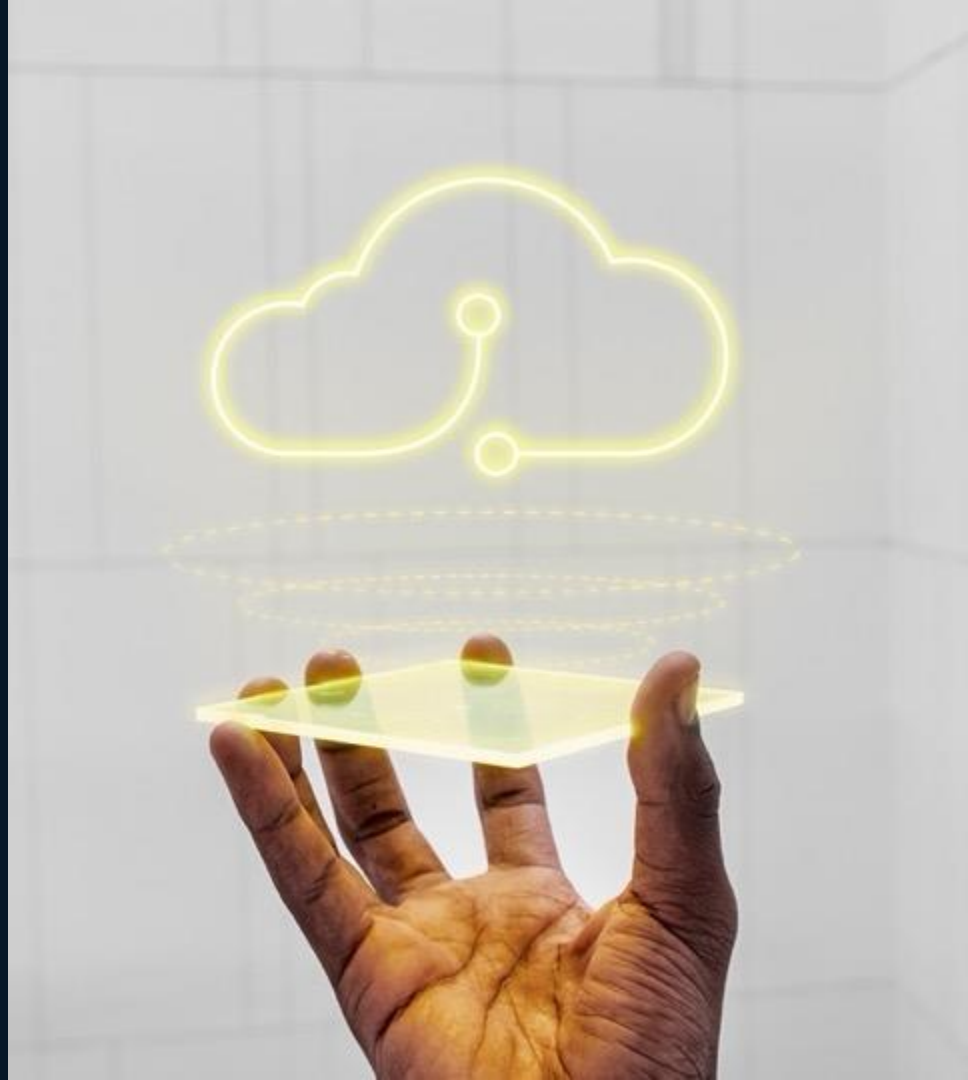
Doing DevOps Right: Trunk-based Development, CICD, and IaC

By Drake Lundstrom



Who am I?

- Senior Software Engineer at Rogue Fitness
- Work with Cloud Migrations and App Modernization on Azure and AWS
- Learning and teaching is what I do for fun

What is Operations?

- The activities, processes, and practices involved in managing and deploying software systems
- How software gets from developer to customer

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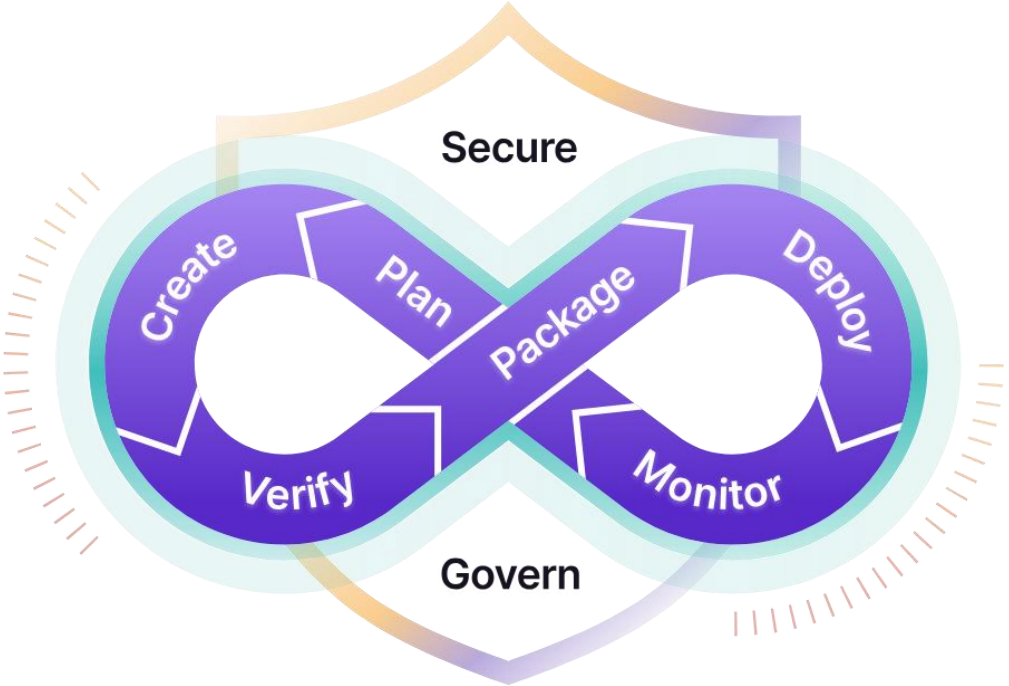
What is Devops?

A philosophy unifying software Development and Operations

- Culture of collaboration
- Shorten development cycles
- Enable faster problem solving and collaboration



