Introduction to .Net Framework

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.Net Evangelist

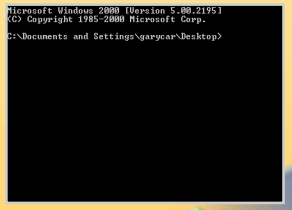
A Rich History

2000
XML
Web Services

1995
Internet

1990
GUI

1981
PC



Microsoft .net

IE, IIS
Visual Studio
Visual Studio .NET

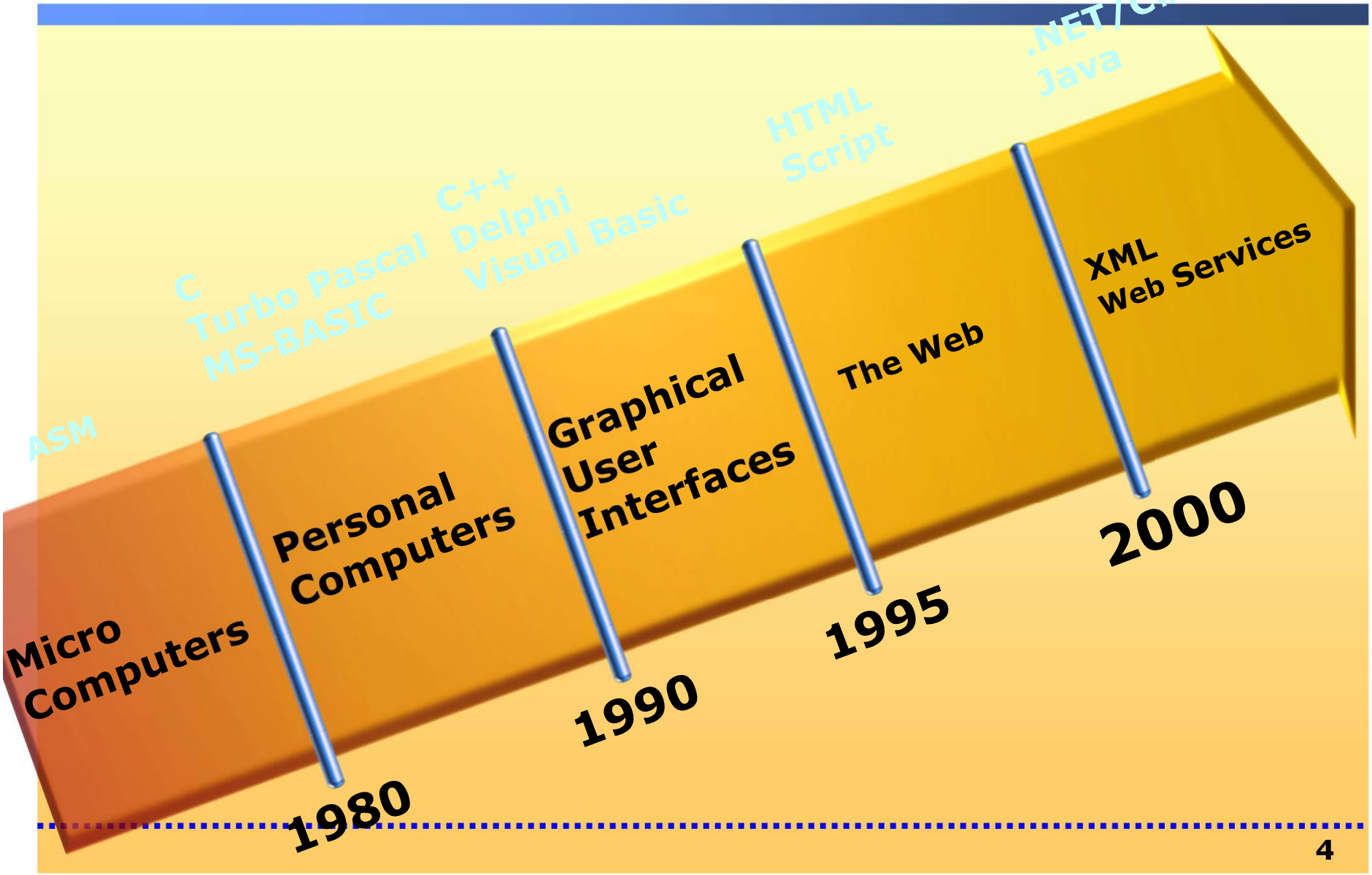
Windows
Visual BASIC

MS-DOS
BASIC

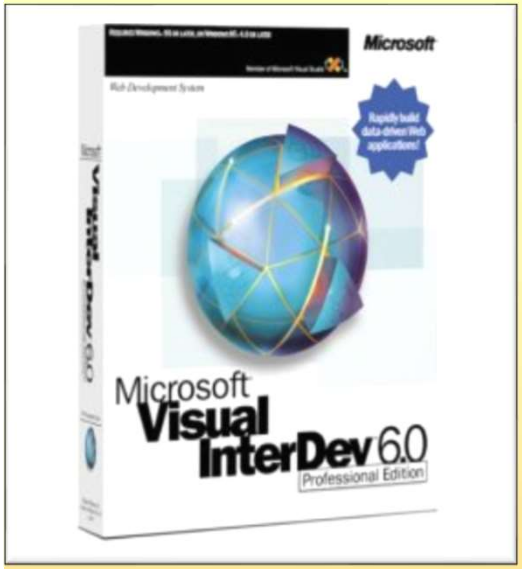
Before .NET

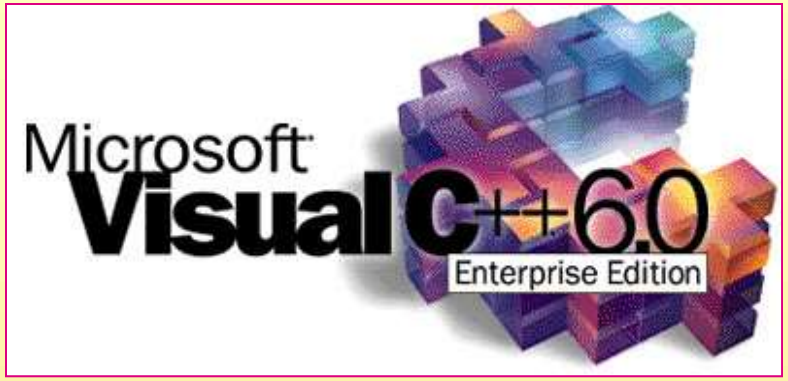
- **C/Win 32 API**
  - Unsafe (C) and complex (Win32)
- **C++ and MFC**
  - Better but still difficult
- **Visual Basic 6.0**
  - Nice, but not completely Object Oriented
- **COM**
  - Binary Compatibility, good model, still complex
  - Versioning problems
- **Java/J2EE**
  - Grate, but not from Microsoft
  - GUI integration not optimal

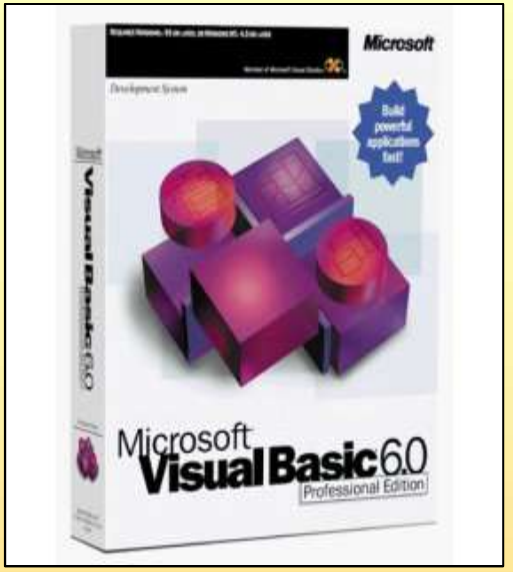
Increasing Level of Abstraction



Why .NET?



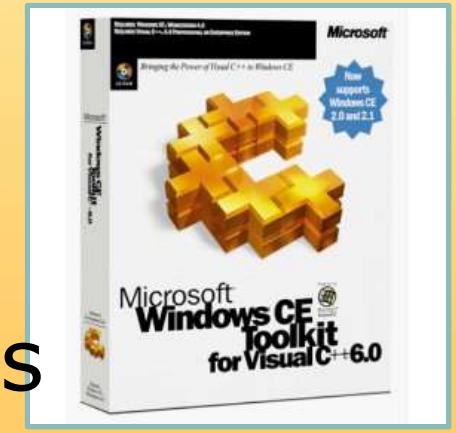




- Low Level
- Advance UI

Web

RAD



Devices

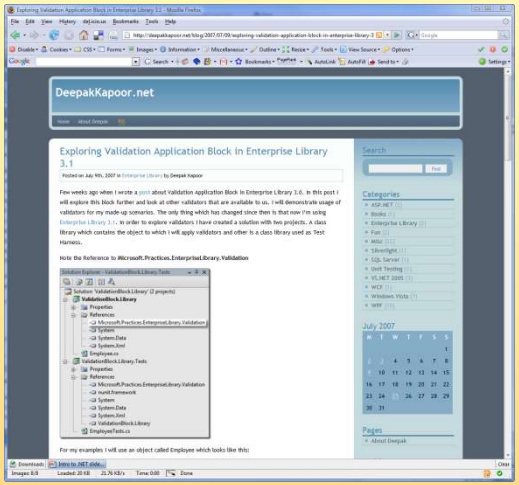
Advance Graphics

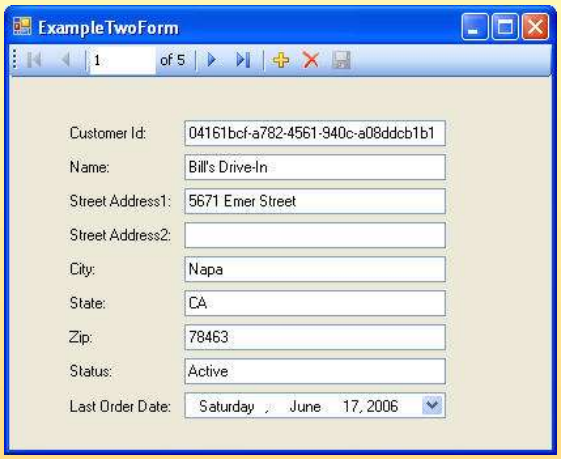
Why .NET?

