



Logs, Metrics, Distributed Tracing and OpenTelemetry

Christian Nagel

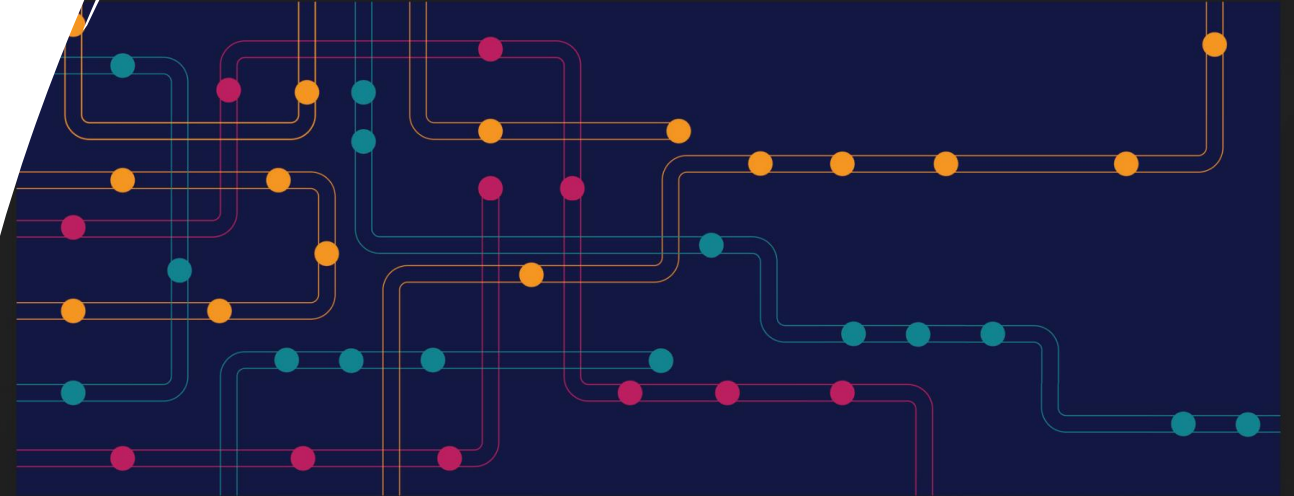
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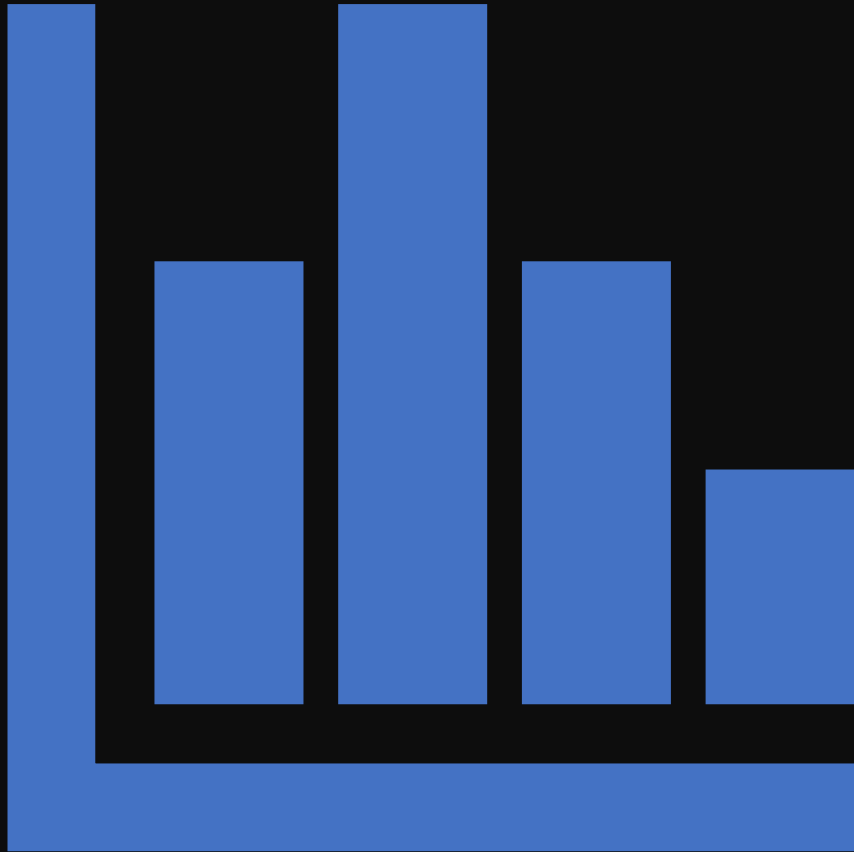
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1ST EDITION

