

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

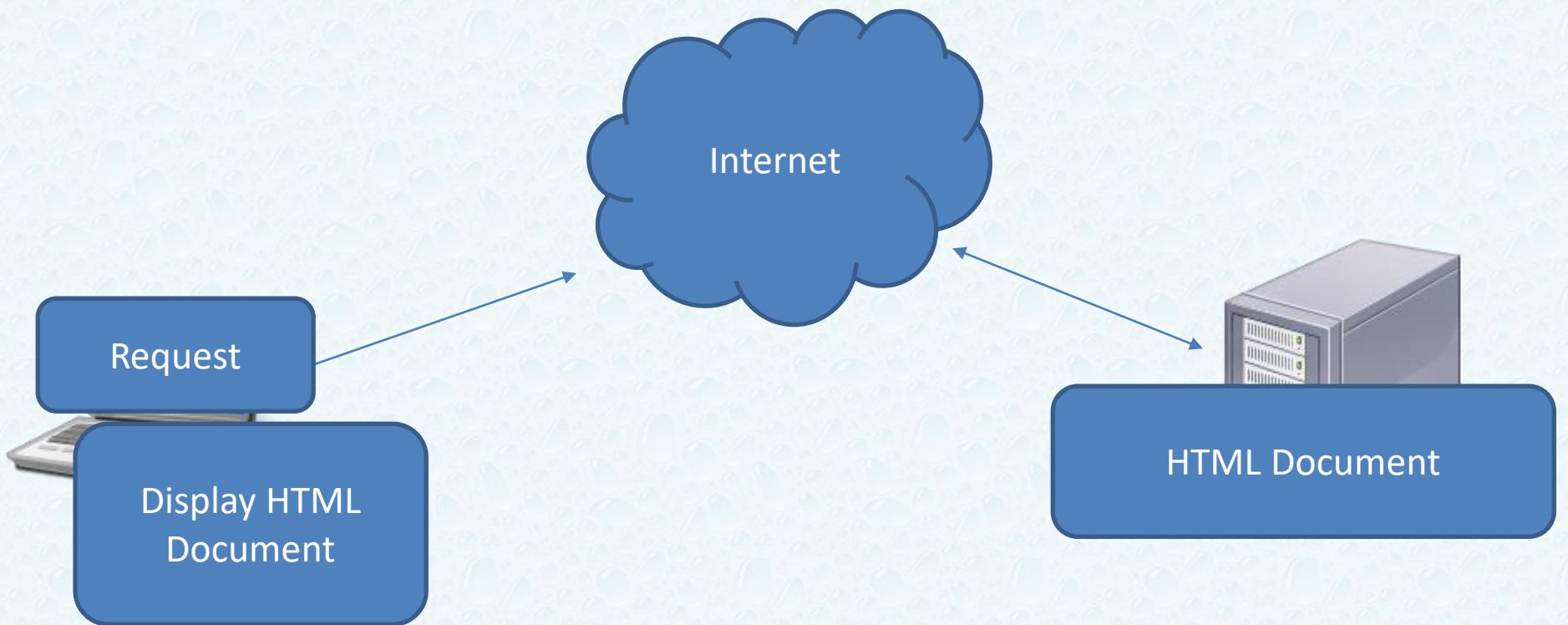
HTML Example

```
<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



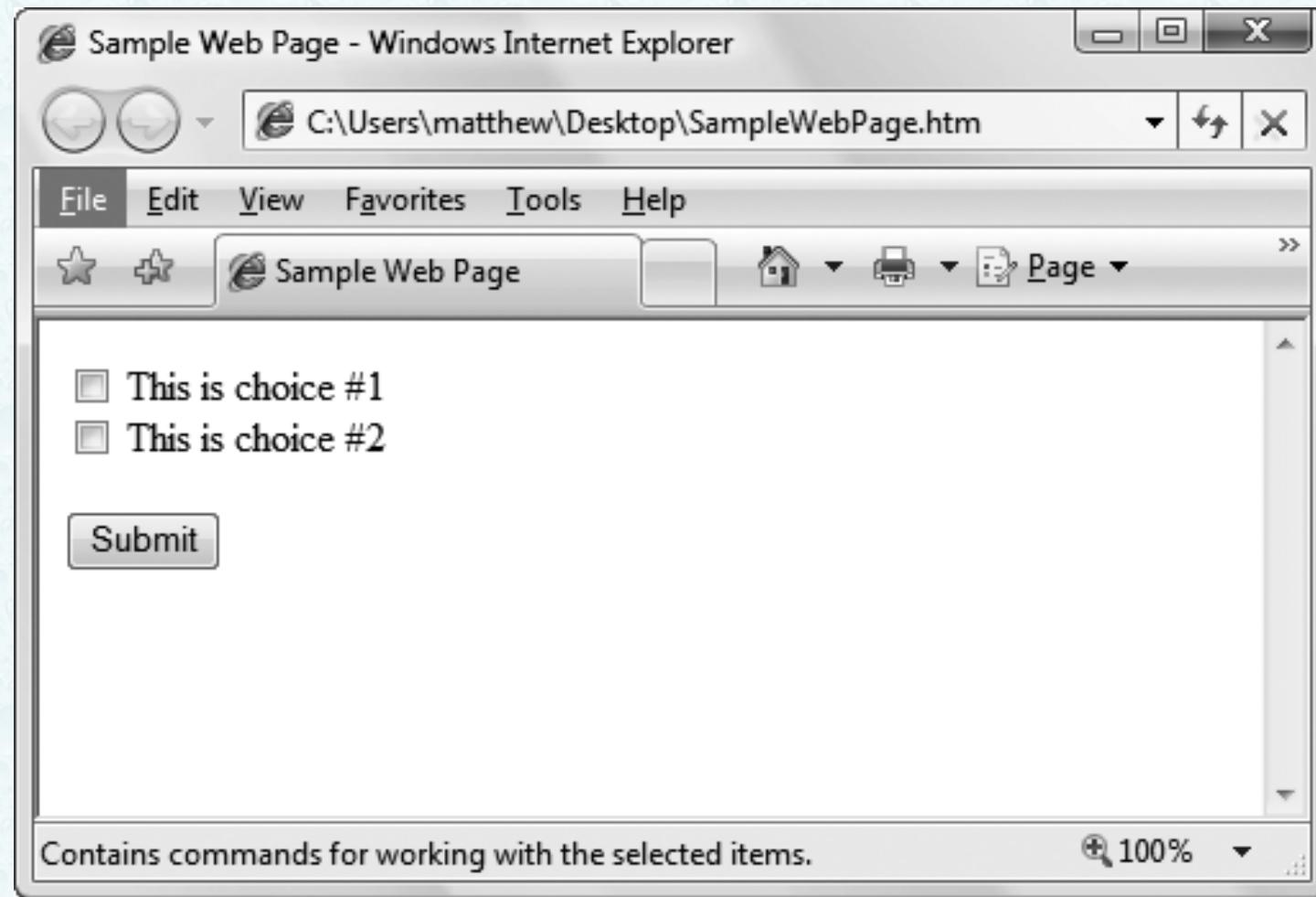
Browsers

- 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**:

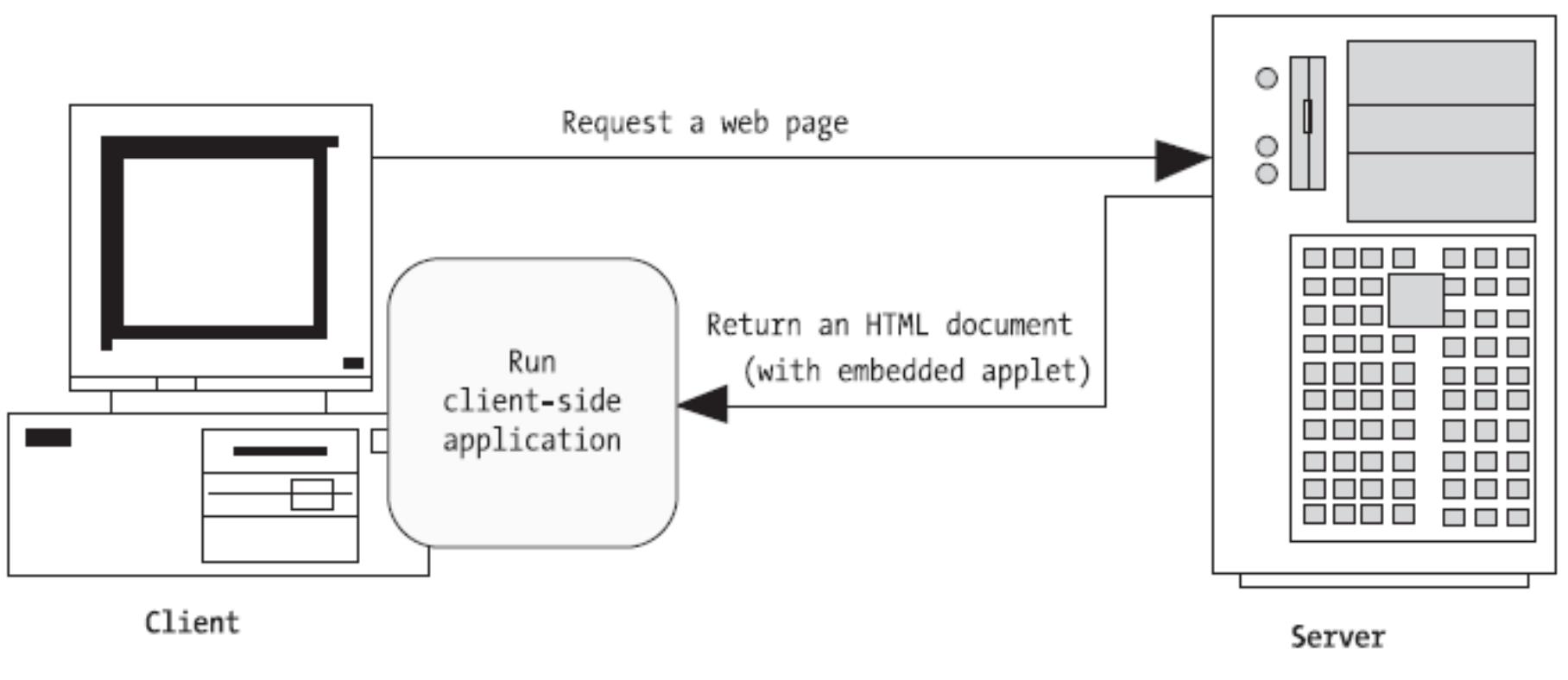
```
<form method="GET">...</form>  
<form method="POST">...</form>
```

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=oман&hl=en>

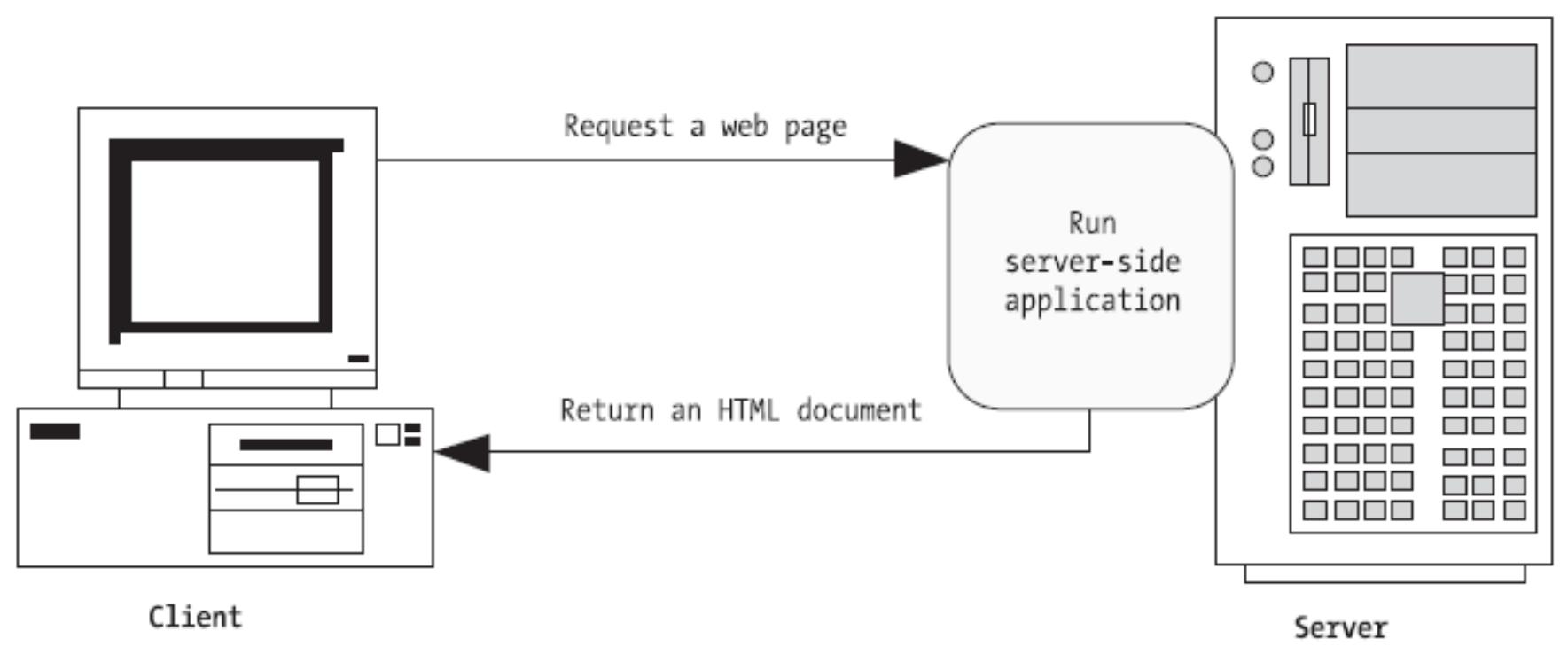
A Client-Side Web Application



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.