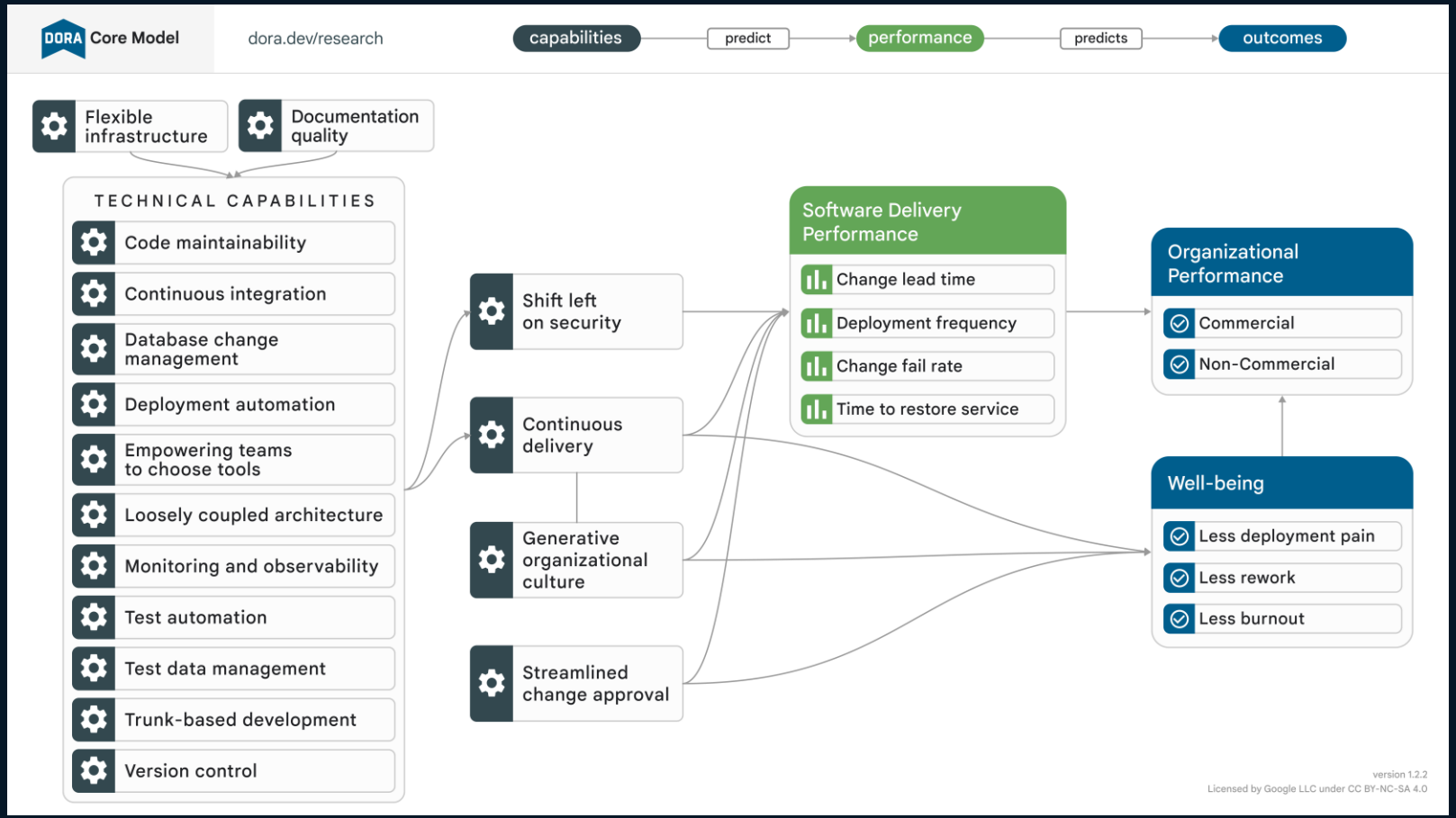
https://about.gitlab.com/topics/devops/

Why Does this Presentation Exist?

- Devops is not prescriptive
- There are better and worse options
- Success results in:
  - ✓ Speed
  - ✓ Rapid Delivery
  - ✓ Reliability
  - ✓ Scale
  - ✓ Profit

https://www.pinterest.com/pin/303218987383222840/

DevOps Research and Assessment



IaC: Infrastructure as Code

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IaC: Infrastructure as Code

- Manage resources programmatically
- Usually best practice

AWS CloudFormation

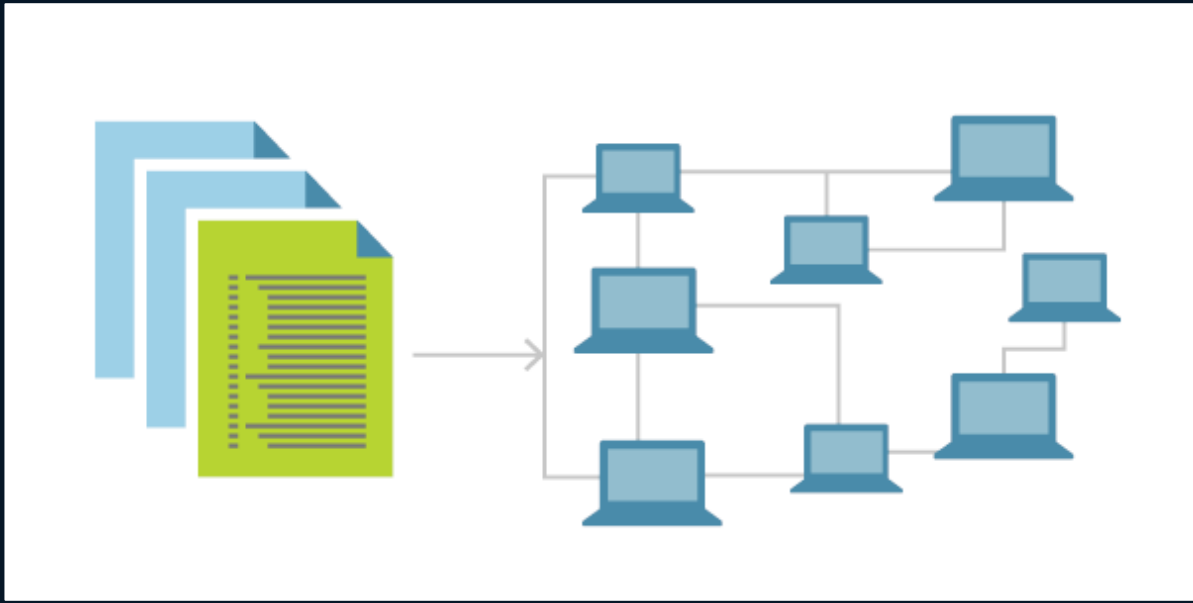
HashiCorp Terraform

Microsoft Azure Resource Manager

AZURE BICEP
An ARM DSL

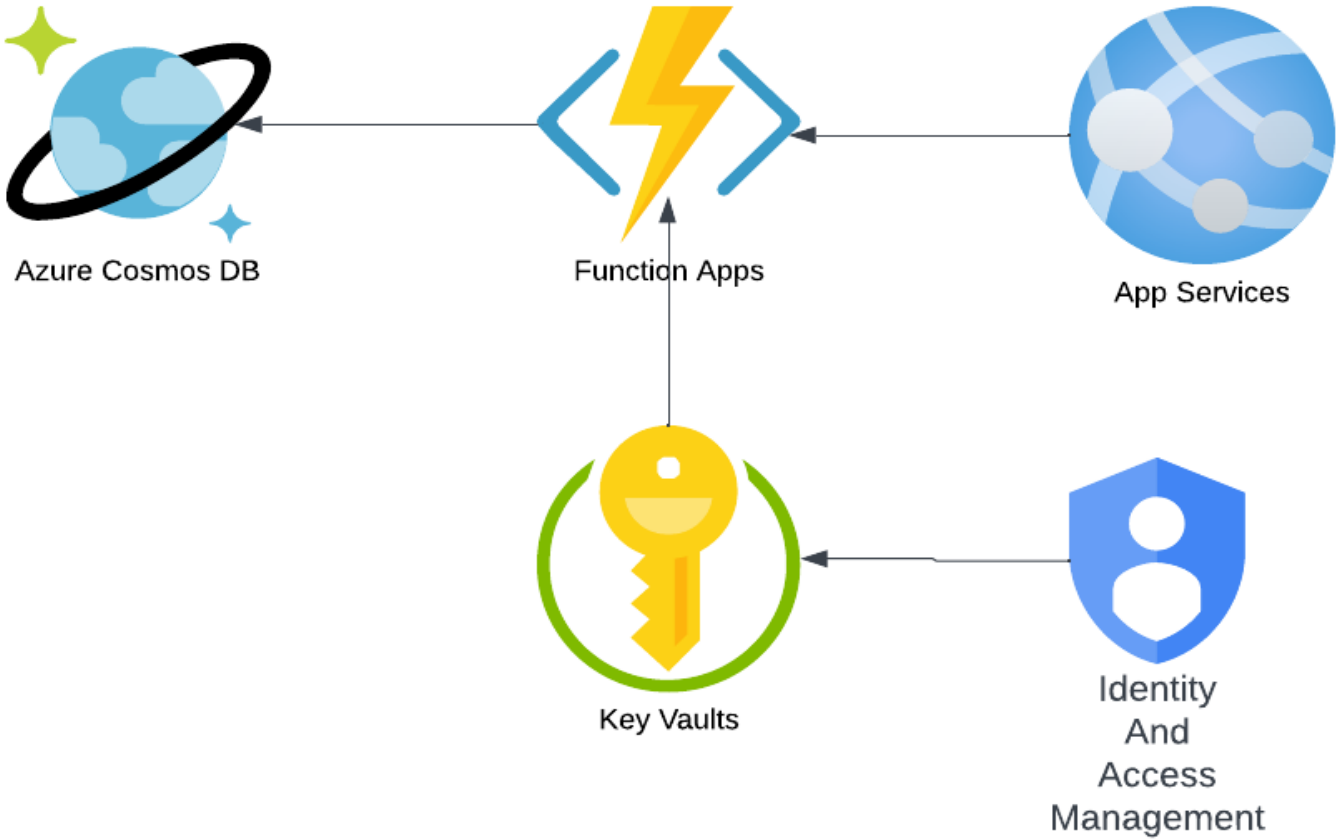
IaC Benefits

- Reduction of human error
- Faster deployment
- Perfect repeatability
- Roll back
- Easy to scale
- Creates change record