Pragmatic Microservices with C# and Azure

Build, deploy, and scale microservices efficiently
to meet modern software demands



Topics

- Implementing
 - Logging
 - Metrics
 - Distributed Tracing
 - Displaying
 - .NET Aspire Dashboard
 - Prometheus and Grafana
 - Application Insights
-

Logging



Logging use cases



MONITOR APPLICATION
BEHAVIOR



DIAGNOSE ISSUES

3 important parts

Providers

- Where is the message written to

Sources

- Who is logging

Levels

- How important is the message

Log Providers

- Console
 - Write messages to the console
- Debug
 - `System.Diagnostics.Debug`
- EventSource
 - Name: Microsoft-Extensions-Logging
- EventLog
 - Only on Windows

Hierarchical Named Log Sources

- *Microsoft.EntityFrameworkCore*
- *Microsoft.AspNetCore.Server.Kestrel*
- *Microsoft.AspNetCore.Mvc.Infrastructure.ControllerActionInvoker*
- *Yarp*
- *System.Net.Http*
- ...

Log Levels

- *Trace*
- *Debug*
- *Information*
- *Warning*
- *Error*
- *Critical*



Filtering

Filter logging based on providers, sources, and log levels

Creating Logs

ILogger and *ILoggerFactory*

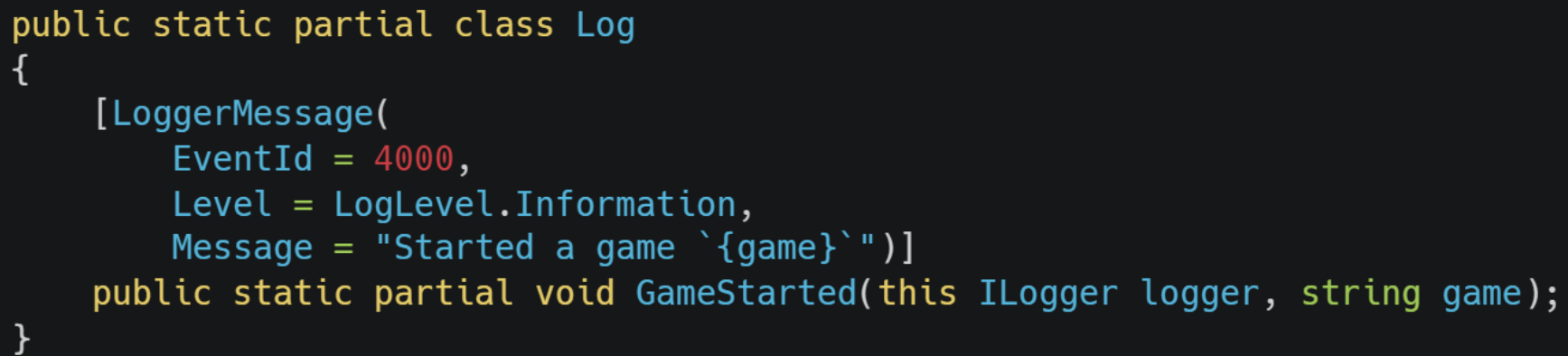
- Inject *ILogger<T>* to specify the log category
- Inject *ILoggerFactory* to specify the log category as string

Structured / Semantic Logging

- Don't use interpolated strings with logging
- *Log* methods use **templates**
- Placeholder names can be used for filtering

Source generated logging

Prefer source generated logging



```
public static partial class Log
{
    [LoggerMessage(
        EventId = 4000,
        Level = LogLevel.Information,
        Message = "Started a game `{game}`")]
    public static partial void GameStarted(this ILogger logger, string game);
}
```

Check event log level for complex parameters

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Metrics

Metrics use cases

- Monitor system behavior
- Monitor solution behavior
- Trigger alerts
- Performance monitoring

Built-in .NET counters

- NET Runtime
- DI Container
- System.Net
- ASP.NET Core
- EF Core
- ...

