

# Leveraging AOP in SharePoint Custom Development



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Bitstream Foundry LLC



## My background

- Developing software since mid '90s

## My company

- Started in early 2013



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Lead Bitsmith and Owner  
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## My background

- Developing software since mid '90s
- Working with SharePoint since 2004
- Many roles: developer, administrator, product manager, evangelist, and more
- Community focus: free solutions, writing, speaking, and mentoring

## My company

- Started in early 2013
- Focus on SharePoint
- Deliver apps for SharePoint and the SharePoint ecosystem
- Doing custom development and infrastructure work on a daily basis





# Our Agenda for this Session

- Problems solved with AOP
- AOP terminology and concepts
- Tools that enable AOP in .NET
- Creating aspects
- Potential watch-outs with AOP
- Q&A throughout!





What  
sort of  
"problems?"



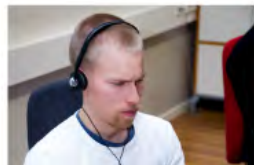
# Our Age

- Problems
- AOP termi
- Tools that
- Creating a



# Let's illustrate with an

example



You've been tasked with building a new enterprise-class, full-trust SharePoint



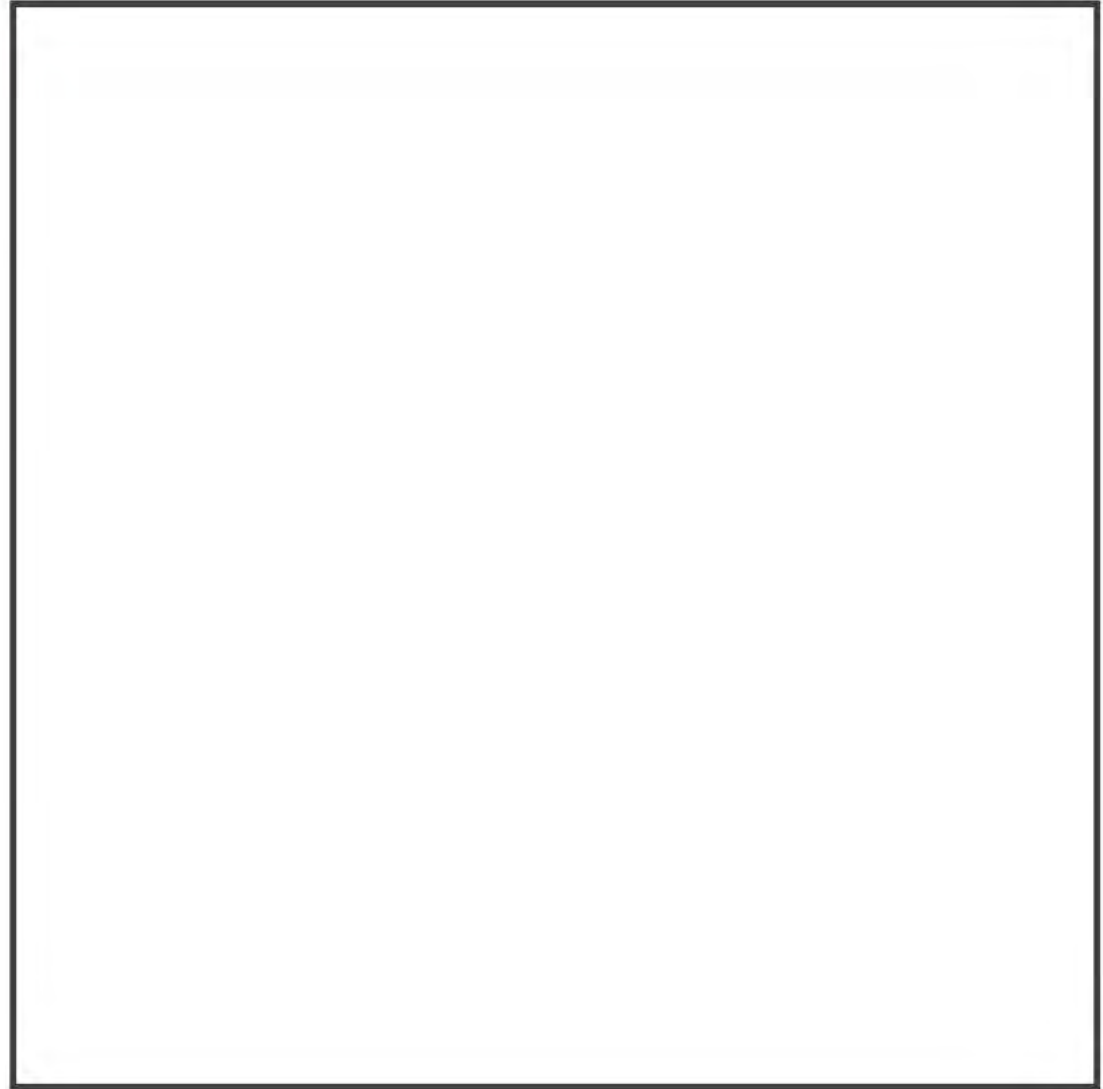
# Let's illustrate with an

example



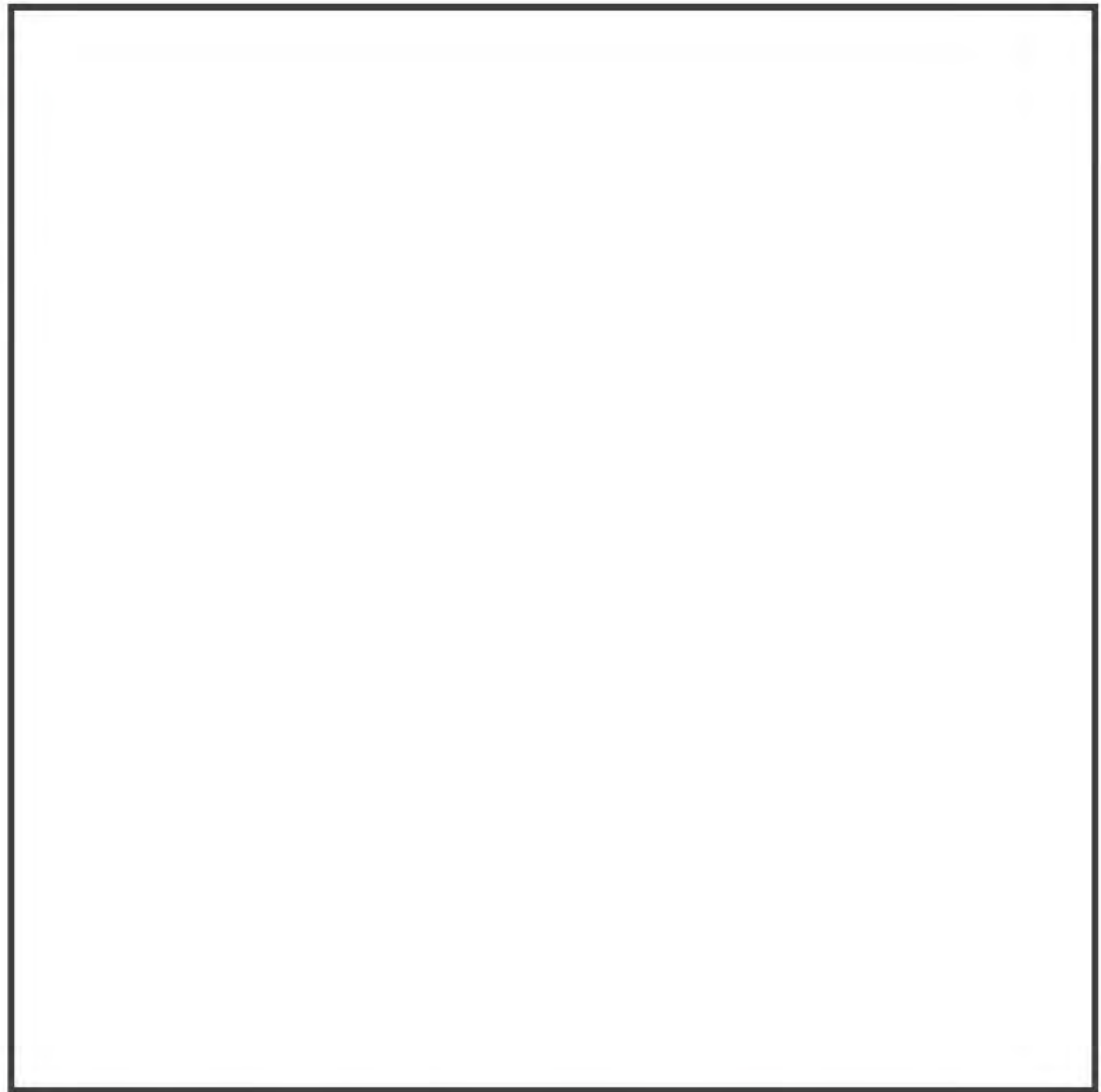
You've been tasked with building a new enterprise-class, full-trust SharePoint solution - complete with a wide-array of functional and non-functional requirements

This box  
represents your  
application



Beautiful, isn't it?

This box  
represents your  
application



Beautiful, isn't it?



