What's new for performance in .NET Core 2.0

Runtime changes, JIT changes
and patterns to get the most from your code

@ben_a_adams

Ben Adams

benaadams

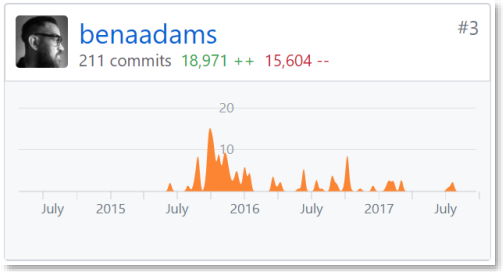
About myself

- Co-founder & CTO of Illyriad Games

- Age of Ascent - Ultra-MMO

- Microsoft MVP

- ASP.NET Core Kestrel webserver



- CoreCLR

.NET Core 1.0 & ASP.NET Core 1.0

The degree of improvement is absolutely astonishing … approximately 85,900% improvement ... That is not a typo, it's 859 times faster!

Microsoft has made C# and ASP.NET one of the most interesting web development platforms available.

We have a brief message to those developers who have avoided Microsoft's web stack thinking it's "slow" or that it's for Windows only: ASP.NET Core is now wicked sick fast

Oh, and of course we're running it on Linux.

You may be thinking about the Microsoft of 10 years ago.

Brian Hauer - TechEmpower – Round 13

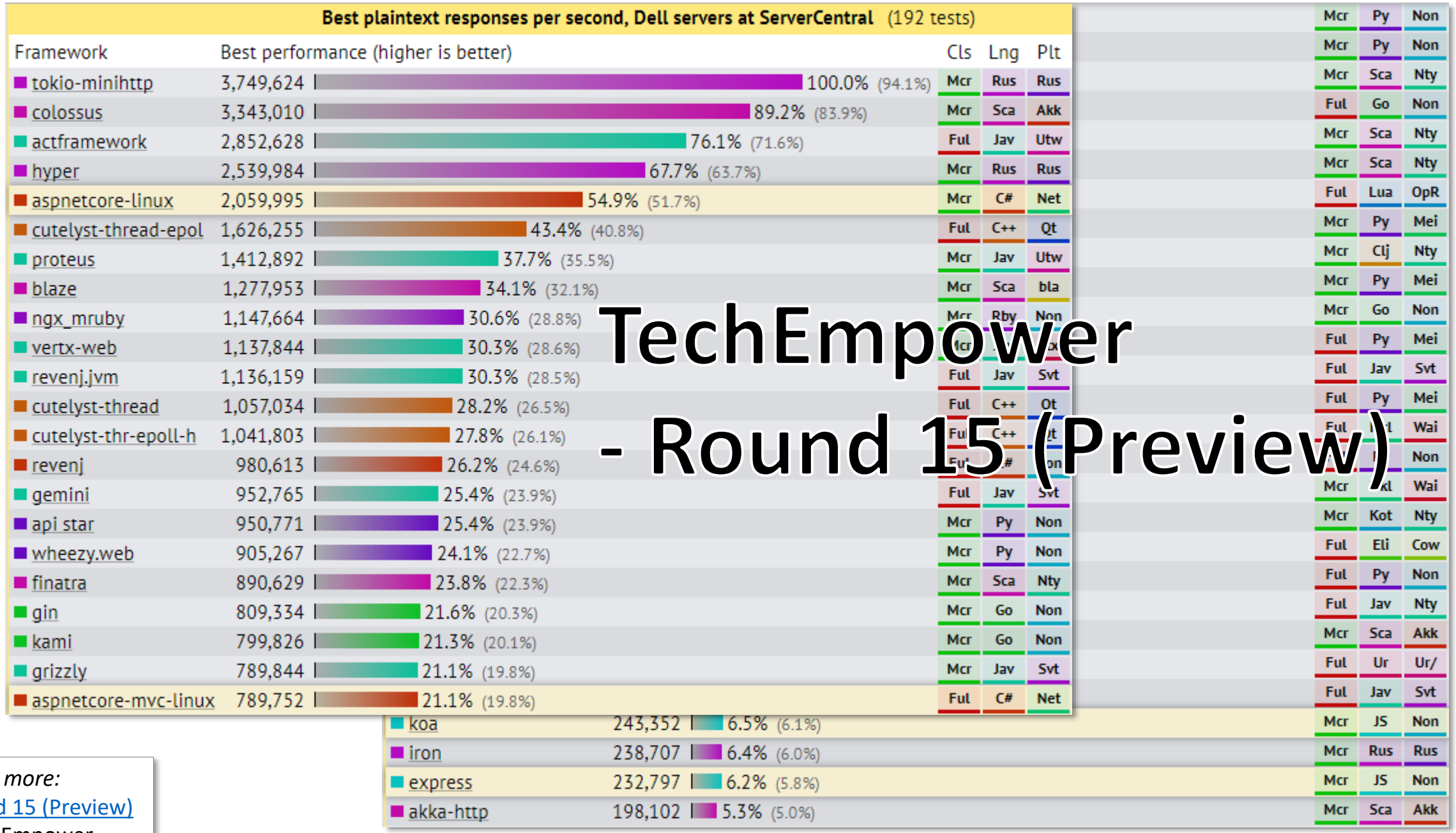
.NET Core 2.0

The Best Yet!

Learn more:
Announcing .NET Core 2.0
- Rich Lander

.NET Core 2.0

- Even Faster
- Profile-guided Optimized Runtime
- Runtime Store for .NET and ASP.NET
- Even more cross-platform
  Windows, macOS, Red Hat, CentOS, Fedora, Debian, Ubuntu, Mint, SUSE, …
- Side-by-side Runtime Installs
  No upgrade fears - Apps on same server can use different versions
- .NET Standard 2.0
  Added 19k+ .NET Framework APIs for 32k+ APIs
- Allows a more compact .csproj



TechEmpower - Round 15 (Preview)

Learn more:
[Round 15 (Preview)]
- TechEmpower

Automatic Gains

Just from using .NET Core 2.0

No code changes

The Framework is Faster

Just by using .NET Core 2.0

Learn more:
Performance Improvements in .NET Core
- Stephen Toub

Collections are faster…

- Queue<T>
  Enqueue/Dequeue + 200% faster
- List<T>
  Add/Remove + 40% faster
  Clear (Primitive Types) – Instant!
- ConcurrentQueue<T>
  Now non-allocating!
  Enqueue/TryDequeue + 350% faster
- ConcurrentBag<T>
  Now non-allocating!
  Enqueue/TryDequeue + 30% faster

Text is faster…

- Guid.ToString + 69% faster
- Encoding.UTF8.GetBytes + 48% faster
- DateTime.ToString + 300% faster
- String
  IndexOf + 200% faster
  StartsWith + 200% faster
- Enum
  Parse + 33% faster
  ToString + 600% faster

Concurrency is faster…

- ThreadPool + 66% faster
- Fail fast contended locks

  SpinLock.TryEnter + 600% faster

  SemaphoreSlim.WaitAsync(0) + 140% faster

  SemaphoreSlim.Wait(0) + 27,515% faster

  Monitor.TryEnter (Contended) + 4,038,980% faster
- Lazy<T> + 500% faster

I/O is faster…

- FileStream
  CopyToAsync + 46% faster
- Sockets
  SocketAsyncEventArgs + 360% faster
- NetworkStream
  CopyToAsync + 500% faster
- SslStream
  + 374% faster
  Huge allocation reduction

Everything is faster!

- Compression (DeflateStream) + 400% faster
- Cryptography
  Now uses Native OS Implementation
  SHA256.ComputeHash + 200% faster
- Math
  BigInteger + 400% faster
  DivRem + 200% faster
- LINQ
  Huge rework, up to +300% faster in places
- So much more..!

