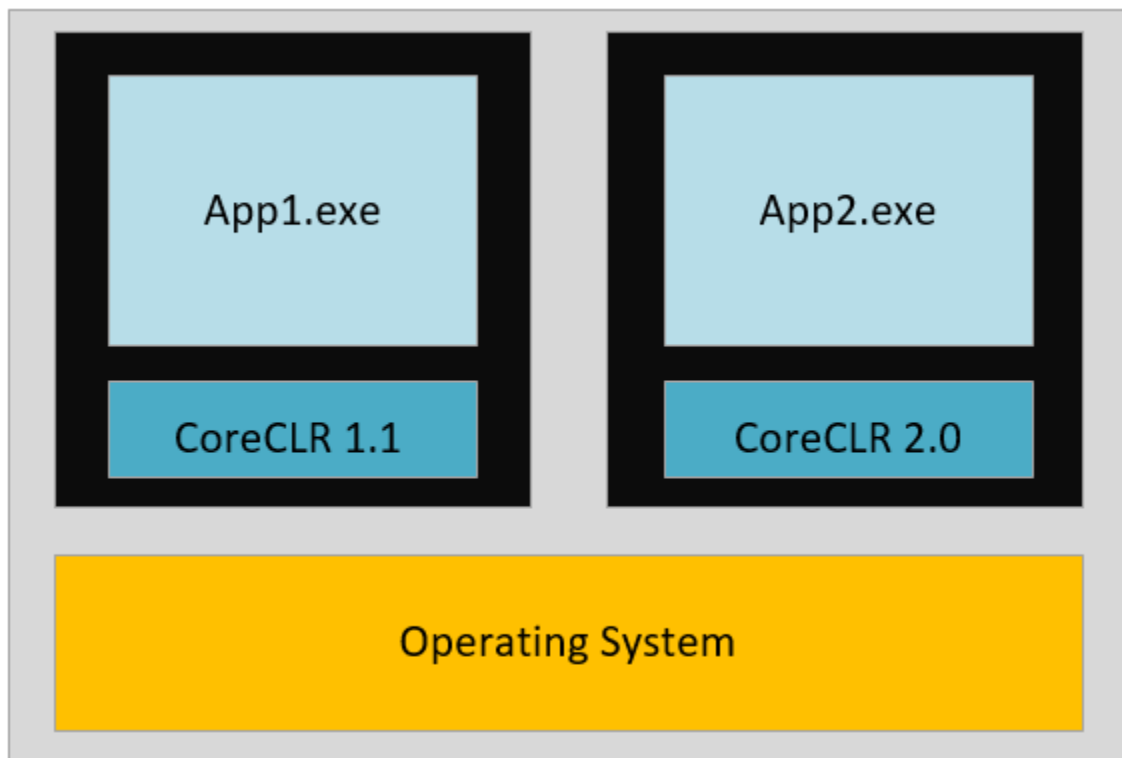
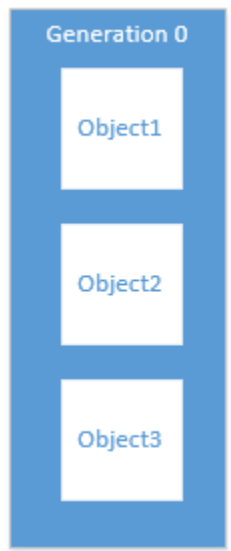
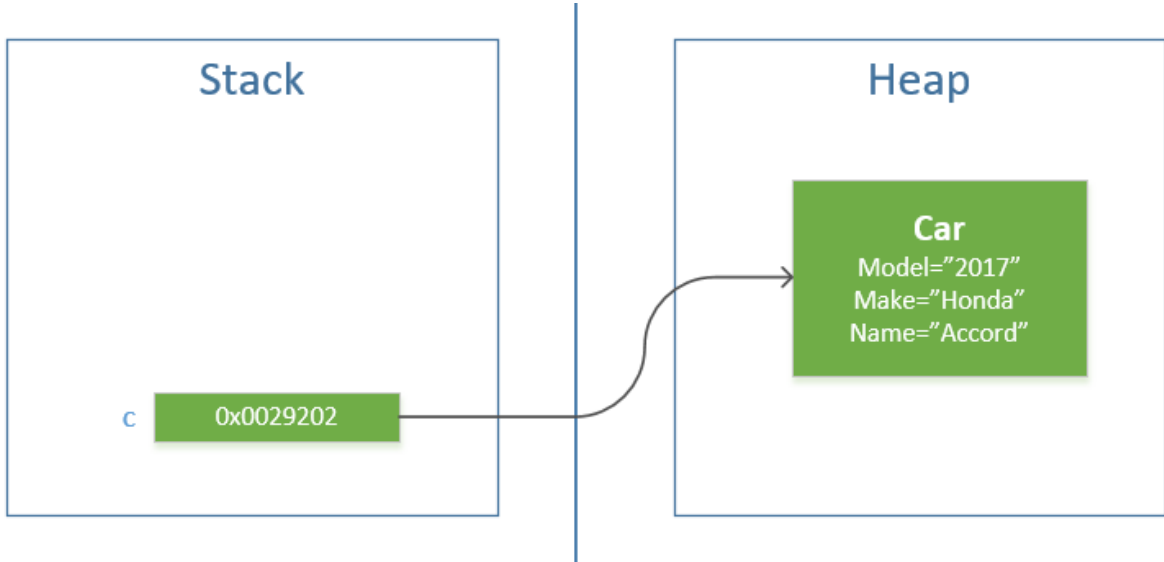
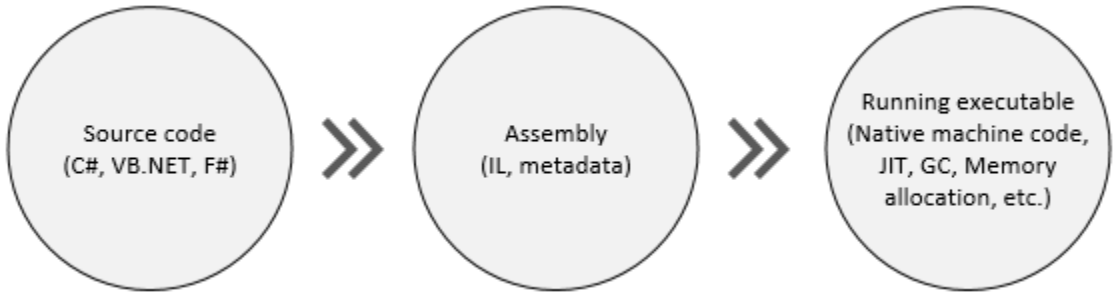


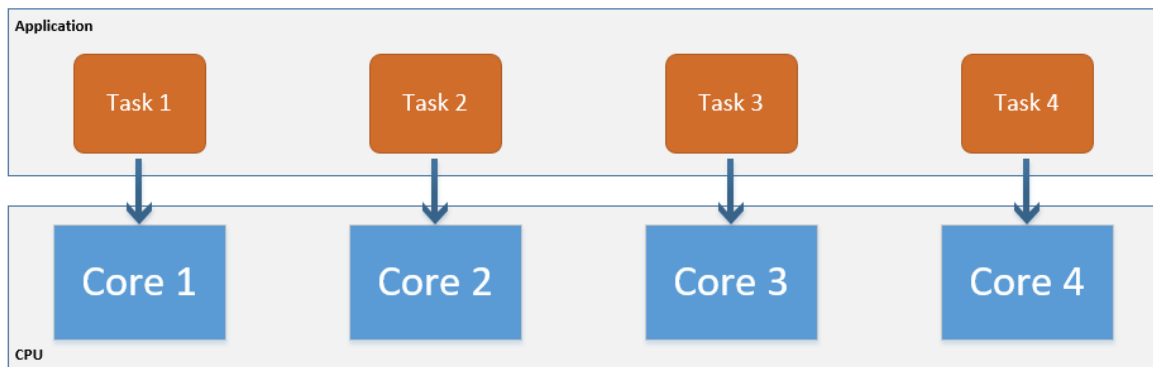
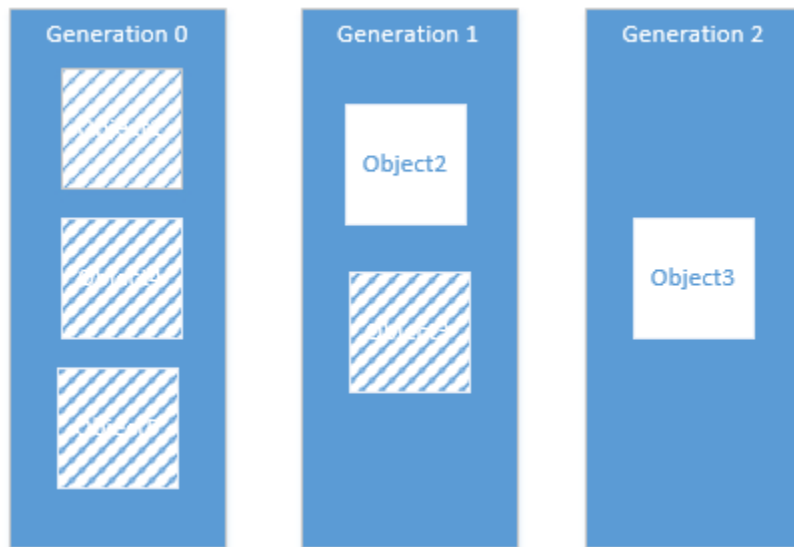
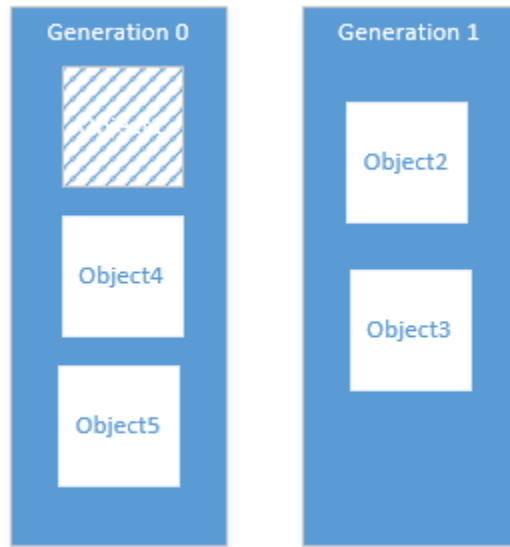
Color Images

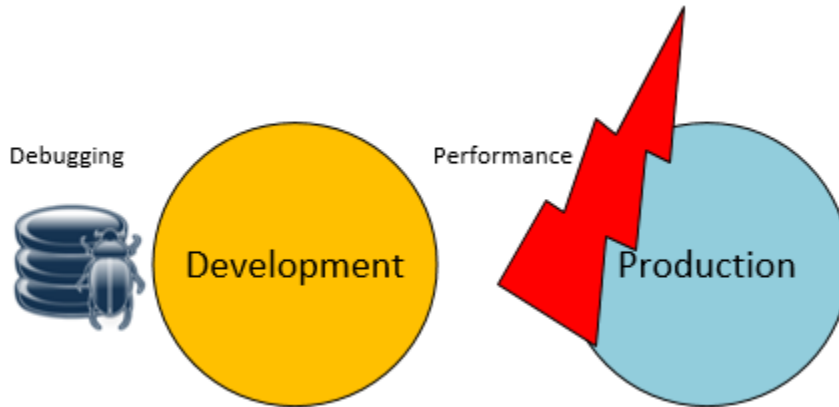
Chapter 14: Understanding .NET Core Internals and Measuring Performance

```
.method private hidebysig static void Main(string[] args) cil managed
{
    .entrypoint
    // Code size          11 (0xb)
    .maxstack 1
    .locals init (int32 U_0,
                 int64 U_1)
    IL_0000: nop
    IL_0001: ldc.i4.1
    IL_0002: stloc.0
    IL_0003: ldc.i4      0x1869F
    IL_0008: conv.i8
    IL_0009: stloc.1
    IL_000a: ret
} // end of method Program::Main
```









```

CA\Program Files\dotnet\dotnet.exe
// * Summary *

BenchmarkDotNet=v0.10.9, OS=Windows 10 Redstone 2 (10.0.15063)
Processor=Intel Core i7-4900MQ CPU 2.80GHz (Haswell), ProcessorCount=8
Frequency=2728057 Hz, Resolution=366.5613 ns, Timer=TSC
.NET Core SDK=2.0.0
[Host] : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT DEBUG [AttachedDebugger]
DefaultJob : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT

-----|-----|-----|-----|
Method | Mean | Error | StdDev |
-----|-----|-----|-----|
Fibonacci | 22.62 us | 0.6201 us | 1.8087 us |
FibonacciRecursive | 17.54 us | 0.2192 us | 0.1943 us |

// * Warnings *
Environment
Summary -> Benchmark was executed with attached debugger
TestBenchmark.Fibonacci: Default -> Benchmark was built without optimization enabled (most probably a DEBUG c
onfiguration). Please, build it in RELEASE.
TestBenchmark.FibonacciRecursive: Default -> Benchmark was built without optimization enabled (most probably a DEBUG c
onfiguration). Please, build it in RELEASE.

// * Legends *
Mean : Arithmetic mean of all measurements
Error : Half of 99.9% confidence interval
StdDev : Standard deviation of all measurements
1 us : 1 Microsecond (0.000001 sec)

// ***** BenchmarkRunner: End *****
// * Artifacts cleanup *