- **Distinct Programming Models**
- **Learning Curve**
  - Rich Client
  - Thin Client
- **Different Job Different Language**

.NET

- **Consistent Programming Model (BCL)**

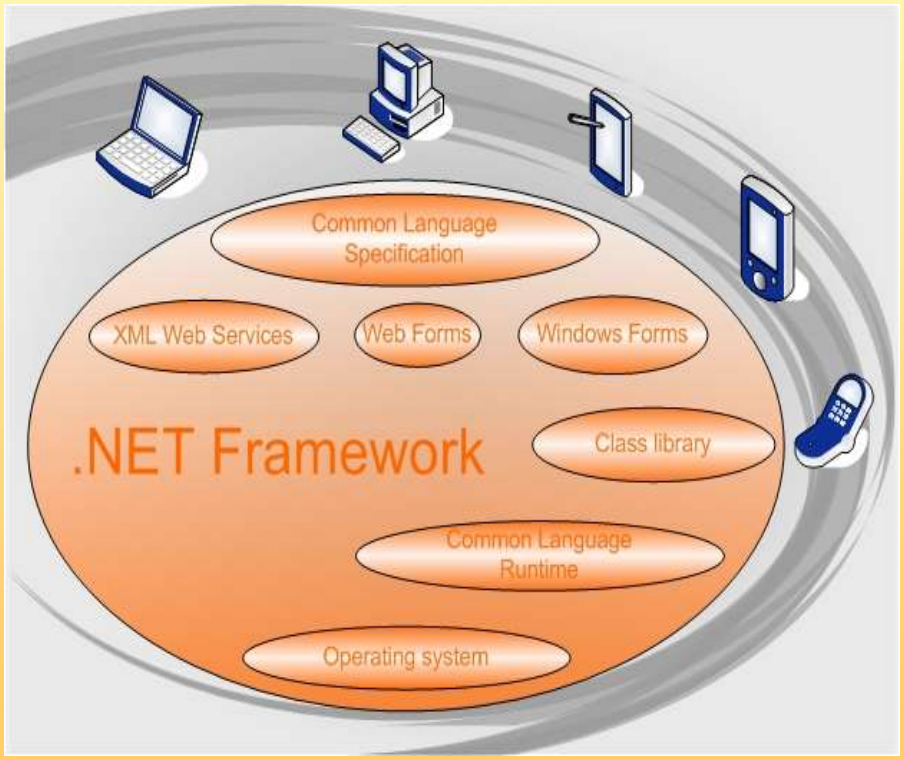


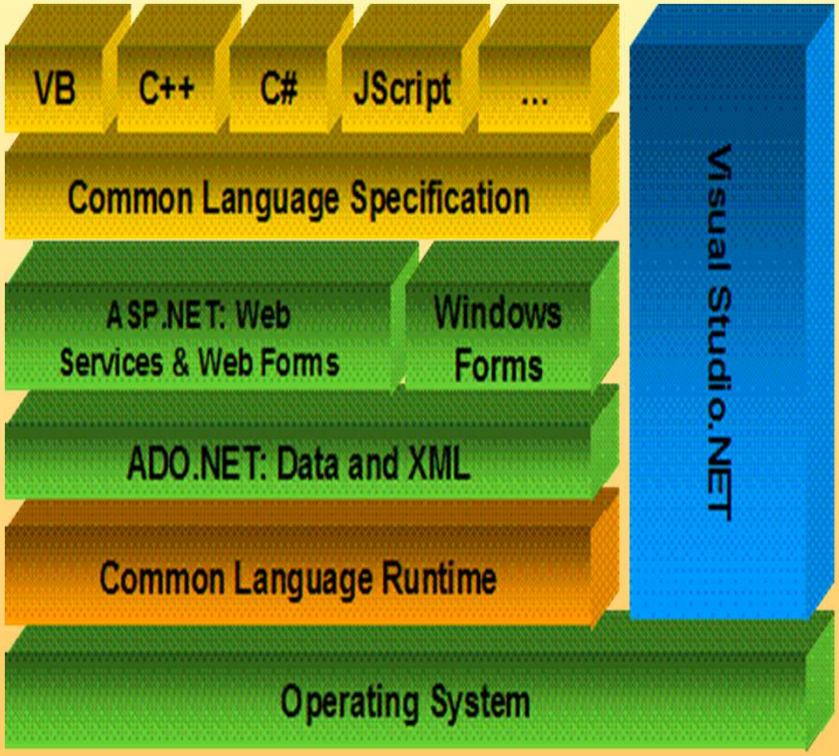


Web App's Desktop App's Mobile App's

What is .NET ?

- **.NET is a set of Microsoft software technologies**
  - for connecting information, people, systems, and devices.





What is a Framework?

- **A Framework is a "defined support structure" in which another software project can be organized and developed.**

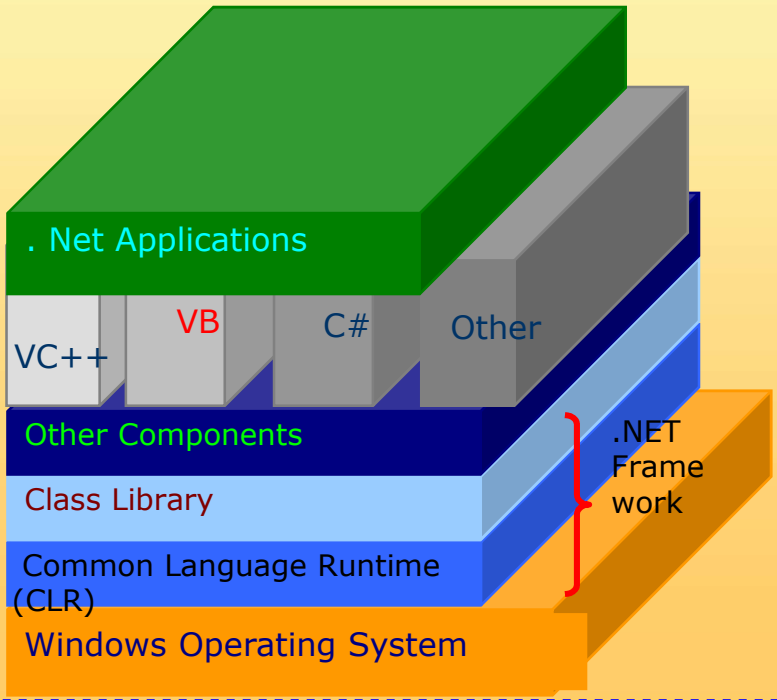
- **Typically, a framework may include**
  - support programs,
  - code libraries
  - and a language amongst other software to help develop and glue together the different components of your project.

What is .NET Framework?

- The .NET framework created by Microsoft is a software development platform focused on rapid application development, platform independence and network transparency.
- .NET is Microsoft's strategic initiative for server and desktop development for the next decade.
- According to Microsoft, .NET includes many technologies that are designed to facilitate rapid development of Internet and intranet applications.

What is .NET ?

- **.NET is a set of Microsoft software technologies for connecting information, people, systems, and devices.**



- .NET Framework is a common layer between .NET applications and Windows OS.
- .NET Applications are VB / VC++ / C# programs written on .NET Framework.

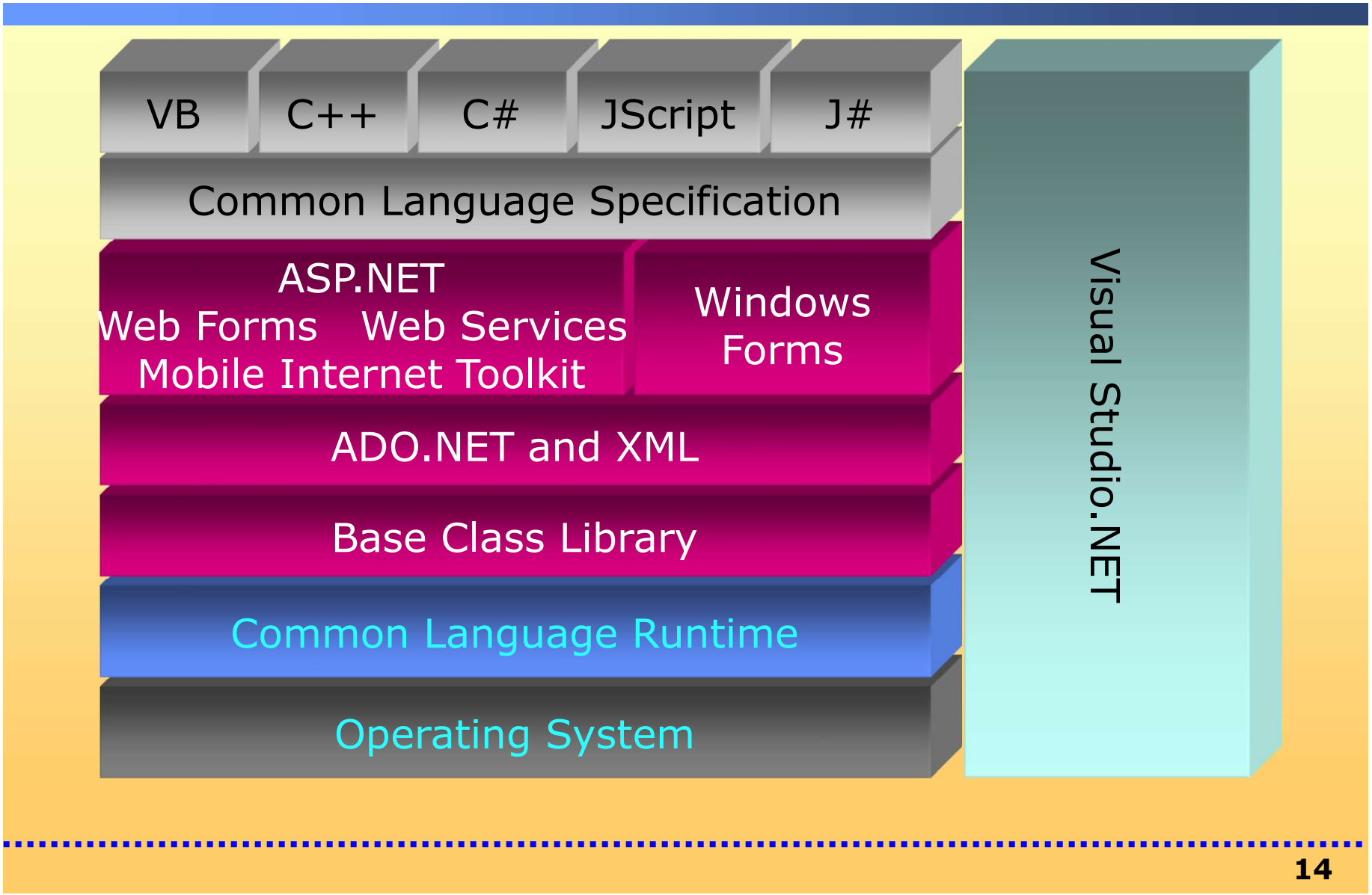
.Net Framework Design Goals

- **Simplify development**
  - More power, less plumbing
- **Unify programming models**
  - Across all languages and application types
- **Utilize web standards and best practices**
  - Rich XML, standard protocols, stateless
- **Easier to deploy, run, & maintain**
  - For components, versioning, availability

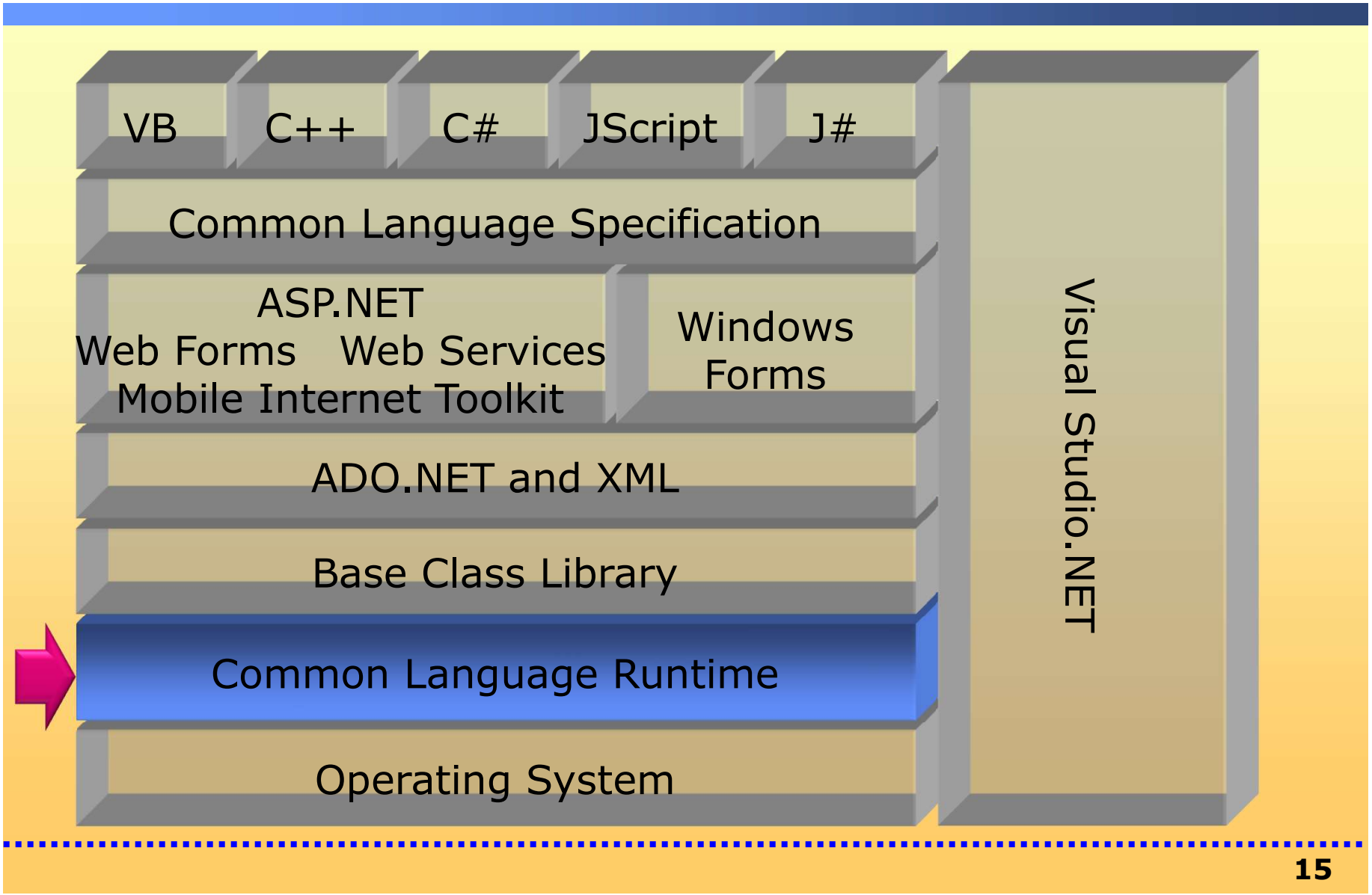
.NET Framework Components

- **Common Language Runtime (CLR)**
  - Common type system for all languages
  - Rich runtime environment
- **Rich class libraries (.NET Framework)**
  - Base class libraries, ADO.NET and XML
  - Windows Forms for rich, Win32 applications
  - Rich, interactive pages
  - Powerful web services

