Building Large, Yet Maintainable, ASP.NET Core Apps

Scott Sauber

scottsauber

Slides up at scottsauber.com

Audience

- Existing ASP.NET/ASP.NET Core Developers
- Building “Large” applications
  - Large to me, means a combination of these:
    - Many Controllers and/or Views
    - Lots of business logic
    - High business impact
    - Frequent Change
  - Large != High Traffic
- You may be:
  - Server-rendered HTML via MVC or Razor Pages
  - API’s only via MVC
  - Building backend logic

Audience Goals

- “New” perspective on a few topics
- You’re not going to agree on everything
- Take away some ideas to evaluate in your future workflow tomorrow

Who am I?

- Software Consultant at Lean TECHniques
- .NET Foundation Action Groups
- IADNUG co-organizer
- Blog (primarily ASP.NET Core) at scottsauber.com

- Background in Mortgage, Health Insurance, Ag Industry
  - Users from 1 – 250K
- Highly Regulated
  - Lots of validation
  - Lots of changes

Agenda

- Lightning Talk approach
- Talk about best practices for all these *in a large app*
  - Folder Structure
  - UI Components
  - Code Flow
  - Validation
  - ORM’s
  - Dependency Injection
  - Unit Testing and Assertions
  - DevOps
  - Feature Toggles
  - Microservices

Overall theme

- Improve Maintainability
  - Better practices
  - Consistency
  - Enjoyable to work with
- Create systems that allow developers to make changes as easy, quick, and bug-free as possible, while allowing that trend to continue into the future.

- “Legacy software is software you have no confidence in.”

Assumptions

- I’m assuming you have a traditional LOB app without crazy volume
- The answer is always “It Depends” but I’m going to throw that out the window and give some real guidance.

Guillermo Rauch
@rauchg

Follow

Every system tends towards complexity, slowness and difficulty
Staying simple, fast and easy-to-use is a battle that must be fought everyday

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5:39 PM - 26 Dec 2016 from San Diego, CA

16 613 1.0K

Michael Feathers
@mfeathers

Follow

Make something simple and add complexity reluctantly.

9:08 PM - 6 Jul 2017

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3 86 137

Folder Structure

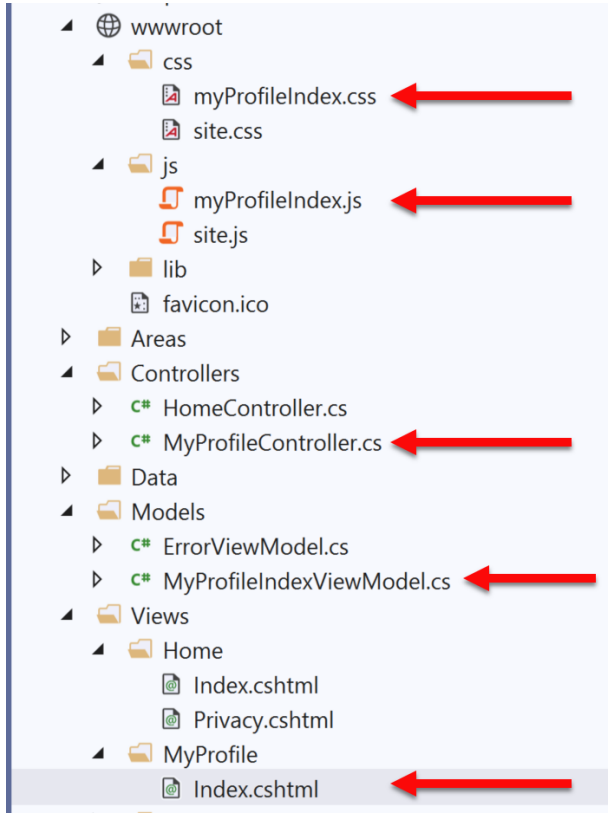
Problem: OOB MVC Folders By Responsibility

- All of these live in their own separate folders and most are required to add a new feature
  - Controllers
  - Views
  - Models
  - wwwroot/css
  - wwwroot/js
- Adds navigation friction
- Scope of a feature is scattered
- Makes it hard to add, delete or extend existing features