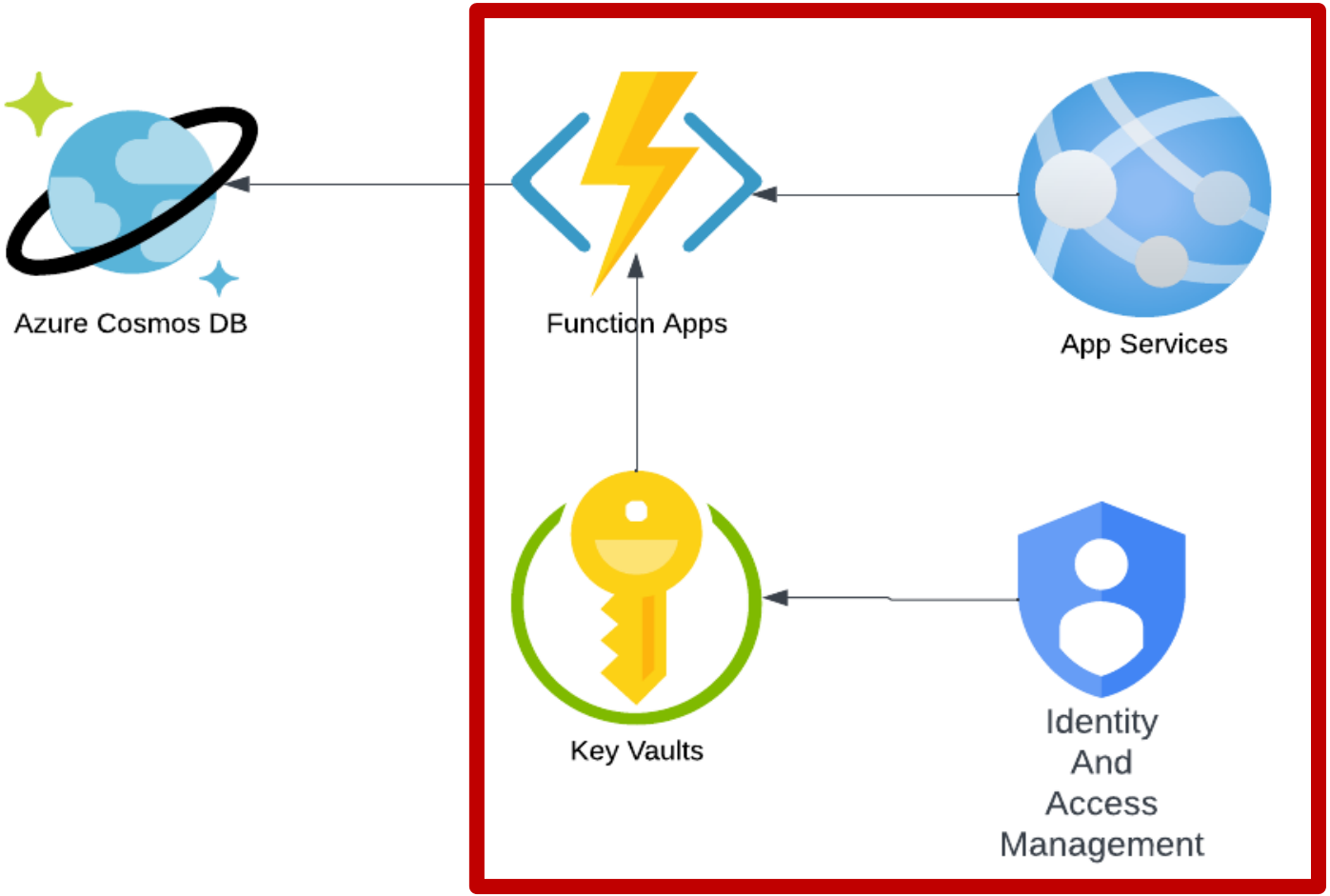


https://learn.microsoft.com/en-us/devops/deliver/what-is-infrastructure-as-code

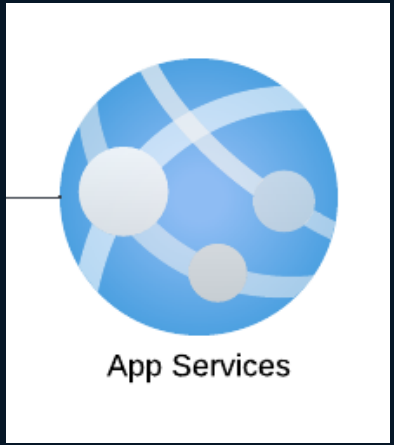
IaC: Infrastructure as Code



IaC: Infrastructure as Code



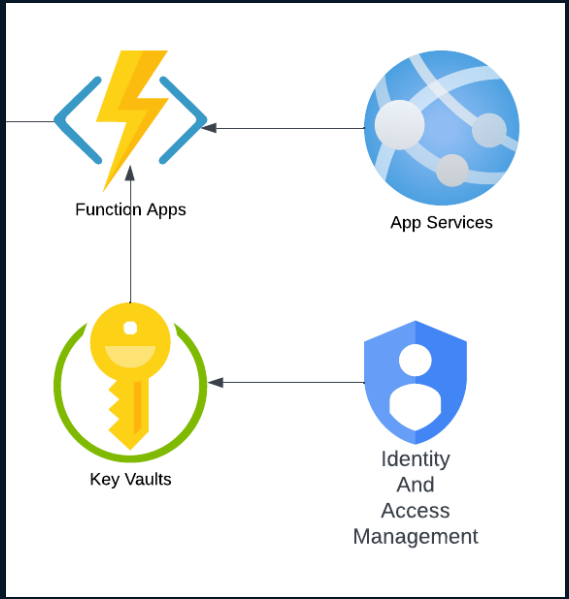
```
1  param location string = resourceGroup().location
2  param kvName string
3  param functionAppName string
4  param functionAppHostingPlanName string
5  param storageAccountName string
6  param frontEndName string
7  param frontEndHostingPlanName string
8
9  resource appServicePlan 'Microsoft.Web/serverfarms@2020-06-01' = {
10   name: frontEndHostingPlanName
11   location: location
12   sku: {
13     name: 'F1'
14   }
15   kind: 'windows'
16 }
17
18 resource appService 'Microsoft.Web/sites@2020-06-01' = {
19   name: frontEndName
20   location: location
21   properties: {
22     serverFarmId: appServicePlan.id
23     siteConfig: {
24       appSettings: [
25         {
26           name: 'testFunctionUrl'
27           value: '@Microsoft.KeyVault(VaultName=${kvName};SecretName=testFunctionUrl)'
28         }
29       ]
30     }
31   }
32   identity: {
33     type: 'SystemAssigned'
34   }
35 }
36
```



```
param location string = resourceGroup().location
param kvName string
param functionAppName string
param functionAppHostingPlanName string
param storageAccountName string
param frontEndName string
param frontEndHostingPlanName string

resource appServicePlan 'Microsoft.Web/serverfarms@2020-06-01' = {
  name: frontEndHostingPlanName
  location: location
  sku: {
    name: 'F1'
  }
  kind: 'windows'
}

resource appService 'Microsoft.Web/sites@2020-06-01' = {
  name: frontEndName
  location: location
  properties: {
    serverFarmId: appServicePlan.id
    siteConfig: {
      appSettings: [
        {
          name: 'testFunctionUrl'
          value: '@Microsoft.KeyVault(VaultName=${kvName};SecretName=testFunctionUrl)'
        }
      ]
    }
  }
  identity: {
    type: 'SystemAssigned'
  }
}

resource keyVault 'Microsoft.KeyVault/vaults@2023-02-01' = {
  name: kvName
  location: location
  properties: {
    sku: {
      family: 'A'
      name: 'standard'
    }
    tenantId: subscription().tenantId
    enableRbacAuthorization: false
    accessPolicies: [
      {
        objectId: azureFunction.outputs.functionIdentity
        permissions: {
          secrets: [
            'all'
          ]
        }
        tenantId: subscription().tenantId
      }
      {
        objectId: appService.identity.principalId
        permissions: {
          secrets: [
            'all'
          ]
        }
        tenantId: subscription().tenantId
      }
    ]
  }
  dependsOn: [
    appService
  ]
}

module azureFunction 'azure-function-module.bicep' = {
  name: 'azureFunction'
  params: {
    location: location
    functionAppName: functionAppName
    hostingPlanName: functionAppHostingPlanName
    storageAccountName: storageAccountName
    kvName: kvName
  }
}
```

```
param functionAppName string
param storageAccountName string
param location string
param hostingPlanName string
param kvName string

resource functionApp 'Microsoft.Web/sites@2022-03-01' = {
  name: functionAppName
  kind: 'functionapp'
  location: location
  properties: {
    siteConfig: {
      appSettings: [
        {
          name: 'FUNCTIONS_WORKER_RUNTIME'
          value: 'dotnet'
        }
        {
          name: 'FUNCTIONS_EXTENSION_VERSION'
          value: '~4'
        }
        {
          name: 'AzureWebJobsStorage'
          value: 'DefaultEndpointsProtocol=https;AccountName=${storageAccountName};AccountKey=$
          {storageAccount.listKeys().keys[0].value}'
        }
        {
          name: 'APPINSIGHTS_INSTRUMENTATIONKEY'
          value: reference('microsoft.insights/components/${functionAppName}', '2015-05-01').
          InstrumentationKey
        }
        {
          name: 'APPLICATIONINSIGHTS_CONNECTION_STRING'
          value: reference('microsoft.insights/components/${functionAppName}', '2015-05-01').
          ConnectionString
        }
        {
          name: 'databaseConnectionString'
          value: '@Microsoft.KeyVault(VaultName=${kvName};SecretName=databaseConnectionString)'
        }
      ]
    }
    serverFarmId: hostingPlan.id
    clientAffinityEnabled: false
  }
  identity: {
    type: 'SystemAssigned'
  }
  dependsOn: [
    applicationInsights
  ]
}

resource hostingPlan 'Microsoft.Web/serverfarms@2022-03-01' = {
  name: hostingPlanName
  location: location
  kind: ''
  properties: {}
  sku: {
    tier: 'Dynamic'
    name: 'Y1'
  }
}

resource storageAccount 'Microsoft.Storage/storageAccounts@2022-09-01' = {
  name: storageAccountName
  location: location
  kind: 'StorageV2'
  sku: {
    name: 'Standard_LRS'
  }
}

resource applicationInsights 'microsoft.insights/components@2020-02-02-preview' = {
  name: functionAppName
  location: location
  tags: {}
  kind: 'web'
  properties: {
    Request_Source: 'IbizaWebAppExtensionCreate'
    Flow_Type: 'Redfield'
    Application_Type: 'web'
  }
  dependsOn: []
}

output functionIdentity string = functionApp.identity.principalId
```

```
{
  "$schema": "https://schema.management.azure.com/schemas/2019-04-01/deploymentParameters.json#",
  "contentVersion": "1.0.0.0",
  "parameters": {
    "kvName": {
      "value": "StirTrekTestKv"
    },
    "functionAppName": {
      "value": "DrakeStirTrekApi"
    },
    "functionAppHostingPlanName": {
      "value": "DrakeStirTrekApiHostingPlan"
    },
    "storageAccountName": {
      "value": "strirtrektestdatabase"
    },
    "frontEndName": {
      "value": "StirTrekTestFrontEnd"
    },
    "frontEndHostingPlanName": {
      "value": "StirTrekTestFrontEndHostingPlan"
    }
  }
}
```



