# Lab - Creating a Diagnostic with Code Fix

In this lab, we will create a diagnostic with code fix to detect and correct a domain specific error. Consider the following code sample for a MVC controller class:

public class TestControllerMisnamed : Controller

{

    public TestControllerMisnamed()

    {

    }

    // GET: Test

    public ActionResult Index()

    {

        return View();

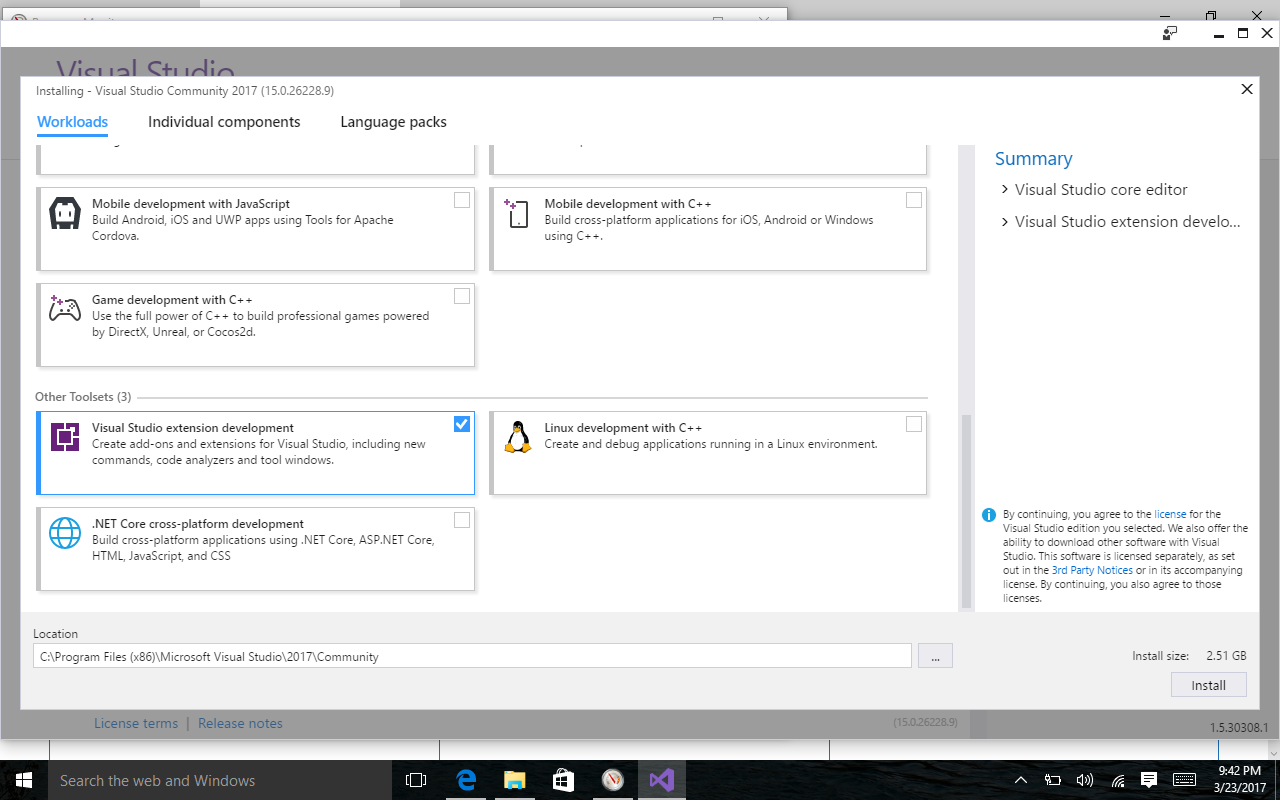
    }

}

This code compiles fine, but poses a hidden bug that could cause plenty of headache at runtime . If you look closer, you’ll notice that the class is misnamed. MVC uses a convention based approach where the controller class’s name must end in the word “Controller” otherwise, the routing engine will not locate the controller at runtime and result in a HTTP 404 – Not Found exception when attempting to navigate to the route. To avoid this, we’ll build a Roslyn diagnostic with code fix to detect the error and offer a resolution to the issue.

## Install Visual Studio 2017 with the Roslyn SDK

To get started, we need to ensure the SDK and tools are installed. If you are using Visual Studio 2017, open the installer and select the Visual Studio extension development workload. This will install the libraries and Syntax Visualizer tool that we will use later.