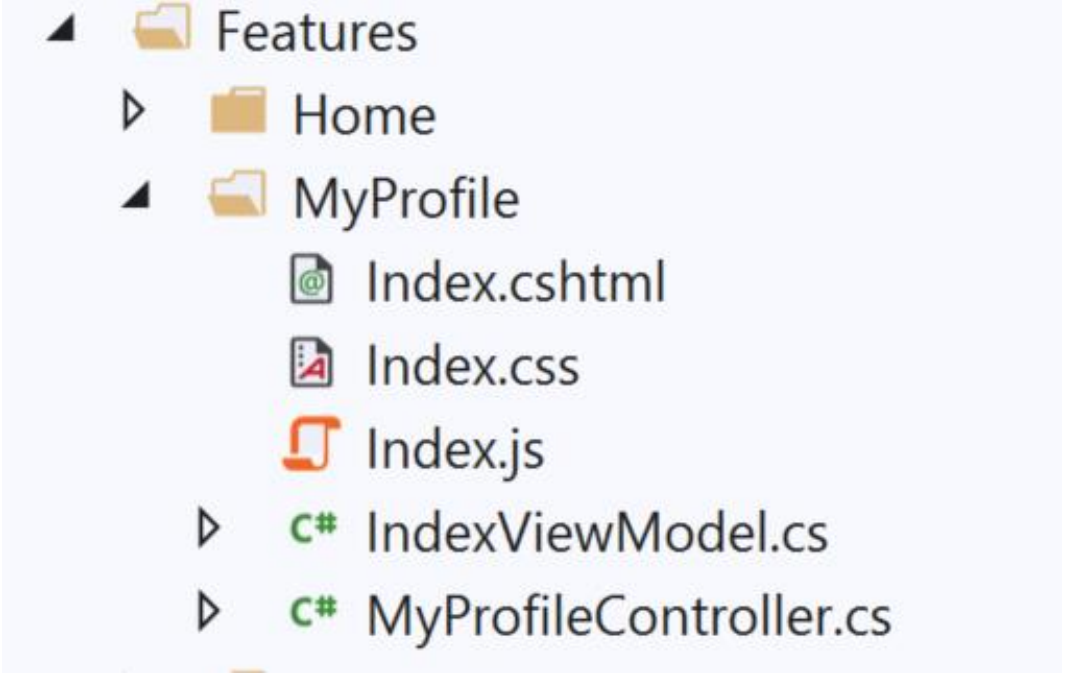
Solution: Use Feature Folders

- Grouping by Feature, not by Responsibility, results in easier maintenance
- Related things remain together (High Cohesion)

MVC out of the box:



Feature Folders:

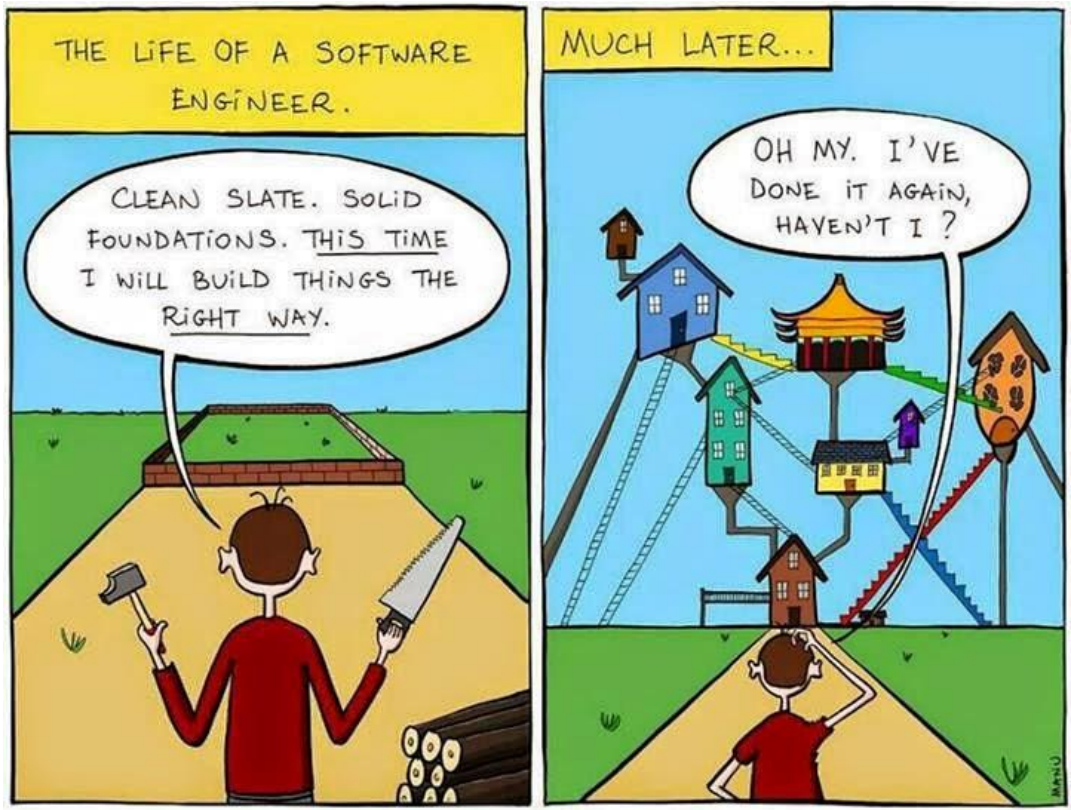


Feature Folder Extra Resources

- How to do this in ASP.NET Core
  - My blog post
  - Steve Smith's Blog on Feature Folders vs. Areas
- How to do this in ASP.NET 4.x
  - Tim Thomas' blog post
- Also used in React, Angular, etc.
  - John Papa