## First up: functional requirements

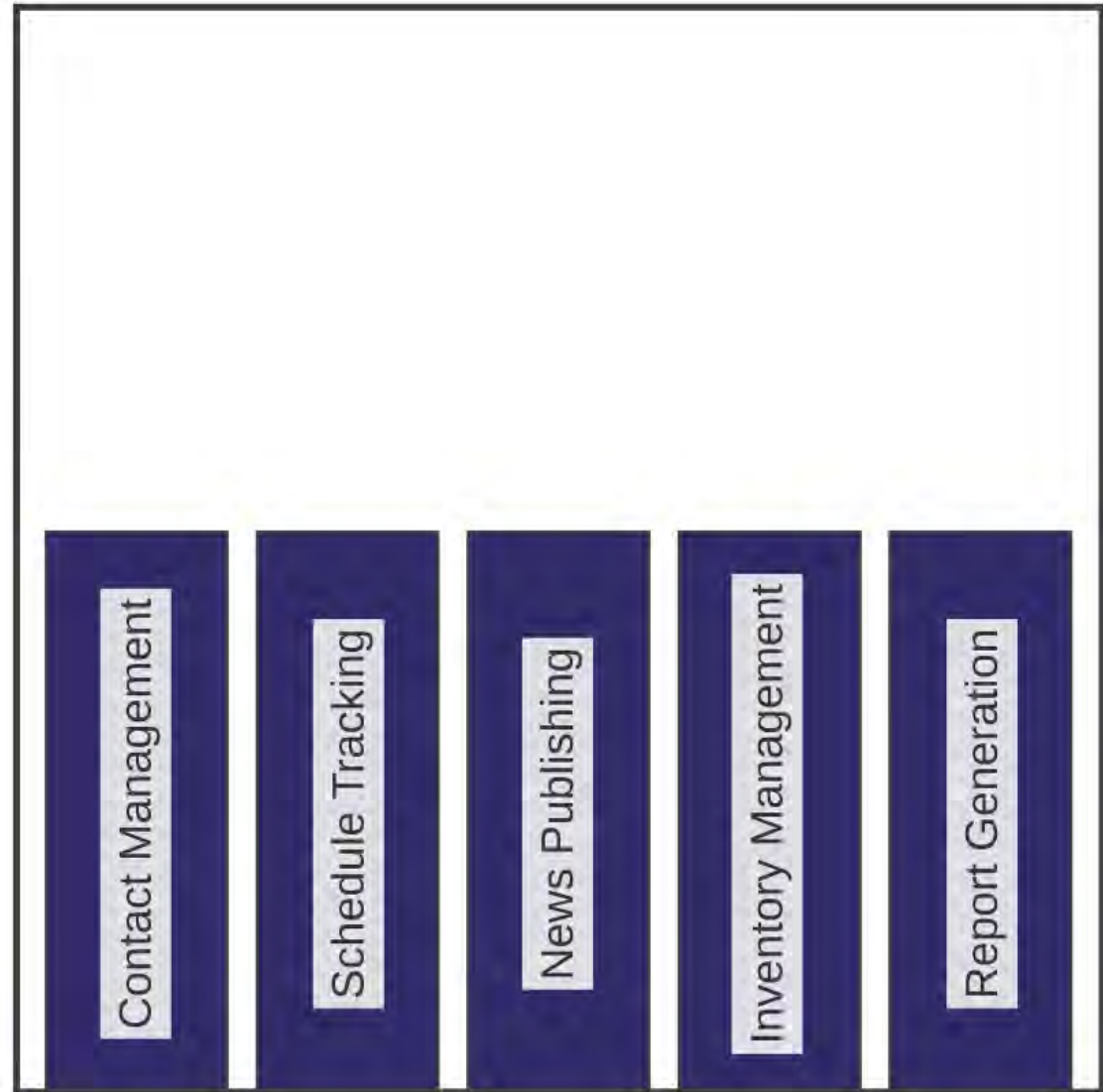
The app needs to do something business-related, so we typically start by adding code based on our solution requirements.



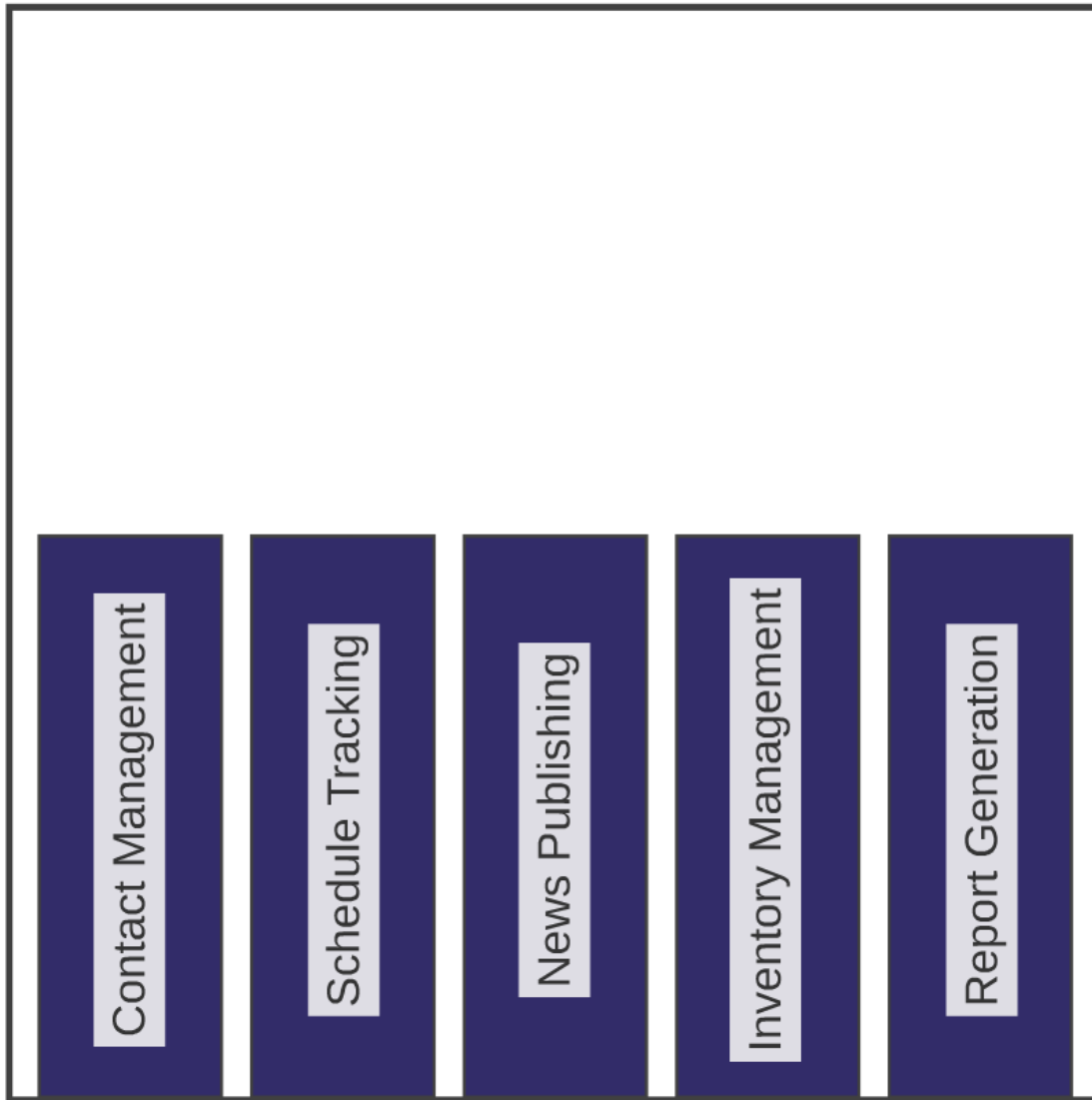
ful, isn't it?

## First up: functional requirements

The app needs to do something business-related, so we typically start by adding code based on our solution requirements.



This is the

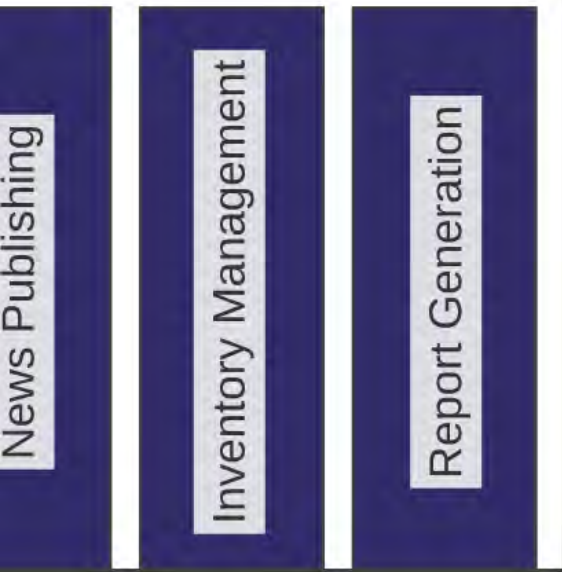


Chunks of code oriented around delivering desired functionality

- Vertical slices
- When end-users think of apps, this is where their focus usually is
- This code is generally "the fun stuff" to design and write

This is the part of our job





around delivering desired functionality

- Vertical slices
- When end-users think of apps, this is where their focus usually is
- This code is generally "the fun stuff" to design and write



This is the part of our job where we feel like rock stars ...

coding like



This code is generally  
"the fun stuff" to design  
and write



This is the part of our job where  
we feel like rock stars ...

... coding like  
crazy, showing  
users what we've  
done, havin' fun!



and then

... is generally  
"fun stuff" to design  
write



... part of our job where  
rock stars ...



Example #1

and then



we feel like rock stars ...

... coding like  
crazy, showing  
users what we've  
done, havin' fun!



... and then ...

---

Reality catches up to us.

Business functionality is only part of the puzzle. There's a less glorious side to all of this solution development stuff.



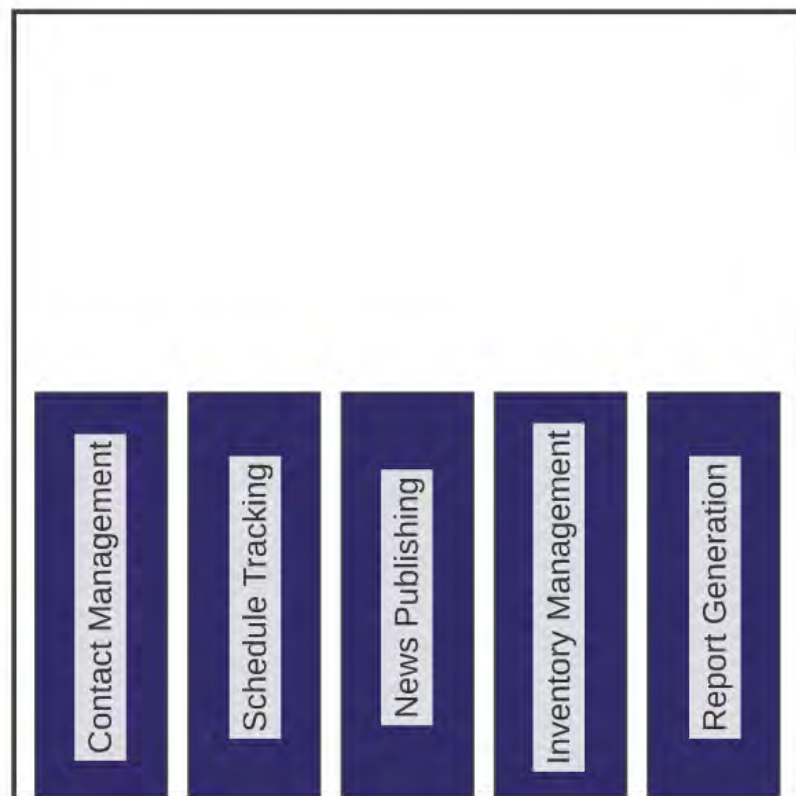
In reality. our

glorious side to all of this  
tion development stuff.



