

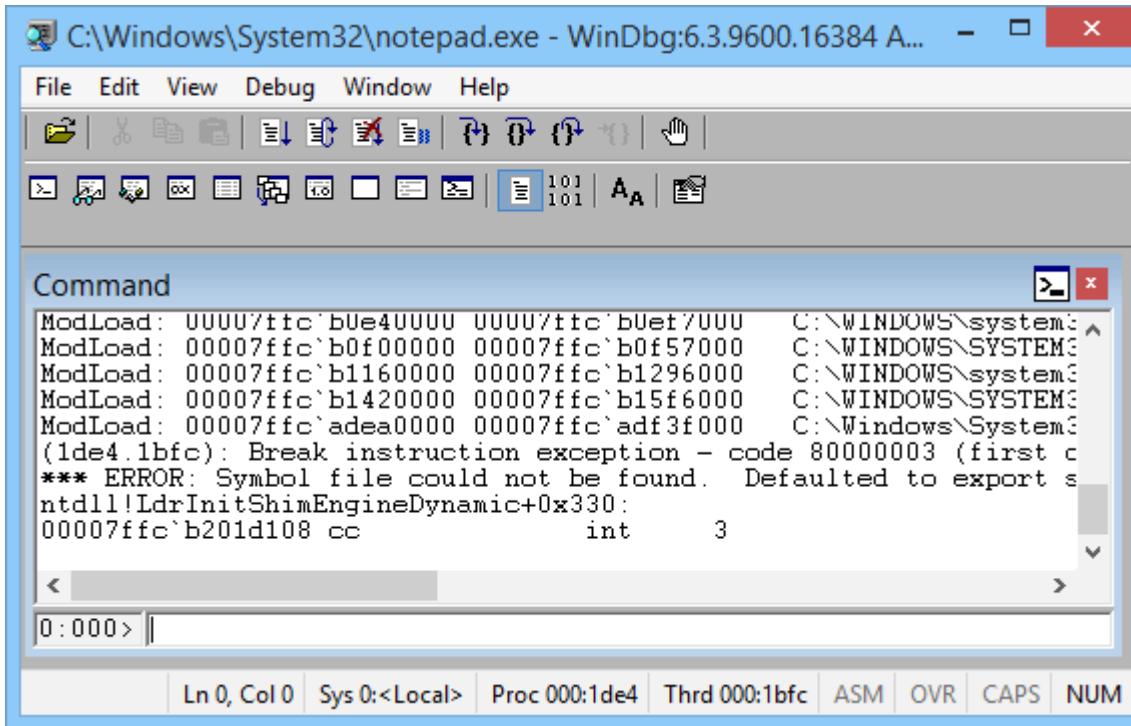
Отладка как процесс

Сергей Щегрикович



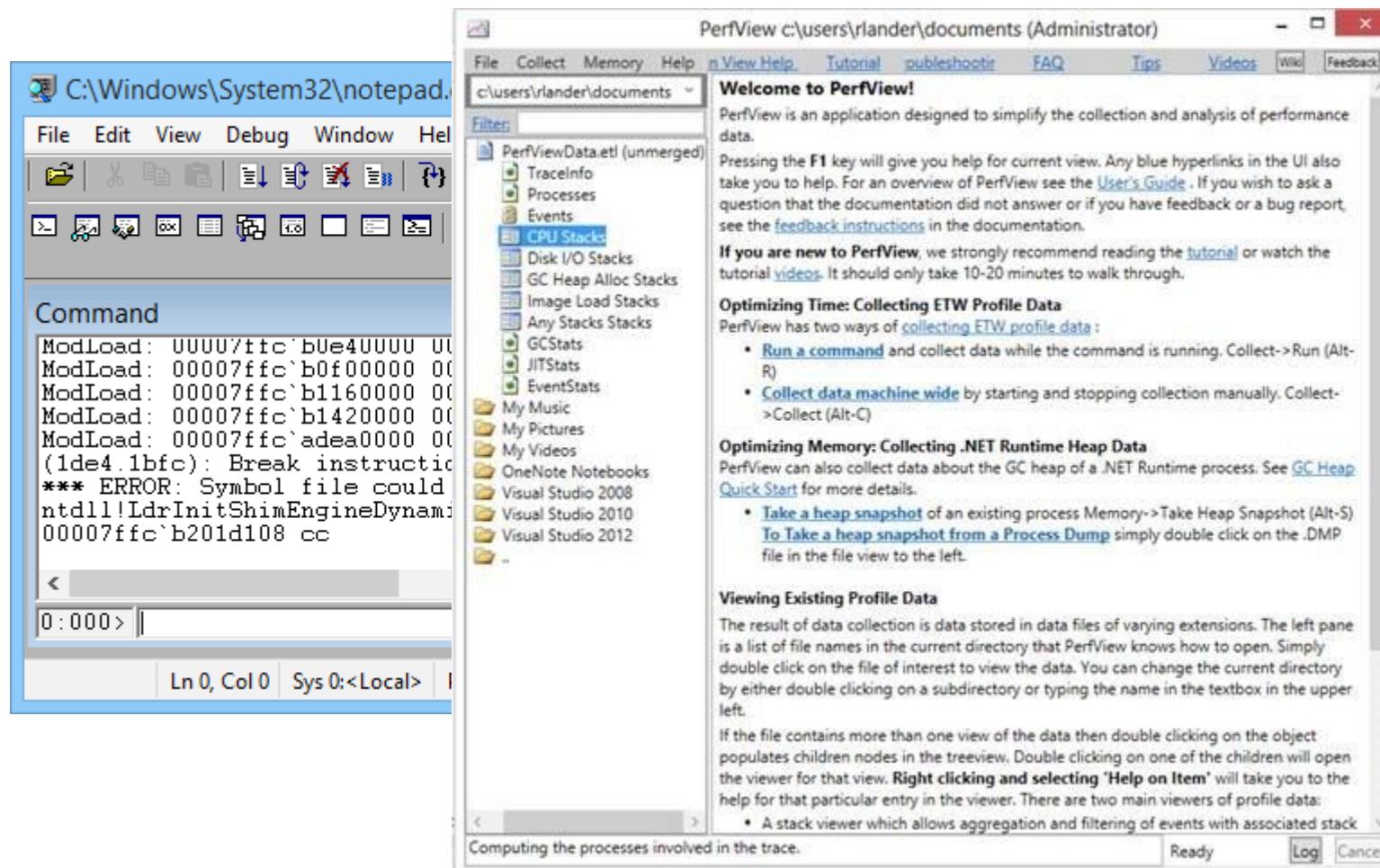
shchegrikovich@gmail.com
[@shchegrikovich](https://twitter.com/shchegrikovich)

Утилиты отладки



<https://docs.microsoft.com/en-us/windows-hardware/drivers/debugger/getting-started-with-windbg>

Утилиты отладки



<https://blogs.msdn.microsoft.com/dotnet/2012/10/09/improving-your-apps-performance-with-perfview/>

Утилиты отладки

The image shows two windows side-by-side. On the left is the WinDbg debugger interface, showing assembly code and memory dump details. On the right is the Process Explorer tool from Sysinternals, displaying a list of running processes with columns for CPU usage, private bytes, working set, and PID.

Process Explorer - Sysinternals: www.sysinternals.com ...

Process	CPU	Private Bytes	Working Set	PID
Secure System	Susp...	48 K	3,700 K	7
System Idle Process	96.20	52 K	8 K	
System	0.13	200 K	2,776 K	
Interrupts	0.37	0 K	0 K	n/a
smss.exe		556 K	832 K	59
Memory Compression		212 K	19,324 K	561
csrss.exe		2,268 K	5,332 K	93
wininit.exe		1,888 K	6,428 K	63
services.exe	0.01	7,268 K	10,632 K	84
svchost.exe		1,176 K	3,768 K	105
svchost.exe		13,116 K	26,996 K	108
WmiPrvSE.exe	< 0.01	41,164 K	39,848 K	588
WmiPrvSE.exe		3,396 K	9,116 K	787
ShellExperienceHost.exe	Susp...	46,956 K	97,016 K	986
SearchUI.exe	Susp...	98,100 K	156,404 K	1028
RuntimeBroker.exe		23,624 K	46,756 K	1048
SkypeHost.exe	Susp...	4,624 K	292 K	1100
SystemSettingsBroker.exe		7,584 K	23,944 K	1674
dllhost.exe		4,388 K	11,436 K	906
smartscreen.exe				

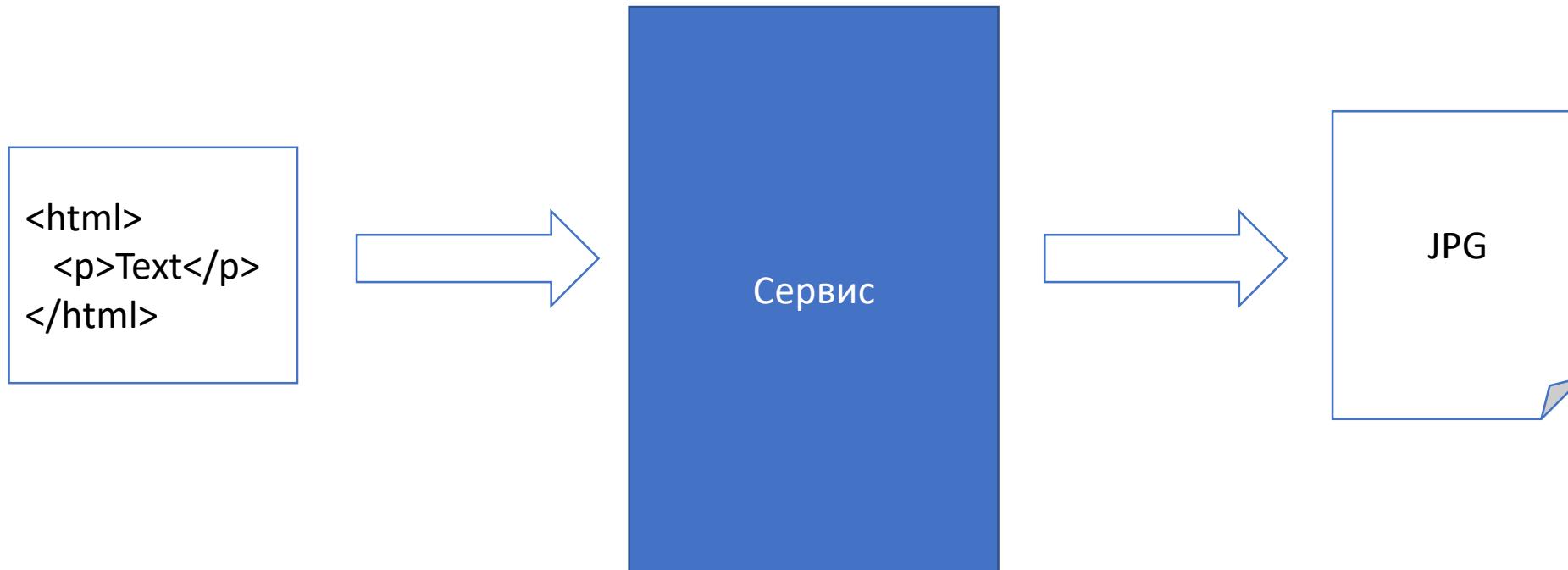
CPU Usage: 3.80% Commit Charge: 32.73% Processes: 205 Physical Usage: 33.40%

