



NINNES

dotNet and Roslyn behind the Curtains

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Introduction

What are we here for?

- NINNES project
- dotNet compilation and execution internals
- Roslyn internals
- Cool demo



NINNES Project

1. Bringing C# into NES game programming
2. Customizing the dotNet compilation process
3. Programming CPU-equivalent libraries



C# Code Tailoring



Cutting C# down to size

<https://www.pexels.com/photo/fabric-scissors-needle-needles-scissors-461035/>



NES dotNet Shims Platform



Bridging the gap to the unknown
<https://www.pexels.com/photo/architecture-bridge-fog-ocean-285283/>



C# Compilation to the NES CPU



One Ace up the sleeve.
<https://www.pexels.com/photo/actor-adult-business-cards-547593/>



Why?

1337

Showcasing dotNet's flexibility
And 1337 internet points



From Visual Studio to F5, dotNet behind the curtains

The Show Begins



From idea to execution, a play by Microsoft
<https://www.pexels.com/photo/people-at-theater-713149/>



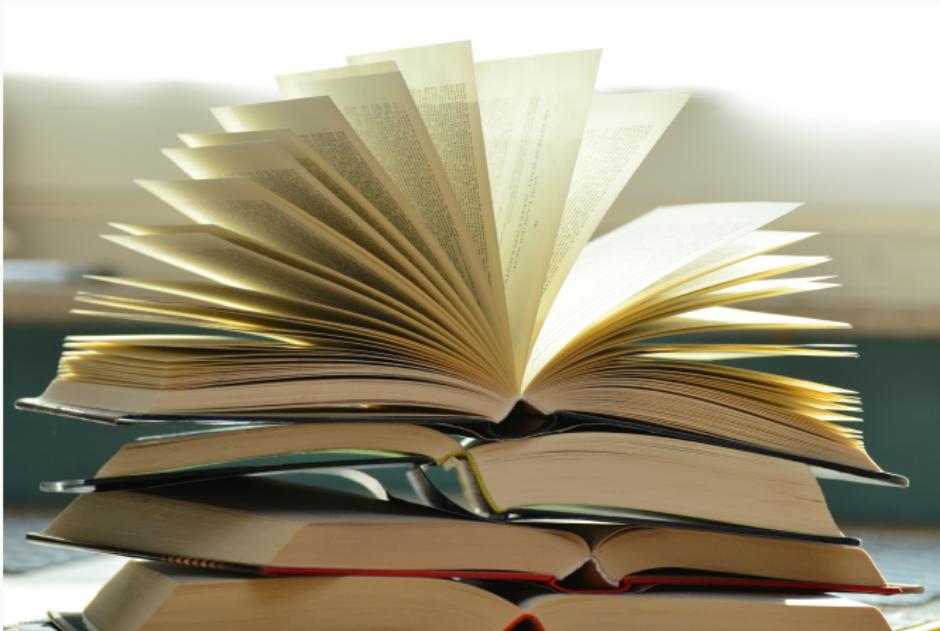
C#, the Typewriter



Just another day in Heaven

<https://www.pexels.com/photo/person-using-typewriter-on-white-surface-886470/>





Theory and Practice of the OS and Hardware
<https://www.pexels.com/photo/pile-of-books-159866/>



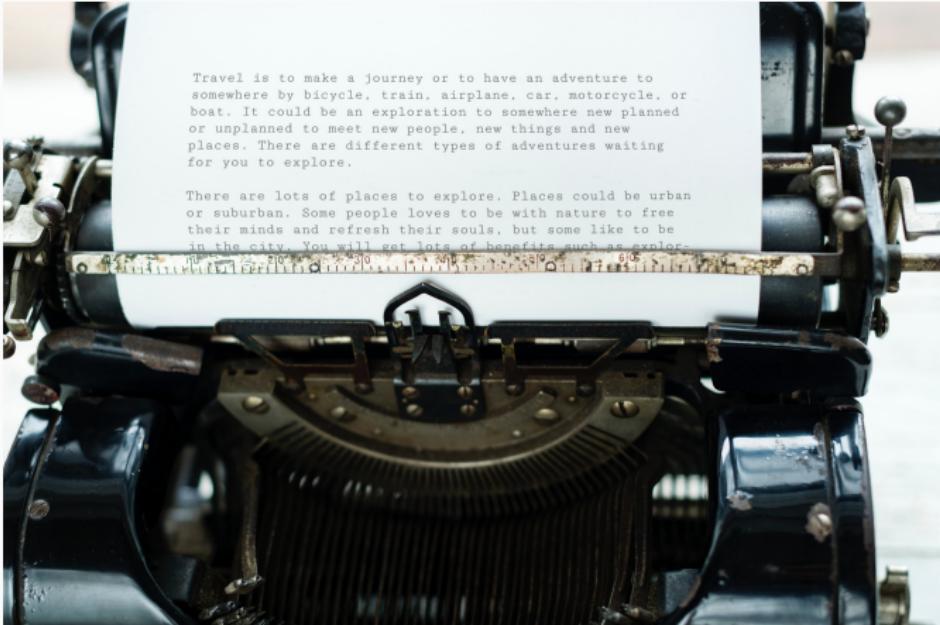
Roslyn, Costumer Extraordinaire



Making sure Actors are properly dressed
<https://www.pexels.com/photo/tailor-measuring-man-s-chest-1282309/>