The Base Class Libraries

Database Access

Desktop GUI APIs

Security

Remoting APIs

Threading

File I/O

Web APIs

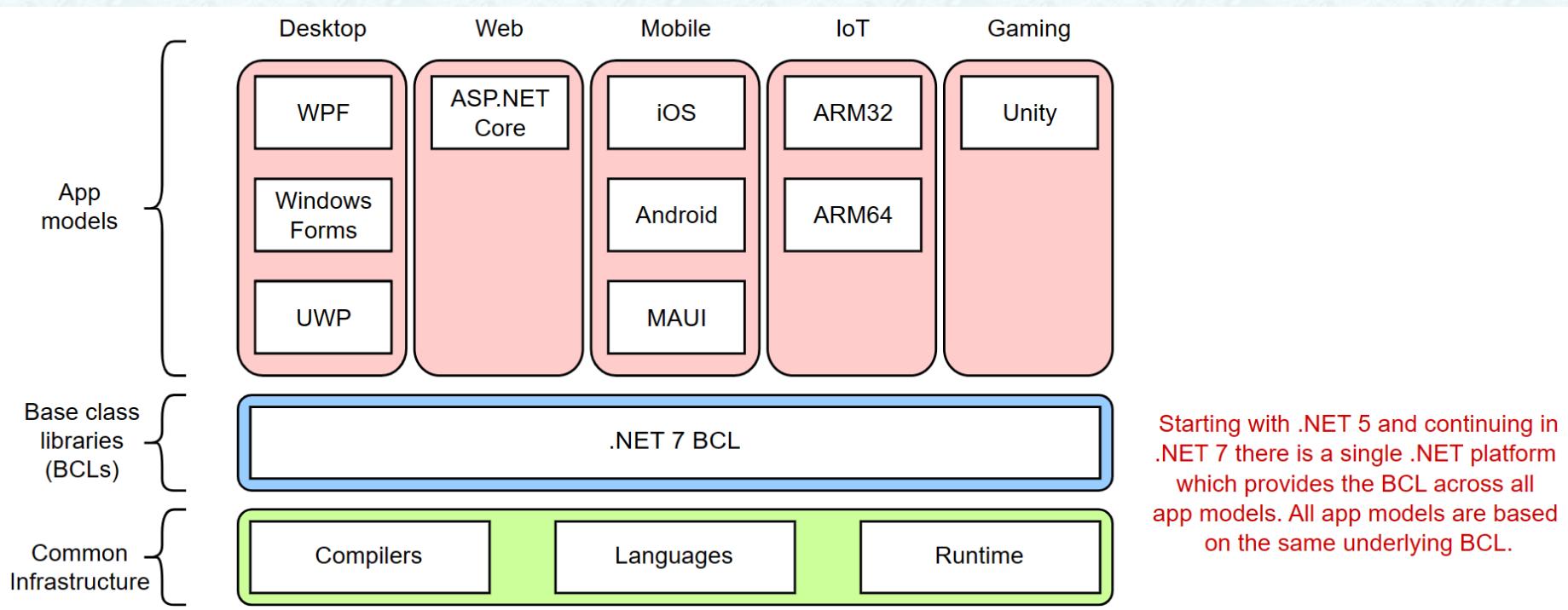
(et al.)

The Common Language Runtime

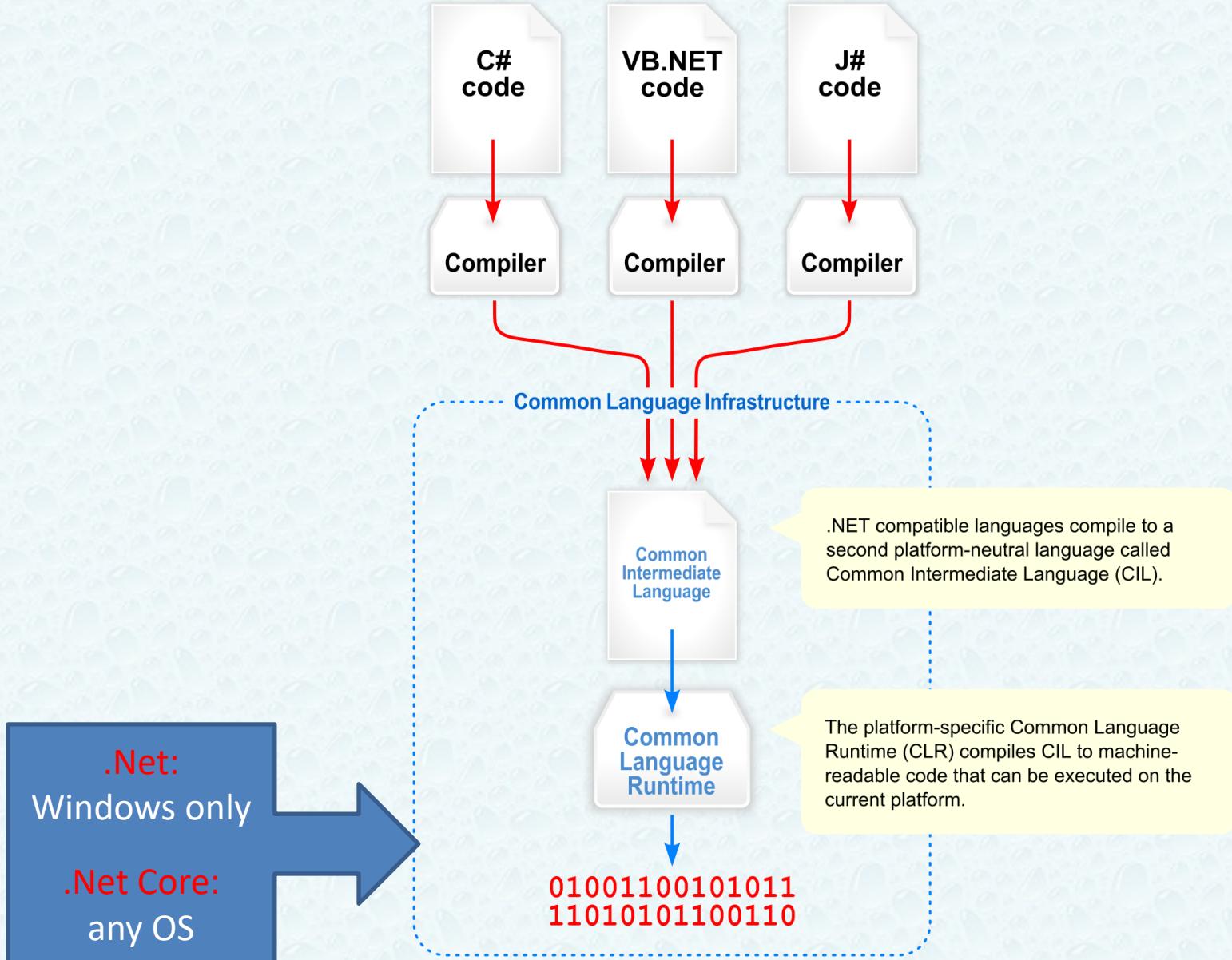
Common Type System

Common Language Specification

.NET Core Framework



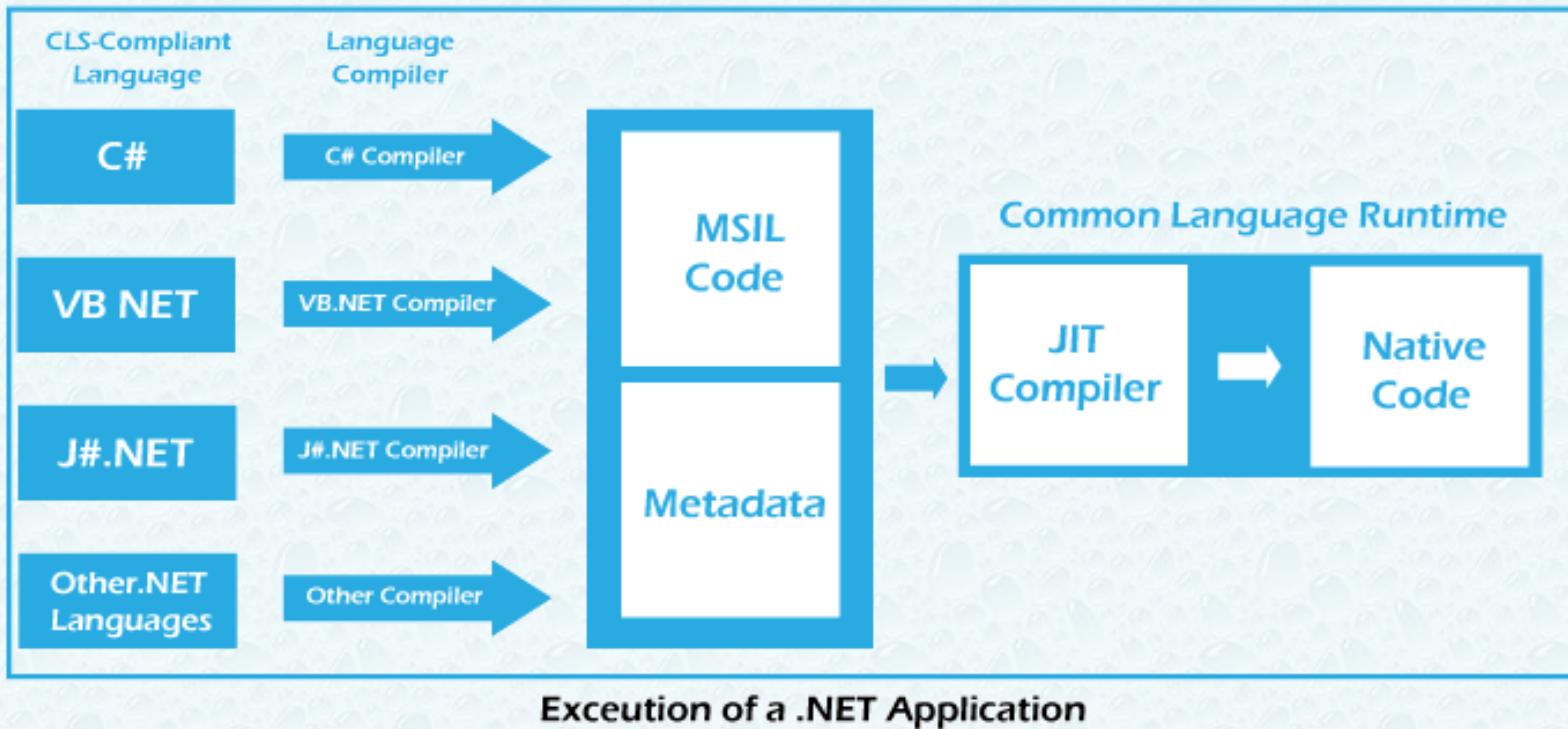
Common Language Infrastructure (CLI)



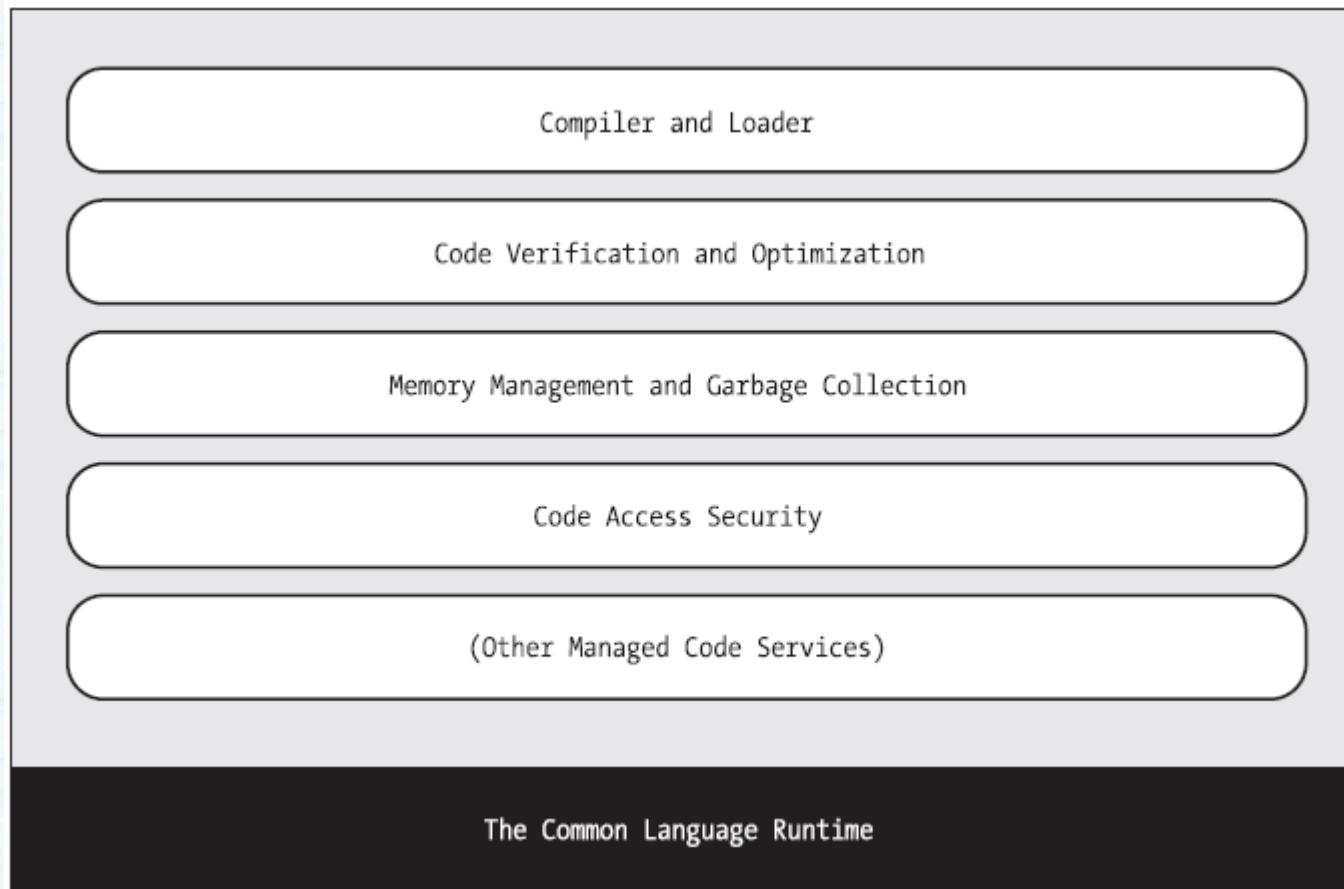
Common Language Runtime

- 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



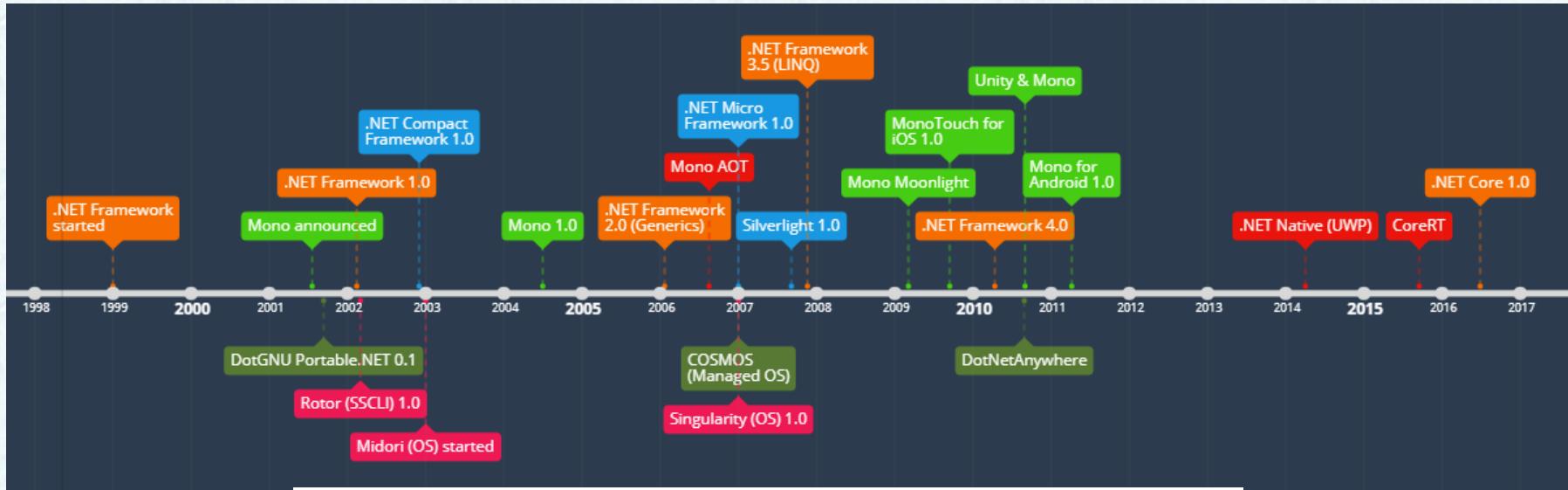
Common Language Runtime (CLR)



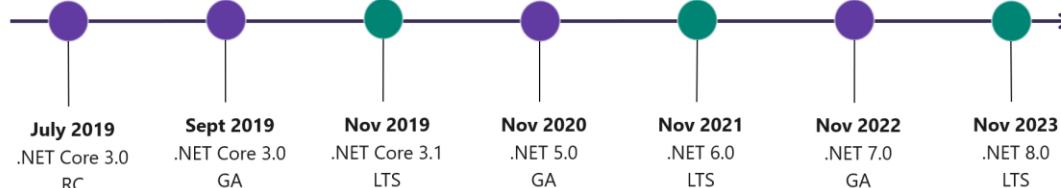
Intermediate Language (IL)

- 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

C# 1.0
2002

ASP
1996

Visual Studio 2002
7.0

C# 2.0
2005

ASP.NET
2002

Visual Studio 2003
7.1

C# 3.0
2007

ASP.NET MVC
2008

Visual Studio 2005
8.0

C# 4.0
2010

ASP.NET Web
Form 2010

Visual Studio 2008
9.0

C# 5.0