.NET Tool

- dotnet counters

Metrics APIs

System.Diagnostics.Tracing.EventSource

- Available since .NET Core 3.1
- Derive from EventSource
- Logging and tracing events
- Limited count types
- Not OTEL compliant
- Preview libraries for OpenTelemetry

System.Diagnostics.Metrics.Meter

- Available since .NET 6
- Use Meter class
- Only metrics
- Advanced features
- OTEL compliant
- Supports OpenTelemetry

Writing custom counts

- Meter
 - Track instruments
- Counter
 - Requests per second or cumulative total
- UpDownCounter
 - Report positive and negative numbers
- Gauge
 - Non-additive values (e.g. room temperature)
- Histogram
 - Arbitrary values likely to be statistic meaningful
- Observable[Counter | UpDownCounter | Gauge]
 - Delegate invoked to retrieve value

.NET 8 Metrics Updates

- *AddMetrics* – register with DI container
- *IMeterFactory*
 - create multiple meters
- *MetricCollector*
 - Record metric measurements

The background of the slide is a dark green field filled with a complex network of glowing green lines and semi-transparent blue circles of various sizes. The lines and nodes are interconnected, creating a sense of a dynamic, distributed system. The text 'Distributed Tracing' is centered in the middle of the image.

Distributed Tracing

Distributed Tracing

- How do services communicate?
- Where did the error originate?
- Which service is a bottleneck?
- What services are dependent on others?





.NET Activity

- Id
 - Hierarchical structure
 - separated by '.' or '_'
- Tags
 - Information logged with activity
- Baggage
 - Logged with activity and passed to child
- Events
 - Time-stamped messages (e.g. "done now")

Distributed Tracing

- Trace information across service boundaries
- ActivitySource.StartActivity
 - Start an activity
 - Hierarchical ids (W3C TraceContextId)
 - ID passed with HTTP header
- Add Information
 - Tags (written to activity trace)
 - Baggage (written to activity trace and forwarded to child activities)



.NET Tools

dotnet trace

- Performance analysis

dotnet counters

- Investigate performance counters

dotnet monitor

- Processes, dumps traces, metrics, logs, operations...

OpenTelemetry



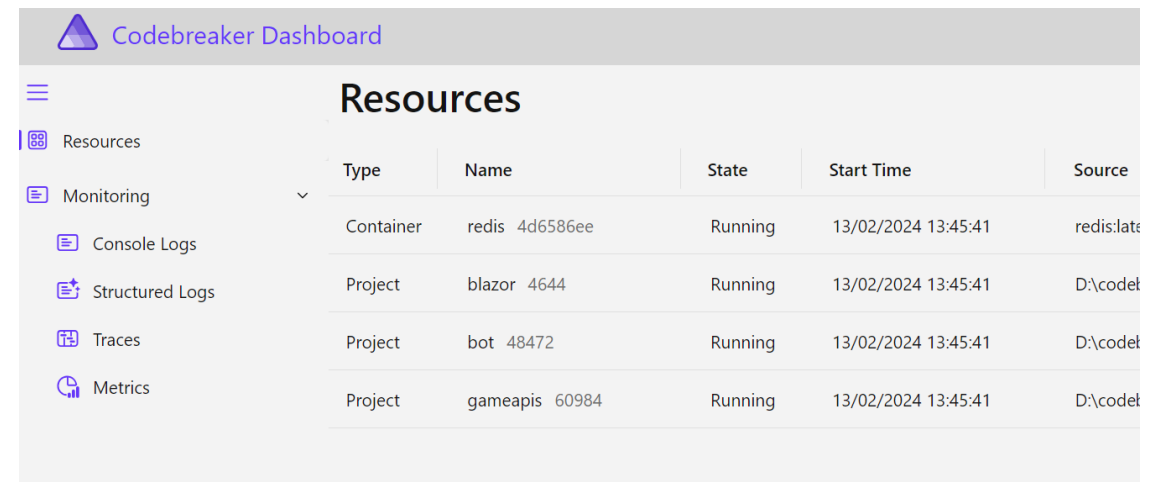
- <https://opentelemetry.io>
- Instrumentation
 - C++, .NET, Erlang/Elixir, Go, Java, JavaScript, PHP, Python, Ruby, Rust, Swift
- Collectors
 - Vendor-agnostic way to receive, process, export telemetry data

.NET Aspire
and more...



