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TECH EVENTS WITH PERSPECTIVE
The Ultimate Education Destination
ORLANDO 2024

# Building and Deploying a .NET 9 App Using Azure, Bicep, and GitHub Actions

**Scott Sauber**
**Director of Engineering**
**Lean TECHniques**

Level: Introductory

# Session Survey

- Your feedback is very important to us
- Please take a moment to complete the session survey found in the mobile app
- Use the QR code or search for “Converge360 Events” in your app store
- Find this session on the Agenda tab
- Click “Session Evaluation”
- Thank you!

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# What you need

- .NET 9
- An Editor that supports .NET 9 and Bicep
  - Visual Studio 2022 Latest
  - Visual Studio Code
- Fork this repo:
  - https://github.com/scottsauber/workshop-dotnet-azure-github-bicep
  - Slides in root
- Download the Azure CLI
- Azure will be provided for free
- Please let Scott know the following if you're participating:
  - Email you will use for Azure
  - Your GitHub username

# What we all need

- Azure to not go down
- GitHub to not go down
- GitHub Actions to not go down
- The conference internet to not go down
- 🙏🙏🙏
- (I do have recordings if needed but that's no fun)

# Audience

- Anyone interested in Azure, GitHub, or Bicep
- .NET Developers
- People interested in DevOps but never got to do it
- Already know Git
- If you have questions, ask them! If no one but me talks this is gonna be boring

# Poll

- How many .NET Developers in the room?
- How many have used Azure?
- How many have used Bicep?
- How many have used GitHub Actions?
- Why are you here? What do you want to learn?

# Agenda

- What is the final state of what we're building?
- What is Azure?
- What is Azure App Service? Plans?
- What is Bicep?
- What are GitHub Actions?
- Health Checks
- Azure Key Vault Integration
- Azure Application Insights Integration
- Hands on all throughout

# Goals

- Learn GitHub Actions, Bicep, and Azure
- How they all integrate with a .NET app
- The feedback loop on this can be slow
- Take home a few things back to work, whether beginner or expert

# Who am I?

- Director of Engineering at Lean TECHniques
- Microsoft MVP
- Dometrain author
- Redgate Community Ambassador
- Co-organizer of Iowa .NET User Group






# What are we building?

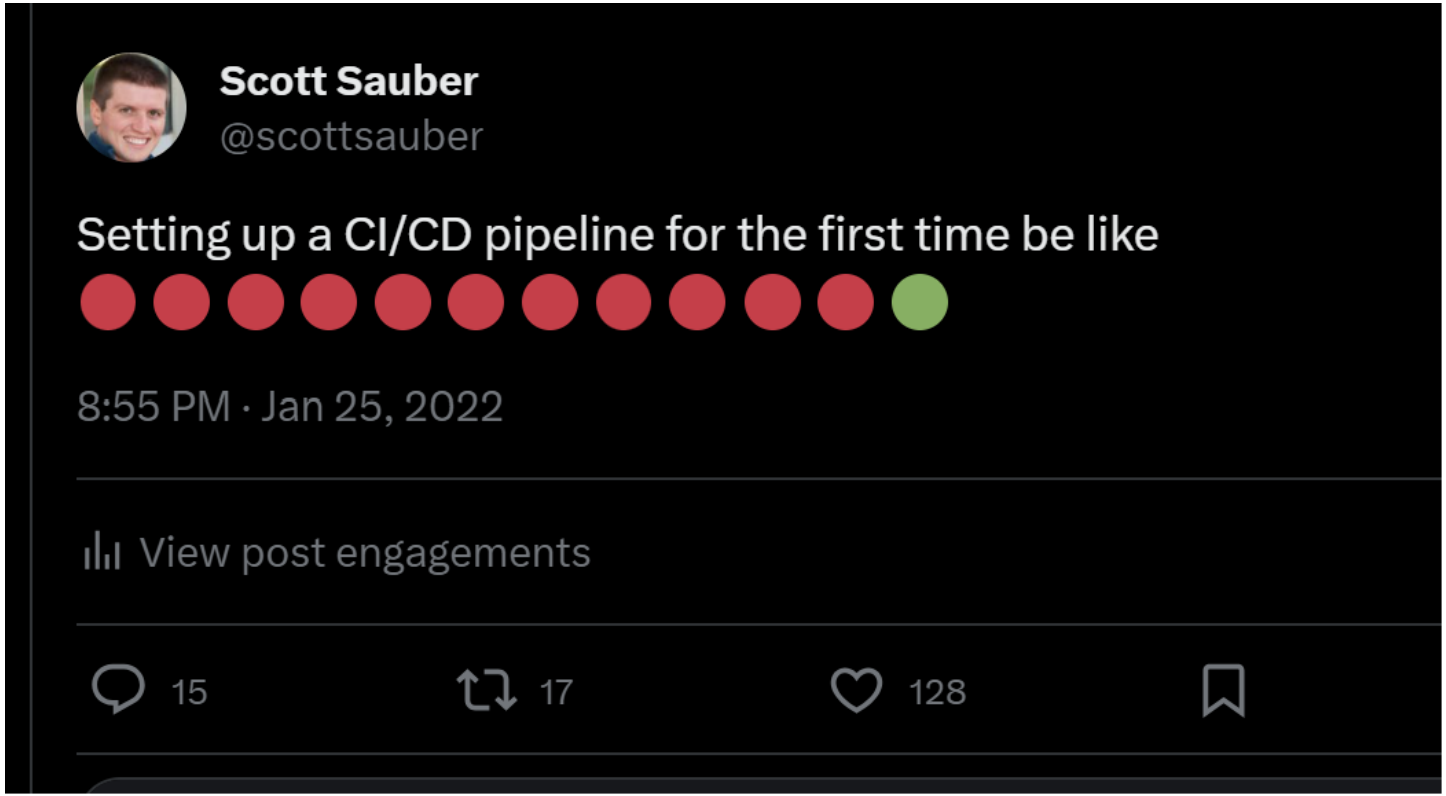
- .NET 9 API
- Running on Azure App Service
- Configured using Infrastructure as Code with Bicep
- Deployed using a CI/CD Pipeline via GitHub Actions

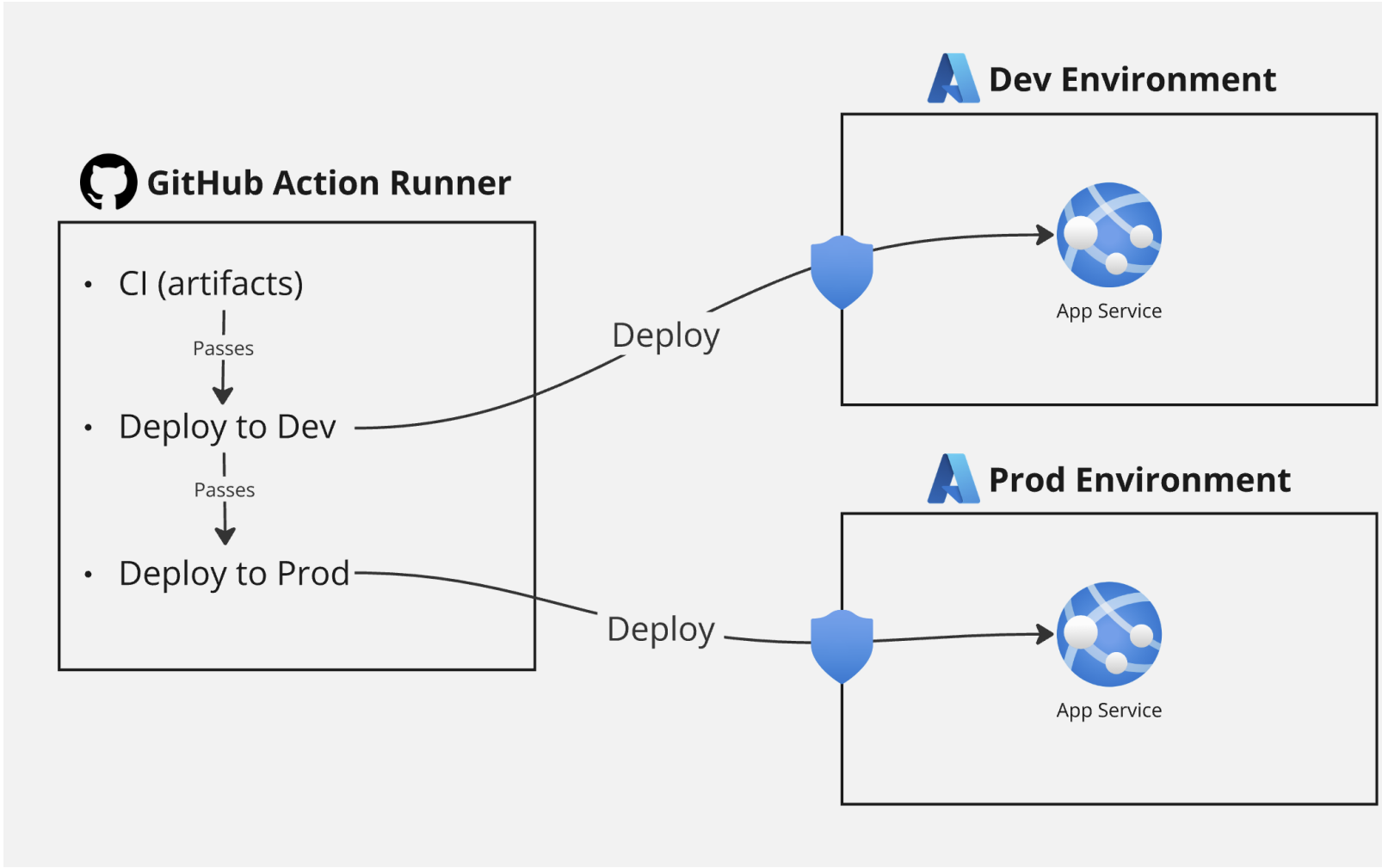
# Features of what we're building

- Zero Downtime Deployments
- Infrastructure managed by code, not clicking in the Azure Portal
- Automated Build and Deploys
- Follows Azure Naming Standards
- Versioning your app so you know what's deployed
- Health Checks
- Secrets in Key Vault, not Source Control
- Observability using Application Insights