Automate Toil

Toil is:

- Manual
- Repetitive
- Devoid of enduring value
- Scales linearly as a service grows

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Clickops

IaC

5x

StirTrekManual - Microsoft Azu

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Monitoring
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Help

Create | Manage view | Delete resource group | Refresh | Export to CSV | Open query

Essentials | JSON View

Subscription (move)
Azure subscription 1

Subscription ID
768cc3b7-ef77-4b9d-9d18-364ad7485c7e

Deployments
No deployments

Location
East US

Tags (edit)
Add tags

Resources | Recommendations

Filter for any field... | Type equals all | Location equals all | Add filter

Showing 0 to 0 of 0 records. | Show hidden types | No grouping | List view

Name | Type | Location

No resources match your filters

Try changing or clearing your filters.

Create resources | Clear filters

Learn more

Give feedback

StirTrekAuto - Microsoft Azure

https://portal.azure.

Contact | Learning | Reading

Microsoft Azure

Home > Resource groups >

StirTrekAuto

Resource group

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Access control (IAM)
Tags
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Monitoring
Automation
Help

Create | Manage view | Delete resource group | Refresh

Essentials | JSON View

Subscription (move) : Azure subscription 1

Subscription ID : 768cc3b7-ef77-4b9d-9d18-364ad7...

Deployments : No deployments

Location : East US

Tags (edit) : Add tags

Resources | Recommendations

Filter for any field... | Add filter | More (2)

Showing 0 to 0 of 0 records. | Show hidden types | No grouping | List view

Name | Type | Location

No resources match your filters

Try changing or clearing your filters.