<https://live.sysinternals.com/>

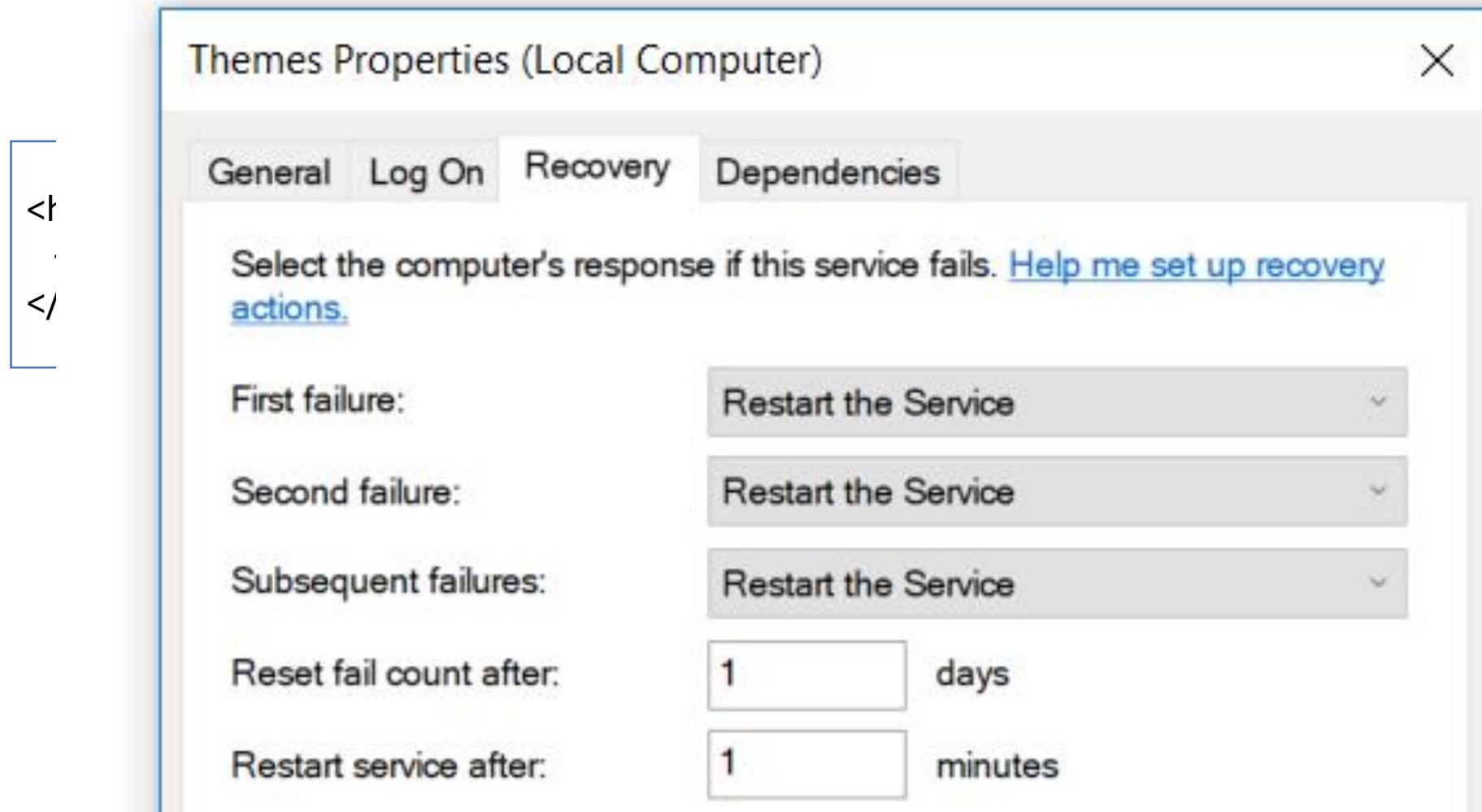
Debugging War Story

Падающий сервис

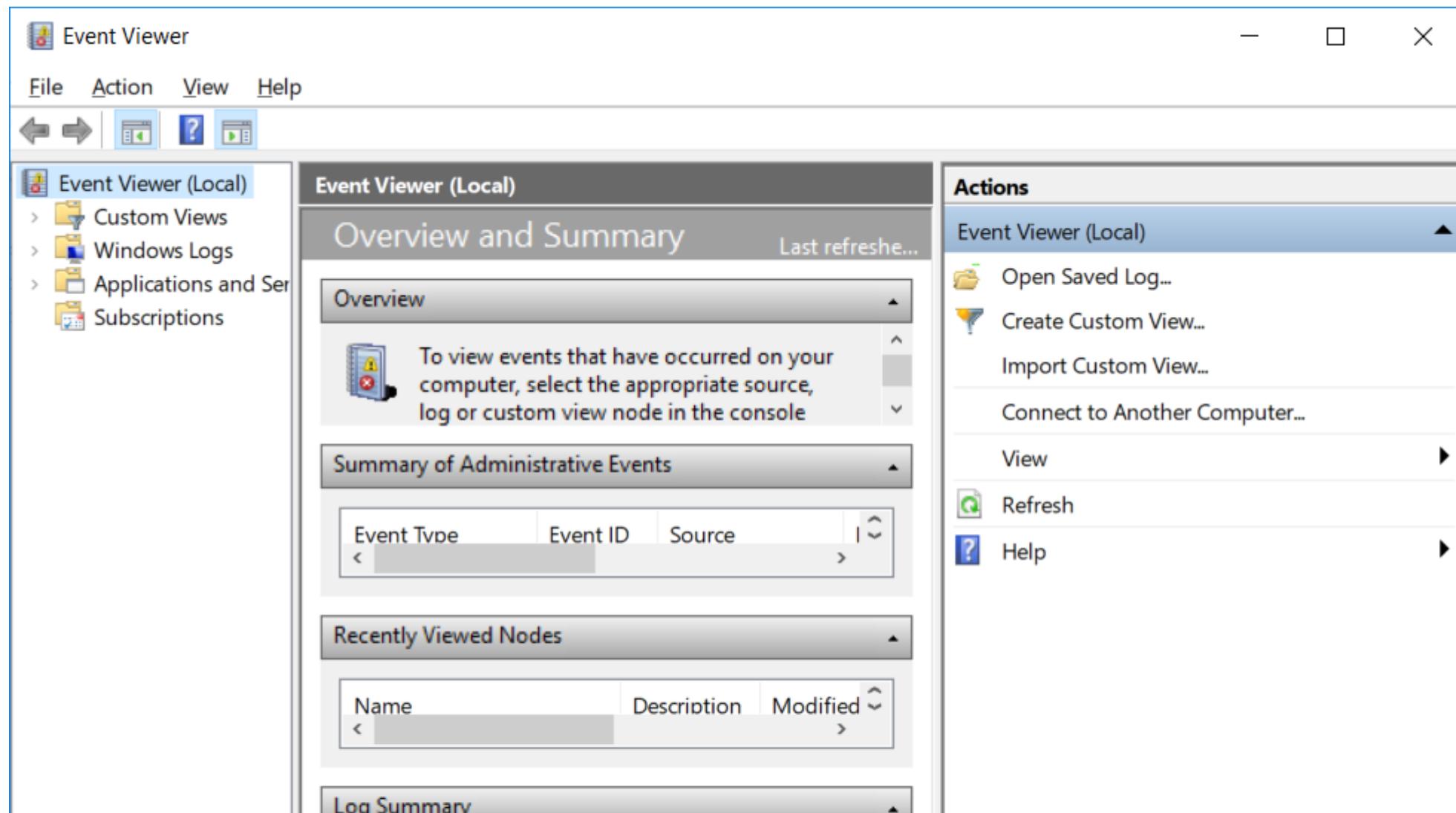
Проблема



Проблема



Ищу ошибку

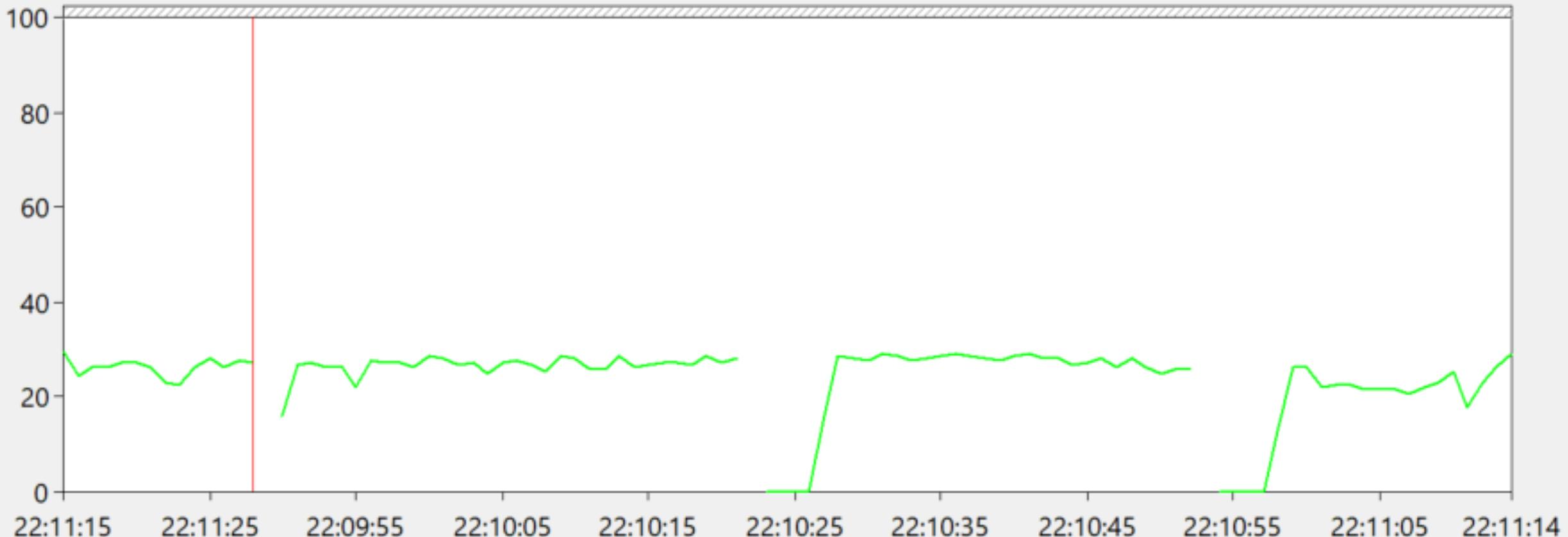


Ищу ошибку

```
try {
    ProcessRequests();
}
catch (Exception ex) {
    LogError(ex);
}
catch {
    LogError();
}
finally {
    LogEndOfExecution();
}
```

