MATHEMA

Revitalizing Legacy Code Approval Testing Unleash

Erfahrungen aus der Legacy-App-Portierung und Einblicke in die Welt von Verify

Patrick Drechsler

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- Software Entwickler
- Beruflich: C#
- Interessen:
  - Software Crafting
  - Test-Driven Development
  - Funktionale Programmierung
  - Domain-Driven Design
- Background: Naturwissenschaftler
- Slides sind online: Siehe QR-Code

Legacy-Context

- Domain
- Tech-Stack(s)
- Architecture

Domain

- expert system
- user: engineers in sales
- Special features:
  - SI units
  - floating point numbers
  - mathematics
    - not just rule of three
    - complex formulas (including integral calculus)
    - a lot of formulas (x * 10^3 LoC)
    - mathematics is core domain!
- perfect match for my background 😎

Tech-Stack(s)

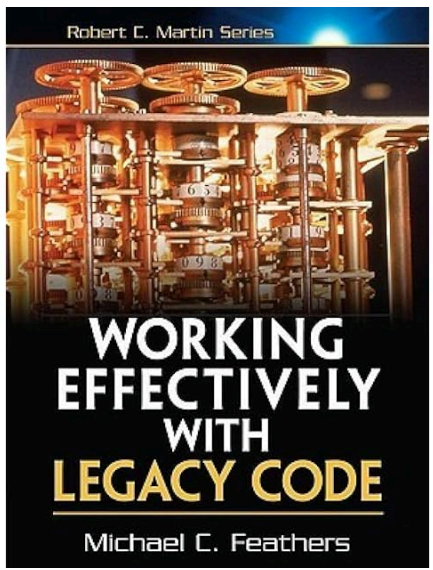
- Main Stack: **LAMP**
  - **L**inux
  - **A**pache
  - **M**ySQL
  - **P**HP
  - ✨ Angular 1 (!) ✨
- Other Stacks
  - C++
  - MATLAB

Architecture

- Frontend (FE): Angular 1
- Backend (BE): PHP
- Bonus: External system calls to FE & BE
  - Let’s ignore this for now

Find a "Seam"

- What is a Seam? 👉 M. Feathers "Working Effectively with Legacy Code"



Find a "Seam" - Example

- Redirecting a php request to a new dotnet console application

```php
// Somewhere inside a PHP controller class...
//
// Seam which toggles between PHP and .NET
if ($this->useDotNet) { // 👈 Feature Toggle
  // C# calculation (new)
  return $this->calcDotNet("calculate", $request);
}
else {
  // PHP calculation (legacy)
  return new CalcWithPhp($request);
}
```

```php
// ⚠️ Use the "Seam"
function calcDotNet($endpointName, Request $request)
{
  // ...
  $encodedJson = base64_encode($request->getContent());
  $result = shell_exec("".$dotnetProgramm." ".$endpointName."  ".$encodedJson."");
  return $result;
}
```

Porting Code from PHP to C# (1/2)

- ⚠ Pay attention to data structures (dynamic vs. static typing)

```php
$foo[1] = 1;
$foo[2] = 2.3;
$foo[3] = "3";
// ...
// in some derived class (developed years later, by a different developer):
$foo["bar"] = [1, "2", 3.3];
```

- and floating point numbers (more on that later)…

Porting Code from PHP to C# (2/2)

- a lot of typing (no AI usage)
- Restructuring / Refactoring:
  - ⚠ Be extremely careful and conservative with restructuring
  - I disagreed with certain decisions in the old system (in my opinion way too much inheritance, followed by a lot of if/else in base classes)
    - 👉 I mapped each product type to an independent type without inheritance (a lot of **code duplication**)
    - 👉 I added "Stateless constructs": even more **code duplication**
- took 2-3 months
- no tests during that time 😭😭😭

Testing the Ported Code

- Get hundreds of realistic example JSONs from the customer
- Run through the old system, save responses
- Run through the new system, compare responses with saved responses
- Rinse and repeat until the code coverage of the new .NET code is close to 100%
  - Extensive use of code coverage tools

How does that work in detail?

