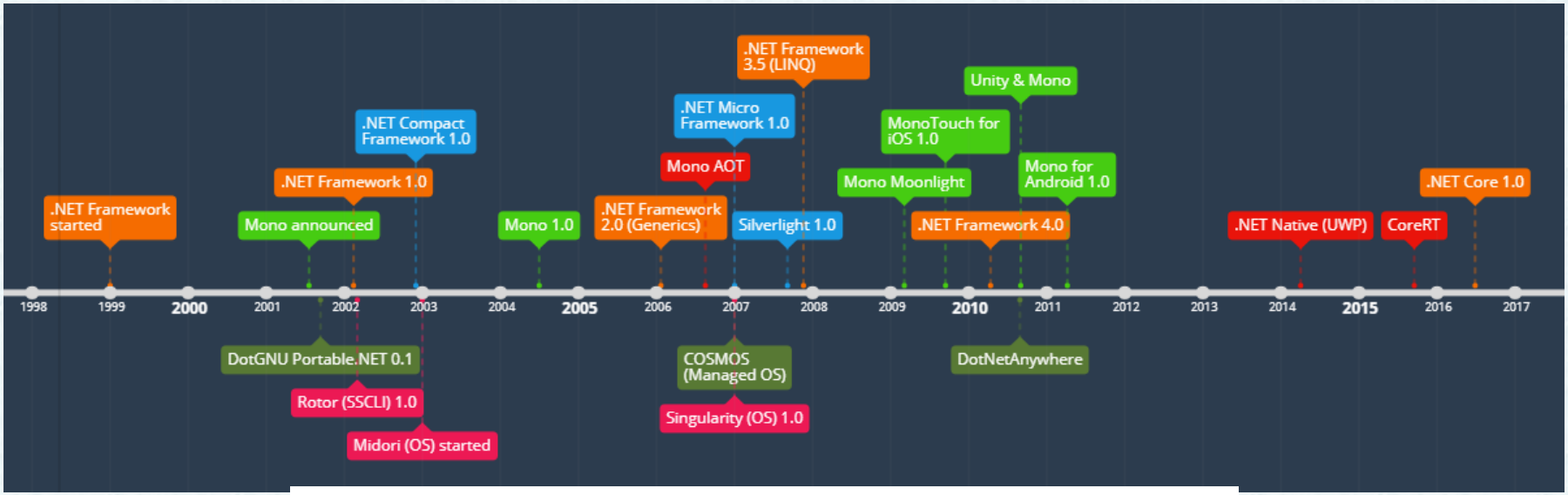
Common Language Runtime (CLR)



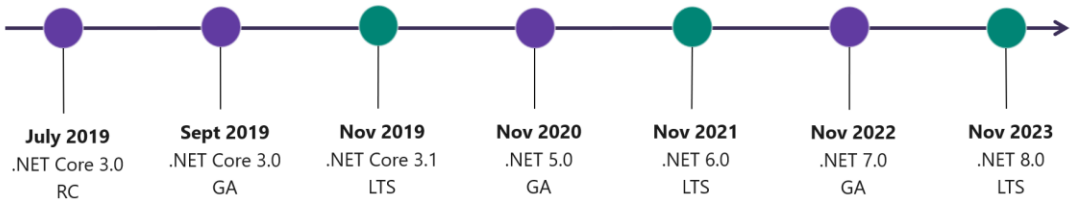
Intermediate Language (IL)

- All .NET languages are compiled into another low-level language before the code is executed
- This lower-level language is the Common Intermediate Language (CIL, or just IL)
- Because of this feature, C# programs can use VB.NET (or any other .NET language) components
- Every EXE or DLL file built with a .NET language contains IL code
- .NET Framework should be installed on the computer that the .NET program is deployed