Create resources | Clear filters

Learn more

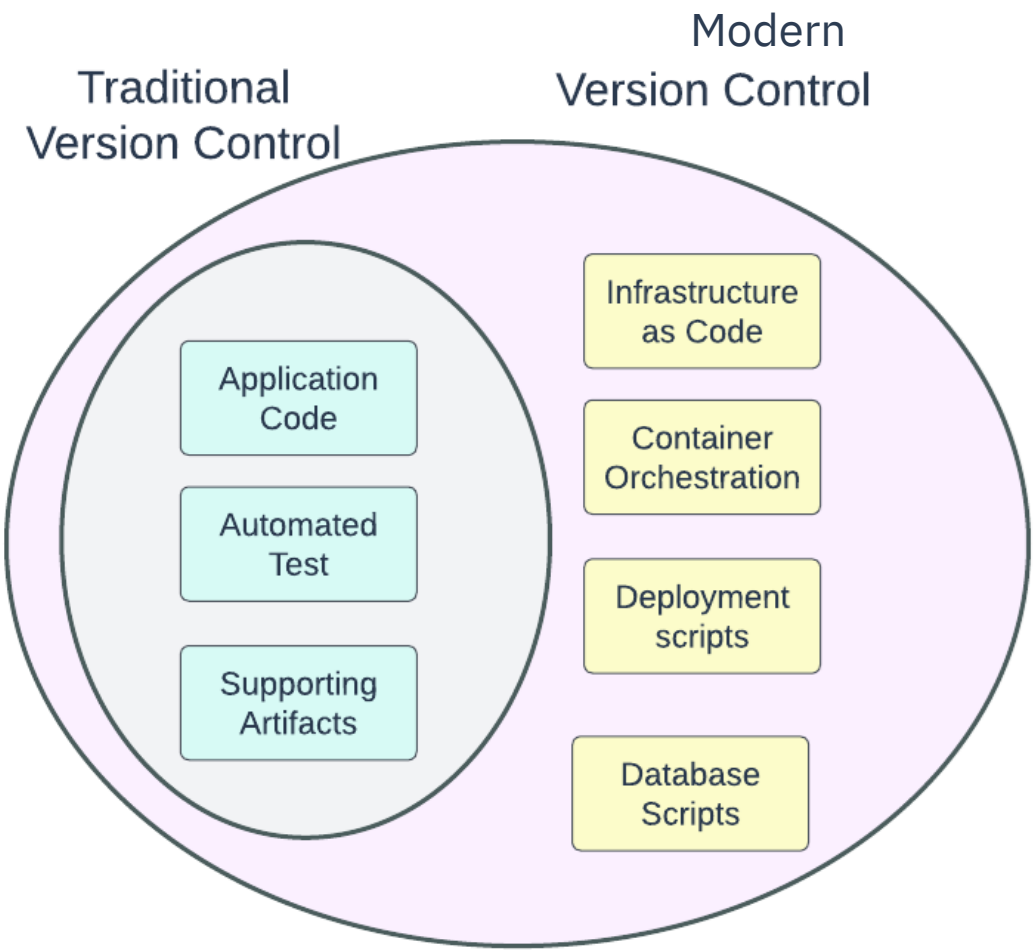
Give feedback

Search

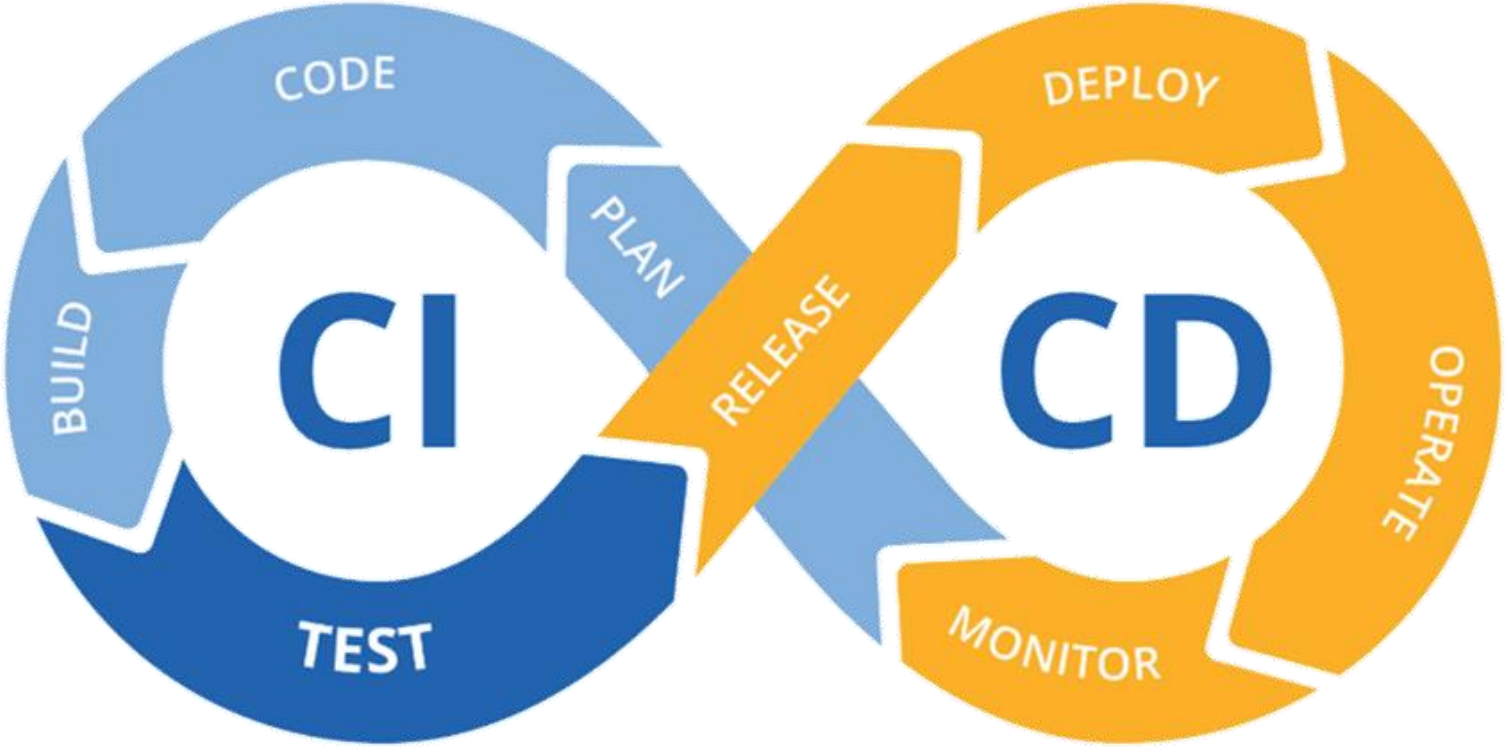
3:18 PM
4/28/2024

Version Control

- Reproducibility
- Traceability
- Disaster recovery
- Auditability
- Higher quality



Continuous Integration, Continuous Delivery/Deployment



https://www.linkedin.com/pulse/devops-continuous-integrationcontinuous-deployment-cicd-strategies/

Continuous Integration, Continuous Delivery/Deployment

- A culture and process around constantly integrating new code
- https://continuousdelivery.com/

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Continuous Integration:

- Committed code is built
- Resolve integration issues
- Resolve deployment issues
- Address bugs early

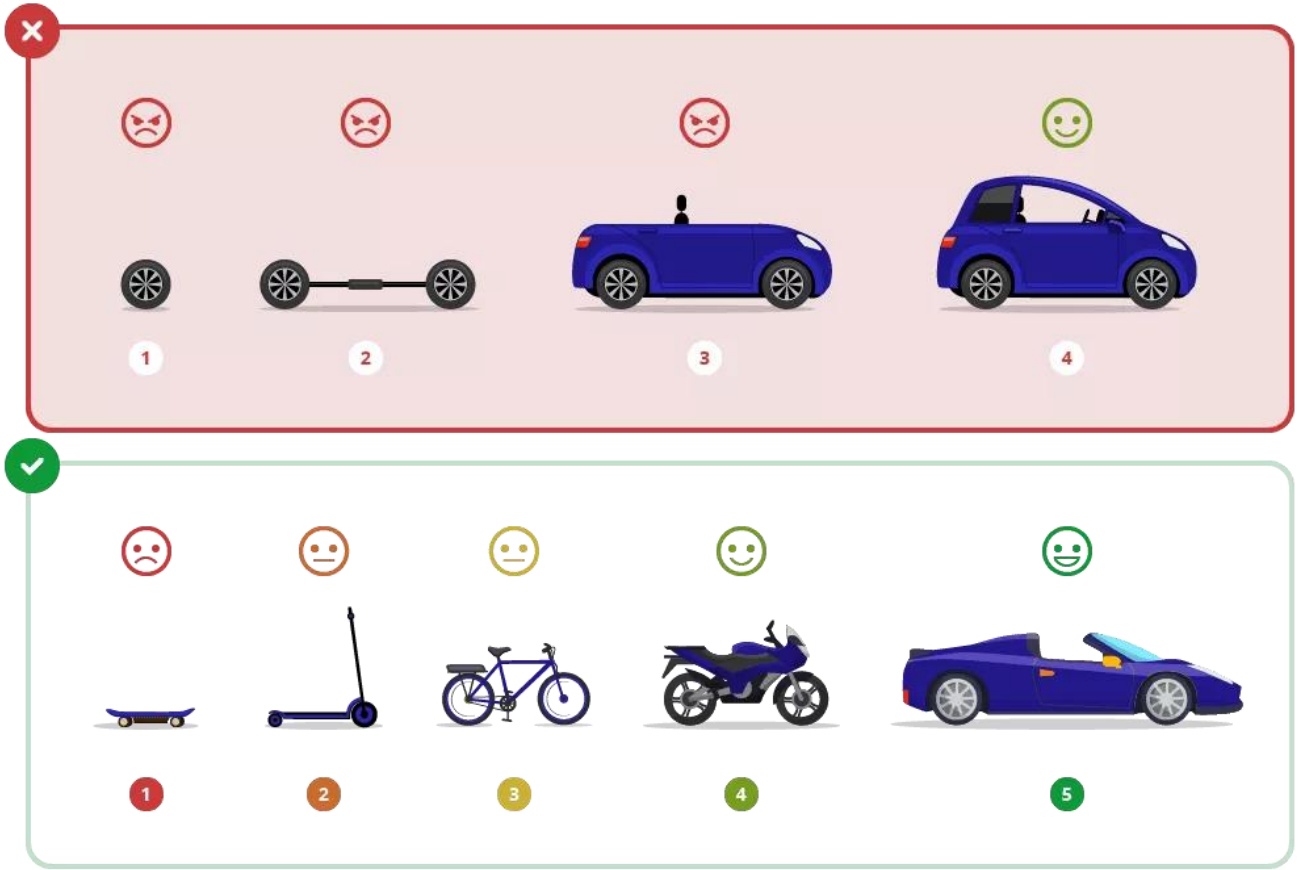
Continuous Delivery/Deployment:

- Pipeline stops on error
- Codebase is always deployable
- Some/all deployment is automated

Gall’s Law:

“A complex system that works is invariably found to have evolved from a simple system that worked. A complex system designed from scratch never works and cannot be patched up to make it work. You have to start over with a working simple system.”

