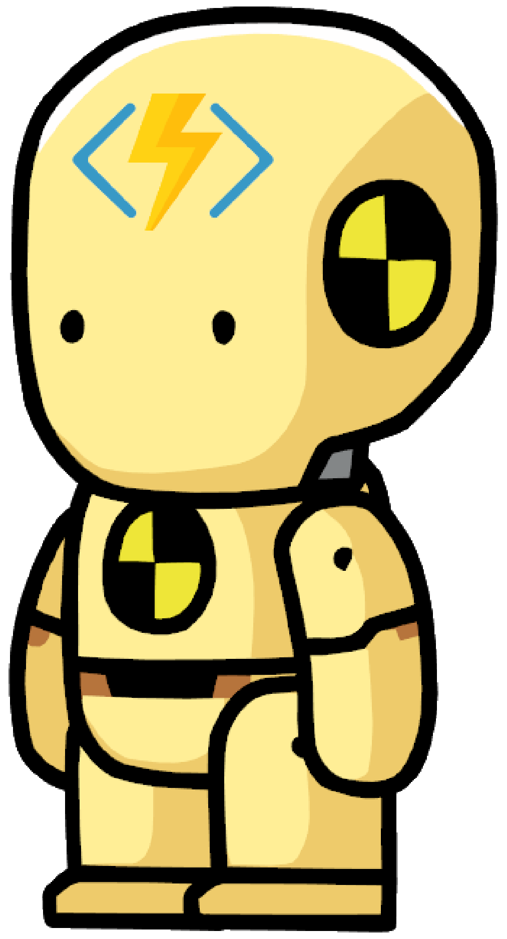
Microsoft Azure



The art of Azure Functions (unit) testing and monitoring

Massimo Bonanni

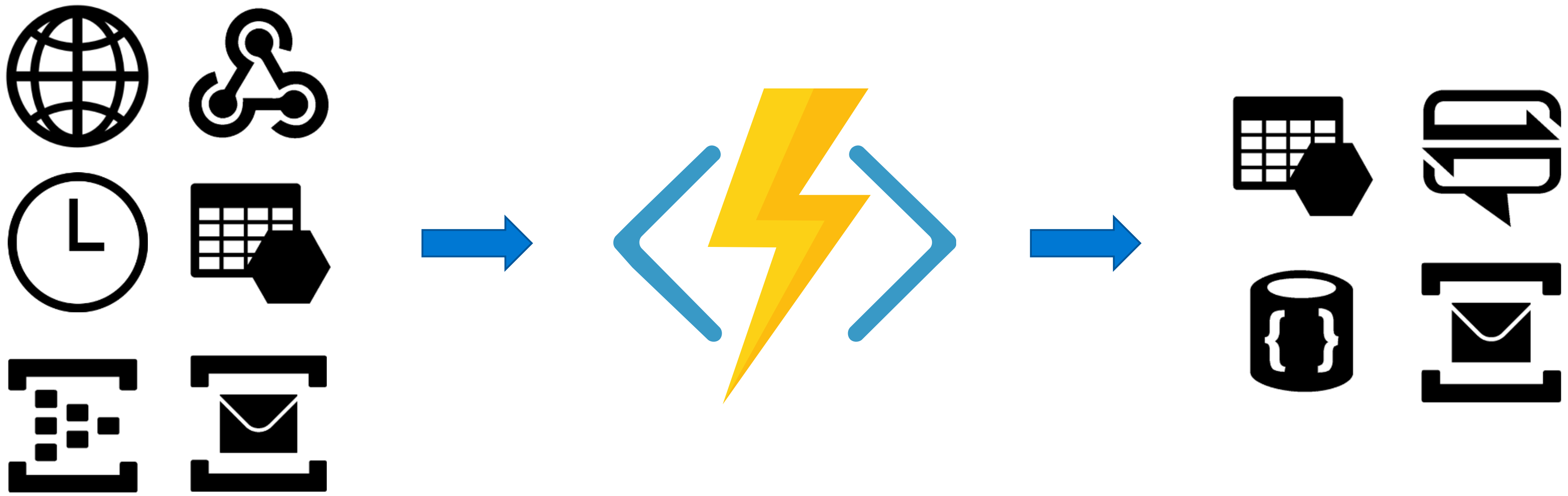
Paranormal Trainer, with the head in the Cloud and all the REST in microservices!

massimo.bonanni@microsoft.com
@massimobonanni

The issue….

If you want to use **Azure Functions** as a components of your **Enterprise solutions,** you **must** to test and monitor them!!!

What are Azure Functions



Events

React to timers, HTTP, or events from your favorite Azure services, with more on the way

Code

Author functions in C#, F#, Node.JS, Java, Powershell, and more

Outputs

Send results to an ever-growing collection of services

What is a Unit Test

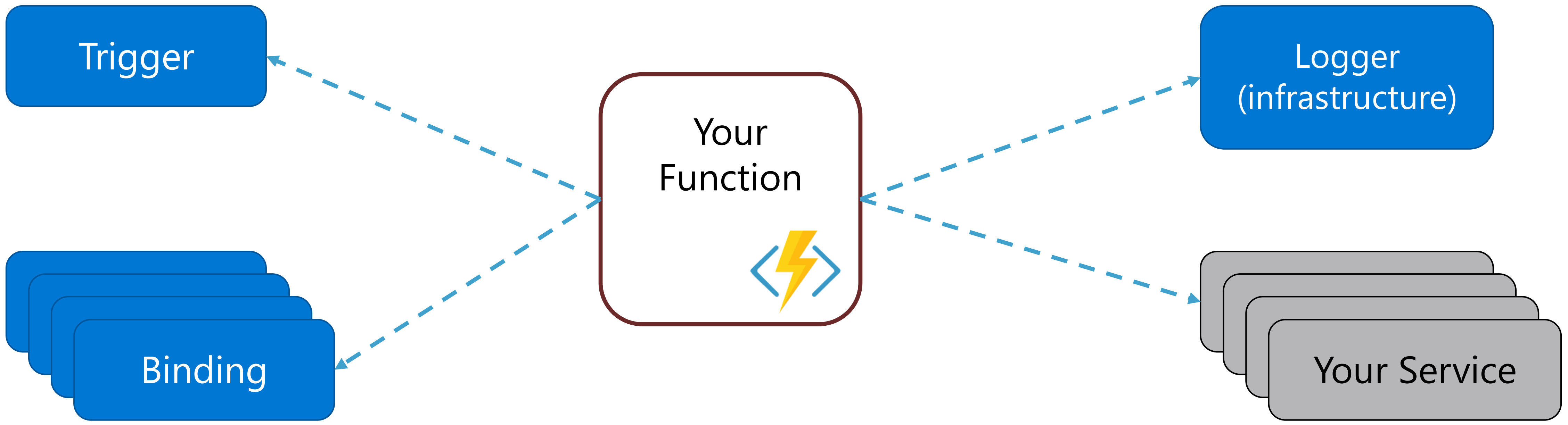
In a **unit test** you invoke a piece of your code with a set of parameters and you checks the correctness its behavior.

In a **unit test** you must substitute all your external reference with a **mock** or **stub**.