The other part: plumbing and  
non- functional requirements

In reality, our  
application doesn't  
look like this

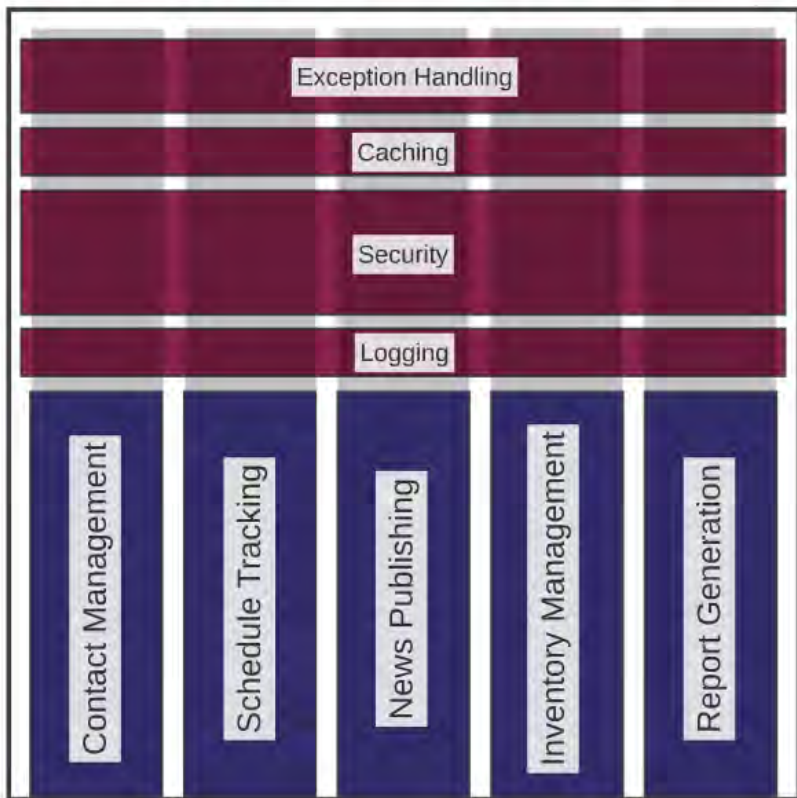






# Cross-cutting concerns

It looks like this



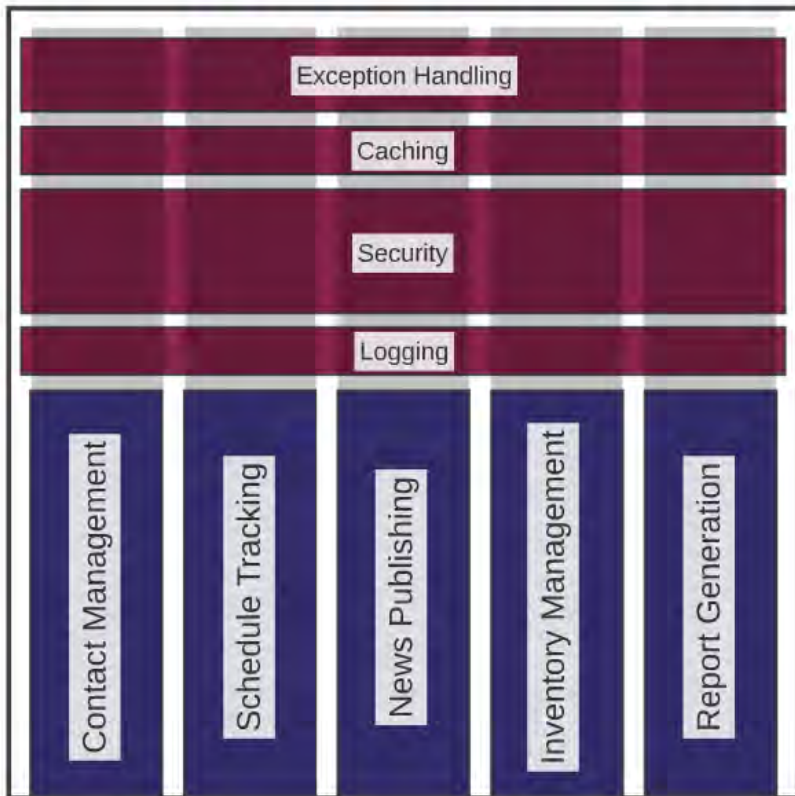
- Needs that "cut across" all of the solution's functional areas
- Plumbing code like security, exception handling, logging, caching, performance monitoring, and more
- Code tends to be highly repetitive in nature

Unfortunately, this tends to lead to a lot of cut-and-paste between classes in the average solution



# Cross-cutting concerns

It looks like this

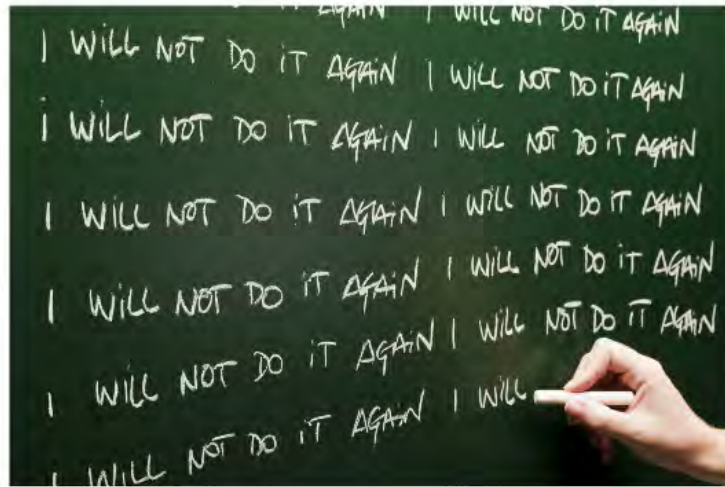


- Needs that "cut across" all of the solution's functional areas
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Unfortunately, this tends to lead to a lot of cut-and-paste between classes in the average solution

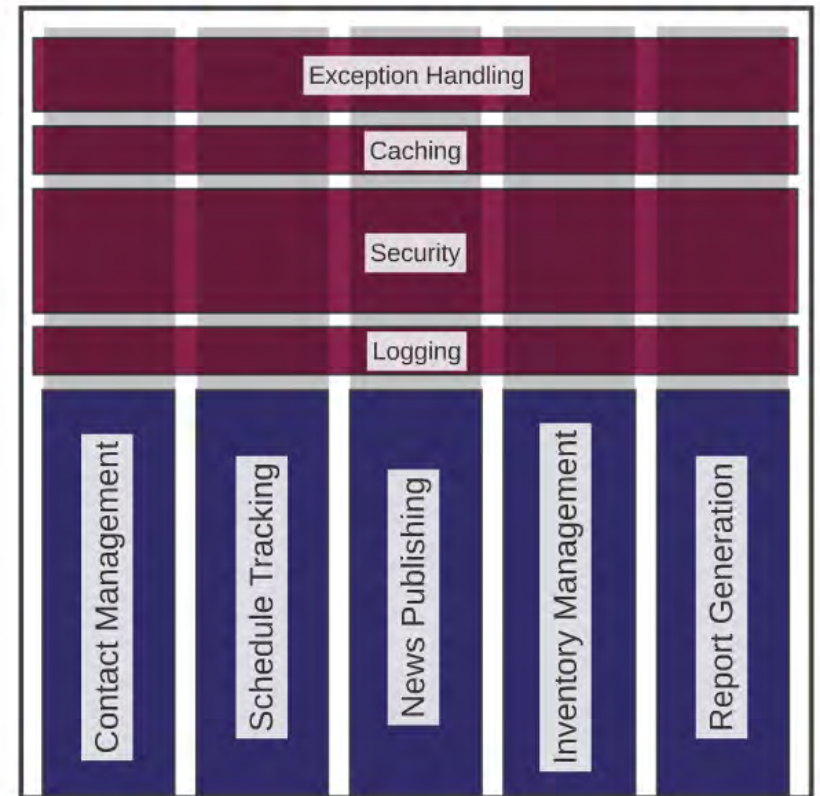






## Example #2

It looks like this



Unfortunately, this tends to  
and-paste between classes





## Going from this:

1 reference | spmcdonough, 14 hours ago | 3 changes

```
private String GenerateLine1()  
{  
    return "It is by caffeine alone that I set my mind in motion.\n";  
}
```

## ... to this:

1 reference | spmcdonough, 18 hours ago | 2 changes

```
private String GenerateLine1()
```

## Going from this:

1 reference | spmcdonough, 14 hours ago | 3 changes

```
private String GenerateLine1()
{
    return "It is by caffeine alone that I set my mind in motion.\n";
}
```

## ... to this:

1 reference | spmcdonough, 18 hours ago | 2 changes

```
private String GenerateLine1()
{
    LoggingSupport.WriteToLog("Entering Method GenerateLine1", 2);
    String whatToWrite = "It is by caffeine alone that I set my mind in motion.\n";
    LoggingSupport.WriteToLog("Exiting Method GenerateLine1", 2);
    return whatToWrite;
}
```

... is a substantial code change

# Going from this:

1 reference | spmcdonough, 14 hours ago | 3 changes

```
private String GenerateLine1()  
{  
    return "It is by caffeine alone that I set my mind in motion.\n";  
}
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    String whatToWrite = "It is by caffeine alone that I set my mind in motion.\n";  
    LoggingSupport.WriteToLog("Exiting Method GenerateLine1", 2);  
    return whatToWrite;  
}
```

... is a substantial code change



not cool



## Going from this:

1 reference | spmcDonough, 14 hours ago | 3 changes


```
private String GenerateLine1()  
{  
    return "It is by caffeine alone that I set my mind on fire";  
}
```

## ... to this:

1 reference | spmcDonough, 18 hours ago | 2 changes

```
private String GenerateLine1()  
{  
    LoggingSupport.WriteToLog("Entering Method GenerateLine1",  
        String whatToWrite = "It is by caffeine alone that I set my mind on fire");  
    LoggingSupport.WriteToLog("Exiting Method GenerateLine1",  
        return whatToWrite;  
}
```

... is a substantial code change



And it only gets worse with each additional concern we add ...