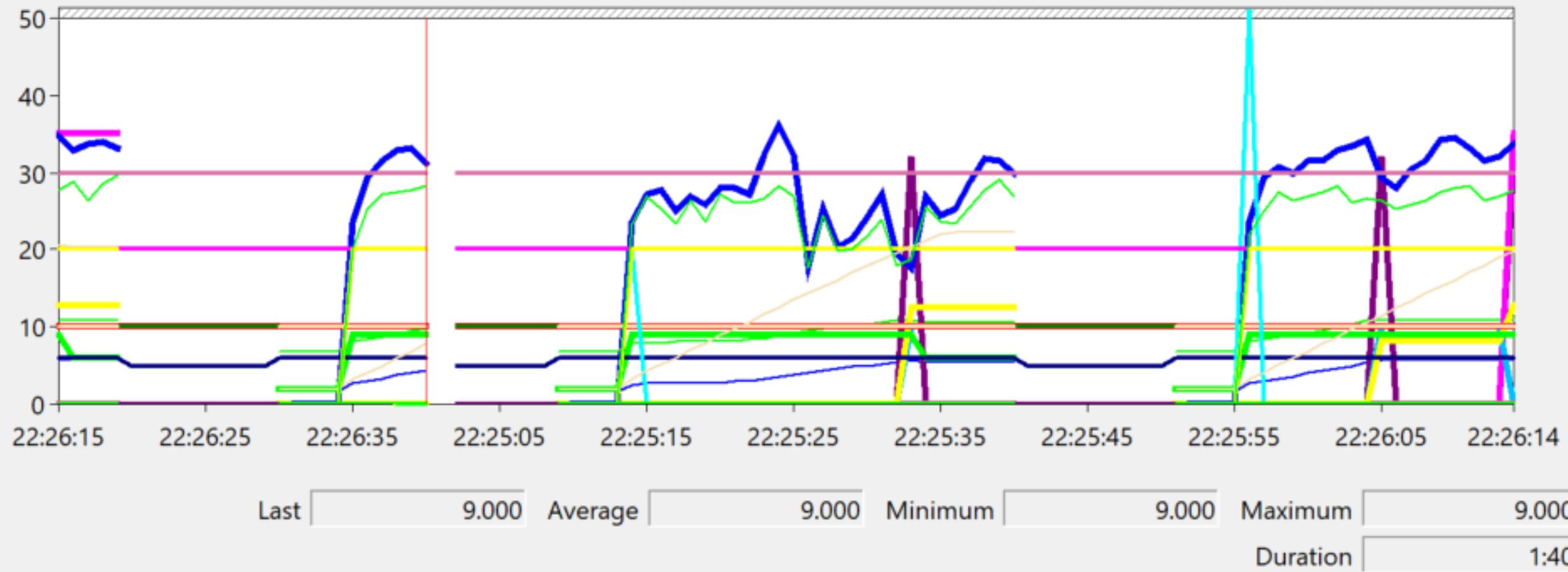
Прошло 3 дня ...

Прошло 2 недели ...



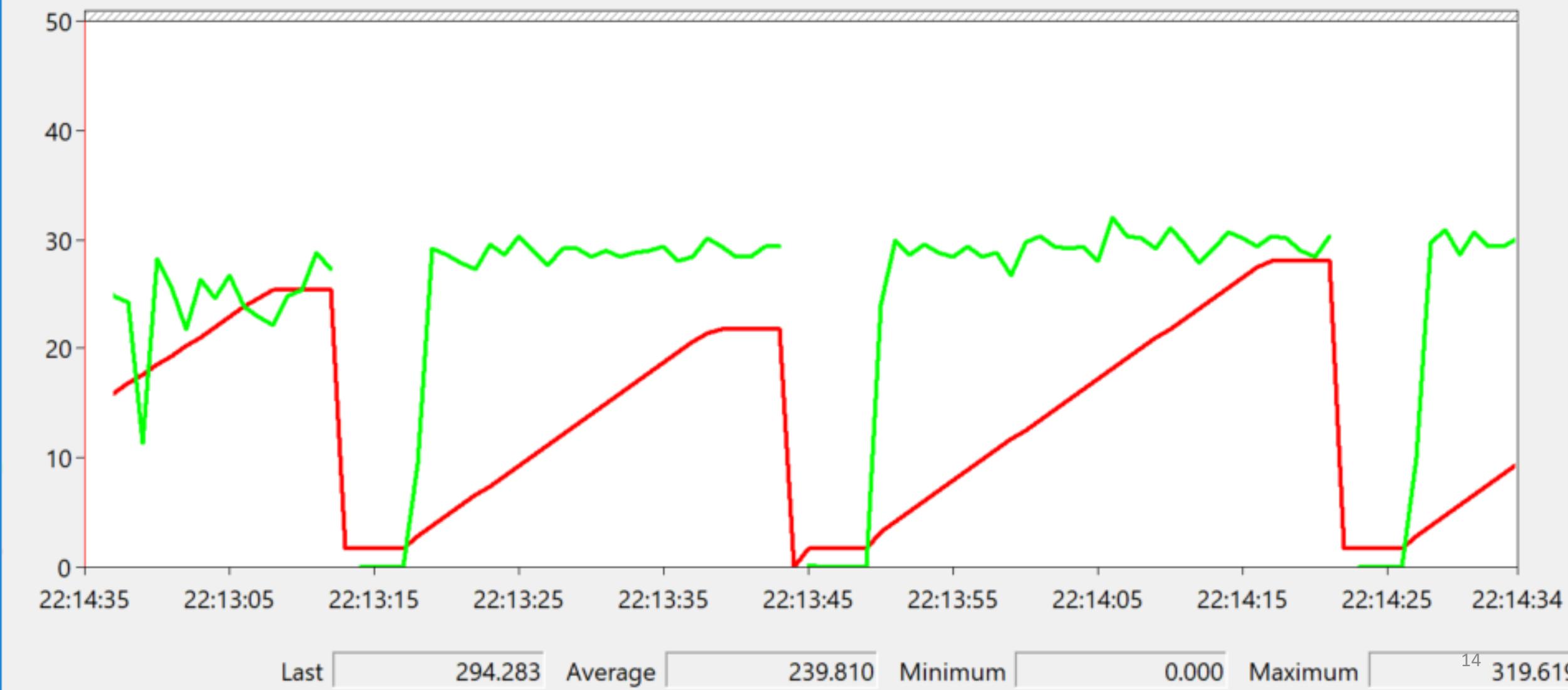
Last 270.432 Average 239.394 Minimum 0.000 Maximum 294.282
Duration 1:40

Show	Color	Scale	Counter	Instance	Parent	Object	Comput
<input checked="" type="checkbox"/>	green	0.1	% User Time	ServiceWithError	---	Process	\SHCHE
<							12 >



Show	Color	Scale	Counter	Instance	Parent	Object	Computer
<input checked="" type="checkbox"/>	Green	0.1	% User Time	ServiceWithError	---	Process	\SHCHEGRIK
<input checked="" type="checkbox"/>	Yellow	0.01	Handle Count	ServiceWithError	---	Process	\SHCHEGRIK
<input checked="" type="checkbox"/>	Green	0.1	# of Exceps Thrown	ServiceWithError	---	.NET CLR Exceptions	\SHCHEGRIK
<input type="checkbox"/>	Blue	1.0	# of CCWs	_Global_	---	.NET CLR Interop	\SHCHEGRIK
<input checked="" type="checkbox"/>	Yellow	10.0	# of CCWs	ServiceWithError	---	.NET CLR Interop	\SHCHEGRIK
<input checked="" type="checkbox"/>	Purple	10.0	# of CCWs	Docker for Win...	---	.NET CLR Interop	\SHCHEGRIK

File Help



File

Home

View

Breakpoints

Model

Scripting

Command

Memory

Source

Command X

16299.15.amd64fre.rs3_release.170928-1534

Machine Name:

Debug session time: Wed Jan 17 21:38:47.000 2018 (UTC + 3:00)

System Uptime: 0 days 22:45:41.657

Process Uptime: 0 days 0:02:26.000

.....

.....

*** ERROR: Symbol file could not be found. Defaulted to export symbols for ntdll.dll -

***** Symbol Loading Error Summary *****

Module name Error

ntdll PDB not found : c:\symbols\local\symbols\dll\ntdll.pdb

You can troubleshoot most symbol related issues by turning on symbol loading diagnostics (!sym noisy) and repe

You should also verify that your symbol search path (.sympath) is correct.

*** ERROR: Symbol file could not be found. Defaulted to export symbols for wow64cpu.dll -

wow64cpu!TurboDispatchJumpAddressEnd+0x544:

00000000`608e1e5c c3 ret

◀ ▶

0:000>

Locals

Name	Value

Threads

[0x860] = ServiceWithError!COM+__Entry_Point <PERF> (ServiceWithError)
[0x4ad0] = ntdll_77e40000!TpTimerOutstandingCallbackCount+0x670 (00000000)
[0x4a88] = ntdll_77e40000!TpTimerOutstandingCallbackCount+0x670 (00000000)
[0xb48] = ntdll_77e40000!TpTimerOutstandingCallbackCount+0x670 (00000000)

0:000> !FinalizeQueue

SyncBlocks to be cleaned up: 0

Free-Threaded Interfaces to be released: 0

MTA Interfaces to be released: 0

STA Interfaces to be released: 0

generation 0 has 1452 finalizable objects (00000269e89f41a0->00000269e89f6f00)

generation 1 has 469 finalizable objects (00000269e89f32f8->00000269e89f41a0)

generation 2 has 26203 finalizable objects (00000269e89c0020->00000269e89f32f8)

Ready for finalization 0 objects (00000269e89f6f00->00000269e89f6f00)

Statistics for all finalizable objects (including all objects ready for finalization):

MT	Count	TotalSize	Class Name
00007ff894273e88	8040	192960	System.WeakReference
00007ff865586350	7968	254976	System.Windows.Forms.AxHost+ConnectionPointCookie
00007ff865586630	3984	382464	System.Windows.Forms.WebBrowserBase+WebBrowserBaseNativeWindow
00007ff86558fb40	3987	446544	System.Windows.Forms.Control+ControlNativeWindow
00007ff865582990	3984	1912320	System.Windows.Forms.WebBrowser
Total 28124 objects			

Падающий сервис – исправление

```
private void Process()
{
    using (var webBrowser = new WebBrowser())
    {
        // Processing
        // ...
    }
}
```