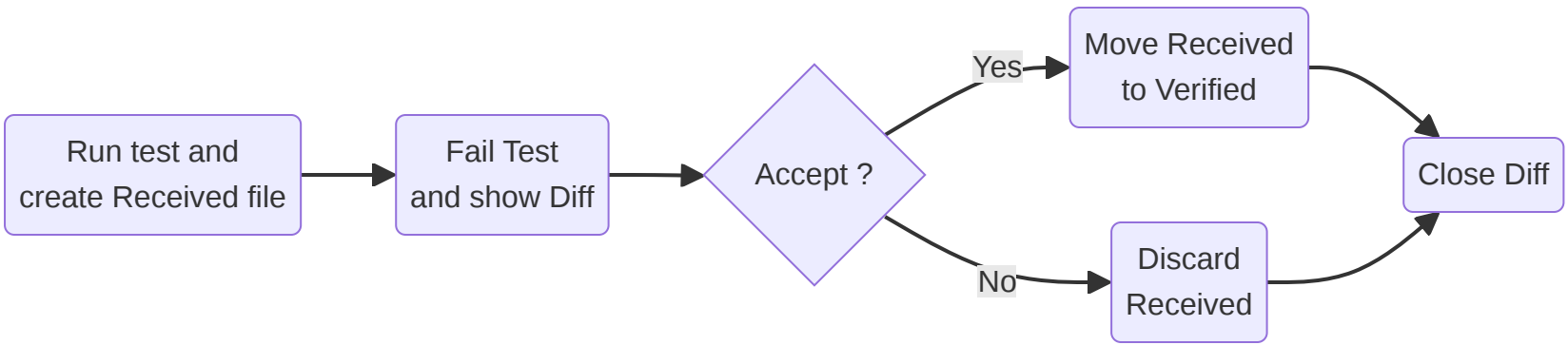
Definitions

- Golden Master Test
- Approval Testing
- Verify
- Regression Test
- Acceptance Test
- Characterization Test

We’ll stick with "Approval Testing" and "Verify" for now. And discuss the others later.

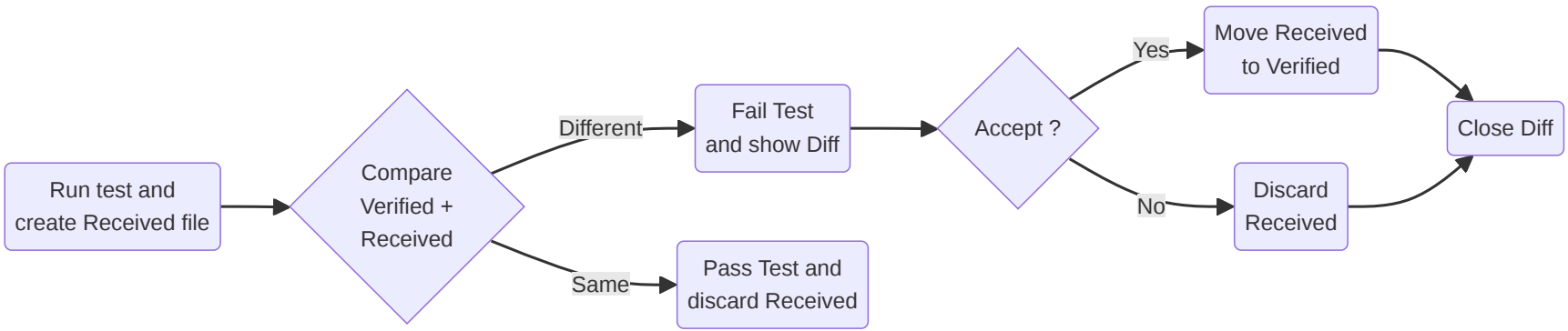
Initial Workflow

- No existing `` `.verified.` `` file.



Subsequent Workflow

- Existing `.verified.` file is compared with `.received.` file...



Hello World Example

```
public record Person(string FirstName, string LastName, int Age);
```

```
// ⚠️ Fact must return Task!
[Fact]
public Task VerifyPersonTest()
{
    var homer = new Person("Homer", "Simpson", 39);
    return Verify(homer); // 👈 don't forget to "return" the Task
}
```

Verified text file:

```
{
  FirstName: Homer,
  LastName: Simpson,
  Age: 39
}
```

Where is the Arrange-Act-Assert?

```
public record PersonRequest(string FirstName, string LastName, int Age);
public record PersonResponse(string FirstName, string LastName,int Age)
{
  public static PersonResponse FromRequest(PersonRequest request) ⇒
    new(request.FirstName, request.LastName,request.Age);
}
```

```
[Fact]
public Task PersonRequest_homer_is_valid()
{
  // Arrange
  var now = DateTime.Now;
  var homer = new PersonRequest(
    "Homer",
    "Simpson",
    39,
    Guid.NewGuid(),
    now,
    now);

  // Act
  var actual = PersonResponse.FromRequest(homer);

  // Assert
  return Verify(actual);
}
```

Verified text file:

```
{
  FirstName: Homer,
  LastName: Simpson,
  Age: 39,
  Id: Guid_1,
  CreatedAt: DateTime_1,
  UpdatedAt: DateTime_1
}
```