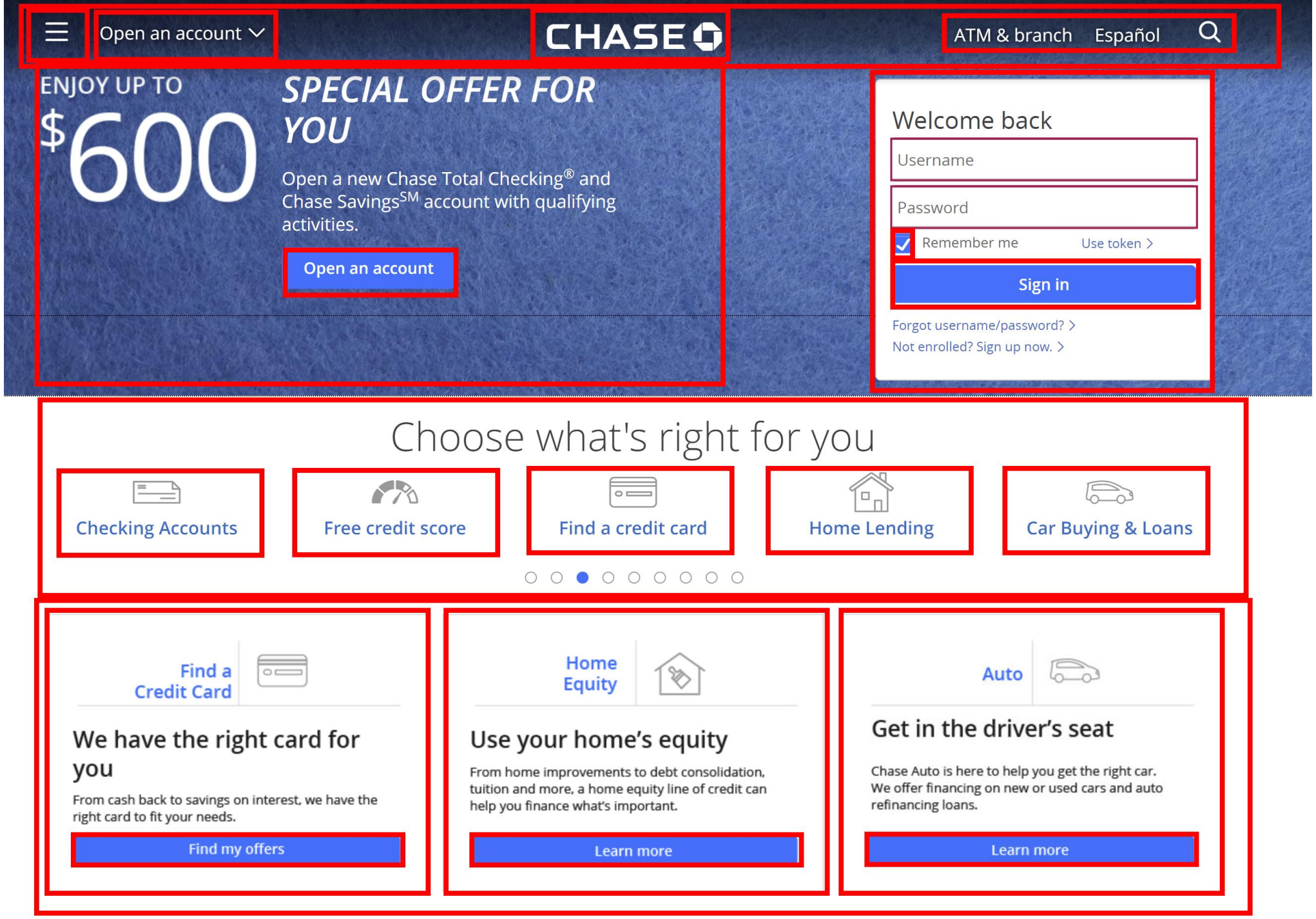
Questions on Feature Folders?

UI Composition



Make as many UI Components as you can

- Benefits
  - SRP for the UI
  - Easier to reason about
  - Reusability
  - Eliminates div soup
- Component architecture is here to stay
  - React, Vue, Angular, AngularJS 1.5+, Knockout 3.2+, Blazor
- Partials
- View Components
- Blazor Components
- Child Actions (in ASP.NET 4)


Open an account
CHASE
ATM & branch
Español
ENJOY UP TO
$600
SPECIAL OFFER FOR YOU
Open a new Chase Total Checking® and Chase Savings℠ account with qualifying activities.
Open an account
Welcome back
Username
Password
Remember me
Use token
Sign in
Forgot username/password?
Not enrolled? Sign up now.
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Questions on Components?