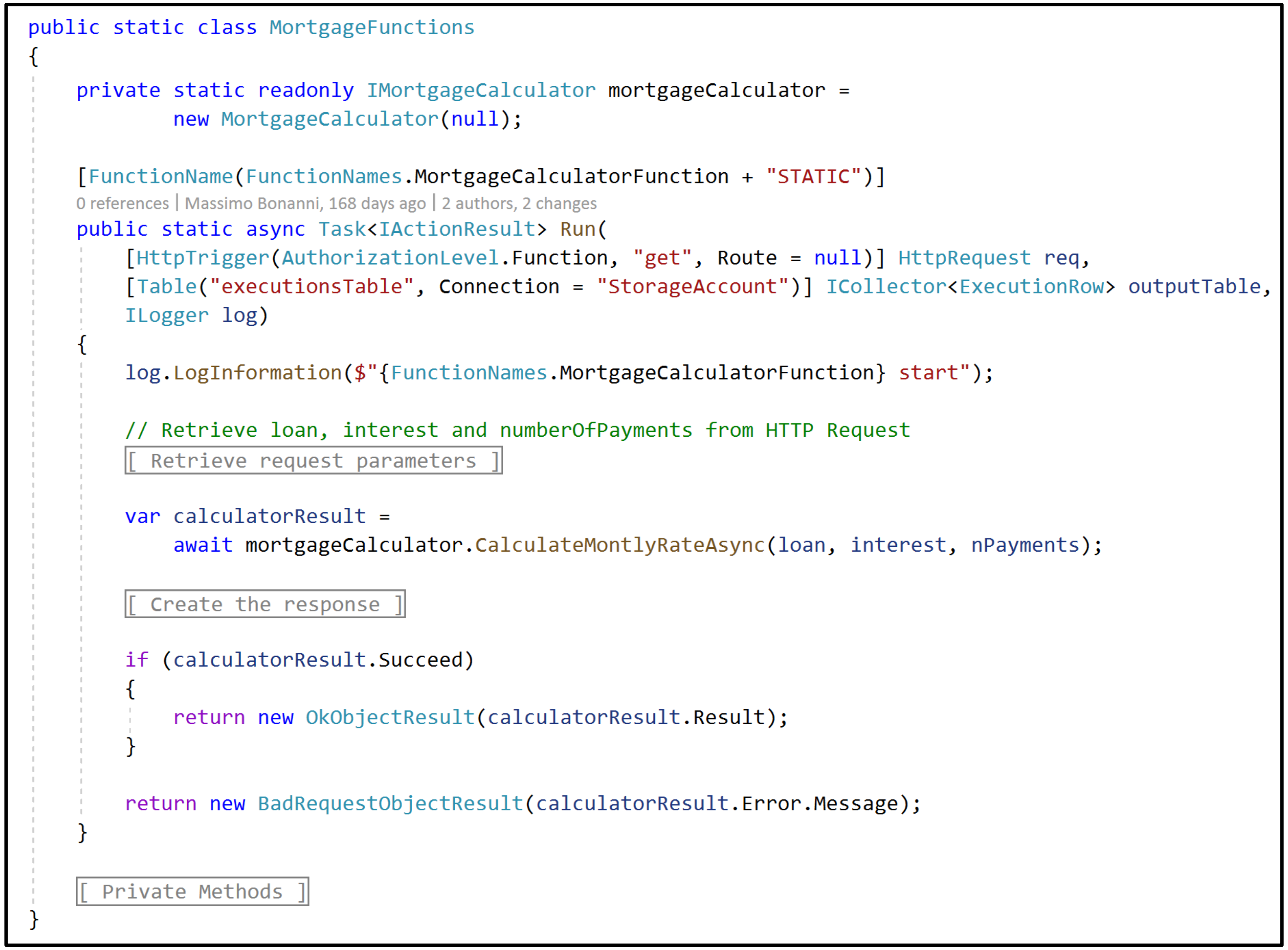
Mock *is for the software what a* ***dummy*** *is for a car crash test (you don't test a car with a human being inside…I Hope!!)*

Azure Functions Dependencies

You **should implement** your Azure Functions to allow you to use mock/stub for all external reference!



Azure Function … untestable!!



```
public static class MortgageFunctions
{
    private static readonly IMortgageCalculator mortgageCalculator =
            new MortgageCalculator(null);

    [FunctionName(FunctionNames.MortgageCalculatorFunction + "STATIC")]
    0 references | Massimo Bonanni, 168 days ago | 2 authors, 2 changes
    public static async Task<IActionResult> Run(
        [HttpTrigger(AuthorizationLevel.Function, "get", Route = null)] HttpRequest req,
        [Table("executionsTable", Connection = "StorageAccount")] ICollector<ExecutionRow> outputTable,
        ILogger log)
    {
        log.LogInformation($"{FunctionNames.MortgageCalculatorFunction} start");

        // Retrieve loan, interest and numberOfPayments from HTTP Request
        [ Retrieve request parameters ]

        var calculatorResult =
            await mortgageCalculator.CalculateMontlyRateAsync(loan, interest, nPayments);

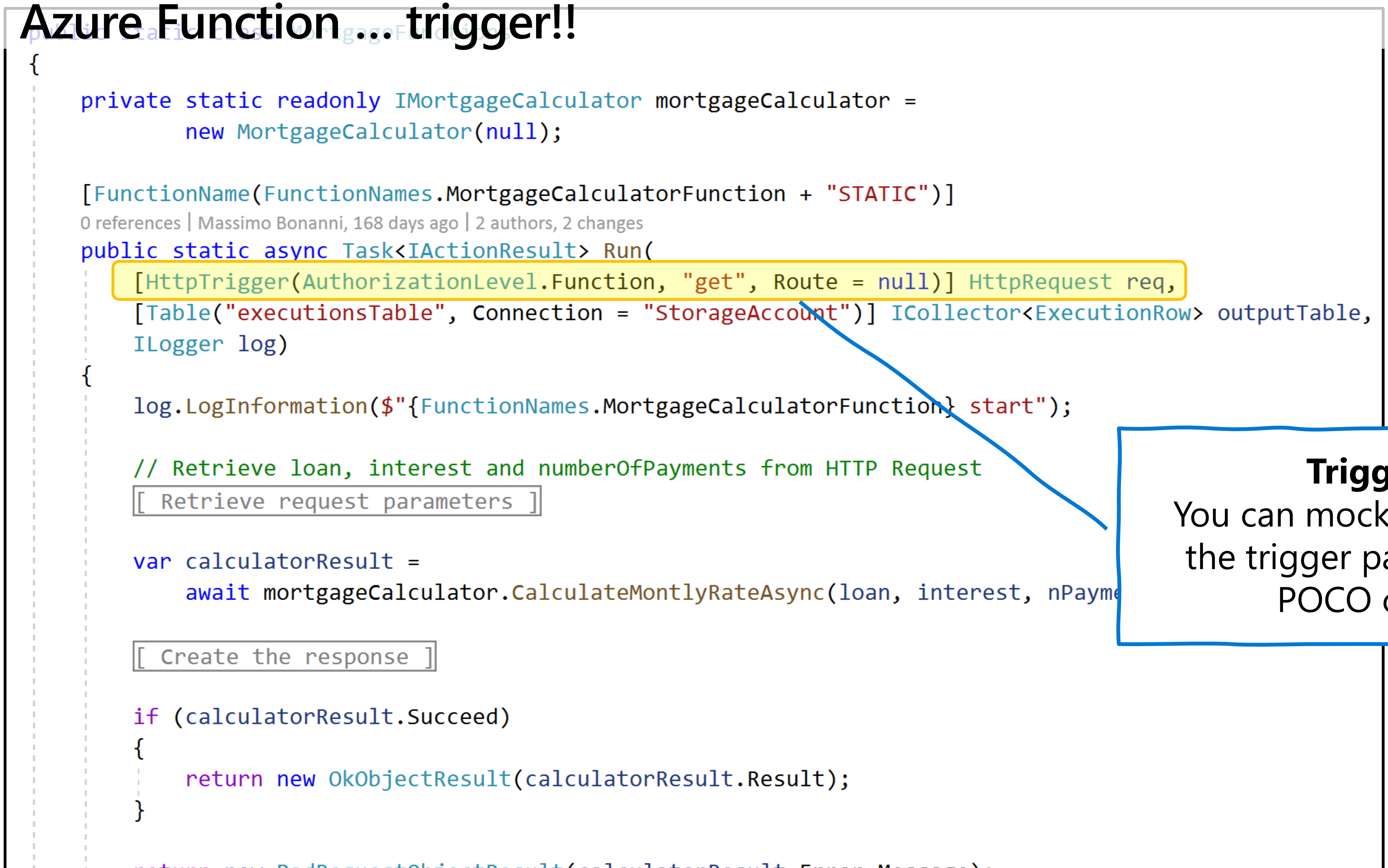
        [ Create the response ]

        if (calculatorResult.Succeed)
        {
            return new OkObjectResult(calculatorResult.Result);
        }

        return new BadRequestObjectResult(calculatorResult.Error.Message);
    }

    [ Private Methods ]
}
```

Azure Function … trigger!!