2012

ASP.NET Web
API, SignalR 2012

Visual Studio 2010
10.0

C# 6.0
2015

ASP.NET 5
2015

Visual Studio 2012
11.0

Visual Studio 2013
12.0

Visual Studio 2015
14.0

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.

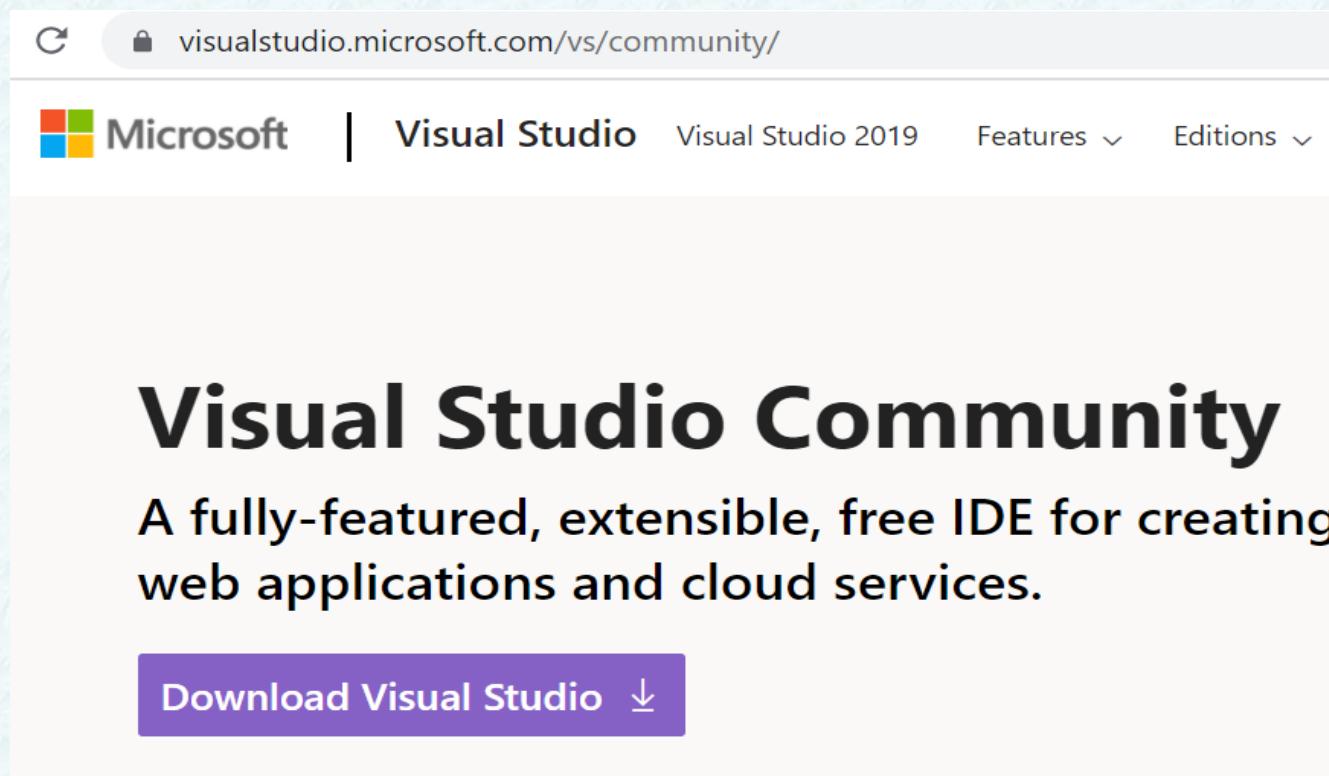
Main C# features

- .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

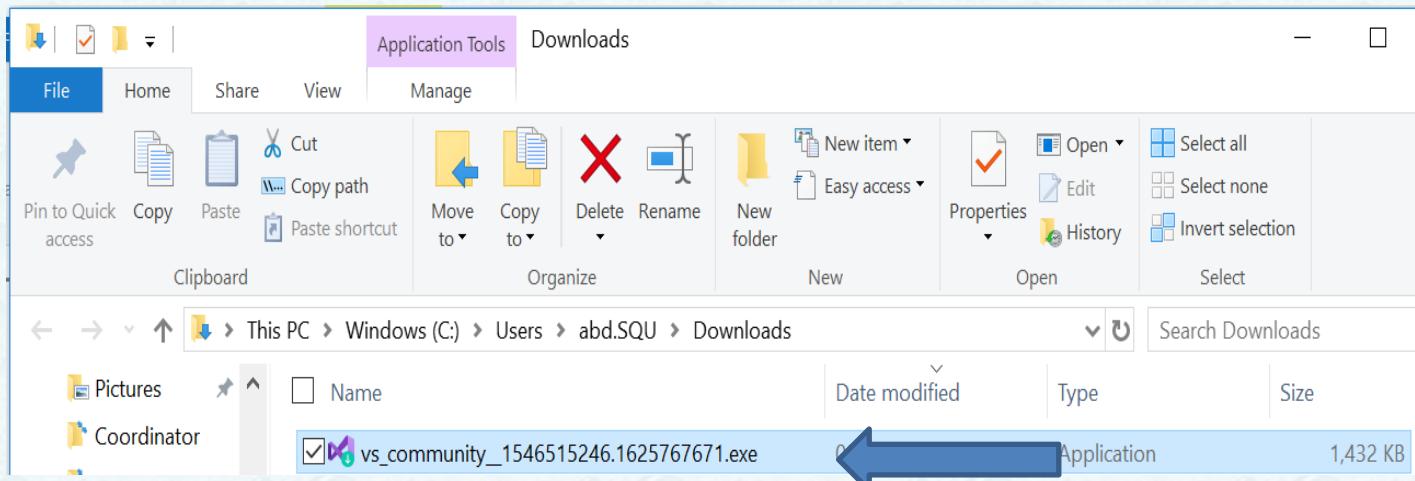
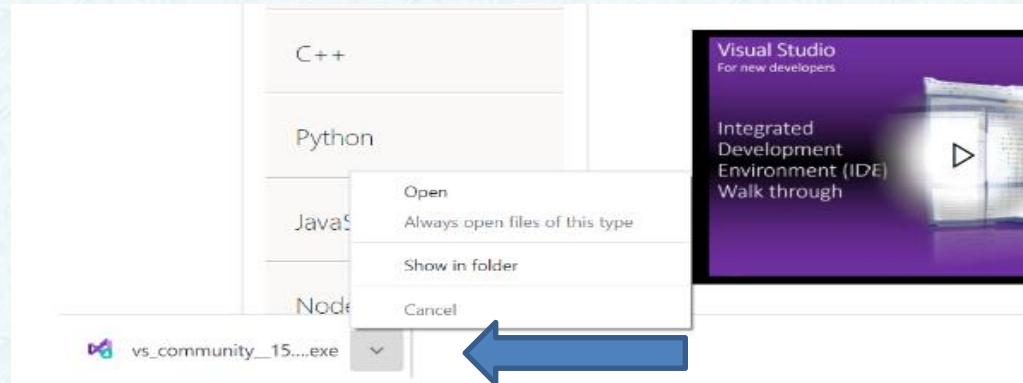
- Website:

<https://visualstudio.microsoft.com/vs/community>

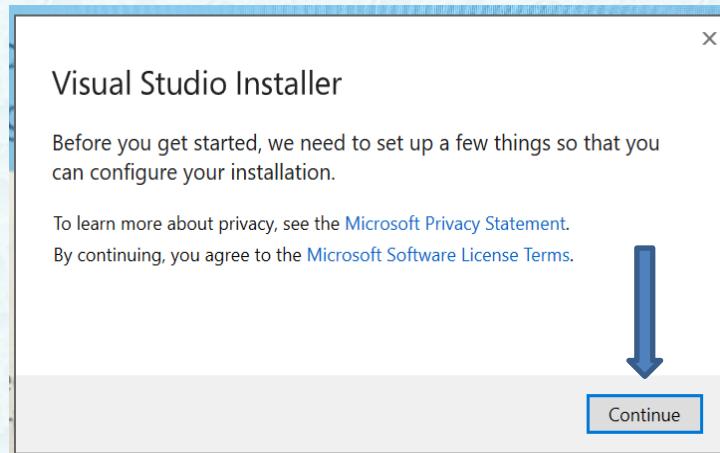
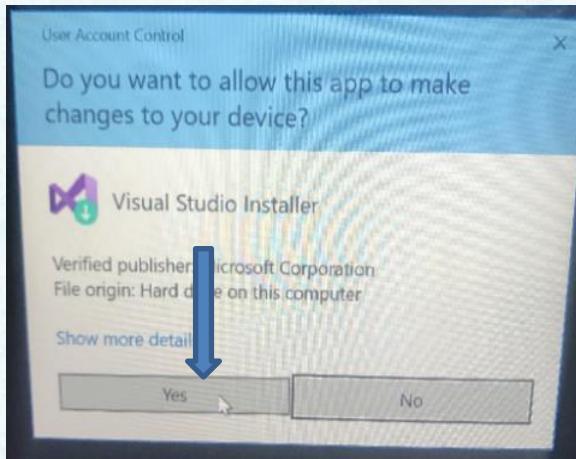


The screenshot shows the Microsoft Visual Studio Community landing page. At the top, there is a navigation bar with a back arrow, a lock icon, and the URL "visualstudio.microsoft.com/vs/community/". Below the navigation bar, the Microsoft logo is on the left, followed by a vertical separator line, "Visual Studio" in bold, and smaller links for "Visual Studio 2019", "Features", and "Editions". The main content area features a large, bold title "Visual Studio Community" and a subtitle "A fully-featured, extensible, free IDE for creating web applications and cloud services." Below this, there is a purple button with white text that says "Download Visual Studio" followed by a downward arrow.

Installing Visual Studio 2019



Installing Visual Studio 2019



Installing Visual Studio 2019

Installing — Visual Studio Community 2019 — 16.10.3

Workloads Individual components Language packs Installation locations

Need help choosing what to install? [More info](#)

Web & Cloud (4)

ASP.NET and web development

Build web applications using ASP.NET Core, ASP.NET, HTML/JavaScript, and Containers including Docker supp...

Python development

Editing, debugging, interactive development and source control for Python.

Desktop & Mobile (5)

.NET desktop development

Build WPF, Windows Forms, and console applications using C#, Visual Basic, and F# with .NET and .NET Frame...

5

6

Azure development

Azure SDKs, tools, and projects for developing cloud apps and creating resources using .NET and .NET Framework...

Node.js development

Build scalable network applications using Node.js, an asynchronous event-driven JavaScript runtime.

Desktop development with C++

Build modern C++ apps for Windows using tools of your choice, including MSVC, Clang, CMake, or MSBuild.

Universal Windows Platform development

Mobile development with .NET

Location

C:\Program Files (x86)\Microsoft Visual Studio\2019\Community [Change...](#)

By continuing, you agree to the [license](#) for the Visual Studio edition you selected. We also offer the ability to download other software with Visual Studio. This software is licensed separately, as set out in the [3rd Party Notices](#) or in its accompanying license. By continuing, you also agree to those licenses.