Code Flow/Smells

Structuring a method

- Happy Path always at the bottom of the method
  - Don’t want to scan for “what happens when all goes well” and find it in the middle of a method
- Use return’s instead of nested if => else

Razor Pages Template Code:

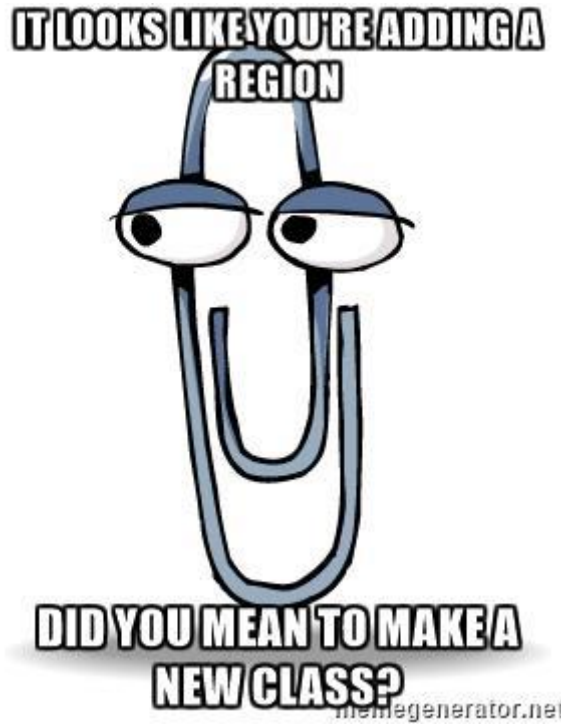
```
public async Task<IActionResult> OnPostAsync(string returnUrl = null)
{
    returnUrl = returnUrl ?? Url.Content("~/");
    if (ModelState.IsValid)
    {
        var user = new IdentityUser { UserName = Input.Email, Email = Input.Email };
        var result = await _userManager.CreateAsync(user, Input.Password);
        if (result.Succeeded)
        {
            _logger.LogInformation("User created a new account with password.");

            var code = await _userManager.GenerateEmailConfirmationTokenAsync(user);
            var callbackUrl = Url.Page("/Account/ConfirmEmail",null, new { userId = user.Id, code = code }, Request.Scheme);

            await _emailSender.SendEmailAsync(Input.Email, "Confirm your email",
                $"Please confirm your account by <a href='{HtmlEncoder.Default.Encode(callbackUrl)}'>clicking here</a>.");

            await _signInManager.SignInAsync(user, isPersistent: false);
            return LocalRedirect(returnUrl);
        }
        foreach (var error in result.Errors)
        {
            ModelState.AddModelError(string.Empty, error.Description);
        }
    }

    // If we got this far, something failed, redisplay form
    return Page();
}
```

Refactored with Happy Path At The Bottom:

```
public async Task<IActionResult> OnPostAsync(string returnUrl = null)
{
    returnUrl = returnUrl ?? Url.Content("~/");
    if (!ModelState.IsValid)
        return Page();

    var user = new IdentityUser { UserName = Input.Email, Email = Input.Email };
    var result = await _userManager.CreateAsync(user, Input.Password);

    if (!result.Succeeded)
    {
        foreach (var error in result.Errors)
        {
            ModelState.AddModelError(string.Empty, error.Description);
        }

        return Page();
    }

    _logger.LogInformation("User created a new account with password.");

    var code = await _userManager.GenerateEmailConfirmationTokenAsync(user);
    var callbackUrl = Url.Page("/Account/ConfirmEmail", null, new { userId = user.Id, code = code }, Request.Scheme);

    await _emailSender.SendEmailAsync(Input.Email, "Confirm your email",
        $"Please confirm your account by <a href='{HtmlEncoder.Default.Encode(callbackUrl)}'>clicking here</a>.");

    await _signInManager.SignInAsync(user, isPersistent: false);
    return LocalRedirect(returnUrl);
}
```

Code smells

- Not hard and fast rules, just my “warning light”
- Methods > 30 lines
- Classes > 200 lines
- Regions
  - You probably should’ve added a new class or method instead



The Indentation Proclamation

- The more indented your code is, the harder it is to follow
- Nested if's, nested loops, etc.
- …I made this up

Questions on Code Flow/Smells?

Validation

Validation – What's wrong with OOB Options

- Data Annotations
  - Only work well for simple scenarios
  - Hard to make custom ones
  - Hard to unit test
  - Separate annotations for each property
    - Can get "tall"
  - SRP violated
    - Model + Validation combined into one class
- Writing own Custom Validation classes
  - Lose client-side hooks Data Annotations provides

Solution: Use FluentValidation

- Fluent interface
- Business rules are easy to maintain and read
- Easy to show a stakeholder
- Easy to test
- Integrates with ModelState.IsValid
- Same Client-Side validation as Data Annotations
- 20.2M downloads
- https://github.com/JeremySkinner/FluentValidation

Template Code:

```
public class RegisterViewModel
{
    [Required]
    [EmailAddress]
    [Display(Name = "Email")]
    2 references | 0 exceptions
    public string Email { get; set; }

    [Required]
    [StringLength(100, ErrorMessage = "The {0} must be at least {2} characters long.", MinimumLength = 6)]
    [DataType(DataType.Password)]
    [Display(Name = "Password")]
    1 reference | 0 exceptions
    public string Password { get; set; }

    [DataType(DataType.Password)]
    [Display(Name = "Confirm password")]
    [Compare("Password", ErrorMessage = "The password and confirmation password do not match.")]
    0 references | 0 exceptions
    public string ConfirmPassword { get; set; }
}
```