Framework, Languages, And Tools



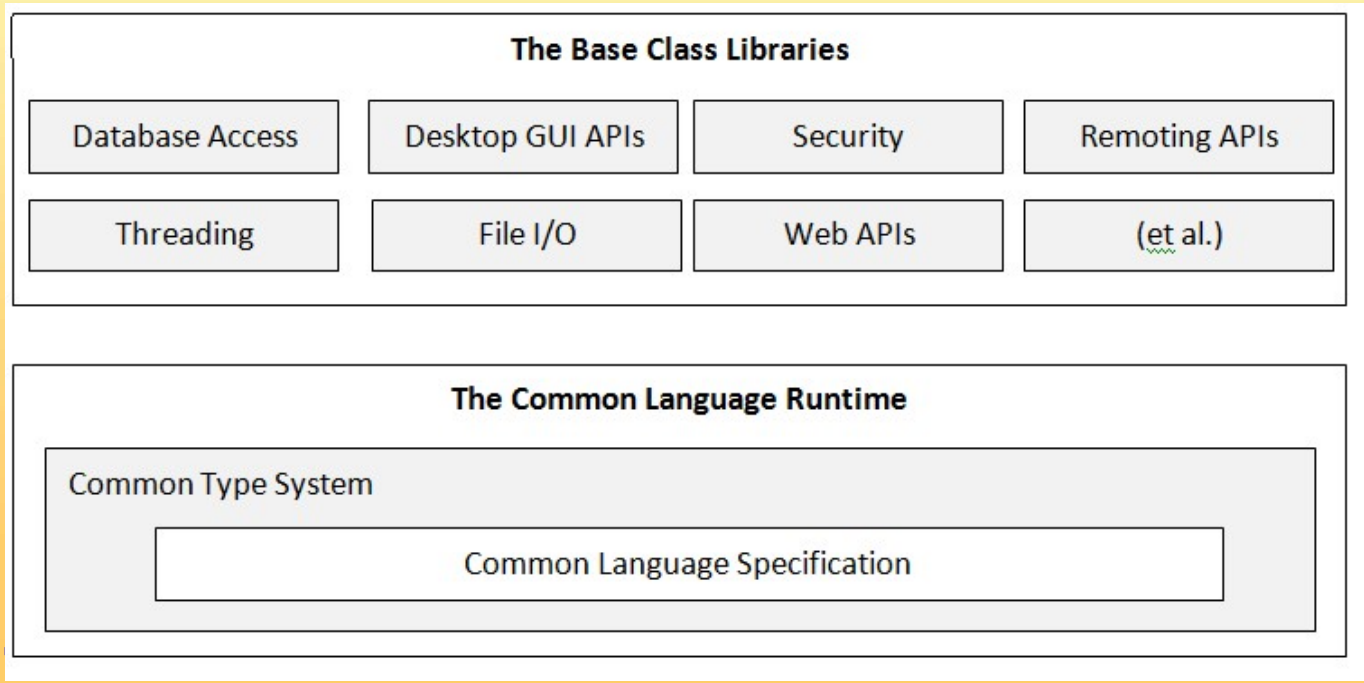
Common Language Runtime (CLR)



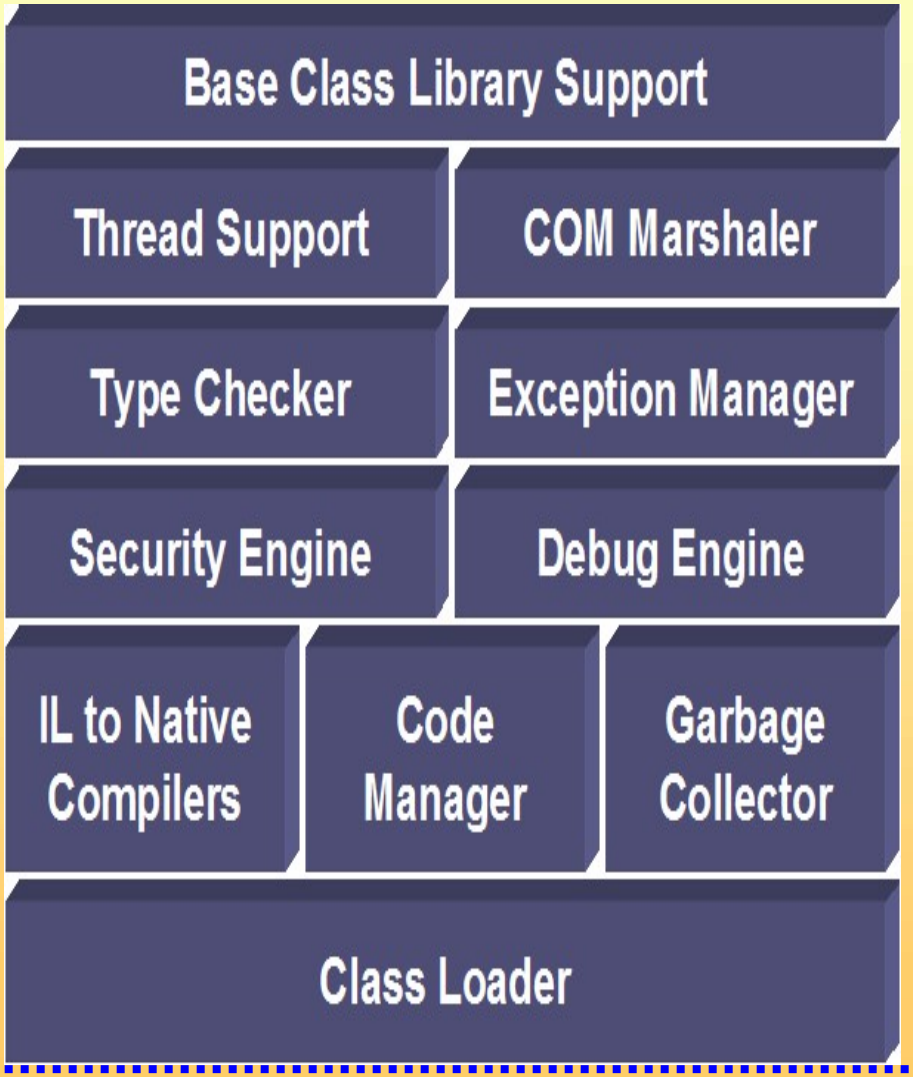
Common Language Runtime - CLR

- **The Common Language Runtime is the execution engine for .NET Framework applications:**

CTS	**Common Type System**	**CIL**	**•Common Intermediate Language •Metadata**
CLS	**Common Language Specification**	**VES**	**•Virtual Execution System**

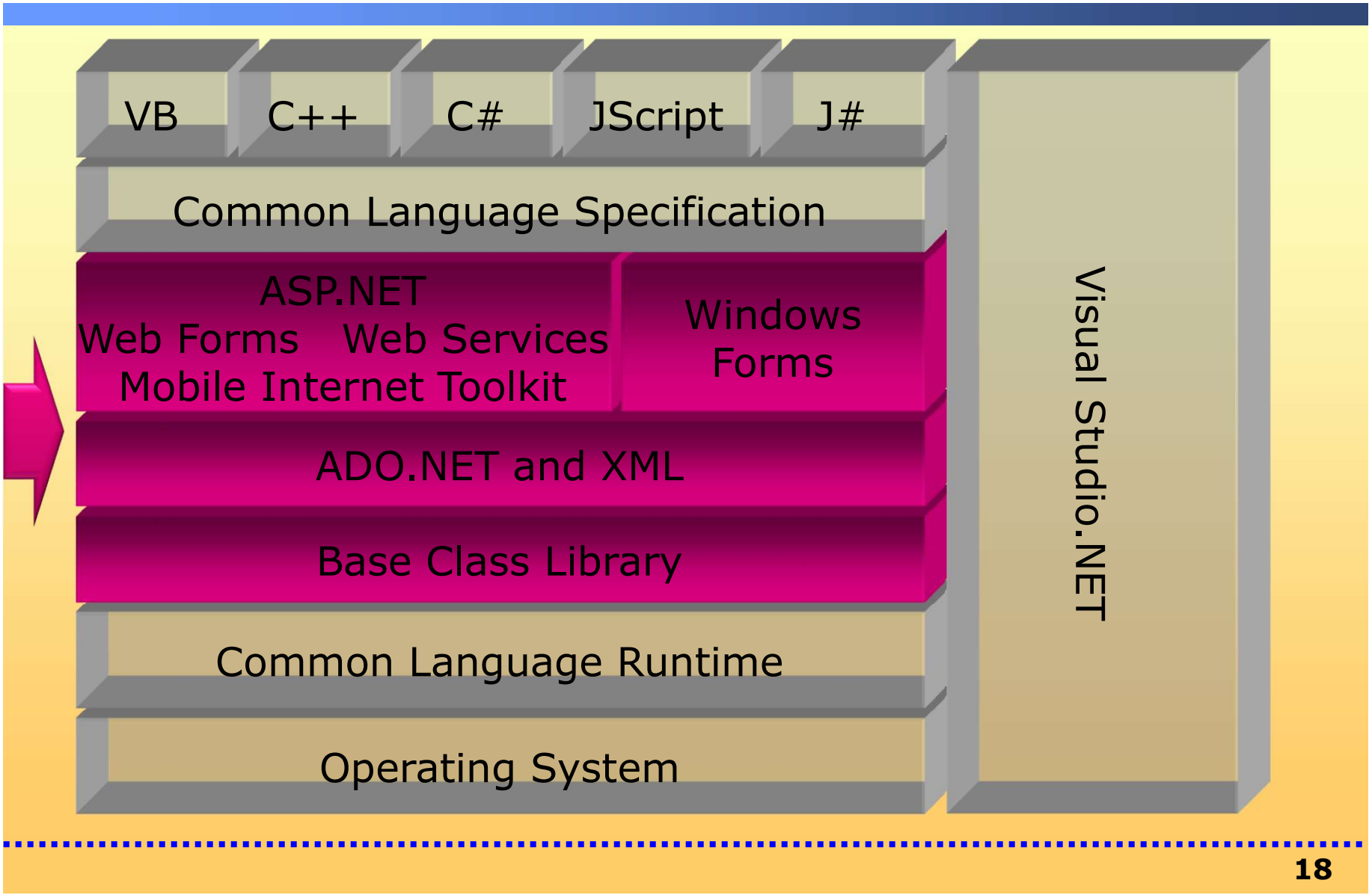


Common Language Runtime



- **Manages running code**
  - Verifies type safety
  - Provides garbage collection, error handling
  - Code access security for semi-trusted code
- **Provides common type system**
  - Value types (integer, float, user defined, etc)
  - Objects, Interfaces
- **Provides access to system resources**
  - Native API, COM interop, etc