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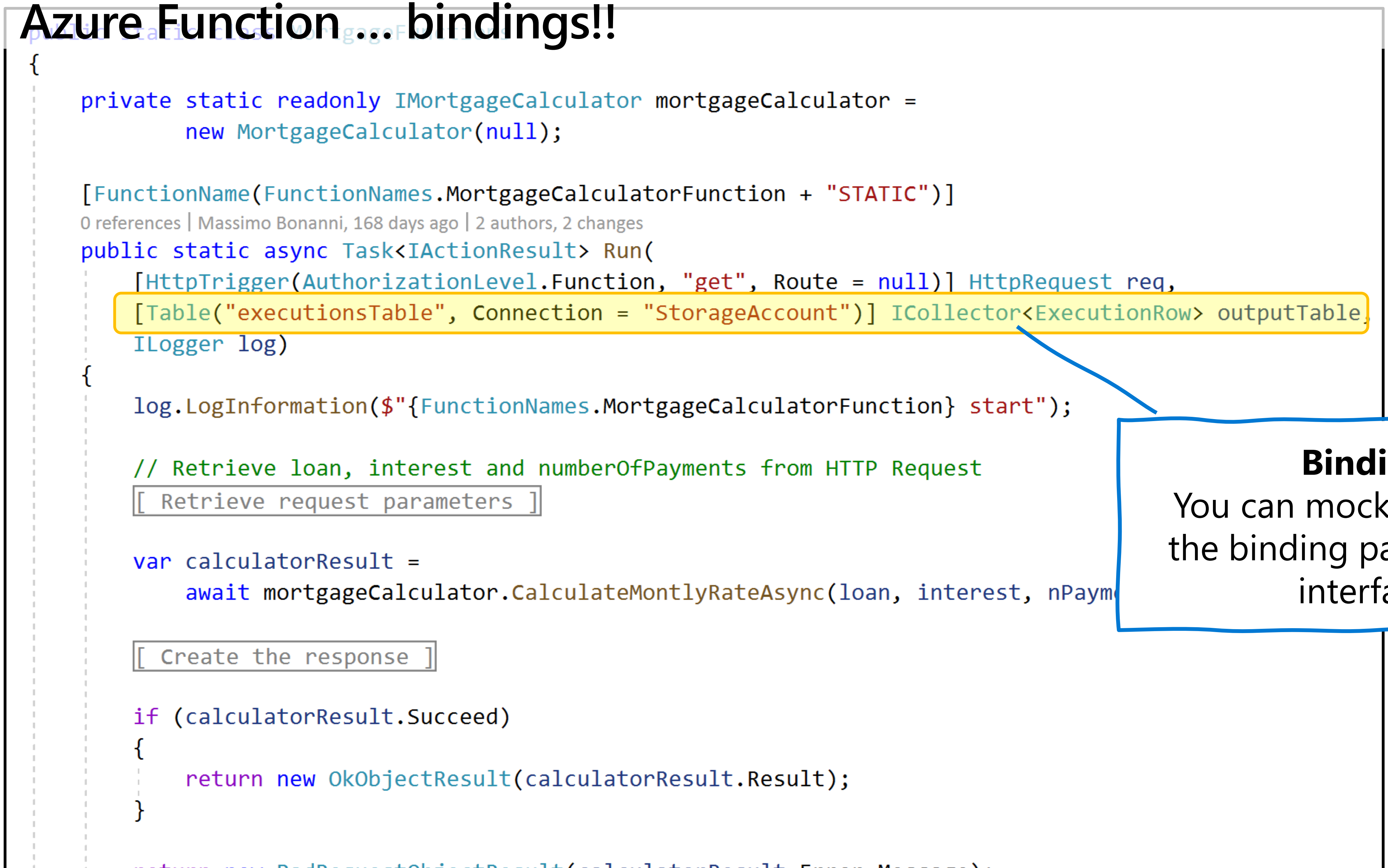
```

Trigger
You can mock it because the trigger payload is a POCO class

Azure Function … bindings!!



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        [ Create the response ]

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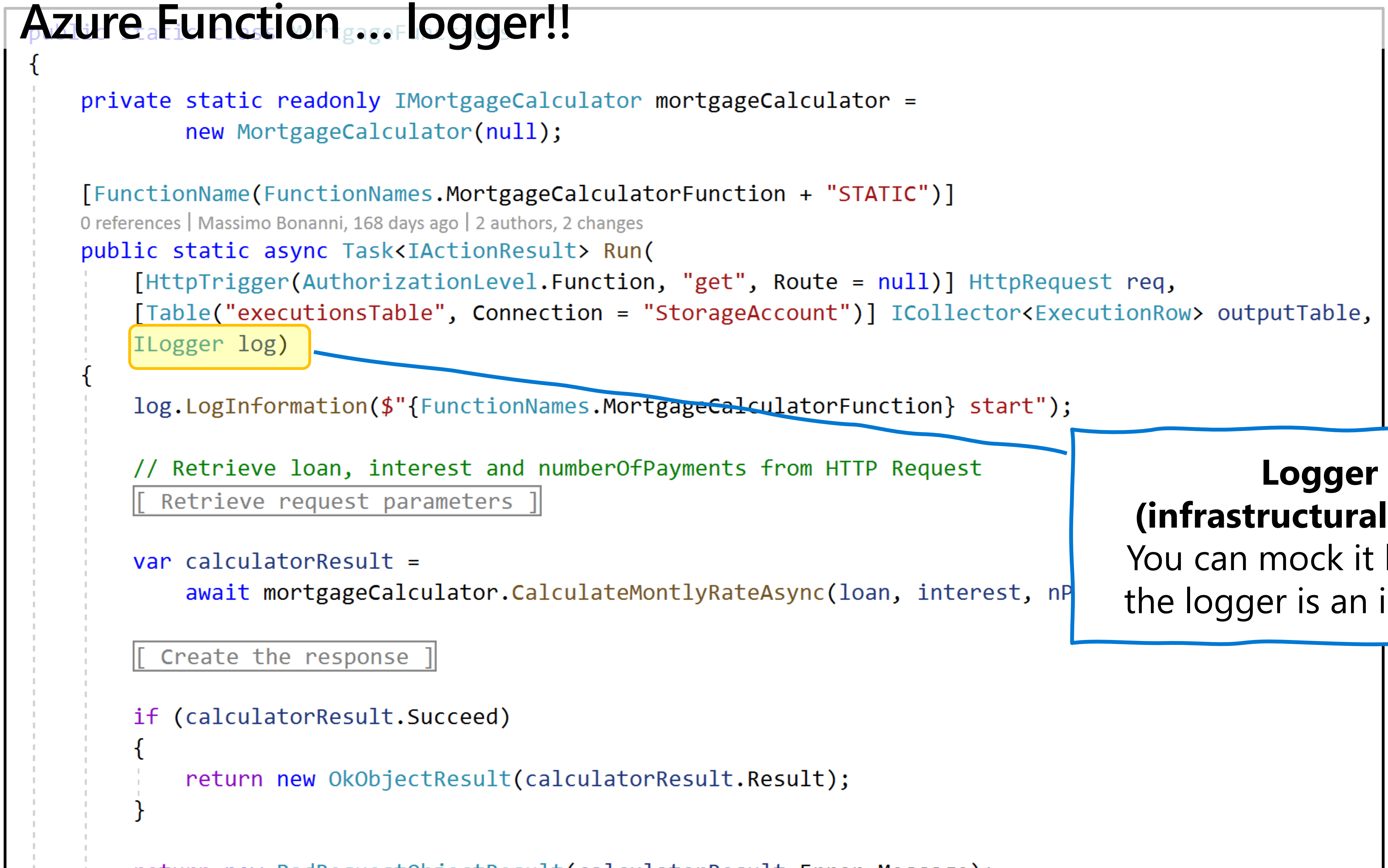
        }
```

Binding
You can mock it because the binding payload is an interface

Azure Function … logger!!