Verify - Randomness

No problem 👉 "Scrubbers" to the rescue

- GUIDs (by default)
- TimeStamps (by default)

Randomness - Default Scrubbers

```
public record Person(
    string FirstName,
    string LastName,
    int Age,
    Guid Id,              // 👈
    DateTime CreatedAt,   // 👈
    DateTime? UpdatedAt); // 👈
```

```
[Fact]
public Task PersonTest()
{
    var now = DateTime.Now;
    var homer = new Person(
        "Homer",
        "Simpson",
        39,
        Guid.NewGuid(), // 👈
        now,            // 👈
        now);           // 👈

    return Verify(homer);
}
```

```
{
  FirstName: Homer,
  LastName: Simpson,
  Age: 39,
  Id: Guid_1,           // 👈
  CreatedAt: DateTime_1, // 👈
  UpdatedAt: DateTime_1  // 👈
}
```

Verify - Custom Scrubbers

https://github.com/VerifyTests/Verify/blob/main/docs/scrubbers.md

- Example when generating SVGs using Plotly.NET: Scrub all lines containing `#clip` followed by a word character
- `ScrubLinesWithReplace` and friends

```fsharp
// F#
let settings = VerifySettings ()
settings.ScrubLinesWithReplace (fun line ->
    System.Text.RegularExpressions.Regex.Replace(line, "#clip\w+", "#clipSCRUBBED"))
```

```csharp
// C# (unverified)
var settings = new VerifySettings();
settings.ScrubLinesWithReplace(line =>
    System.Text.RegularExpressions.Regex.Replace(line, "#clip\\w+", "#clipSCRUBBED"));
```

Verify - Diff-Tooling for Devs

- Windows: DiffEngineTray
- Resharper test runner
- Rider test runner
- Terminal via `` `dotnet verify` ``: Verify.Terminal
- 1st class support for all major IDEs
- 1st class integration for most common diff tools

Very cool: customizable to your needs!

Verify - Setup

- We can define the output folder, file extensions, etc.
- Example `` `ModuleInitializer` `` for global setup, defining the output folder:

```
using System.Runtime.CompilerServices;

public static class ModuleInitializer
{
  [ModuleInitializer]
  public static void Initialize()
  {
    // To prevent cluttering the main folder, we will collect all verified snapshots in a dedicated folder.
    // For details, see: https://github.com/VerifyTests/Verify/blob/main/docs/naming.md#derivepathinfo
    DerivePathInfo(
    (_, projectDirectory, type, method) => new(
      directory: Path.Combine(projectDirectory, "VerifiedData"),
      typeName: type.Name,
      methodName: method.Name));
  }
}
```

Verify - CI

- works out of the box
- No need to install anything on the CI server
- Customizable to your needs

Verify - JSON/XML

- JSON/XML are first-class citizens:
  - Instead of verifiying a string, you can verify a JSON/XML object:
  - `VerifyJson` instead of `Verify`
  - `VerifyXml` instead of `Verify`
  - These customized methods will fail fast if the input is not valid JSON/XML

Verify - JSON/XML: Example

```
string InvalidJson = """{ "FirstName": "Homer" """;

[Fact(Skip = "This does not fail fast, and will do a string comparison... and fail")]
public Task Invalid_json_demo1() ⇒
    Verify(InvalidJson);     // 👈 Verify, vs...

[Fact(Skip = "This fails fast, because the input is invalid JSON")]
public Task Invalid_json_demo2() ⇒
    VerifyJson(InvalidJson); // 👈 VerifyJson 😎
```

Error message from second test:

```
Argon.JsonReaderException: Unexpected end of content while loading JObject
```

It does not try to compare the invalid JSON with the verified JSON.

So, if you know that you are working with JSON/XML, use `` `VerifyJson` `` / `` `VerifyXml` ``!

Verify - Simplify Reading Test Data

```
[Fact]
public Task Reading_from_file()
{
    var fileContent = GetFileContent("valid-demo1.xml");
    return VerifyXml(fileContent);
}

// This saves us the hassle from having to deal with file paths in the tests.
// No more marking the file as "Copy if newer" or "Copy always".
private static string GetFileContent(string filename)
{
    const string sampleFolder = "SampleData";
    var relative = CurrentFile.Relative(Path.Combine(sampleFolder, filename));
    var fileContent = File.ReadAllText(relative);
    return fileContent;
}
```

Verify - Floating Point Numbers

- Floating point numbers are always a joy 😾
- Especially when working with different programming languages and platforms
- .NET will produce different results depending on the platform (Windows, Linux, macOS)
  - especially when doing real math: MathNet.Numerics
  - probably a niche case, but be aware of it
  - CI and/or target platform might differ from your dev machine 🤔
  - possible solutions… 👉