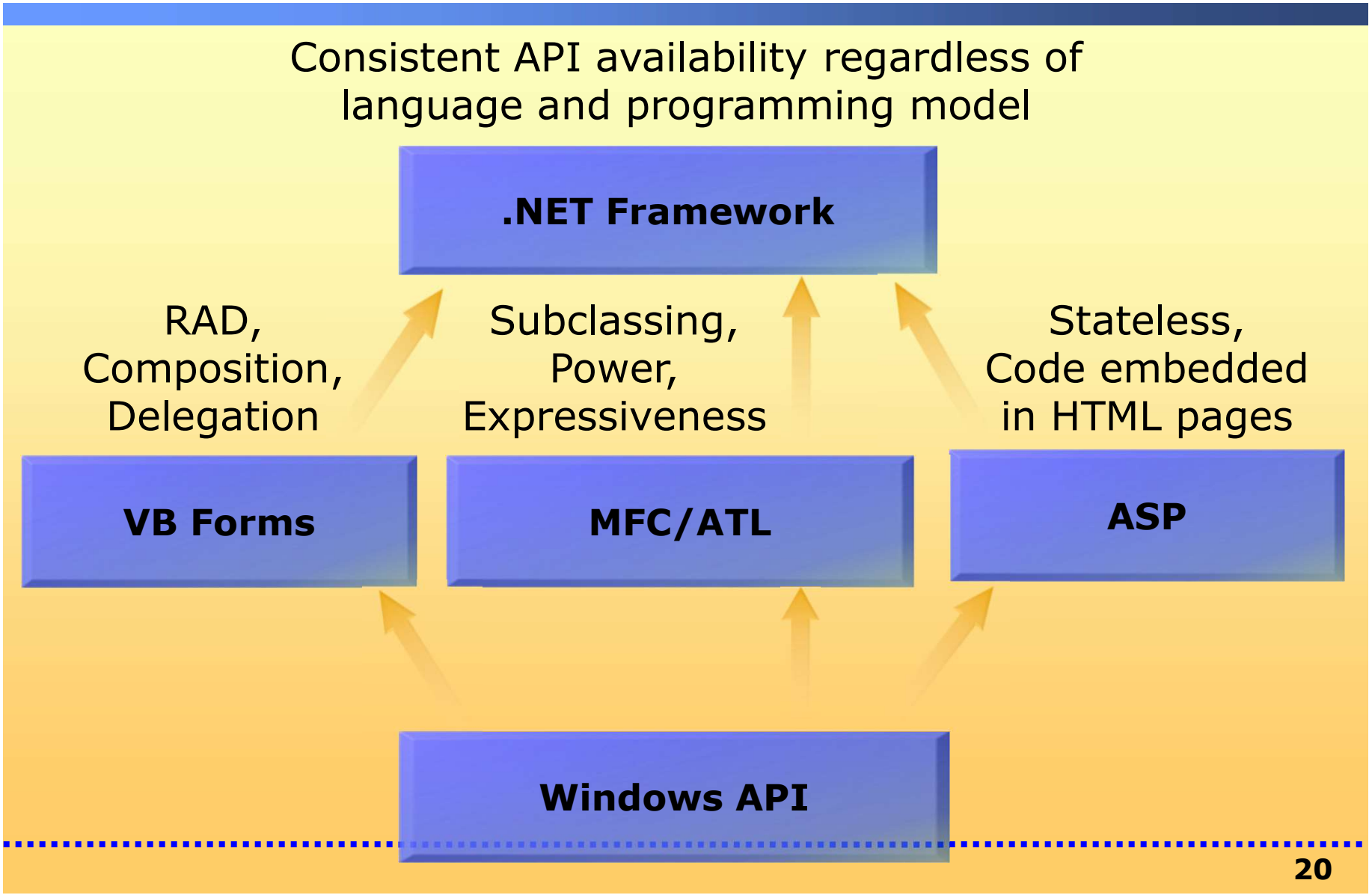
Base Class Library (BCL)



.NET Framework Libraries

- **Single *consistent* set of object oriented class libraries to enable building distributed applications (Unified Classes)**
- **Built using classes arranged across logical hierarchical namespaces**
  - For example: System.Data.SQL
- **Work with all CLR languages**
  - No more “VBRun” or “MFC” divide

Unify Programming Models



How Much Simpler?

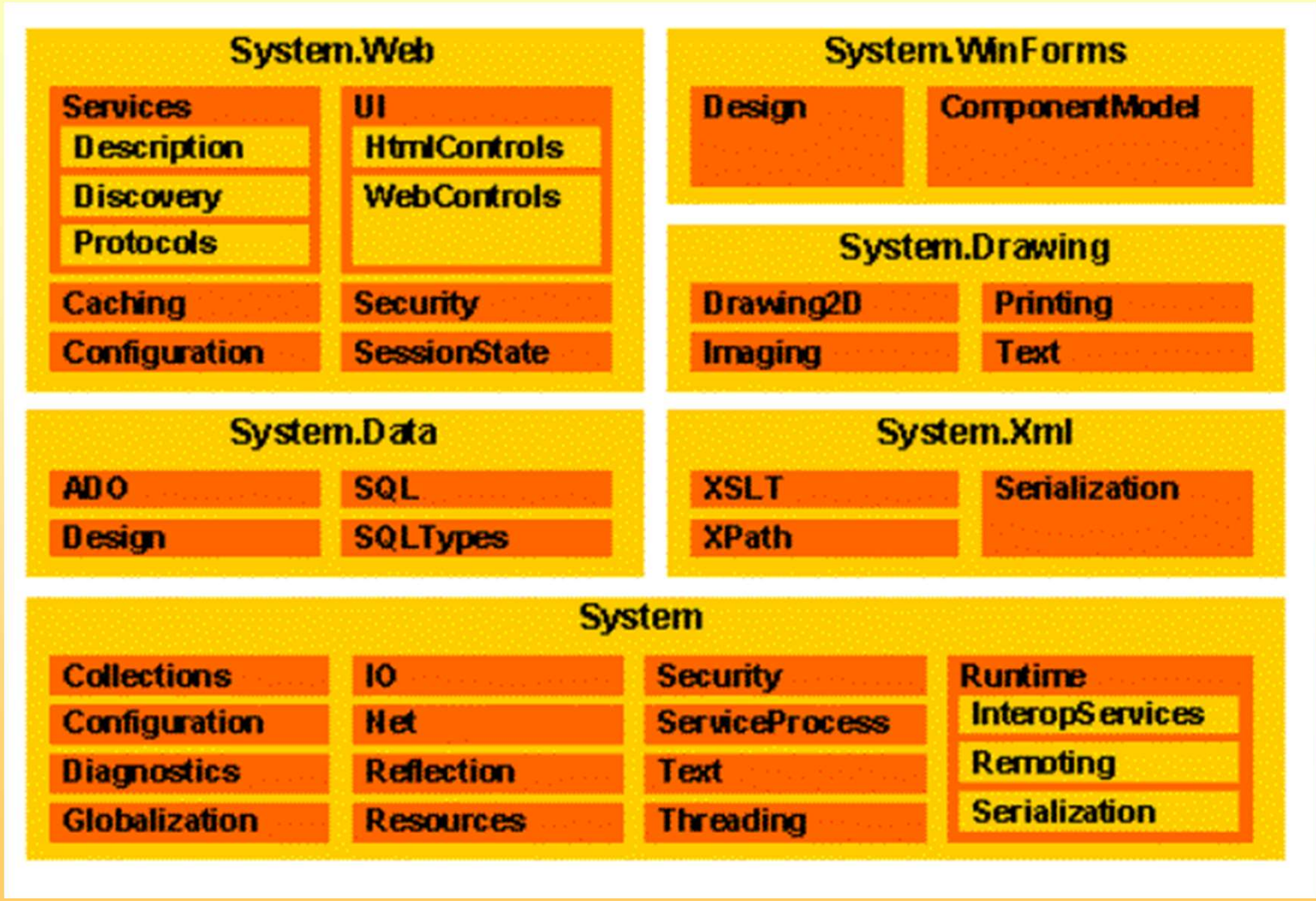
Windows API

```
HWND hwndMain = CreateWindowEx(
    0, "MainWClass", "Main Window",
    WS_OVERLAPPEDWINDOW | WS_HSCROLL | WS_VSCROLL,
    CW_USEDEFAULT, CW_USEDEFAULT,
    CW_USEDEFAULT, CW_USEDEFAULT,
    (HWND)NULL, (HMENU)NULL, hInstance, NULL);
ShowWindow(hwndMain, SW_SHOWDEFAULT);
UpdateWindow(hwndMain);
```

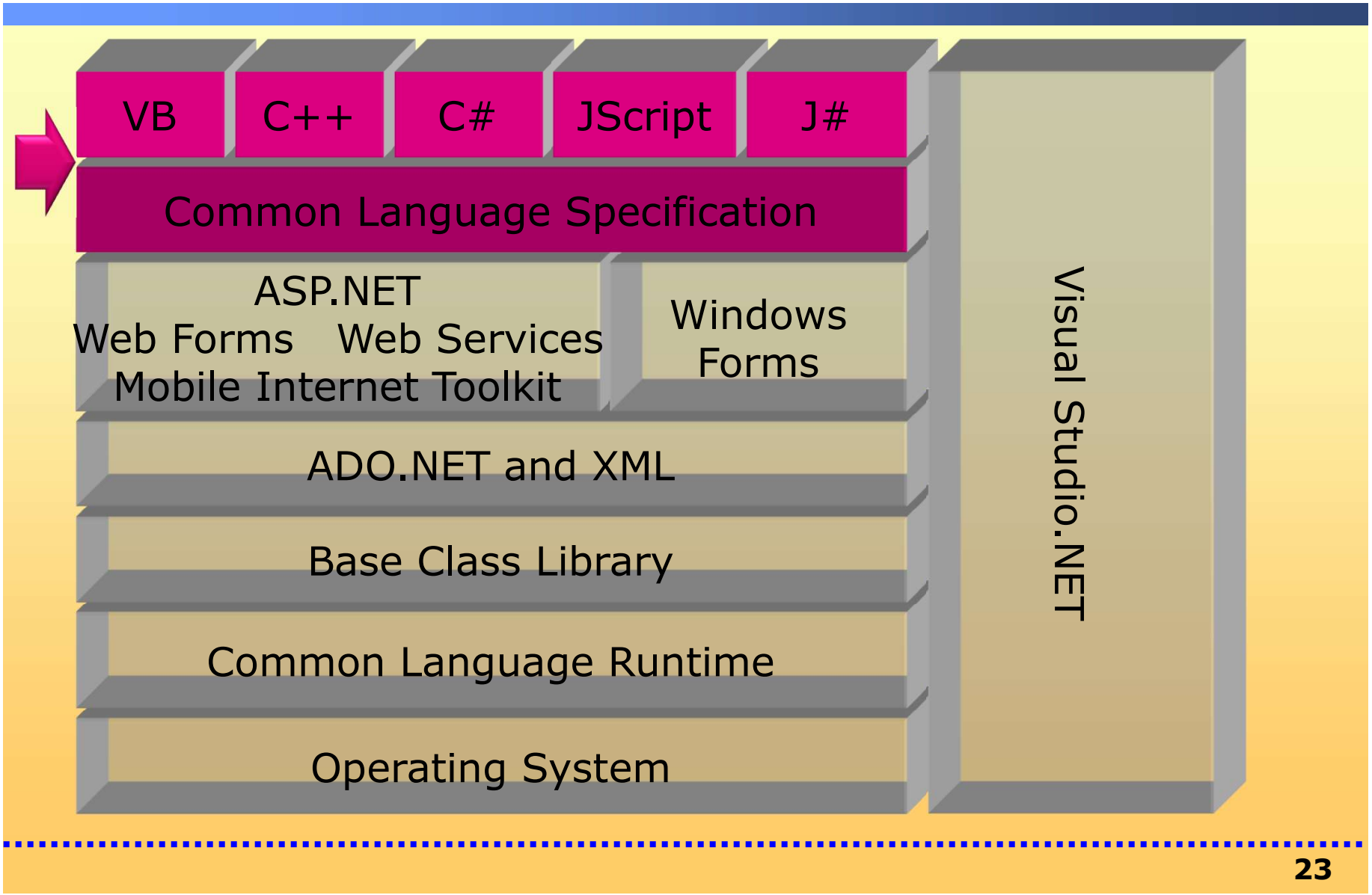
.NET Framework

```
Form form = new Form();
form.Text = "Main Window";
form.Show();
```