```

```

BenchmarkDotNet=v0.10.9, OS=Windows 10 Redstone 2 (10.0.15063)
Processor=Intel Core i7-4900MQ CPU 2.80GHz (Haswell), ProcessorCount=8
Frequency=2728057 Hz, Resolution=366.5613 ns, Timer=TSC
.NET Core SDK=2.0.0
[Host] : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT DEBUG [AttachedDebugger]
DefaultJob : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT

```

Method	Mean	Error	StdDev
Fibonacci	22.62 us	0.6201 us	1.8087 us
FibonacciRecursive	17.54 us	0.2192 us	0.1943 us

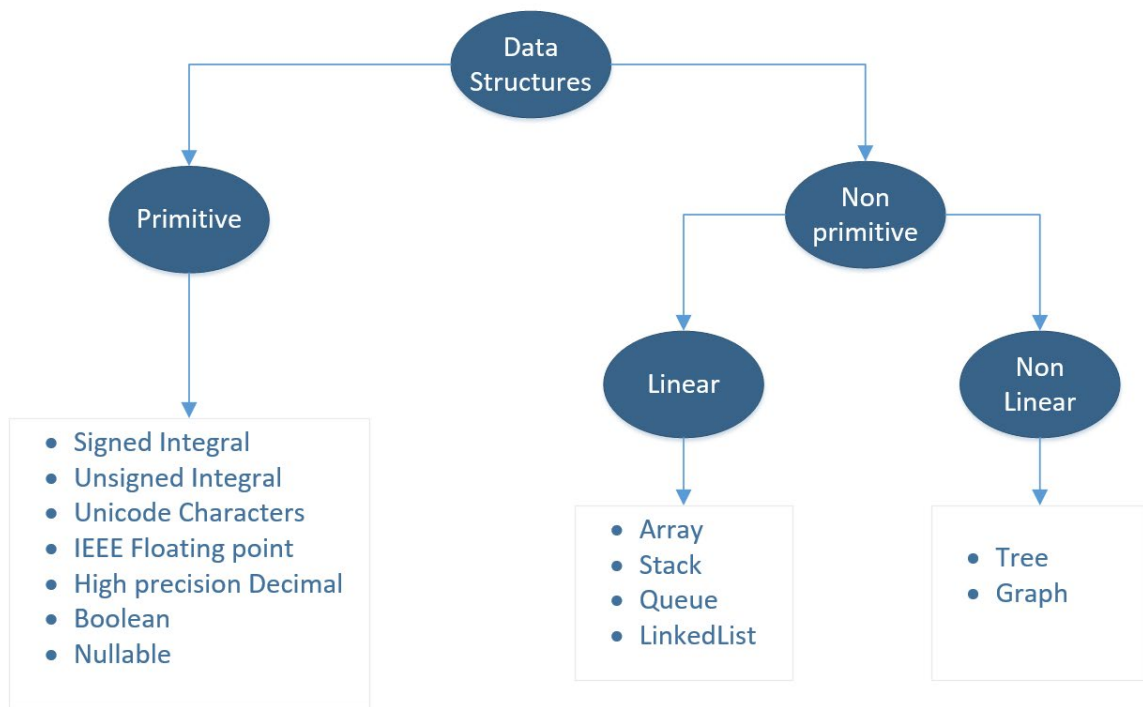
BenchmarkDotNet=v0.10.9, OS=Windows 10 Redstone 2 (10.0.15063)
 Processor=Intel Core i7-4900MQ CPU 2.80GHz (Haswell), ProcessorCount=8
 Frequency=2728057 Hz, Resolution=366.5613 ns, Timer=TSC
 .NET Core SDK=2.0.0
 [Host] : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT DEBUG
 DefaultJob : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT

Method	Len	Mean	Error	StdDev
Fibonacci	10	16.35 us	0.3267 us	0.3889 us
FibonacciRecursive	10	17.69 us	0.2207 us	0.2064 us
Fibonacci	20	36.52 us	0.6865 us	0.6742 us
FibonacciRecursive	20	38.50 us	0.7291 us	0.7488 us
Fibonacci	30	59.66 us	0.8321 us	0.7377 us
FibonacciRecursive	30	65.35 us	1.2867 us	1.1406 us

BenchmarkDotNet=v0.10.9, OS=Windows 10 Redstone 2 (10.0.15063)
 Processor=Intel Core i7-4900MQ CPU 2.80GHz (Haswell), ProcessorCount=8
 Frequency=2728057 Hz, Resolution=366.5613 ns, Timer=TSC
 .NET Core SDK=2.0.0
 [Host] : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT DEBUG
 DefaultJob : .NET Core 2.0.0 (Framework 4.6.00001.0), 64bit RyuJIT

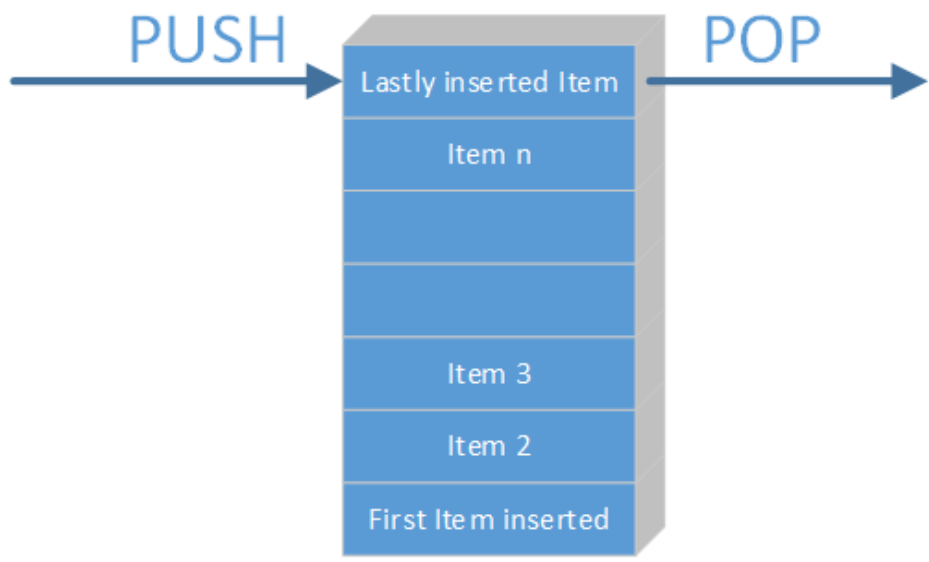
Method	Len	Mean	Error	StdDev	Median	Gen 0	Gen 1	Allocated
Fibonacci	10	16.50 us	0.3281 us	0.7604 us	16.37 us	0.1984	-	848 B
FibonacciRecursive	10	25.46 us	3.2510 us	9.3799 us	20.97 us	0.1984	-	880 B
Fibonacci	20	62.13 us	3.8042 us	10.8537 us	62.22 us	0.4272	0.0012	1816 B
FibonacciRecursive	20	81.60 us	15.0942 us	44.5056 us	63.55 us	0.4272	-	1848 B
Fibonacci	30	99.37 us	9.4387 us	27.3834 us	97.40 us	0.6714	-	2856 B
FibonacciRecursive	30	103.11 us	7.1130 us	20.1784 us	103.42 us	0.6714	-	2888 B

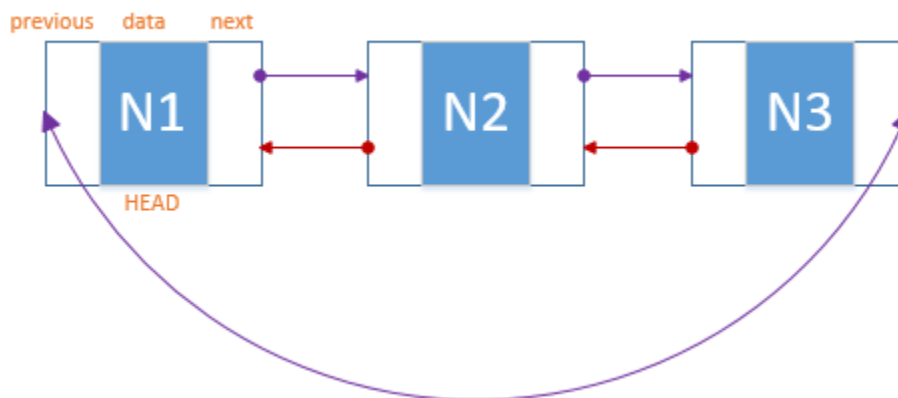
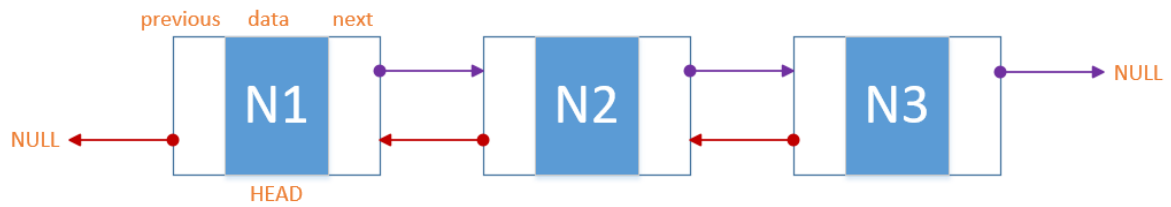
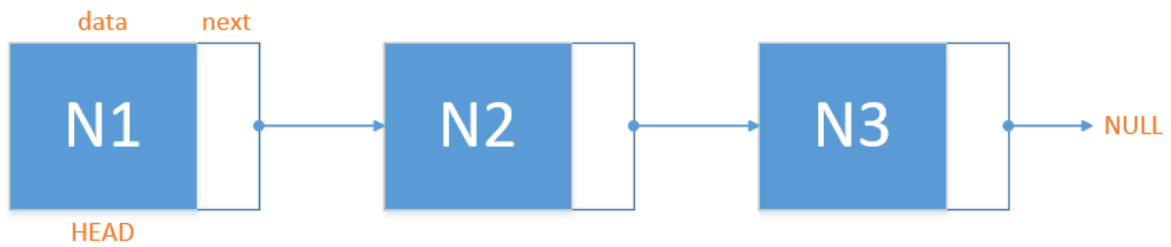
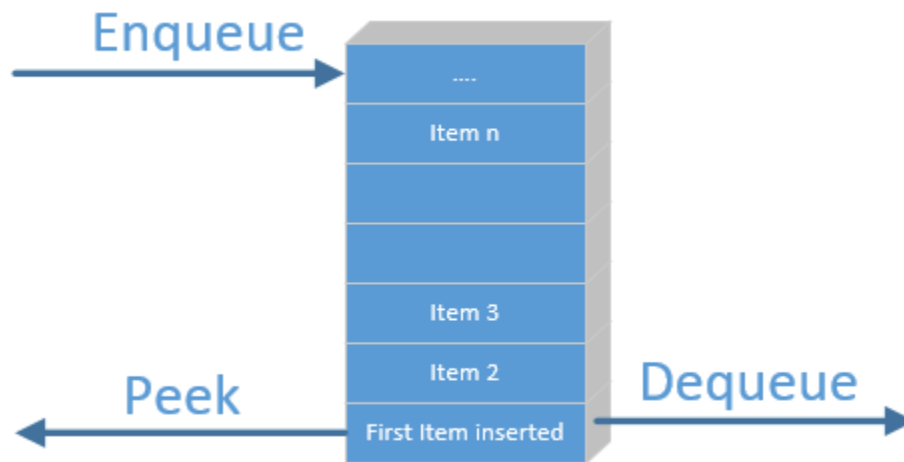
Chapter 15: Data Structures and Writing Optimized Code in C#