# Why is this important?

- https://dora.dev/
- DORA
- Continuous Delivery, Deployment Automation, Flexible Infrastructure, Continuous Integration, Version Control, Monitoring/Observability are all listed as 6 of the 18 capabilities listed for high performing teams.
- We will touch on all of these today

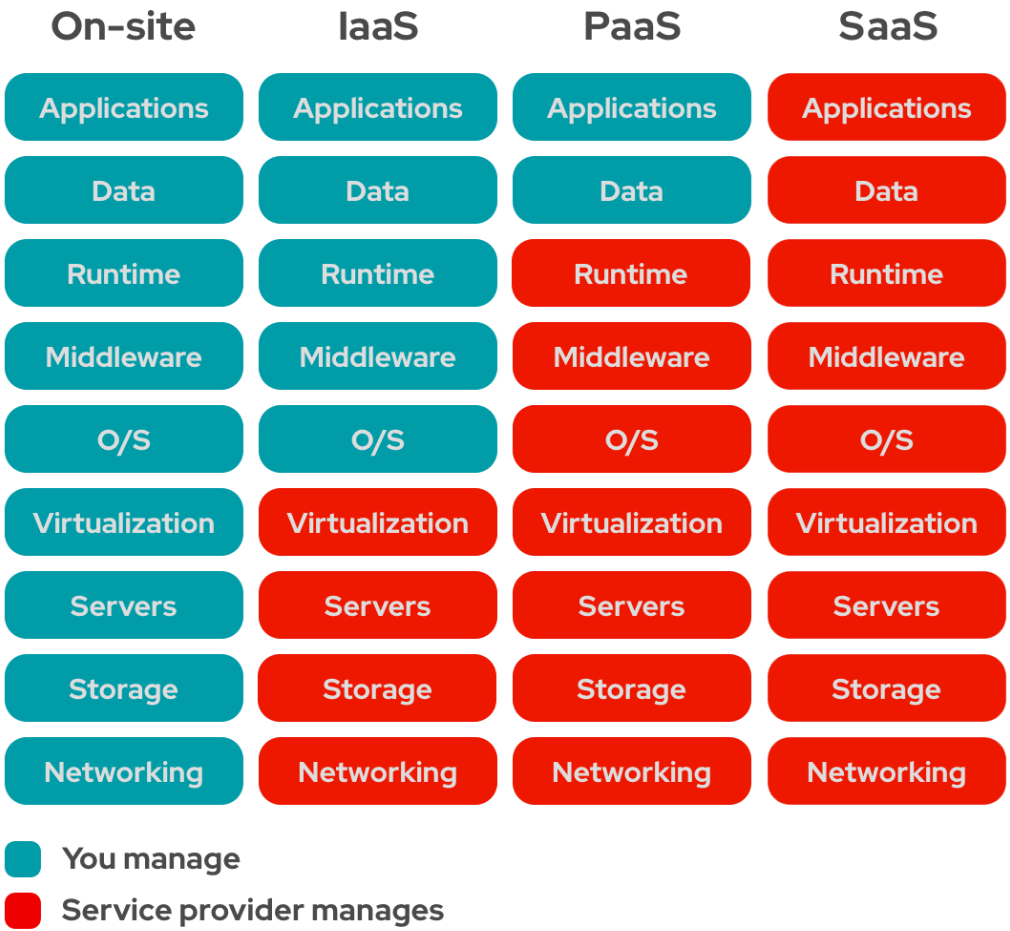


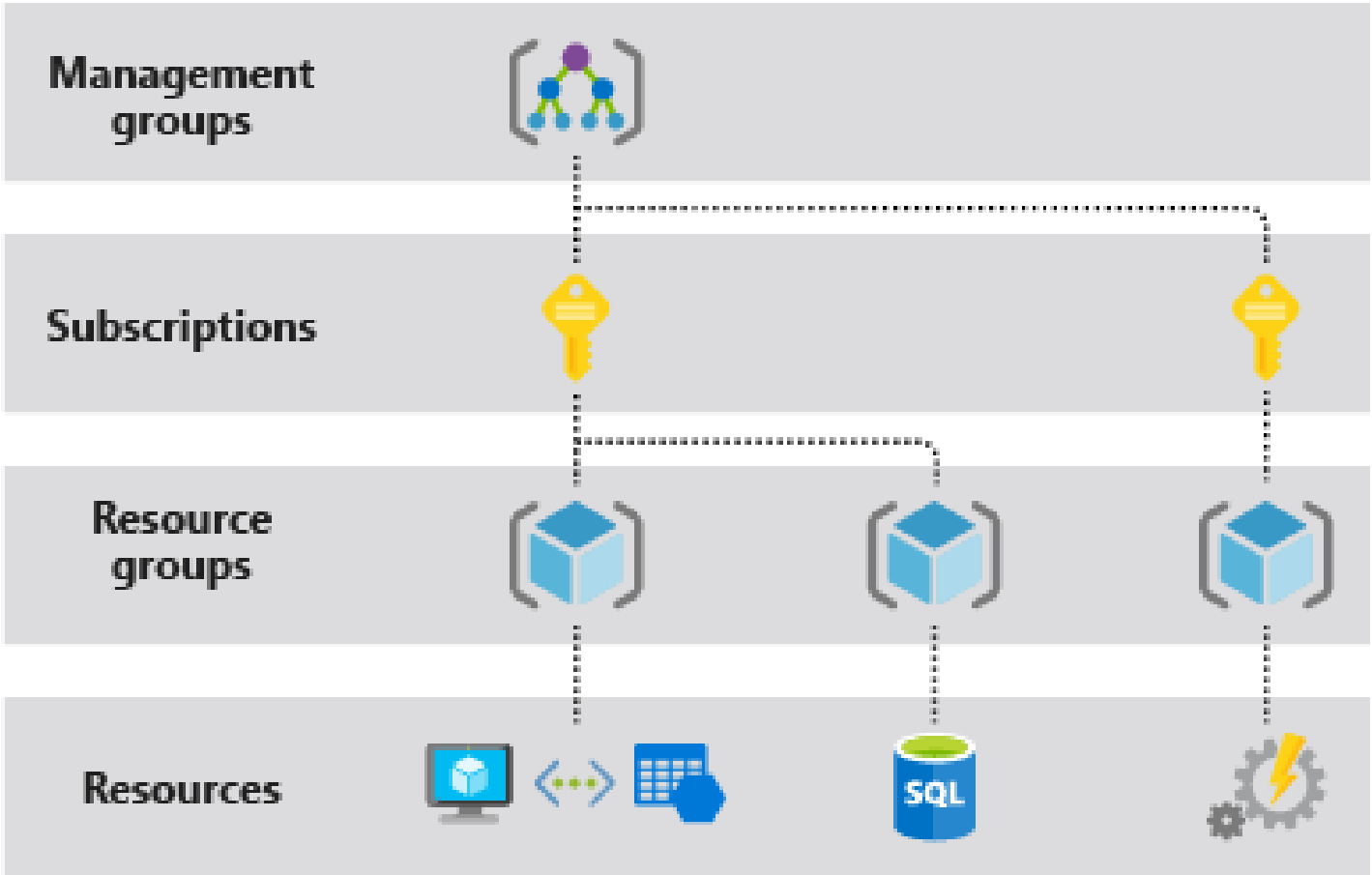

GitHub Action Runner
CI (artifacts)
Passes
Deploy to Dev
Passes
Deploy to Prod
Deploy
Deploy
Dev Environment
App Service
Prod Environment
App Service

# Azure

# What is Azure?

- Microsoft offering for cloud hosting
- Offers many services from hosting web apps to databases to caching to messaging to…
- You should probably be picking PaaS offerings (i.e. not VMs)



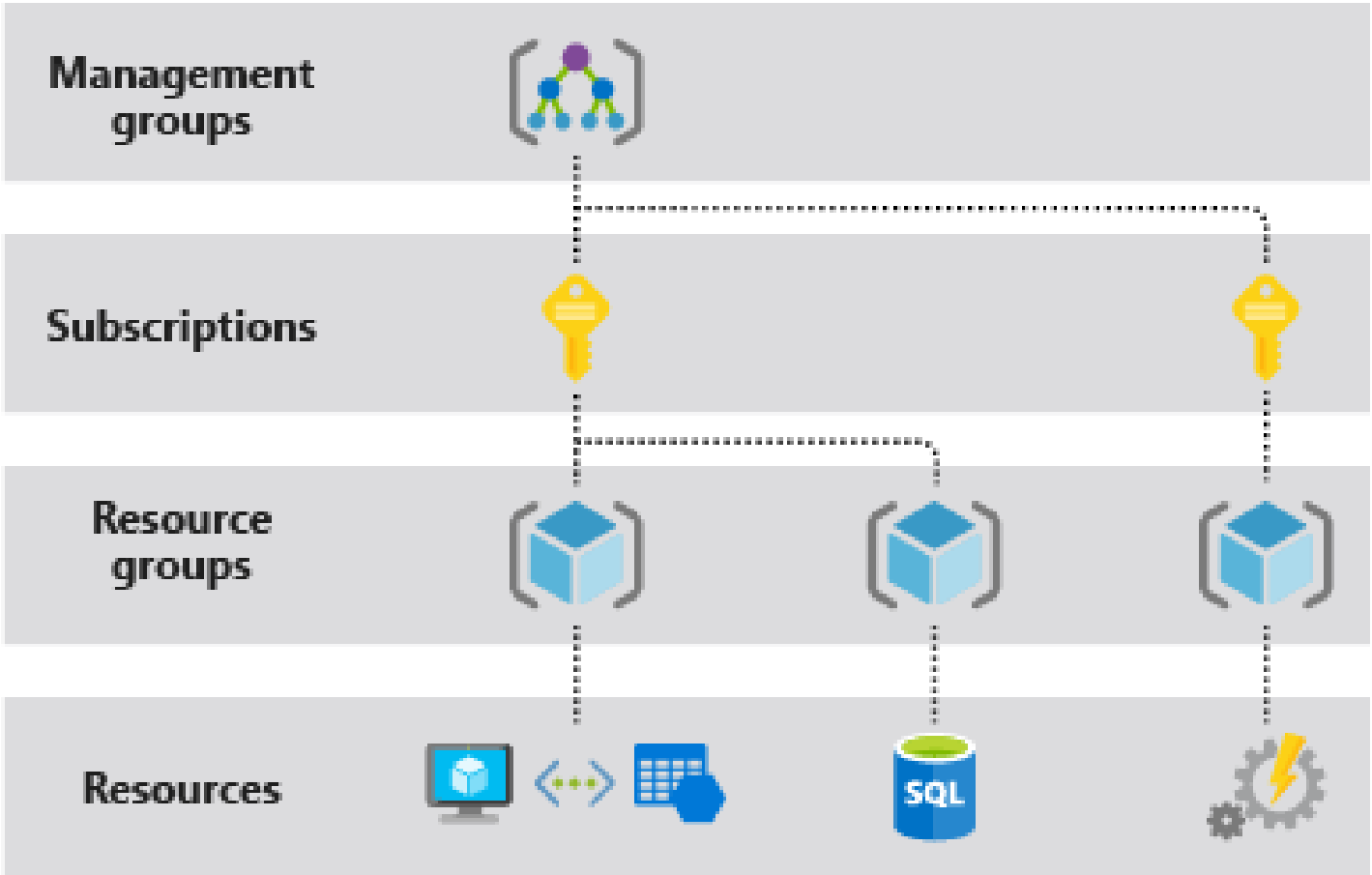


# Subscriptions

- Top-ish level organization (ignoring Tenants, Management Groups)
- Recommended per team per env
- Naming convention: sub-<team>-<env>
  - Ex: sub-accounting-dev
- Role access separation
- Billing separation