.NET Base Class Libraries



.NET Languages



.Net Languages

- **The .NET Platform is language neutral**
  - All .NET languages are first class players
  - You can leverage your existing skills
- **Common language specification**
  - Set of features guaranteed to be in all languages

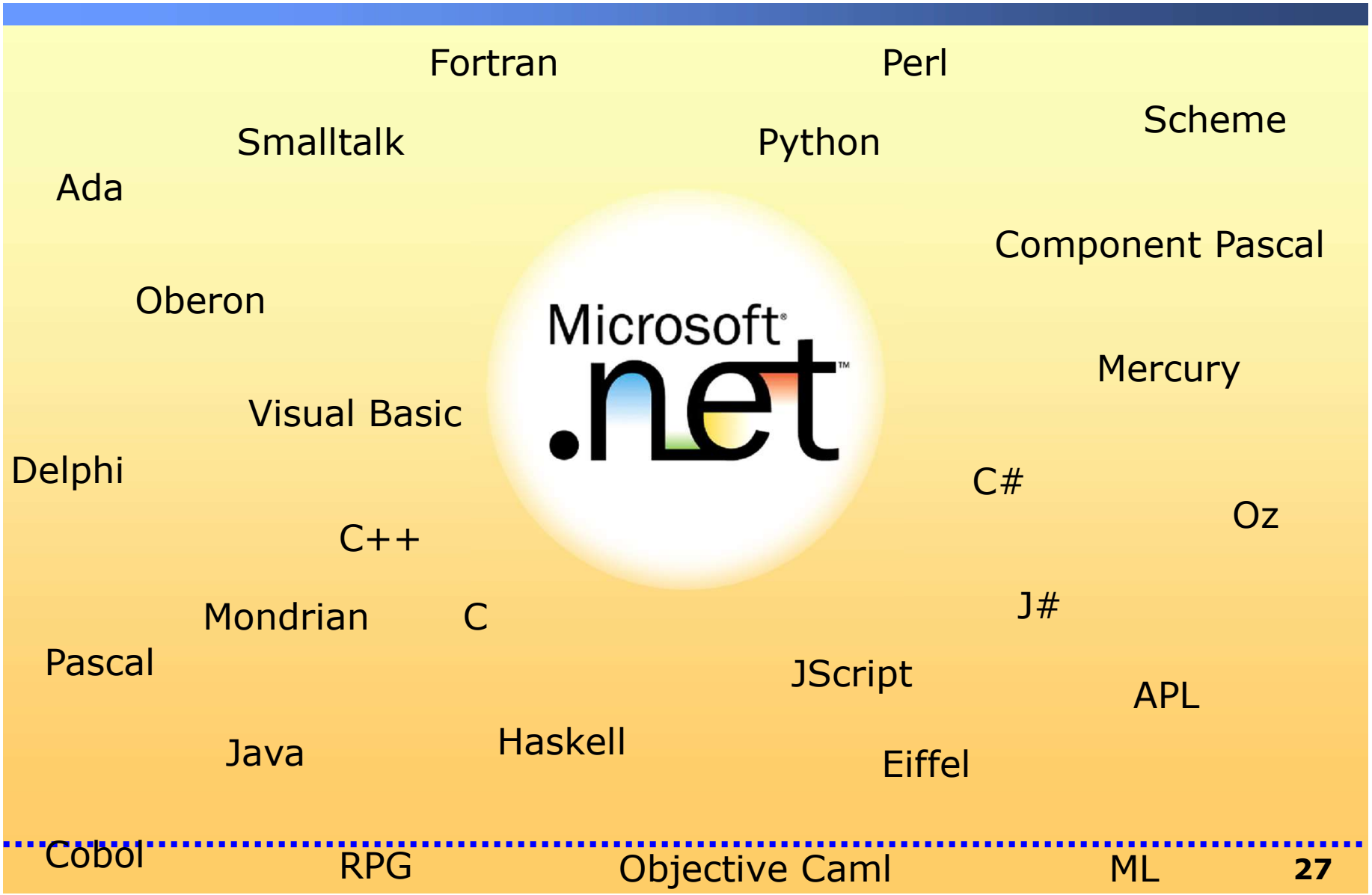
.NET Languages from Microsoft

- **Microsoft: Visual Basic.NET**
- **Microsoft: C#**
- **Microsoft: C++ (Managed/Unmanaged)**
- **Microsoft: J#**
- **Microsoft F#**

.NET Languages from Others

- APL
- Fujitsu COBOL
- Micro Focus COBOL
- Eiffel
- Forth
- FORTRAN 95
- Haskell
- Mercury
- Mondrian
- Oberon
- Pascal
- Perl
- Python
- RPG
- S#
- Scheme
- Standard Meta Language

Multilingual Development



The .NET Platform is multi-language

- **Benefits:**
  - Make code modules reusable
  - Complete cross-language integration
  - Make API access the same for all languages
  - Let developers use the right language for the task and share the code
- **All .NET languages are first-class players**
  - Performance roughly equal
  - Can use all .NET features

Multi Language Support

VB.NET

```
Dim s as String
s = "authors"
Dim cmd As New SqlCommand("select * from " & s, sqlconn)
cmd.ExecuteReader()
```

C#

```
string s = "authors";
SqlCommand cmd = new SqlCommand("select * from "+s, sqlconn);
cmd.ExecuteReader();
```

C++

```
String *s = S"authors";
SqlCommand cmd = new SqlCommand(String::Concat(S"select * from ", s), sqlco
cmd.ExecuteReader();
```

J#

```
String s = "authors";
SqlCommand cmd = new SqlCommand("select * from "+s, sqlconn);
cmd.ExecuteReader();
```

JScript

```
var s = "authors"
var cmd = new SqlCommand("select * from " + s, sqlconn)
cmd.ExecuteReader()
```

Python

```
s = "authors"
cmd =SqlCommand("select * from " + s, sqlconn)
cmd.ExecuteReader()
```

Multi Language Support

COBOL

```
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
REPOSITORY.
    CLASS SqlCommand AS "System.Data.SqlClient.SqlCommand"
    CLASS SqlConnection AS "System.Data.SqlClient.SqlConnection".
DATA DIVISION.
WORKING-STORAGE SECTION.
01 str PIC X(50).
01 cmd-string PIC X(50).
01 cmd OBJECT REFERENCE SqlCommand.
01 sqlconn OBJECT REFERENCE SqlConnection.
PROCEDURE DIVISION.
 *> Establish the SQL connection here somewhere.
MOVE "authors" TO str.
STRING "select * from " DELIMITED BY SIZE,
   str DELIMITED BY " " INTO cmd-string.
INVOKE SqlCommand "NEW" USING BY VALUE cmd-string sqlconn RETURNING cmd.
INVOKE cmd "ExecuteReader".
```

Fortran

```
assembly_external(name="System.Data.SqlClient.SqlCommand")
sqlcmdcharacter*10 xsqlcmd
Cmd x='authors'
cmd = sqlcmd("select * from "//x, sqlconn)
call cmd.ExecuteReader()
end
```

Multi Language Support

Smalltalk

```
|s| := 'authors'.
|cmd| := SqlCommand('select * from '+s, sqlconn).
cmd.ExecuteReader().
```

Scheme

```
(let* (  (s "authors")
  (cmd (new-SqlCommand (string-append "select * from " s) sqlconn)
(execute-command cmd))
```

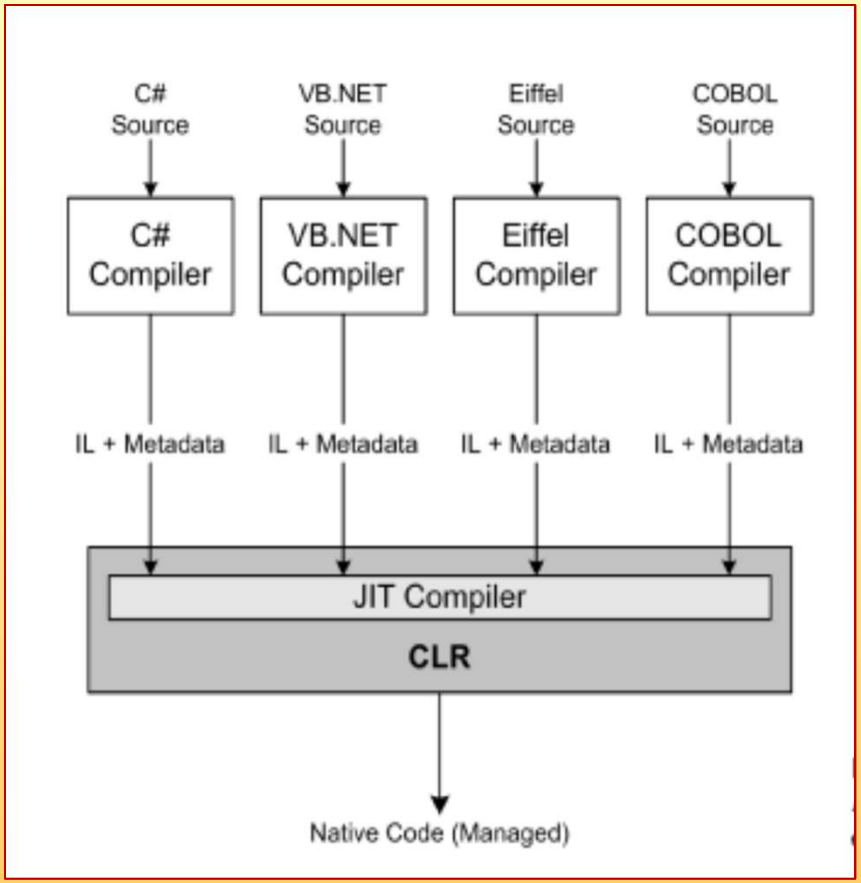
Eiffel

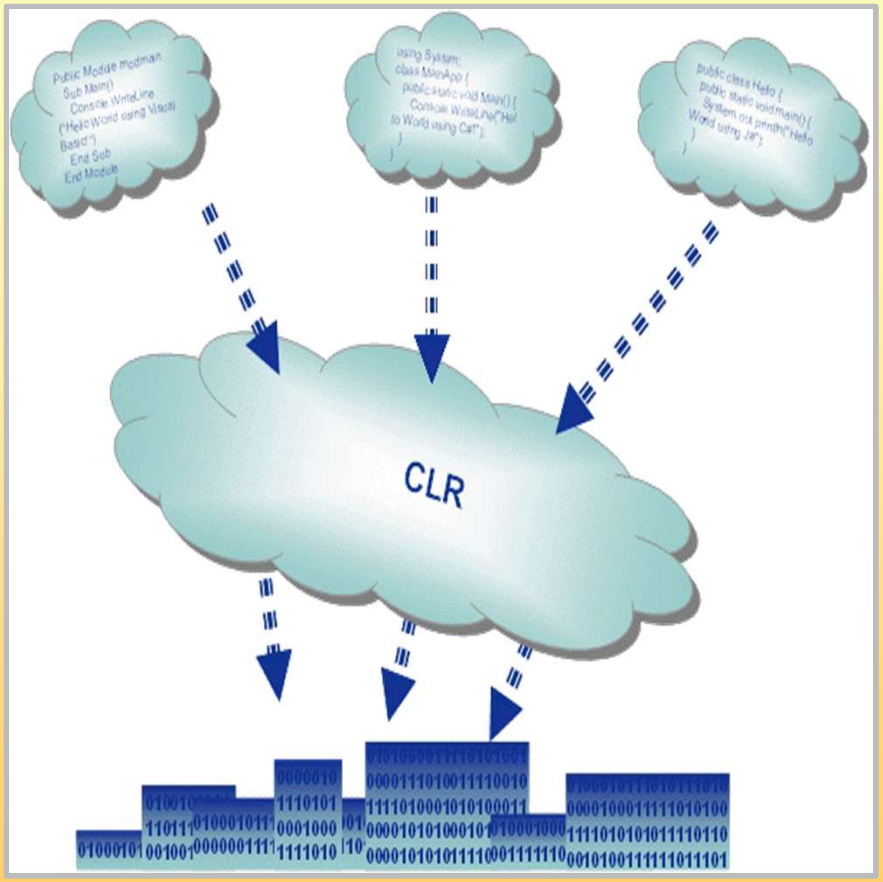
```
local
      s: STRING
      cmd: SQLCOMMAND
do
      s := "authors"
      create cmd("select * from " + s, sqlconn)
      cmd.ExecuteReader()
end
```