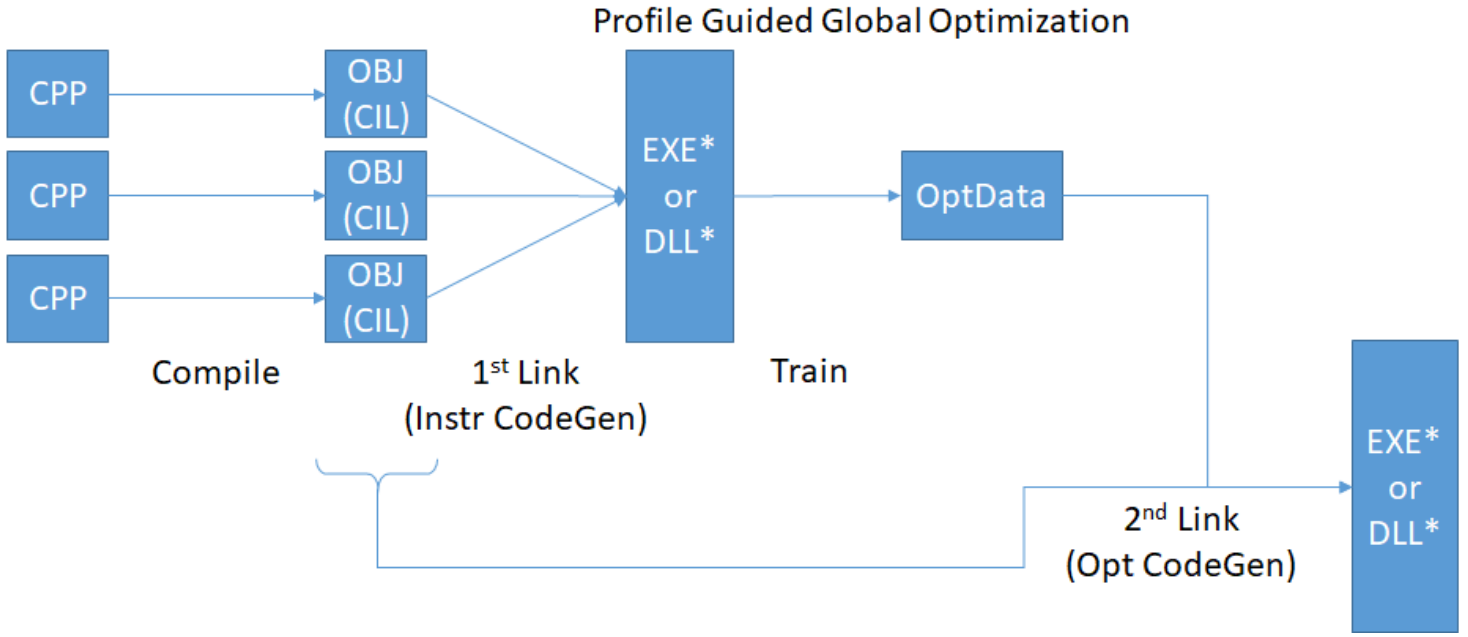
The Runtime is Faster

…and it gets going faster

Learn more:
Profile-guided optimization in .NET Core 2.0
- Daniel Podder and Bertrand Le Roy

Profile Guided Optimization

- Affects the native part of the runtime
  - Faster start-up
  - Faster Jitting
  - Faster GC



The Jit Produces Faster Code

RyuJIT is magic

Learn more:
Performance Improvements in RyuJIT in .NET Core and .NET Framework
- Joseph Tremoulet

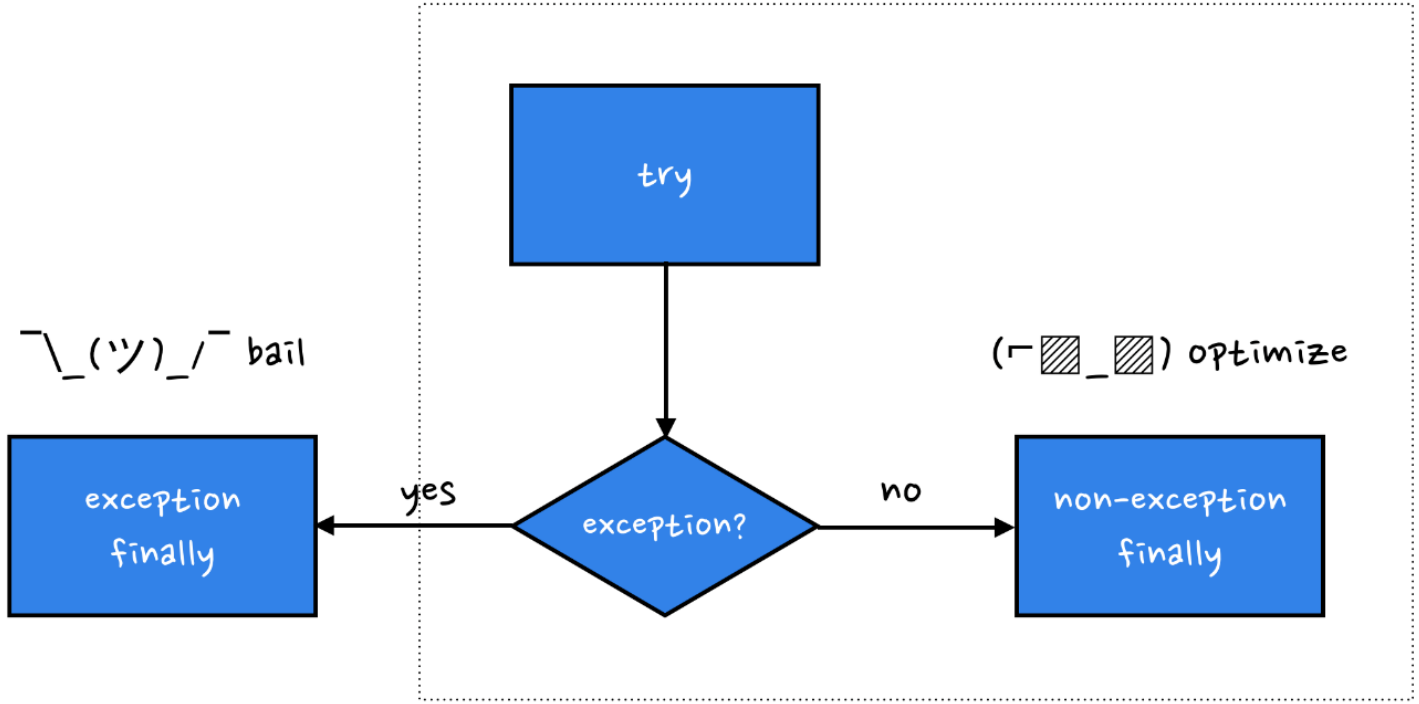
RyuJIT

- Now used for x86 as well as x64 and ARM
- Rotate Patterns
- Devirtualization
  (and sealed now means something)
- Enhanced Range Inference
- Shift Count Mask Removal
- Improved Vectors

Learn more:
coreclr#9908 JIT: devirtualization next steps
- Andy Ayers

RyuJIT - Exception Handling

- Enabled Inlining of methods with conditional throws
- Non-returning methods
- Empty Finally Removal
- Finally Cloning



Learn more:
Do not inline methods that never return
- mikedn

Learn more:
Finally optimizations
- Andy Ayers

`throw` is free?

If it never runs..?