History of .NET

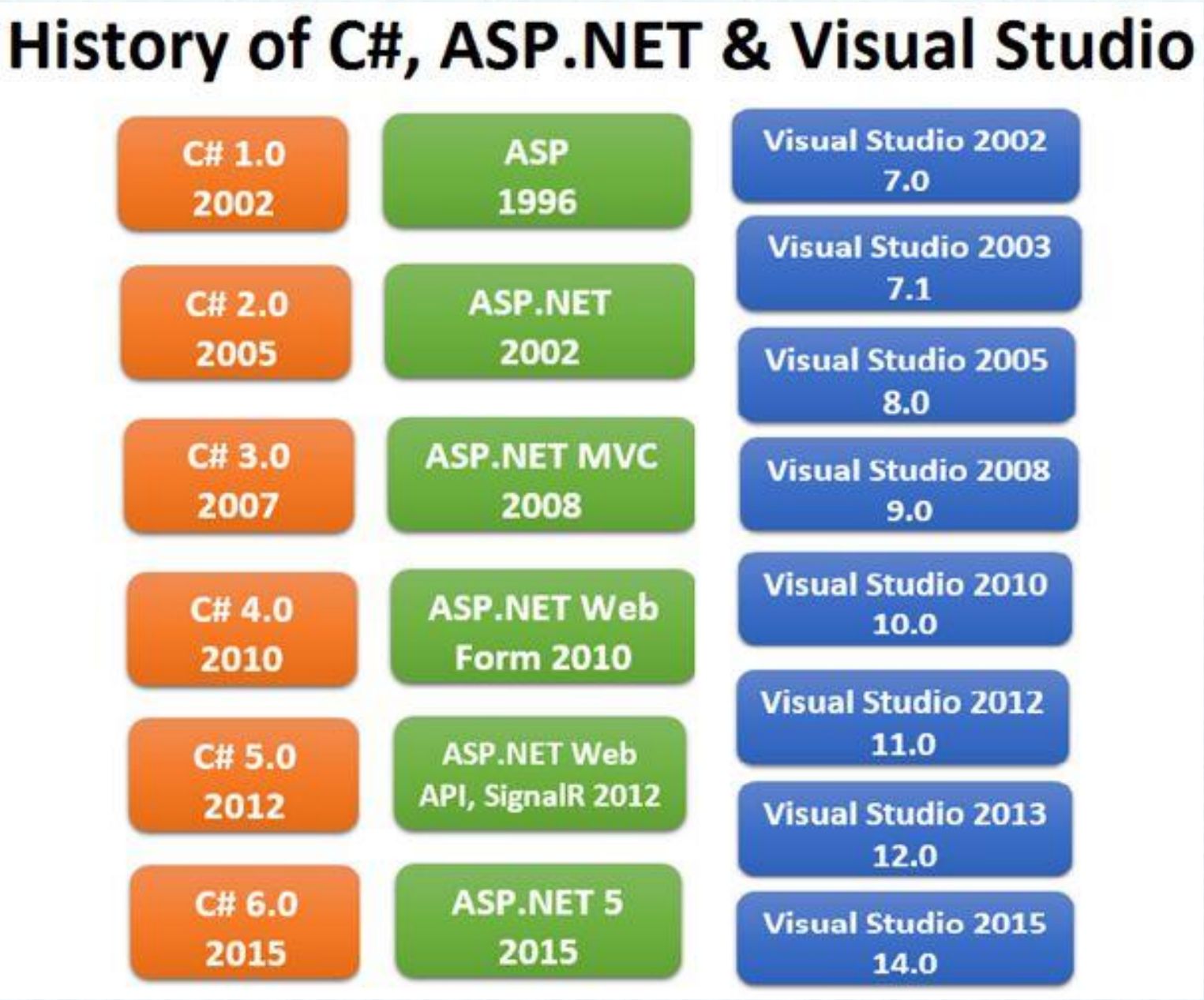


.NET Schedule



- .NET Core 3.0 release in September
- .NET Core 3.1 = Long Term Support (LTS)
- .NET 5.0 release in November 2020
- Major releases every year, LTS for even numbered releases
- Predictable schedule, minor releases if needed

History of C#, ASP.NET & Visual Studio



Application Types

- Use to develop the following types of apps and services:
  - Console apps. (black screen)
  - Windows GUI apps (Windows Forms).
  - ASP.NET apps.
  - Windows services.
  - Windows Presentation Foundation (WPF) apps.
  - Service-oriented apps using Windows Communication Foundation (WCF).
  - Workflow-enabled apps using Windows Workflow Foundation (WF).

Link: https://docs.microsoft.com/en-us/dotnet/framework

ASP.Net Core Frameworks

- ASP.NET offers four primary development frameworks
  - ASP.NET Web Forms
    - Declarative and control-based programming similar to Windows Forms.
    - Build a web application without having experience in HTML and JavaScript.
  - ASP.NET MVC
    - Use patterns and principles like test-driven development and separation of concerns.
    - Separating the business logic layer of a web application from its presentation layer.
  - ASP.NET Web Pages
    - In the Web Pages model, you create HTML pages and then add server-based code to the page in order to dynamically control how that markup is rendered.
      - Using HTML controls for existing HTML pages
  - ASP.NET Single Page Application
    - ASP.NET Single Page Application (SPA) helps you build applications that include significant client-side interactions using HTML 5, CSS 3 and JavaScript.
    - New template for building single page applications using **ASP.NET Web API**.

.NET Languages

- The .NET Framework is a language-independent platform that allows interoperability among the supported programming languages.
- The framework supports these programming languages:
  - C#:
    - object-oriented programming language
    - Offers type-safety, scalability support, garbage collection, and other productivity-enhancing features.
    - Easy to use and can reduce application development time.
  - F#:
    - Open-source, cross-platform language with object-oriented and imperative programming capabilities.
    - Core functional programming language for .NET.
  - Visual Basic:
    - build object-oriented apps.
    - Type-safety and uses simple syntax.
  - Developers can also use managed C++, Python, COBOL, Ruby and many other languages found in the Visual Studio Languages to code in .NET.

.NET Languages

- C# is designed for .NET technology
- C# and VB.NET uses the same .NET library
- C# and VB.NET codes are very similar
- Both C# and VB.NET are object-oriented languages
- A C# programmer can easily understand and convert VB.NET programs

Main C# features

- .NET 1.0 (released 2001) - C# version 1.0
  - No pointers required.
  - Automatic memory management through garbage collection.
    - C# does not support a delete keyword.
  - Formal syntactic constructs for classes, interfaces, structures, enumerations, and delegates.
  - Overload operators for a custom type

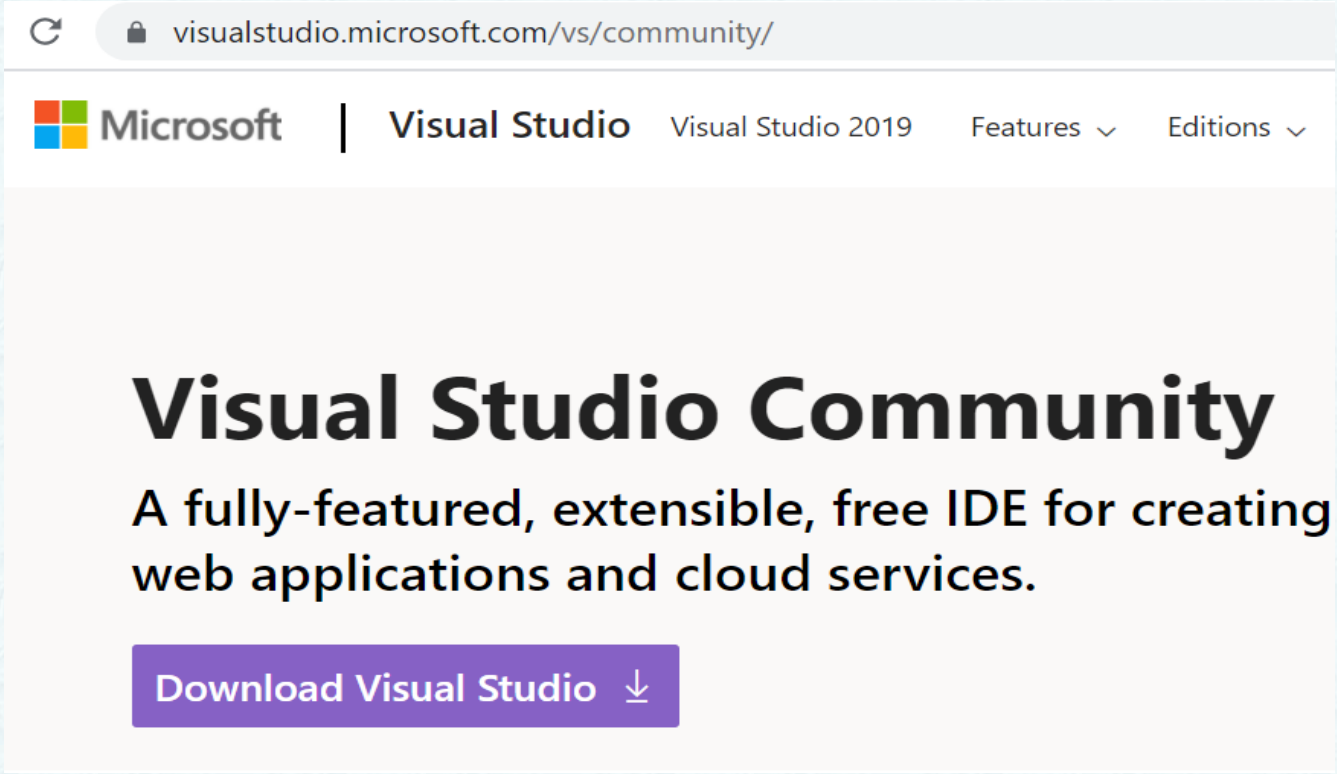
- .NET 2.0 (released 2005) - C# version 2.0
  - Generics - defer the specification of types until the class or method is declared
  - Anonymous methods - inline function anywhere a delegate type is required.
  - Partial keyword - single class across multiple code files.
  - Nullable value types – adding null values to value types
  - Iterators are used to step through collections such as lists and arrays
  - Covariance and contravariance - implicit reference conversion for array types and delegate types.