Mondrian

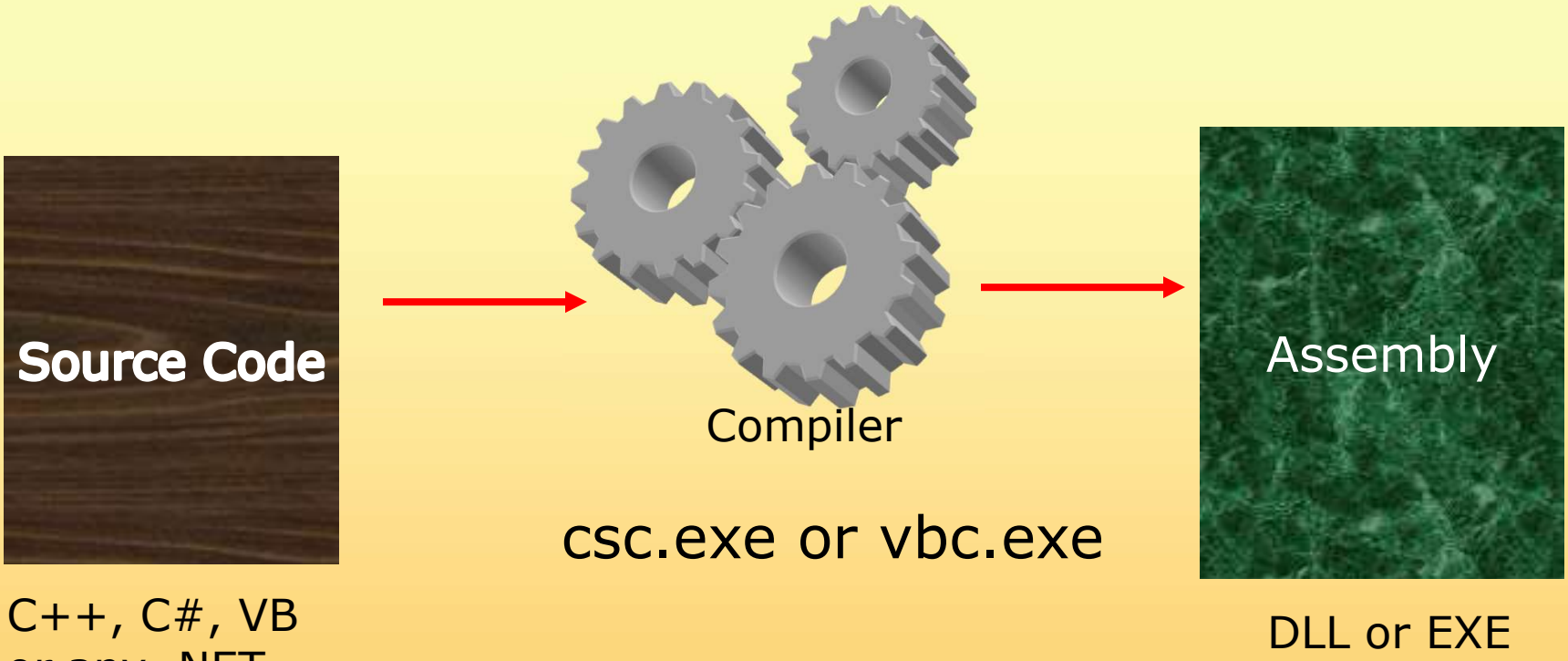
```
ExecuteReader = invoke System.Data.SqlClient.ExecuteReader();
SqlCommand = create System.Data.SqlClient.SqlCommand(String,\
                  System.Data.SqlClient.SqlConnection);
query = sqlconn -> let{ s = "authors"; } in {
   cmd <- SqlCommand ("select * from "+s, sqlconn);
   cmd # ExecuteReader();
};
```