# Let's add in some exception handling

0 references | 0 authors | 0 changes

```
private String GenerateLine1()
{
    LoggingSupport.WriteToLog("Entering Method GenerateLine1", 2);
    String whatToWrite;

    try
    {
        whatToWrite = "It is by caffeine alone that I set my mind in motion.\n";
    }
    catch (Exception ex)
    {
        var newAppException = new Exception("Unexpected problem generating line 1", ex);
        LoggingSupport.WriteToLog(newAppException.ToString(), 3);
        throw newAppException;
    }

    LoggingSupport.WriteToLog("Exiting Method GenerateLine1", 2);
    return whatToWrite;
}
```





# exception handling, and caching brought us to this

And some memory-based caching



```
0 references | 0 authors | 0 changes
private String GenerateLine1()
{
    LoggingSupport.WriteToLog("Entering Method GenerateLine1", 2);
    const String lineCacheKey = "TESTAPP_GenerateLine1_KEY";
    String whatToWrite;

    try
    {
        var aspNetCache = HttpContext.Current.Cache;
        Object targetLineObject = aspNetCache[lineCacheKey];
        if (targetLineObject == null)
        {
            targetLineObject = "It is by caffeine alone that I set my mind in motion.\n";
            aspNetCache.Add(lineCacheKey, targetLineObject, null, Cache.NoAbsoluteExpiration,
                TimeSpan.FromMinutes(15), CacheItemPriority.Default, null);
        }
        whatToWrite = targetLineObject.ToString();
    }
    catch (Exception ex)
    {
        var newAppException = new Exception("Unexpected problem generating line 1", ex);
        LoggingSupport.WriteToLog(newAppException.ToString(), 3);
        LoggingSupport.WriteToLog("Exiting Method GenerateLine1 due to exception", 2);
        throw newAppException;
    }

    LoggingSupport.WriteToLog("Exiting Method GenerateLine1", 2);
    return whatToWrite;
}
```



We started with this:

1 reference | spmcdonough, 14 hours ago | 3 changes

```
private String GenerateLine1()
{
    return "It is by caffeine alone that I set my mind in motion.\n";
}
```

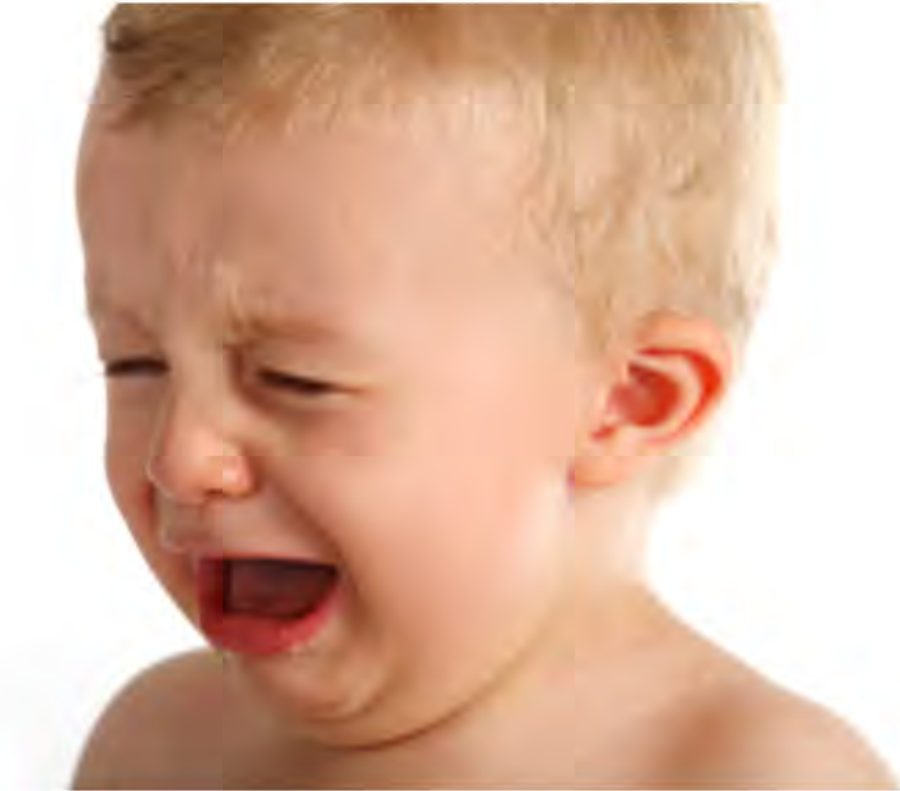
And adding logging, exception handling, and caching brought us to this

0 references | 0 authors | 0 changes

```
private String GenerateLine1()
{
    LoggingSupport.WriteToLog("Entering Method GenerateLine1", 2);
    const String lineCacheKey = "TESTAPP_GenerateLine1_KEY";
    String whatToWrite;

    try
    {
        var aspNetCache = HttpContext.Current.Cache;
        Object targetLineObject = aspNetCache[lineCacheKey];
        if (targetLineObject == null)
        {
            targetLineObject = "It is by caffeine alone that I set my mind in motion.\n";
            aspNetCache.Add(lineCacheKey, targetLineObject, null, Cache.NoAbsoluteExpiration,
                TimeSpan.FromMinutes(15), CacheItemPriority.Default, null);
        }
        whatToWrite = targetLineObject.ToString();
    }
    catch (Exception ex)
    {
        var newAppException = new Exception("Unexpected problem generating line 1", ex);
        LoggingSupport.WriteToLog(newAppException.ToString(), 3);
        LoggingSupport.WriteToLog("Exiting Method GenerateLine1 due to exception", 2);
        throw newAppException;
    }

    LoggingSupport.WriteToLog("Exiting Method GenerateLine1", 2);
    return whatToWrite;
}
```



24 lines

And the worst part



We started with this:

1 reference | spmcdonough, 14 hours ago | 3 changes

```
private String GenerateLine1()
{
    return "It is by caffeine alone that I set my mind in motion.\n";
}
```

1 line

And adding logging, exception handling, and caching brought us to this

```
0 references | 0 authors | 0 changes
private String GenerateLine1()
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    LoggingSupport.WriteToLog("Entering Method GenerateLine1", 2);
    const String lineCacheKey = "TESTAPP_GenerateLine1_KEY";
    String whatToWrite;
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        }
        whatToWrite = targetLineObject.ToString();
    }
    catch (Exception ex)
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        LoggingSupport.WriteToLog(newAppException.ToString(), 3);
        LoggingSupport.WriteToLog("Exiting Method GenerateLine1 due to exception", 2);
        throw newAppException;
    }
    LoggingSupport.WriteToLog("Exiting Method GenerateLine1", 2);
    return whatToWrite;
}
```



24 lines

And the worst part of this ...

We end up doing it for nearly all







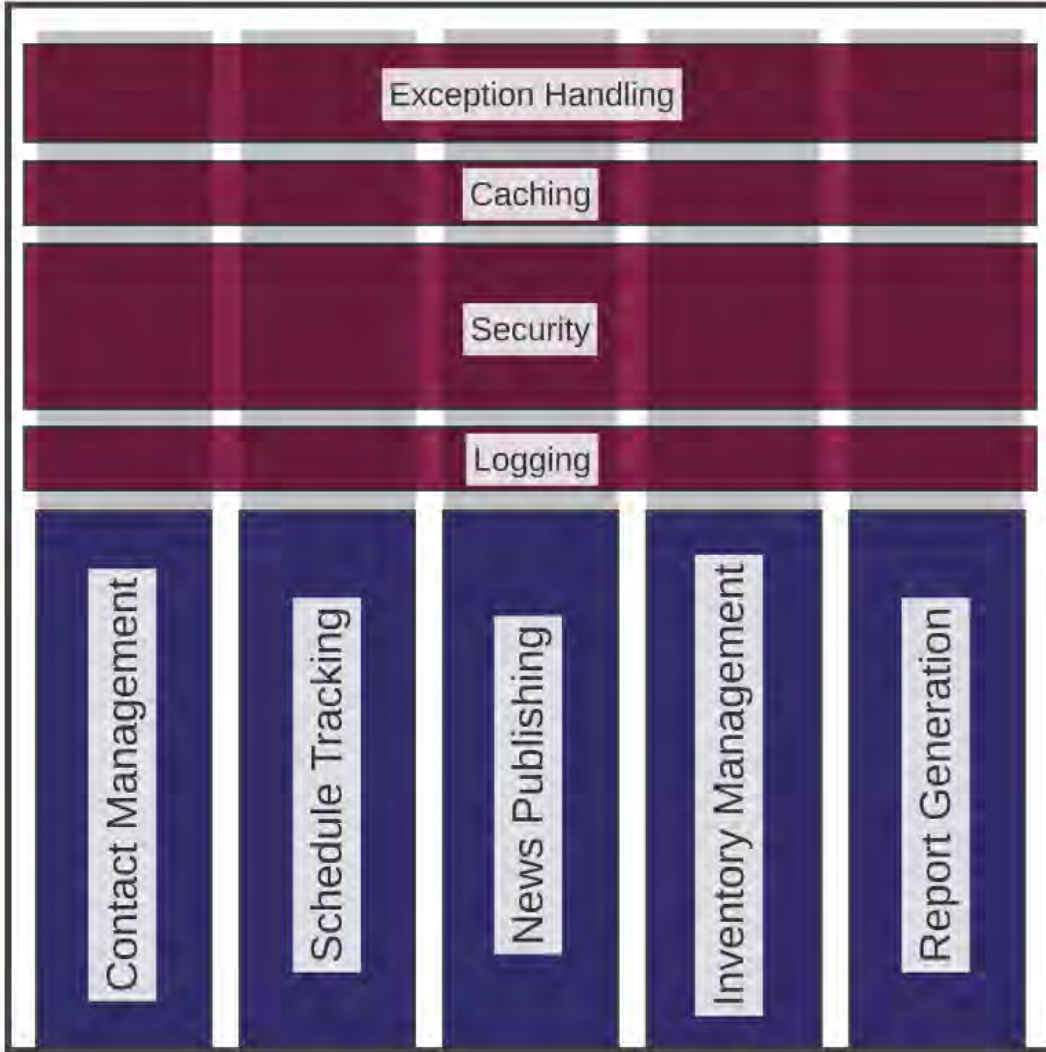
And the worst part of this ...