Main C# features

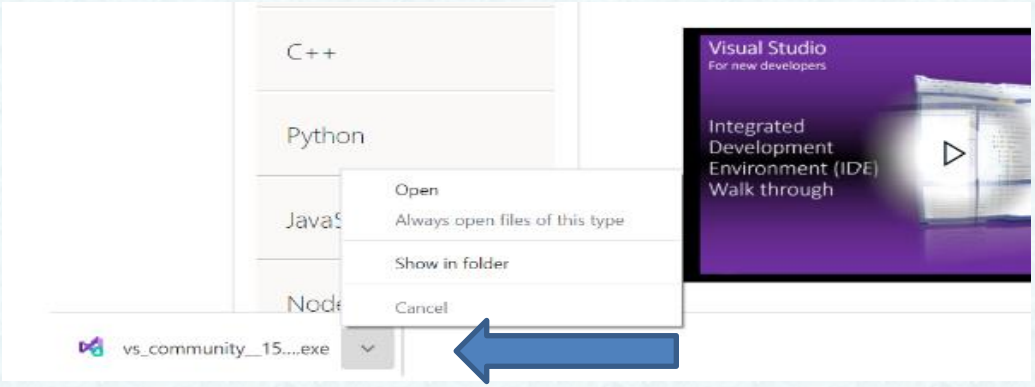
- .NET 3.5 (released 2008) - C# version 3.0
  - Auto-implemented properties - no additional logic is required in the property accessors.
  - Strongly typed queries (e.g., LINQ) - set of instructions that describes what data to retrieve
  - Anonymous types read-only properties into a single object without having to define a type
  - Extension methods - extend the functionality of an existing type (without subclassing)
  - Lambda operator (=>) further simplifies working with .NET delegate types.
- .NET 4.0 (released 2010) - C# version 4.0
  - Optional method parameters, as well as named method arguments.
  - dynamic binding - dynamic lookup of members at runtime.
- .NET 4.5. (Released 2012) - C# version 5.0
  - async and await, which massively simplify multithreaded and asynchronous programming.
- .NET 4.6 (Released 2015) - C# version 6.0
  - Release many smaller features
    - Static imports, Exception filters, Auto-property initializers, Expression bodied members, Null propagator, String interpolation, nameof operator, Index initializers.
- .NET Core (Released 2017) - C# version 7.0 – Cross Platforms (working in different OS)
  - Azure Support, AI Support
  - Improved performance and productivity
    - Out variables, Tuples and deconstruction, Pattern matching, Local functions, Expanded expression bodied members, Ref locals and returns

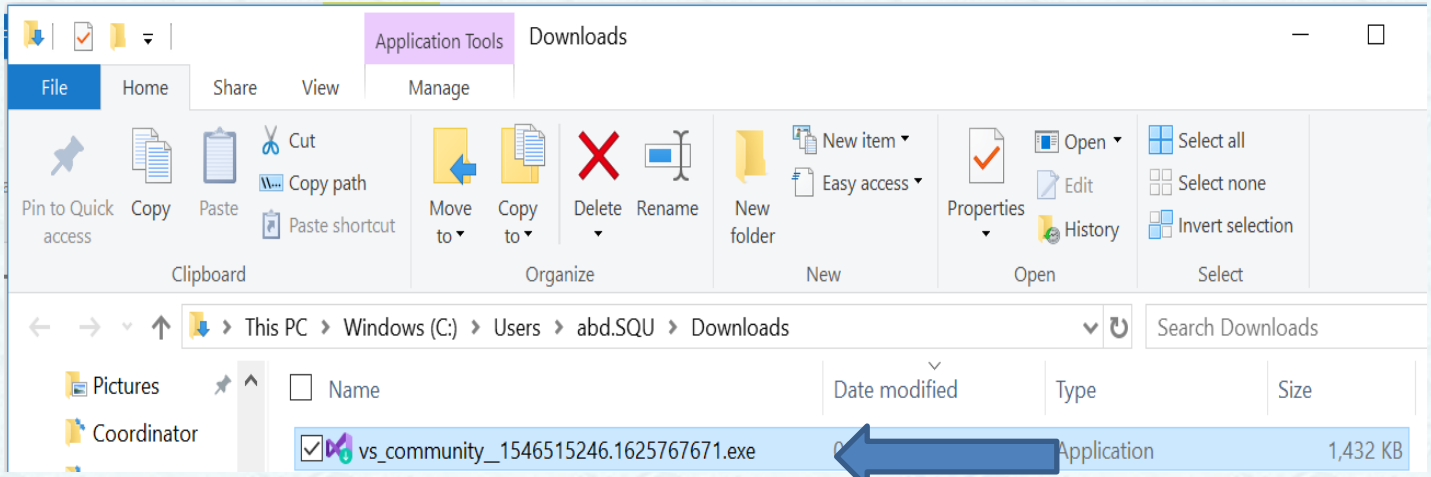
Installing Visual Studio 2019

- **Website: https://visualstudio.microsoft.com/vs/community**



Installing Visual Studio 2019





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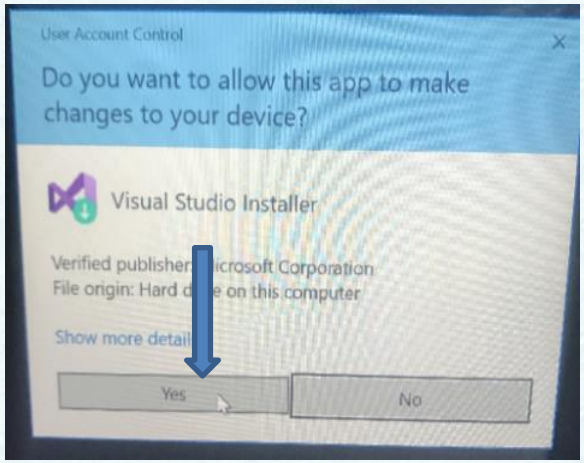