Refactored with Fluent Validation:

```
public class RegisterViewModel
{
    [Display(Name = "Email")]
    4 references | 0 exceptions
    public string Email { get; set; }

    [DataType(DataType.Password)]
    [Display(Name = "Password")]
    5 references | 0 exceptions
    public string Password { get; set; }

    [DataType(DataType.Password)]
    [Display(Name = "Confirm password")]
    1 reference | 0 exceptions
    public string ConfirmPassword { get; set; }
}
```

```
public class RegisterViewModelValidator : AbstractValidator<RegisterViewModel>
{
    0 references | 0 exceptions
    public RegisterViewModelValidator()
    {
        RuleFor(m => m.Email).NotEmpty()
            .WithMessage("Email is required.");

        RuleFor(m => m.Email).EmailAddress()
            .WithMessage("Email must be a valid email address.");

        RuleFor(m => m.Password).NotEmpty()
            .WithMessage("Password is required.");

        RuleFor(m => m.Password).MaximumLength(100)
            .WithMessage("The password cannot be longer than 100 characters.");

        RuleFor(m => m.Password).MinimumLength(6)
            .WithMessage("The password must be at least 6 characters long");

        RuleFor(m => m.ConfirmPassword).Equal(m => m.Password)
            .WithMessage("The password and confirmation password do not match.");
    }
}
```

A Rule that only exists if….

```
public class InsuranceEnrollmentValidator : AbstractValidator<InsuranceEnrollment>
{
    0 references
    public InsuranceEnrollmentValidator()
    {
        RuleFor(model => model.Age)
            .Must(age => age < 26)
            .When(model => model.IsDependent)
            .WithMessage("A dependent must be younger than 26.");
    }
}
```

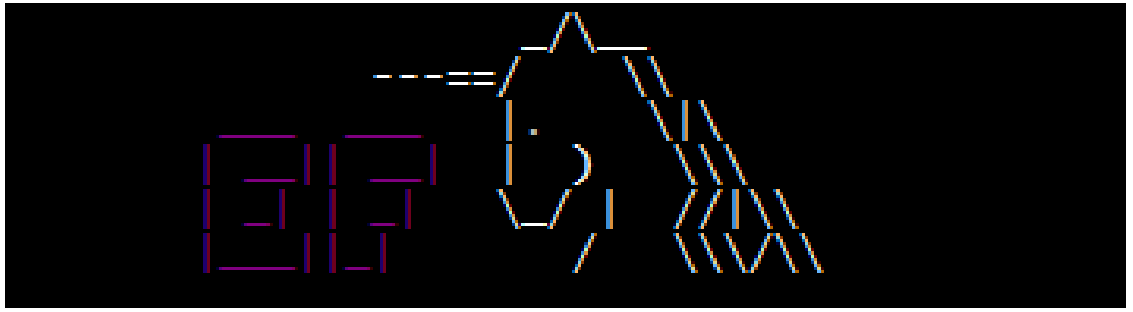
Questions on Fluent Validation?

ORM’s

Don’t use raw ADO - Use an ORM

Entity Framework – Full ORM

- Pros
  - Developer Productivity
  - Compile-time safety with LINQ Queries
  - Extremely quick to add new CRUD operations
  - Built in Unit of Work
  - Migration support
- Cons
  - Less performant
  - Less control over the queries generated
  - Heavier



Dapper – Micro ORM

- Pros
  - Performance near ADO
  - More control over the queries
  - Extremely simple to setup
  - Stack Overflow beta tests
- Cons
  - SQL strings = Big column name refactorings are harder
  - Less features than EF

ORM usage comparison

Entity Framework:

```
public List<Customer> GetCustomersByState(string state)
{
    var context = new ApplicationDbContext();
    return context.Customers.Where(c => c.State == state).ToList();
}
```

Dapper:

```
public List<Customer> GetCustomersByState (string state)
{
    var connection = new SqlConnection();

    string sql = @"SELECT *
                   FROM Customers
                   WHERE State = @State";

    var parameters = new
    {
        State = state
    };

    return connection.Query<Customer>(sql, parameters).ToList();
}
```

Other ORM things

- Both manage connection lifetimes
- Both give you SQL Injection protection
- I use both depending on the job
- Common for us to start with EF and supplement with Dapper
  - EF for Developer Productivity
  - Dapper for hot paths
  - Dapper for queries that are tough to write in LINQ
- DON’T WRITE YOUR OWN ORM

Questions on ORM’s?