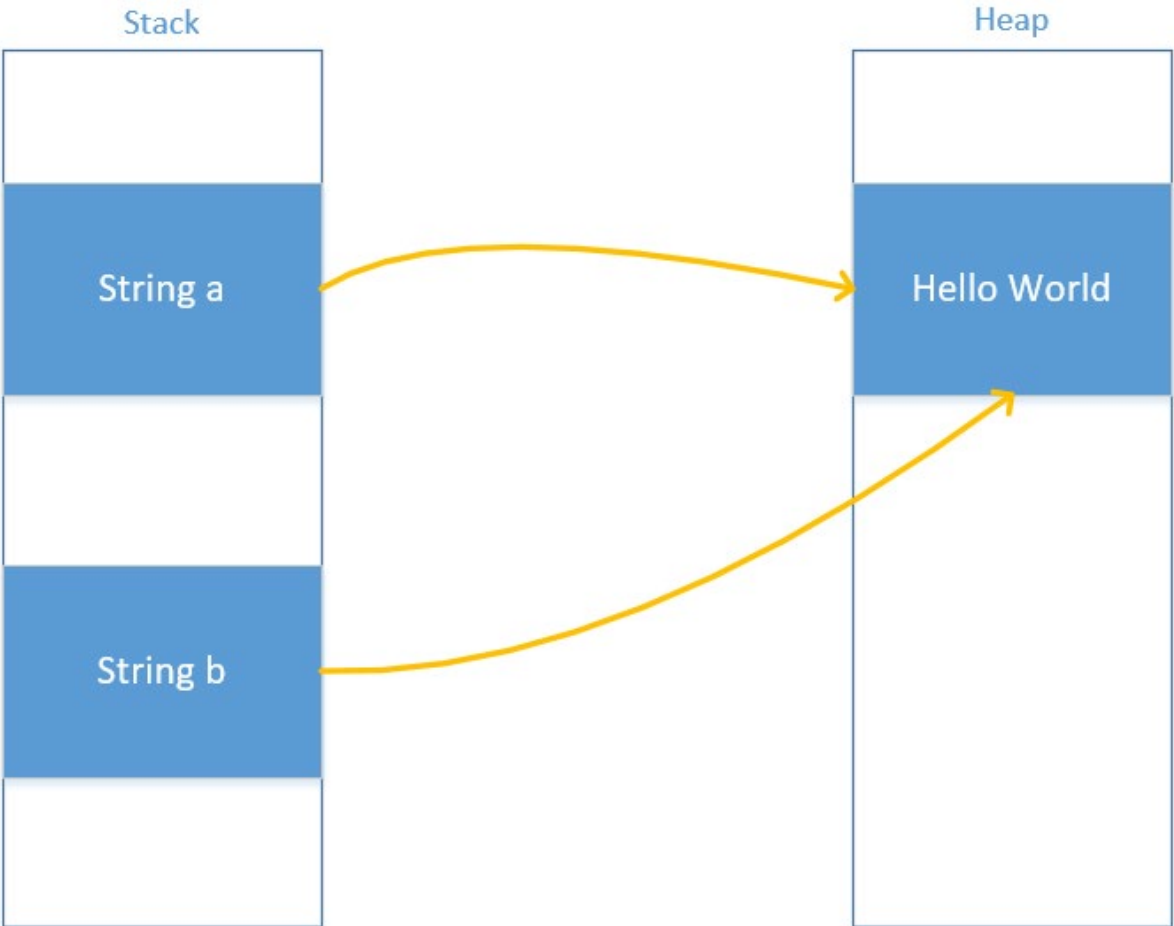
```

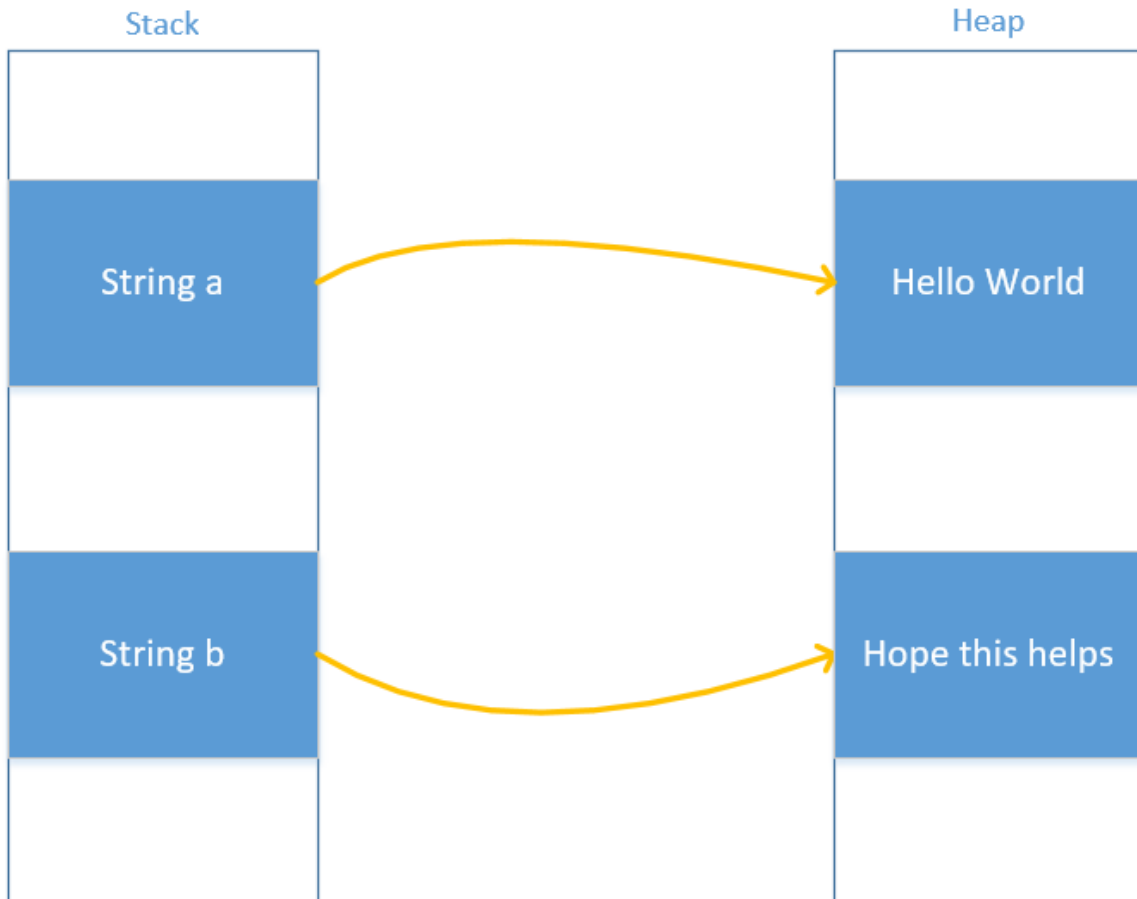
Root
Child 1
  Grand Child 1
  Child 1 (Sibling)
  
```





```
C:\WINDOWS\system32\cmd.exe
AvoidBoxingUnboxing: Time taken 1
BoxingUnboxing: Time taken 5
-
Total time taken with ArrayList is 63
Total time taken with List<int> is 6
```