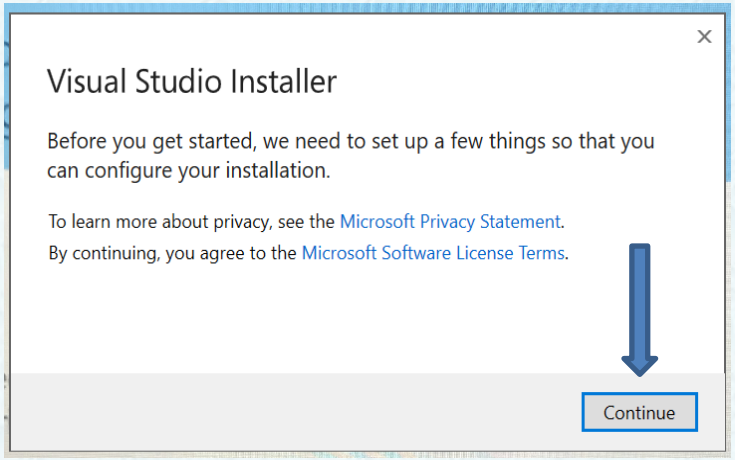

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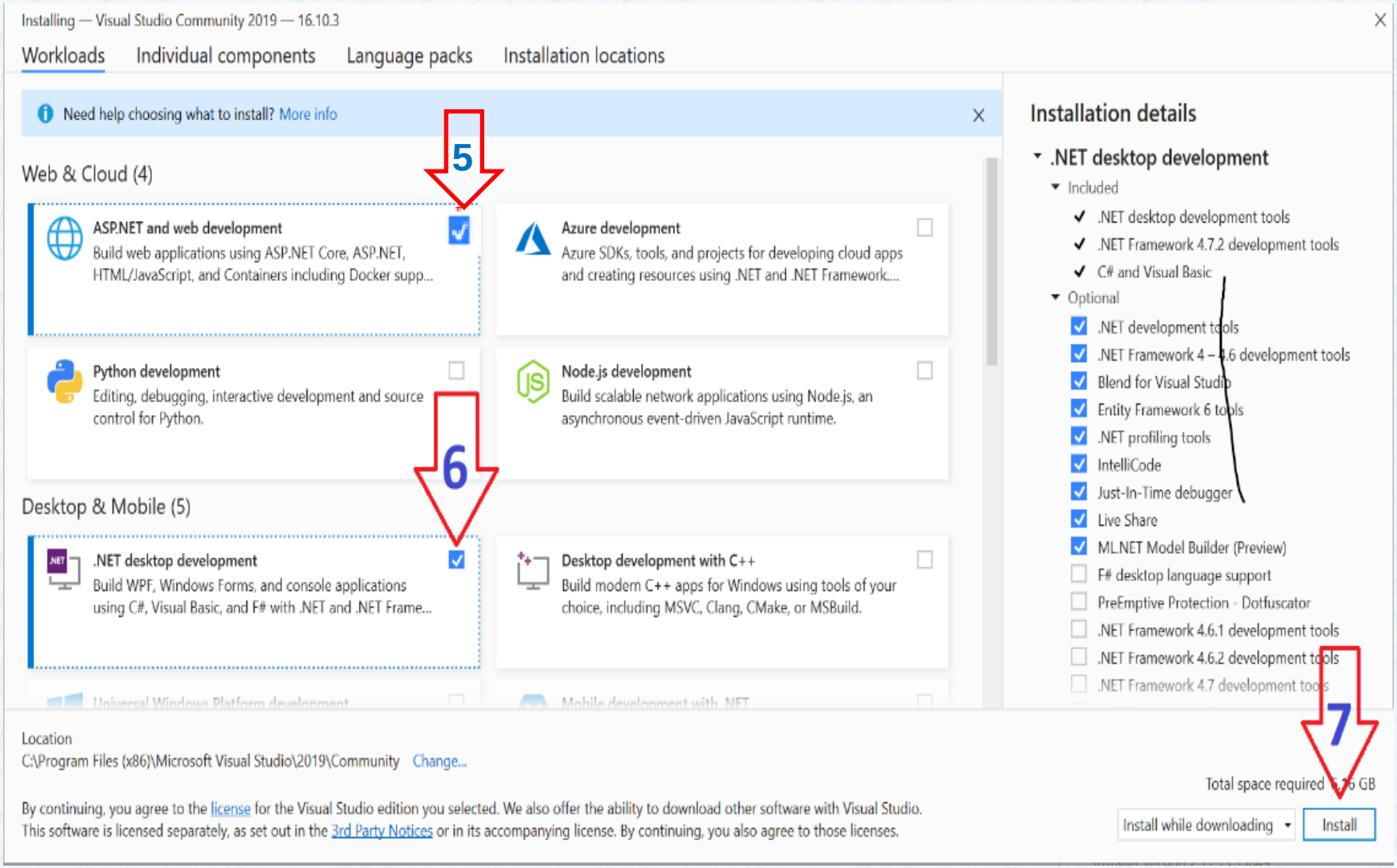