# Resource Groups

- Related groups of resources (ie web, db, key vault, etc)
- Quickly view all resources related to app
- RG = folder, Resources = files
- Recommended per app per env
- Naming convention: rg-<product>-<env>
  - Example: rg-fancyapp-dev
- May have many RG's in 1 subscription
- Role access separation
- Billing separation



# Questions?

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# Azure App Service

# App Service

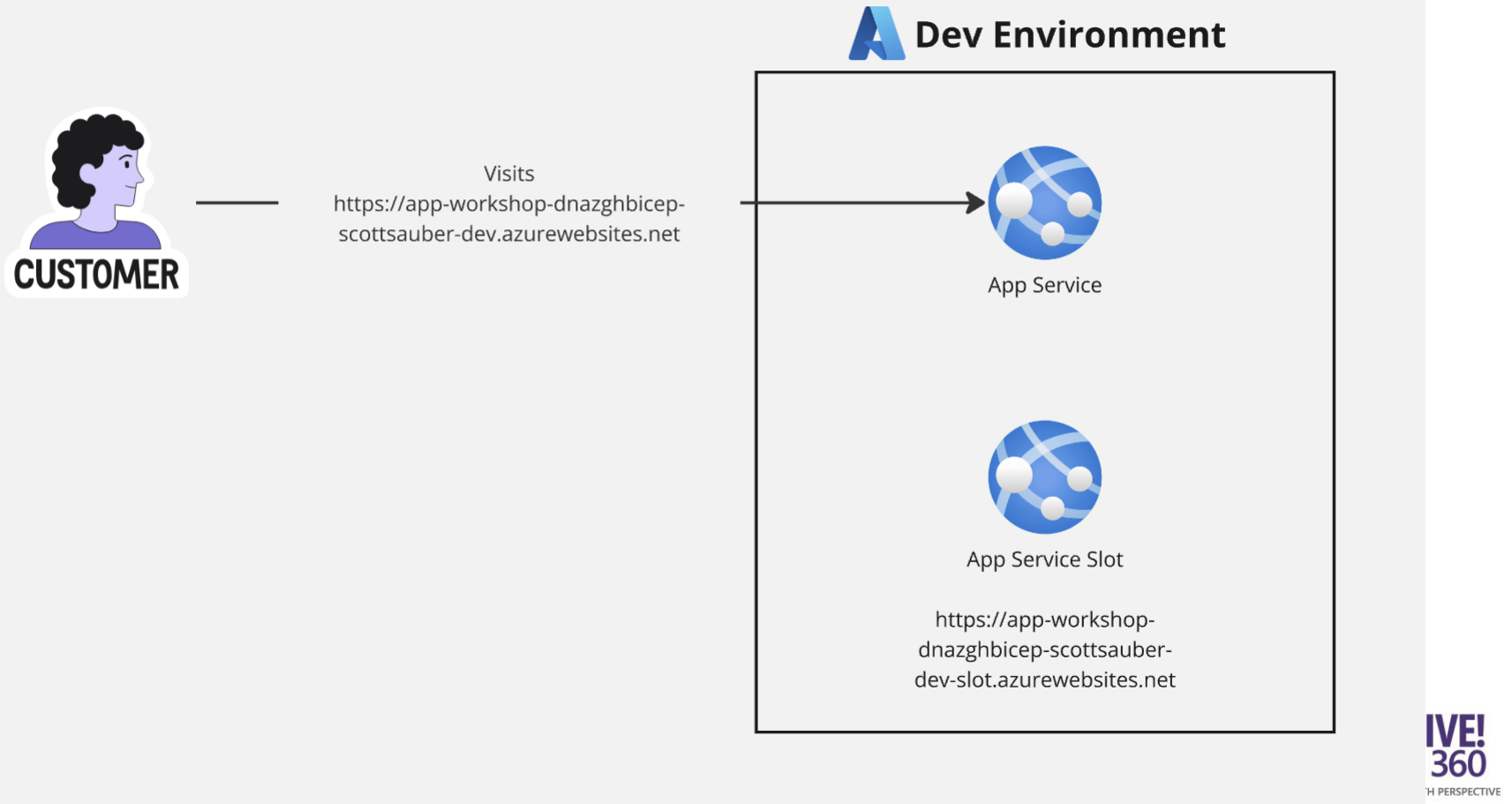
- PaaS offering for hosting applications
- ✅ Handles OS patches, Framework patches
- ✅ Zero downtime deployments via Slots
- ✅ SSL Certs
- ✅ Custom domains
- ✅ Autoscaling
- ✅ Very simple
- ✅ And more
- ❌ Less control because PaaS