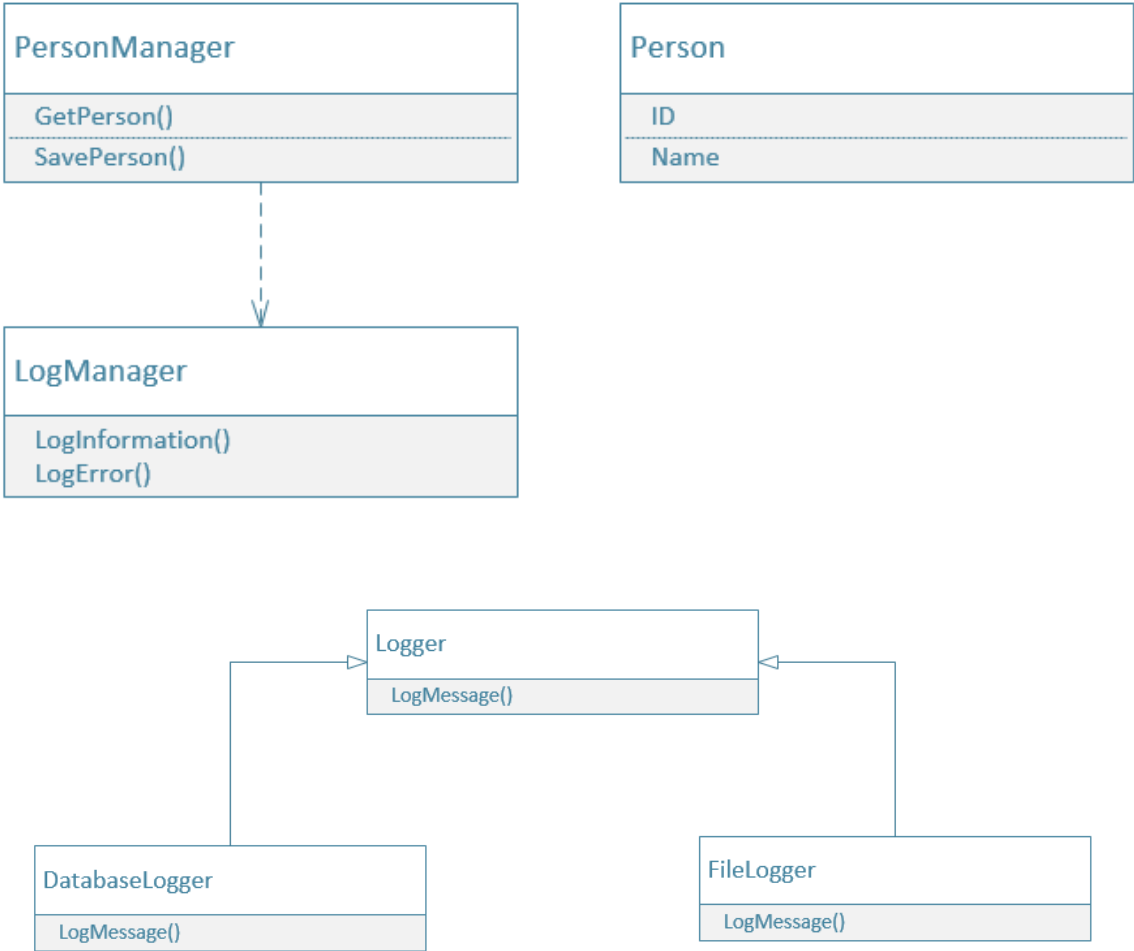


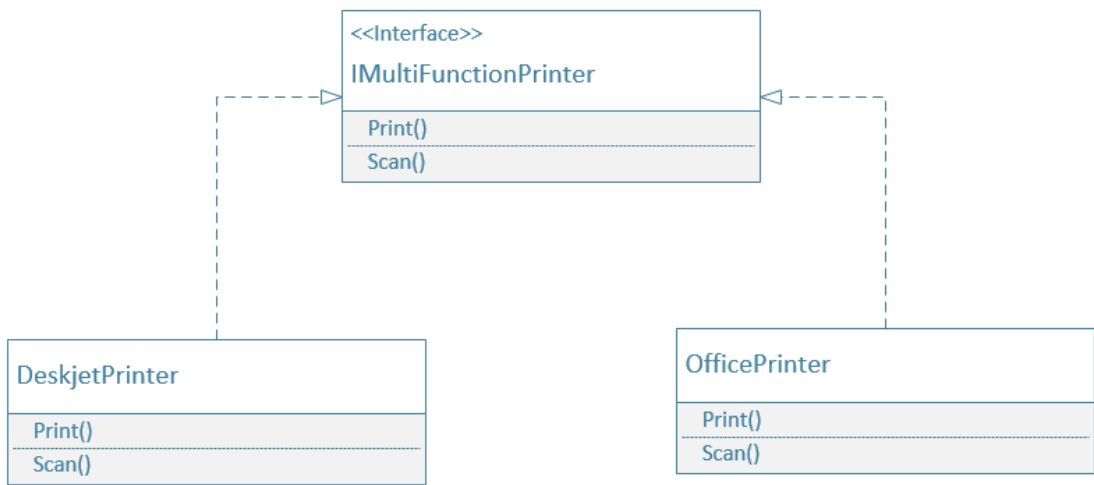
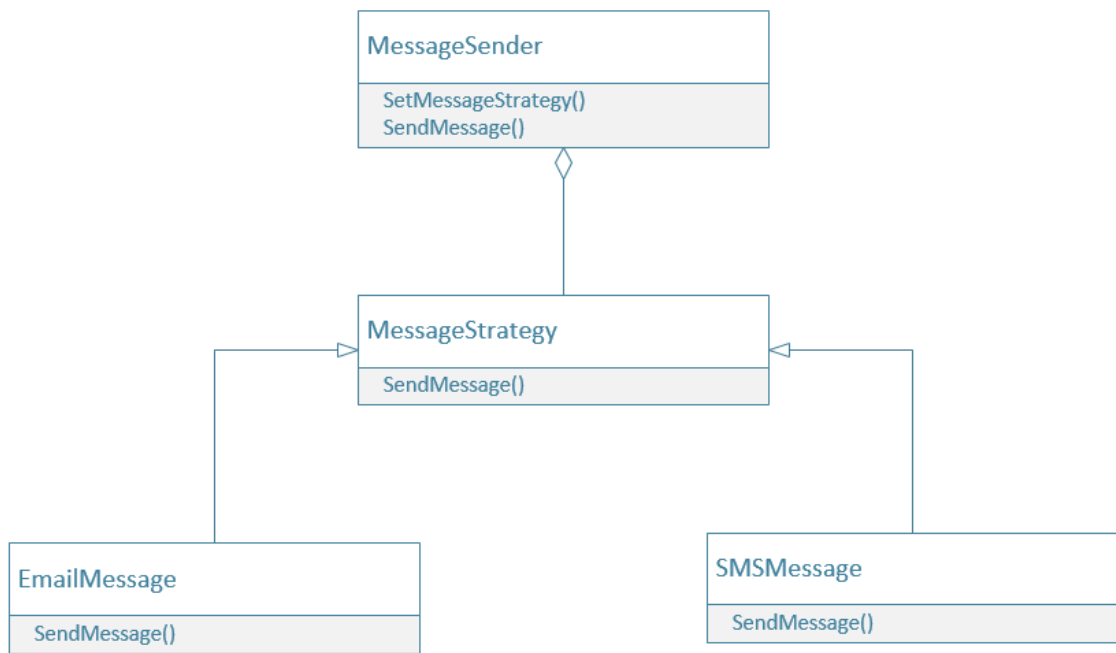


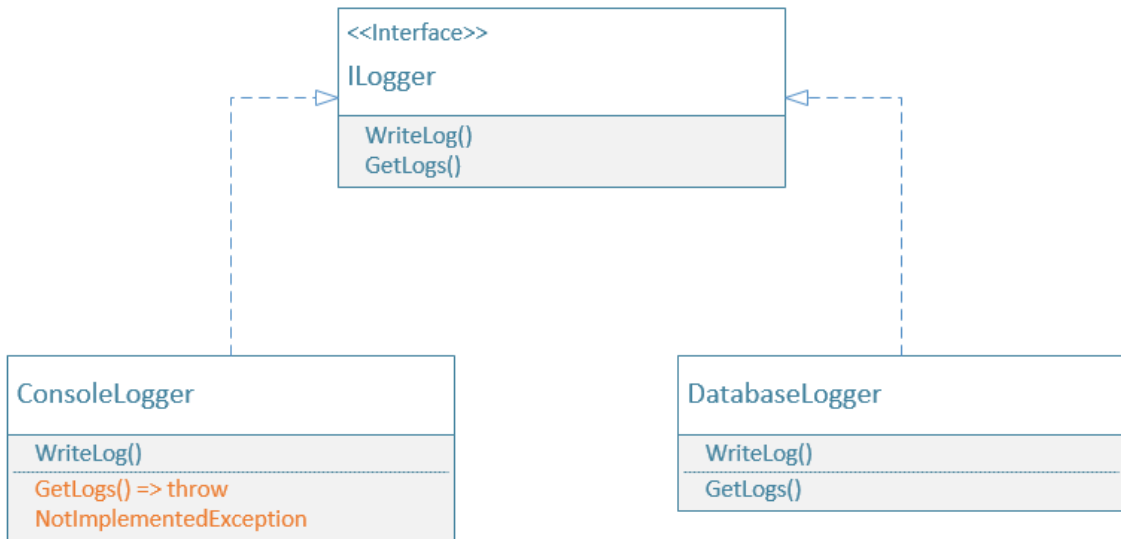
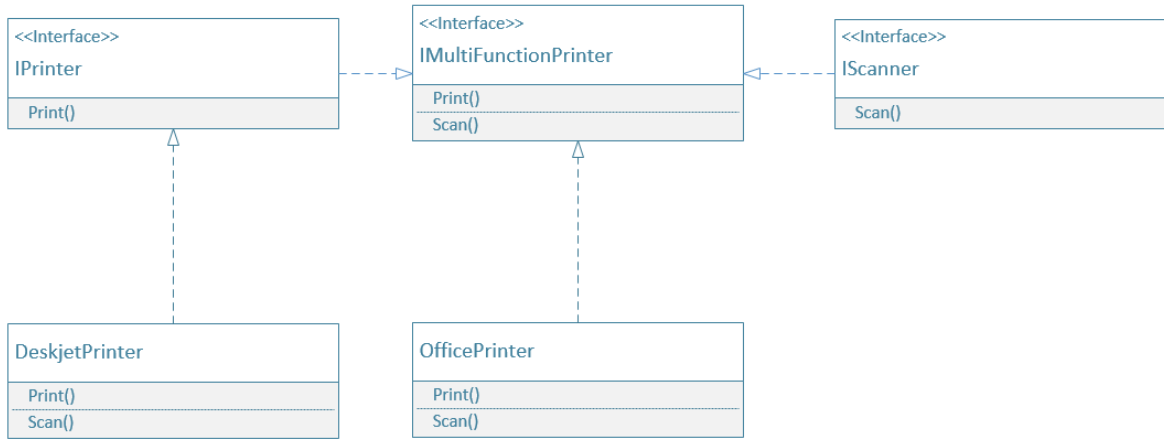
Chapter 16: Designing Guidelines for .NET Core Application Performance

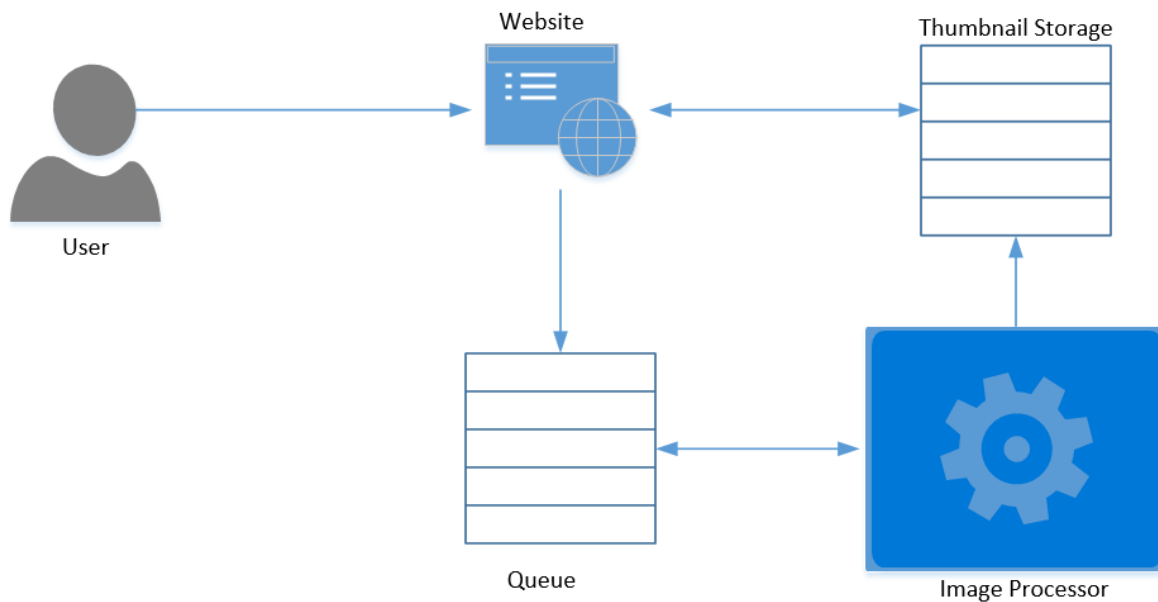
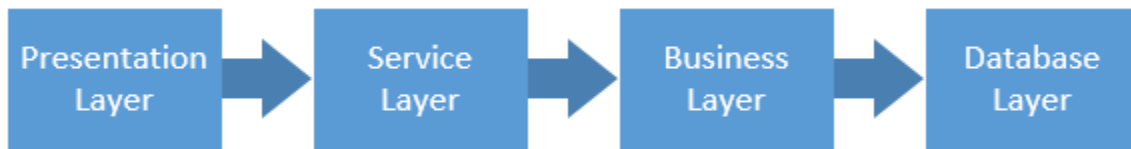
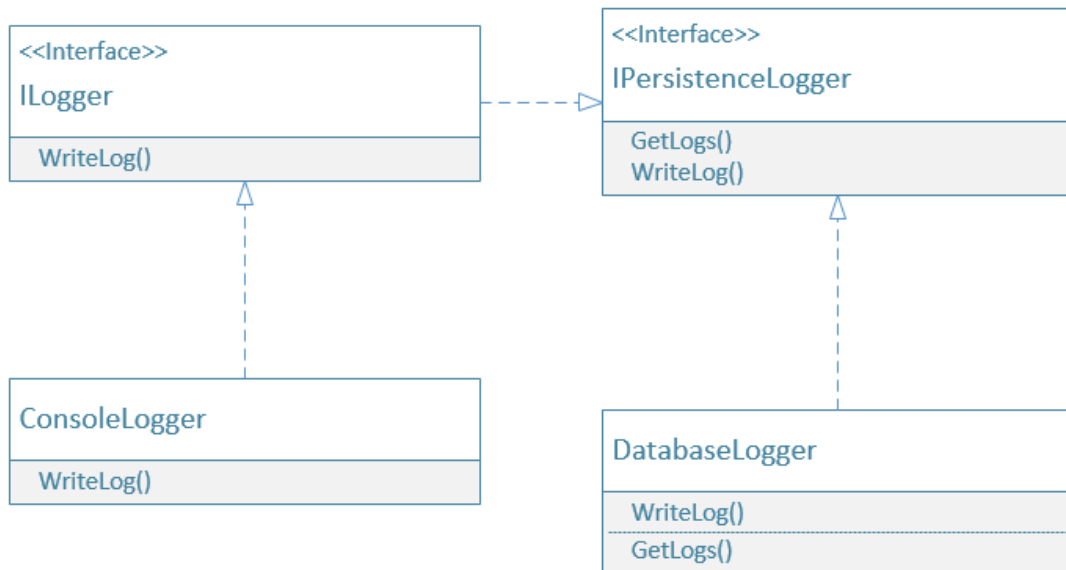
PersonManager
GetPerson()
SavePerson()
LogInformation()
LogError()