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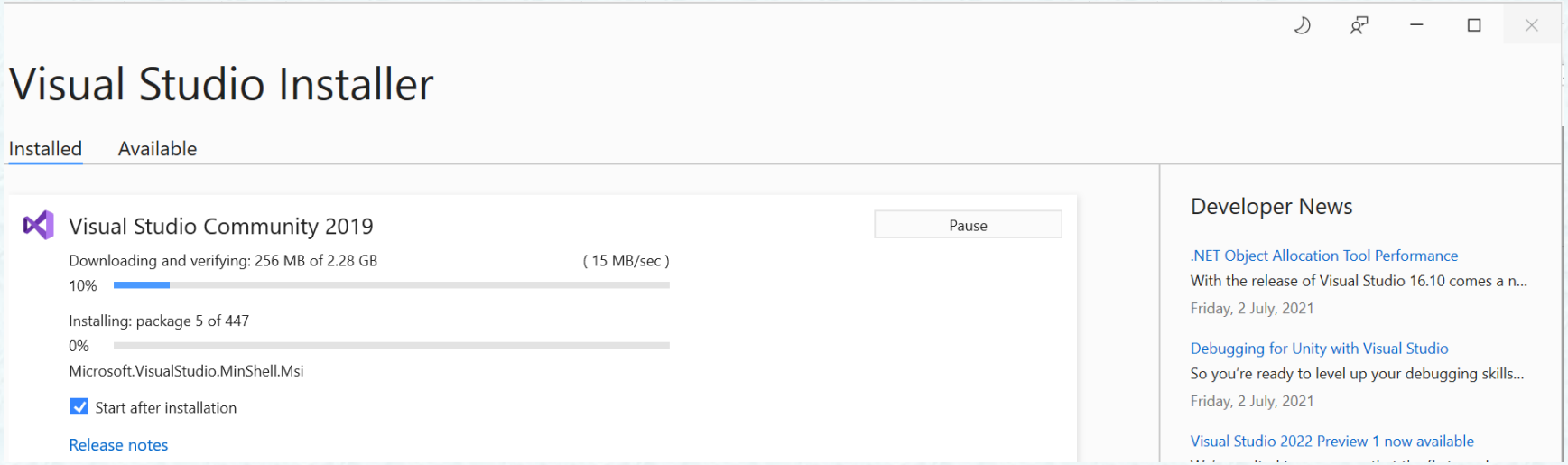
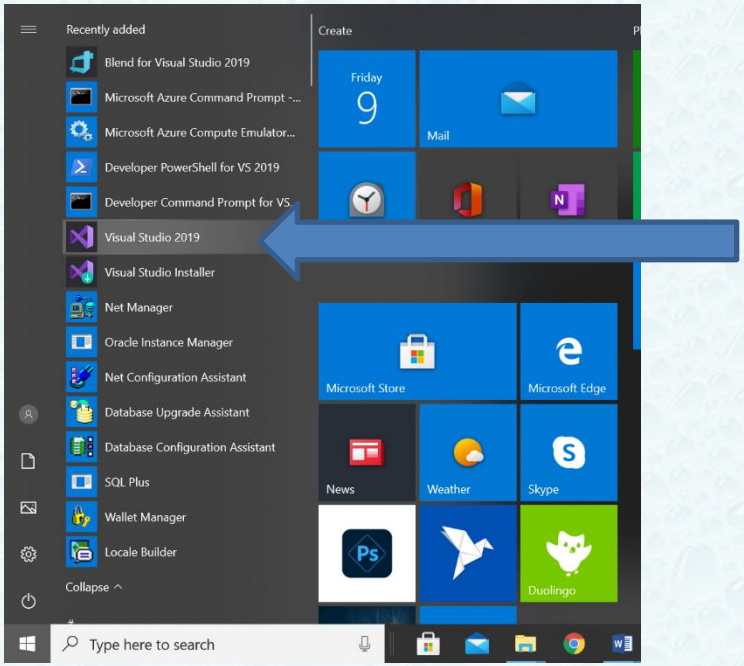
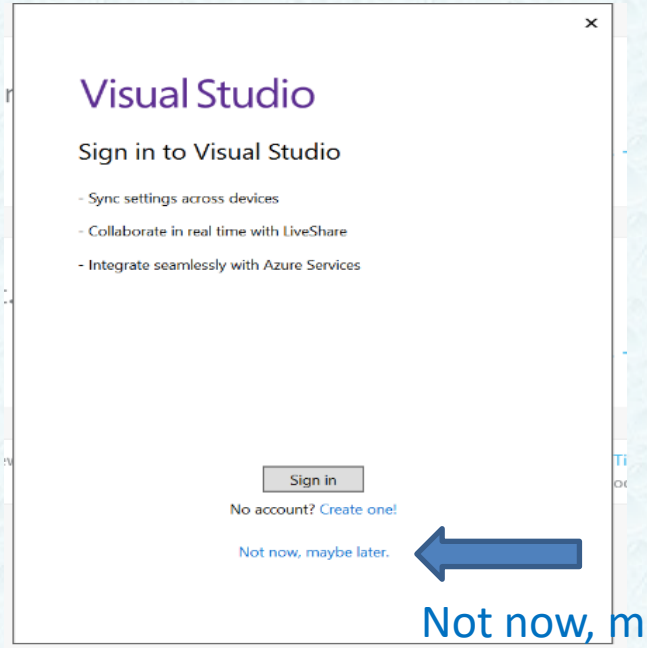