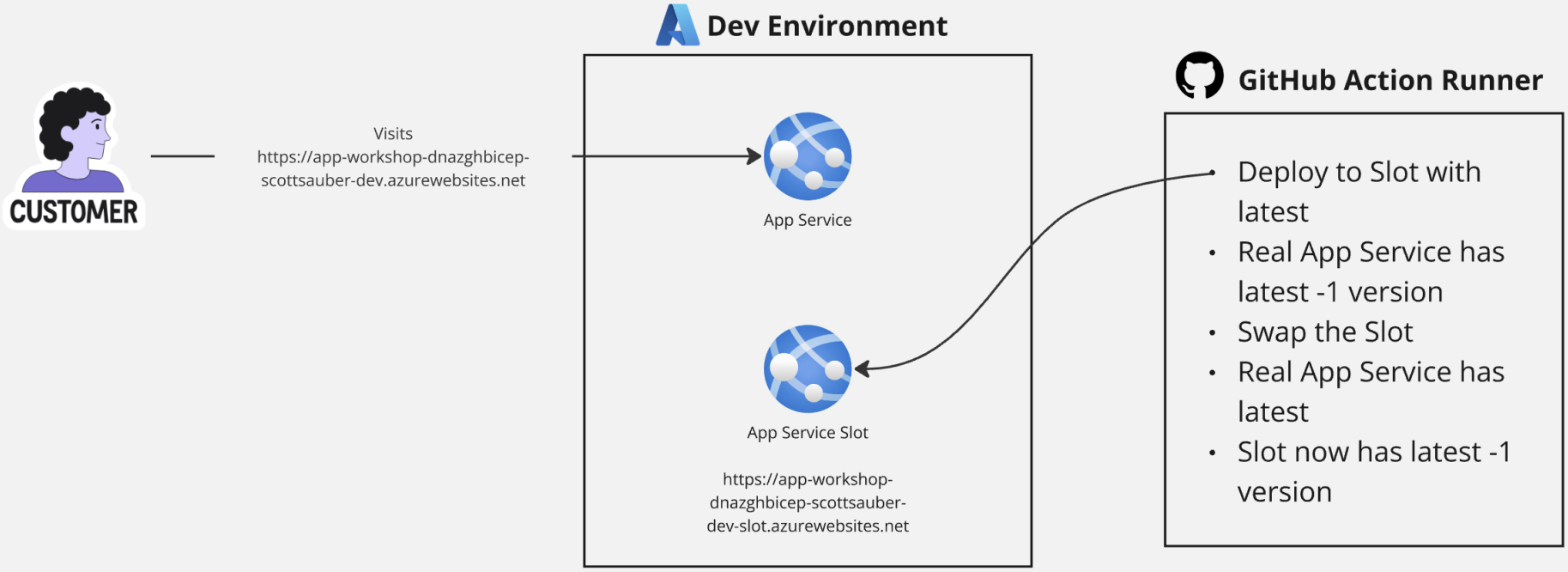
# App Service Plan

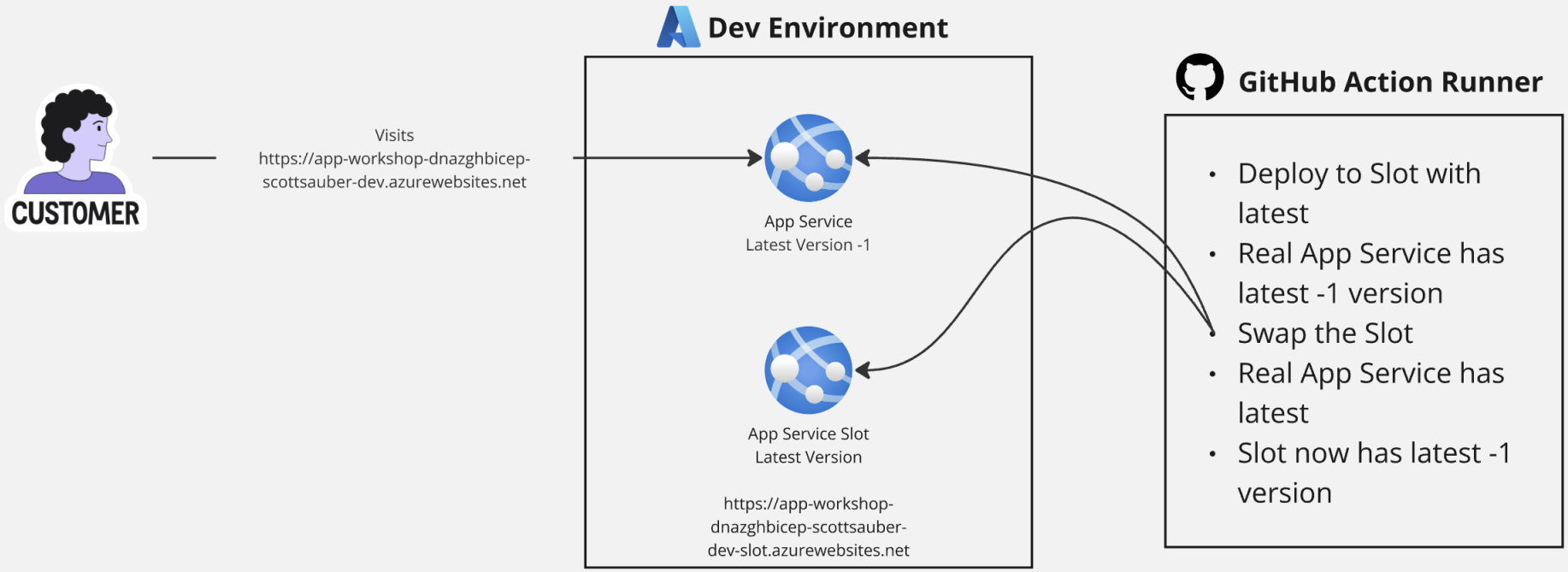
- Kinda like VM for your App Service(s)
- Pick how much memory, storage, CPU
- Multiple app service on one ASP (should you?)
- Many apps can get away with P0V3 ($62/mo for Linux)
- Need to be at least Standard to get Slots

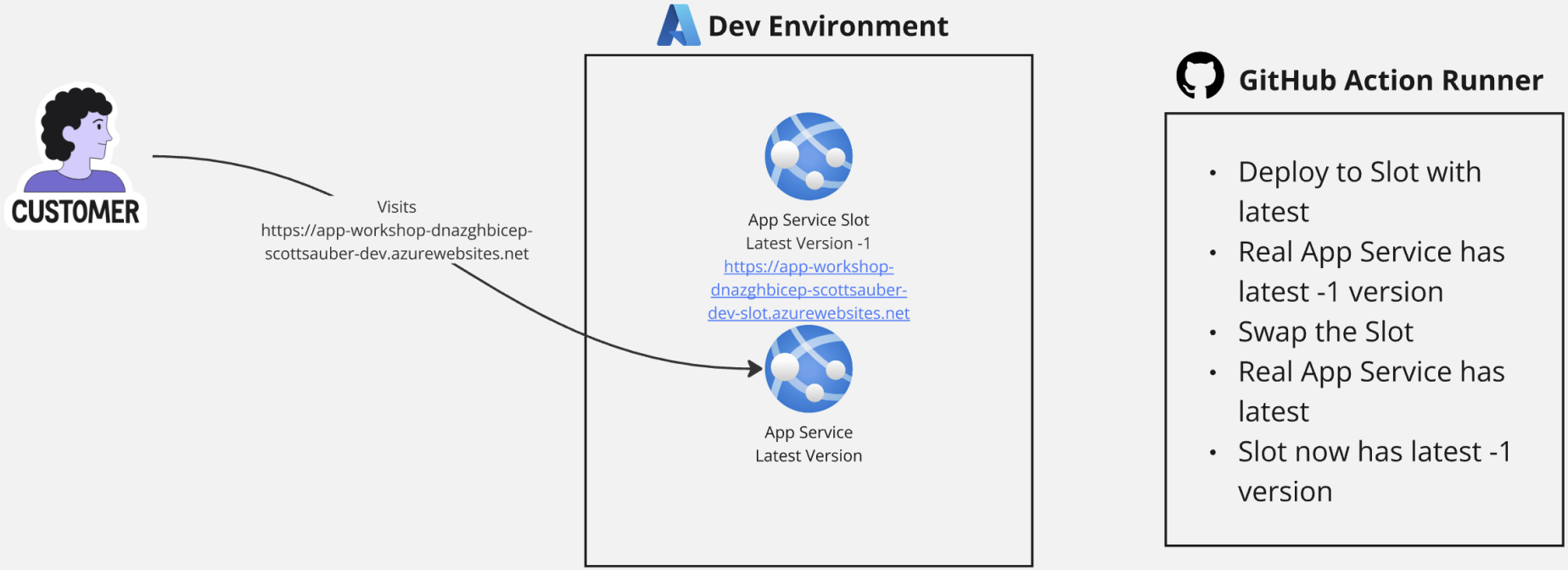
# $ an issue?

- Savings Plan – commit to $ amount
- Save 25% 1 yr, 45% 3 yrs
- Reservation – commit to compute tier
- Save 35% 1 yr, 55% 3 yrs


Dev Environment
CUSTOMER
Visits
https://app-workshop-dnazghbicep-scottsauber-dev.azurewebsites.net
App Service
App Service Slot
https://app-workshop-dnazghbicep-scottsauber-dev-slot.azurewebsites.net







# Live Demo

# Questions?

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# Bicep

# Infrastructure as Code (IAC)

- Source code defining what resources to provision
- Stored in version control
- Declarative – what resources to create, not how to create them
- Deployed via pipeline

# Without IAC

- Clickety Clack Configuration™
- Repeat yourself for each environment
- “It worked in Dev/UAT/Staging, not Prod”
- “It works on my machine”

# What is Azure Bicep?

- Used to configure Azure resources
- Built and maintained by Microsoft
- Domain-specific language (fancy word for custom)

# What is Azure Bicep?

- Provides intellisense, error checking, “whatif,” and orders the resource creations
- Built on top of Azure Resource Manager (ARM) – don’t use ARM directly
- Can compose multiple files into “modules”
- Can pass data between modules via outputs
- No state file

# What is Azure Bicep?

appservice.bicep

```
1  resource appServicePlan 'Microsoft.Web/serverfarms@2022-09-01' = {
2    name: 'asp-myapp-dev'
3    location: 'centralus'
4    sku: {
5      name: 'S1'
6    }
7    kind: 'linux'
8  }
```

appservice.bicep

```
1  resource appServicePlan 'Microsoft.Web/serverfarms@2022-09-01' = {
2    name: 'asp-myapp-dev'
3    kind: 'linux'
4    location: 'centralus'
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8  }
```

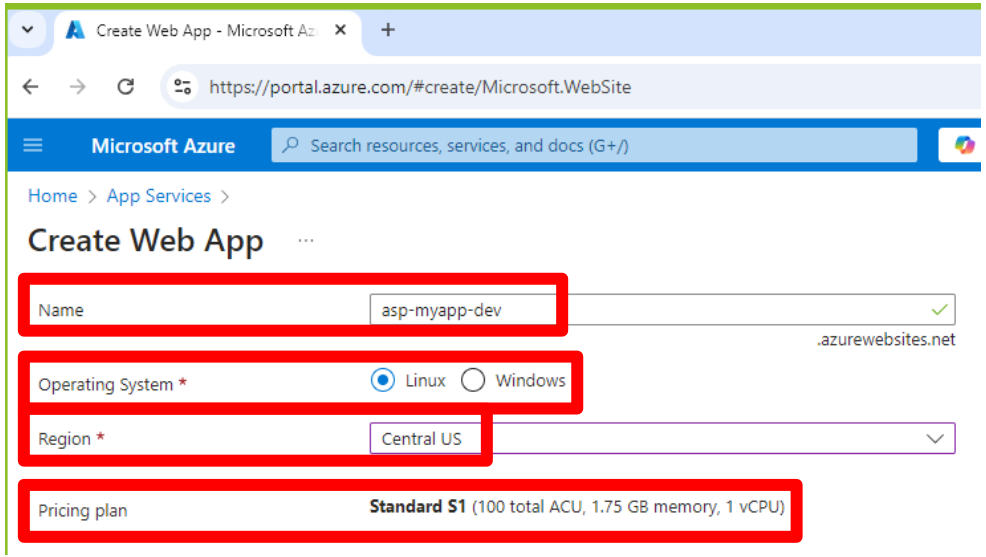

```
resource appServicePlan 'Microsoft.Web/serverfarms@2022-09-01' = {
  name: 'asp-workshop-demo'
  location: 'centralus'
  sku: {
    name: 'S1'
  }
  kind: 'linux'
}
```

```
resource appService 'Microsoft.Web/sites@2022-09-01' = {
  name: 'app-workshop-demo'
  location: 'centralus'
  properties: {
    serverFarmId: appServicePlan.id
    // others
  }
}
```

```
param appName string
@allowed(['dev', 'prod'])
param environment string
param location string

resource appServicePlan 'Microsoft.Web/serverfarms@2022-09-01' = {
  name: 'asp-${appName}-${environment}'
  location: location
  sku: {
    name: 'S1'
  }
  kind: 'linux'
}
```

# dev.biccepparam file

```
using '../main.bicep'

param environment = 'dev'
```

# But how do I deploy it?

```
az deployment group create
  --name dev-deployment-1
  --template-file infrastructure/main.bicep
  --parameters infrastructure/environments/dev.bicepparam
  --resource-group rg-some-name-here
  --verbose
```

# Key Concepts – Quiz time!

- Resources
- Modules
- Parameters
- .bicepparam
- Outputs
- --whatif

# Benefits

- No manual work of configuring in the portal (and repeating for each env)
- Eliminate configuration drift
- Traceability of who, did what, and when
- Give Contributor access to the pipeline – not to individuals
- No more “it works in Dev, not Prod” bc they’re the same!

# Additional Resources

- Documentation for various Bicep resources:
  - https://learn.microsoft.com/en-us/azure/templates/microsoft.web/sites?pivots=deployment-language-bicep

# Live Demo

# Questions?

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# First Hands On Lab coming up…
# …how do you want to run these?