But… can miss out on Inlining

```
public Segment(T[] array, int start, int length)
{
    if (array == null)
    {
        throw new ArgumentNullException(nameof(array));
    }
    if (start < 0)
    {
        throw new ArgumentOutOfRangeException(nameof(start));
    }
    if (start >= array.Length)
    {
        throw new ArgumentOutOfRangeException(nameof(start));
    }
    if (length < 0)
    {
        throw new ArgumentOutOfRangeException(nameof(length));
    }
    // subtract start else may overflow
    if (length > array.Length - start)
    {
        throw new ArgumentOutOfRangeException(nameof(length));
    }

    _array = array;
    _start = start;
    _length = length;
}
```

102 bytes cil
367 bytes asm
[FAILED: too many il bytes]
Marking as NOINLINE because of too many il bytes

```
public Segment(T[] array, int start, int length)
{
    if (array == null)
    {
        throw new ArgumentNullException(nameof(array));
    }
    if (start < 0 || start >= array.Length)
    {
        throw new ArgumentOutOfRangeException(nameof(start));
    }
    // subtract start else may overflow
    if (length < 0 || length > array.Length - start)
    {
        throw new ArgumentOutOfRangeException(nameof(length));
    }

    _array = array;
    _start = start;
    _length = length;
}
```

80 bytes cil
249 bytes asm
[FAILED: unprofitable inline]

Two less tests

```
if ((uint)start >= (uint)array.Length)
```

Quicker way to test both

```
if (start < 0 ||
    start >= array.Length)
```

Negative as `uint` > `int`.MaxValue

```
public Segment(T[] array, int start, int length)
{
    if (array == null)
    {
        throw new ArgumentNullException(nameof(array));
    }
    if ((uint)start >= (uint)array.Length)
    {
        throw new ArgumentOutOfRangeException(nameof(start));
    }
    // subtract start else may overflow
    if ((uint)length > (uint)(array.Length - start))
    {
        throw new ArgumentOutOfRangeException(nameof(length));
    }

    _array = array;
    _start = start;
    _length = length;
}
```

72 bytes cil
237 bytes asm
[FAILED: unprofitable inline]

Non-returning methods

```
public Segment(T[] array, int start, int length)
{
    if (array == null ||
        (uint)start >= (uint)array.Length ||
        (uint)length > (uint)(array.Length - start))
    {
        ThrowHelper.ThrowValidationError(array, start);
    }

    _array = array;
    _start = start;
    _length = length;
}
```

46 bytes cil
72 bytes asm
[profitable inline]

```
internal static class ThrowHelper
{
    1 reference
    public static void ThrowValidationError(Array array, int start)
    {
        throw GetValidationError(array, start);
    }

    // Don't inline on older runtimes
    [MethodImpl(MethodImplOptions.NoInlining)]
    1 reference
    private static Exception GetValidationError(Array array, int start)
    {
        if (array == null)
        {
            throw new ArgumentNullException(nameof(array));
        }
        if ((uint)start >= (uint)array.Length)
        {
            throw new ArgumentOutOfRangeException(nameof(start));
        }

        throw new ArgumentOutOfRangeException("length");
    }
}
```

New terser .csproj (1)

- Huge list of files, gone

```
<!-- the defaults -->
<Compile Include="**\*.cs" />
<EmbeddedResource Include="**\*.resx" />
```

- Project References

Old

```
<ProjectReference Include="..\ClassLibrary1\ClassLibrary1.csproj">
  <Project>{2C7DF870-5B35-49EF-963D-EE1E72C3177E}</Project>
  <Name>ClassLibrary1</Name>
</ProjectReference>
```

New

```
<ProjectReference Include="..\ClassLibrary1\ClassLibrary1.csproj" />
```

Learn more:
Old csproj to new csproj: Visual Studio 2017 upgrade guide
- Nate McMaster

New terser .csproj (2)

- Removed `packages.config` and **packages** directory
- Old

```
<Import Project="..\..\packages\xunit.runner.visualstudio.2.2.0\build\net20\xunit.runner.visualstudio.props" Condition=

<ItemGroup>
  <None Include="packages.config" />

  <Reference Include="MySql.Data, Version=6.9.9.0, Culture=neutral, PublicKeyToken=c5687fc88969c44d, processorArchitect
  <HintPath>..\..\packages\MySql.Data.6.9.9\lib\net45\MySql.Data.dll</HintPath>
  <Private>True</Private>
</Reference>
</ItemGroup>
```

- New

```
<ItemGroup>
  <PackageReference Include="MySql.Data" Version="6.9.9" />
</ItemGroup>
```

Common Performance Issues

Thread-pool starvation

- Isn’t “sync vs async”; its blocking vs async
- Blocking calls on Threadpool threads
  - Read -> ReadAsync
  - Write -> WriteAsync
  - task.Result -> await task
  - task.GetAwaiter.GetResult() -> await task
  - task.Wait() -> await task
  - Task.WaitAny(…) -> await Task.WhenAny(…)
  - Task.WaitAll(…) -> await Task.WhenAll(…)
- Can use `.Result` **if** you have checked `.IsCompletedSucessfully == true`

Detect Blocking Calls

TaskBlockingListener

.Start();

- **.Result**
- **.GetAwaiter.GetResult()**
- **.Wait()**
- **Task.Wait(…)**
- **Task.WaitAll(…)**

```
public sealed class TaskBlockingListener : EventListener
{
    private static readonly Guid s_tplGuid = new Guid("2e5dba47-a3d2-4d16-8ee0-6671ffdcd7b5");
    private static readonly Lazy<TaskBlockingListener> s_listener
       = new Lazy<TaskBlockingListener>(() => new TaskBlockingListener());

    public static void Start() { object ignored = s_listener.Value; }
    private TaskBlockingListener() { }
    protected override void OnEventSourceCreated(EventSource eventSource)
    {
        if (eventSource.Guid == s_tplGuid)
        {
            // 3 == Task|TaskTransfer
            EnableEvents(eventSource, EventLevel.Informational, (EventKeywords)3);
        }
    }
    protected override void OnEventWritten(EventWrittenEventArgs eventData)
    {
        if (eventData.EventId == 10 && // TASKWAITBEGIN_ID
            eventData.Payload != null &&
            eventData.Payload.Count > 3 &&
            eventData.Payload[3] is int value && // Behavior
            value == 1) // TaskWaitBehavior.Synchronous
       {
           Console.WriteLine("Blocking on an incomplete task.\n" + Environment.StackTrace);
       }
   }
}
```

Learn more:
Tips of the Toub [corefx#8931 (comment)]
- Stephen Toub

Panic Workaround

You are in production and you need a panic workaround; what to do?

Unthrottle the thread pool min threads:

```
using System.Threading;

var threadCount = 2000; // 2GB :-(
ThreadPool.GetMaxThreads(out _, out var completionThreads);
ThreadPool.SetMinThreads(threadCount, completionThreads);
```

Then fix the source… go async

HttpClient

- Use xAsync methods (on threadpool thread)
  Thread-pool starvation
- Either Dispose
  Keep-alive connections increasing outbound connections
- Or use `static` HttpClient
  Less load on server
  Don’t change DefaultHeaders – Not thread-safe
- Increase concurrent outbound connections
  `ServicePointManager.DefaultConnectionLimit = 1024`
- Pipelining

Garbage Collector

The Garbage Collector is your friend

- Reduces errors
- Easier development
- Allows **very fast** allocation

… **but**, you pay for it later

- Not deterministic
- If you allocate a lot, you can get pauses

What does a GC Pause look like?