Содержание

1. Правила отладки
2. Алгоритм нахождения ошибок
3. Проактивные техники отладки

Правила отладки

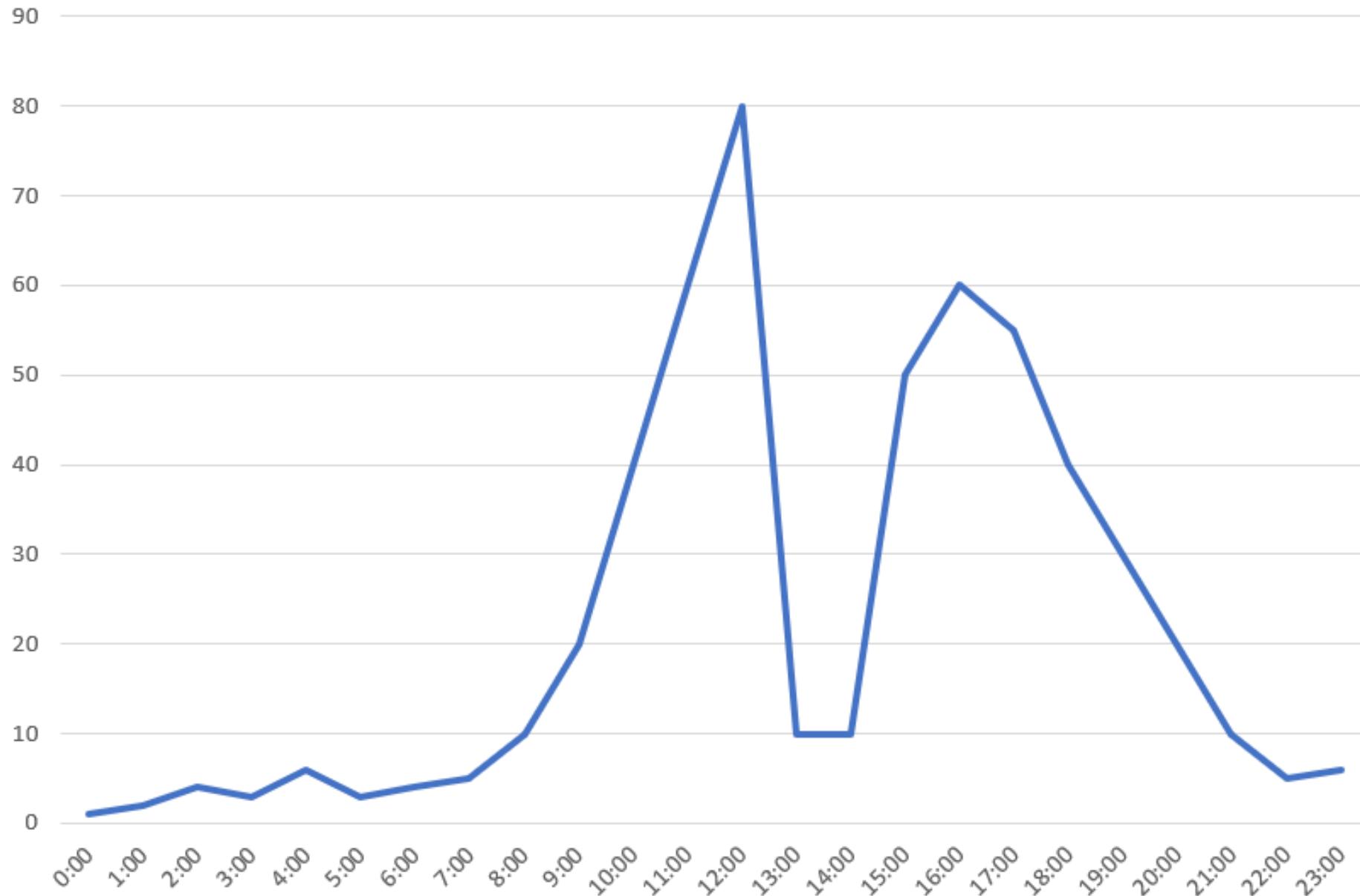
Правила отладки (ПО)

- Повтори ошибку
- Если ты не исправил ошибку, она не исправлена
- Пойми систему
- Проверь штепсель
- Разделяй и властвуй
- Освежись
- Это твой баг
- Пять почему

A long time ago in a galaxy far, far away ...

Пойми систему

Запросы





C:\Programs\PerfView

Filter:



..

Welcome to PerfView!

PerfView is an application designed to simplify the collection and analysis of performance data.

Pressing the **F1** key will give you help for current view. Any blue hyperlinks in the UI also take you to help. For an overview of PerfView see the [User's Guide](#). If you wish to ask a question that the documentation did not answer or if you have feedback or a bug report, see the [feedback instructions](#) in the documentation.

If you are new to **PerfView**, we strongly recommend reading the [tutorial](#) or watch the tutorial [videos](#). It should only take 10-20 minutes to walk through. Also recommend is reading [what perfView can do for you](#).

Optimizing Time, or Unmanaged Memory: Collecting ETW Profile Data

PerfView can collect a time based ETW trace for investigating [CPU](#) and [Server Response Time](#), as well as [Wall Clock / Blocked Time](#), [Unmanaged memory](#) or [Managed memory](#). For these cases PerfView has two ways of [collecting ETW trace data](#):

- [Run a command](#) and collect data while the command is running. Collect->Run (Alt-R)
- [Collect data machine wide](#) by starting and stopping collection manually. Collect->Collect (Alt-C)

GC Stats for Process 12532: Service

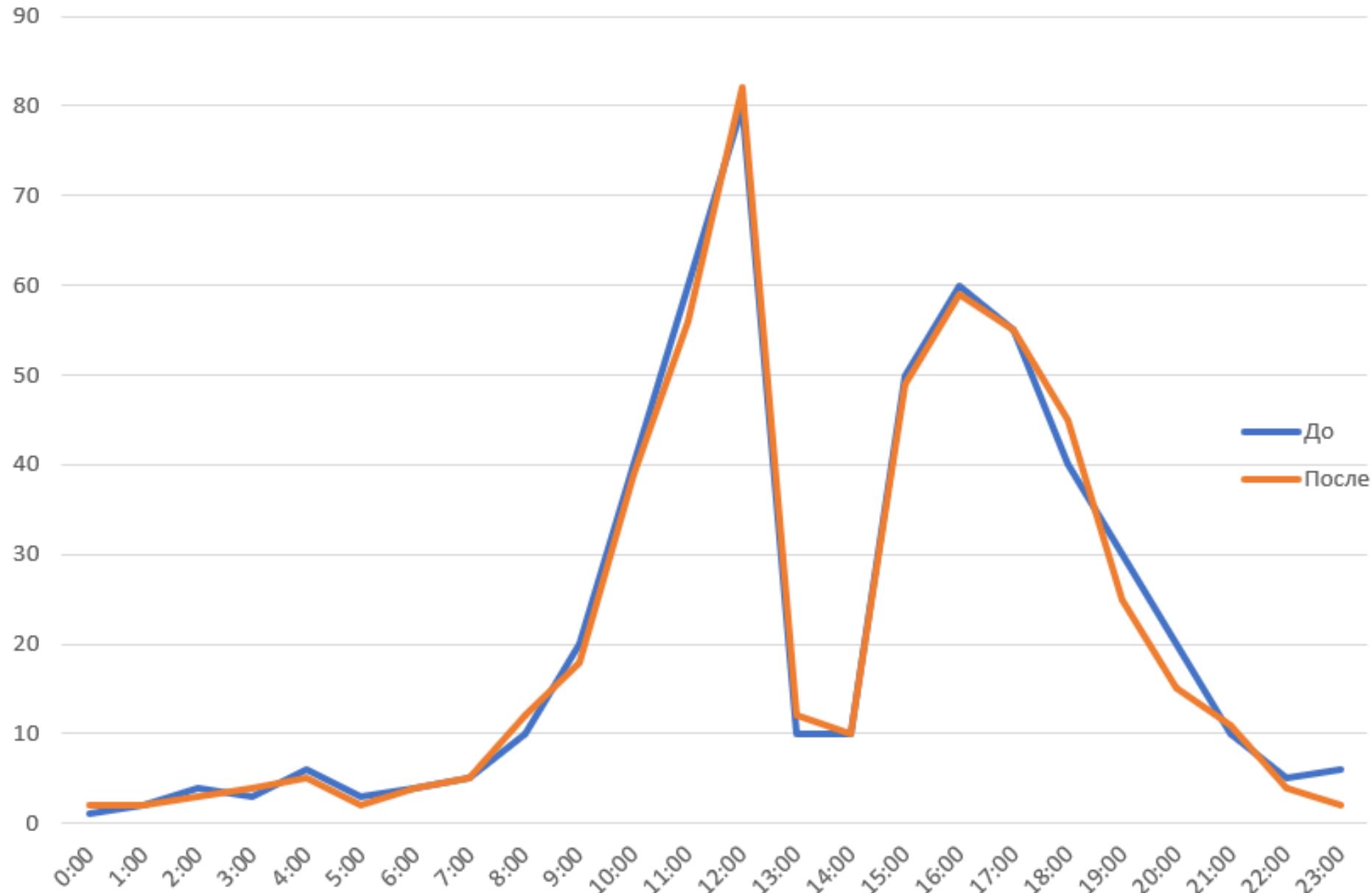
- CommandLine: "C:\temp\Service.exe" 400
- Runtime Version: V 4.0.30319.0 (built on 06-Oct-17 16:54:18)
- CLR Startup Flags: CONCURRENT_GC
- Total CPU Time: 33,755 msec
- Total GC CPU Time: 28,350 msec
- Total Allocs : 17,415.203 MB
- GC CPU MSec/MB Alloc : 1.628 MSec/MB
- Total GC Pause: 28,839.7 msec
- % Time paused for Garbage Collection: 85.4%
- % CPU Time spent Garbage Collecting: 84.0%
- Max GC Heap Size: 67.033 MB
- Peak Process Working Set: 86.385 MB
- Peak Virtual Memory Usage: 229.949 MB

GC CPU %

Methods that call Type System.String

Name ?	Inc % ?	Inc ?
<input checked="" type="checkbox"/> Type System.String	99.7	22,368,26
+ <input checked="" type="checkbox"/> OTHER <<mscorlib.ni!System.String.CtorCharCount(Char, Int32)>>	99.7	22,368,26
+ <input type="checkbox"/> service!Service.Processing.Processor.Process()	81.2	18,215,56
+ <input type="checkbox"/> service!Service.Data.Writer.Write()	16.6	3,716,28
+ <input type="checkbox"/> service!Service.Data.Reader.Read()	1.9	436,40