Person
ID
Name









Chapter 17: Memory Management Techniques in .NET Core

Directory of D:\Authoring\C#7.0NetCore2.0\My Chapters\Chapter6\Chapter6\Chapter6WebApp

```
24-Dec-2017 09:55 PM <DIR> .
24-Dec-2017 09:55 PM <DIR> ..
24-Dec-2017 09:55 PM          36 .bowerrc
24-Dec-2017 09:55 PM        178 appsettings.Development.json
24-Dec-2017 09:55 PM        113 appsettings.json
24-Dec-2017 09:55 PM <DIR> bin
24-Dec-2017 09:55 PM        207 bower.json
24-Dec-2017 09:55 PM        628 bundleconfig.json
24-Dec-2017 09:55 PM        397 Chapter6WebApp.csproj
24-Dec-2017 09:55 PM <DIR> Controllers
24-Dec-2017 09:55 PM <DIR> Models
24-Dec-2017 11:12 PM <DIR> obj
24-Dec-2017 09:55 PM        631 Program.cs
24-Dec-2017 09:55 PM <DIR> Properties
24-Dec-2017 09:55 PM      1,472 Startup.cs
24-Dec-2017 09:55 PM <DIR> Views
24-Dec-2017 09:55 PM <DIR> wwwroot
          8 File(s)          3,662 bytes
          9 Dir(s) 41,166,479,360 bytes free
```

```
C:\Program Files (x86)\Windows Kits\10\Debuggers\x64>windbg dotnet D:\Authoring\C#7.0NetCore2.0\My Chapters\Chapter6\Chapter6\Chapter6WebApp\bin\debug\netcoreapp2.0\chapter6webapp.dll
```

dotnet "D:\Authoring\C#7.0NetCore2.0\My Chapters\Chapter6\Chapter6\Chapter6WebApp\bin\debug\

File Edit View Debug Window Help

101 101 A

Command - dotnet "D:\Authoring\C#7.0NetCore2.0\My Chapters\Cha...

```
ModLoad: 00007115`59ac0000 00007115`59ac4000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`3f390000 00007ff9`3f5d4000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`59570000 00007ff9`595b5000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`59550000 00007ff9`59564000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58ff0000 00007ff9`59092000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`59530000 00007ff9`59546000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58e30000 00007ff9`58e47000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`98da0000 00007ff9`98e03000 C:\Windows\System32\mscoree.dll
ModLoad: 00007ff9`98630000 00007ff9`986cc000 C:\Windows\Microsoft.NET\Framework6
ModLoad: 00007ff9`4c6e0000 00007ff9`4c7a6000 C:\Windows\Microsoft.NET\Framework6
ModLoad: 00000000`504f0000 00000000`505b9000 C:\WINDOWS\WinSxS\amd64_microsoft.v
ModLoad: 00007ff9`59520000 00007ff9`59524000 C:\Program Files\dotnet\store\x64\n
ModLoad: 00007ff9`58fe0000 00007ff9`58fe3000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58e20000 00007ff9`58e24000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58e10000 00007ff9`58e1b000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58e00000 00007ff9`58e04000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`57df0000 00007ff9`57e3e000 C:\Program Files\dotnet\store\x64\n
ModLoad: 00007ff9`ab2e0000 00007ff9`ab34c000 C:\WINDOWS\System32\WS2_32.dll
ModLoad: 00007ff9`ac100000 00007ff9`ac108000 C:\WINDOWS\System32\PSAPI.DLL
ModLoad: 00007ff9`a9f90000 00007ff9`a9fb9000 C:\WINDOWS\SYSTEM32\USERENV.dll
ModLoad: 00007ff9`a9360000 00007ff9`a9399000 C:\WINDOWS\SYSTEM32\IPHLPAPI.DLL
ModLoad: 00007ff9`58df0000 00007ff9`58df4000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`a95d0000 00007ff9`a9636000 C:\WINDOWS\system32\mswsock.dll
```

BUSY | Debuggee is running...

dotnet "D:\Authoring\C#7.0NetCore2.0\My Chapters\Chapter6\Chapter6\Chapter6WebApp\bin\debug\

File Edit View Debug Window Help



Command - dotnet "D:\Authoring\C#7.0NetCore2.0\My Chapters\Cha...

```
ModLoad: 00007119`59550000 00007119`59564000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58ff0000 00007ff9`59092000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`59530000 00007ff9`59546000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58e30000 00007ff9`58e47000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`98da0000 00007ff9`98e03000 C:\Windows\System32\mscoree.dll
ModLoad: 00007ff9`98630000 00007ff9`986cc000 C:\Windows\Microsoft.NET\Framework6
ModLoad: 00007ff9`4c6e0000 00007ff9`4c7a6000 C:\Windows\Microsoft.NET\Framework6
ModLoad: 00000000`504f0000 00000000`505b9000 C:\WINDOWS\WinSxS amd64_microsoft.v
ModLoad: 00007ff9`59520000 00007ff9`59524000 C:\Program Files\dotnet\store\x64\n
ModLoad: 00007ff9`58fe0000 00007ff9`58fe3000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58e20000 00007ff9`58e24000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`58e10000 00007ff9`58e1b000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`57df0000 00007ff9`57e3e000 C:\Program Files\dotnet\store\x64\n
ModLoad: 00007ff9`ab2e0000 00007ff9`ab34c000 C:\WINDOWS\System32\WS2_32.dll
ModLoad: 00007ff9`ac100000 00007ff9`ac108000 C:\WINDOWS\System32\PSAPI.DLL
ModLoad: 00007ff9`a9f90000 00007ff9`a9fb9000 C:\WINDOWS\SYSTEM32\USERENV.dll
ModLoad: 00007ff9`ab360000 00007ff9`ab399000 C:\WINDOWS\SYSTEM32\IPHLPAPI.DLL
ModLoad: 00007ff9`58e00000 00007ff9`58e04000 C:\Program Files\dotnet\shared\Micr
ModLoad: 00007ff9`a95d0000 00007ff9`a9636000 C:\WINDOWS\system32\mswsock.dll
ModLoad: 00007ff9`58df0000 00007ff9`58df4000 C:\Program Files\dotnet\shared\Micr
(3998.423c): Break instruction exception - code 80000003 (first chance)
ntdll!DbgBreakPoint:
00007ff9`adde37d0 cc int 3
```

0:019> .loadby sos coreclr

Command - dotnet "D:\Authoring\C#7.0NetCore2.0\My Chapters\Chapter6\Chapter6\Chapter6WebApp\bin\debug\netcoreapp2.0\chapter6webapp.dll" - WinDbg:10.0.16299.15 AMD64

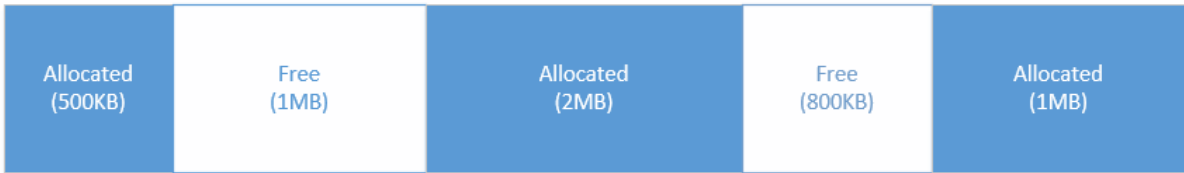
000001b8d-c162390	00007ff94619b7d0	72
000001b8d-c1623d8	00007ff94612fc20	38
000001b8d-c162400	00007ff94612fc20	27
000001b8d-c162420	00007ff94618c9b0	88
000001b8d-c162478	00007ff98e881e80	64
000001b8d-c1624b8	00007ff98e8b90b8	96
000001b8d-c162518	00007ff98e8b8bc8	120
000001b8d-c162530	00007ff94617ad58	24
000001b8d-c1625a8	00007ff94616f848	72
000001b8d-c1625f0	00007ff98e8b3c878	64
000001b8d-c162630	00007ff98e8b3d18	48
000001b8d-c162640	00007ff98e8b90b8	96
000001b8d-c1626c0	00007ff98e8b8bc8	120
000001b8d-c162738	00007ff94617ad58	24
000001b8d-c162750	00007ff94616f848	72
000001b8d-c162788	00007ff98e8b3c878	64
000001b8d-c1627d8	00007ff98e8b90b8	96
000001b8d-c162838	00007ff98e8b8bc8	120
000001b8d-c1628b0	00007ff94617ad58	24
000001b8d-c1628e8	00007ff94616f848	72
000001b8d-c162910	00007ff98e8b3c878	64
000001b9cc101000	000001b55a3cd480	24 Free

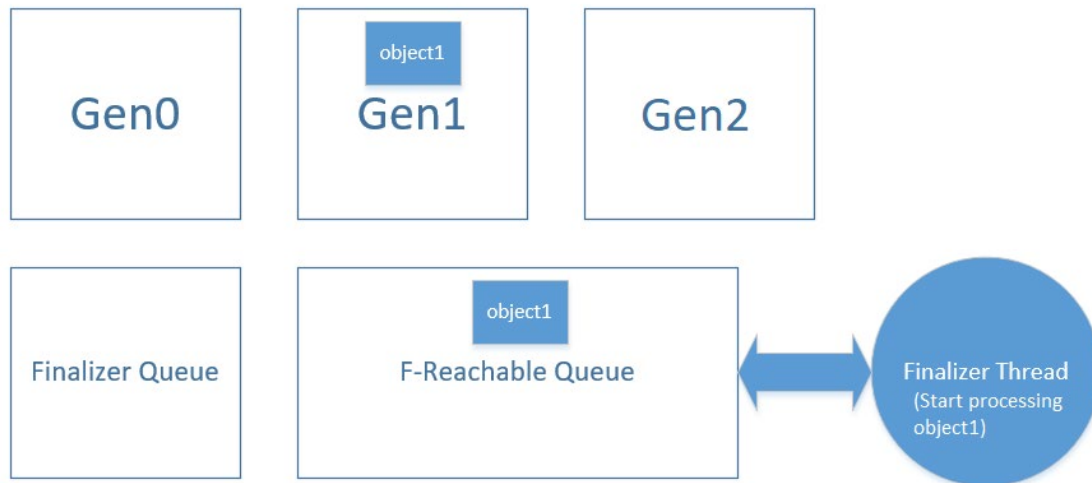
Statistics:

MT	Count	TotalSize	Class Name
00007ff94619678	1	24	System.Collections.Generic.GenericEqualityComparer`1[[System.Int32, System.Private.CoreLib]]
00007ff9461bccc40	1	24	System.Collections.Generic.GenericComparer`1[[System.Int32, System.Private.CoreLib]]
00007ff9461b83c0	1	24	System.Collections.Generic.GenericEqualityComparer`1[[System.Int64, System.Private.CoreLib]]
00007ff9461b2e88	1	24	System.Collections.Generic.GenericArraySortHelper`1[[System.UInt64, System.Private.CoreLib]]
00007ff9461b5850	1	24	System.Collections.Generic.GenericComparer`1[[System.Guid, System.Private.CoreLib]]
00007ff9461b56d8	1	24	System.Collections.Generic.GenericEqualityComparer`1[[System.Guid, System.Private.CoreLib]]
00007ff9461b4a78	1	24	System.Collections.Generic.GenericComparer`1[[System.DateTimeOffset, System.Private.CoreLib]]
00007ff9461b1b80	1	24	System.Collections.Generic.GenericEqualityComparer`1[[System.Char, System.Private.CoreLib]]
00007ff9461a7e08	1	24	System.Threading.AsyncLocalValueMap+EmptyAsyncLocalValueMap
00007ff9461a5f80	1	24	System.Environment+<>c
00007ff9461a53d8	1	24	System.Runtime.CompilerServices.TypeForwardedFromAttribute
00007ff9461a3c38	1	24	System.Runtime.InteropServices.ComVisibleAttribute
00007ff9461a2018	1	24	System.Runtime.InteropServices.ClassInterfaceAttribute
00007ff9461a02a0	1	24	System.Collections.Generic.ObjectEqualityComparer`1[[System.Object, System.Private.CoreLib]]
00007ff9461a00f0	1	24	System.Collections.Generic.GenericEqualityComparer`1[[System.String, System.Private.CoreLib]]
00007ff94619dd00	1	24	System.Text.EncoderExceptionFallback
00007ff94619d878	1	24	System.Text.DecoderExceptionFallback
00007ff946199148	1	24	System.Reflection.Missing
00007ff9461957a0	1	24	System.Threading.Tasks.ThreadPoolTaskScheduler+<>c
00007ff9461936d8	1	24	System.Threading.Tasks.ThreadPoolTaskScheduler
00007ff946193418	1	24	System.Threading.TimerHolder
00007ff9461933b8	1	24	System.Security.Policy.ApplicationTrust
00007ff94618f068	1	24	System.OrdinalIgnoreCaseComparer
00007ff94618efc0	1	24	System.OrdinalCaseSensitiveComparer
00007ff94618d8e8	1	24	System.DBNull
00007ff94618d708	1	24	System.PinnableBufferCacheEventSource
00007ff94618cba0	1	24	System.SharedStatics
00007ff946181008	1	24	System.AppDomainManager
00007ff94617e2a0	1	24	System.Threading.CancellationTokensource+LinkedNCancellationTokensource+<>c
00007ff94617e248	1	24	System.Threading.Overlapped+<>c
00007ff94617df20	1	24	System.Runtime.CompilerServices.AsyncMethodBuilderCore+MoveNextRunner+<>c
00007ff94617de88	1	24	System.Threading.TimerQueueTimer+<>c
00007ff94617d480	1	24	System.Resources.FastResourceComparer
00007ff946175c78	1	24	System.Threading.Timer
00007ff946173e10	1	24	System.Threading.Tasks.Task+<>c