(Video)

Ben Adams
@ben_a_adams

Blaming perf issues on Garbage Collection is like blaming your hangover on your liver... Its the thing that's saving you from your code

2:41 AM - 21 Aug 2016

578 Retweets **629** Likes

20 578 629

Niall Connaughton @nconnaughton · 3h

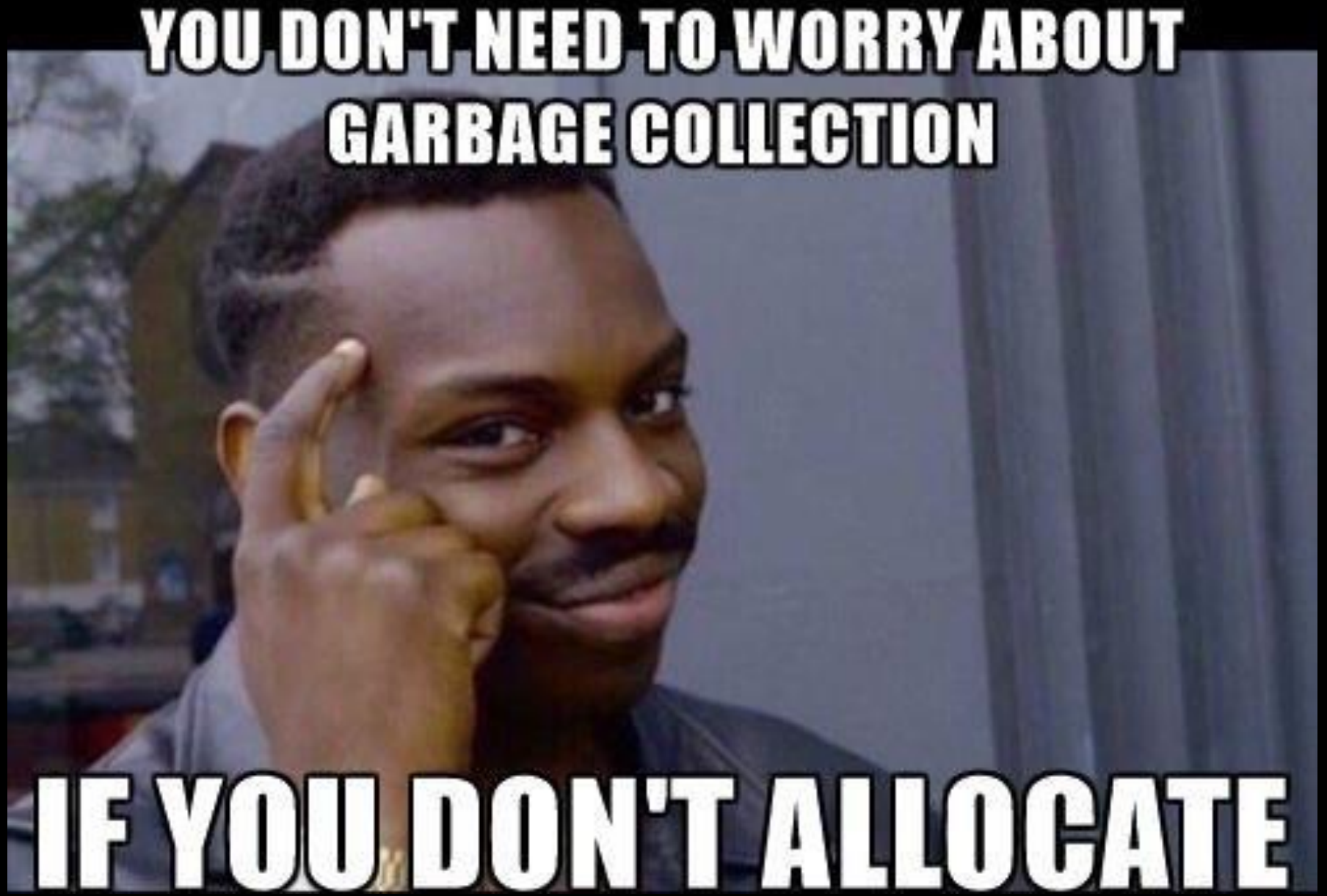
Replying to @matthewwarren @ben_a_adams @LeeRyanCampbell

So often the focus with GC is "how do I make it stop hurting me?!", when it should be "how do I stop hurting the GC?"

Nick Craver @Nick_Craver · 34m

Ask not what your garbage collector can do for you — ask what you can do for your garbage collector.

> **Niall Connaughton** @nconnaughton
>
> Replying to @matthewwarren @ben_a_adams @LeeRyanCampbell
>
> So often the focus with GC is "how do I make it stop hurting me?!", when it should be "how do I stop hurting the GC?"


YOU DON'T NEED TO WORRY ABOUT
GARBAGE COLLECTION
IF YOU DON'T ALLOCATE

Gains with Changes

Allocate less

- Don’t box! (Allocates and is slow)
- Don’t capture in Lambdas (Closures)
- Don’t use LINQ and IEnumerable<T> in hot paths
- Object Pools
- ArrayPool<T>
- Span<T> & ReadOnlySpan<T>
- ValueTask<T>
- Cached Tasks (e.g. Task.CompletedTask)

Learn more:
.NET Core: Performance Revolution
- Adam Sitnik

ValueTask<T>

```
[MethodImpl(MethodImplOptions.AggressiveInlining)]
0 references
ValueTask<int> ReadAsync(byte[] array)
    => IsDataReady
        ? new ValueTask<int>(result: GetData(array)) // INLINEABLE!!!
        : new ValueTask<int>(task: GetDataAsync(array));
1 reference
int GetData(byte[] array)
1 reference
Task<int> GetDataAsync(byte[] array)
```

```
async ValueTask<long> CountDataLength(int repeats)
{
    long total = 0;
    int current;
    do
    {
        ValueTask<int> valueTask = ReadAsync(_scratchBuffer); // INLINEABLE
        current = valueTask.IsCompletedSuccessfully
            ? valueTask.Result // hot path
            : await valueTask.AsTask();

        total += current;
    } while (current > 0);
    return total;
}
```

Learn more:
[.NET Core: Performance Revolution](#)
- Adam Sitnik

Ref returns

```
; Assembly listing for method Dictionary`2:TryGetValue(char,byref):bool:this
; Emitting BLENDED_CODE for X64 CPU with SSE2
; Lcl frame size = 40

G_M28467_IG01:
       57                push     rdi
       56                push     rsi
       4883EC28          sub      rsp, 40
       488BF1            mov      rsi, rcx
       498BF8            mov      rdi, r8

G_M28467_IG02:
       0FB7D2            movzx    rdx, dx
       488BCE            mov      rcx, rsi
       E800000000        call     Dictionary`2:FindEntry(char):int:this
       85C0              test     eax, eax
       7C29              jl       SHORT G_M28467_IG04
       488B5610          mov      rdx, gword ptr [rsi+16]
       3B4208            cmp      eax, dword ptr [rdx+8]
       732C              jae      SHORT G_M28467_IG06
       4863C8            movsxd   rcx, eax
       488D0C49          lea      rcx, [rcx+2*rcx]
       488B54CA10        mov      rdx, gword ptr [rdx+8*rcx+16]
       488BCF            mov      rcx, rdi
       E800000000        call     CORINFO_HELP_CHECKED_ASSIGN_REF
       B801000000        mov      eax, 1

G_M28467_IG03:
       4883C428          add      rsp, 40
       5E                pop      rsi
       5F                pop      rdi
       C3                ret

G_M28467_IG04:
       33C0              xor      rax, rax
       488907            mov      qword ptr [rdi], rax

G_M28467_IG05:
       4883C428          add      rsp, 40
       5E                pop      rsi
       5F                pop      rdi
       C3                ret

G_M28467_IG06:
       E800000000        call     CORINFO_HELP_RNGCHKFAIL
       CC                int3

; Total bytes of code 86, prolog size 6 for method
Dictionary`2:TryGetValue(char,byref):bool:this
```

C#6

```
; Assembly listing for method Dictionary`2:TryGetValue(char,byref):bool:this
; Emitting BLENDED_CODE for X64 CPU with SSE2
; Lcl frame size = 48

G_M28467_IG01:
       56                push     rsi
       4883EC30          sub      rsp, 48
       498BF0            mov      rsi, r8

G_M28467_IG02:
       0FB7D2            movzx    rdx, dx
       4C8D442428        lea      r8, bword ptr [rsp+28H]
       E800000000        call     Dictionary`2:FindEntryByRef(char,byref):byref:this       :this
       807C242800        cmp      byte  ptr [rsp+28H], 0
       7507              jne      SHORT G_M28467_IG03
       488BCE            mov      rcx, rsi
       33D2              xor      rdx, rdx
       EB06              jmp      SHORT G_M28467_IG04

G_M28467_IG03:
       488BCE            mov      rcx, rsi
       488B10            mov      rdx, gword ptr [rax]

G_M28467_IG04:
       E800000000        call     CORINFO_HELP_CHECKED_ASSIGN_REF
       8B442428          mov      eax, dword ptr [rsp+28H]
       0FB6C0            movzx    rax, al

G_M28467_IG05:
       4883C430          add      rsp, 48
       5E                pop      rsi
       C3                ret

; Total bytes of code 59, prolog size 5 f
; =========================================
```