.NET Aspire Dashboard

- Resources
- Monitoring
 - Console Logs
 - Structured Logs
 - Traces
 - Metrics

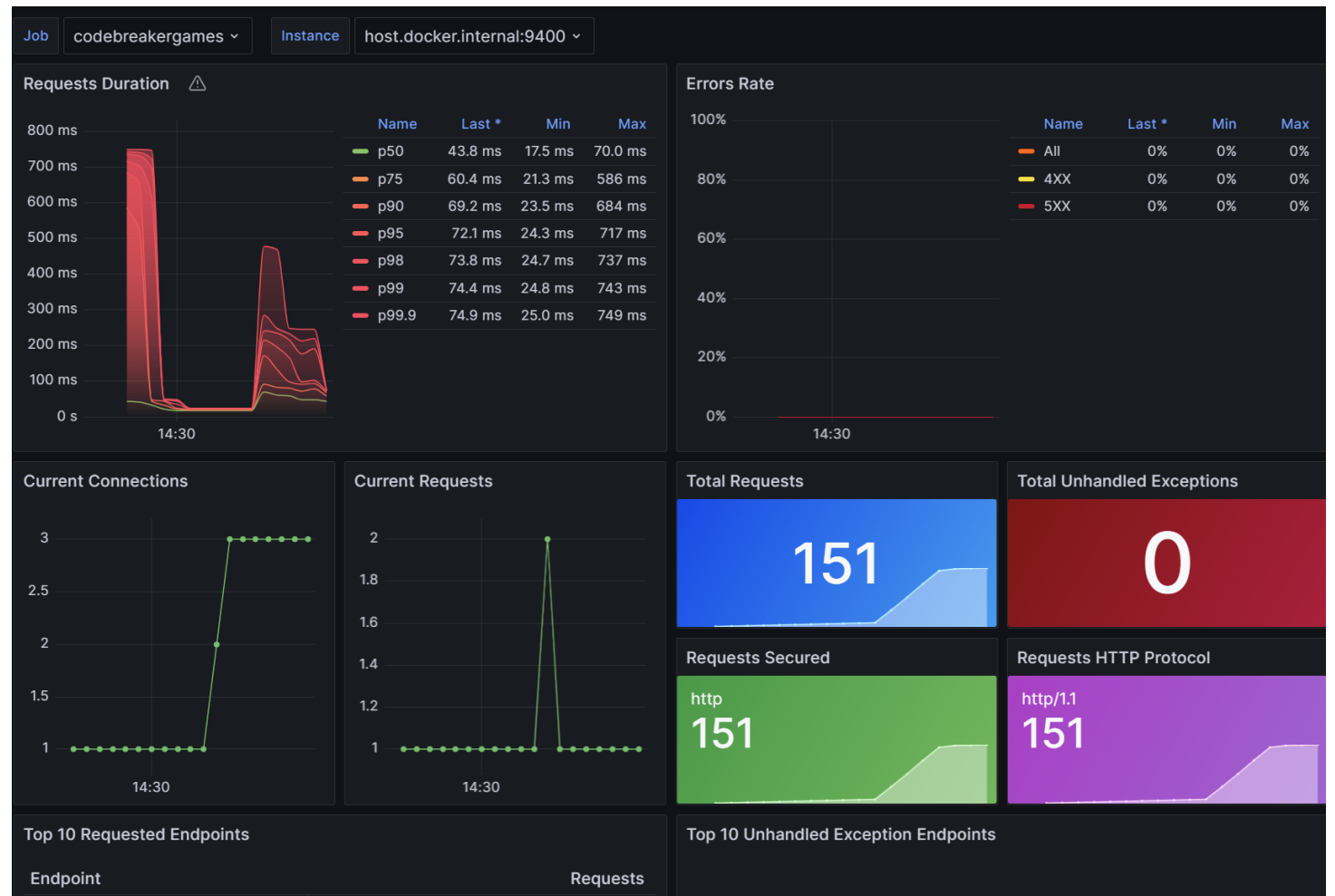


The screenshot shows the 'Codebreaker Dashboard' interface. On the left is a sidebar with a menu containing 'Resources' (selected), 'Monitoring', 'Console Logs', 'Structured Logs', 'Traces', and 'Metrics'. The main area is titled 'Resources' and contains a table with the following data:

Type	Name	State	Start Time	Source
Container	redis 4d6586ee	Running	13/02/2024 13:45:41	redis:lat
Project	blazor 4644	Running	13/02/2024 13:45:41	D:\code
Project	bot 48472	Running	13/02/2024 13:45:41	D:\code
Project	gameapis 60984	Running	13/02/2024 13:45:41	D:\code

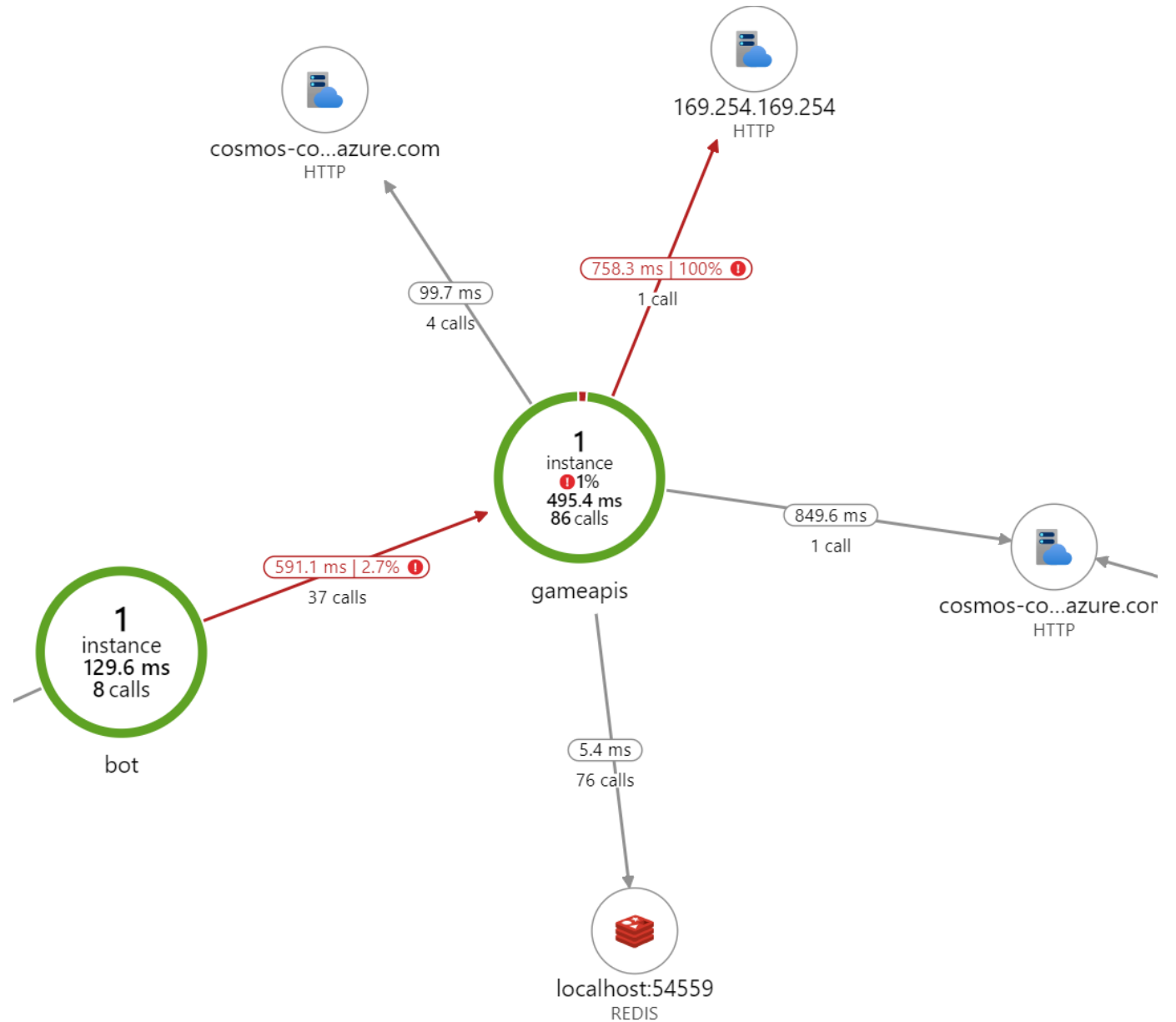
Prometheus and Grafana

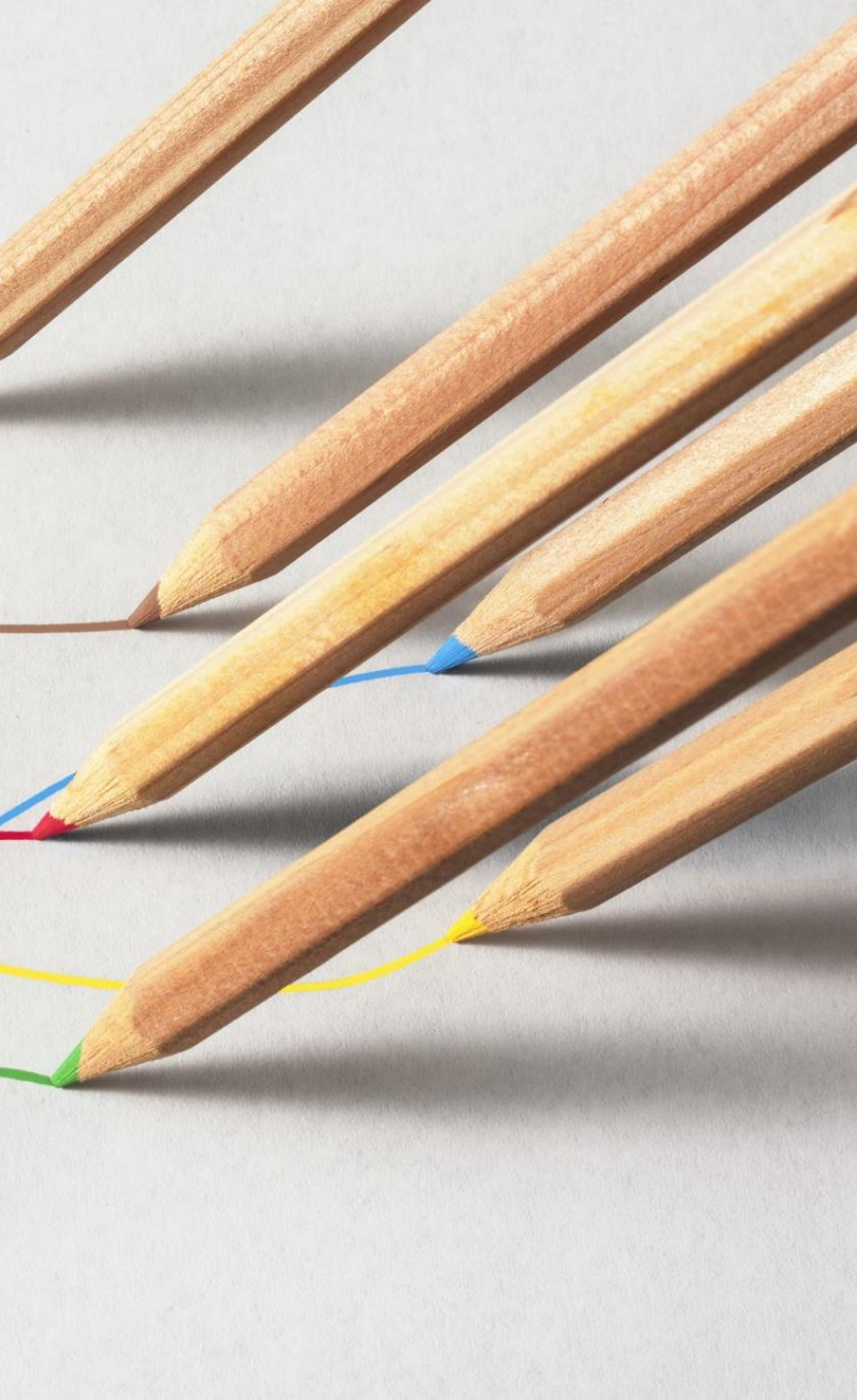
- Using Docker images
- ASP.NET Core configured dashboards



And Azure Log Analytics
Workspace

Application Insights





Summary

- Logging
- Metrics
- Distributed Tracing
- .NET Aspire



Thank you for joining!

Questions?

- <https://github.com/cnilearn/bastamainz2024>
- <https://csharp.christiannagel.com>
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