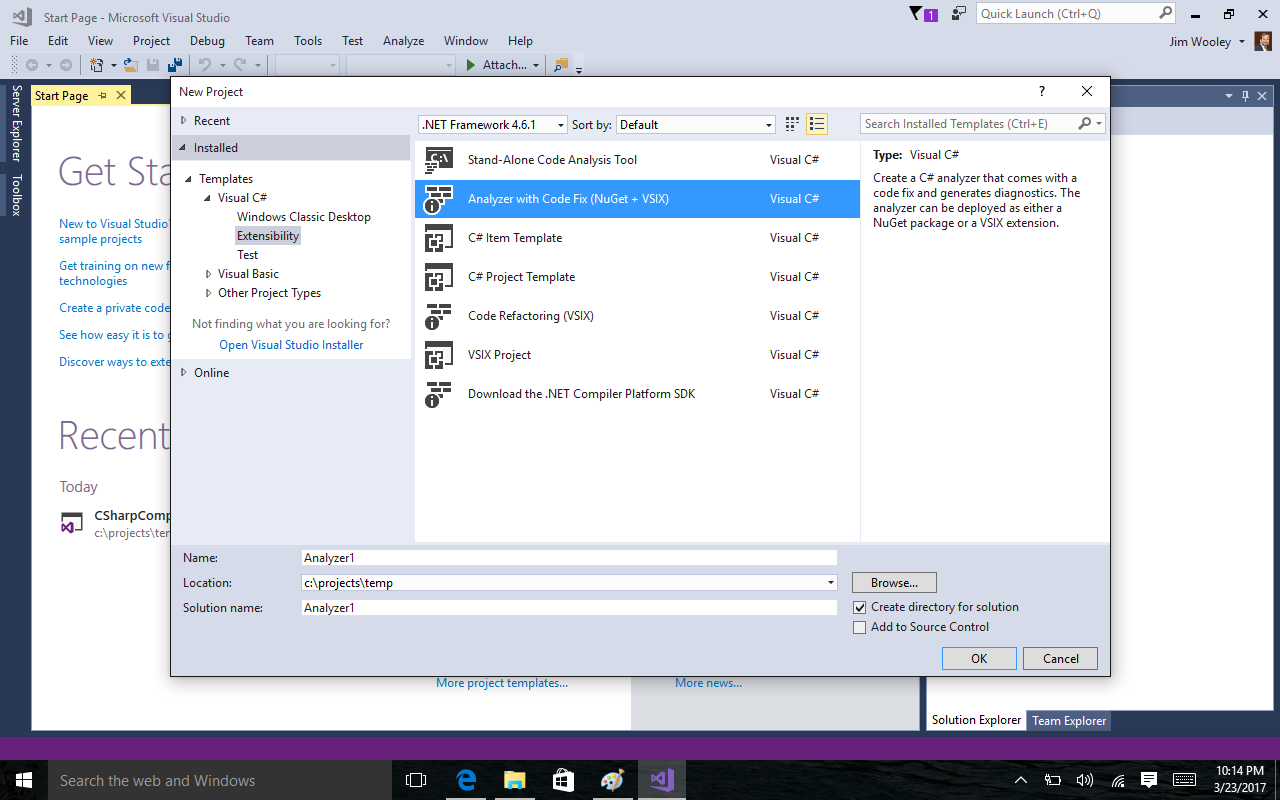


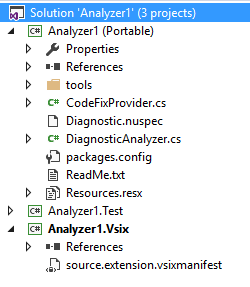
Now that you have the tools, you will need to download and install the Visual Studio templates from <https://go.microsoft.com/fwlink/?LinkID=526901>.

If you are using Visual Studio 2015, you can find the instructions to install the Visual Studio SDK at <https://msdn.microsoft.com/en-us/library/mt683786.aspx>.

## Creating the project

With the SDK installed, it’s time to create your first analyzer. From File -> New Project, select the Extensibility templates and locate the “Analyzer with Code Fix (NuGet + VSIX)” template. Name the project or just take the defaults and click Ok.