C#7

```
public bool TryGetValue(TKey key, out TValue value)
{
    int i = FindEntry(key);
    if (i >= 0)
    {
        value = _entries[i].value;
        return true;
    }
    value = default(TValue);
    return false;
}
```

```
public bool TryGetValue(TKey key, out TValue value)
{
+   ref var entry = ref FindEntryByRef(key, out var found);
+   value = found ? entry.value : default(TValue);
+   return found;
}
```

Runtime Store

Nick Craver @Nick_Craver · Aug 14

The entire MiniProfiler #AspNetCore sample **upgrade** to 2.0 in pictures:

```
4   -   <TargetFramework>netcoreapp1.0</TargetFramework>
    4   +   <TargetFramework>netcoreapp2.0</TargetFramework>
```

```
12  -   <PackageReference Include="Microsoft.AspNetCore.Diagnostics" Version="1.1.1" />
13  -   <PackageReference Include="Microsoft.AspNetCore.Mvc" Version="1.1.2" />
14  -   <PackageReference Include="Microsoft.AspNetCore.Routing" Version="1.1.1" />
15  -   <PackageReference Include="Microsoft.AspNetCore.Server.IISIntegration" Version="1.1.1" />
16  -   <PackageReference Include="Microsoft.AspNetCore.Server.Kestrel" Version="1.1.1" />
17  -   <PackageReference Include="Microsoft.AspNetCore.StaticFiles" Version="1.1.1" />
18  -   <PackageReference Include="Microsoft.Data.SQLite" Version="1.1.0" />
19  -   <PackageReference Include="Microsoft.EntityFrameworkCore.Sqlite" Version="1.1.1" />
20  -   <PackageReference Include="Microsoft.Extensions.Configuration.EnvironmentVariables" Version="1.1.1" />
21  -   <PackageReference Include="Microsoft.Extensions.Configuration.Json" Version="1.1.1" />
22  -   <PackageReference Include="Microsoft.Extensions.Logging" Version="1.1.1" />
23  -   <PackageReference Include="Microsoft.Extensions.Logging.Console" Version="1.1.1" />
24  -   <PackageReference Include="Microsoft.Extensions.Logging.Debug" Version="1.1.1" />
25  -   <PackageReference Include="Microsoft.Extensions.Options.ConfigurationExtensions" Version="1.1.1" />
26  -   <PackageReference Include="Microsoft.VisualStudio.Web.BrowserLink.Loader" Version="14.1.0" />
    12  +   <PackageReference Include="Microsoft.AspNetCore.All" Version="2.0.0" />
```

Tools

To help you make things faster

Profilers

Discover hot spots in the code

- dotTrace (JetBrains) (+ memory in Timeline Trace)
- ANTS Performance Profiler (redgate)
- NProfiler www.nprofiler.com
- CodeTrack www.getcodetrack.com

Discover allocations in the code

- dotMemory (JetBrains)
- .NET Memory Profiler

Do both

- Performance Explorer (Visual Studio)
- PerfView (watch channel9 videos on how to use!)

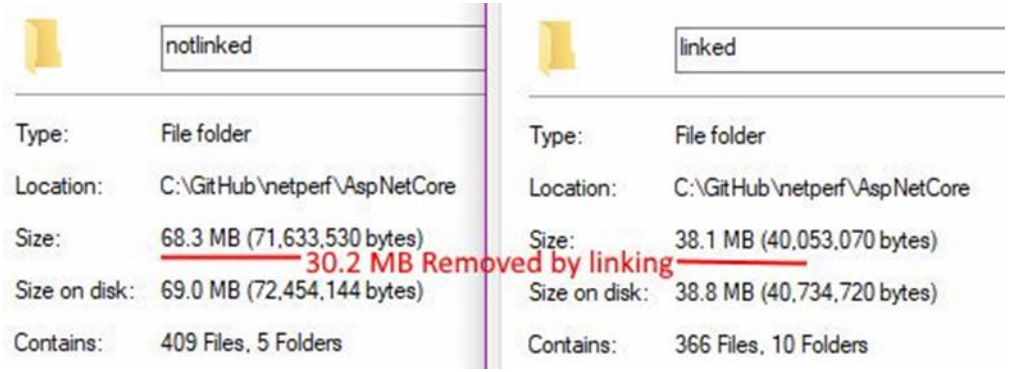
Isolate a function and iterate improvements

- BenchmarkDotNet

Self-contained Apps

Faster deployment

- Own copy of runtime – xcopy deploy on vanilla machine
- Needs to be built for target platform
- Patching (security) needs to be rebuilt and redeployed
  Standard/Portable Apps only need runtime patched on machine
- .NET IL Linker



Installed runtime

- 307 kB for WebApi + .All

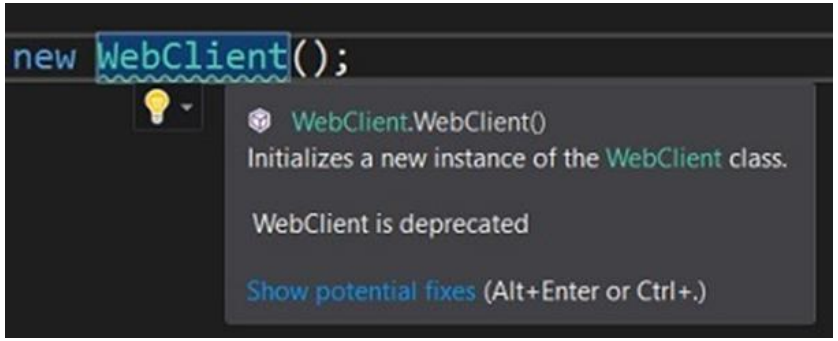
Standalone

- 68 MB for console & only Kestrel (+deps)
- 38 MB using .NET IL Linker
- 93 MB WebApi + .All

Learn more:
ILLinker instructions
(available on myget)