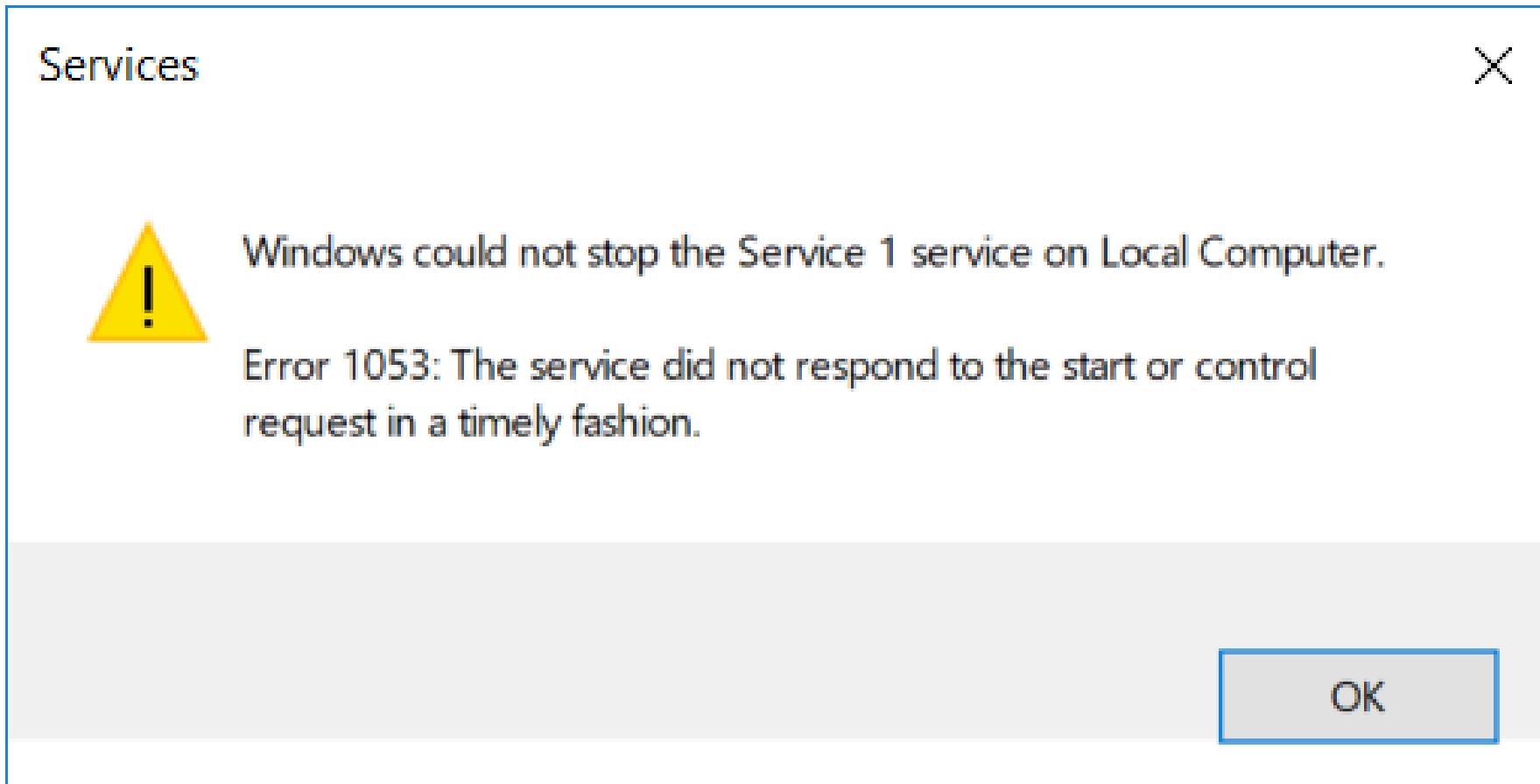
Запросы



A long time ago in a galaxy far, far away ...

Разделяй и властвуй

Проблема



```
0:000> ~*e!ClrStack  
OS Thread Id: 0x2fc0 (0)
```

Child SP	IP Call Site
0000005e7631e8b8	00007ffeafc9ff04 [InlinedCallFrame: 0000005e7631e8b8]
0000005e7631e8b8	00007ffe9753bf17 [InlinedCallFrame: 0000005e7631e8b8]
0000005e7631e890	00007ffe9753bf17 DomainBoundILStubClass.IL_STUB
0000005e7631e940	00007ffe9753eef6 System.ServiceProcess.Service
0000005e7631e9b0	00007ffe3c0904fb Ex4_Service.Program.Main()
0000005e7631ec30	00007ffe9b695863 [GCFrame: 0000005e7631ec30]

OS Thread Id: 0x3210 (6)

Child SP	IP	Call Site
0000005e772fe418	00007ffeafca09d4	[GCFrame: 0000005e772fe418]
0000005e772fe4e8	00007ffeafca09d4	[HelperMethodFrame_1OBJ: 0000005e772fe4e8] System.Threading.
0000005e772fe600	00007ffe99043ec3	System.Threading.ManualResetEventSlim.Wait(Int32, System.Thr
0000005e772fe690	00007ffe9903cbf6	System.Threading.Tasks.Task.SpinThenBlockingWait(Int32, Syst
0000005e772fe700	00007ffe999da8f1	System.Threading.Tasks.Task.InternalWait(Int32, System.Threa
0000005e772fe7d0	00007ffe9903c2e8	System.Threading.Tasks.Task.Wait(Int32, System.Threading.Canc
0000005e772fe800	00007ffe999da6b2	System.Threading.Tasks.Task.Wait()
0000005e772fe830	00007ffe3c091fe2	Ex4_Service.Service1.OnStop() [C:\Users\Sergey\YandexDisk\Pr
0000005e772fe860	00007ffe9753e9ab	System.ServiceProcess.ServiceBase.DeferredStop()
0000005e772fec28	00007ffe9b695863	[HelperMethodFrame_PROTECTOBJ: 0000005e772fec28] System.Runt
0000005e772ff000	00007ffe99a3fc34	System.Runtime.Remoting.Messaging.StackBuilderSink.AsyncProc
0000005e772ff0a0	00007ffe99014770	System.Threading.ExecutionContext.RunInternal(System.Threadi
0000005e772ff170	00007ffe99014604	System.Threading.ExecutionContext.Run(System.Threading.Execu
0000005e772ff1a0	00007ffe9901f150	System.Threading.QueueUserWorkItemCallback.System.Threading.
0000005e772ff1e0	00007ffe9901f76e	System.Threading.ThreadPoolWorkQueue.Dispatch()
0000005e772ff678	00007ffe9b695863	[DebuggerU2MCatchHandlerFrame: 0000005e772ff678]

OS Thread Id: 0x710 (3)

Child SP	IP Call Site
0000005e76dfe748	00007ffeafca09d4 [GCFrame: 0000005e76dfe748]
0000005e76dfe818	00007ffeafca09d4 [HelperMethodFrame_10B]: 0000005e76dfe818] System.Threading.Monitor
0000005e76dfe930	00007ffe99043ec3 System.Threading.ManualResetEventSlim.Wait(Int32, System.Threading.CancellationToken)
0000005e76dfe9c0	00007ffe999dc2b5 System.Threading.Tasks.Task.WaitAllBlockingCore(System.Collections.Generic.IEnumerable<System.Threading.Tasks.Task>)
0000005e76dfa60	00007ffe999dbef0 System.Threading.Tasks.Task.WaitAll(System.Threading.Tasks.Task[])
0000005e76dfeb80	00007ffe999dbbdd System.Threading.Tasks.Task.WaitAll(System.Threading.Tasks.Task[])
0000005e76dfebc0	00007ffe999dbaec System.Threading.Tasks.Task.WaitAll(System.Threading.Tasks.Task[])
0000005e76dfefb0	00007ffe3c090e37 Ex4_Service.Service1.RunTasks() [C:\Users\Sergey\YandexDisk\Presentations\Ex4\Ex4_Service\bin\Debug\net6.0\Ex4_Service.dll]
0000005e76dfecd0	00007ffe3c0906d5 Ex4_Service.Service1.b__5_0() [C:\Users\Sergey\YandexDisk\Presentations\Ex4\Ex4_Service\bin\Debug\net6.0\Ex4_Service.dll]
0000005e76dfed00	00007ffe9903c6a6 System.Threading.Tasks.Task.Execute()
0000005e76dfed40	00007ffe99014770 System.Threading.ExecutionContext.RunInternal(System.Threading.ExecutionContext, System.Threading.ContextCallback, Object, Boolean)
0000005e76dfee10	00007ffe99014604 System.Threading.ExecutionContext.Run(System.Threading.ExecutionContext, System.Threading.ContextCallback, Object, Boolean)
0000005e76dfee40	00007ffe9903c948 System.Threading.Tasks.Task.ExecuteWithThreadLocal(System.Threading.Tasks.Task, System.Threading.ThreadLocal<Object>, Boolean)
0000005e76dfeef0	00007ffe9903c083 System.Threading.Tasks.Task.ExecuteEntry(Boolean)
0000005e76dfef30	00007ffe9901f76e System.Threading.ThreadPoolWorkQueue.Dispatch()
0000005e76dff3c8	[DebuggerU2MCatchHandlerFrame: 0000005e76dff3c8]

```
0:000> !DumpObj /d 000001a480008418
```

Name: Ex4_Service.InitWorker

MethodTable: [00007ffe3bf870e0](#)

EEClass: [00007ffe3c0d1b98](#)

Size: 40(0x28) bytes

File: C:\temp\Service\Ex4-Service.exe

Fields:

MT	Field	Offset	Type	VT	Attr	Value	Name
00007ffe991d9b10	4000001	8	System.Boolean	1	instance	1	isError
00007ffe991cdc40	4000002	10	... CancellationToken	1	instance	000001a480008428	<Token>k_BackingField
00007ffe3bf74dc8	4000003	18	...olean, mscorelib]]	0	instance	000001a480008388	_initLock

```
0:000> !DumpObj /d 000001a480008440
```

Name: Ex4_Service.RealWorker

MethodTable: [00007ffe3bf871e0](#)

EEClass: [00007ffe3c0d1c10](#)

Size: 40(0x28) bytes

File: C:\temp\Service\Ex4-Service.exe

Fields:

MT	Field	Offset	Type	VT	Attr	Value	Name
00007ffe991d9b10	4000001	8	System.Boolean	1	instance	0	isError
00007ffe991cdc40	4000002	10	... CancellationToken	1	instance	000001a480008450	<Token>k_BackingField
00007ffe3bf74dc8	4000004	18	...olean, mscorelib]]	0	instance	000001a480008388	_initLock

Исправление

```
try
{
    await OpenAsync();
    _initLock.SetResult(true);
}
catch (Exception ex)
{
    _initLock.SetException(ex);
}
```

A long time ago in a galaxy far, far away ...

ЭТО ТВОЙ баг

Проблема

AccessViolationException

AccessViolationException

```
mscorlib_ni!System.RuntimeMethodHandle.InvokeMethod  
mscorlib_ni!System.Reflection.RuntimeMethodInfo.UnsafeInvokeInternal  
mscorlib_ni!System.Delegate.DynamicInvokeImpl  
System_Data_Linq_ni!System.Data.Linq.SqlClient.QueryConverter.VisitInvocation  
System_Data_Linq_ni!System.Data.Linq.SqlClient.QueryConverter.VisitInner  
System_Data_Linq_ni!System.Data.Linq.SqlClient.QueryConverter.VisitExpression
```

AccessViolationException

← → ⌂

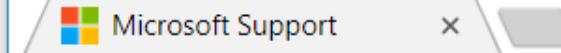
Secure

| <https://www.microsoft.com/en-us/download/details.aspx?id=42642>

Microsoft .NET Framework 4.5.2 (Offline Installer) for Windows Vista SP2, Windows 7 SP1, Windows 8.1, Windows 10, Windows Server 2008 SP2, Windows Server 2008 R2 SP1, Windows Server 2012 and Windows Server 2012 R2

[Download](#)

The Microsoft .NET Framework 4.5.2 is a highly compatible, in-place update to the Microsoft .NET Framework 4, Microsoft .NET Framework 4.5 and Microsoft .NET Framework 4.5.1. The offline package can be used in situations where the web installer cannot be used due to lack of internet connectivity.