We end up doing it  
for nearly all  
methods and  
properties



There has to be a better way



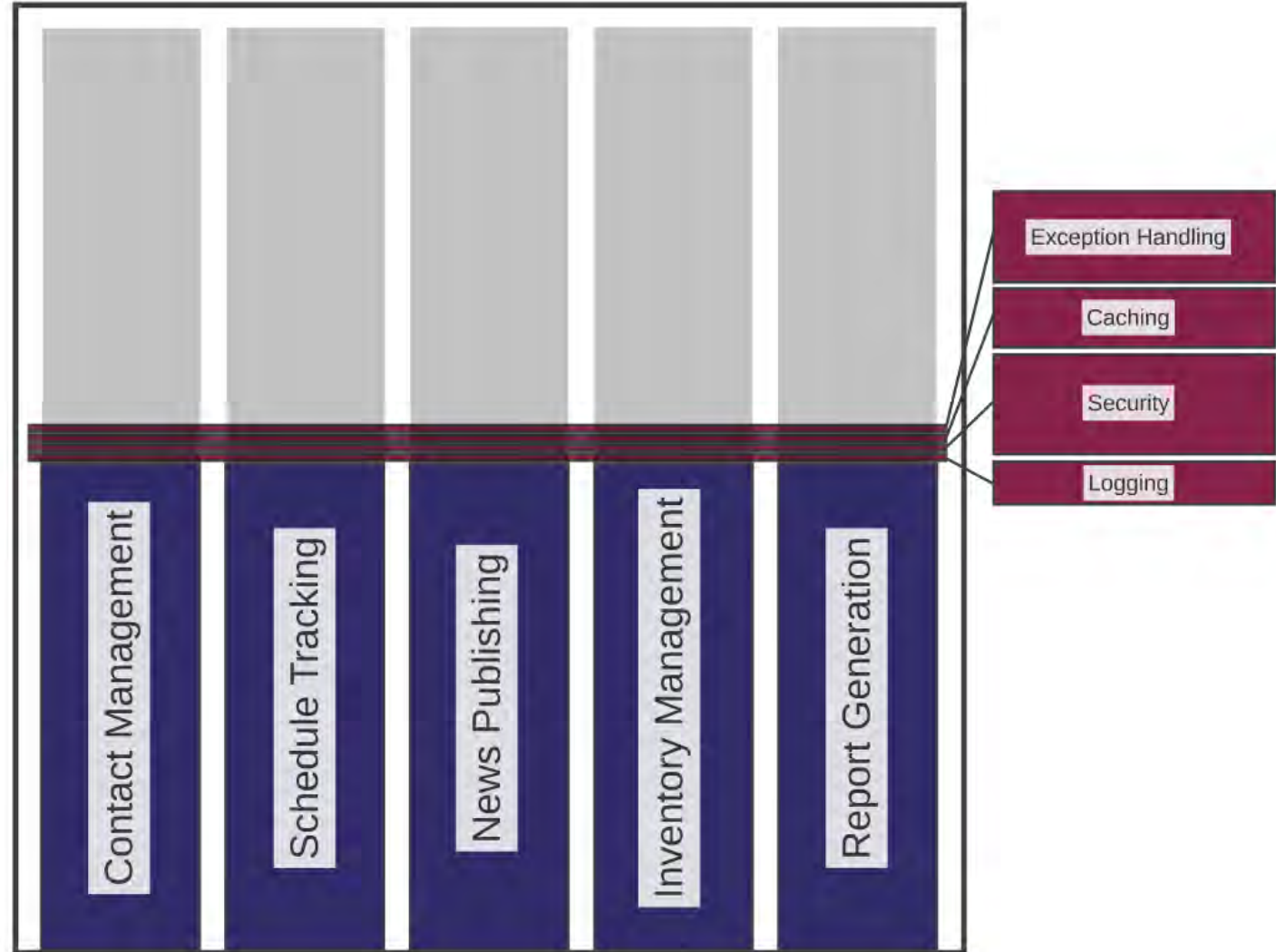


Instead of this



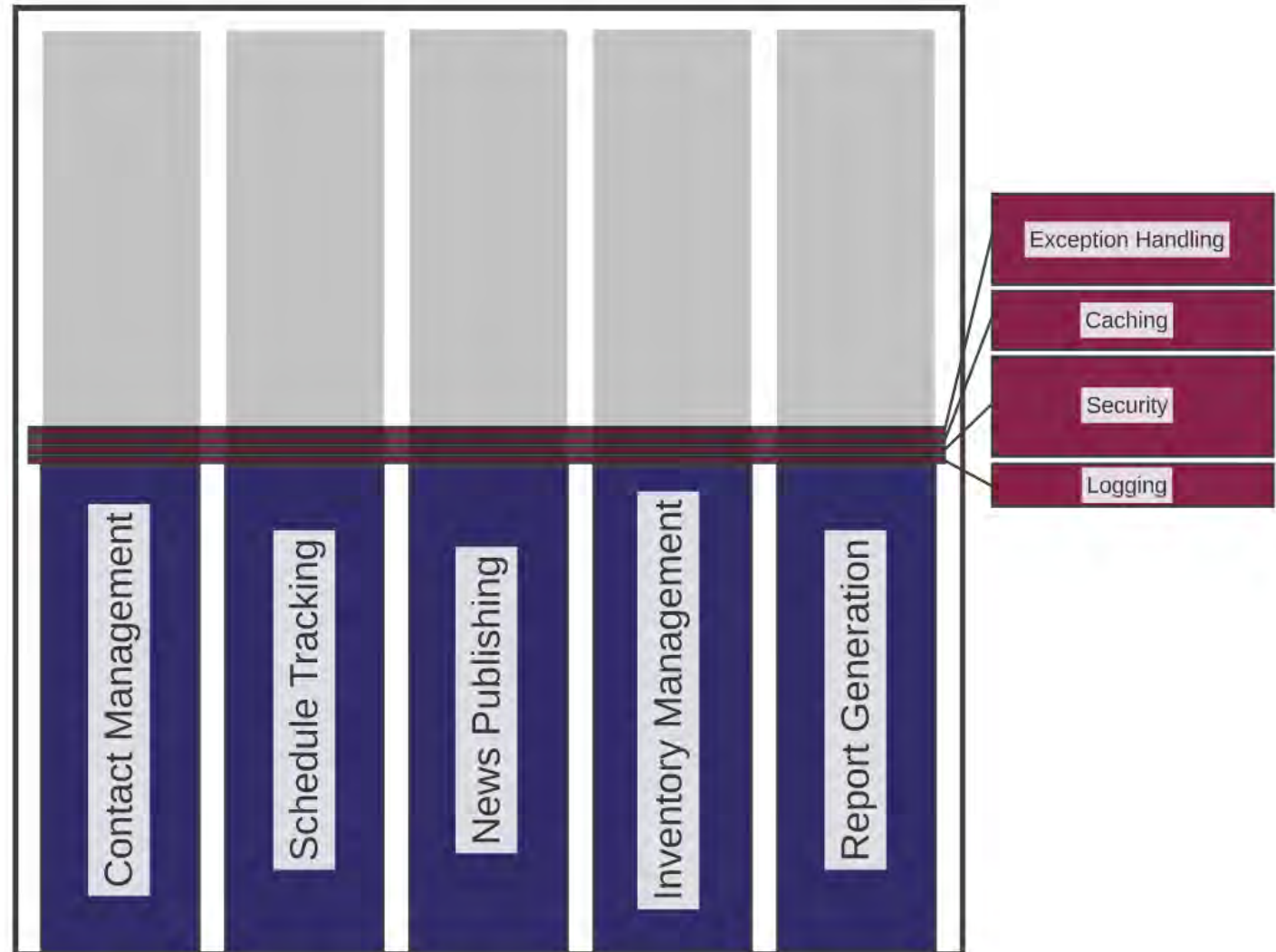
# This is exactly what AOP offers

we need  
this

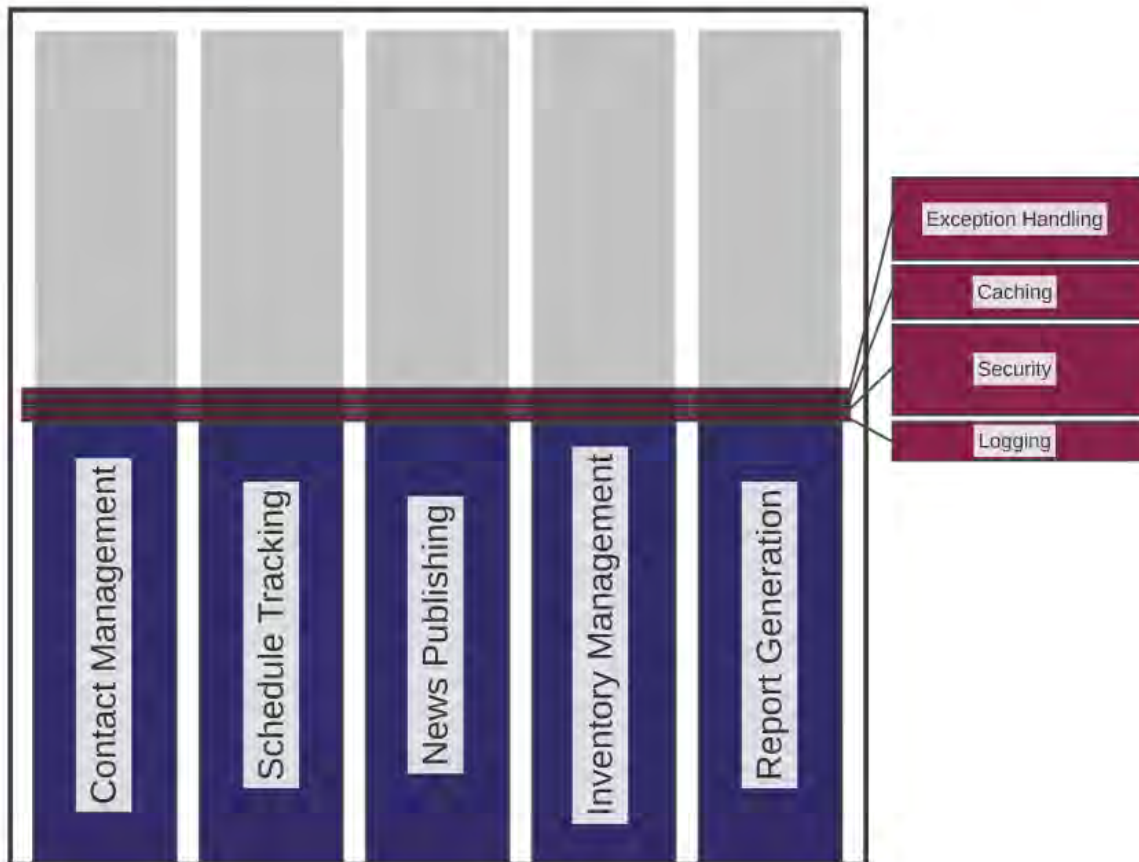


# This is exactly what AOP offers

we need this



# Exactly what AOP offers



- Cross-cutting concerns are encapsulated within aspects
- Functional code remains clear of redundant plumbing code
- Reduces clutter and overall line counts
- Simplifies maintenance



- Cross-cutting concerns are encapsulated within aspects
- Functional code remains clear of redundant plumbing code
- Reduces clutter and overall line counts
- Simplifies maintenance



## Example #3

- Simplifies maintenance

# FREQUENTLY ASKED QUESTION

Seems neat, but if AOP is so useful, how come I haven't seen it "in the wild" by now?





# Aspects come in many forms

And if you haven't been looking




And if you haven't been looking,  
you may have missed them






HTTP Modules and ASP.NET MVC Action

# Have you ever used an HTTP Module?

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    - [Walkthrough: Creating an Asynchronous HTTP Handler](#)
    - [Walkthrough: Creating and Registering HTTP Handler Factories](#)
    - [Walkthrough: Creating and Registering a Custom HTTP Module](#)**

## Walkthrough: Creating and Registering a Custom HTTP Module

[.NET Framework 4](#) | [Other Versions](#) | 15 out of 24 rated this helpful - [Rate this topic](#)

This walkthrough illustrates the basic functionality of a custom HTTP module. An HTTP module is called on every request in response to the `BeginRequest` and `EndRequest` events. As a result, the module runs before and after a request is processed.

If the ASP.NET application is running under IIS 6.0, you can use HTTP modules to customize requests for resources that are serviced by ASP.NET. This includes ASP.NET Web pages (.aspx files), Web services (.asmx files), ASP.NET handlers (.ashx files), and any file types that you have mapped to ASP.NET. If the ASP.NET application is running under IIS 7.0, you can use HTTP modules to customize requests for any resources that are served by IIS. This includes not just ASP.NET resources, but HTML files (.htm or .html files), graphics files, and so on. For more information, see [ASP.NET Application Life Cycle Overview for IIS 5.0 and 6.0](#) and [ASP.NET Application Life Cycle Overview for IIS 7.0](#).

The example module in this topic adds a message to the requested ASP.NET Web page at the beginning of any HTTP request. It adds another message after the page has been processed. The module includes code that makes sure that it does not add text to a request for any other file type.

Each event handler is written as a private method of the module. When the registered events are raised, ASP.NET calls the appropriate handler in the module, which writes information to the ASP.NET Web page.



# How about an ASP.NET MVC Action Filter?

The screenshot shows the ASP.NET MVC 4 Custom Action Filters tutorial page. The page features a navigation menu with 'Learn' selected, and a sub-menu for 'MVC' with 'Tutorials' highlighted. The main content area contains the article title, author information, a 'Print' button, and a light blue callout box with introductory text and a note. A sidebar on the left lists related topics, and the bottom of the page shows the start of the 'Objectives' section.