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    [FunctionName(FunctionNames.MortgageCalculatorFunction + "STATIC")]
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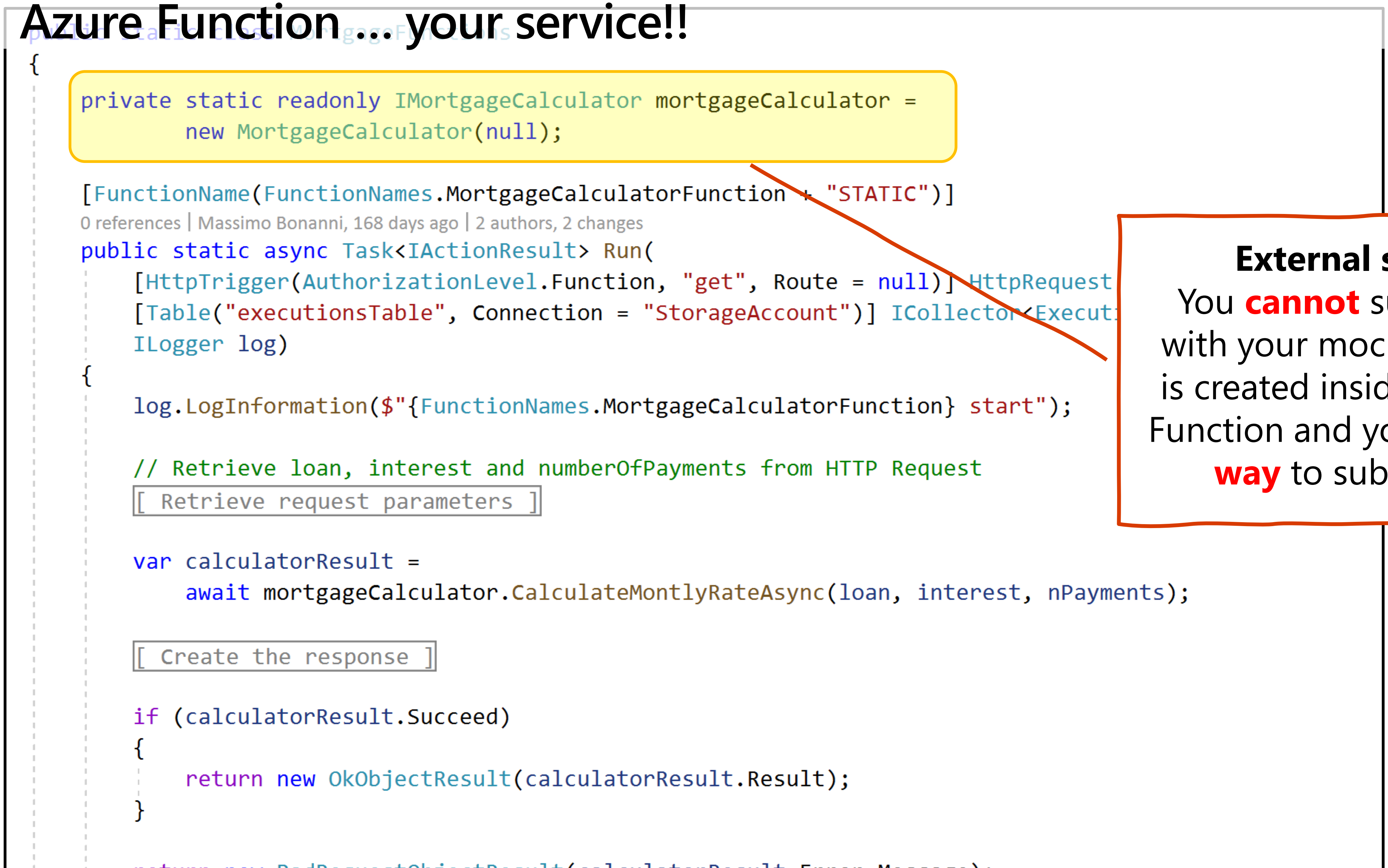
        }

        return new BadRequestObjectResult(calculatorResult.ErrorMessage);
```

Logger
(infrastructural stuffs)
You can mock it because the logger is an interface

Azure Function … your service!!



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            return new OkObjectResult(calculatorResult.Result);
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        return new BadRequestObjectResult(calculatorResult.ErrorMessage);
```

External service

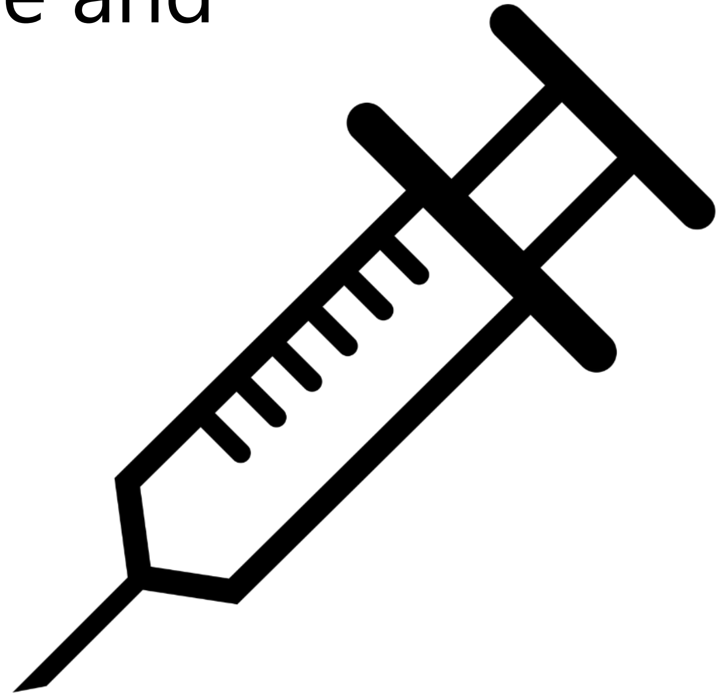
You **cannot** substitute it with your mock because it is created inside the Azure Function and you **haven't a way** to substitute it

Make your Azure Function testable!!!

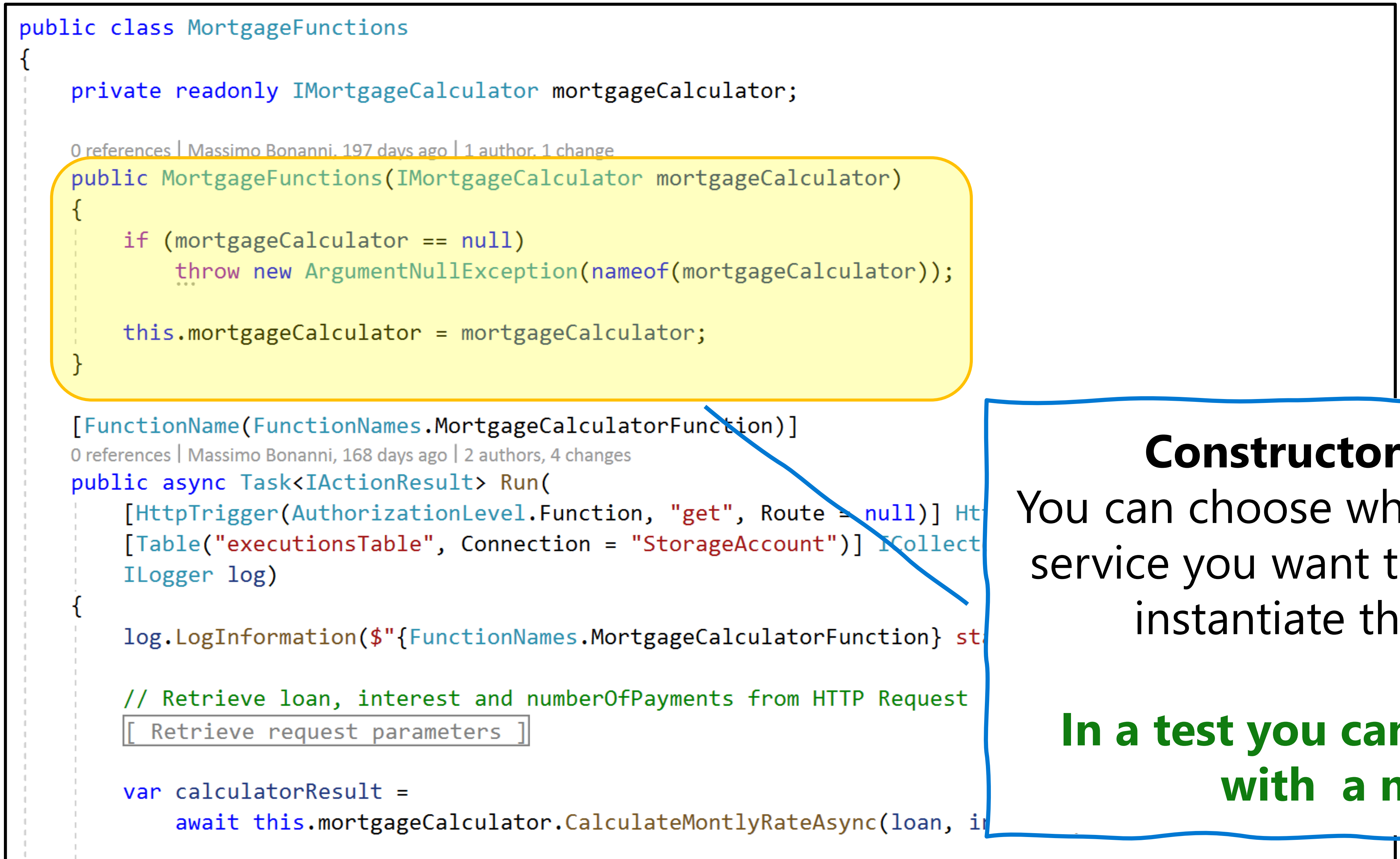
The solution of your problem is: **Dependency Injection !!**

Azure Functions Runtime is based on .NET Core and supports the same ASP.NET Core Dependency Injection framework!!!