Secure | https://support.microsoft.com/en-us

Try Microsoft Edge

A fast and secure browser that's designed for Windows 10

[No thanks](#)

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Windows

Surface

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Deals

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[Ask the Virtual Agent](#)



.NET Framework 4.6.1 is now available!



November 30, 2015 by The .NET Fundamentals Team // 34 Comments



Updated (2017): See [.NET Framework Releases](#) to learn about newer releases.

Updated (1/2016): This post was updated to add information about [reference source](#) for .NET Framework 4.6.1.

Today we are announcing the availability of .NET Framework 4.6.1. You can download this release now.

- [.NET Framework 4.6.1 \(Web Installer; Offline Installer\)](#)
- [.NET Framework 4.6.1 Developer Pack](#)

Here is a summary of key improvements available in .NET Framework 4.6.1:

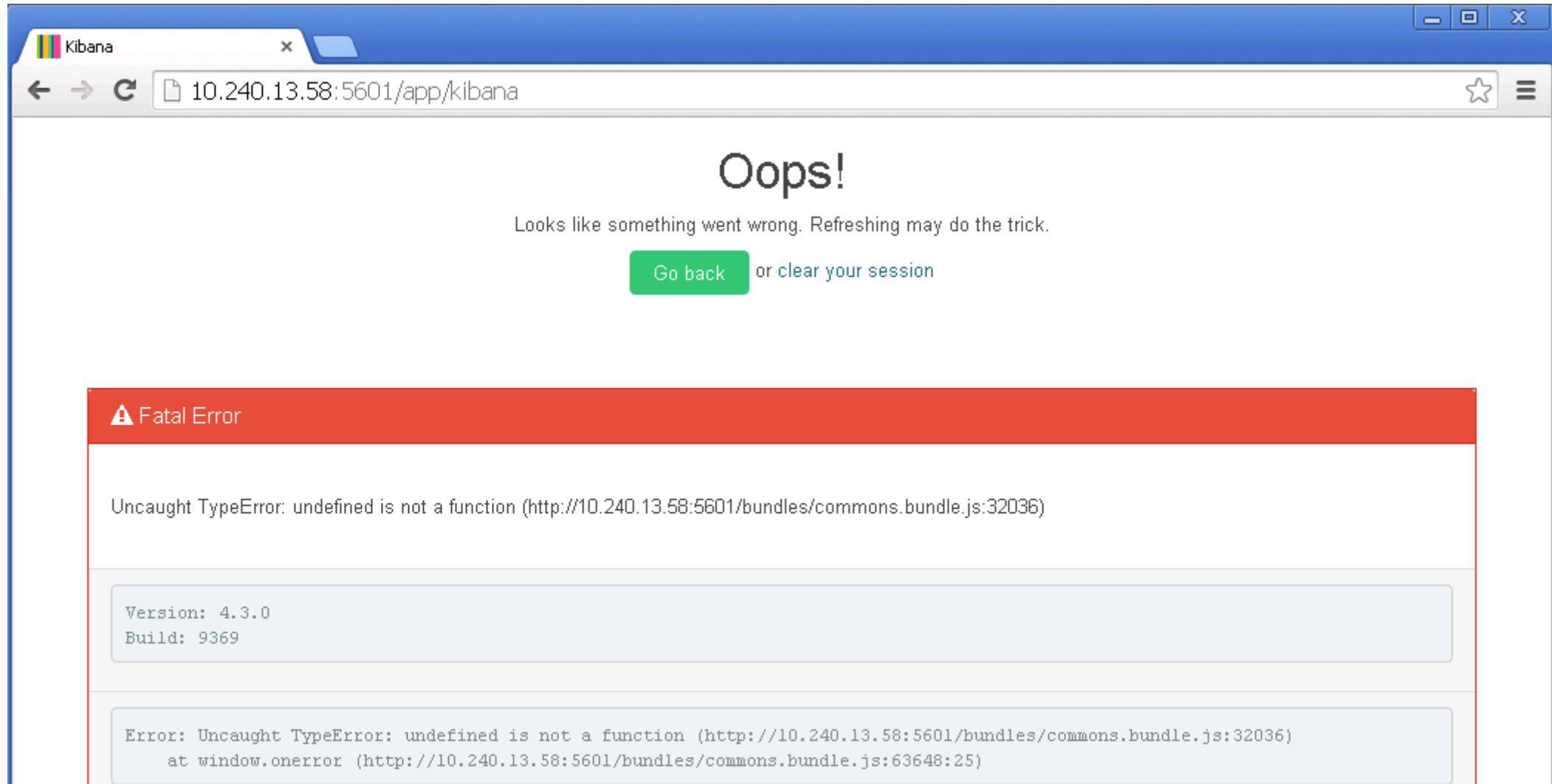
- WPF improvements for spell check, support for per-user custom dictionaries and improved touch performance
- Enhanced support for Elliptic Curve Digital Signature Algorithm (ECDSA) X509 certificates
- Added support in SQL Connectivity for AlwaysOn, Always Encrypted and improved connection open resiliency when connecting to Azure SQL Database
- Azure SQL Database now supports distributed transactions using the updated System.Transactions APIs
- Many other performance, stability, and reliability related fixes in RyuJIT, GC, WPF and WCF.

Many other performance, stability, and reliability related fixes in RyuJIT, GC, WPF and WCF.

A long time ago in a galaxy far, far away ...

Пять почему

Пять почему



Почему лежит
Elastic?

Упали Master
Nodes.

Почему не
поднялись?

Несоответствие
версий плагина

Почему упали?

Почему памяти
мало?

Их убил ООМ
Killer.

Запустилось
обновление

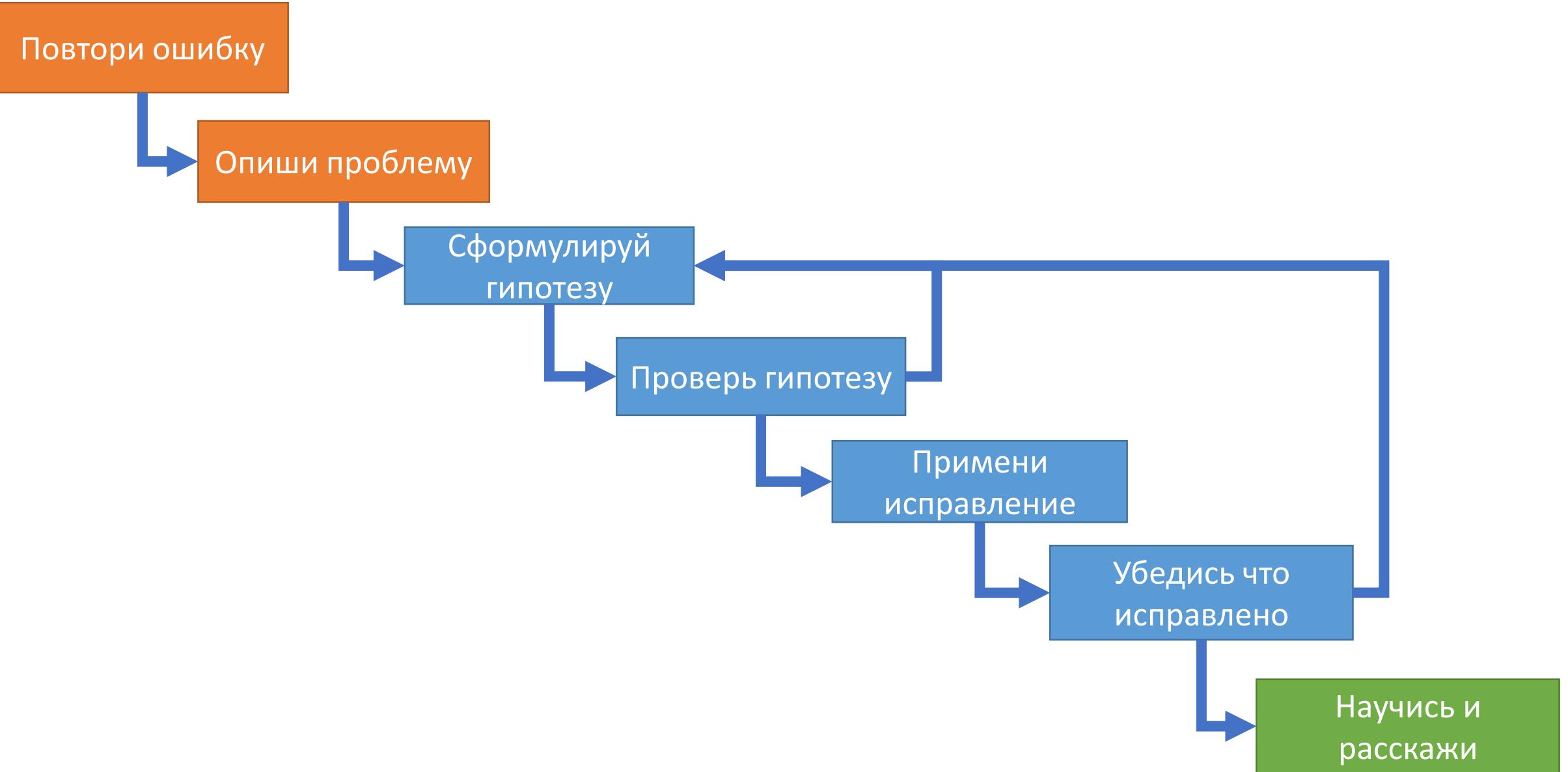
Почему раньше
не падало?

Мы добавили
новые узлы.

Правила отладки – выводы

- Вскрывают проблемы
- Сдвигают фокус
- Помогают общаться

Алгоритм отладки



Debugging War Story

Алгоритм отладки

Алгоритм отладки

An unhandled exception occurred while processing the request.

StructureMapException: Exception of type 'StructureMap.StructureMapException' was thrown.

WebApplication1.Controllers.HomeController.About() in `HomeController.cs`, line 29

Stack Query Cookies Headers

StructureMapException: Exception of type 'StructureMap.StructureMapException' was thrown.