1. I give you time to do alone then move on
2. We “Do It Live™” together

# Break then Hands On for 40 minutes

**Module 4:**
**https://github.com/scottsauber/workshop-dotnet-azure-github-bicep**

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# CI/CD Pipelines

# Continuous Integration

- Automated verification of your application that generates artifacts
- Compiles the app
- Runs the tests
- Independent witness - eliminates “works on my machine”

# Continuous Delivery

- Takes the artifacts from CI and deploys them automatically
- Doesn’t deploy all the way to Production
- Deploying to Production is a button click

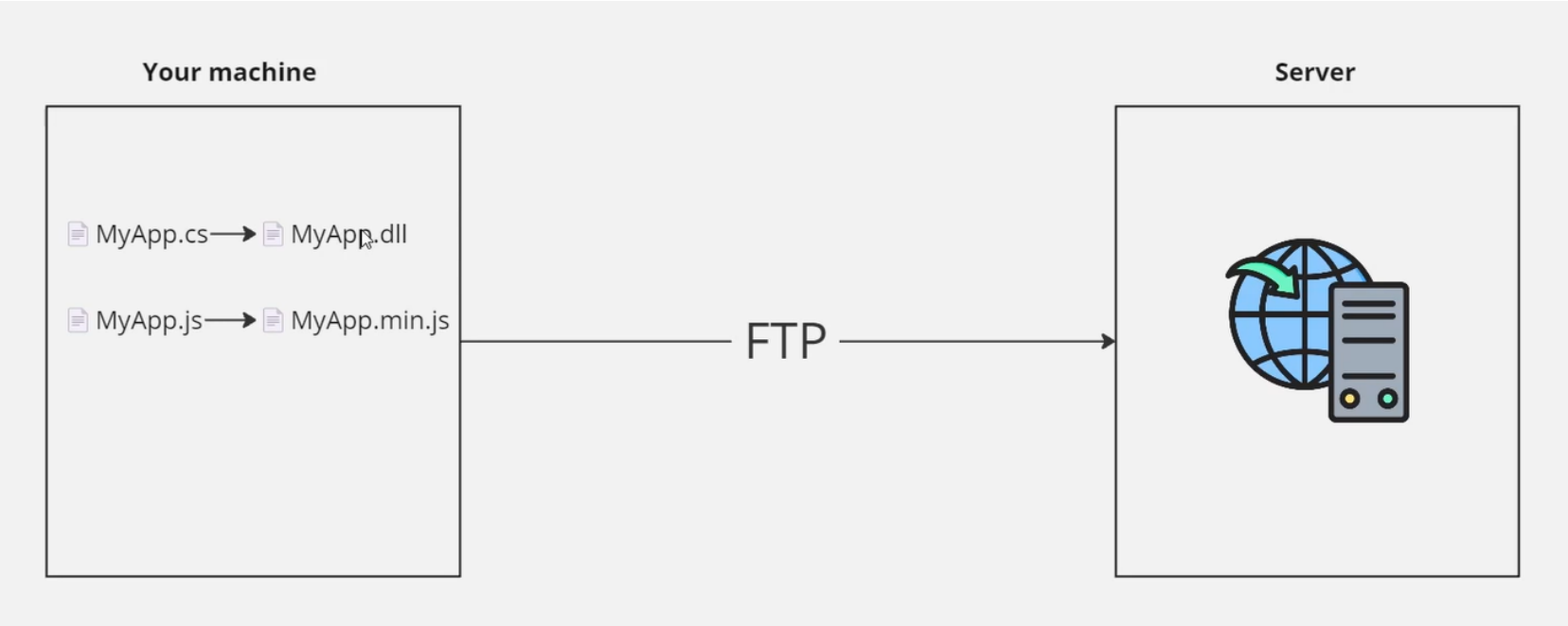
# Continuous Deployment

- Deploys all the way to Production automatically
- If the pipeline is green, it’s going to Production

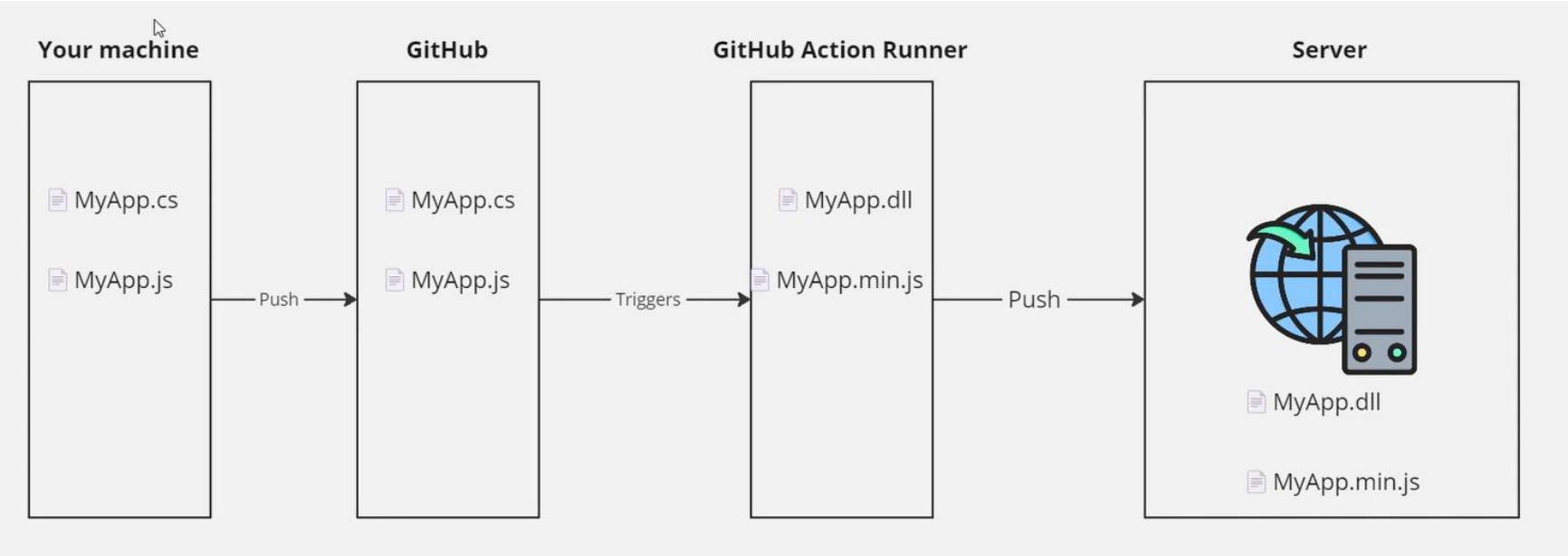
# Confident Green

- If our build passes – why aren't we shipping to Production?
- Likely lack of confidence
- Likely missing automated tests or zero downtime deployments, let's fix that
- Ok now why?
- Repeat