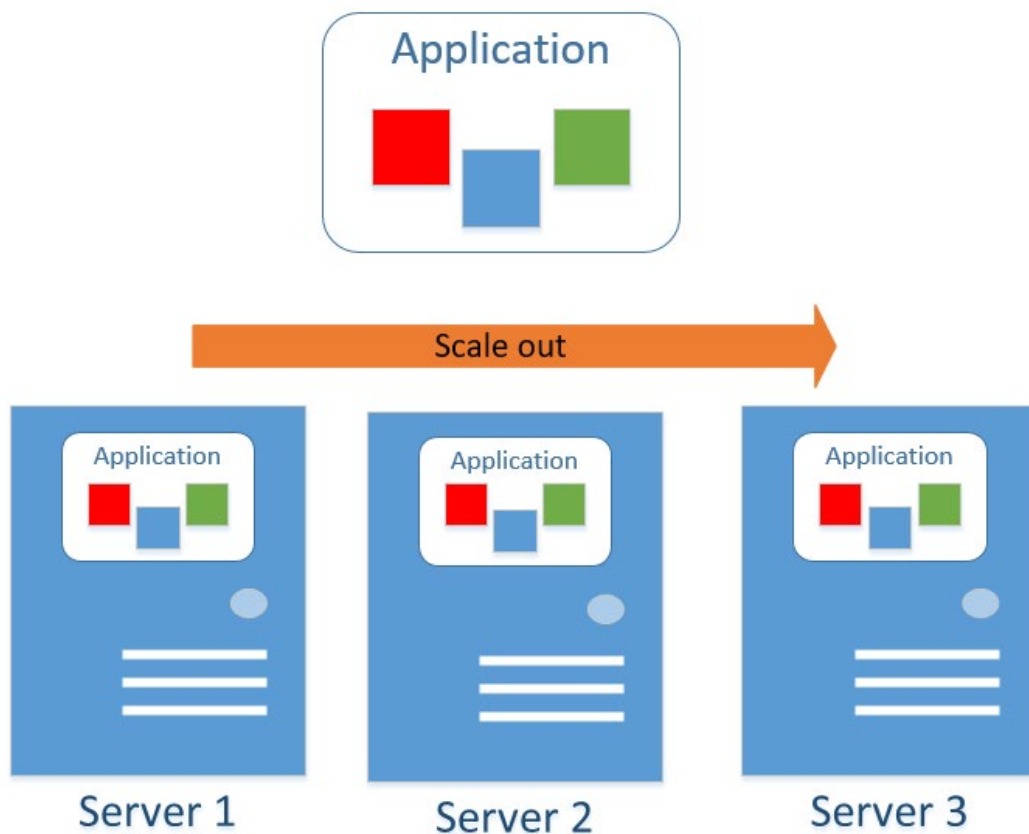
Command - dotnet "D:\Authoring\C#7.0NetCore2.0\My Chapters\Chapter6\Chapter6\Chapter6WebApp\bin\debug\netcoreapp2.0\chapter6webapp.dll"

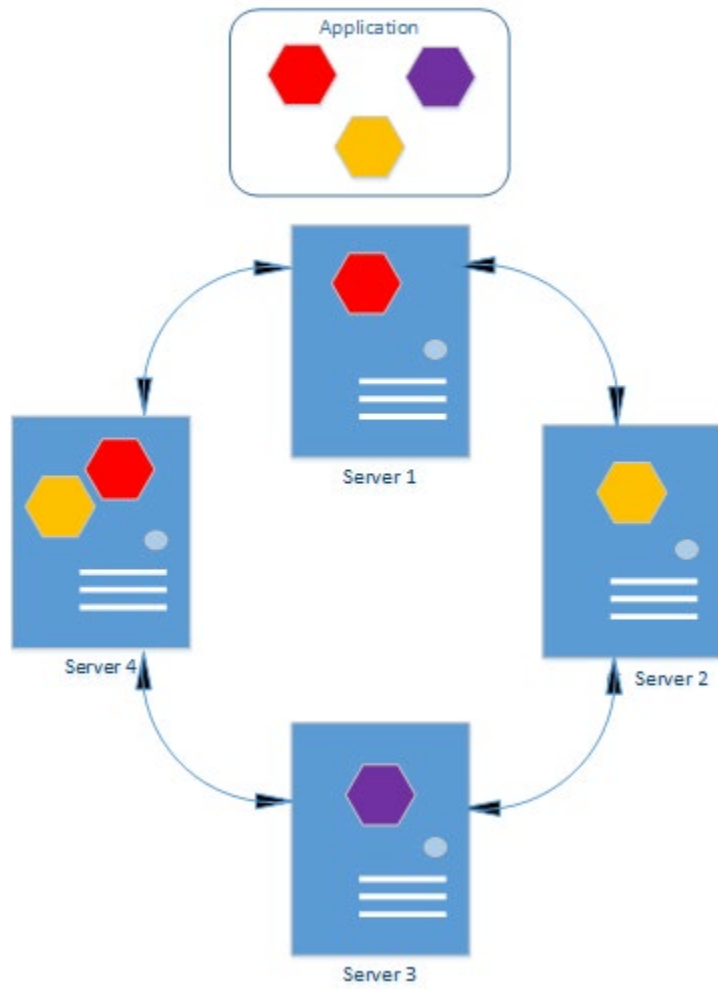
000001b8d-c162390	00007ff94619b7d0	72
000001b8d-c1623d8	00007ff94612fc20	38
000001b8d-c162400	00007ff94612fc20	27
000001b8d-c162420	00007ff94618c9b0	88



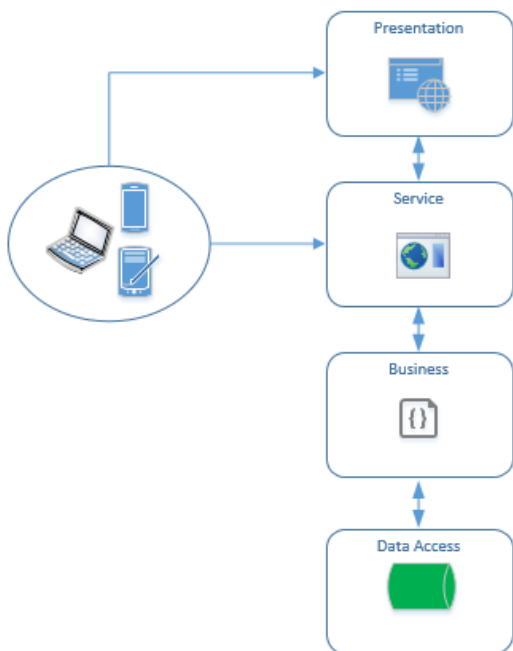


Chapter 18: Microservices Architecture

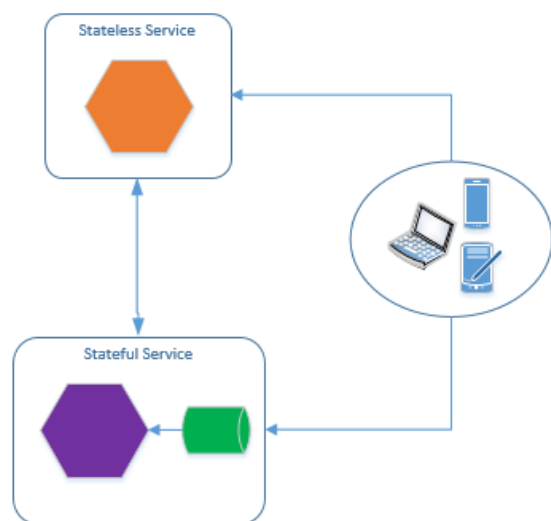


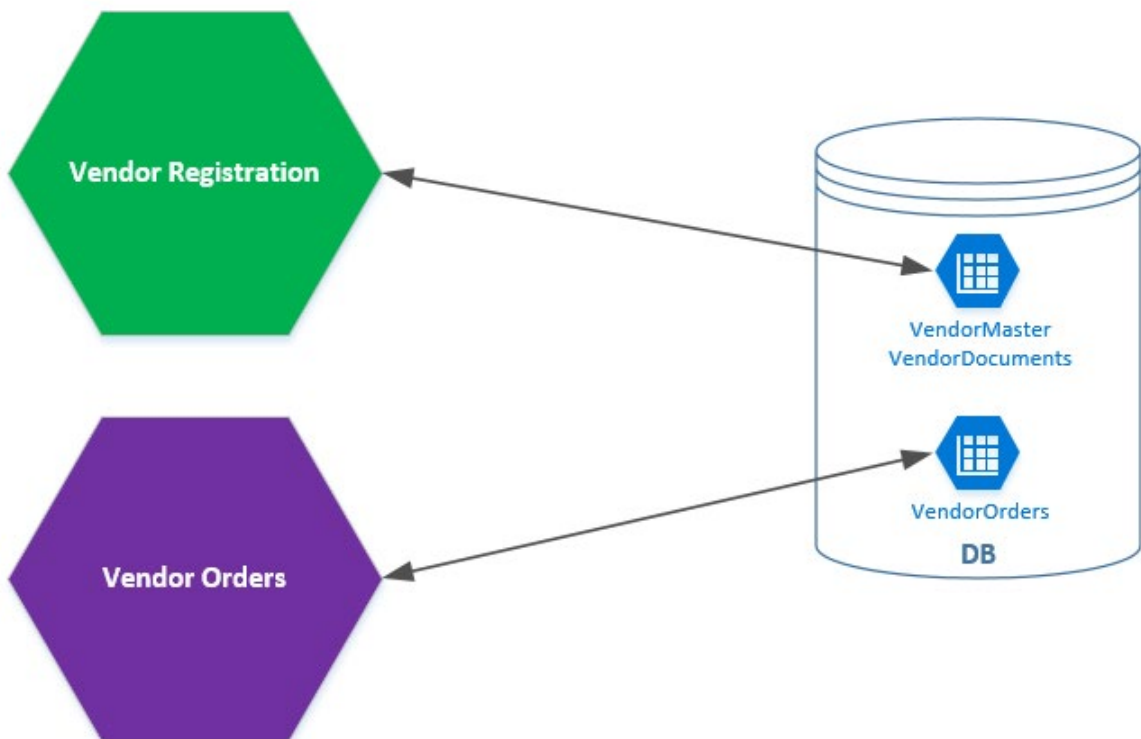
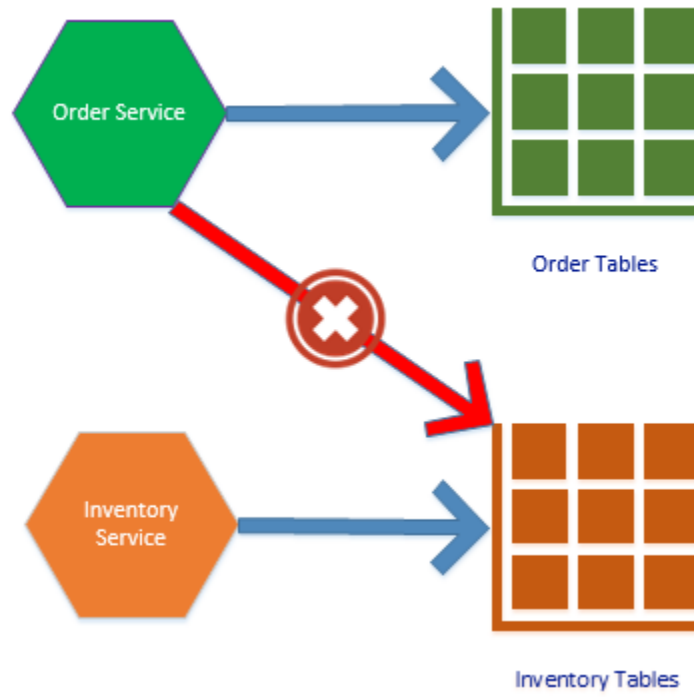