Installation details

▼ .NET desktop development

▼ Included

- .NET desktop development tools
- .NET Framework 4.7.2 development tools
- C# and Visual Basic

▼ Optional

- .NET development tools
- .NET Framework 4 – 4.6 development tools
- Blend for Visual Studio
- Entity Framework 6 tools
- .NET profiling tools
- IntelliCode
- Just-In-Time debugger
- Live Share
- ML.NET Model Builder (Preview)
- F# desktop language support
- PreEmptive Protection - Dotfuscator
- .NET Framework 4.6.1 development tools
- .NET Framework 4.6.2 development tools
- .NET Framework 4.7 development tools

7

Total space required 15.6 GB

Install while downloading ▾

Install

Installing Visual Studio 2019

Visual Studio Installer

Installed Available

Visual Studio Community 2019

Downloading and verifying: 256 MB of 2.28 GB

10% 

(15 MB/sec)

Installing: package 5 of 447

0% 

Microsoft.VisualStudio.MinShell.Msi

Start after installation

[Release notes](#)

[Pause](#)

Developer News

[.NET Object Allocation Tool Performance](#)

With the release of Visual Studio 16.10 comes a n...

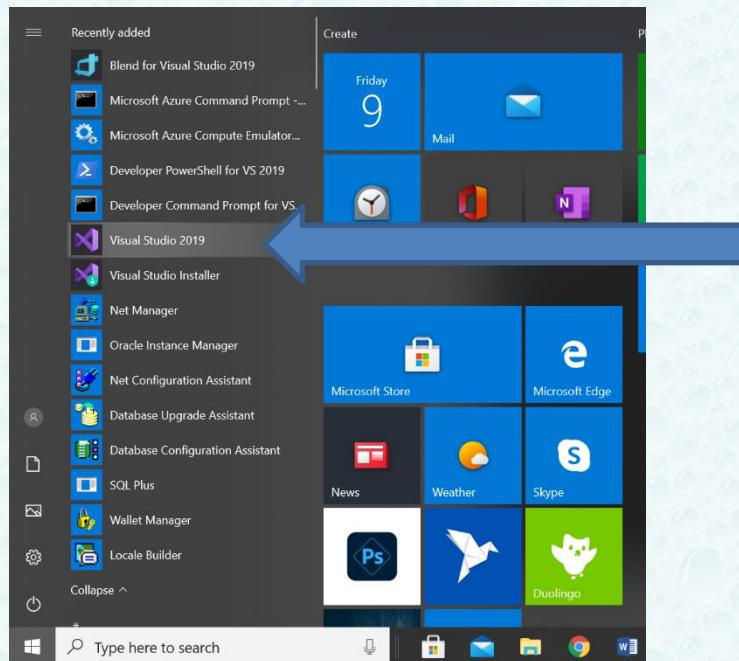
Friday, 2 July, 2021

[Debugging for Unity with Visual Studio](#)

So you're ready to level up your debugging skills...

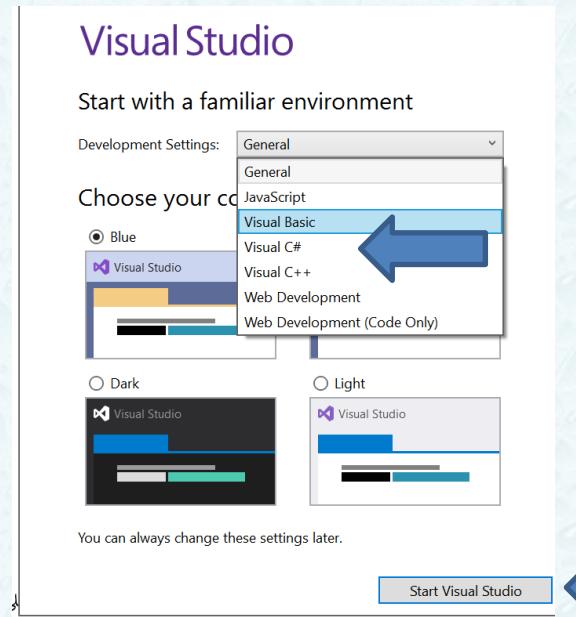
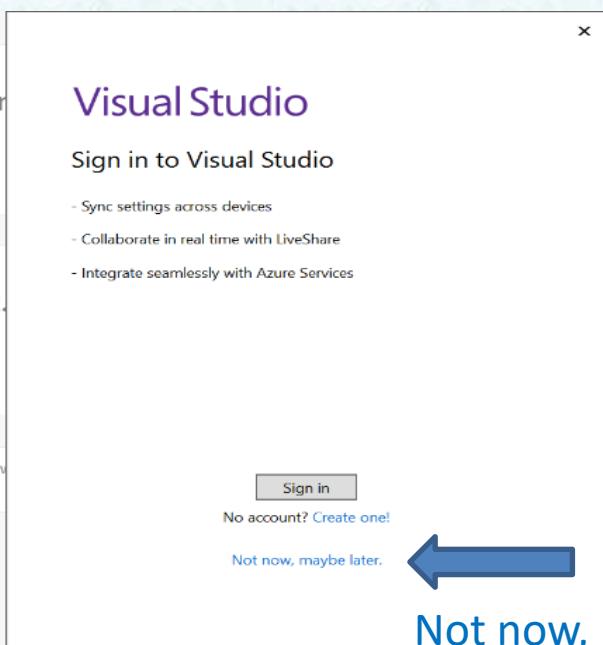
Friday, 2 July, 2021

[Visual Studio 2022 Preview 1 now available](#)



Launching Visual Studio

Opening Visual Studio 2019 for the first time



Not now, maybe later

Create a New Project

The screenshot shows the Visual Studio 2019 start page. At the top, it says "Visual Studio 2019". On the left, there's a section titled "Open recent" with a note about pinning frequently used items. On the right, under "Get started", there are four main options: "Clone a repository", "Open a project or solution", "Open a local folder", and "Create a new project". A large blue arrow points from the bottom right towards the "Create a new project" button. At the bottom center, there's a link to "Continue without code".

Visual Studio 2019

Open recent

As you use Visual Studio, any projects, folders, or files that you open will show up here for quick access.