The template creates a solution with three projects:

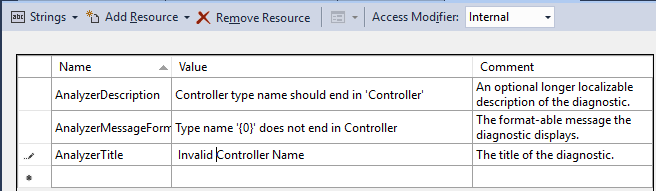
* Analyze1r – This is the main analyzer library and contains the core logic for the tool.
* Analyzer1.Test – This is a unit test project. Unit tests are the best way to test and debug your analyzer. We’ll use this later in the lab.
* Analyzer1.Vsix – This is a Visual Studio extension project. It will only be used if you F5 debug your application. It is not used for typical deployments unless you create Code Refactoring packages. (Many refactorings are actually done by setting the analyzer’s severity level to None and simplifies the deployment mechanism to just NuGet packges.)

## Implementing the Analyzer

Let’s start implementing our analyzer. From the solution explorer, open the DiagnosticAnalyzer. Start by changing the DiagnosticIId constant to a value that you will use to recognize it in the ruleset editor. This is typically an abbreviated name of the analyzer tool and a unique number within that tool. In our case, change this to INDY0001:

public const string DiagnosticId = "Indy0001";

Next, we need to modify the configuration information that we’ll use to register our fix with Visual Studio. This will include a title, description, message, category and default severity. The default template from the SDK that we created this project from uses a resource file to manage these values and stores them in a resource file so that it can be easily globalized. Open the Resources.resx file and update these as follows:



Returning to the DiagnosticAnalyzer.cs file, let’s adjust the Rule that we will use to register with Visual Studio for our fix. Since the diagnostic that we’re creating detects issues that will cause errors at runtime, let’s adjust the default severity on our rule to DiagnosticSeverity.Error as follows:

private static DiagnosticDescriptor Rule =

new DiagnosticDescriptor(DiagnosticId, Title, MessageFormat,

Category, DiagnosticSeverity.Error,

isEnabledByDefault: true,

description: Description);

We can leave the rest of the configuration section alone and just stay with the values set in the template. Now we can turn our attention to the implementation code.

Our implementation starts with the Initialize method. Here we indicate the type of code that we want to detect and when to detect it. In the Initialize method. Place a dot after context to explore the actions you can register. They are:

* RegisterCodeBlockAction
* RegisterCodeBlockStartAction
* RegisterCompilationAction
* RegisterCompilationStartAction
* RegisterSemanticModelAction
* RegisterSymbolAction
* RegisterSyntaxNodeAction
* RegisterSyntaxTreeAction

As a general guide, we need to use the least invasive and performance intensive option in order to keep our analyzer from needlessly hogging resources. In our case, we only need to evaluate our rule if the class name or its base class changes. As a result, we can just use the RegisterSymbolAction.

Next, we need to identify the kind of symbol that we want to watch. If you check the intellisense on SymbolKind, you’ll find the following enum values:

* Alias
* ArrayType
* Assembly
* DynamicType
* ErrorType
* Event
* Field
* Label
* Local
* Method
* NetModule
* NamedType
* Namespace
* Parameter
* PointerType
* Property
* RangeVariable
* TypeParameter
* Preprocessing

In the case of a class, we’re dealing with a NamedType. As a result, we’re just going to leave the Initialize implementation alone and use the value from the template:

context.RegisterSymbolAction(AnalyzeSymbol, SymbolKind.NamedType);

The only thing remaining to our diagnostic is to implement the actual logic to detect if there is a potential error. Change the Analyzer implementation to the following:

private void AnalyzeSymbol(SymbolAnalysisContext context)

{

    var symbol = (INamedTypeSymbol)context.Symbol;

    if (symbol.BaseType == null) return;

    if ((symbol.BaseType.Name == "Controller"

|| symbol.BaseType.Name == "ApiController") &&

        !symbol.Name.EndsWith("Controller"))

    {

        var diagnostic = Diagnostic.Create(Rule,

symbol.Locations[0], symbol.Name);

        context.ReportDiagnostic(diagnostic);

    }

}

In this code, we start by casting the context’s Symbol as an INamedTypeSymbol. We should be safe here because when we registered the rule, we told Roslyn to only let our analyzer know about Named Type symbols. Next, we check to see if our class derives from any other types. If it doesn’t, there’s no reason to evaluate any other conditions. Roslyn best practices dictate that we exit out of the process as soon as we can to increase performance.