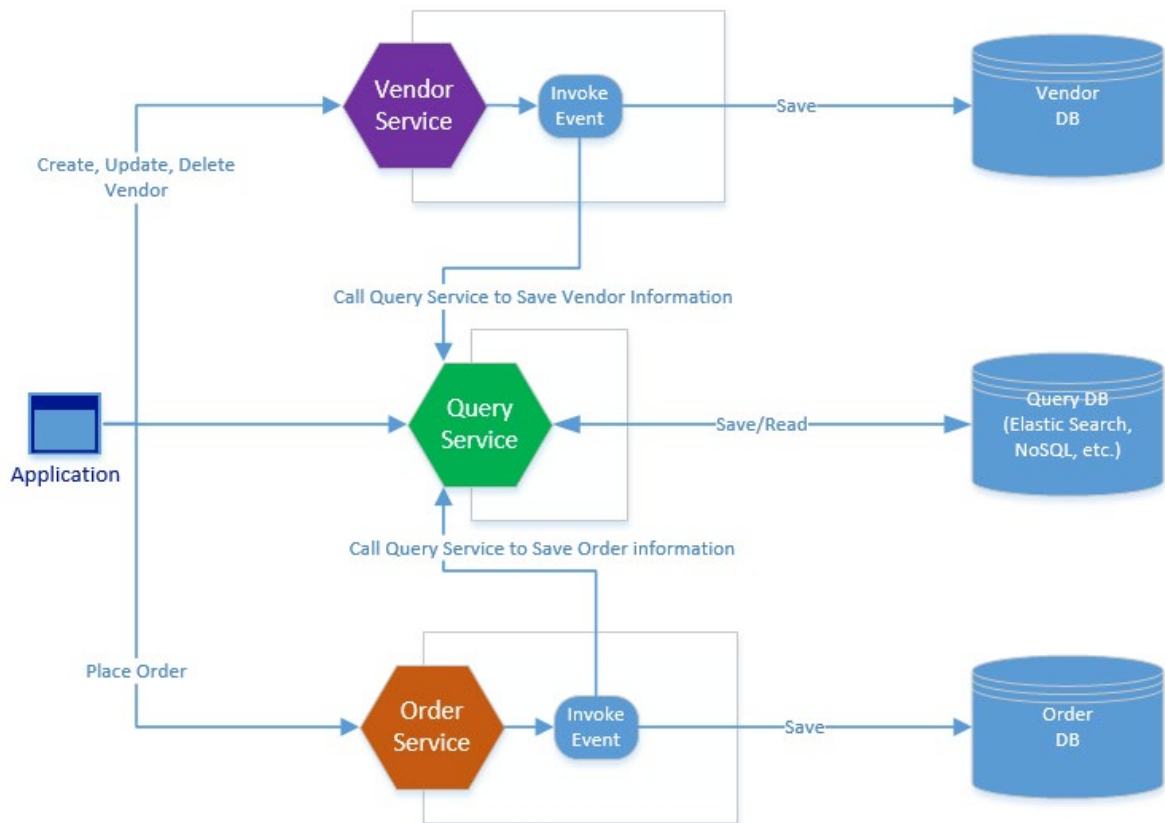
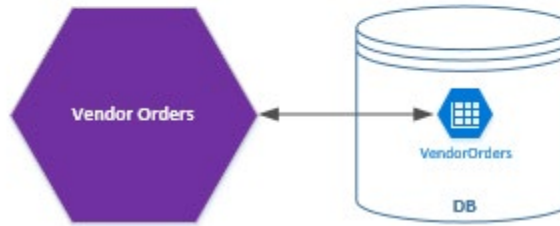
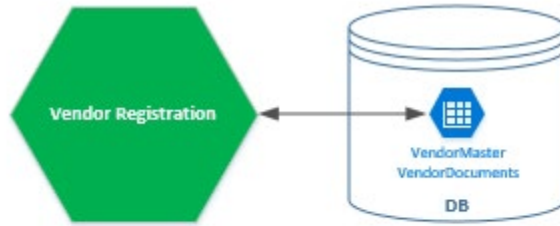
Layered Architecture



Microservices Architecture







.NET Core ASP.NET Core 2.0 [Learn more](#)

Empty Web API Web Application Web Application (Model-View-Controller) Angular

React.js React.js and Redux

A project template for creating an ASP.NET Core application with an example Controller for a RESTful HTTP service. This template can also be used for ASP.NET Core MVC Views and Controllers.

[Learn more](#)

Change Authentication

Authentication **No Authentication**

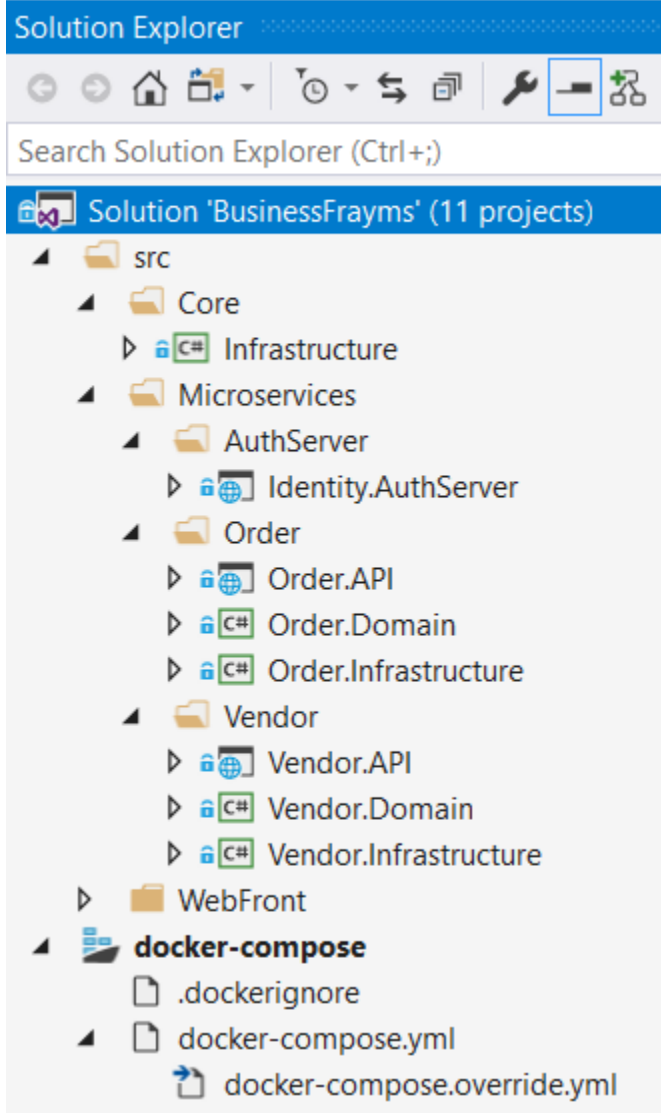
Enable Docker Support

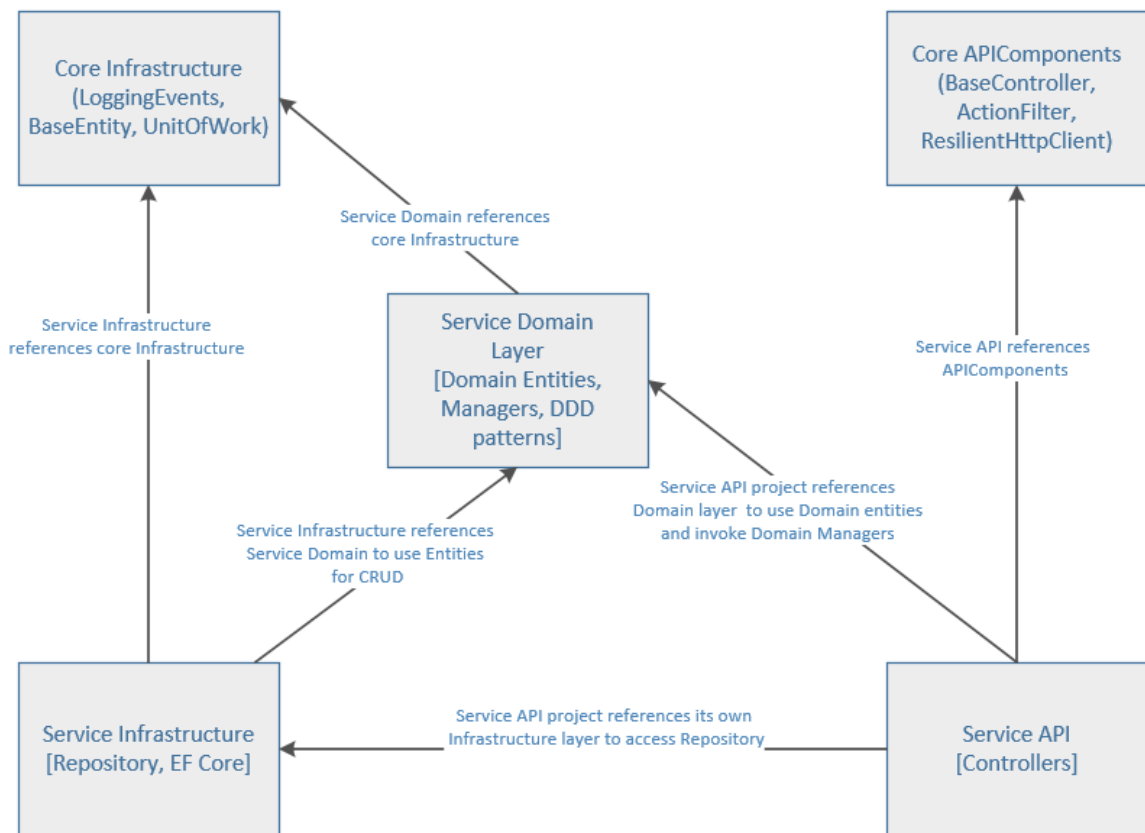
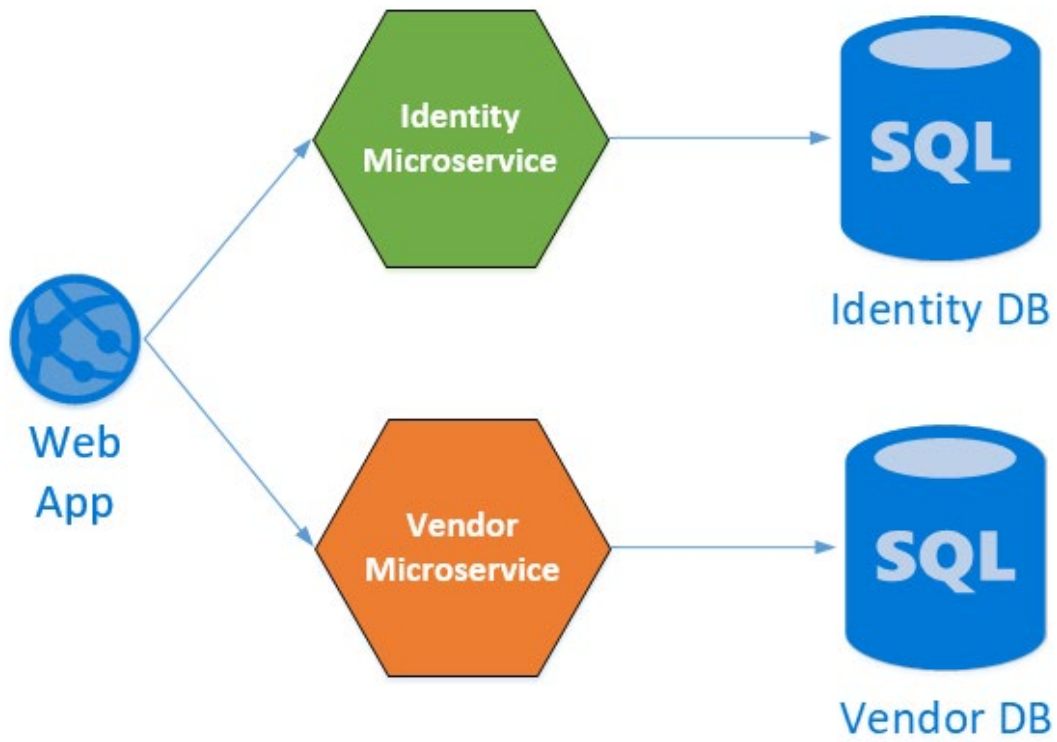
OS: Windows