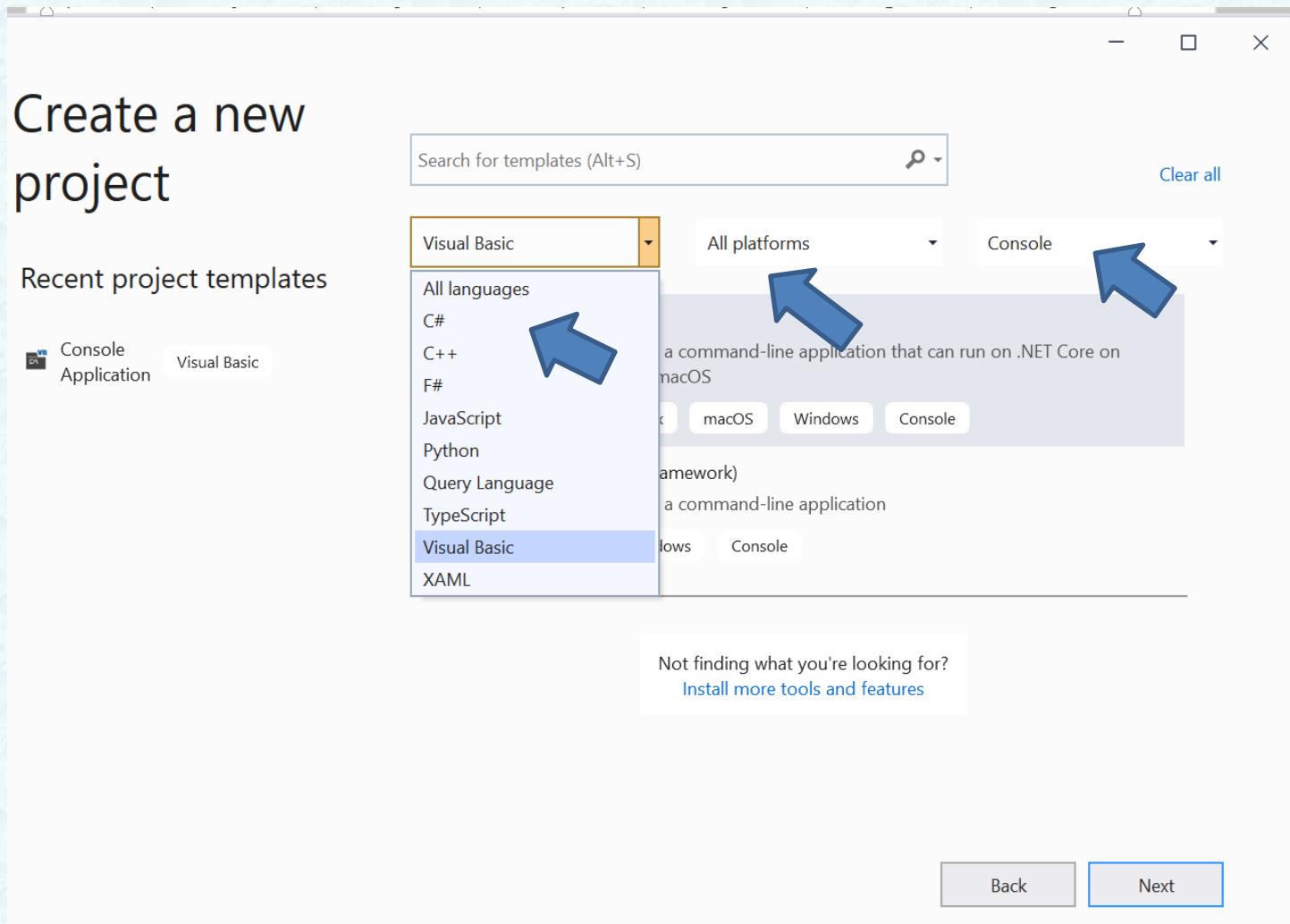
You can pin anything that you open frequently so that it's always at the top of the list.

Get started

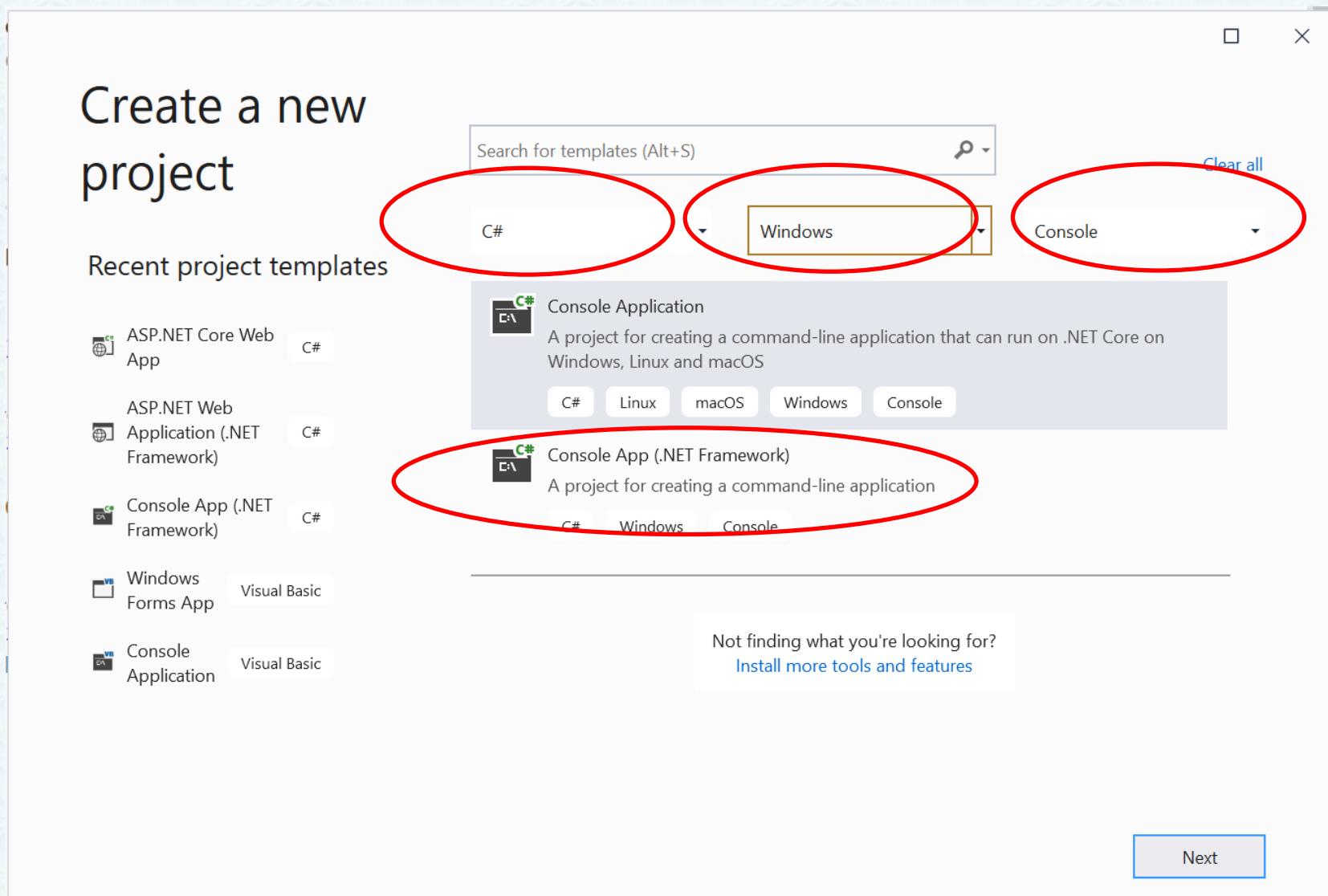
- Clone a repository
Get code from an online repository like GitHub or Azure DevOps
- Open a project or solution
Open a local Visual Studio project or .sln file
- Open a local folder
Navigate and edit code within any folder
- Create a new project
Choose a project template with code scaffolding to get started

Continue without code →

Choosing the application Type



Creating C# Application



Creating C# Application

Configure your new project

Console Application C# Linux macOS Windows Console

Project name

Location

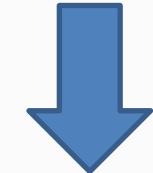
 ...

Solution

Solution name i

Place solution and project in the same directory

Back Next



Creating C# Application

□ X

Additional information

Console Application C# Linux macOS Windows Console

Target Framework [\(i\)](#)

.NET 5.0 (Current) ▾



[Back](#) [Create](#)

FIRST C# Application