API Compatibility Analyzer

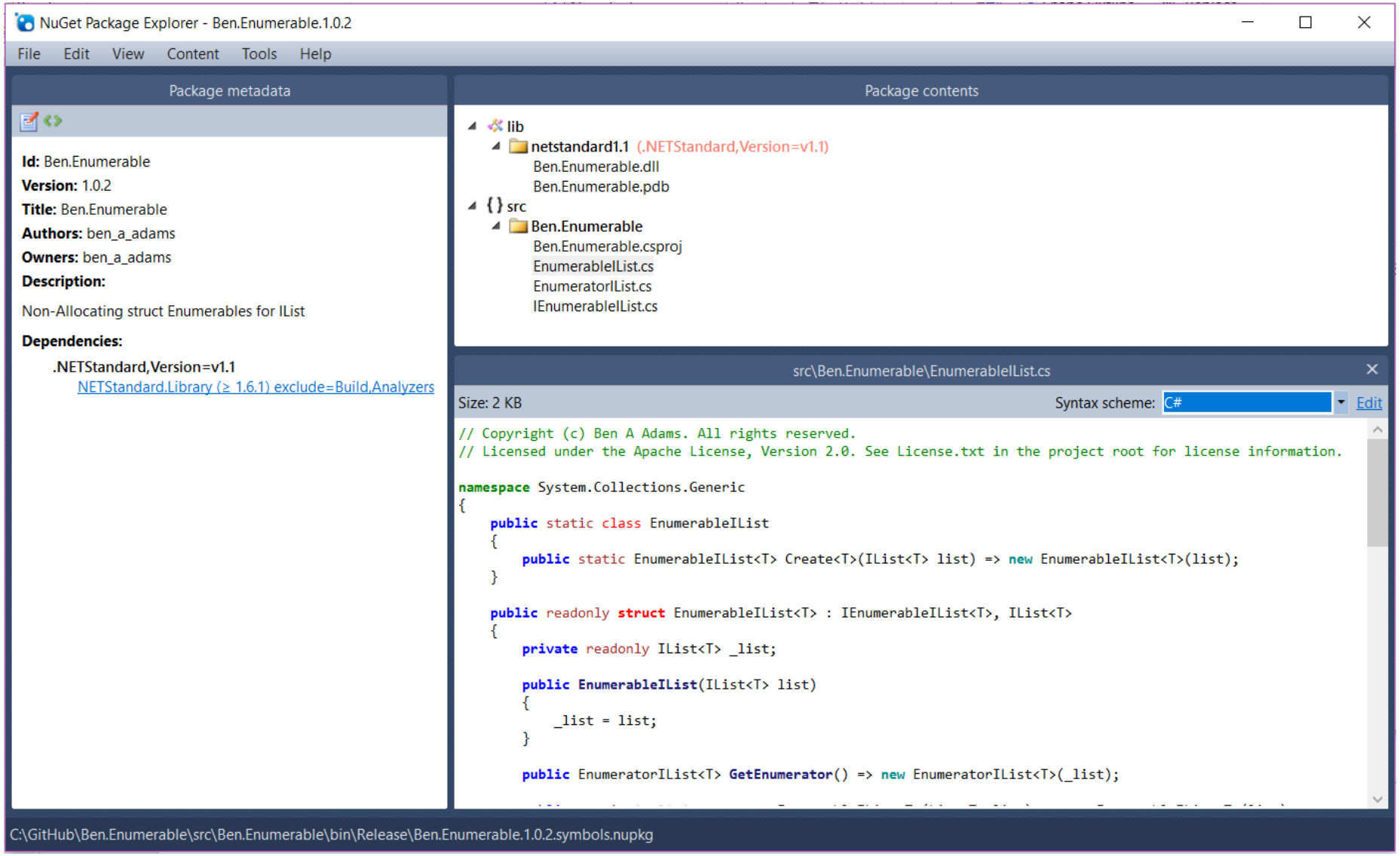
- Use of .NET Standard API that will throw PNSE (cross platform)
- Use of a .NET Standard API not available on .NET Framework 4.6.1
- Use of a native API that doesn't exist in UWP
- Use of an API that is marked as deprecated



- Roslyn analyzer, so works in VS, CLI, CI

Learn more:
Introducing API Analyzer
- Olia Gavrysh and Immo Landwerth

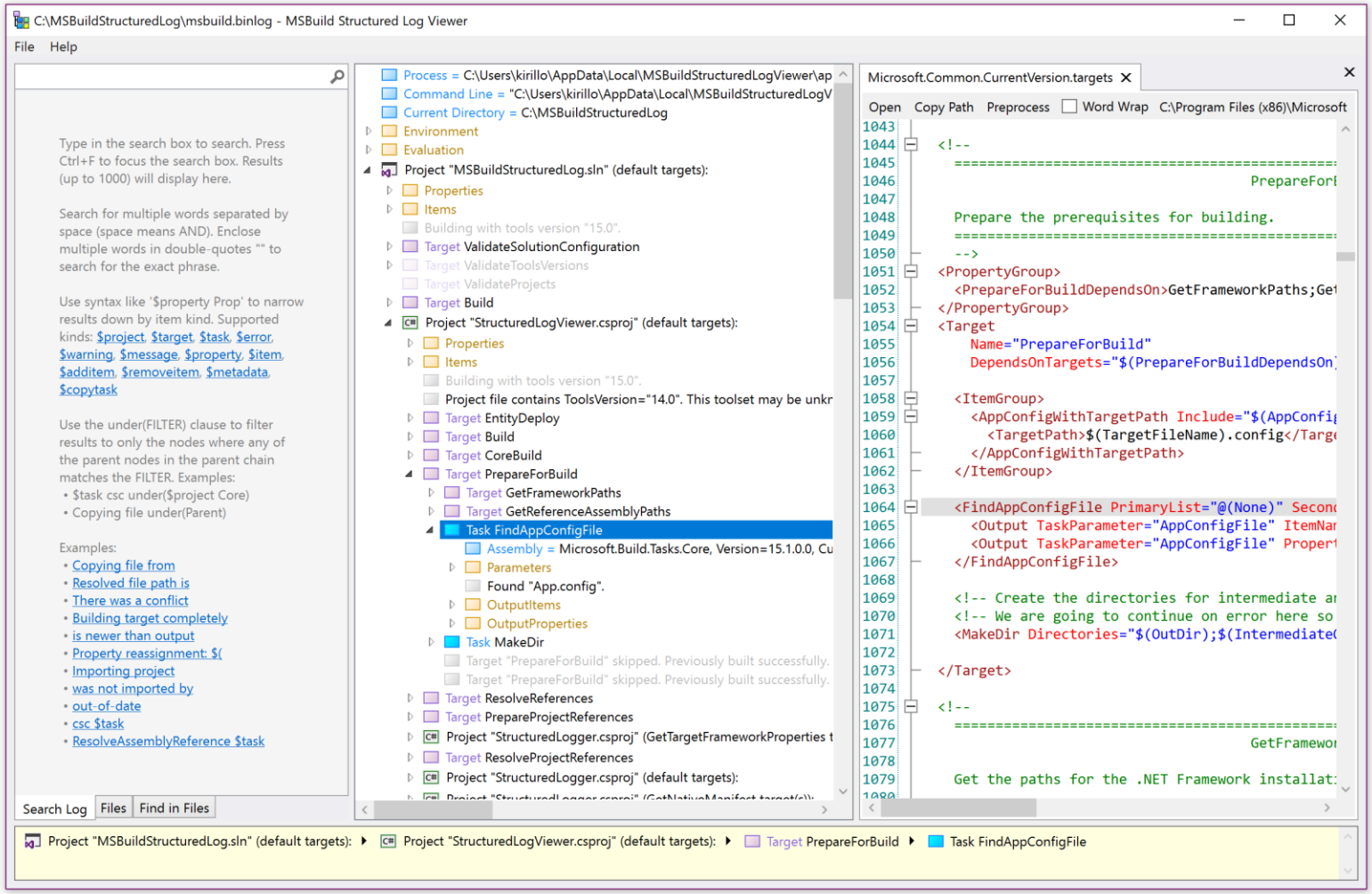
NuGet Package Explorer



NuGet Package Explorer - [in Microsoft Store](#) (free)