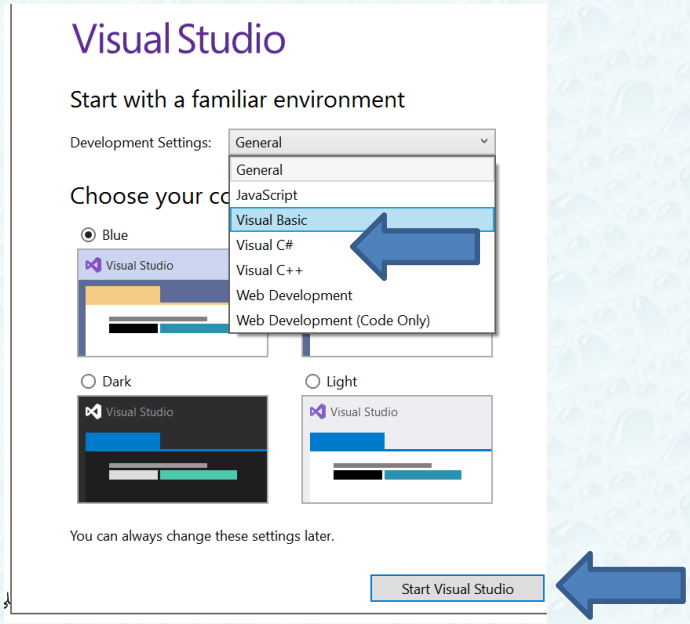


Launching Visual Studio

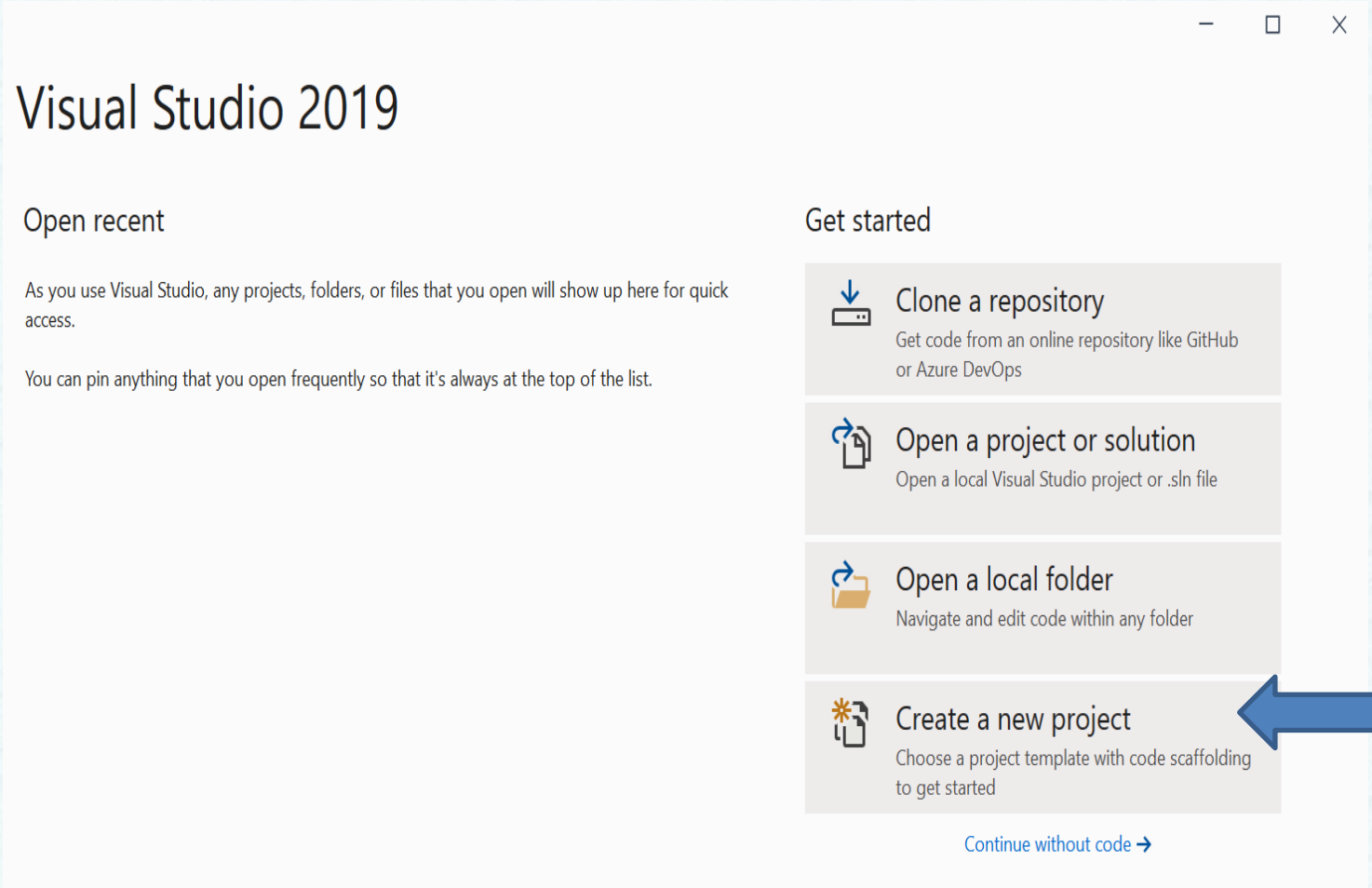
Opening Visual Studio 2019 for the first time