Dependency Injection

Dependency Injection and IoC containers

- DI/IoC helps you loosely couple your “large” apps
- Lets you unit test anything if done correctly
- I use Microsoft.Extensions.DependencyInjection
  - Scrutor for auto-registration

Common DI Pitfalls

- "New Is Glue"
- "Static Cling"
- DateTime.Now (and variants)
  - Instead inject in IClock or have method take in DateTime? and default to Now
- HttpContext
  - IHttpContextAccessor in ASP.NET Core
- ConfigurationManager in ASP.NET 4.x
  - Instead, inject a POCO Settings class

Questions on Dependency Injection?

Automated Testing

Automated Testing with xUnit

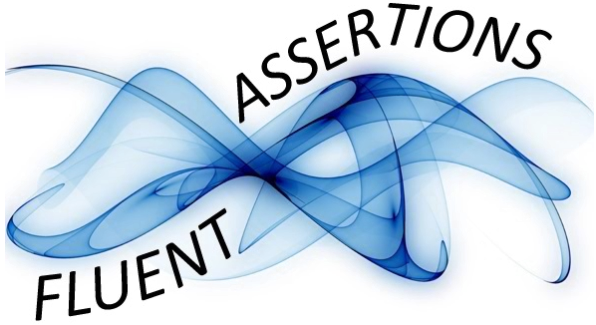
- You should be writing automated tests
  - Exposes holes in your architecture
  - Proven to be faster long-term
    - Make changes quickly and confidently because have a regression test suite
- “Start at the back”
- Use xUnit or NUnit
  - Just not MSTest which is wayyy more verbose and has less features
- xUnit used by ASP.NET team
- I used to use NUnit and switched to xUnit
- NUnit more boilerplate
  - No [TestFixture] in xUnit
  - No [SetUp] method just use a constructor in xUnit

Problem: OOB Assertion Libraries Annoy Me

- Assert.Equal(value, value)
  - Hard to remember that it's Assert.Equal(expected, actual)
  - Can lead to funky looking assertion failures if you flip them
- No "Because" string in xUnit's assertions

Solution: Use FluentAssertions for assertions

- Adds a Should() extension method to object
  - result.Should().Be(0);
  - Easier to read than Assert.Equal(0, result);



- Because string to explain why
  - can12YearOldDriveResult.Should().Be(false, “because you must be 16 years old to drive.”)
- 28.7M downloads

Questions on Automated Testing?

DevOps

The Expert Beginner
@ExpertBeginner1

Follow

The most important thing you can do is have well-defined handoff procedures between Dev and DevOps and between DevOps and Ops.

9:24 AM - 14 Sep 2017

43 Retweets **54** Likes

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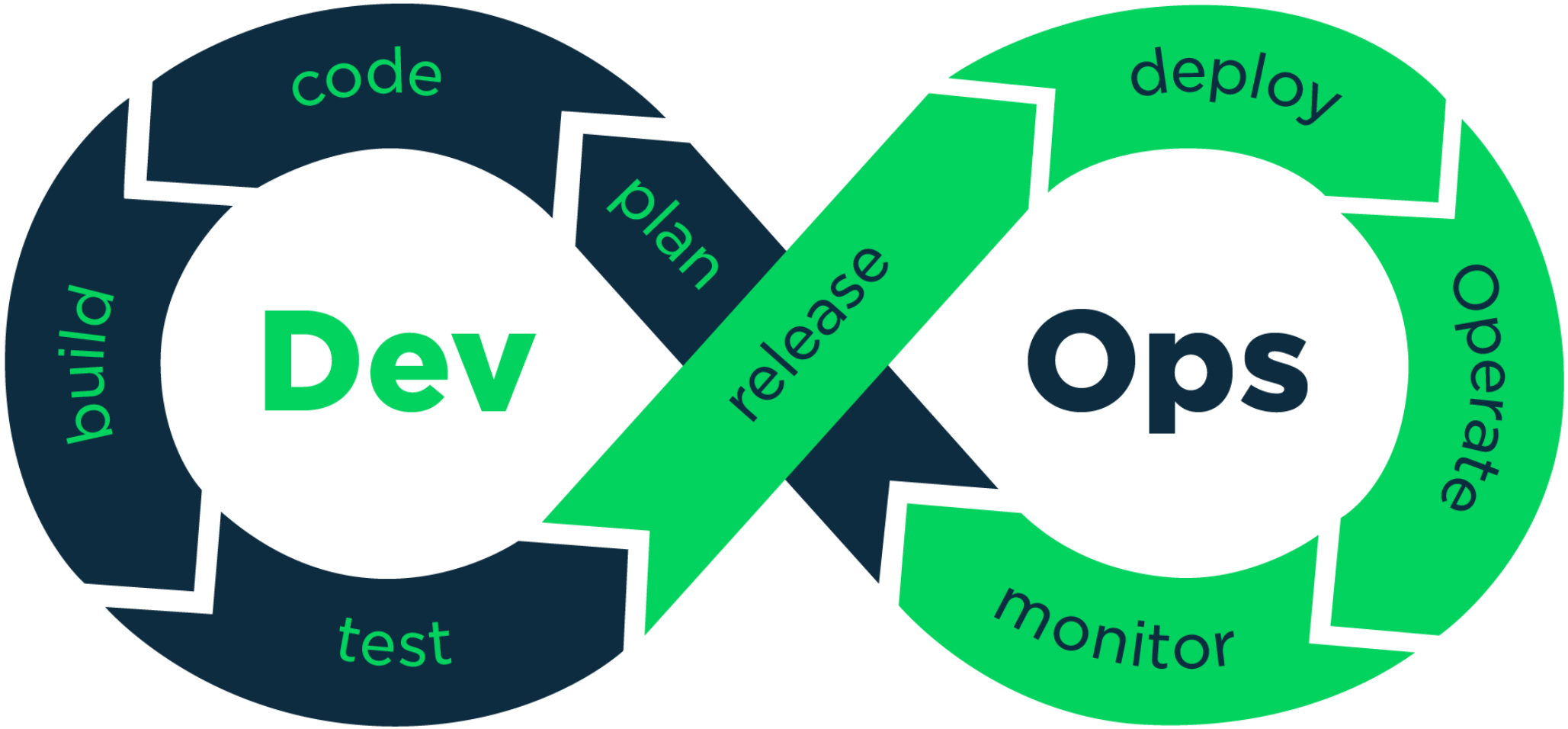
What is DevOps