If we do have a base class, we’ll check to see if that class name is Controller or ApiController and if so, see if our class’s name ends in the word Controller. If not, then we will create the diagnostic for our rule indicating the location of the symbol and name. The name will be concatenated into the MessageFormat that we specified in the resource file. The location will indicate which parts of the code will be identified as an error in the IDE. We then call context.ReportDiagnostic with the one we created which is what causes Visual Studio to show the diagnostic to the user.

At this point, we’re done with this diagnostic. We could end here and force the user to manually fix their code, but in our case we know that there is a relatively simple fix, to change the name to end in “Controller”, so let’s continue by adding the CodeFix for our diagnostic.

## Implementing the CodeFix

In the Analyzer project, open the CodeFixProvider.cs file from the template. We’ll update this code to implement our fix. The beginning of the CodeFixProvider primarily consists of boiler plate. We’ll just change the title constant to be more appropriate to our tool.

private const string title = "Ensure type ends in 'Controller'"

The meat of our work is in the RegisterCodeFixesAsync method and in the actual fixer method. Delete the template’s MakeUppercaseAsync method and replace it with the following method that performs the fix:

private async Task<Document> MakeEndInControllerAsync(

Document document,

TypeDeclarationSyntax typeDecl,

CancellationToken cancellationToken)

{

    var identifierToken = typeDecl.Identifier;

    var originalName = identifierToken.Text;

    var nameWithoutController =

Regex.Replace(originalName, "controller", String.Empty,

RegexOptions.IgnoreCase);

    var newName = nameWithoutController + "Controller";

    var semanticModel =

await document.GetSemanticModelAsync(cancellationToken);

    var typeSymbol =

semanticModel.GetDeclaredSymbol(typeDecl, cancellationToken);

    var root = await document.GetSyntaxRootAsync(cancellationToken);

    var newIdentifier = SyntaxFactory.Identifier(newName)

        .WithAdditionalAnnotations(Formatter.Annotation);

    var newDeclaration =

typeDecl.ReplaceToken(identifierToken, newIdentifier);

    var newRoot = root.ReplaceNode(typeDecl, newDeclaration);

    return document

        .WithSyntaxRoot(newRoot);

}

Add the following using clauses to the top of your code file.

using System.Text.RegularExpressions;

using Microsoft.CodeAnalysis.Formatting;

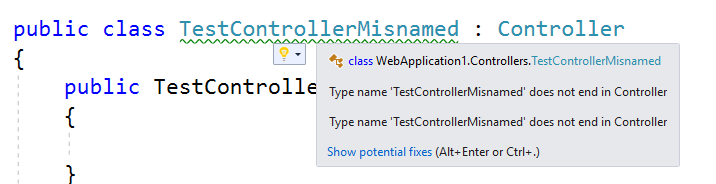
Because we have a new fix method, we need to update the code that registers the fix in the RegisterCodeFixesAsync method. The last line should be changed to:

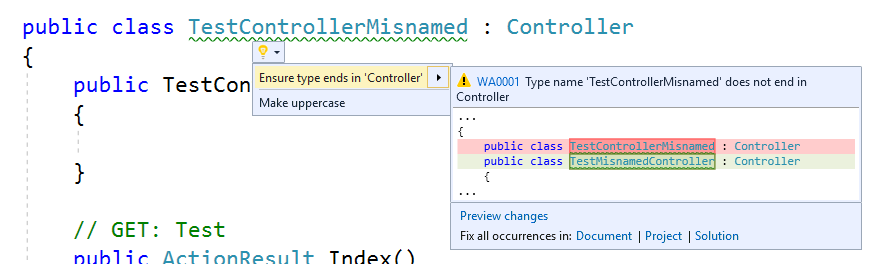
context.RegisterCodeFix(CodeAction.Create(title,

c => MakeEndInControllerAsync(context.Document, declaration, c)), diagnostic);

## Debugging the change

At this point, the code should be ready to test. Press F5 to debug the application. This will launch a second “Experimental” version of Visual Studio. Realize that VS can’t debug the extension if it is installed in its own workspace, thus we need to create a new workspace to test against. When the new instance opens, create a new MVC web site. Open the HomeController and rename it to HomeControllerMisnamed. If all goes well, you should see the class name underlined with a code lightbulb identifying the issue that your analyzer identified. You can always put a breakpoint in your AnalyzeSymbol method to interrogate the various objects from your test code base.

Expanding the potential code fixes, you should be presented with a diff between the current value and the revised fix that you wrote.