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## ASP.NET MVC 4 Custom Action Filters

By [Web Camps Team](#) | February 18, 2013 Print

ASP.NET MVC provides Action Filters for executing filtering logic either before or after an action method is called. Action Filters are custom attributes that provide declarative means to add pre-action and post-action behavior to the controller's action methods.

In this Hands-on Lab you will create a custom action filter attribute into MvcMusicStore solution to catch controller's requests and log the activity of a site into a database table. You will be able to add your logging filter by injection to any controller or action. Finally, you will see the log view that shows the list of visitors.

**Note:** This Hands-on Lab assumes you have basic knowledge of **ASP.NET MVC**. If you have not used **ASP.NET MVC** before, we recommend you to go over **ASP.NET MVC 4 Fundamentals** Hands-on Lab.

### Objectives

In this Hands-On Lab, you will learn how to:

Waiting for www.microsofttranslator.com...



you may have missed them



HTTP Modules and ASP.NET MVC Action Filters are just two examples of AOP at work

There are other tools, but this  
the best implemented and supported

# My AOP Tool of Choice:

PostSharp Ultimate



There are other tools, but this is (in my opinion)  
the best implemented and supported

PostSharp Ultimate

- Free version available
- Cleanest separation of concerns (no spaghetti code)
- Employs compile-time weaving

Um ...





spagnetti code)

- Employs compile-time weaving



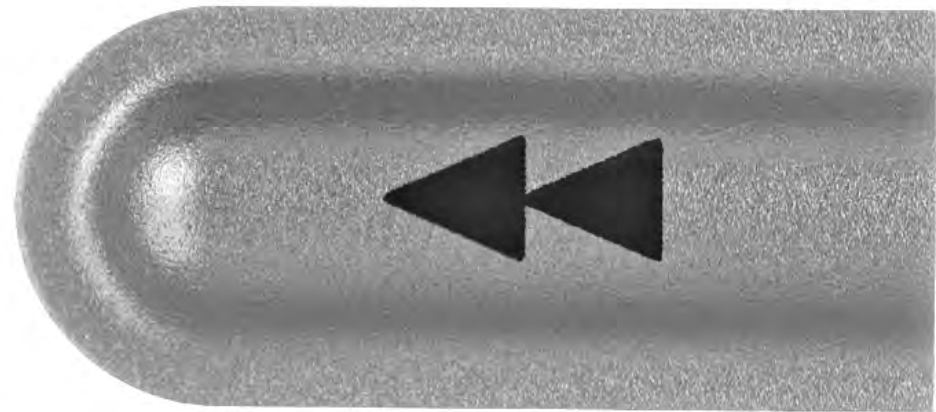
Um ...

compile-time what?



Okay, let's pause  
for a second

And rewind  
to cover  
some basics





# A code snippet from the LoggingToTextboxAspect

```
/// <summary>
/// This method boundary aspect (created with PostSharp) is responsible
/// for handling logging activities for each of the methods with which
/// it is associated.
/// </summary>
[Serializable]
1 reference | spmcidonough, 3 days ago | 1 change
internal class LoggingToTextboxAspect : OnMethodBoundaryAspect
{
    #region Overrides: OnMethodBoundaryAspect

    /// <summary>
    /// The OnEntry method fires on the join point that occurs just before
    /// a method is entered and its first lines of code are executed.
    /// </summary>
    0 references | spmcidonough, 3 days ago | 1 change
    public override void OnEntry(MethodExecutionArgs args)
    {
        | CreateLogEntry(args, "Entering Method");
    }

    /// <summary>
    /// The OnExit method fires on the join point that occurs just after
    /// a method is exited and its execution is complete.
    /// </summary>
    0 references | spmcidonough, 3 days ago | 1 change
    public override void OnExit(MethodExecutionArgs args)
    {
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    }

    #endregion Overrides: OnMethodBoundaryAspect
}
```



Let's establish some

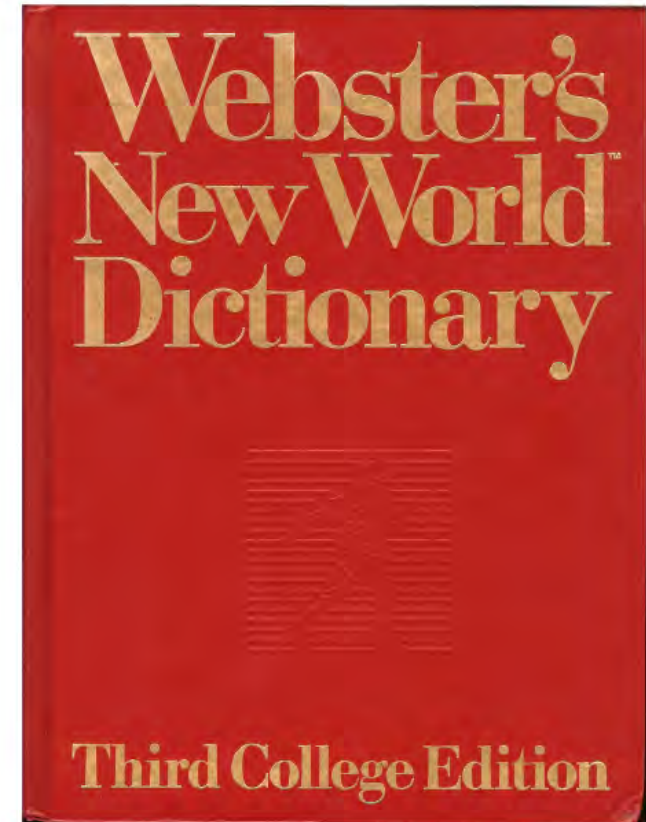
# Get from the LoggingToTextboxAspect

```
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    public override void OnExit(MethodExecutionArgs args)
    {
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    }

    #endregion Overrides: OnMethodBoundaryAspect
}
```