MSIL, the Script



Business Value, one OpCode at a time
<https://www.pexels.com/photo/paper-attached-to-typewriter-921780/>



MSBuild, the Producer



Keeping track of everything
<https://www.pexels.com/photo/man-desk-notebook-office-7060/>



RyuJIT, the Director



Making sure the actors perform their best

<https://www.pexels.com/photo/acting-action-actor-actress-275200/>



CLI, the Stage



Solid ground to stand on

<https://www.pexels.com/photo/architecture-room-indoors-auditorium-109669/>



dotNet Native, the Cameraman



Recording from all angles
<https://www.pexels.com/photo/camera-event-live-settings-66134/>



From Visual Studio to the NES

The Limits of the NES

The NES runs on a MOS6502 8-bit CPU implementation from Ricoh, although without the decimal/floating point mode enabled. This brings forth several limitations:

- No floating point calculations
- No multiplication or division implemented in hardware
- No Operating System
- Limited memory access capabilities



Removing dotNet from C#, 8 bits at a time

To be able to fit a C# program inside the NES some concessions must be made, including:

- No Garbage Collection
- No Threading
- No Operating System services
- No DLR
- No Reflection
- No Sockets/Communication



MSIL and 8-bit CPUs don't mix

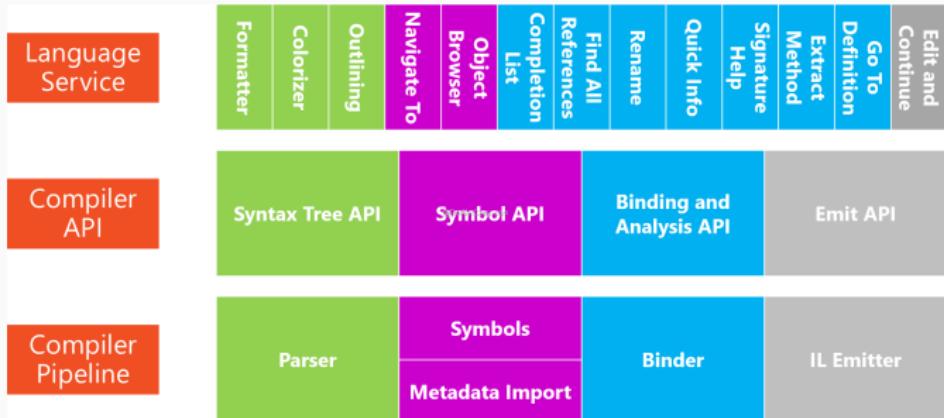
Bringing C# compilation output to a MOS6502-compatible format may entail

- Direct ASM transpilation from Roslyn C# ASTs
- C++ transpilation from Roslyn C# ASTs for compilation with a MOS6502-compatible compiler
- MSIL recompilation with LLILC
- Researching the work of the .Net Micro Framework



Roslyn is a Friend, not an Enemy

General Roslyn Services



Some of the services exposed by Roslyn

<https://www.dotnetcurry.com/csharp/1258/dotnet-platform-compiler-roslyn-overview>



Compiler basics - What is compilation?

Compilation produces a directly usable binary from code

Transpilation produces code in a different language from the source

<https://stackoverflow.com/a/40605701/528131>



Compiler basics - What is code?

English is the language of the human, Assembler OpCodes is the language of the machine. Compilers must act as a bridge in between these two realms of knowledge, and they too have their own abstraction: The Abstract Syntax Tree.

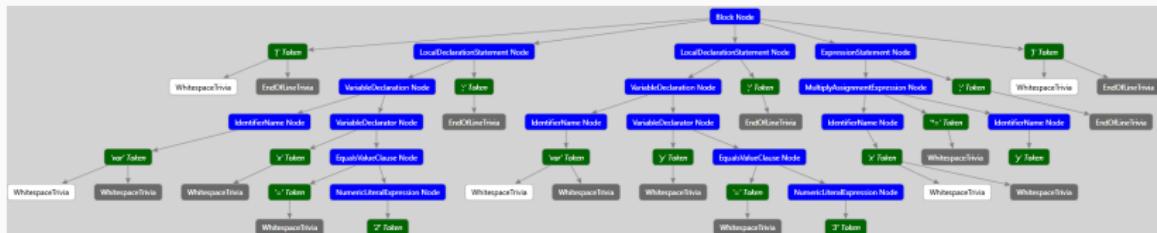


Compiler basics - Code Sample

```
var x = 2;  
var y = 3;  
x *= y;
```



Compiler basics - Abstract Syntax Tree



A basic Roslyn AST

Own work



Roslyn Design Goals:

Speed

Analysis must be performed incrementally and in real time

Memory Economy

Visual Studio can already be daunting for some machines



Roslyn Basics - Code Diagnostics

Two words: CUSTOM SQUIGGLIES



DEMO

Takeaway

Roslyn allows to program specific non-functional requirements to aid programmers



QUESTIONS?

Thank you!

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The NINNES Project
<https://github.com/Machinarius/NINNES>





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