All Languages are compiled to IL code

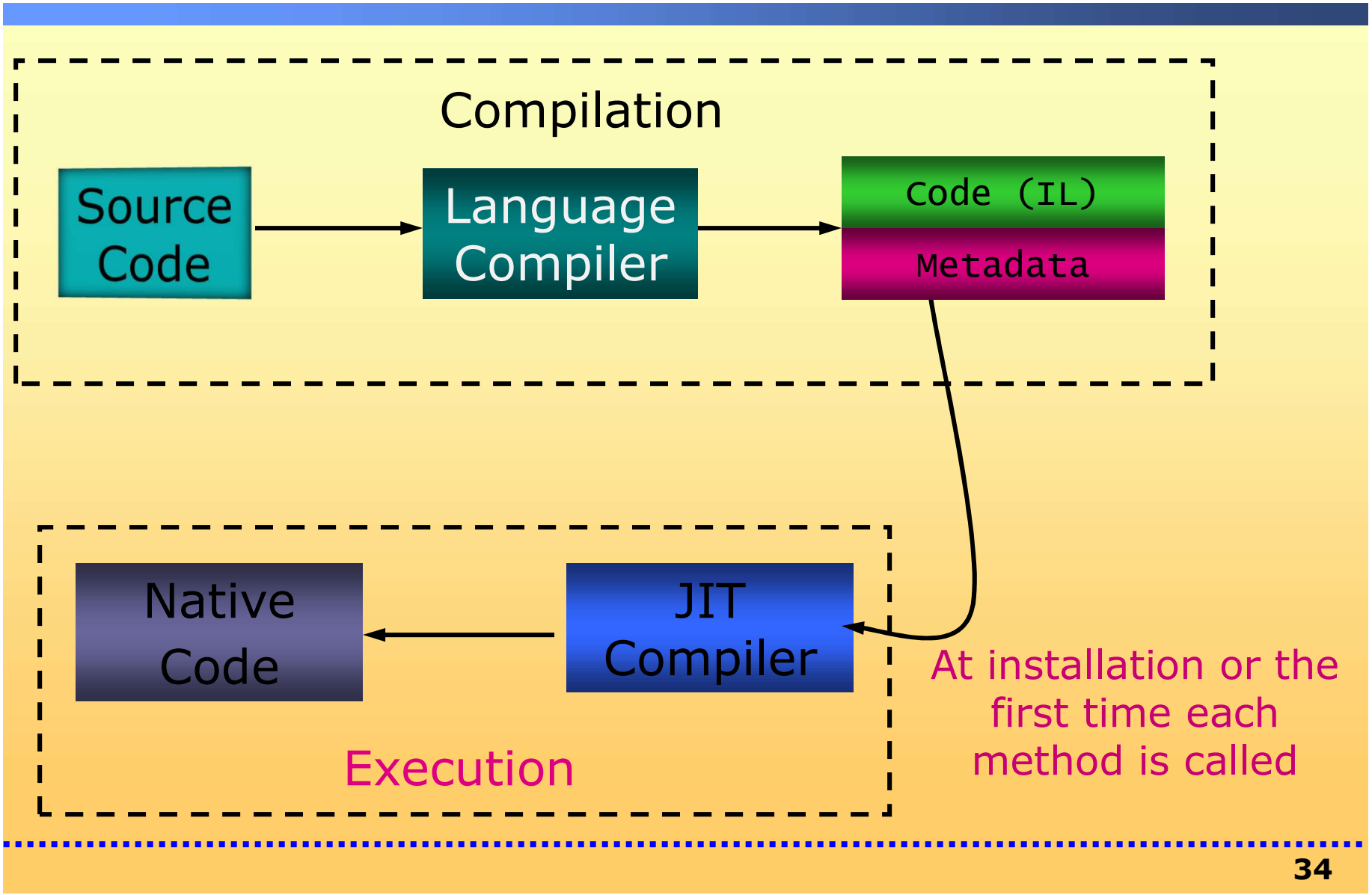




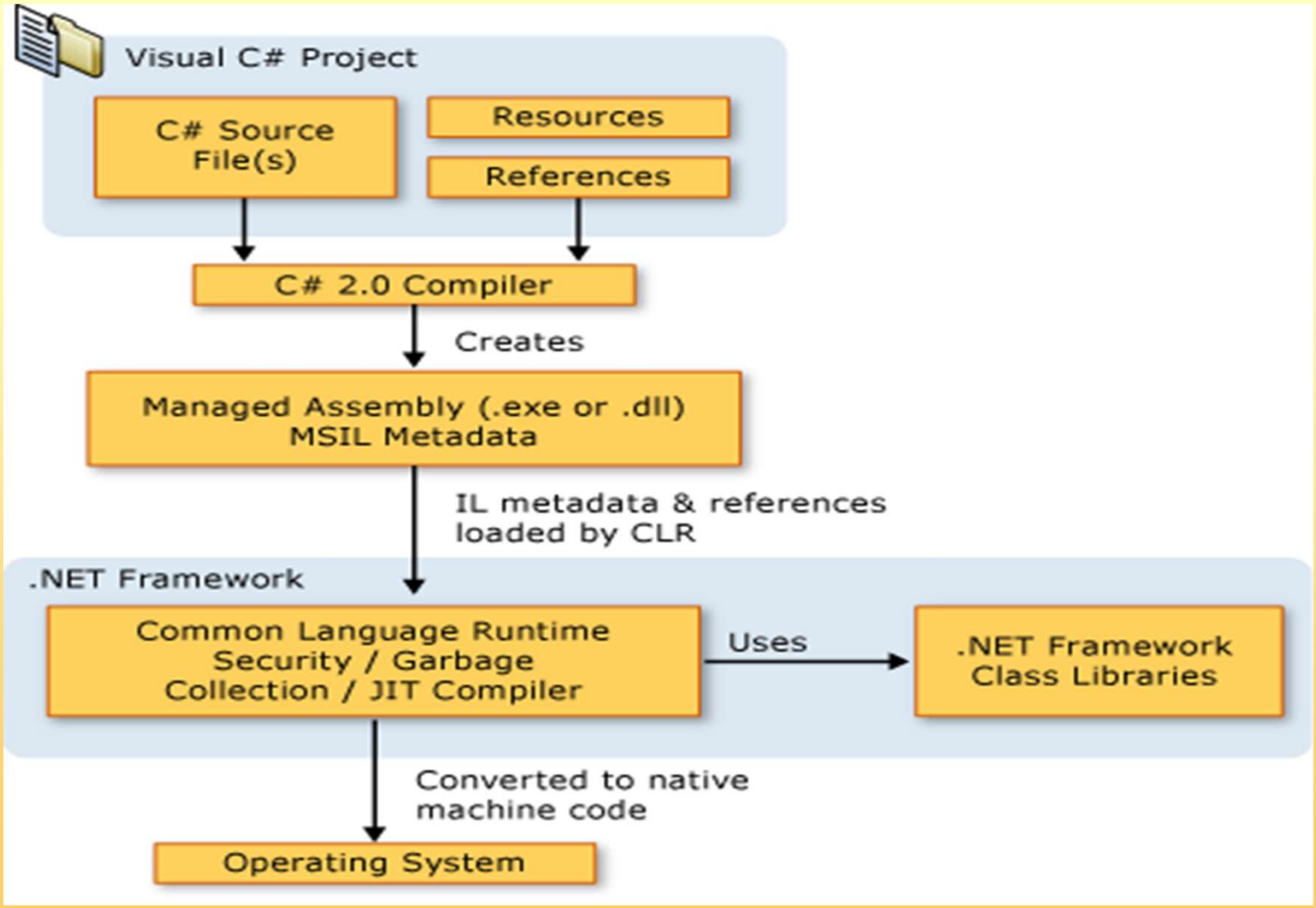
.Net Assemblies: *Compilation*



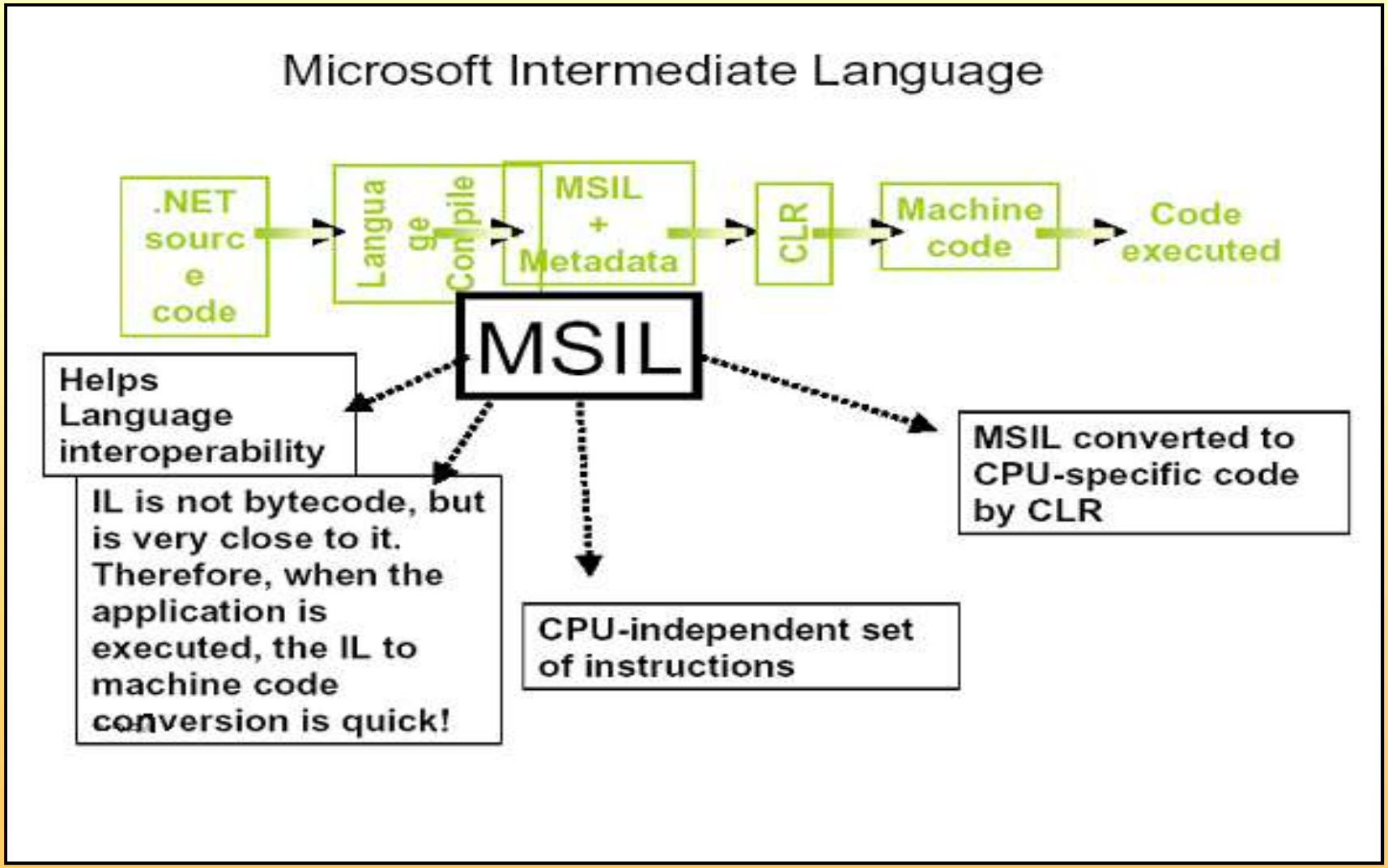
Compilation And Execution



.Net Execution Model



MSIL

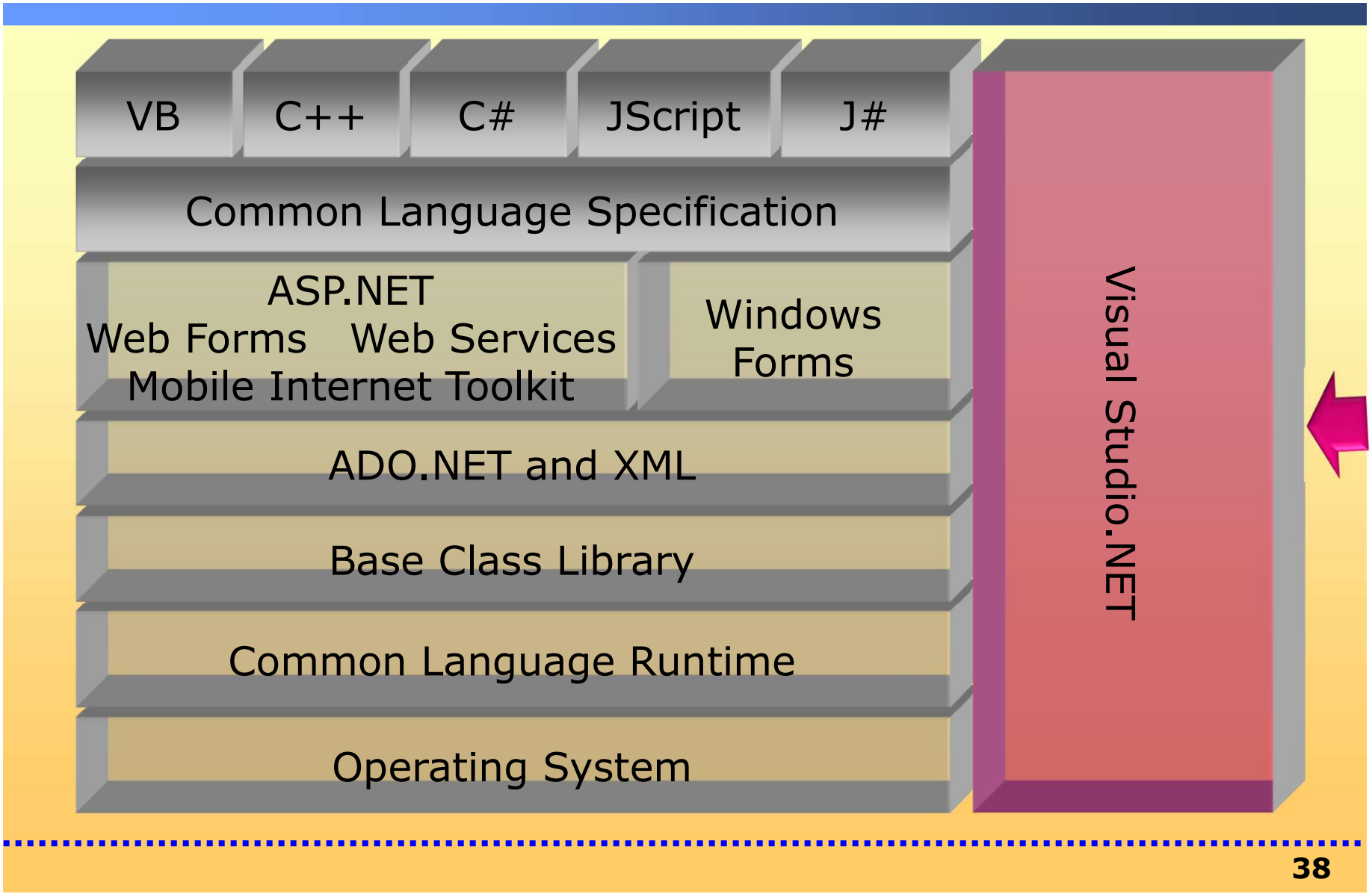

Microsoft Intermediate Language
.NET source code
Language Compile
MSIL + Metadata
CLR
Machine code
Code executed
MSIL
Helps Language interoperability
IL is not bytecode, but is very close to it. Therefore, when the application is executed, the IL to machine code conversion is quick!
CPU-independent set of instructions
MSIL converted to CPU-specific code by CLR

Metadata and IL Code

Example: Hello World!

- **Metadata:**
  - data about data; description of assembly, description of types, attributes
  - objects can communicate with each other
  - Stored in binary format, CLR loads metadata into memory for reference
- **IL code:**
  - intermediate language, CPU independent sets of instructions
- **Assembly:**
  - a basic unit of versioning, deployment, security management, execute, reuse and sharing.
- **Manifest:** **Assembly Metadata**

Visual Studio.NET



Visual Studio .NET

- Comprehensive best-of-breed tool for building connected applications based on .NET for Windows and the Web
- All languages under one roof
- All application types under one roof
- Consistent programming model for all application types
- Enterprise Lifecycle Support (VSS, Visio, Enterprise Templates)

Developer Productivity Features

Increased IDE Performance
Startup time reduced
Improved IntelliSense®
Dynamic help faster
Object browser faster
Code editor drop-down menus faster
Enhanced "Add Web Reference" dialog
Code editor enhancements
New components
Debugging enhancements
Designer enhancements
Schema designer zoom
Mobile Web form designer
Integrated community search
Run multiple version of Visual Studio side-by-side:
- **Visual Studio 6.0**
- **Visual Studio .NET 2002**
- **Visual Studio .NET 2003**

Upgrade from Visual Studio .NET 2002 to Visual Studio
- **Only the project files are updated**
- **Doesn't change *any* of your source files**

Visual Basic .NET
- Fully object-oriented
- Free threading, structured exception handling
- Host VB6.0 controls in WinForms applications
- Improved IntelliSense and debugger
- Variable declaration in loops
- Bitshift operators
- Mobile applications

Microsoft® Visual C++® .NET
- Managed extensions for C++
- ISO C++ conformance
- Windows Forms designer
- Enhanced floating point performance optimizations
- P4 targeting

Microsoft® Visual C# ® .NET
- Component-oriented, type-safe
- Improved IntelliSense
- Custom build steps
- Code insertion for common tasks