Let's establish some definitions

# A code snippet from the LoggingToTe

The aspect  
code itself  
is called ..



```
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    public override void OnExit(MethodExecutionArgs args)
    {
        CreateLogEntry(args, "Exiting Method");
    }

    #endregion Overrides: OnMethodBoundaryAspect
}
```

Let's establish

/// <summary>



# The arrows represent

1 reference | sprmcDonough, 14 hours ago | 3 changes

```
private String GenerateLine1()
{
    return "It is by caffeine alone that I set my mind in motion.\n";
}
```

```
/// <summary>
/// This method boundary aspect (created with PostSharp) is responsible
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}
```

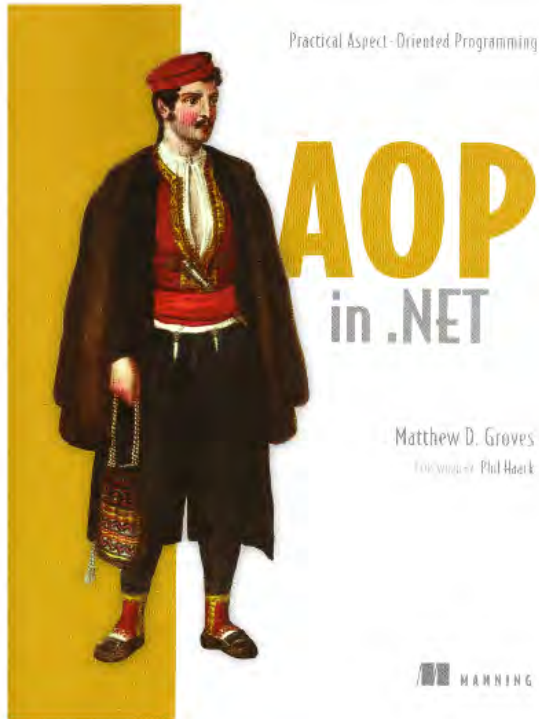
# Join Points



*"A join point is a place that can be defined between logical steps"*

**AOP targets**

# Join Points

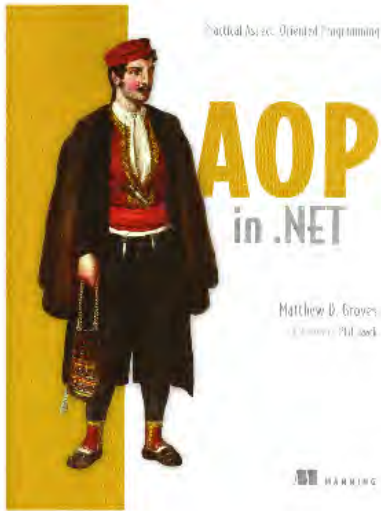


*"A join point is a place that can be defined between logical steps of the execution of your program."*

**- Matthew D. Groves**

# Join Points

```
/// </summary>  
0 references | spmcdonough, 3 days ago |  
public override void OnExit  
{  
    CreateLogEntry(args, "  
}  
  
#endregion Overrides: OnMe
```



*"A join point is a place that can be defined between logical steps of the execution of your program."*

- Matthew D. Groves

AOP  
targets  
these



A set of join points is known as a **pointcut**



roves



pointcut

brings us to

weaving

The process by which  
aspects (advice) are

us to

# weaving

The process by which aspects (advice) are applied to pointcuts for use by and with your code

Compile-Time



Run-Time



Compile-Time

Weaving  
Options

ols

est

mpile  
ct IL  
nde





# Run-Time

- Typically relies on reflection
- Doesn't require special tools
- Easier to (unit) test
- Acts similarly to a proxy or decorator

**Example: Castle DynamicProxy**



# Compile-Time

- Requires tools
- Hard to (unit) test
- Involves a post-compile step to weave aspect IL with main solution code
- Allows for optimizations

**Example:**  
**PostSharp**





# We've covered key AOP concepts:

- Advice
- Join Points
- Pointcuts
- Weaving



these apply to aspects



# Aspects



We've covered

- Advice
- Join Points
- Pointcuts
- Weaving

And we've talked about how these apply to aspects

Let's look at some of the common  
aspect types and how they work

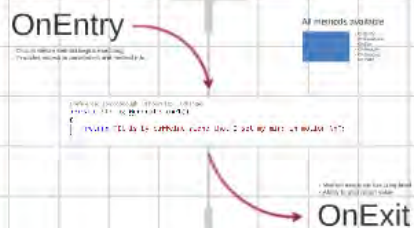


# Aspects

# Aspect Types We're Going To Examine

## How It Works Potential Uses Considerations

### Method Boundary



Well-suited to repetitive tasks

- (ULS) Logging
- Tracing
- Performance profiling
- Exception handling\*



Aspect methods are statically scoped

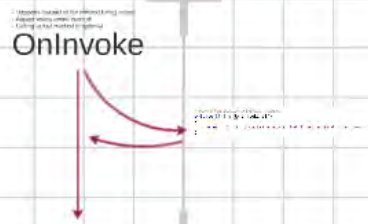
- Only one instance of each method services all requests from implementing types
- Sidestep this with either the `MethodExecutionTag` or by implementing `IInstanceScopeAspect`

IL can be optimized by PostSharp\*

- Arguments selectively copied boxed/unboxed

Multiple methods = great flexibility

### Method Interception



Perfect for tasks that involve selective execution

- Caching
- Retry support
- Threading



Shared state benefits

- All activity happens in `OnInvoke`, so state is easy to track outside of intercepted method
- No need for `MethodExecutionTags` and what-not

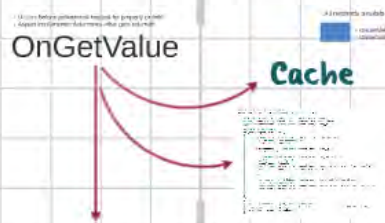
Somewhat reduced clarity

- Downside of everything in one method

IL cannot be optimized

- All arguments are boxed/unboxed per invocation

### Location Interception



Similar to method interception, but more granular

- Validation
- Filtering
- Change tracking & notification
- Lazy loading & initialization

Same basic set of considerations as method interception aspects

- Again, similar in operation - just narrower scope

Works for properties and fields

- Including auto-properties



Method

Boundary

Method

# OnEntry

- Occurs before method begins executing
- Provides access to parameters and method info

All methods available



- OnEntry
- OnException
- OnExit
- OnResume
- OnSuccess
- OnYield

1 reference | spmcndonough, 14 hours ago | 3 changes

```
private String GenerateLine1()  
{  
    return "It is by caffeine alone that I set my mind in motion.\n";  
}
```

- Method execution has completed
- Ability to alter return value

# OnExit

- Happens instead of the method being called
- Aspect wraps entire method
- Calling actual method is optional

# OnEntry



- Occurs before method begins executing
- Provides access to parameters and method info



- Method execution has completed
- Ability to alter return value



# OnExit

# All methods available



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## Aspect methods are statically scoped

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## Multiple methods = great flexibility

## Shared state benefits



# Example #4

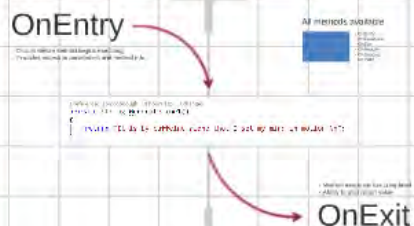




# Aspect Types We're Going To Examine

## How It Works Potential Uses Considerations

Method  
Boundary  
Method  
Interception  
Location  
Interception



Well-suited to repetitive tasks

- (ULS) Logging
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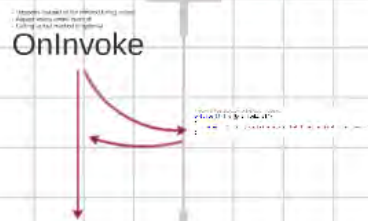
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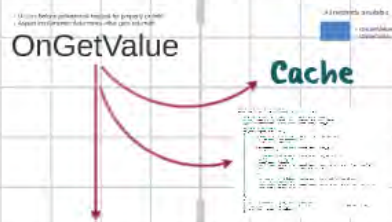
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Boundary

Method

Interception

Location

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# OnInvoke

1 reference | spmcodonough, 14 hours ago | 3 changes

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- Occurs before get/retrieval request for property or field
- Aspect implementer determines what gets returned



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# OnInvoke



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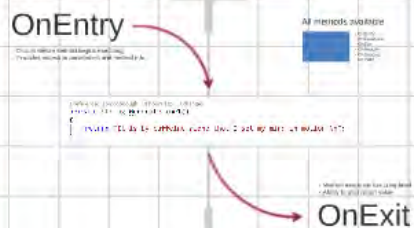




# Aspect Types We're Going To Examine

## How It Works Potential Uses Considerations

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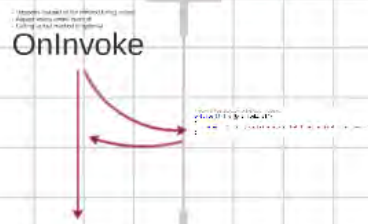
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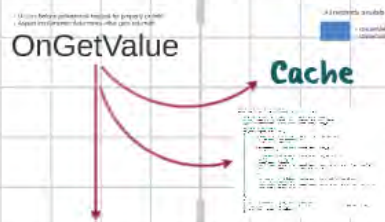
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Interception