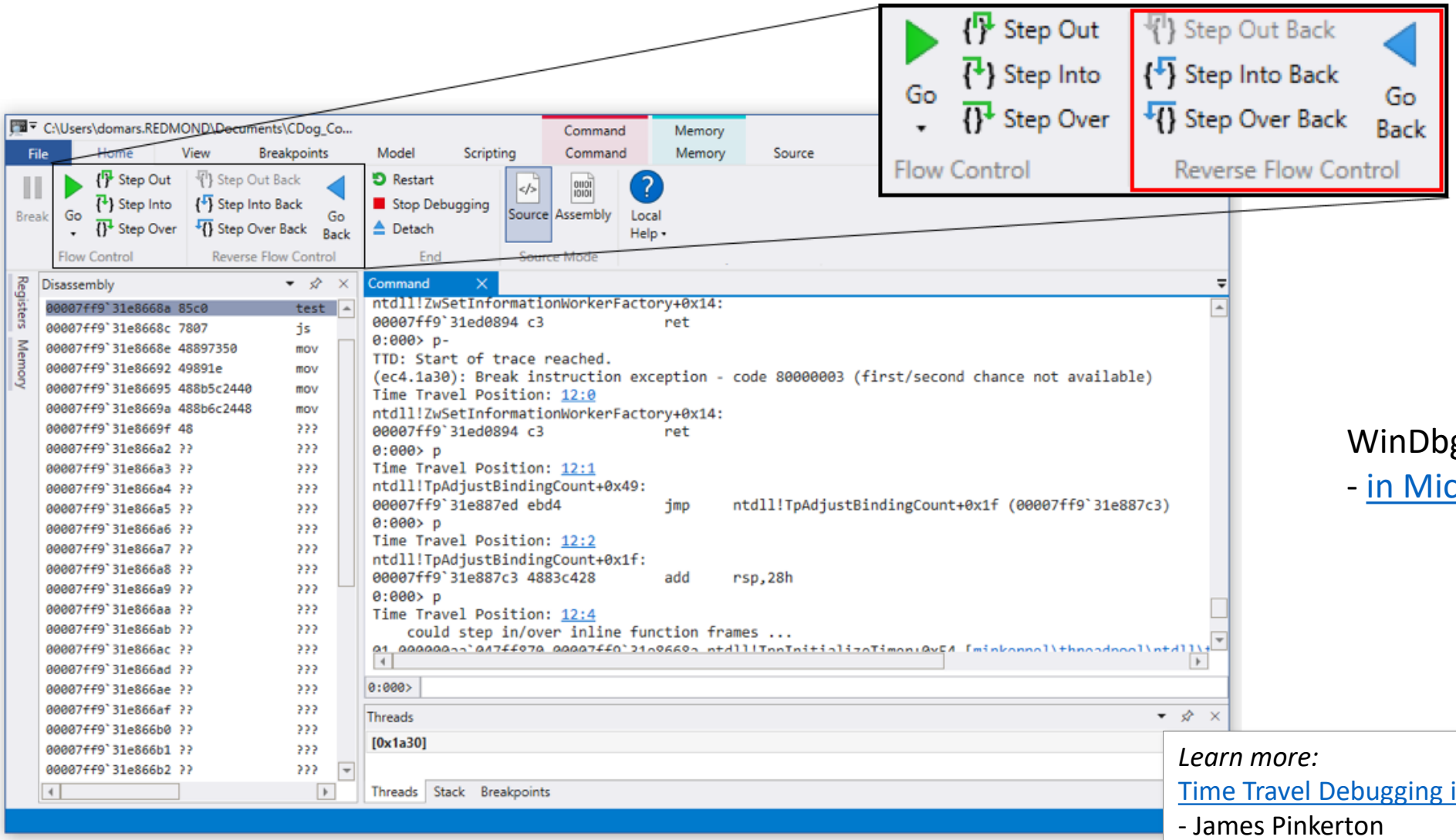
MSBuild Binary and Structured Log Viewer

- Binary logs
- Faster builds
- Smaller logs
- Easier to analyze



Learn more:
[MSBuild Binary and Structured Log Viewer]
- Kirill Osenkov

WinDBG - Time Travel Debugging



WinDbg Preview
- in Microsoft Store (free)

Learn more:
Time Travel Debugging is now available in WinDbg Preview
- James Pinkerton

Error Logs and Stack Traces

How can we improve performance here?

What's wrong with Error Logs?

- Constructors
- Iterators/ LINQ
  `<Iterator>d__3.MoveNext()`
- Lambdas
  `<>c__DisplayClass2_0.<.ctor>b__0(Object state)`
- Local functions
  `<RefMethod>g__LocalFuncParam|10_0(String val, <>c__DisplayClass10_0&)`
- Value tuples
  `ValueTuple`2` should be `(string val, bool)`
- Generics
  `RunLambda(Func`1 lambda)`

Learn more:
Ben.Demystifer
- Ben Adams

var errorLog = await WrongAsync()?

- What function?

```
at Program.<MethodAsync>d__5`1.MoveNext()
```

- Noise

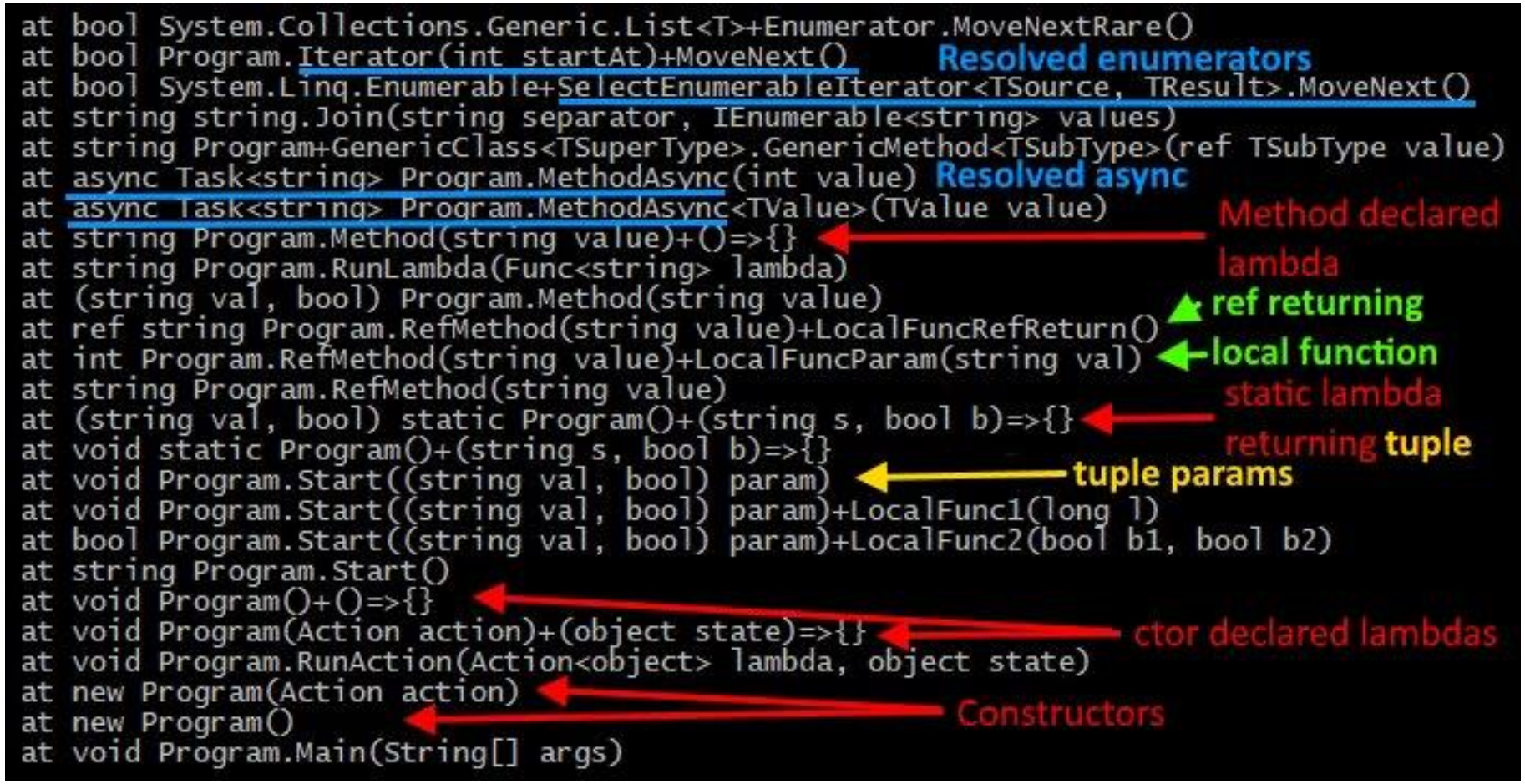
```
--- End of stack trace from previous location where exception was thrown ---
at System.Runtime.ExceptionServices.ExceptionDispatchInfo.Throw()
at System.Runtime.CompilerServices.TaskAwaiter.ThrowForNonSuccess(Task task)
at System.Runtime.CompilerServices.TaskAwaiter.HandleNonSuccessAndDebuggerNotification(Task task)
at System.Runtime.CompilerServices.TaskAwaiter.ValidateEnd(Task task)
at System.Runtime.CompilerServices.TaskAwaiter.GetResult()
```