WebApplication1.Controllers.HomeController.About() in `HomeController.cs`

+ 29. `throw new StructureMapException();`

`Iambda_method(Closure , object , Object[])`

`Microsoft.Extensions.Internal.ObjectMethodExecutor.Execute(object target, Object[] parameters)`

`Microsoft.AspNetCore.Mvc.Internal.ControllerActionInvoker+<InvokeActionMethodAsync>d_12.MoveNext()`

`System.Runtime.ExceptionServices.ExceptionDispatchInfo.Throw()`

`System.Runtime.CompilerServices.TaskAwaiter.HandleNonSuccessAndDebuggerNotification(Task task)`

`Microsoft.AspNetCore.Mvc.Internal.ControllerActionInvoker+<InvokeNextActionFilterAsync>d_10.MoveNext()`

Алгоритм отладки

procdump.exe -ma -e -f StructureMap w3wp.exe

```
Command
0:093> !DumpObj /d 000000350359f508
Name: System.NullReferenceException
MethodTable: 00007ffb025b65a0
EEClass: 00007ffb01f6f180
Size: 160(0xa0) bytes
File: C:\Windows\Microsoft.Net\assembly\GAC_64\mscorlib\v4.0_4.0.0.0__b77a5c561934e089\mscorlib.dll
Fields:
          MT      Field     Offset           Type VT     Attr            Value Name
00007ffb025a6948 400028e         8     System.String  0 instance 0000000000000000 _className
00007ffb025bf6b8 400028f        10 ...ection.MethodBase 0 instance 0000000000000000 _exceptionMethod
```

Алгоритм отладки

```
Command
0:093> !ClrStack
OS Thread Id: 0x1ca4 (93)
    Child SP          IP Call Site
0000003855658848 00007ffb12ec079a [HelperMethodFrame: 0000003855658848]
0000003855658930 00007ffaabde0f3e StructureMap.Pipeline.ObjectBuilder.ApplyInterception [System.Type, System.Object]
000000385565a870 00007ffb09fb120d [FaultingExceptionFrame: 000000385565a870]
000000385565ad70 00007ffaabde0ea0 StructureMap.Pipeline.ObjectBuilder.ApplyInterception(System.Type, System.Object)
000000385565adc0 00007ffaabde0b38 StructureMap.Pipeline.ObjectBuilder.Resolve(System.Type, StructureMap.Pipeline.IObjectBuilder)
000000385565ae40 00007ffaabde05b4 StructureMap.BuildSession.CreateInstance(System.Type, StructureMap.Pipeline.IContainer)
000000385565ae90 00007ffaabddf420 StructureMap.Container.GetInstance[[System.__Canon, mscorelib]]()
```

Алгоритм отладки

```
Command  
and  
> !lno 000000350359f508  
e: 000000350359f4f0      24 (0x18) StructureMap.Interceptors.InterceptorLibrary+c__DisplayC  
nt: 000000350359f508      160 (0xa0) System.NullReferenceException  
: 000000350359f5a8       80 (0x50) System.String  
local consistency confirmed.  
| 000000350359f508 000000350359f4f0 StructureMap.BuilldSession.CreateInstance<System.Type, StructureMap.Fixture>  
| 000000385565ae90 00007ffaabddf420 StructureMap.Container.GetInstance[[System.__Canon, mscorelib]]()
```

Алгоритм отладки

```
public CompoundInterceptor FindInterceptor(Type type)
{
    CompoundInterceptor interceptor;
    if (!_analyzedInterceptors.TryGetValue(type, out interceptor))
    {
        lock (_locker)
        {
            if (!_analyzedInterceptors.TryGetValue(type, out interceptor))
            {
                var interceptorArray = _interceptors.FindAll(i => i.MatchesType(type));
                interceptor = new CompoundInterceptor(interceptorArray);
                _analyzedInterceptors.Add(type, interceptor);
            }
        }
    }
    return interceptor;
}
```

Алгоритм отладки

```
public CompoundInterceptor FindInterceptor(Type type)
{
    CompoundInterceptor interceptor;
    if (!_analyzedInterceptors) TryGetValue(type, out interceptor)
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        lock (_locker)
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                _analyzedInterceptors.Add(type, interceptor);
            }
        }
    }
    return interceptor;
}
```

Алгоритм отладки – выводы

- Интуитивный алгоритм
- Экономит время
- Делай упор на гипотезу

Проактивная отладка



Kelly Vaughn

@kvilly

Follow



Have no fear: programming isn't actually debugging 100% of the time. There's some time set aside for creating new bugs.

6:26 AM - 21 Mar 2018

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36

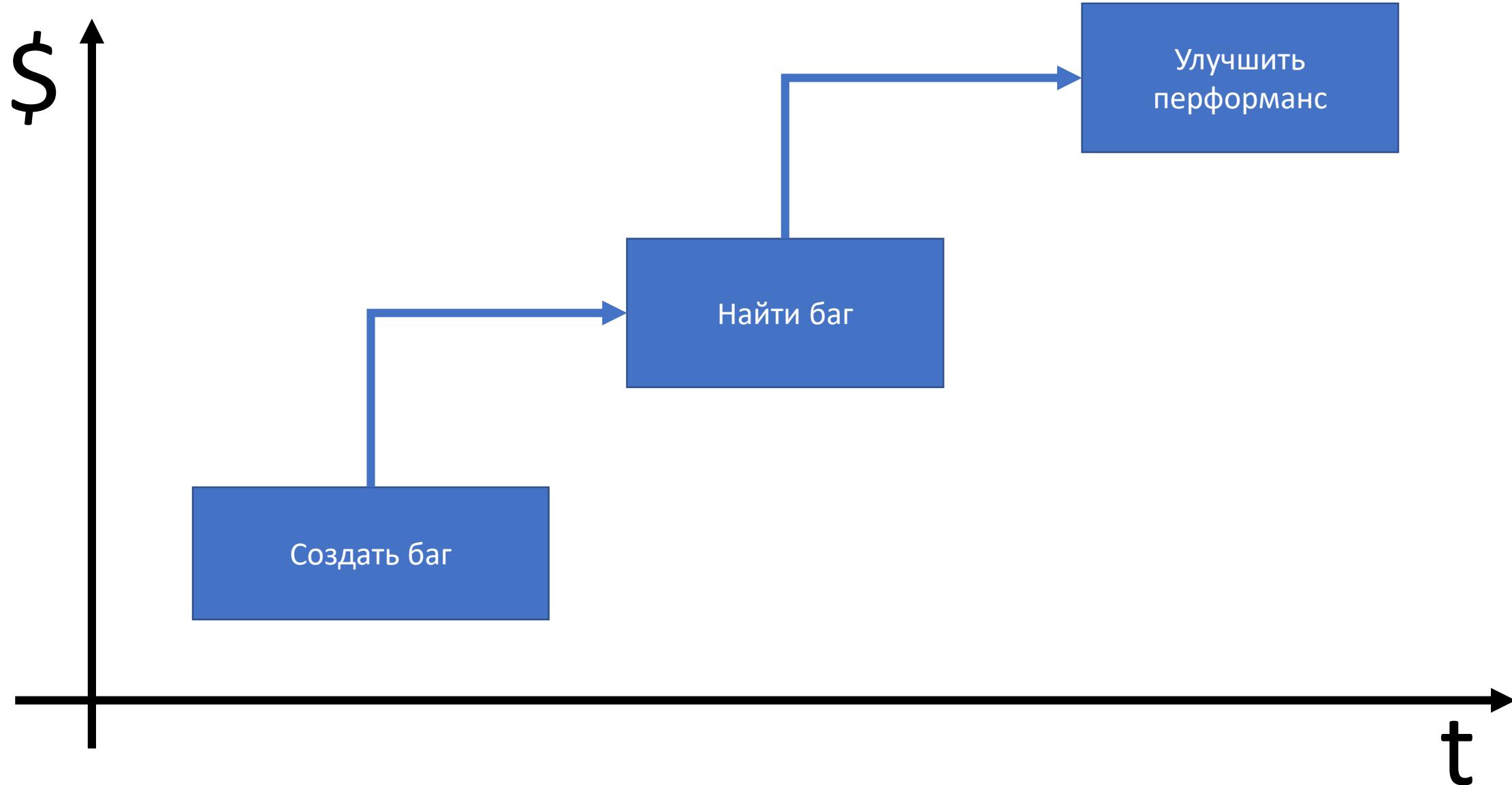
816



2.3K



Жизненный цикл бага



Minimum Debuggable Product (MDP)

- Фитнес функции
- USE метод

MDP: Фитнес функции

```
Describe 'Debuggability' {

    It 'Contains line numbers in PDBs' {

        Get-ChildItem -Path . -Recurse -Include @("*.exe", "*.dll") `

            | ForEach-Object { &symchk.exe /v "$_" /s "\\network\" *>&1 } `

            | where-Object { $_ -like "*Line numbers: TRUE*" } `

            | Should -Not -BeNullOrEmpty

    }

}
```

MDP: Фитнес функции

```
Describe 'Debuggability' {

    It 'Contains package for logging' {

        Get-ChildItem -Path . -Recurse -Name "packages.config"
            | ForEach-Object { Get-Content "$_" }
            | where-Object { $_ -like "*nlog*" }
            | Should -Not -BeNullOrEmpty
    }

}
```

MDP: USE метод

- Utilization (Использование)
- Saturation (Насыщение)
- Errors (Ошибки)