Continuous Delivery



https://viblo.asia/p/what-is-mvp-what-are-the-key-mvp-types-RQqKLNWNl7z

Pipeline

```yaml
name: deploy infra and app using github functions`
on:
  workflow_dispatch:
  push:
    branches:
      - main
env:
  NODE_VERSION: "14.x"
jobs:
  build-infrastructure:
    name: build infrastructure
    runs-on: ubuntu-latest
    steps:
      - name: checkout
        uses: actions/checkout@main

      - name: Log in to Azure
        run: |
          az login --service-principal -u ${{ secrets.AZURE_CLIENT_ID }} -p ${{ secrets.AZURE_CLIENT_SECRET }} --tenant ${{ secrets.AZURE_TENANT_ID }}

      - name: build infrastructure
        uses: azure/arm-deploy@v1
        with:
          scope: resourcegroup
          resourceGroupName: "StirTrekAuto"
          deploymentMode: incremental
          template: ./infra/main.bicep
          parameters: ./infra/main.parameters.json
```

1

StirTrekApp

testFunction.cs 1, M | App.tsx (Working Tree)

backEnd > testFunction.cs > CreateContactsForCountries > Run

```
15      public static class CreateContactsForCountries
18          public static async Task<IActionResult> Run(
26              var emailsContainer = cosmos.GetContainer("fre
27
28                  // Get the contacts for the district.  Res
29                  var query = new QueryDefinition("SELECT TO
30                  var messages = await emailsContainer.GetIt
31
32                  if (messages.Count == 0)
33                  {
34                      return new NotFoundResult();
35                  }
36                  return new OkObjectResult(messages);
37
38              }
39              catch (Exception e)
40              {
41                  return new StatusCodeResult(500);
42              }
43          }
44      }
```

PROBLEMS 13 | OUTPUT | TERMINAL | powershell

```
PS C:\Projects\StirTrekApp> git add -A
PS C:\Projects\StirTrekApp>
```

main* | 0 13 | 0 | Attach to .NET Functions (StirTrekApp) | Projects: 1 | Live Share | Prettier

Resource groups - Microsoft Az | stirtrektestfrontend.azurewebsit

https://portal.azure.com/#view/HubsExtension/Brows...

Contact | Learning | Reading | Rotary | Other | Coding | general - Remotask... | Coding Instructions | To Do | Trello

Microsoft Azure | Search resources, services, and docs (G+/) | drakelundstrom@outlo... DEFAULT DIRECTORY (DRAKELU...

Home >

Resource groups

Default Directory (drakelundstromoutlook.onmicrosoft.com)

Create | Manage view | Refresh | Export to CSV | Open query | Assign tags

Filter for any field... | Subscription equals all | Location equals all | Add filter

Showing 1 to 3 of 3 records. | No grouping | List view

Name	Subscription	Location
DefaultResourceGroup-EUS	Azure subscription 1	East US
freedatabase	Azure subscription 1	East US
StirTrekAuto	Azure subscription 1	East US

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2

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drakelundstrom/StirTrekApp...

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Coc | ull requests | Actions | Projects | Wiki | Security

← deploy infra and app using github functions

complete demo app! #36

Summary

Triggered via push 2 minutes ago

drakelundstrom pushed 77acc6b main

Status	Total duration	Artifacts
In progress	–	–

infraAndAppDeploy.yml

on: push

validate azure credentials 7s → build infrastructure 1m 45s → build react app 3s → deploy react app → build-and-deploy-back-end

Annotations

1 warning

StirTrekAuto - Microsoft Azure

stirtrektestfrontend1.azurewebs

https://portal.azure.com/#@studyabroadscholarships...

Contact | Learning | Reading | Rotary | Other | Coding | general - Remotask... | Coding Instructions | To Do | Trello

Microsoft Azure | Search resources, services, and docs (G+/) | studyabroadscholarship... DEFAULT DIRECTORY

Home >

StirTrekAuto

Resource group

Search

- Overview
- Activity log
- Access control (IAM)
- Tags
- Resource visualizer
- Events

Settings

- Deployments
- Security
- Deployment stacks
- Policies
- Properties
- Locks

Cost Management

- Cost analysis
- Cost alerts (preview)
- Budgets
- Advisor recommendations

Monitoring

- Insights (preview)
- Alerts
- Metrics

Create | Manage view | Delete resource group | Refresh | Export to CSV

Essentials | JSON View

Subscription (move)
Azure subscription 1

Subscription ID
0ac70d73-7e0b-4608-9fe3-c073e04fa381

Tags (edit)
Add tags

Deployments
2 Deploying,2 Succeeded

Location
East US

Resources | Recommendations

Filter for any field... | Type equals all | Add filter | More (1)

Showing 1 to 9 of 9 records. | Show hidden types | No grouping

List view

Name	Type	Location
DrakeStirTrekApi	Application Insights	East US
DrakeStirTrekApi1	Application Insights	East US
DrakeStirTrekApi1	Function App	East US
DrakeStirTrekApiHostingPlan	App Service plan	East US
Failure Anomalies - DrakeStirTrekApi	Smart detector alert rule	Global
Failure Anomalies - DrakeStirTrekApi1	Smart detector alert rule	Global
StirTrekTestFrontEndHostingPlan	App Service plan	East US
StirTrekTestKv	Key vault	East US

Page 1 of 1

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10:44 PM
5/2/2024

3

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drakelundstrom/StirTrekApp...

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Coc | ull requests | Actions | Projects | Wiki | Security

← deploy infra and app using github functions

complete demo app! #36

Summary

Triggered via push 3 minutes ago

drakelundstrom pushed 77acc6b main

Status	Total duration	Artifacts
In progress	–	–

infraAndAppDeploy.yml

on: push

validate azure credentials 7s → build infrastructure 1m 43s → build react app 12s → deploy react app 18s → build-and-deploy-back-end 6s

Annotations

5 warnings

StirTrekAuto - Microsoft Azure | Microsoft Azure App Service -

https://stirtrektestfrontend1.azurewebsites.net

Contact | Learning | Reading | Rotary | Other | Coding | general - Remotask... | Coding Instructions | To Do | Trello

Microsoft Azure

Your web app is running and waiting for your content

Your web app is live, but we don't have your content yet. If you've already deployed, it could take up to 5 minutes for your content to show up, so come back soon.

Supporting Node.js, Java, .NET and more

Haven't deployed yet? Use the deployment center to publish code or set up continuous deployment.

Starting a new web site? Follow our Quickstart guide to get a web app ready quickly.

Quickstart

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5/2/2024

4

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drakelundstrom/StirTr...

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Coc | ull requests | Actions | Projects | Wiki | Security

← deploy infra and app using github functions

complete demo app! #36

Summary

Triggered via push 8 minutes ago

drakelundstrom pushed 77acc6b main

Status	Total duration	Artifacts
Success	7m 59s	1

infraAndAppDeploy.yml

on: push

validate azure credentials 7s → build infrastructure 1m 43s → build react app 12s → deploy react app 18s → build-and-deploy-back-e... 5m 2s

Annotations

7 warnings

StirTrekAuto - Microsoft Azure | Vite + React + TS

https://stirtrektestfrontend1.azurewebsites.net

Contact | Learning | Reading | Rotary | Other | Coding | general - Remotask... | Coding Instructions | To Do | Trello