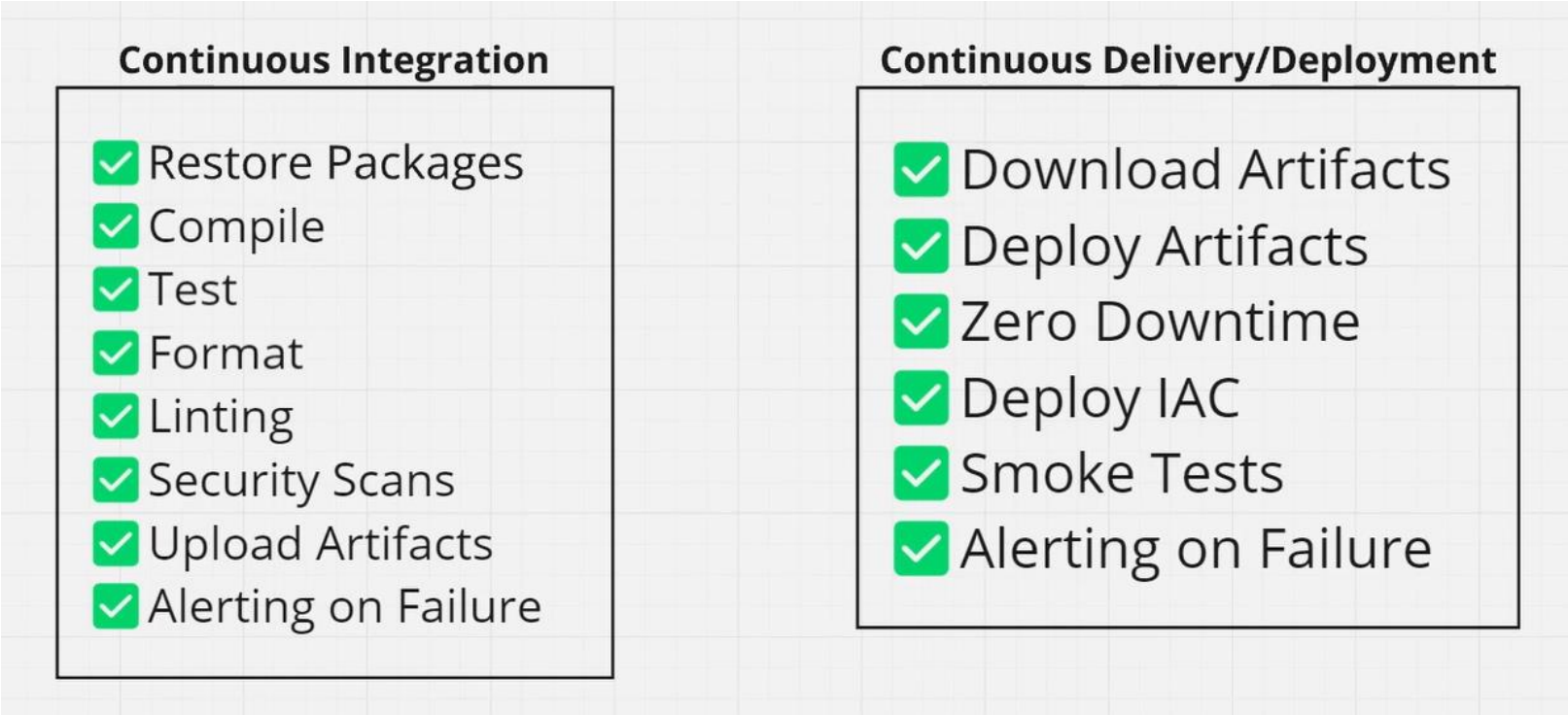
# Before CI/CD



# After CI/CD



# What's in a Pipeline?



# Questions?


# GitHub Actions

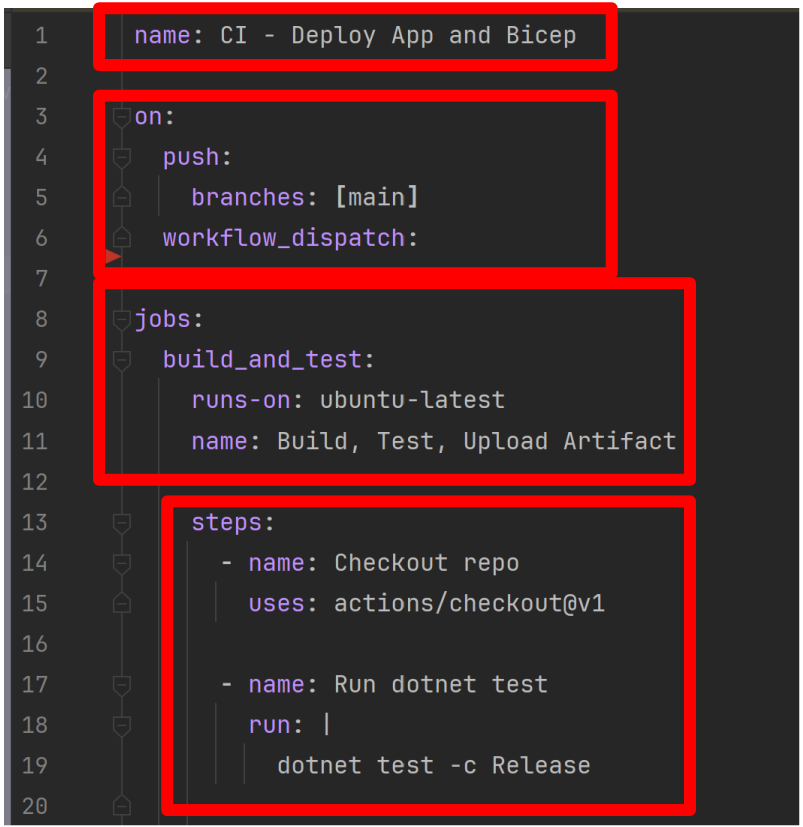
# What is GitHub Actions?

- Thing doer on a trigger
- Trigger could be PR, push to main branch, open an issue, etc
- Automatically build and deploys your application
- Including the infrastructure (i.e. Bicep)

# GitHub Actions Concepts

- Workflows
- Triggers
- Jobs
- Steps
- Inputs
- Secrets

# Example

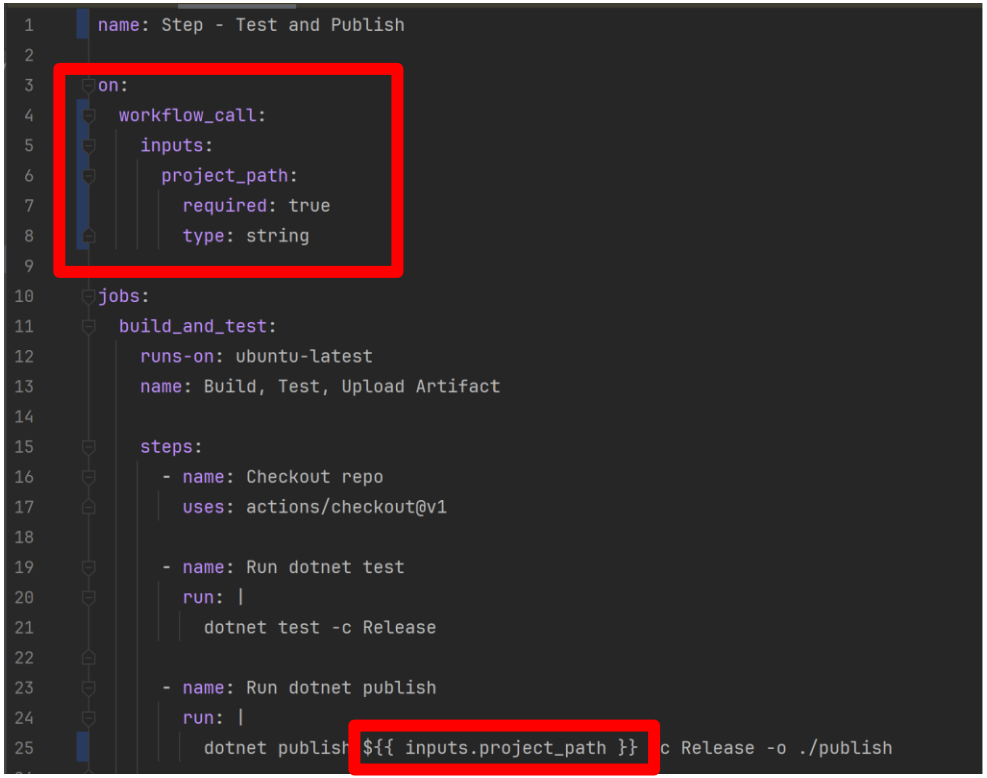


```yaml
name: CI - Deploy App and Bicep

on:
  push:
    branches: [main]
  workflow_dispatch:

jobs:
  build_and_test:
    runs-on: ubuntu-latest
    name: Build, Test, Upload Artifact

    steps:
      - name: Checkout repo
        uses: actions/checkout@v1

      - name: Run dotnet test
        run: |
          dotnet test -c Release
```

# How do I reuse workflows?

```yaml
name: CI - Deploy App and Bicep

on:
  push:
    branches: [main]
  workflow_dispatch:

jobs:
  build_and_test:
    runs-on: ubuntu-latest
    name: Build, Test, Upload Artifact

    steps:
      - name: Checkout repo
        uses: actions/checkout@v1

      - name: Run dotnet test
        run: |
          dotnet test -c Release

      - name: Run dotnet publish
        run: |
          dotnet publish ./src/WorkshopDemo/WorkshopDemo.csproj -c Release -o ./publish
```

# How do I reuse workflows?



```yaml
name: Step - Test and Publish

on:
  workflow_call:
    inputs:
      project_path:
        required: true
        type: string

jobs:
  build_and_test:
    runs-on: ubuntu-latest
    name: Build, Test, Upload Artifact

    steps:
      - name: Checkout repo
        uses: actions/checkout@v1

      - name: Run dotnet test
        run: |
          dotnet test -c Release

      - name: Run dotnet publish
        run: |
          dotnet publish ${{ inputs.project_path }} -c Release -o ./publish
```

# Consume reusable workflow

```yaml
name: CI - Test and Publish

on:
  push:
    branches: [main]
  workflow_dispatch:

jobs:
  build_and_test:
    uses: ./.github/workflows/step-build-and-test.yml
    with:
      project_path: ./src/WorkshopDemo/WorkshopDemo.csproj
```

# Consume from another repo

```yaml
name: CI - Test and Publish

on:
  push:
    branches: [main]
  workflow_dispatch:

jobs:
  build_and_test:
    uses: my-org-or-username/repo-name/step-build-and-test.yml
    with:
      project_path: ./src/WorkshopDemo/WorkshopDemo.csproj

```

# Live Demo

# Questions?


# Break then Hands On for 40 minutes

**Module 6:**
**https://github.com/scottsauber/workshop-dotnet-azure-github-bicep**

# Health Checks

# What are Health Checks?

- Health Checks check an app's status
- Might stop a rolling deployment
- Might restart the app on failure
- App Services allow configuring Health Check endpoint

# What are Health Checks?

- /api/healthz
- Why z?
- Z-pages from Google

# What do you check?

- Even “nothing” is useful. If it can’t get to the URL – the app didn’t boot
- Can I connect to dependencies? (ie DB, APIs, Secret Store, etc)
- Note: be careful here – if your DB goes down/blips, do you want your app to restart?

C#

```
var builder = WebApplication.CreateBuilder(args);

builder.Services.AddHealthChecks();

var app = builder.Build();

app.MapHealthChecks("/healthz");

app.Run();
```

# Questions?

# Hands On for 15 minutes

**Module 8:**
**https://github.com/scottsauber/workshop-dotnet-azure-github-bicep**

# Azure Key Vault

# What is Azure Key Vault

- Secret Store for Azure
- Don’t store secrets in Version Control
- Traceability
- Rotate Secrets
- $0.03 per 10K requests

# Best Practices

- Separate Key Vault per app per env
- 1 app * 3 envs = 3 key vaults
- 2 apps * 3 envs = 6 key vaults
- Don’t leak keys across envs or apps
- Naming: kv-<appname>-<environment>
- ie kv-myapp-dev

# .NET Integration

- Plugs into IConfiguration
- Loads keys on app boot (saves $ and more performant)
- Azure.Security.KeyVault.Secrets
- builder.Configuration.AddAzureKeyVault( “url”);

# Managed Identities

- Essentially the user (Service Principal) a service (ie App Service) runs as
- Allows you to say “this App Service can talk to this Key Vault/DB/etc”
- Microsoft handles the credentials for you behind the scenes

# Access Policies for Key Vault

- Allows you to specify who can connect to Key Vault
- Could be a group (ie Developers), user, or application
- Applications usually just need Read not Write

# Local Secret Management

- Local dev often requires secrets
- .NET User Secrets is incompatible with teams, especially large ones
- Everyone has their own file on their machine
- Then secrets get shared around when they’re added/updated
- Recommendation: use Key Vault even for local

# Key Vault for Local

- When someone adds/updates/deletes a secret, everyone gets it
- Very team friendly
- Only downside – heartbeat to an Azure service
- In practice – rarely a problem