MDP: USE метод



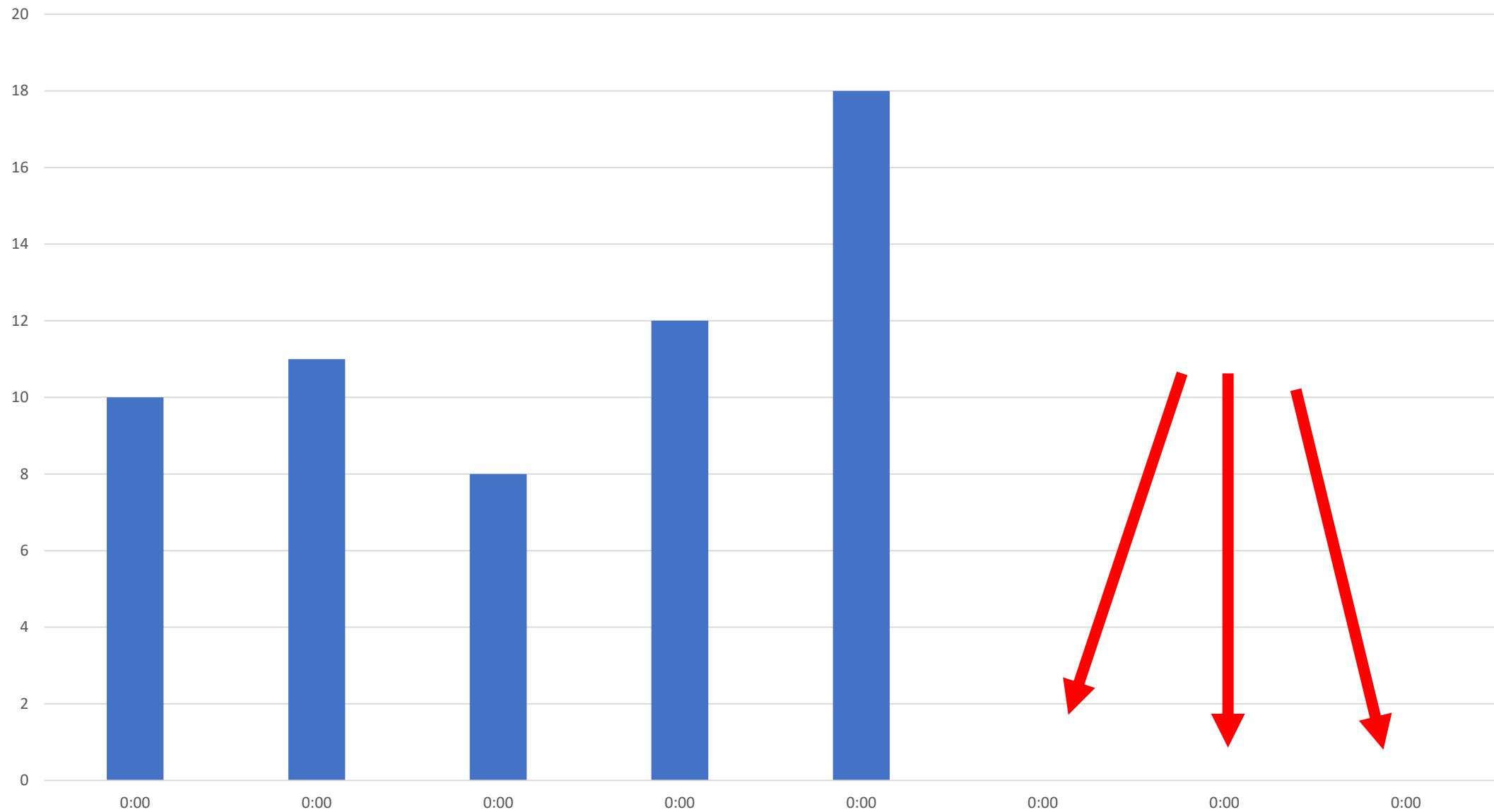
<https://www.circonus.com/2017/08/system-monitoring-with-the-use-dashboard/>

MDP: USE метод для проектирования

- Использование – время обработки запроса
- Насыщение – длина очереди
- Ошибки – любые исключительные ситуации

Debugging War Story

MDP



[Image](#)[Performance](#)[Performance Graph](#)[Disk and Network](#)[GPU Graph](#)

CPU Usage



Private Bytes



I/O



Administrator: C:\WINDOWS\system32\cmd.EXE

```
ExceptionCatch/Stop [PNAME=Ex5-Service PID=10532 TID=2428 TIME=19-Mar-18 20:41:46]
Exception/Stop [PNAME=Ex5-Service PID=10532 TID=2428 TIME=19-Mar-18 20:41:46]
Exception/Start [PNAME=Ex5-Service PID=10532 TID=2428 TIME=19-Mar-18 20:41:46]
```

ExceptionType	= System.OutOfMemoryException
ExceptionMessage	= NULL
ExceptionEIP	= 1914576607
ExceptionHRESULT	= -2147024882
ExceptionFlags	= CLSCompliant
ClrInstanceID	= 10

```
ExceptionCatch/Start [PNAME=Ex5-Service PID=10532 TID=2428 TIME=19-Mar-18 20:41:46]
EntryEIP = 53544144
MethodID = 53235028
MethodName = void [Ex5-Service] Ex5_Service.Program::Main(string[])
ClrInstanceID = 10
```

```
ExceptionCatch/Stop [PNAME=Ex5-Service PID=10532 TID=2428 TIME=19-Mar-18 20:41:46]
Exception/Stop [PNAME=Ex5-Service PID=10532 TID=2428 TIME=19-Mar-18 20:41:46]
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EntryEIP = 53544144
MethodID = 53235028
MethodName = void [Ex5-Service] Ex5_Service.Program::Main(string[])
```

```
while (ShouldContinue())
{
    try
    {
        Do();
    }
    catch (OutOfMemoryException)
    {
        Thread.Sleep(100);
        GC.CollectionCount(2);
        GC.WaitForPendingFinalizers();
    }
}
```

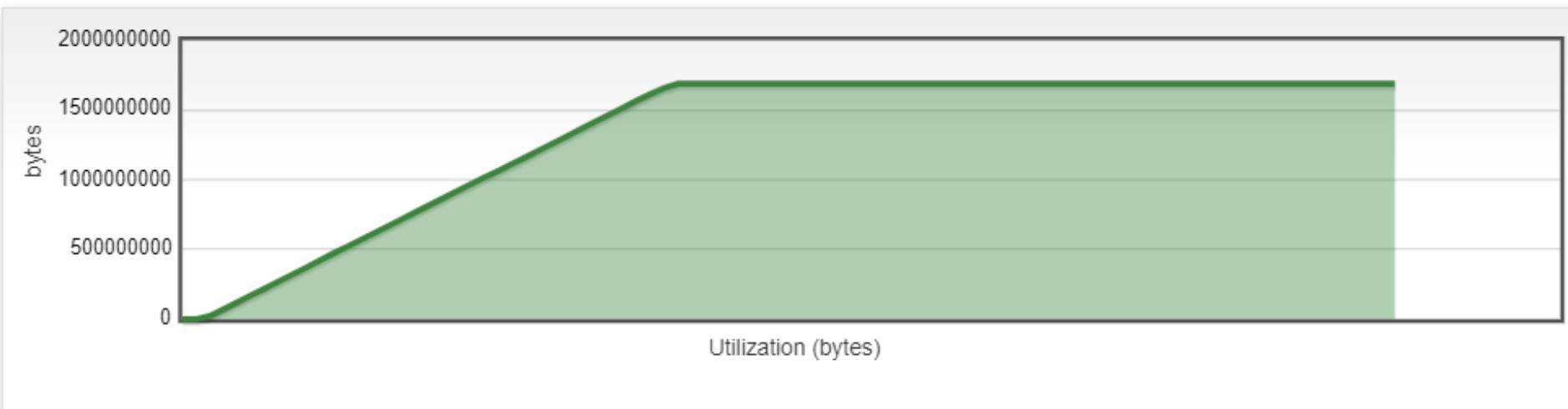
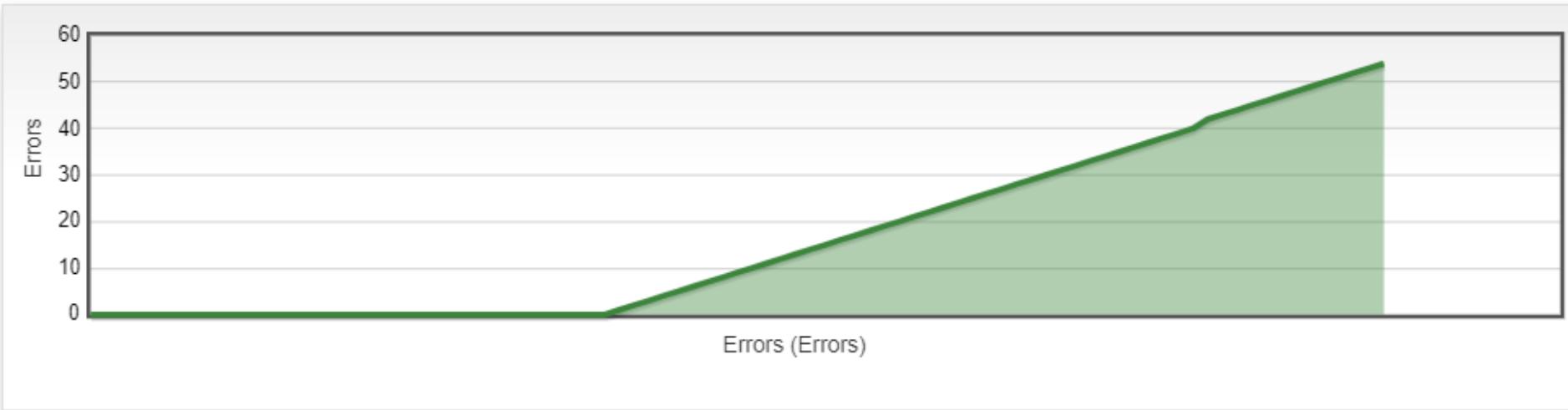
```
public class Cache
{
    private static ConcurrentDictionary<int, String> _items = new ConcurrentDictionary<int, String>();

    public String GetFromCache(int key)
    {
        if (_nextClearTime < DateTime.UtcNow)
        {
            _nextClearTime = DateTime.UtcNow.AddHours(1);
            _items.Clear();
        }
    }
}
```

Metrics.NET Dashboard

localhost:1234/#/

Metrics (1000 ms) Timers Meters Counters Gauges Histograms Health Status (5 s)



Проактивная отладка - выводы

- Отладка – это требование к архитектуре
- Уменьшай путь бага в системе
- Minimum Debuggable Product

Как фиксить баги эффективно?

1. Применяй проактивную отладку
2. Следуй алгоритму
3. Проверяй гипотезы

Q&A

1. Применяй проактивную отладку
2. Следуй алгоритму
3. Проверяй гипотезы



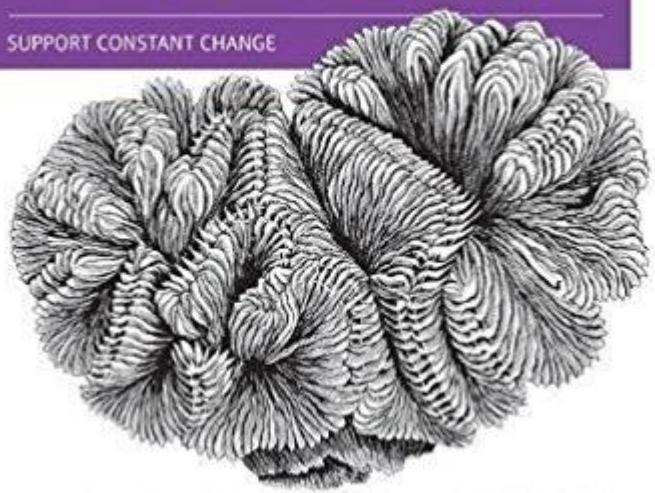
Сергей Щегрикович
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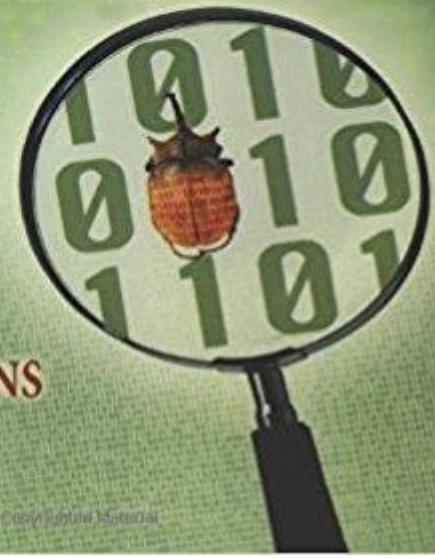
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DAVID J. AGANS

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