An Introduction to the .NET Framework

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Adapted from Applied .NET Framework Programming by Jeffrey Richter
(Microsoft Press)
Introduction

• Development tools:
  – Languages and Compilers.
  – Development environments (Visual Studio)
  – C# vs Visual C#

• Class Library.
The CLR

- Common Language Runtime.
- Runtime used to execute all .NET code.
- Instead of compiling to native code, a CLR-compliant language compiles to IL (intermediate language).
Managed Modules

- **PE (Portable Executable) Header:**
  - Native Windows executable header contains details such as whether the application is a console or window based application or a DLL.

- **CLR header:**
  - Header interpreted by the CLR.
  - Version of CLR required, entry point (Main()), location of resources, …

- **Metadata:**
  - Tables of types and members created and referenced.

- **IL Code:**
  - The output of the .NET compiler. The CLR later translates this to native code.
Calling a Method for the First Time

- Consider the Console.WriteLine method being called in the Main() method.
- Interally the CLR has an undocumented method called JITCompiler:
  - Look up the assembly that contains the WriteLine method (Console).
  - Search the metadata of the assembly to locate the WriteLine method.
  - Get the IL of the WriteLine method.
  - Compile the IL into memory.
  - Set the ‘execution pointer’ to that memory block.
  - Jump to the execution pointer.
Calling a Method for the Second Time

- The JIT compiler ‘caches’ the native CPU instructions in dynamic memory.
- The second time a method is called, the compiled native code block for the method is detected and executed.
- A performance hit (due to re-compilation) is incurred only once.
IL and Verification

- IL is stack based.
- Idea (not actual IL):
  \[
  \text{load 3} \\
  \text{add 5} \\
  = 8
  \]
- S
  - When compiling IL into Native code, the CLR verifies the code. E.g.:
    - Checks that no memory is read if it wasn’t written to.
    - Methods are called with the right type and number of parameters.
    - ...
- Verification has the advantage of guaranteeing that an application running on the CLR does not effect another application on the CLR.
- This means that you can have multiple ‘managed’ applications running inside the SAME windows process without them interfering with each other (these managed applications are called AppDomains).
Framework Class Libraries

- XML Web Services.
- Web Forms (web user interfaces).
- Windows Forms.
- Console Applications.
- Windows Services.
- Component development.
Common Namespaces

- System: basic types.
- System.Collections: stacks, array lists, queues, ...
- System.Drawing: 2D graphics (GDI).
- System.IO: Streams, files, directories.
- System.Text: Handling different text encodings (e.g. ASCII and Unicode).
- System.XML.
The Common Type System (CTS)

• The CTS specification states that a type can have zero or more members:
  – Fields (state of an object).
  – Methods.
  – Properties (one or two methods actually).
  – Events.

• Access modifiers:
  – Private, Family (protected), Assembly (internal), Family and Assemble, Family or Assembly, public.

• Inheritance.

• CTS only supports single inheritance.
Further Reading

• Common Language Specification (CLS).
• Interoperability with unmanaged code (unsafe, DLLImport).