# Live Demo

# Questions?

# Hands On for 30 minutes

**Module 9:**

**https://github.com/scottsauber/workshop-dotnet-azure-github-bicep**

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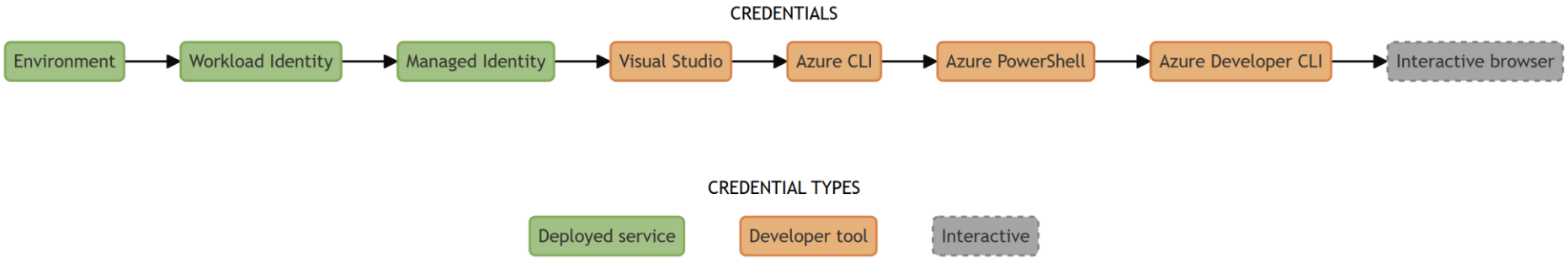
# DefaultAzureCredential

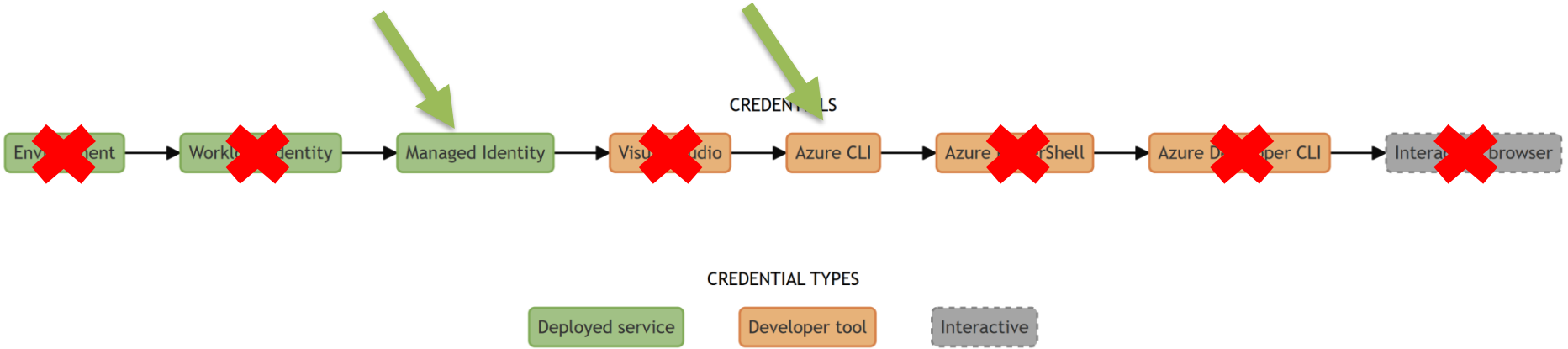
# What is DefaultAzureCredential?

- Azure services need to be authenticated to
- There are lots of ways to do this – CLI, Environment Variables, ManagedIdentity, etc
- DefaultAzureCredential tries all these for you until one works

# What order does it try?



# Which ones do we use?



# What's the problem?

- Often need 1-2 ways of authing
- Local dev + deployed envs
- In our case, Azure CLI (Local) and Managed Identity (Dev + Prod)
- All other tries waste time
- I've seen 10+ seconds saved doing what I'm about to do

# Solution

- DefaultAzureCredential has “Excludes”
- ChainedTokenCredential
- if local => CLI, else => ManagedIdentity

# Live Demo

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# Questions?

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# Break?

# Azure Log Analytics

# What is Log Analytics?

- Part of Azure Monitor - observability platform
- Store Logs in central spot
- Not in Log Stream
- Query logs
- SQL like syntax
- Alert based on logs

Home >

# Logs

Demo

New Query 1*

Try the new Log Analytics | Feedback | Queries hub

Demo | Run | Time range : Last 12 hours | Save | Share | New alert rule | Export | Pin to

Tables | Queries | Functions

Search

Filter | Group by: Solution

Collapse all

LogManagement

- AegDeliveryFailureLogs
- AGSGrafanaLoginEvents
- ALBHealthEvent
- Alert
- AppAvailabilityResults
- AppBrowserTimings
- AppDependencies
- AppEvents
- AppExceptions
- AppMetrics
- AppPageViews
- AppPerformanceCounters
- AppRequests
- AppServiceAntivirusScanAudit...
- AppServiceAppLogs
- AppServiceAuditLogs
- AppServiceAuthenticationLogs
- AppServiceConsoleLogs
- AppServiceFileAuditLogs
- AppServiceHTTPLogs
- AppServiceIPSecAuditLogs

```
1  AppRequests
```

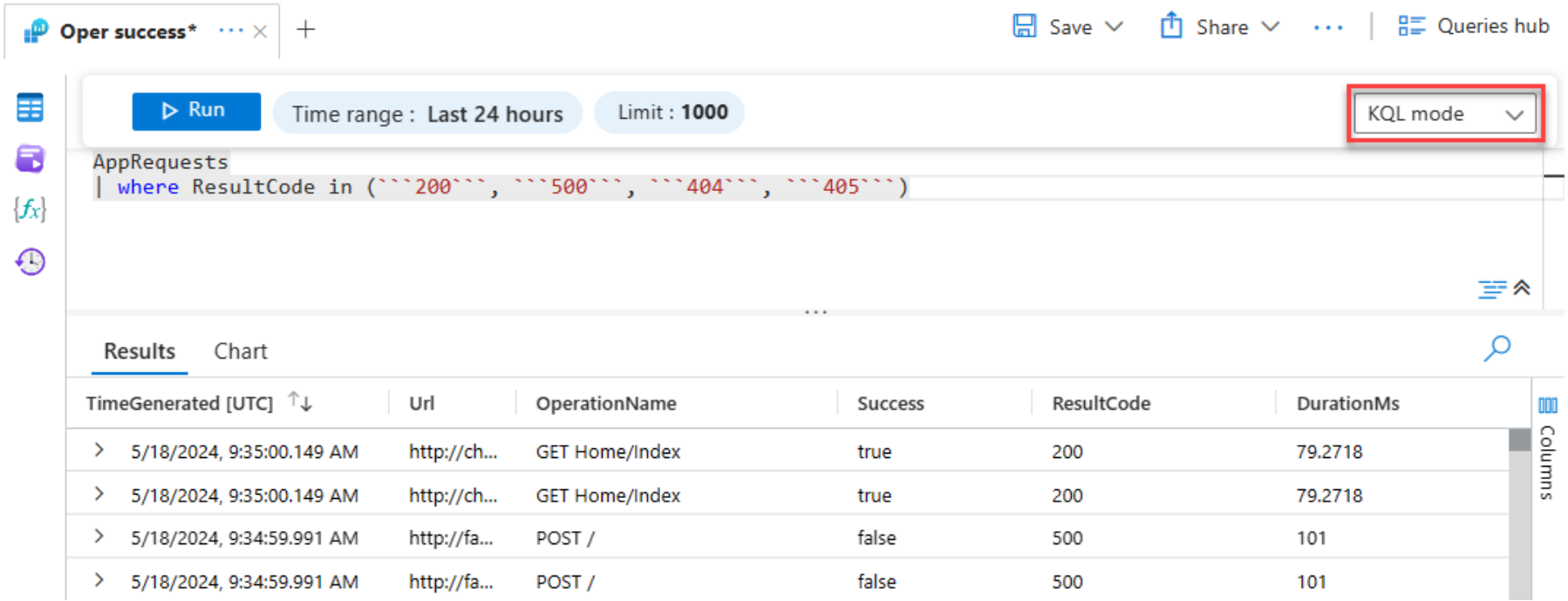
Results | Chart

Showing the first 30,000 results. Learn more on how to narrow down the result set.

| Success | ResultCode | DurationMs | PerformanceBucket | Properties |
|---|---|---|---|---|
| true | 200 | 9.7892 | <250ms | {"_MS.ProcessedBy |
| true | 200 | 102.1439 | <250ms | {"_MS.ProcessedBy |
| false | 404 | 2.6933 | <250ms | {"_MS.ProcessedBy |
| false | 0 | 5.6817 | <250ms | {"LogLevel":"Error" |
| false | 0 | 5.1909 | <250ms | {"LogLevel":"Error" |
| true | 200 | 3136.4451 | 3sec-7sec | {"_MS.ProcessedBy |
| true | 200 | 103.5109 | <250ms | {"_MS.ProcessedBy |
| true | 200 | 100.8381 | <250ms | {"_MS.ProcessedBy |
| true | 200 | 6.6667 | <250ms | {"_MS.ProcessedBy |
| false | 404 | 1 | <250ms | |
| false | 404 | 0.8159 | <250ms | {"_MS.ProcessedBy |
| true | 200 | 8.8905 | <250ms | {"_MS.ProcessedBy |