Using Dependency Injection you provide a way to substitute your Services with a mock!



Azure Function … testable!!



```
public class MortgageFunctions
{
    private readonly IMortgageCalculator mortgageCalculator;

    0 references | Massimo Bonanni, 197 days ago | 1 author, 1 change
    public MortgageFunctions(IMortgageCalculator mortgageCalculator)
    {
        if (mortgageCalculator == null)
            throw new ArgumentNullException(nameof(mortgageCalculator));

        this.mortgageCalculator = mortgageCalculator;
    }

    [FunctionName(FunctionNames.MortgageCalculatorFunction)]
    0 references | Massimo Bonanni, 168 days ago | 2 authors, 4 changes
    public async Task<IActionResult> Run(
        [HttpTrigger(AuthorizationLevel.Function, "get", Route = null)] Ht
        [Table("executionsTable", Connection = "StorageAccount")] ICollect
        ILogger log)
    {
        log.LogInformation($"{FunctionNames.MortgageCalculatorFunction} st

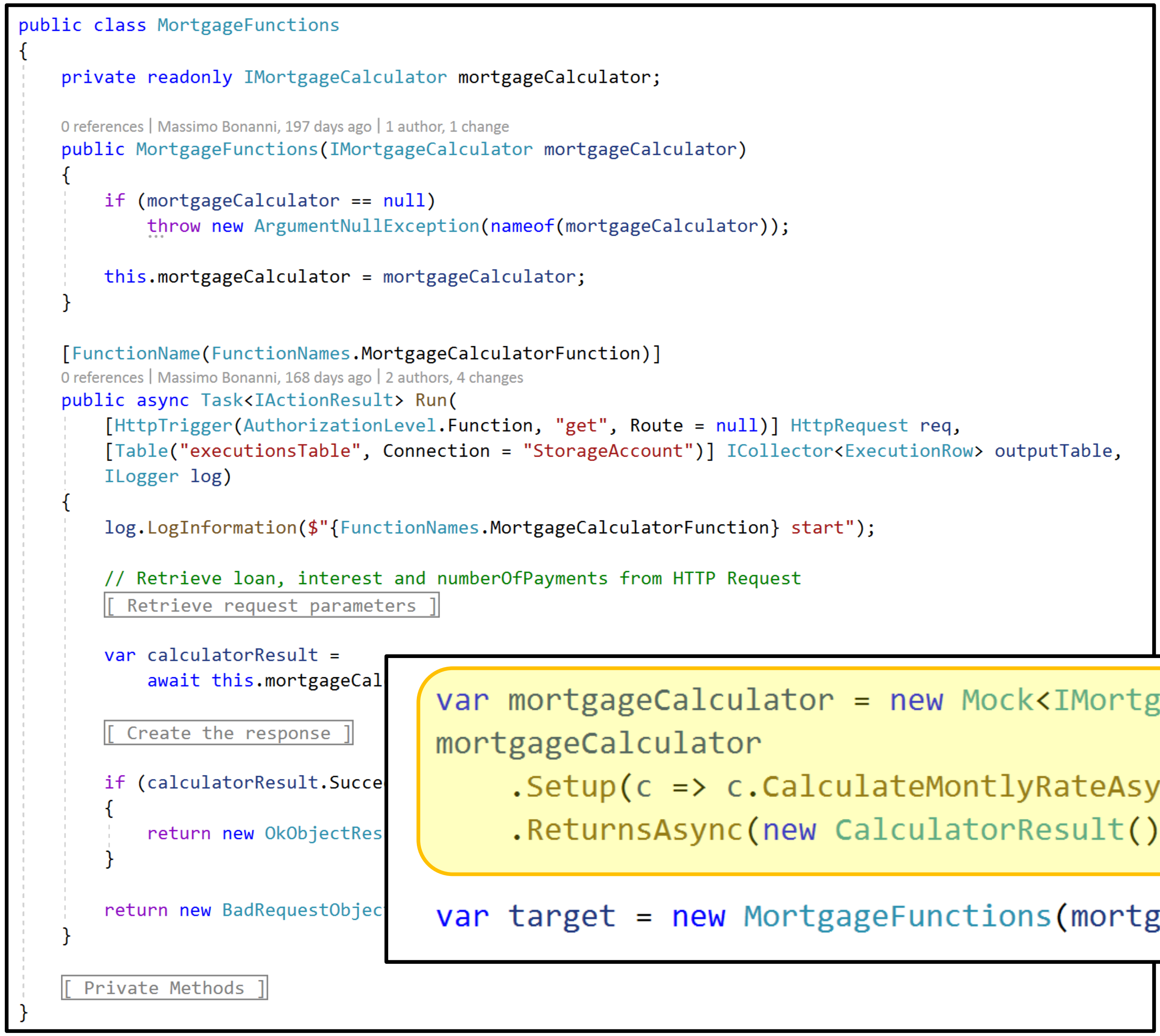
        // Retrieve loan, interest and numberOfPayments from HTTP Request
        [ Retrieve request parameters ]

        var calculatorResult =
            await this.mortgageCalculator.CalculateMontlyRateAsync(loan, in
```

Constructor Injection
You can choose what kind of actual service you want to use when you instantiate the function.

In a test you can substitute it with a mock!!

Azure Function … how to use mock!!



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    {
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        [ Retrieve request parameters ]

        var calculatorResult =
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        [ Create the response ]

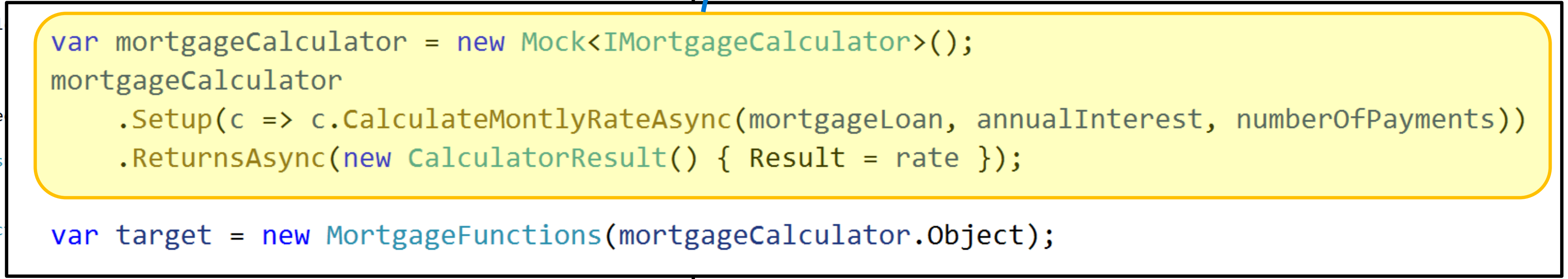
        if (calculatorResult.Succe
        {
            return new OkObjectRes
        }