Location

Interception

- Occurs before get/retrieval request for property or field
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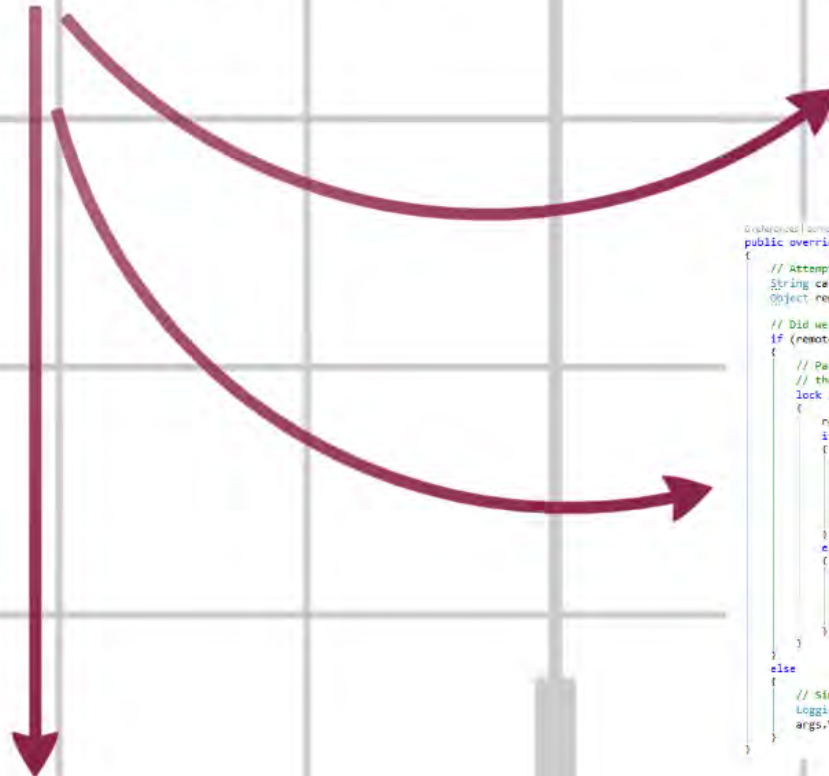
# OnGetValue

All methods available



- OnGetValue
- OnSetValue

## Cache



```
public override void OnGetValue(LocationInterceptionArgs args)
{
    // Attempt to fetch the desired property from the ASP.NET Cache.
    String cacheKey = String.Format(CACHE_KEY_TEMPLATE, args.LocationName);
    Object remotePropertyValue = HttpContext.Current.Cache[cacheKey];

    // Did we get anything back?
    if (remotePropertyValue == null)
    {
        // Pause here by locking to ensure that only one caller actually makes
        // the call to retrieve the property value.
        lock (_remotePropertyLockObject)
        {
            remotePropertyValue = HttpContext.Current.Cache[cacheKey];
            if (remotePropertyValue == null)
            {
                // The property value isn't available in the Cache, so we need to
                // fetch it, store it, and pass it back.
                args.ProceedGetValue();
                LoggingSupport.WriteToLog(args.LocationName + " property value fetched from source.");
                HttpContext.Current.Cache.Insert(cacheKey, args.Value);
            }
            else
            {
                // Property wasn't initially in cache, but another thread (in ahead of the
                // current one) populated it.
                LoggingSupport.WriteToLog(args.LocationName + " property value fetched from ASP.NET Cache.");
                args.Value = remotePropertyValue;
            }
        }
    }
    else
    {
        // Simply assign the property value from the Cache.
        LoggingSupport.WriteToLog(args.LocationName + " property value fetched from ASP.NET Cache.");
        args.Value = remotePropertyValue;
    }
}
```

- Occurs before get/retrieval request for property or field
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# OnGetValue





# All methods available



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- OnSetValue

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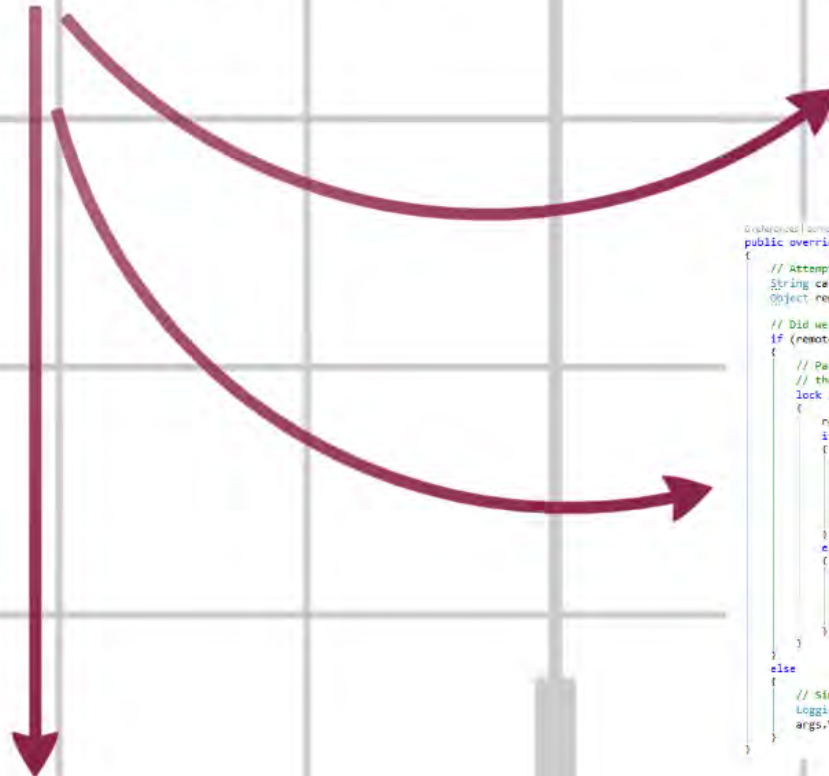
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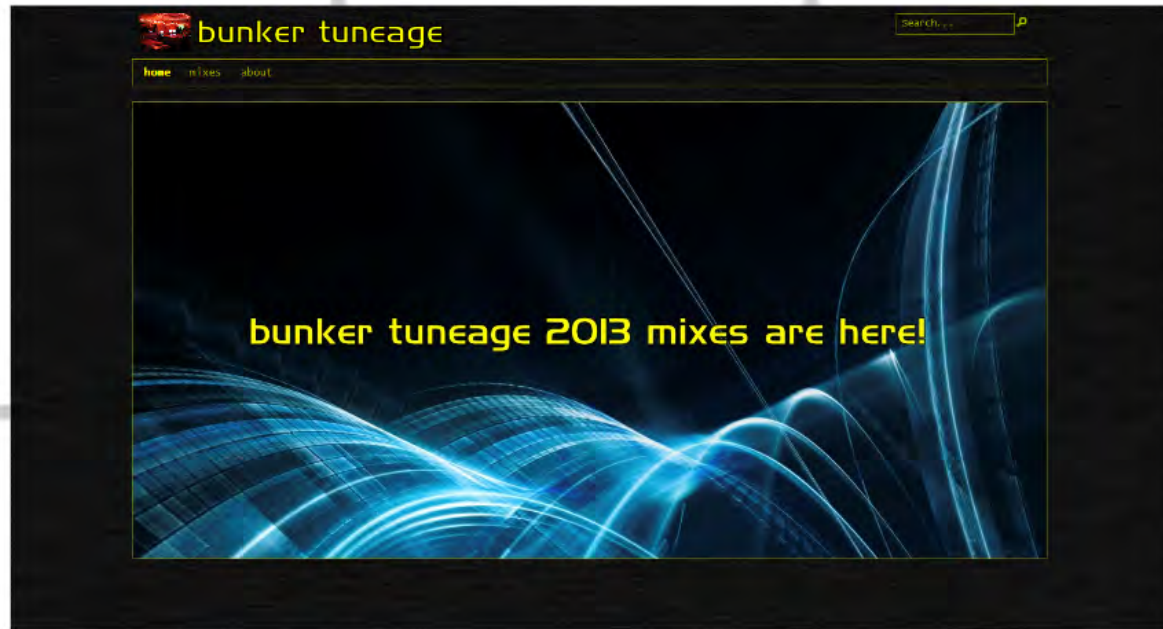
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# Example #6

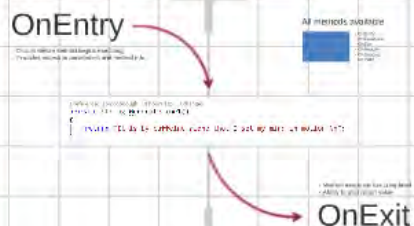




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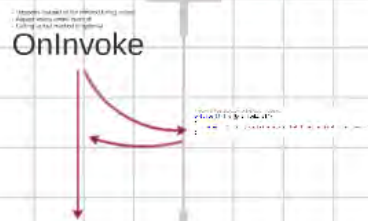
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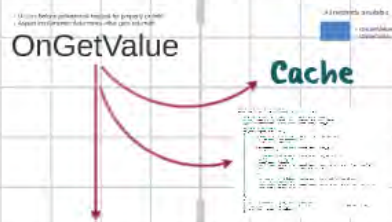
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## Walkthrough: Creating and Registering a Custom HTTP Module

[http://msdn.microsoft.com/en-us/library/ms227673\(v=vs.110\).aspx](http://msdn.microsoft.com/en-us/library/ms227673(v=vs.110).aspx)

## ASP.NET MVC 4 Custom Action Filters

<http://www.asp.net/mvc/tutorials/hands-on-labs/aspnet-mvc-4-custom-action-filters>

## PostSharp in the Visual Studio Gallery

<http://visualstudiogallery.msdn.microsoft.com/a058d5d3-e654-43f8-a308-c3bdfdd0be4a>

## PostSharp

<http://www.postsharp.net>

## AOP in .NET

<http://tinyurl.com/AOPinDotNet>

## Castle DynamicProxy

<http://www.castleproject.org/projects/dynamicproxy/>

# References





# Sean P. McDonough

SharePoint Gearhead,  
Developer, and Problem-Solver

**My Company:**



**Twitter:**

@spmcdonough

**Blog:**

<http://SharePointInterface.com>

**About:**

<http://about.me/spmcdonough>