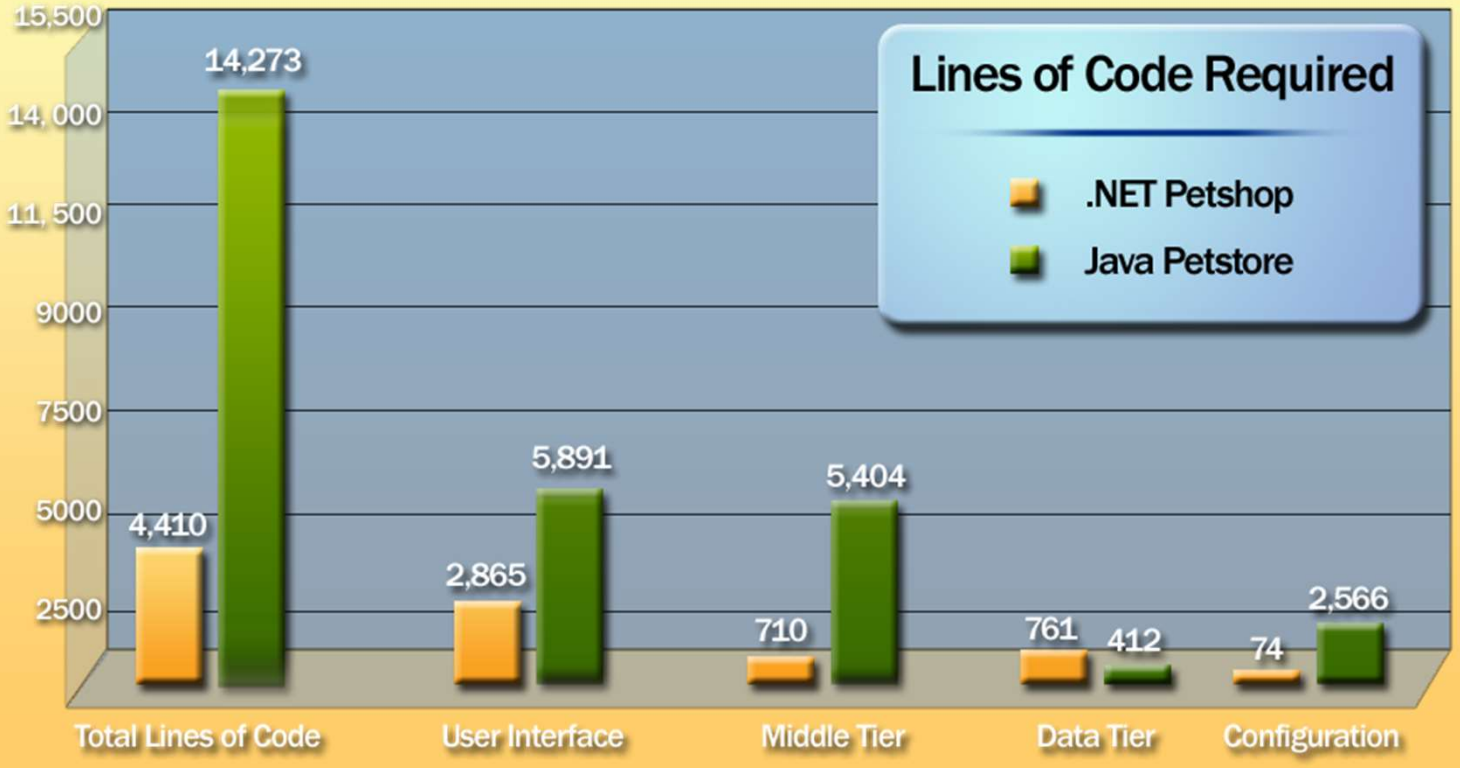
Mobile applications Microsoft® Visual J#™ .NET
- Java-language syntax
- Full integration with Visual Studio .NET
- Easy way to move Java-language skills,
- Full access to the .NET Framework

Visual Studio.NET

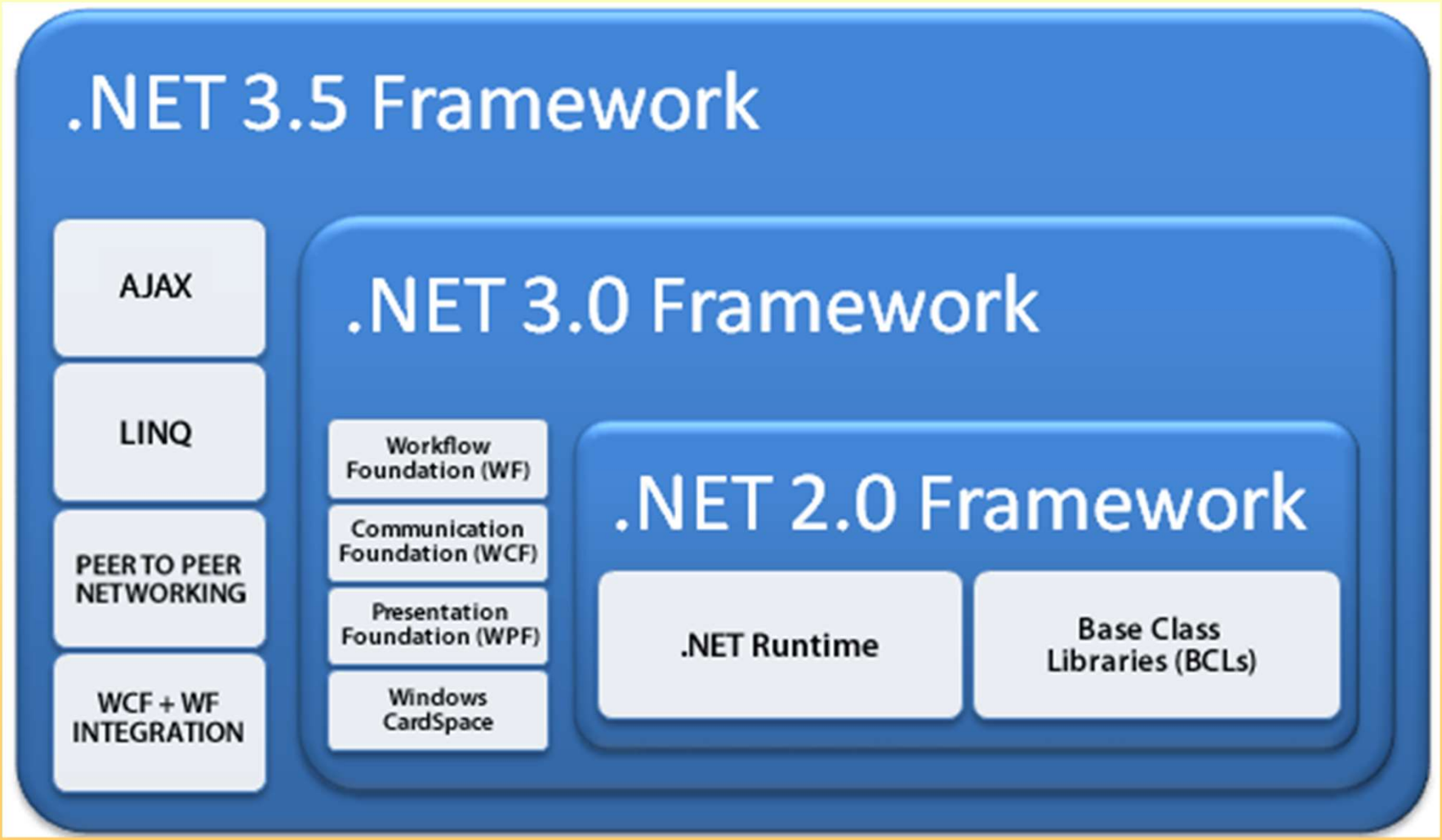
- **Integrated Development Environment**
  - Visual Basic.NET
    - Many language enhancements
    - Inheritance,Overloading, Free Threading
  - Visual C++
    - Integration with .NET Framework with managed extensions (classes)
  - C#
    - New development language
    - Based on C/C++ with Garbage Collection/Memory Management

Developer Productivity

Productivity	• One third the code
Performance	• 28 times faster
Scalability	• 6 times more users

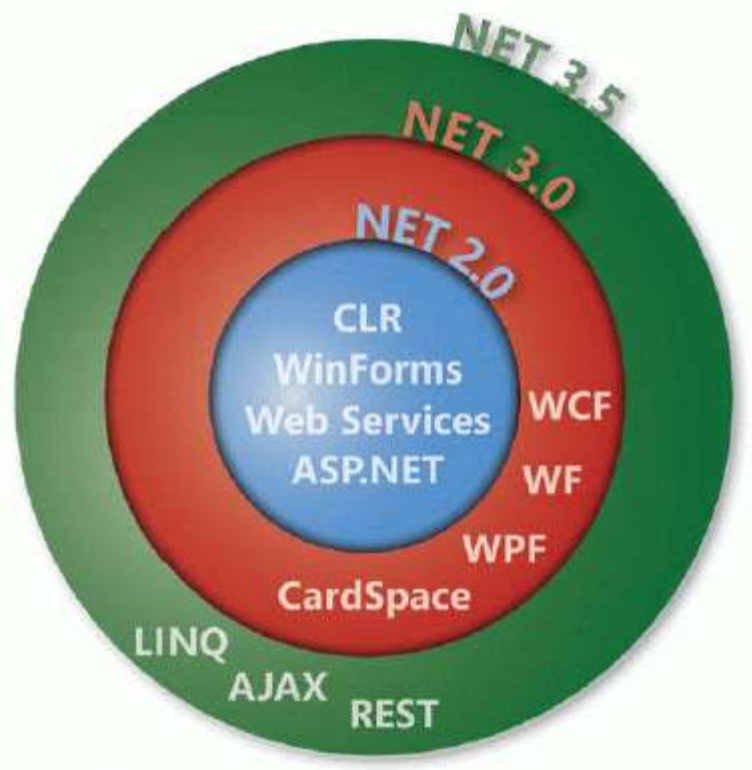


The .NET Framework Stack



.Net Framework History

- **.NET Framework 1.0 - January 2002**
  - Initial release
- **.NET Framework 1.1 - April 2003**
  - Mobile ASP.NET Support
  - Security Enhancements
  - ODBC/Oracle Support
  - .NET Compact Framework
  - IPv6 Support
  - Various API Changes
- **.NET Framework 2.0 - November 2005**
  - *Generics!*
  - Hosting API
  - 64-bit Support
  - ASP.NET enhancements(web controls, personalisation)
  - Data Controls with Declarative Data Bringing
  - .NET Micro Framework
  - Various API Changes
- **.NET Framework 3.0 - November 2006**
  - Windows Presentation Framework
  - Windows Communication Framework
  - Windows Workflow Foundation
  - Windows CardSpace
- **.NET Framework 3.5 – November 2007**
  - ASP.NET AJAX
  - LINQ
  - Various API Changes
- **.NET Framework 4.0 – April 2010**
  - MEF, TPL, PLINQ, DLR, MVC, ADO.NET EF



Additive versions of the .NET Framework

Summary

- **The .NET Framework**
  - Dramatically simplifies development and deployment
  - Unifies programming models
  - Provides robust and secure execution environment
  - Supports multiple programming languages

Introduction to C#

Need for C#

- **Existing languages are powerful. Why do we need another language?**
- **Important features are spread out over multiple languages**
  - Example: must choose between pointers (C++) or garbage collection (Java)?
- **Old languages + new features = poor syntax**
  - Garbage collection in C++?
  - Event-driven GUIs in Java?

Goals of C#

- **Give developers a single language with**
  - A full suite of powerful features
  - A consistent and simple syntax
- **Increase developer productivity!**
  - Type safety
  - Garbage collection
  - Exceptions
  - Leverage existing skills

Goals of C# cont.

- **Support component-oriented programming**
  - First class support for component concepts such as properties, events, attributes
- **Provide unified and extensible type system**
  - Where everything can be treated as an object
- **Build foundation for future innovation**
  - Concise language specification
  - Standardization

Architectural History of C#

- **Anders Hejlsberg.**
  - C#'s principal designer and lead architect at Microsoft.
  - He designed
    - Visual J++
    - Borland Delphi
    - Turbo Pascal
    - .NET CLR (Core)
    - C# Language

Anders Hejlsberg, Microsoft Technical Fellow and Chief Architect, C#

Design of C#

- **Derived from the features and syntaxes of other languages**
  - The safety of Java
  - The ease of Visual Basic
  - The power of C++
- **Uses the .NET Framework**
- **Plus several unique features**

The safety of Java

- 100% object oriented
- Automatic garbage collection
- Array bounds checking at runtime
- Strict type checking
- Structured exception handling

The ease of Visual Basic

- First class support for properties
- First class support for events
- For-each loops

The power of C++

- **Enumerations**
- **Operator overloading**
  - Mathematical, Indexing, and Casting
- **Function pointers**
  - Called “delegates”
  - Type safe
- **Structs**
- **Option to pass parameters by reference or by value**
- **Can disable type-safety, garbage collection, and bounds checking**
- **Can directly manipulate memory with pointers (unsafe)**

C# Program Structure

- **Namespaces**
  - Contain types and other namespaces
- **Type declarations**
  - Classes, structs, interfaces, enums, and delegates
- **Members**
  - Constants, fields, methods, properties, indexers, events, operators, constructors, destructors
- **Organization**
  - No header files, code written “in-line”
  - No declaration order dependence

General Structure of C# Program