        return new BadRequestObjec
    }

    [ Private Methods ]
}
```

Mock

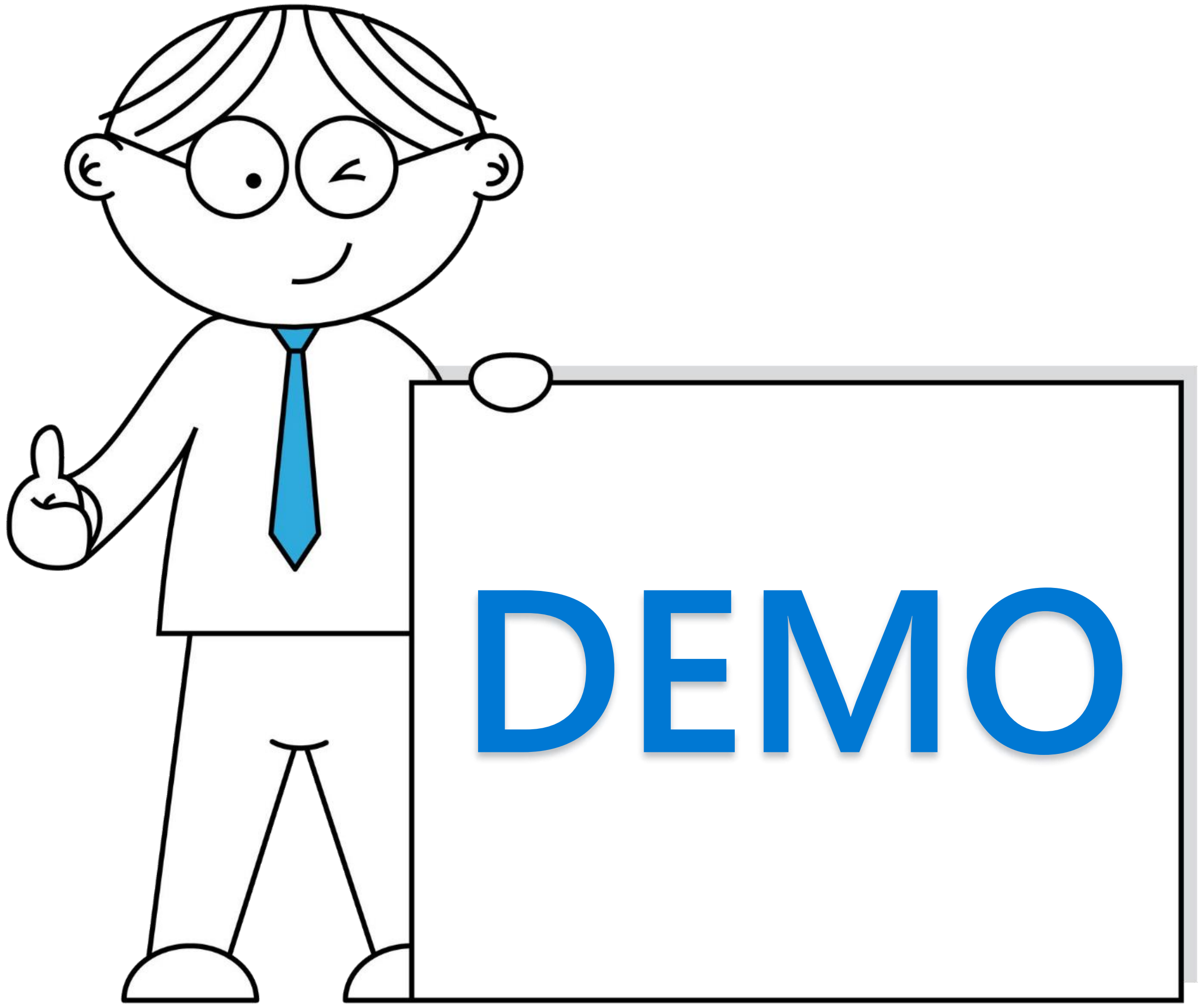
Create a mock to use in the test!!



```
var mortgageCalculator = new Mock<IMortgageCalculator>();
mortgageCalculator
    .Setup(c => c.CalculateMontlyRateAsync(mortgageLoan, annualInterest, numberOfPayments))
    .ReturnsAsync(new CalculatorResult() { Result = rate });

var target = new MortgageFunctions(mortgageCalculator.Object);
```

Azure Functions Unit Testing

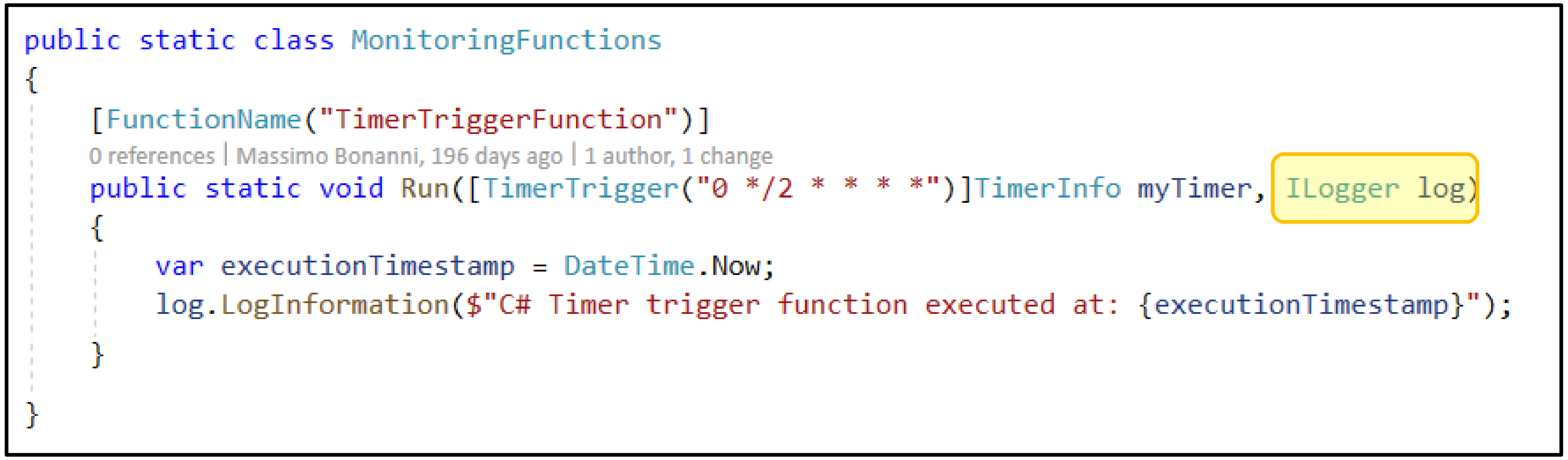


Monitoring Azure Functions

Once you deploy your Azure Functions on Azure, you need to monitor them to check when something goes wrong.

The signature of an Azure Function method provides the instance of **ILogger** that you can use to log information about your code.

Using **ILogger**, you can collect information from your code execution to monitor and triage errors and exceptions.

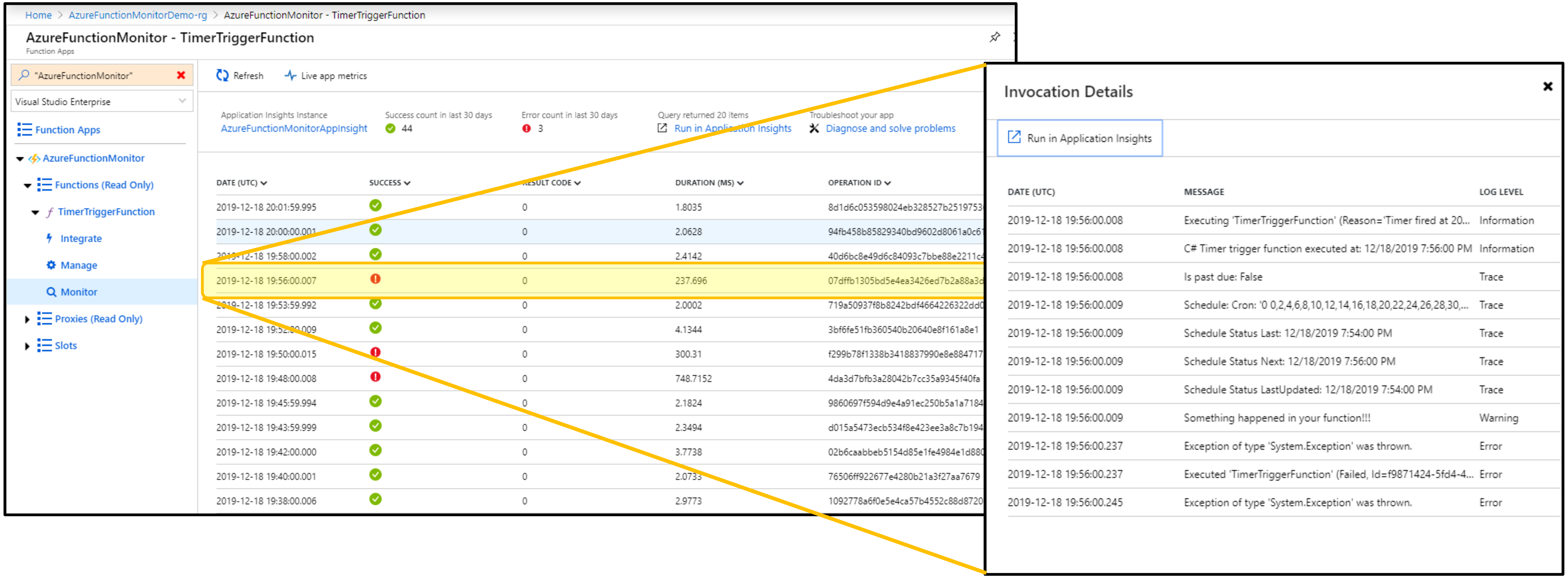