Verify - Floating Point Numbers

Verify offers different strategies:

- Custom rounding

```
VerifierSettings.AddExtraSettings(x ⇒ x.FloatPrecision = 8);
```

- Custom tests for each platform (if above fails)

```
// ...
settings.UniqueForOSPlatform()
// ...
```

  Drawback:

  - works on Linux dev machine, CI pipeline, target platform
  - fails on Windows dev machine, until windows dev commits ☹

Verify - F#

Support

works out of the box 😎

Verify - Many Extensions

https://github.com/VerifyTests/Verify?tab=readme-ov-file#extensions

- Images
- PDFs
- Databases
- HTTP
- Desktop-UI
- Infrastructure
- and many more...

- Verify.Avalonia: Verification of Avalonia UIs.
- Verify.Blazor: Verification of Blazor Component via bunit or via raw Blazor rendering.
- Verify.Brighter: Verification of Brighter bits.
- Verify.CommunityToolkit.Mvvm: Verification of CommunityToolkit.Mvvm.
- Verify.Cosmos: Verification of Azure CosmosDB.
- Bunsen-Burner support: BunsenBurner.Verify.NUnit / BunsenBurner.Verify.Xunit.
- Verify.DiffPlex: Comparison of text via DiffPlex.
- Verify.DocNet: Verification of pdfs via DocNet.
- Verify.EntityFramework: Verification of EntityFramework bits.
- Verify.FakeItEasy: Verification of FakeItEasy bits.
- Verify.Flurl: Verification of Flurl bits.
- Verify.HeadlessBrowsers: Verification of Web UIs using Playwright, Puppeteer Sharp, or Selenium.
- Verify.Http: Verification of Http bits.
- Verify.ICSharpCode.Decompiler: Comparison of assemblies and types via ICSharpCode.Decompiler.
- Verify.ImageHash: Comparison of images via ImageHash.
- Verify.ImageSharp.Compare: Verification and comparison of images via Codeuctivity.ImageSharp.Compare.
- Verify.ImageMagick: Verification and comparison of images via Magick.NET.
- Verify.ImageSharp: Verification of images via ImageSharp.
- Verify.MailMessage: Verification of MailMessage and related types.
- Verify.MassTransit: Support for MassTransit test helpers.
- Verify.MicrosoftLogging: Verify MicrosoftLogging.
- Verify.MongoDB: Verification of MongoDB bits.
- Verify.Moq: Verification of Moq bits.
- Verify.NodaTime: Support for NodaTime.
- Verify.NewtonsoftJson: Support for converting Newtonsoft.Json types (JObject and JArray).
- Verify.NServiceBus: Verify NServiceBus Test Contexts.
- Verify.NSubstitute: Support for NSubstitute types.
- Verify.Nupkg: Verification of NuGet .nupkg files.
- Verify.PdfPig: Verification of pdfs via PdfPig.
- Verify.Phash: Comparison of images via Phash.
- Verify.Quibble: Comparison of objects via Quibble.
- Verify.QuestPDF: Verification of pdf documents via QuestPDF.
- Verify.RavenDb: Verification of RavenDb bits.
- Verify.SendGrid: Verification of SendGrid.
- Verify.Serilog: Verification of Serilog bits.
- Verify.SqlServer: Verification of SqlServer bits.
- Verify.SourceGenerators: Verification of C# Source Generators.

Verify - For all the languages!

Similar libraries exist for most programming languages.

Overview: https://github.com/approvals

Definitions - Revisited

- Synonyms:
  - ✅ Golden Master Test
  - ✅ Approval Test
  - ✅ Snapshot Test
  - ✅ Verification Test / Verify
- NOT a synonym for:
  - ⚠ **Regression Test**
    - a test which is run to ensure that the code still works after a change
  - ⚠ **Acceptance Test**
    - a test which is run to ensure that the code works as expected
  - ⚠ **Characterization Test** (Martin Fowler)
    - a test which is run to understand the behavior of the code

Verify - Maintainer

- Simon Cropp
- https://github.com/SimonCropp
- Simon reacts to issues and PRs very quickly

Summary

- Verify is a great tool when dealing with legacy code
- You must find a "seam" in the legacy code to inject the new code
- Once you found it, you can start porting the code and writing tests
- Try to keep the "testing the seam" loop as short as possible
- As always: tests should be automated (especially in CI)...
- You might still have to deal with the final output format (encoding, floating point numbers, etc.)

Thank You!

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Slides 👇

- QR Code or
- https://draptik.github.io/2024-4-mathemacampus-approval-testing
- sample code: https://github.com/draptik/2024-04-mathemacampus-approval-testing