Columns

7s 195ms | Display time (UTC+00:00) | Query details | 1 - 13 of 30000

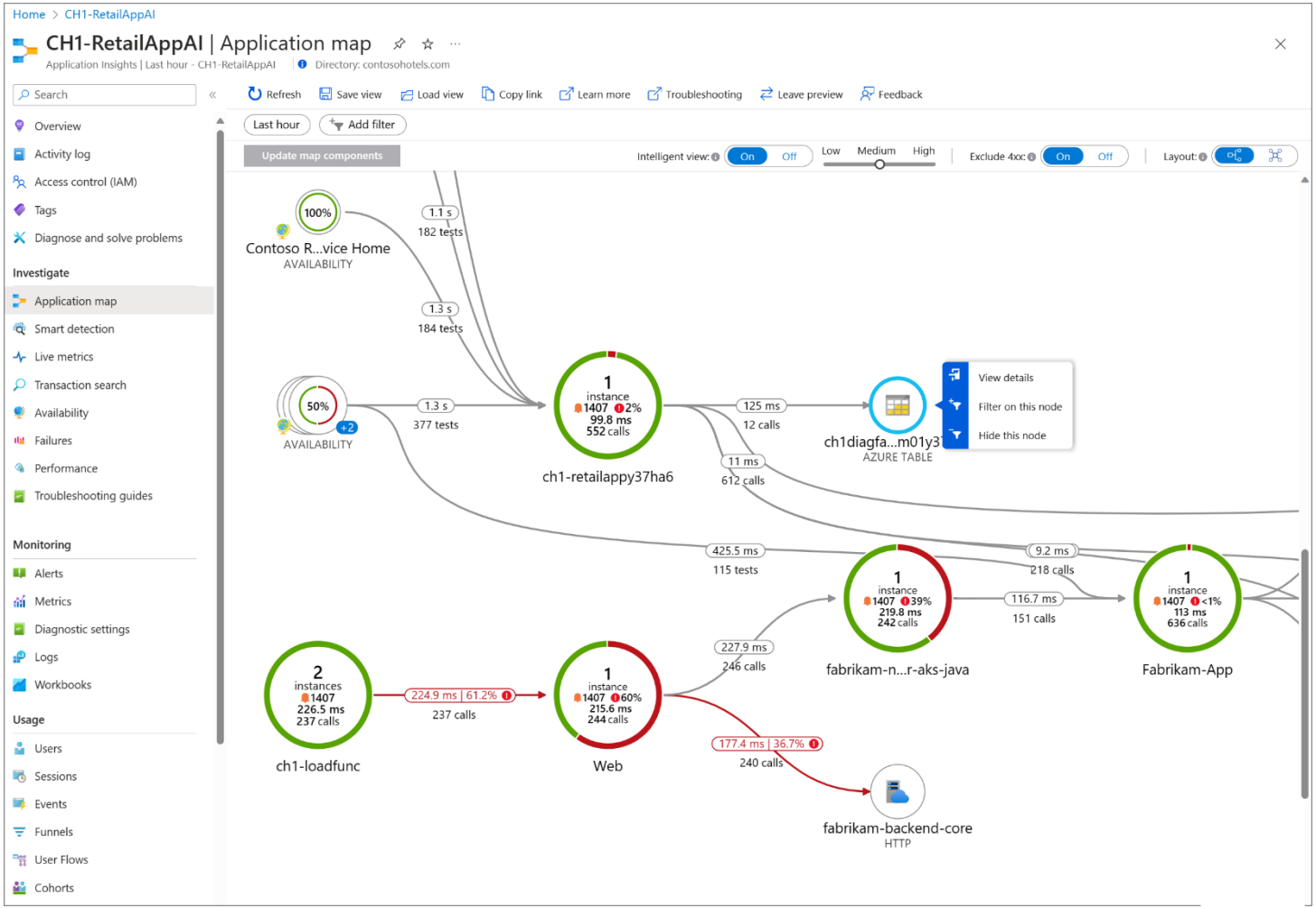


# Questions?

# Azure App Insights

# What is Application Insights?

- Part of Azure Monitor
- Metrics
- Traces
- Application Maps
- Diagnose Performance Issues



Search results | Learn more | Feedback

**End-to-end transaction**

Operation ID: b8e278fcfd20456a88ab48ac9cde6476

= Request (incoming) = Dependency (outgoing) = Exception = Profiler trace = Debug snapshot

| EVENT | RES. | DURATION |
|---|---|---|
| App Service Customer Details Central US | | 557 ms |
| http://fabrikamfiberapp.azurewebsites.net/Customers/Details/8469 | | 557 ms |
| fabrikamfiberapp GET Customers/Details | 500 | 430.3 ms |
| fabrikamxyz FabrikamISQL | | 57 ms |
| fabrikamaccount POST fabrikamaccount/Tables | 409 | 112 ms |
| fabrikamaccount POST fabrikamaccount/fabrikamfiber | 409 | 111 ms |
| fabrikamaccount GET fabrikamaccount/fabrikamfiber | 200 | 48 ms |
| EXCEPTION System.FormatException | | |
| Failed Central US | | 0 |

0MS 200 MS300 MS400 MS500 MS

10 All 1 Traces 0 Events

View all telemetry

Create work item | Open profiler traces

**fabrikamfiberapp**

GET Customers/Details

## Request Properties

Show all

| | |
|---|---|
| Event time | 8/23/2018, 6:14:49 AM |
| Request name | GET Customers/Details |
| Response code | 500 |
| Successful request | False |
| Response time | 430.3 ms |
| Request URL | http://fabrikamfiberapp.azurewebsites.net/Customers/Details/8469 |

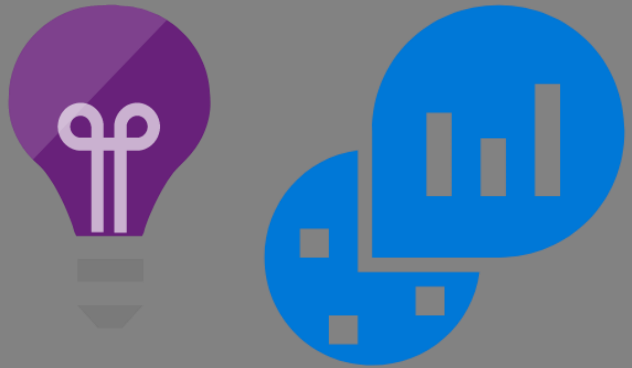
## Call Stack

Show Just My Code

```
System.FormatException:
   at System.Number.StringToNumber (mscorlib, Version=4.0.0.0, Cult
   at System.Number.ParseInt32 (mscorlib, Version=4.0.0.0, Culture=
   at System.Int32.Parse (mscorlib, Version=4.0.0.0, Culture=neutra
   at FabrikamFiber.DAL.Data.AddressValidator.ValidZipCode (Fabrika
   at FabrikamFiber.DAL.Models.Address.FullAddress (FabrikamFiber.D
   at ASP._Page_Views_Customers_Details_cshtml.Execute (App_Web_sw4
   at System.Web.WebPages.WebPageBase.ExecutePageHierarchy (System.
   at System.Web.Mvc.WebViewPage.ExecutePageHierarchy (System.Web.M
   at System.Web.WebPages.StartPage.RunPage (System.Web.WebPages, V
   at System.Web.WebPages.StartPage.ExecutePageHierarchy (System.We
   at System.Web.WebPages.WebPageBase.ExecutePageHierarchy (System.
   at System.Web.Mvc.RazorView.RenderView (System.Web.Mvc, Version=
   at System.Web.Mvc.BuildManagerCompiledView.Render (System.Web.Mv
   at System.Web.Mvc.ViewResultBase.ExecuteResult (System.Web.Mvc,
```

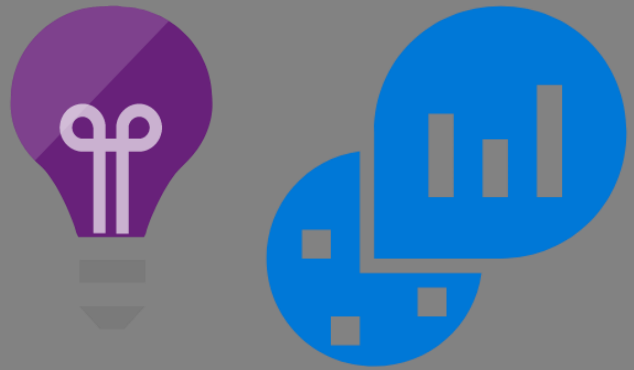
# Questions?

# Live Demo



# Hands On for 30 minutes

**Module 13:**
**https://github.com/scottsauber/workshop-dotnet-azure-github-bicep**



# Takeaways

- How to leverage Azure
- How to integrate Azure with .NET
- Why IAC is useful and how Bicep works
- How GitHub Actions fits into CI/CD Pipelines
- Some takeaway tips and tricks, even if you had prior experience with some of this

# Resources

- This slide deck
- https://github.com/scottsauber/workshop-dotnet-azure-github-bicep
  - “final” branch has the final state of things

# Live360 things to know

- 5:45 – 6:15 – Live360! First Timers Guide with Phil Japiske in
- 6:30 – 8:00 – Mix + Mingle Upstairs Patio HardRock Café City Walk

LIVE! 360
TECH EVENTS WITH PERSPECTIVE

# Any other Questions?

ssauber@leantechniques.com
@scottsauber on Twitter
@scottsauber.com on Bluesky

# Session Survey

- Your feedback is very important to us
- Please take a moment to complete the session survey found in the mobile app
- Use the QR code or search for “Converge360 Events” in your app store
- Find this session on the Agenda tab
- Click “Session Evaluation”
- Thank you!

LIVE! 360
TECH EVENTS WITH PERSPECTIVE

# THANK YOU!

# Bonus PR Checks for Infra

- When you change some Bicep it'd be nice to know what it's going to do
- --whatif for PR's
- Have the –whatif comment back on the PR what it's going to do
- Example

# Bonus PR Checks for Infra

- Checkov security scanner
- Tells you if something is misconfigured
- ie TLS 1.2 is not the minimum TLS setting for an App Service
- Public Storage Accounts

```
➜  bicep checkov -d /Users/maciejpoborca/Desktop/temp/bicep
[ bicep framework ]: 100%|                    |[1/1], Current File Scanned=main.bicep


      _               _
   ___| |__   ___  ___| | _______   __
  / __| '_ \ / _ \/ __| |/ / _ \ \ / /
 | (__| | | |  __/ (__|   < (_) \ V /
  \___|_| |_|\___|\___|_|\_\___/ \_/

By bridgecrew.io | version: 2.1.75
Update available 2.1.75 -> 2.1.87
Run pip3 install -U checkov to update


bicep scan results:

Passed checks: 0, Failed checks: 6, Skipped checks: 0

Check: CKV_AZURE_132: "Ensure cosmosdb does not allow privileged escalation by restricting management plane changes"
        FAILED for resource: Microsoft.DocumentDB/databaseAccounts.cosmosAccount
        Severity: MEDIUM
        File: /main.bicep:46-63
        Guide: https://docs.bridgecrew.io/docs/bc_azr_storage_4

                46 | resource cosmosAccount 'Microsoft.DocumentDB/databaseAccounts@2021-04-15' = {
                47 |   name: cosmosAccountName
                48 |   kind: 'GlobalDocumentDB'
                49 |   location: location
                50 |   properties: {
                51 |     consistencyPolicy: {
                52 |       defaultConsistencyLevel: 'Session'
                53 |     }
                54 |     locations: [
                55 |       {
                56 |         locationName: location
                57 |         failoverPriority: 0
                58 |         isZoneRedundant: false
                59 |       }
                60 |     ]
                61 |     databaseAccountOfferType: 'Standard'
                62 |   }
                63 | }

Check: CKV_AZURE_15: "Ensure web app is using the latest version of TLS encryption"
```