```
public static class MonitoringFunctions
{
    [FunctionName("TimerTriggerFunction")]
    0 references | Massimo Bonanni, 196 days ago | 1 author, 1 change
    public static void Run([TimerTrigger("0 */2 * * * *")]TimerInfo myTimer, ILogger log)
    {
        var executionTimestamp = DateTime.Now;
        log.LogInformation($"C# Timer trigger function executed at: {executionTimestamp}");
    }
}
```

Azure Functions Monitor

Azure Functions provide out-of-the-box monitor feature.

For each Function, you have info about every function execution.



AzureFunctionMonitor - TimerTriggerFunction
Function Apps

Application Insights Instance: AzureFunctionMonitorAppInsight
Success count in last 30 days: ✓ 44
Error count in last 30 days: ❗ 3
Query returned 20 items: Run in Application Insights
Troubleshoot your app: Diagnose and solve problems

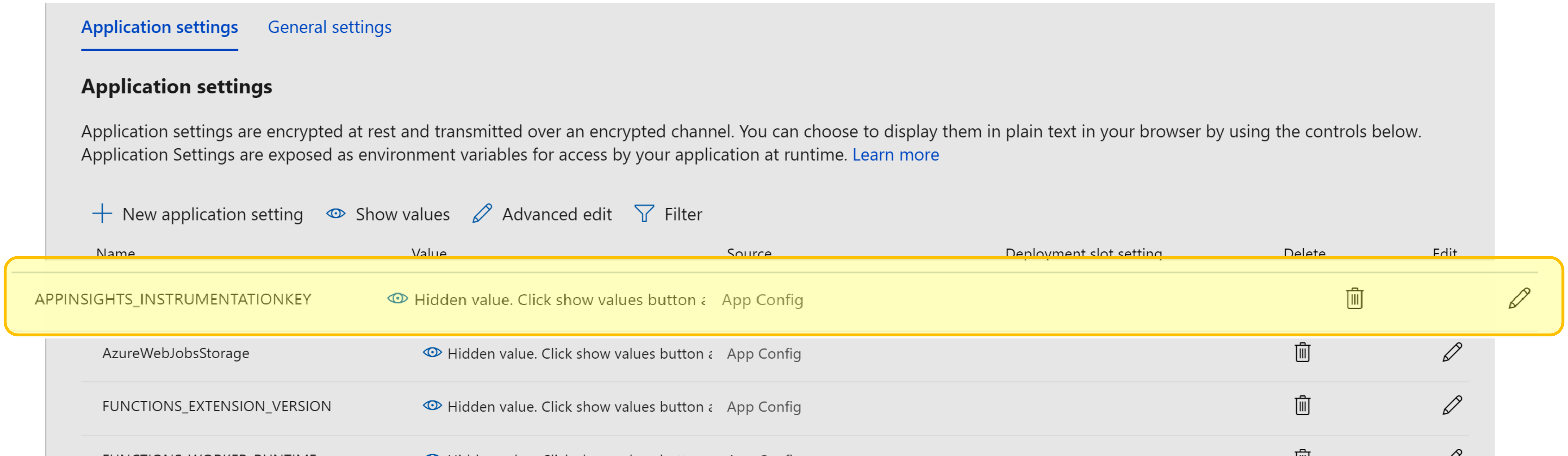
DATE (UTC)	SUCCESS	RESULT CODE	DURATION (MS)	OPERATION ID
2019-12-18 20:01:59.995	✓	0	1.8035	8d1d6c053598024eb328527b2519753
2019-12-18 20:00:00.001	✓	0	2.0628	94fb458b85829340bd9602d8061a0c61
2019-12-18 19:58:00.002	✓	0	2.4142	40d6bc8e49d6c84093c7bbe88e2211c4
2019-12-18 19:56:00.007	❗	0	237.696	07dffb1305bd5e4ea3426ed7b2a88a3d
2019-12-18 19:53:59.992	✓	0	2.0002	719a50937f8b8242bdf4664226322dd0
2019-12-18 19:52:00.009	✓	0	4.1344	3bf6fe51fb360540b20640e8f161a8e1
2019-12-18 19:50:00.015	❗	0	300.31	f299b78f1338b3418837990e8e884717
2019-12-18 19:48:00.008	❗	0	748.7152	4da3d7bfb3a28042b7cc35a9345f40fa
2019-12-18 19:45:59.994	✓	0	2.1824	9860697f594d9e4a91ec250b5a1a7184
2019-12-18 19:43:59.999	✓	0	2.3494	d015a5473ecb534f8e423ee3a8c7b194
2019-12-18 19:42:00.000	✓	0	3.7738	02b6caabbeb5154d85e1fe4984e1d880
2019-12-18 19:40:00.001	✓	0	2.0733	76506ff922677e4280b21a3f27aa7679
2019-12-18 19:38:00.006	✓	0	2.9773	1092778a6f0e5e4ca57b4552c88d8720

DATE (UTC)	MESSAGE	LOG LEVEL
2019-12-18 19:56:00.008	Executing 'TimerTriggerFunction' (Reason='Timer fired at 20...	Information
2019-12-18 19:56:00.008	C# Timer trigger function executed at: 12/18/2019 7:56:00 PM	Information
2019-12-18 19:56:00.008	Is past due: False	Trace
2019-12-18 19:56:00.009	Schedule: Cron: '0 0,2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,...	Trace
2019-12-18 19:56:00.009	Schedule Status Last: 12/18/2019 7:54:00 PM	Trace
2019-12-18 19:56:00.009	Schedule Status Next: 12/18/2019 7:56:00 PM	Trace
2019-12-18 19:56:00.009	Schedule Status LastUpdated: 12/18/2019 7:54:00 PM	Trace
2019-12-18 19:56:00.009	Something happened in your function!!!	Warning
2019-12-18 19:56:00.237	Exception of type 'System.Exception' was thrown.	Error
2019-12-18 19:56:00.237	Executed 'TimerTriggerFunction' (Failed, Id=f9871424-5fd4-4...	Error
2019-12-18 19:56:00.245	Exception of type 'System.Exception' was thrown.	Error

Azure Functions and Application Insight

The Azure Functions platform offers built-in integration with Azure Application Insights.

Put the **Application Insights instrumentation key** in the function app settings.



Application settings | General settings

Application settings

Application settings are encrypted at rest and transmitted over an encrypted channel. You can choose to display them in plain text in your browser by using the controls below. Application Settings are exposed as environment variables for access by your application at runtime. Learn more

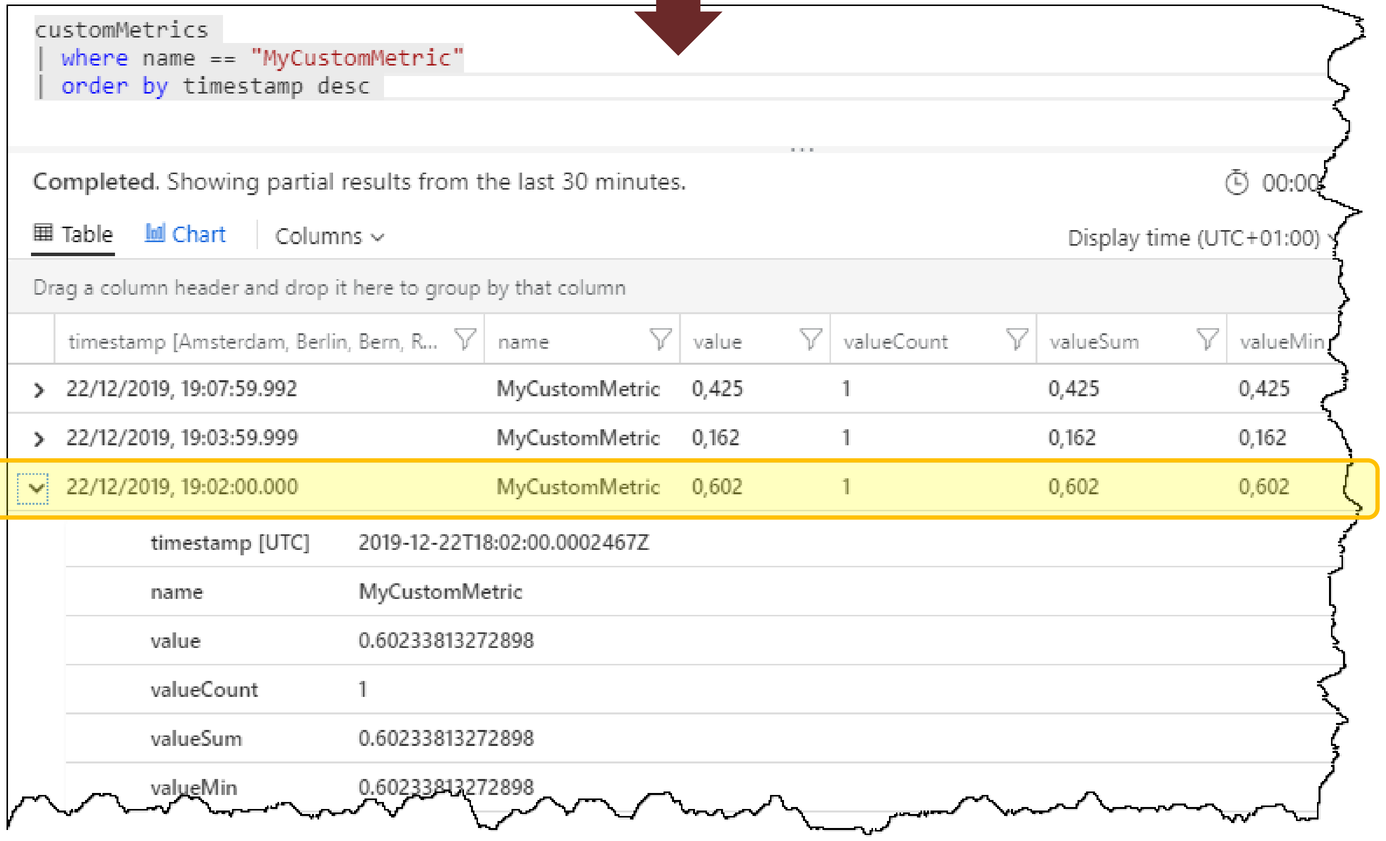
+ New application setting | Show values | Advanced edit | Filter

Name	Value	Source	Deployment slot setting	Delete	Edit
APPINSIGHTS_INSTRUMENTATIONKEY	Hidden value. Click show values button a	App Config			
AzureWebJobsStorage	Hidden value. Click show values button a	App Config			
FUNCTIONS_EXTENSION_VERSION	Hidden value. Click show values button a	App Config			

Custom Metric

Azure Function SDK provides you extension methods to log custom metrics.