Error Logs

```
System.InvalidOperationException: Collection was modified; enumeration operation may not execute.
   at System.ThrowHelper.ThrowInvalidOperationException_InvalidOperation_EnumFailedVersion() // ? low value
   at System.Collections.Generic.List`1.Enumerator.MoveNextRare()
   at Program.<Iterator>d__3.MoveNext()                                          // which enumerator?
   at System.Linq.Enumerable.SelectEnumerableIterator`2.MoveNext()               // which enumerator?
   at System.String.Join(String separator, IEnumerable`1 values)
   at Program.GenericClass`1.GenericMethod[TSubType](TSubType& value)
   at Program.<MethodAsync>d__4.MoveNext()                                       // which async overload?
--- End of stack trace from previous location where exception was thrown ---     // ? no value
   at System.Runtime.ExceptionServices.ExceptionDispatchInfo.Throw()             // ? no value
   at System.Runtime.CompilerServices.TaskAwaiter.HandleNonSuccessAndDebuggerNotification(Task task) // ? no value
   at System.Runtime.CompilerServices.TaskAwaiter`1.GetResult()                  // ? no value
   at Program.<MethodAsync>d__5`1.MoveNext()                                     // which async overload?
--- End of stack trace from previous location where exception was thrown ---     // ? no value
   at System.Runtime.ExceptionServices.ExceptionDispatchInfo.Throw()             // ? no value
   at System.Runtime.CompilerServices.TaskAwaiter.HandleNonSuccessAndDebuggerNotification(Task task) // ? no value
   at System.Runtime.CompilerServices.TaskAwaiter`1.GetResult()                  // ? no value
   at Program.<>c__DisplayClass8_0.<Method>b__0()                                //  ¯\_(ツ)_/¯
   at Program.RunLambda(Func`1 lambda)
   at Program.Method(String value)
   at Program.<RefMethod>g__LocalFuncRefReturn|10_1(<>c__DisplayClass10_0& )     // local function
   at Program.<RefMethod>g__LocalFuncParam|10_0(String val, <>c__DisplayClass10_0& ) // local function
   at Program.RefMethod(String value)
   at Program.<>c.<.cctor>b__18_1(String s, Boolean b)                           //  ¯\_(ツ)_/¯
   at Program.<>c.<.cctor>b__18_0(String s, Boolean b)                           //  ¯\_(ツ)_/¯
   at Program.Start(ValueTuple`2 param)                                          // Tuple param?
   at Program.<Start>g__LocalFunc1|11_0(Int64 l)                                 // local function
```

Ben.Demystifier

High performance understanding for stack traces



Coming soon at:
GitHub [Ben.Demystifier]

.NET Core Futures

Its still getting better!

(Also flows into Desktop Framework, but slower…)

Futures (.NET Core 2.1+)

- Even more cross-platform (Alpine Linux)
- Enum.HasFlag (Intrinsic)
- EqualityComparer<T>.Default (Intrinsic)
- Block Layout for Search Loops

Method	Toolchain	Mean
LoopReturn	.NET Core 2.0	61.97 ns
LoopGoto	.NET Core 2.0	53.63 ns
LoopReturn	.NET Core 2.1.0-preview1-25719-04	53.75 ns
LoopGoto	.NET Core 2.1.0-preview1-25719-04	53.52 ns

- SSE/SSE2/SSE3/SSSE3/SSE41/SSE42/AVX/AVX2 AES/BMI1/BMI2/FMA/LZCNT/PCLMULQDQ CRC/POPCNT Intrinsics

RyuJIT x64 .NET Core 2.0

```
mov rcx, [[AttributeTargets type]]
call    [[box]]
mov     rbx,rax
mov rcx, [[AttributeTargets type]]
call    [[box]]
mov     ecx,dword ptr [rsi+8]
mov     dword ptr [rbx+8],ecx
mov     rcx,rbx
mov     dword ptr [rax+8],0Ch
mov     rdx,rax
call    [[System.Enum.HasFlag]]
mov     byte ptr [rsi+0Ch],al
```

RyuJIT x64 .NET Core 2.1.0-preview1-25719-04

```
mov     r8d,edx
and     r8d,0Ch
cmp     r8d,0Ch
sete    r8b
mov     byte ptr [rcx+0Ch],r8b
```

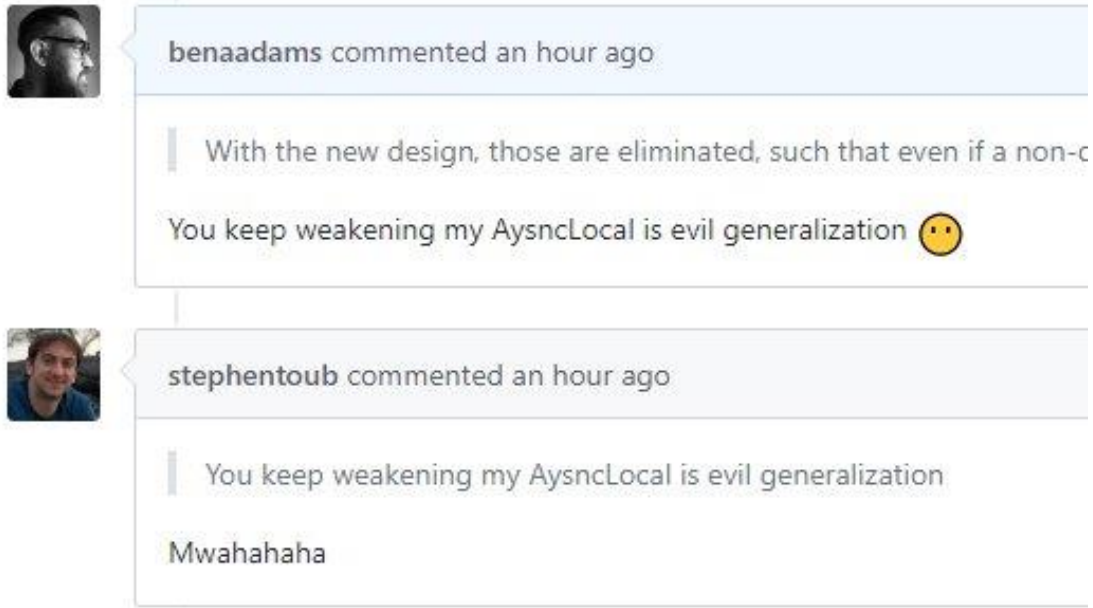
Enum.HasFlag

Learn more:
Add Intel hardware intrinsic APIs to CoreFX
- Fei Peng (Intel)

Learn more:
RyuJIT Just-in-Time Compiler Optimization Enhancements
- Joseph Tremoulet

Futures (.NET Core 2.1+)

- Faster Tasks and async
- Faster AsyncLocal
  Still don't use it, its evil 😐
- Better Concurrency for Timers
- Faster SslStream - Though its fast now



ASP.NET Core 2.0 Kestrel - plaintext
Windows Server 2016 - Azure Standard L32s

Kestrel	Requests per second		
(Connections)	256	512	1024
http	1,797,487	1,914,983	1,893,890
https	1,114,302	1,154,201	1,131,808

Faster Tasks and async:
coreclr #2718, #3132, #3139, #4918, #5131, #8567, #8846, #9342, #9343, #9471, #12819, #13105, #13270, #13390, #14178, #14541, #14759 ***wow!***
- Stephen Toub

Futures (.NET Core 2.1+)

Epic Performance

Performance Epic #24747

Open **danmosemsft** opened this issue 16 days ago · 2 comments

danmosemsft commented 16 days ago • edited — Member

This Epic is to track work we are doing in CoreFX (and corelib) to monitor and improve performance for the next release - excepting Networking performance, which is likely in the Networking Epic.

danmosemsft added the Epic label 16 days ago

danmosemsft added the tenet-performance label 16 days ago

CORESTART 2.0

Děkuji!

Thank you!

@ben_a_adams

#corestart

benaadams