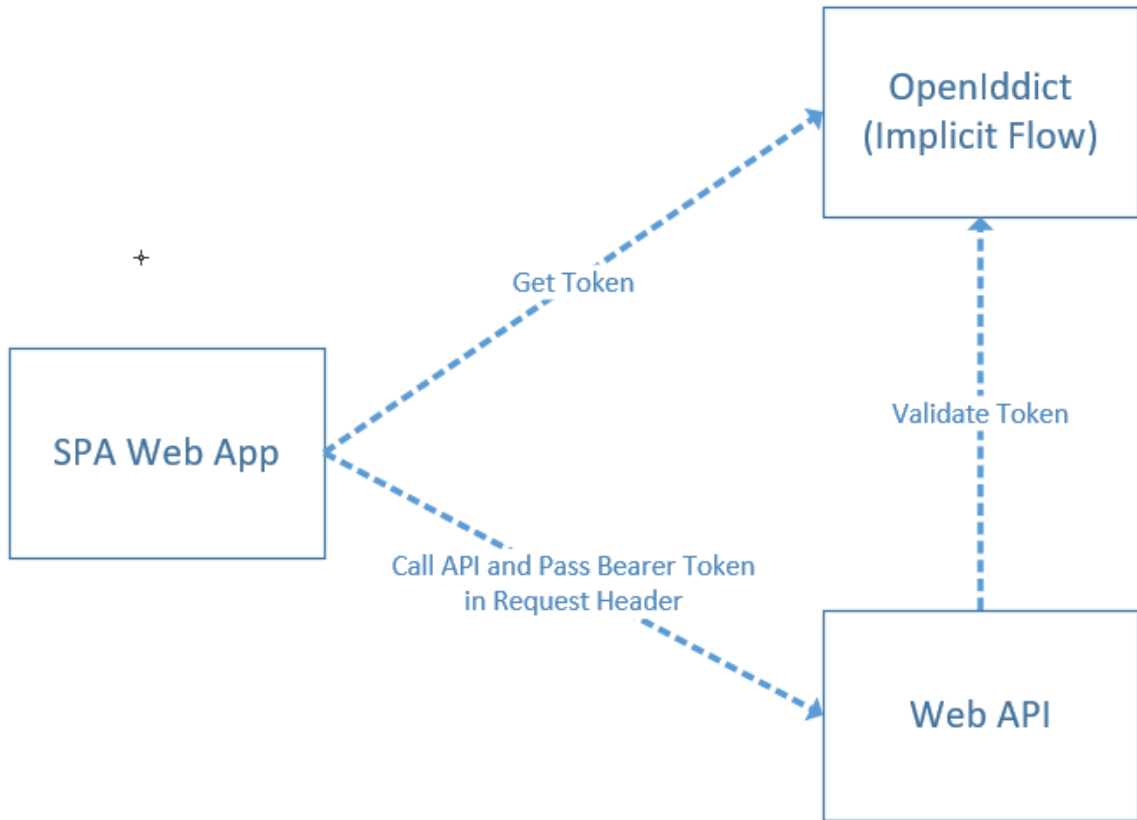
Requires [Docker for Windows](#)

Docker support can also be enabled later [Learn more](#)

OK Cancel







NuGet Package Manager: Identity.AuthServer

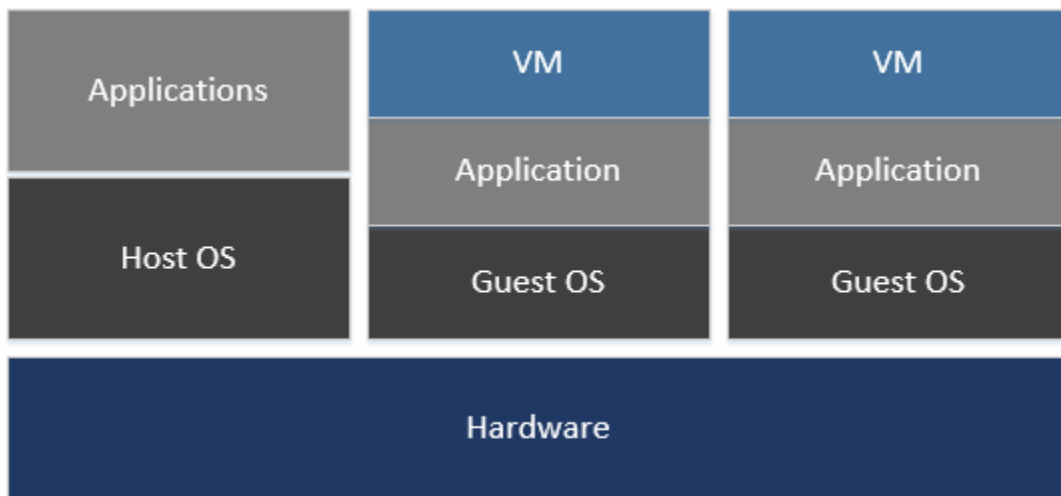
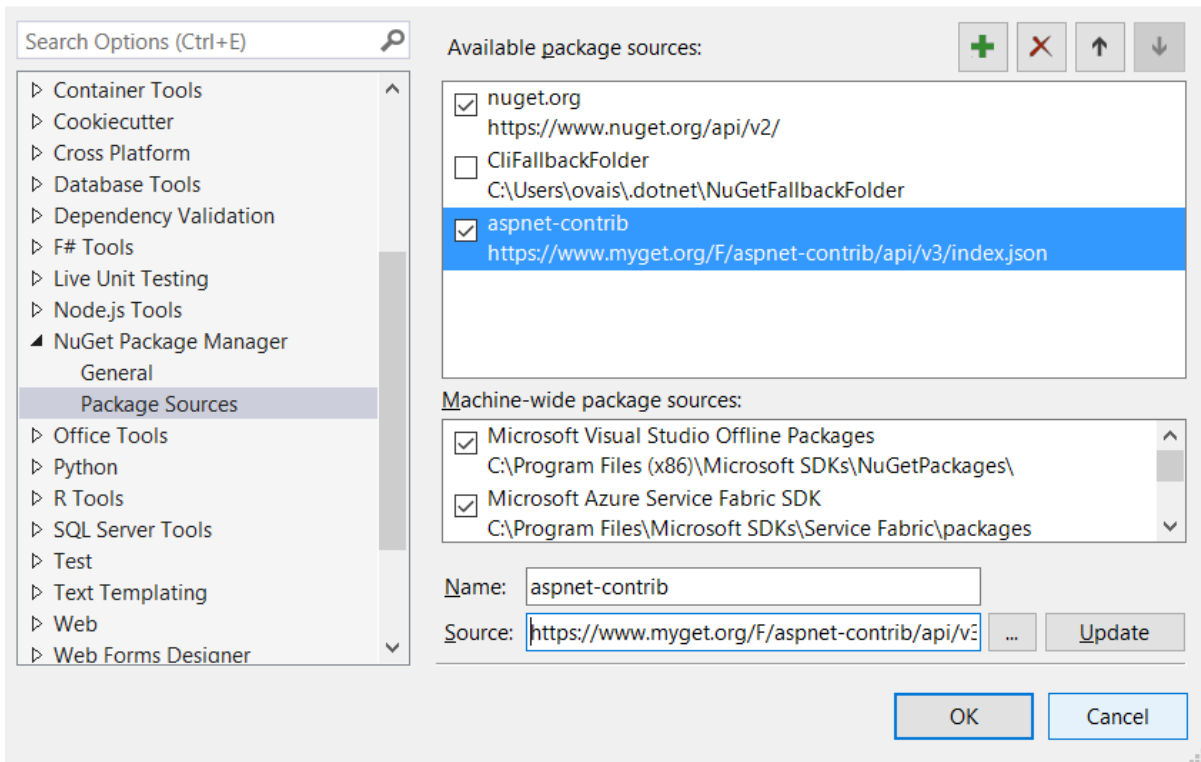


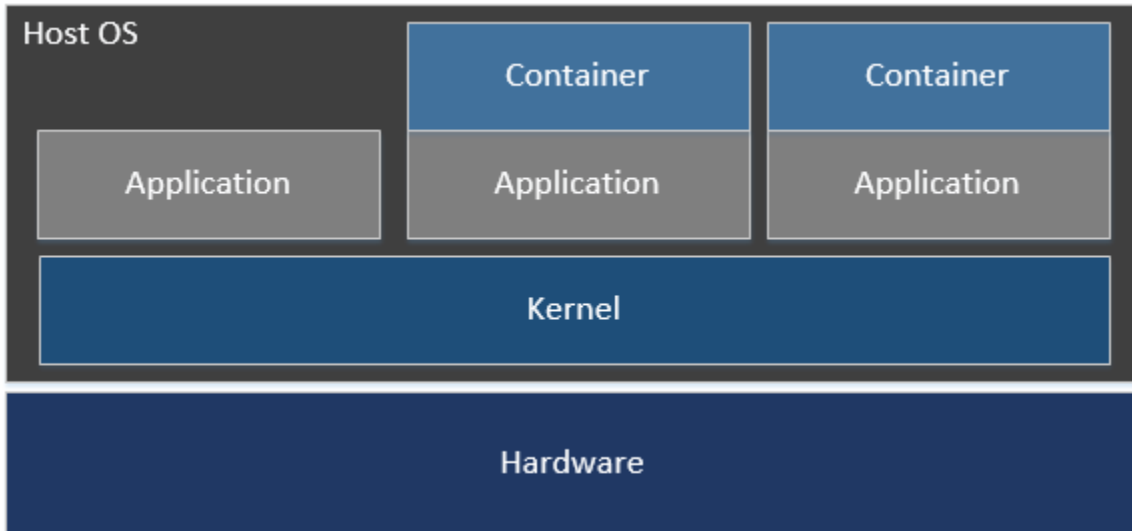
Include prerelease

Package source:

All







New ASP.NET Core Web Application - DockerNetCoreApp

.NET Core ASP.NET Core 2.0 [Learn more](#)

Empty
 Web API
 Web Application
 Web Application (Model-View-Controller)
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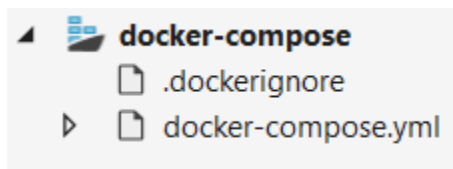
Enable Docker Support

OS: Windows

Requires [Docker for Windows](#)

Docker support can also be enabled later [Learn more](#)

OK Cancel



```
C:\Users\ovais>docker ps
CONTAINER ID        IMAGE               COMMAND                  CREATED        STATUS        PORTS
a12d3a37a644      vendor.api:dev     "C:\\remote_debugger\\..." 6 minutes ago  Up 5 minutes  0.0.0.0:40277
->80/tcp          dockercompose17175663515996174189_vendor.api_1
```

```
C:\Users\ovais>docker inspect -f "{{range .NetworkSettings.Networks}}{{.IPAddress}}{{end}}" a12d3a37a644
192.168.44.35
```