```
log.LogMetric("MyCustomMetric", CalculateMyCustomMetric());
```



```
customMetrics
| where name == "MyCustomMetric"
| order by timestamp desc
```

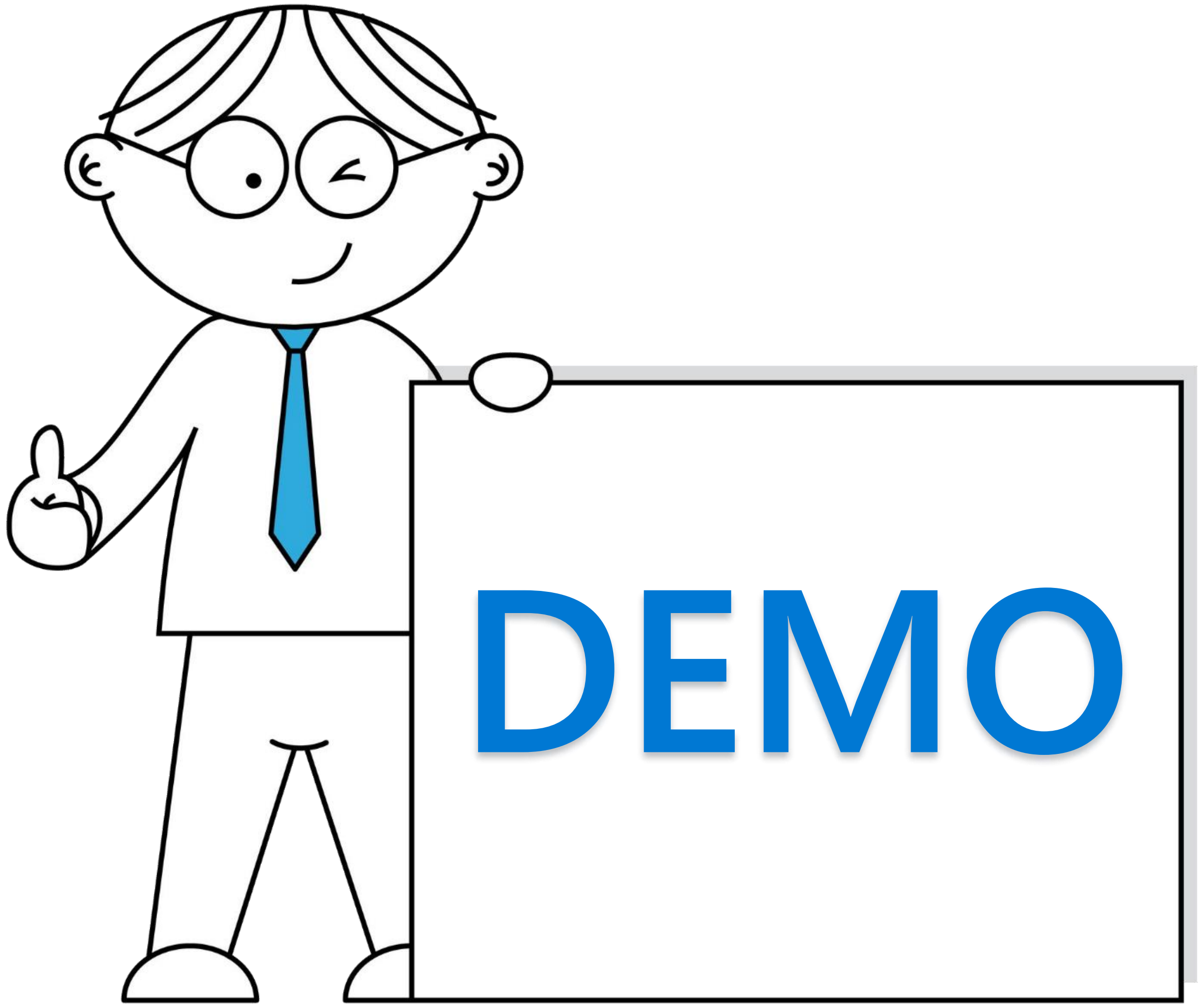
Completed. Showing partial results from the last 30 minutes. 00:00

Table
Chart
Columns
Display time (UTC+01:00)
Drag a column header and drop it here to group by that column

timestamp [Amsterdam, Berlin, Bern, R...	name	value	valueCount	valueSum	valueMin
22/12/2019, 19:07:59.992	MyCustomMetric	0,425	1	0,425	0,425
22/12/2019, 19:03:59.999	MyCustomMetric	0,162	1	0,162	0,162
22/12/2019, 19:02:00.000	MyCustomMetric	0,602	1	0,602	0,602

timestamp [UTC]	2019-12-22T18:02:00.0002467Z
name	MyCustomMetric
value	0.60233813272898
valueCount	1
valueSum	0.60233813272898
valueMin	0.60233813272898

Azure Functions Monitoring



Take away

Writing an Azure Functions is **simple**!

Testing Azure Functions is **simple**!

Monitoring Azure Functions is **simple**!

…. then ….

KEEP

CALM

AND

USE

AZURE FUNCTIONS

Thanks for your attention!!!!!

Connect with me on LinkedIn

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Azure Technical Trainer @ Microsoft

massimo.bonanni@microsoft.com
@massimobonanni

Mastering
Azure Serverless Computing
A practical guide to buil
applications using Azure
Packt>
www.packt.com
Lorenzo Barbieri and Massimo Bonanni

http://bit.ly/MasteringServerless

Q&A

References

- Azure Functions Documentation
  https://docs.microsoft.com/en-US/azure/azure-functions/
- Azure Functions Code Samples
  https://azure.microsoft.com/en-us/resources/samples/?service=functions&sort=0
- Azure Updates
  https://azure.microsoft.com/en-us/roadmap/?category=compute
- Demo MortgageCalculator – GitHub

  http://bit.ly/TestAZFunc
- Demo Monitor Azure Functions – GitHub
  http://bit.ly/MonitorAZFunc