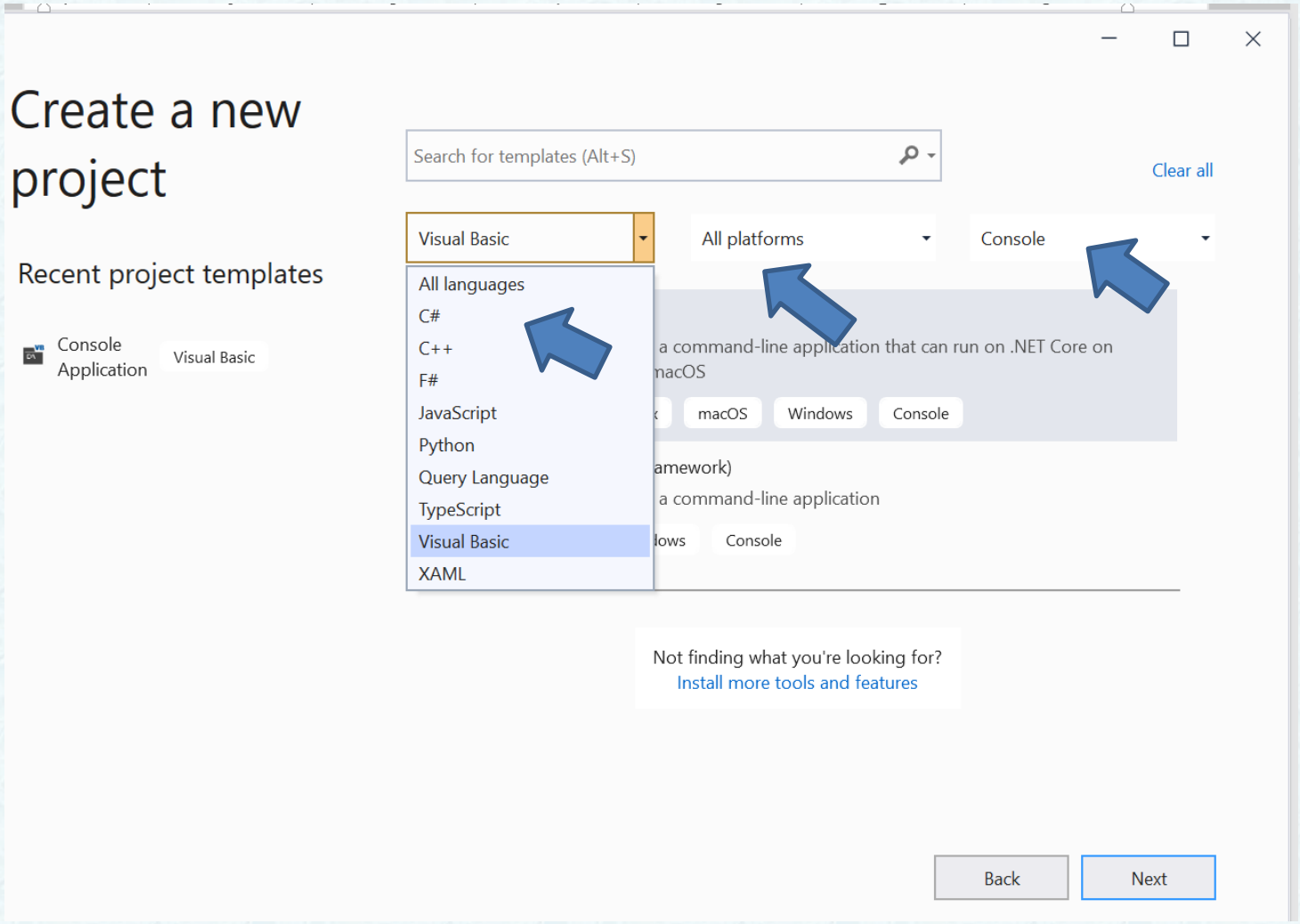
Not now, maybe later



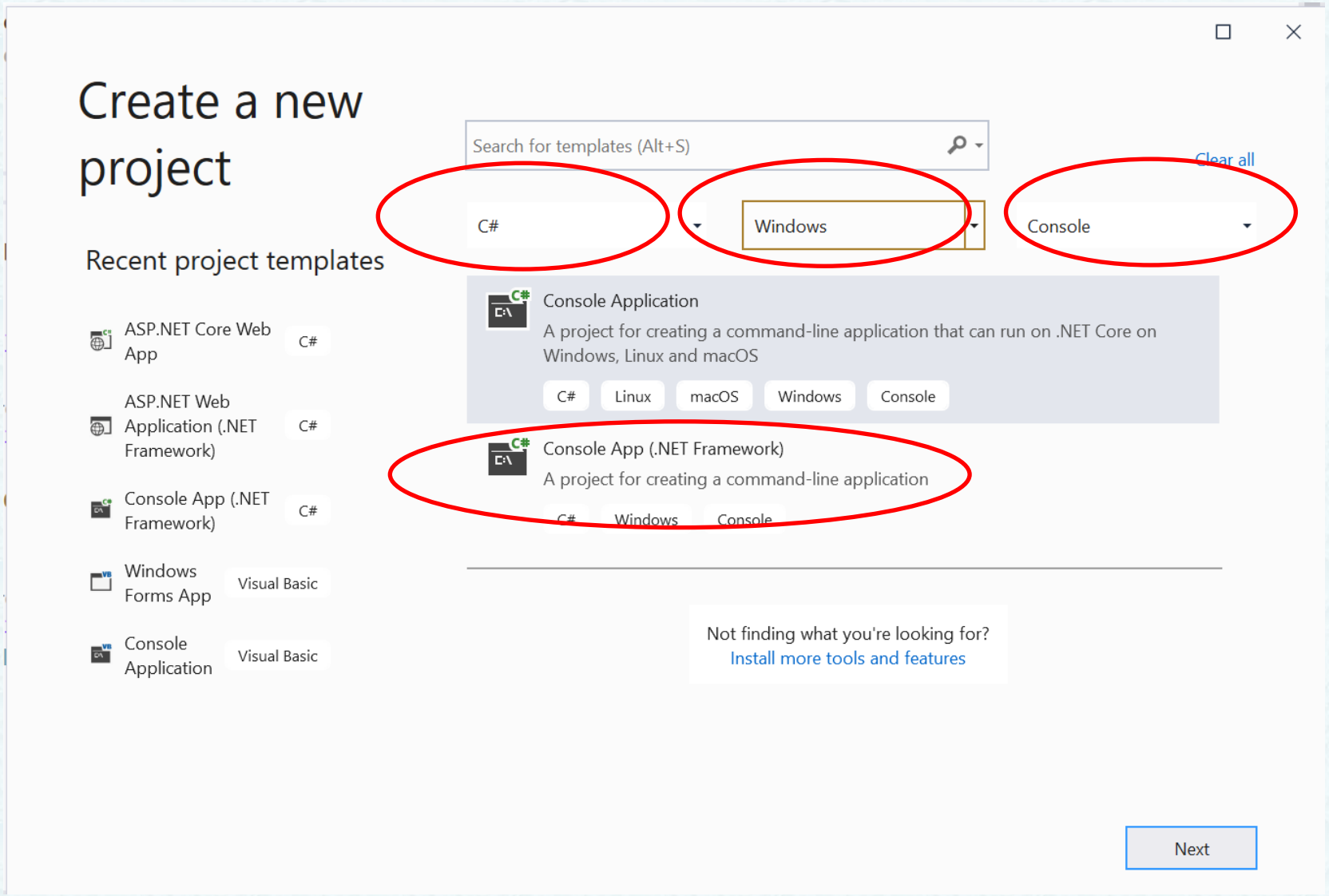
Create a New Project



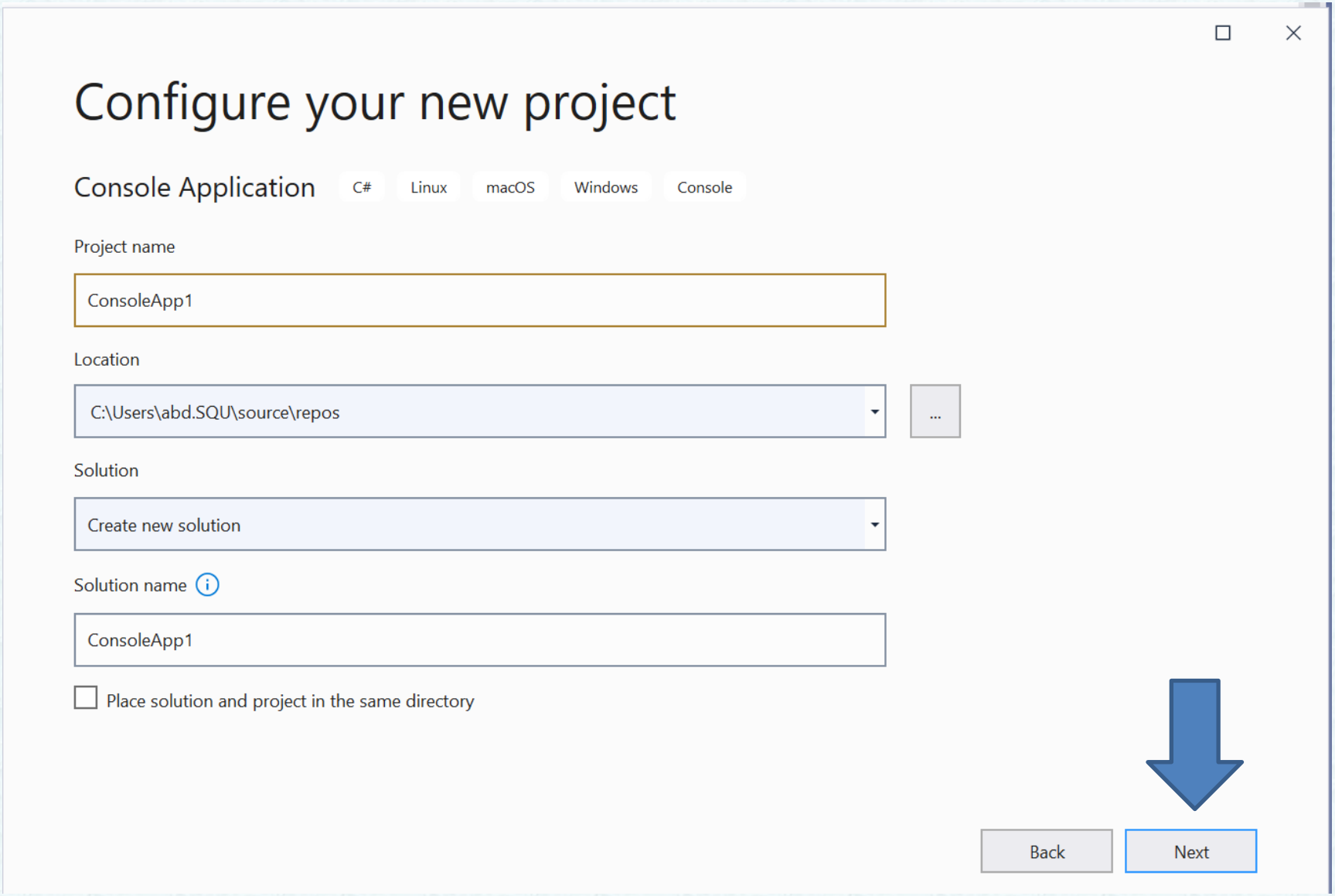