"DevOps is the union of people, process, and products to enable continuous delivery of value to our end users."

- Donovan Brown

DevOps Pipeline



Continuous Integration and Delivery

- Continuous Integration Server
  - Automated builds running on an independent build server
  - Automatically running automated tests
  - Creates an output
- Continuous Delivery
  - Takes the output from the build server and deploys it
  - Go through different environments
  - Automated configuration of VM, IIS, folder permissions, Azure WebApp, etc.
- These two together will be transformational for you and your company

Continuous Integration with TeamCity

- Free for up to 100 build configs
  - No support or $1999/year with support
- NuGet Restores
- MSBuild
  - Don’t need to install VS on your build server
- Run automated tests
- Produces an output
- Zips up and sends to Octopus Deploy

Continuous Delivery with Octopus Deploy

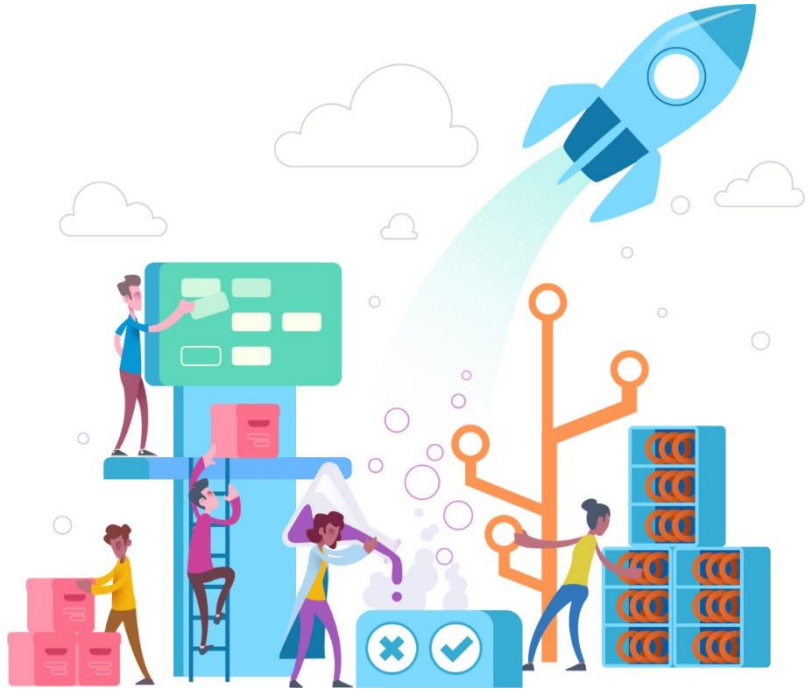
- Lets you promote your package through different environments
- Controls all appsettings/web.config scoped to each environment
- Auto-creates IIS Site and App Pool for you
- Deploys and rollbacks are click of a button
- Lets you run any scripts you want to as part of your deployment
- Easy to install and easy to use
- Professional – 25 deployment targets $2300/yr
- Full Audit Trail
  - Who/What/When changed
- My single favorite piece of software – ever

TeamCity + Octopus Deploy enables…

- Consistency
  - Machine repeats the same steps over and over again
- Consistency promotes Confidence
  - Passes build
  - Passes automated tests
  - Configuration is correct
  - Let’s deploy it to Prod!
- Confidence enables agility
  - Mid-day publishes are no big deal
    - For a single app, our record is 24 publishes to Prod in 1 day with 2 developers