## Adding tests

As you may have noticed when testing the change inside Visual Studio, it takes a while to spin up Visual Studio and test interactively. The better alternative is to create coded unit tests that exercises input code snippets and asserts that the analyzer detects positive and negative scenarios and can fix the code based on your fix logic. Open the unittests.cs file in the .Test project. Replace the test method with the following test (don’t replace the overrides for GetCSharpCodeFixProvider or GetCSharpDiagnosticAnalyzer):

[TestMethod]

public void MvcClassWithoutConstructorFixes()

{

    var test = @"

using System.Web.Mvc;

namespace WebApplicationCS.Controllers

{

    public class HomeControllerTest : Controller

    {

        public ActionResult Index()

        {

            return View();

        }

    }

}";

    var expected = new DiagnosticResult

    {

        Id = "Indy0001",

        Message = String.Format("Type name '{0}' does not end in Controller", "HomeControllerTest"),

        Severity = DiagnosticSeverity.Error,

        Locations =

            new[] {

                   new DiagnosticResultLocation("Test0.cs", 6, 18)

                }

    };

    VerifyCSharpDiagnostic(test, expected);

    var fixtest = @"

using System.Web.Mvc;

namespace WebApplicationCS.Controllers

{

    public class HomeTestController : Controller

    {

        public ActionResult Index()

        {

            return View();

        }

    }

}";

    VerifyCSharpFix(test, fixtest);

}

Run the test and see that it passes. If it indicates errors, try debugging the test. Now, isn’t this a quicker option? Try adding another test to check cases where the class derives from ApiController as well as Controller. You should also be able to write tests to make sure that if the class name does end in “Controller” that the analyzer does not fire. Also ensure that the analyzer doesn’t fire if the class doesn’t inherit from Controler.

Before we declare this done, let’s try to make one change to our test. Add a constructor to both the test and fixtest strings as follows and run the new test:

//Diagnostic and CodeFix both triggered and checked for

[TestMethod]

public void MvcClassNotEndingInControllerCreatesDiagnostics()

{

    var test = @"

using System.Web.Mvc;

namespace WebApplicationCS.Controllers

{

    public class HomeControllerTest : Controller

    {

public HomeControllerTest()

{

}

        public ActionResult Index()

        {

            return View();

        }

    }

}";

    var expected = new DiagnosticResult

    {

        Id = ControllerNamingConventionAnalyzer.DiagnosticId,

        Message = String.Format("Type name '{0}' does not end in Controller", "HomeControllerTest"),

        Severity = DiagnosticSeverity.Warning,

        Locations =

            new[] {

                    new DiagnosticResultLocation("Test0.cs", 6, 18)

                }

    };

   VerifyCSharpDiagnostic(test, expected);

    var fixtest = @"

using System.Web.Mvc;

namespace WebApplicationCS.Controllers

{

    public class HomeTestController : Controller

    {

public HomeTestController()

{

}

        public ActionResult Index()

        {

            return View();

        }

    }

}";

    VerifyCSharpFix(test, fixtest);

}

Oops, it appears that this test fails. Take a look back at your fix code. Notice that it handled changing the name of the class, but didn’t fix any references to that new class name, including the self-referencing constructor. Let’s make a small change to our fix code to leverage a Roslyn helper method. Update it to the following:

private async Task<Solution> MakeEndInControllerAsync(

Document document,

TypeDeclarationSyntax typeDecl,

CancellationToken cancellationToken)

{

    var identifierToken = typeDecl.Identifier;

    var originalName = identifierToken.Text;

    var nameWithoutController =

Regex.Replace(originalName, "controller", String.Empty,

RegexOptions.IgnoreCase);

    var newName = nameWithoutController + "Controller";

    var semanticModel =

await document.GetSemanticModelAsync(cancellationToken);

    var typeSymbol =

semanticModel.GetDeclaredSymbol(typeDecl, cancellationToken);

    var originalSolution = document.Project.Solution;

    var optionSet = originalSolution.Workspace.Options;

    var newSolution =

await Renamer.RenameSymbolAsync(originalSolution, typeSymbol,

newName, optionSet, cancellationToken)

.ConfigureAwait(false);

    return newSolution;

}

Re-run your test and it should now pass.

## Additional challenge

Now that you have finished this test, you’re ready to try your hand at some more challenges. For example, the current test doesn’t handle cases where the class derives from a controller method in another namespace. Also, it doesn’t work if you use a custom BaseController which derives from Controller. Try updating the analyzer to be able to test for these scenarios.