Choosing the application Type



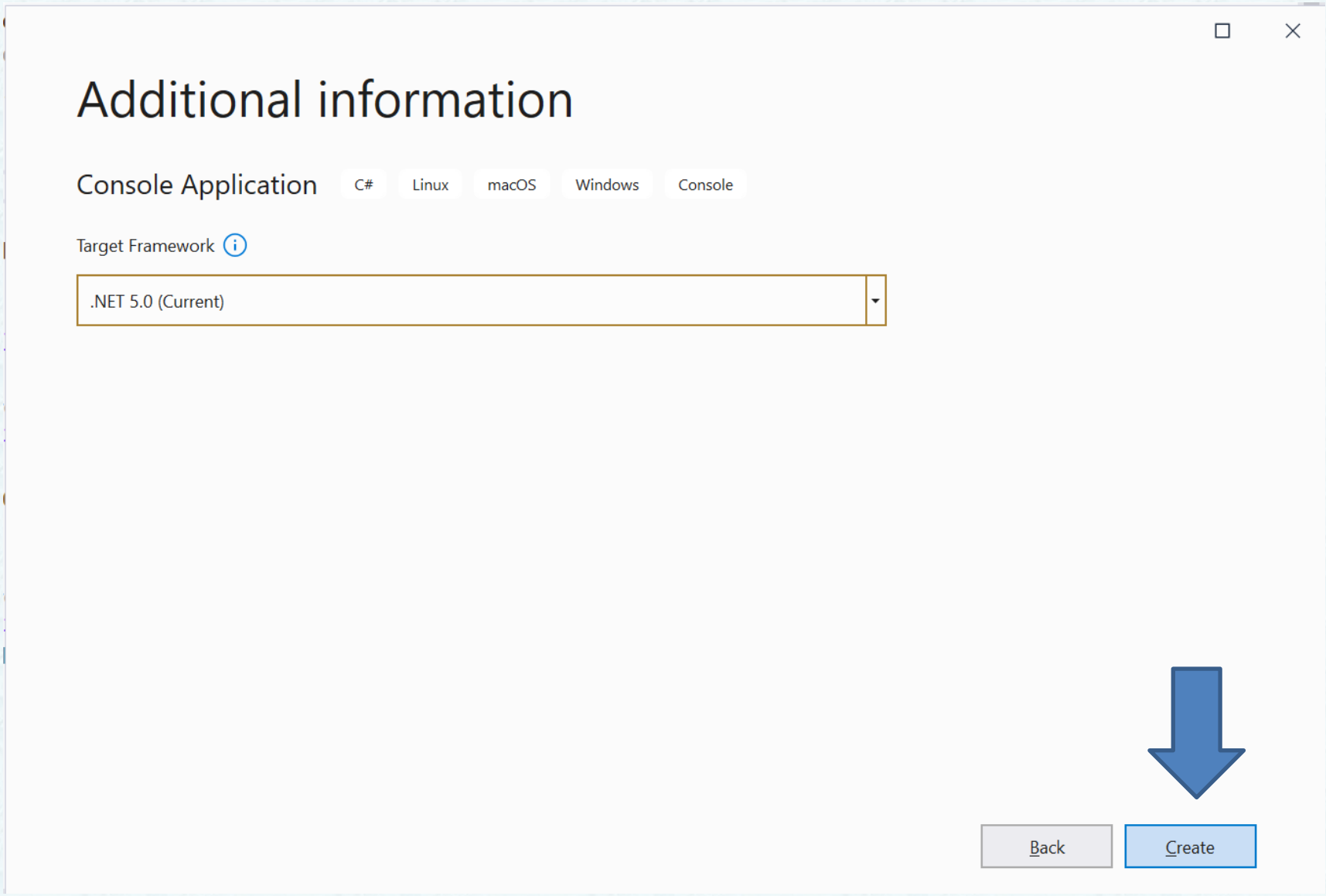
Creating C# Application



Creating C# Application



Creating C# Application



FIRST C# Application