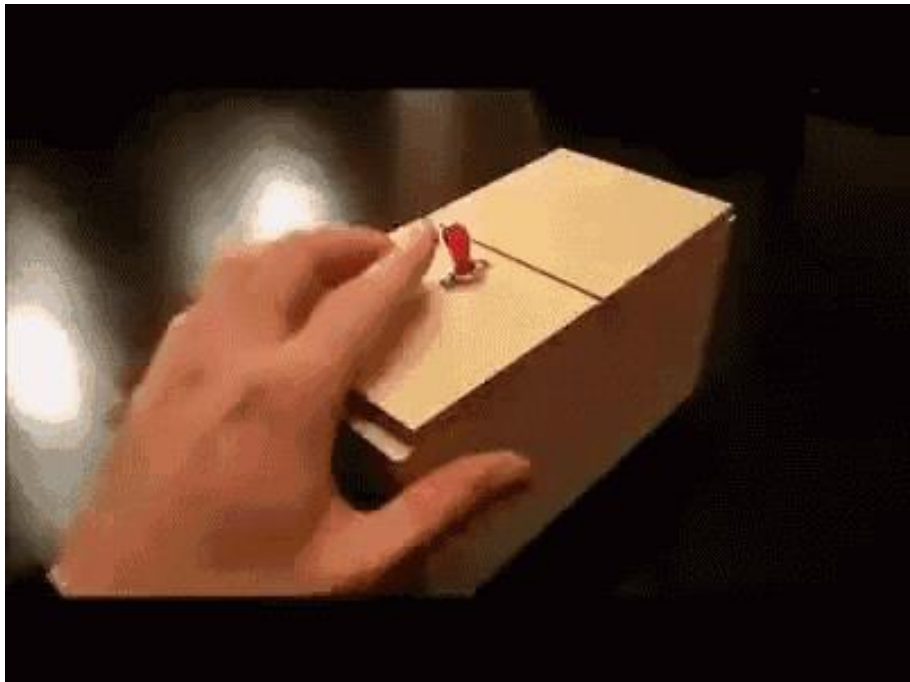
Azure DevOps

- Can handle Source Control, Builds, Deploys
- Octopus is still more full featured
- But AzDO gives you 1 product
- Also can do work item tracking



Questions on DevOps?

Feature Toggles



Feature Toggles

- No long lived branches
  - No environment branches
- Commit to master instead!
  - Behind an if statement
- Reduce merge conflicts
- Simplest way: config files
  - appsettings.{Environment}.json
- Commit to cleaning up after it’s live
- Clearly separate out your Feature Toggles to make it obvious what Feature Toggles exist
  - Have a FeatureToggles class or section in your config file

Questions on Feature Toggles?

Microservices

<Something about Microservices />

- When I say Microservices I mean some out of process call of some sort (web service, queue, etc.)
- Microservices add operational complexity
  - Health Checks
    - Is it running? Are the dependencies ok?
  - Load Balancing
  - Service Discovery (via Consul or something simple like config files with primary/backup)
  - Perf is worse
- Microservices add development complexity
  - HTTP call (most likely) instead of a method call
  - If calling from C#, likely want a client library wrapper around HttpClient sending JSON
  - Dev environment needs multiple projects running
  - Cross-cutting things (users, logging, common packages, versions, etc.)

<Something about Microservices />

- Benefits
  - Iterate on microservices separate from other app (SRP)
  - Reuse
  - Scale independently
  - Easy to reason about in small chunks
- You are not Google/Facebook/Netflix/Amazon
- Use where it makes sense:
  - Needs scale
  - High CPU usage
  - Isolate an annoying dependency
  - Separate teams
  - Hard costs is a priority over engineering costs (i.e. Lambda, Azure Functions)

Daniel Vassallo
@dvassallo

Step 1: Forget that all these things exist: Microservices, Lambda, API Gateway, Containers, Kubernetes, Docker.

Anything whose main value proposition is about “ability to scale” will likely trade off your “ability to be agile & survive”. That’s rarely a good trade off.

4/25

5:20 PM · Jul 25, 2019 from Seattle, WA · Twitter for iPad

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@mfeathers

Follow

Make something simple and add complexity reluctantly.

9:08 PM - 6 Jul 2017

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Questions on Microservices?

Real benefits of these practices

- 1 web app went from deploying to Prod 20x a year to deploying to Prod over 500x a year.
- Faster delivery of value to users.

Summary

- Feature Folders > MVC Folders
- SRP for UI with Components
- Happy Path at the Bottom of a Method
- FluentValidation over Data Annotations/Custom
- Use an ORM
- Avoid new, Statics, HttpContext, ConfigurationManager for testing
- Automate your Build and Release pipeline
- Use Feature Toggles over environment branches
- Resist Microservices until there's a good reason not to

Closing

- Hope you got at least one idea out of this.
- You likely don’t agree with everything I just said.
- Remember – point is to deliver value to your end users as quickly and reliably as possible and allowing that trend to continue in the future.
- Don’t get caught up in what library you’re using
  - If you use NUnit instead of xUnit and have no reason to switch – who cares?
  - Important thing is you’re doing automated testing.

Questions?

- Feel free to reach out on Twitter (@scottsauber) if you think of a question later
- Slides posted on my blog (scottsauber.com) and I'll tweet them out
- Don't forget to fill out evals, please

Thanks!