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5/2/2024

Keys to Success

- ✓ Test in the “real” environment
- ✓ Automate testing
- ✓ Reduce toil

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Triggered via push 3 minutes ago

drakelundstrom pushed a47a43b main

Status

Failure

Total duration

2m 41s

Artifacts

–

infraAndAppDeploy.yml

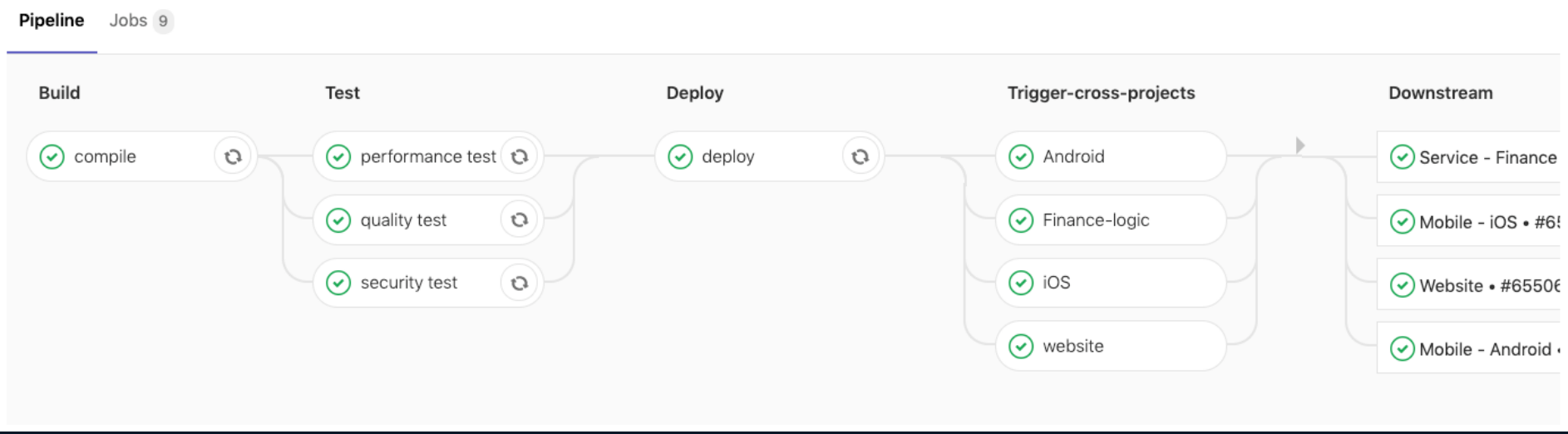
on: push

validate azure credentials 9s	build infrastructure 1m 53s	build react app 14s	deploy react app 0s	build-and-deploy-back-end 0s

“Bear in mind: continuous delivery is not magic. It’s about continuous, daily improvement — the constant discipline of pursuing higher performance by following the heuristic ‘if it hurts, do it more often, and bring the pain forward.’”

- https://continuousdelivery.com/

Removing toil makes space for innovation



https://about.gitlab.com/blog/2019/07/24/cross-project-pipeline/

Where do developers come in?

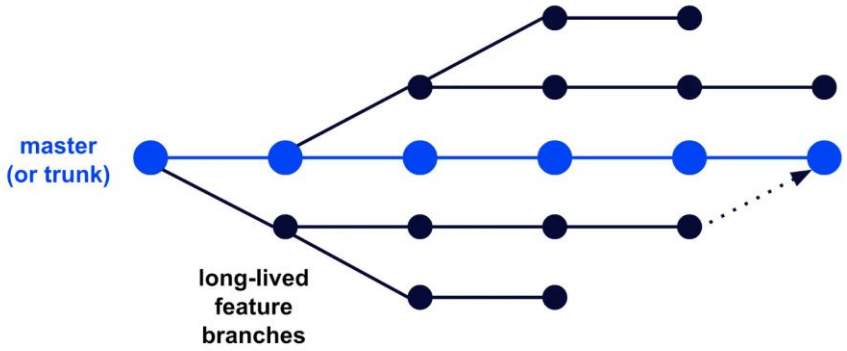
Infrastructure isn’t useful without code to run on it

Trunk Based Development: What is It?

- Development is done on short-lived branches that merge into main often
- https://trunkbaseddevelopment.com/

https://www.freepngimg.com/svg/4811-large-tree

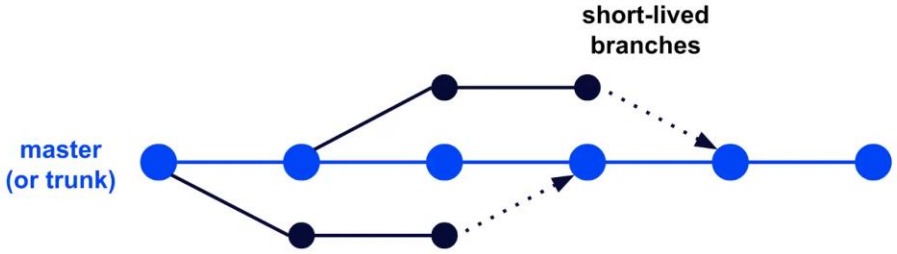
Feature-branched development



merging is difficult on a longer-lived feature branch

https://www.optimizely.com/optimization-glossary/trunk-based-development/

Trunk-based development



merging is done more frequently and more easily for shorter branches

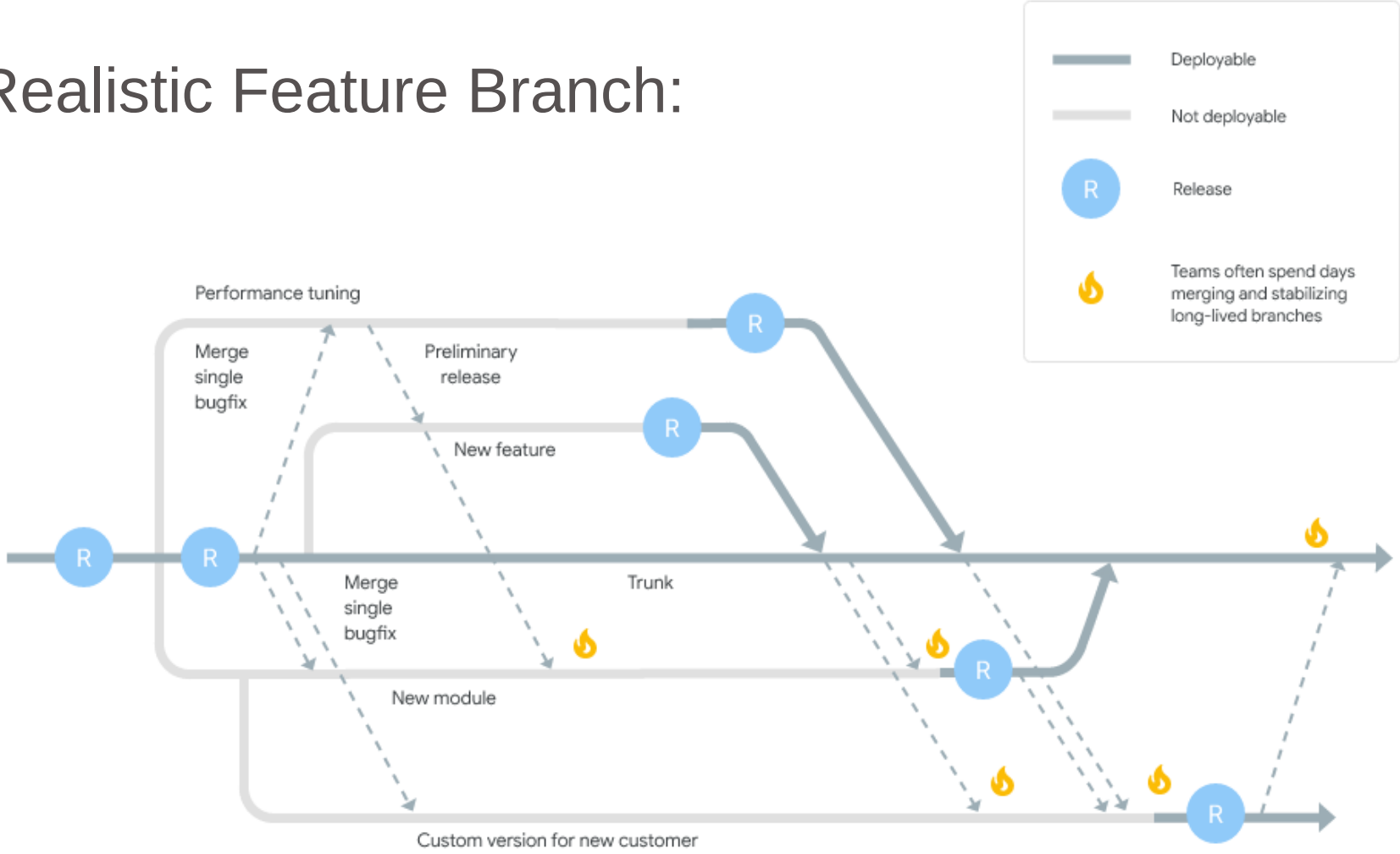
Trunk Based:

- Small stories
- Low WIP
- Merge to trunk >1 per day
- Limit branches
- Fast PRs

Feature Branch:

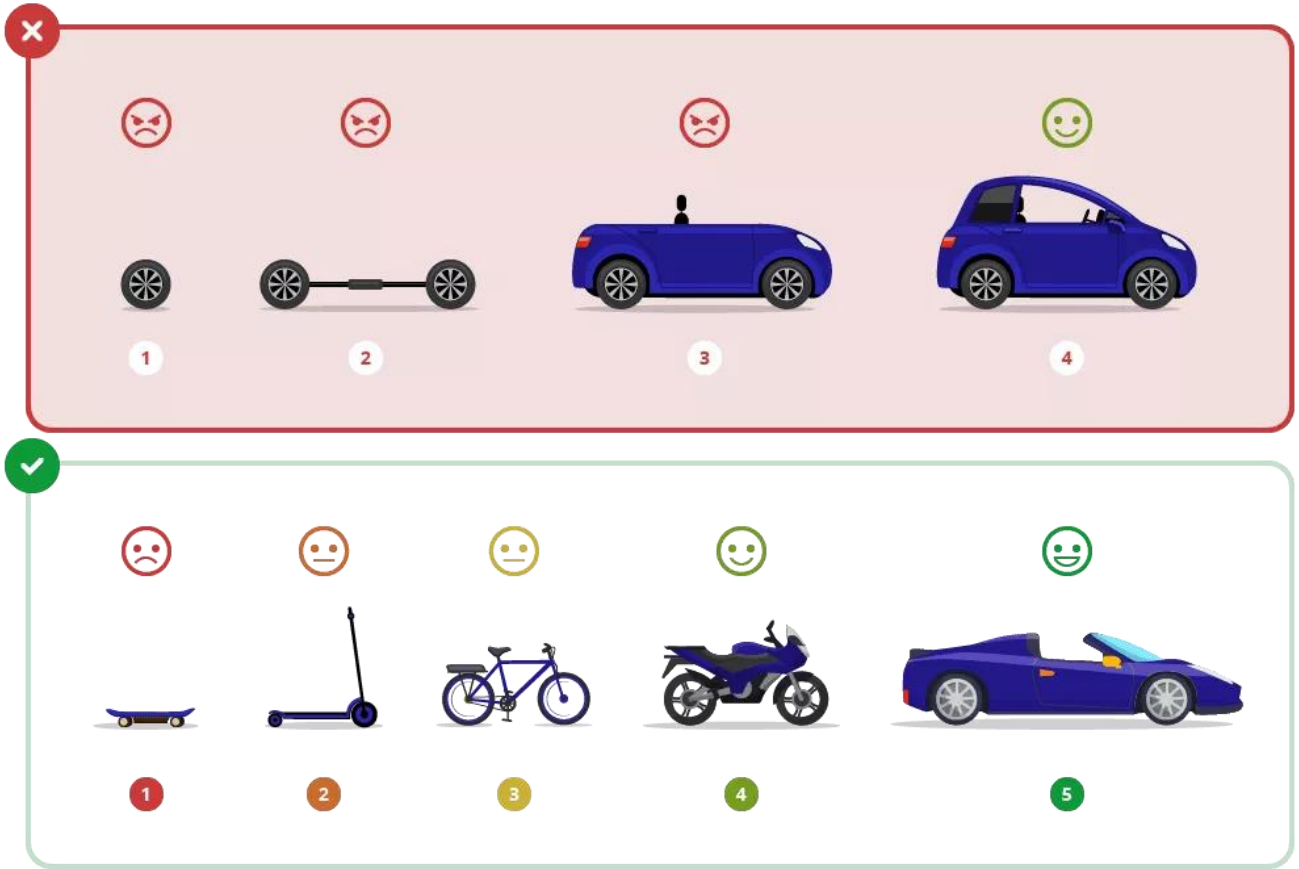
- Large stories
- Variable WIP
- Branches live weeks or months
- Many nested branches
- Code freezes

Realistic Feature Branch:



https://dora.dev/devops-capabilities/technical/trunk-based-development/

Trunk Based Development



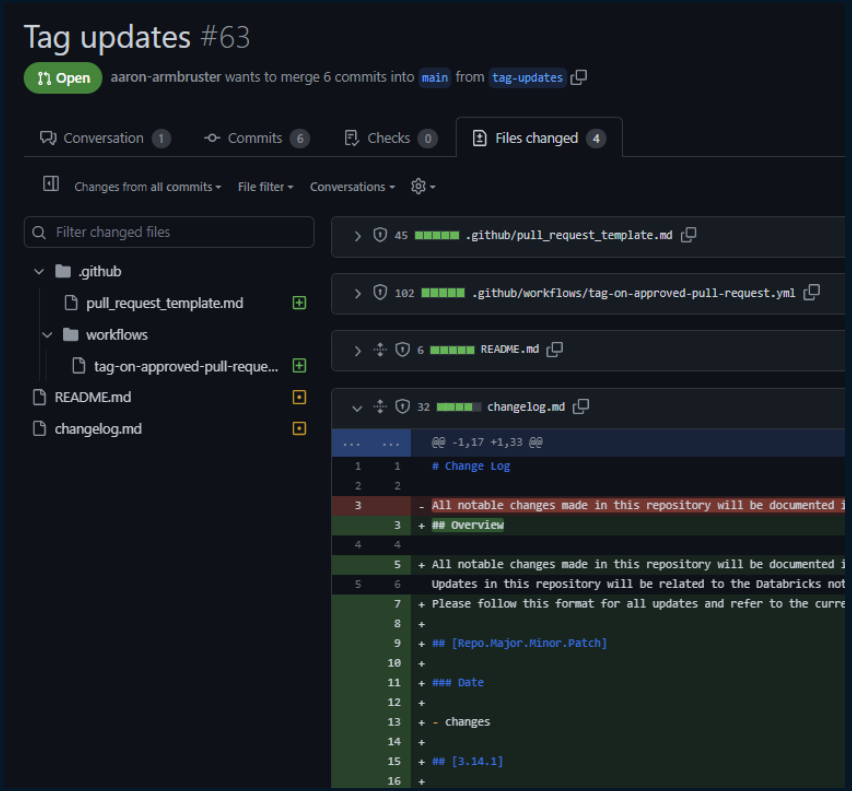
https://viblo.asia/p/what-is-mvp-what-are-the-key-mvp-types-RQqKLNWNl7z

Trunk Based Development: Remove Friction

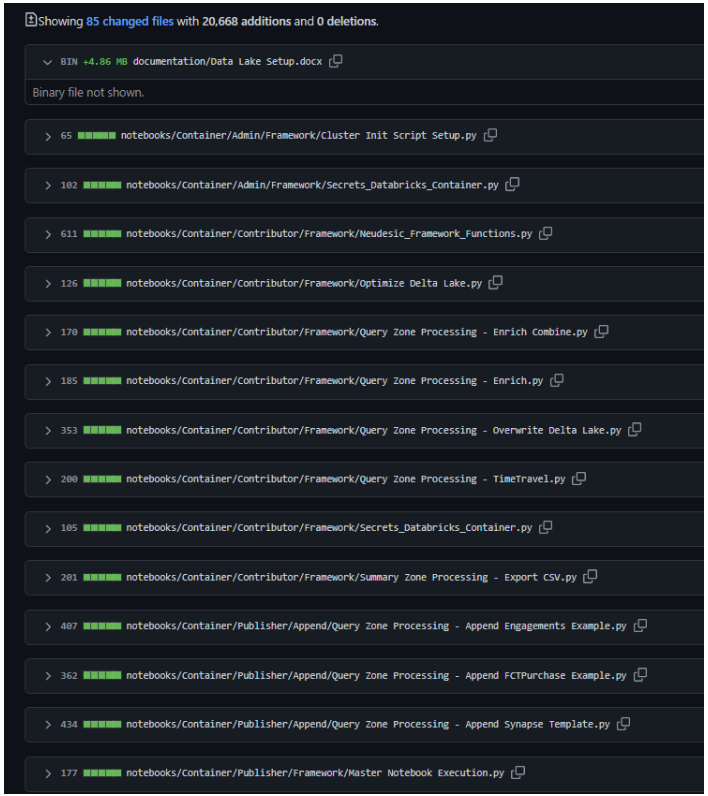
- Fast PRs
- Easy/fast to build
- Lightweight review process
- Automated pipelines
- Automated testing

https://byrslf.co/the-mental-trap-that-keeps-us-from-moving-forward-d03a3a3cba32?gi=3aab5a6d3afb

Trunk Based:

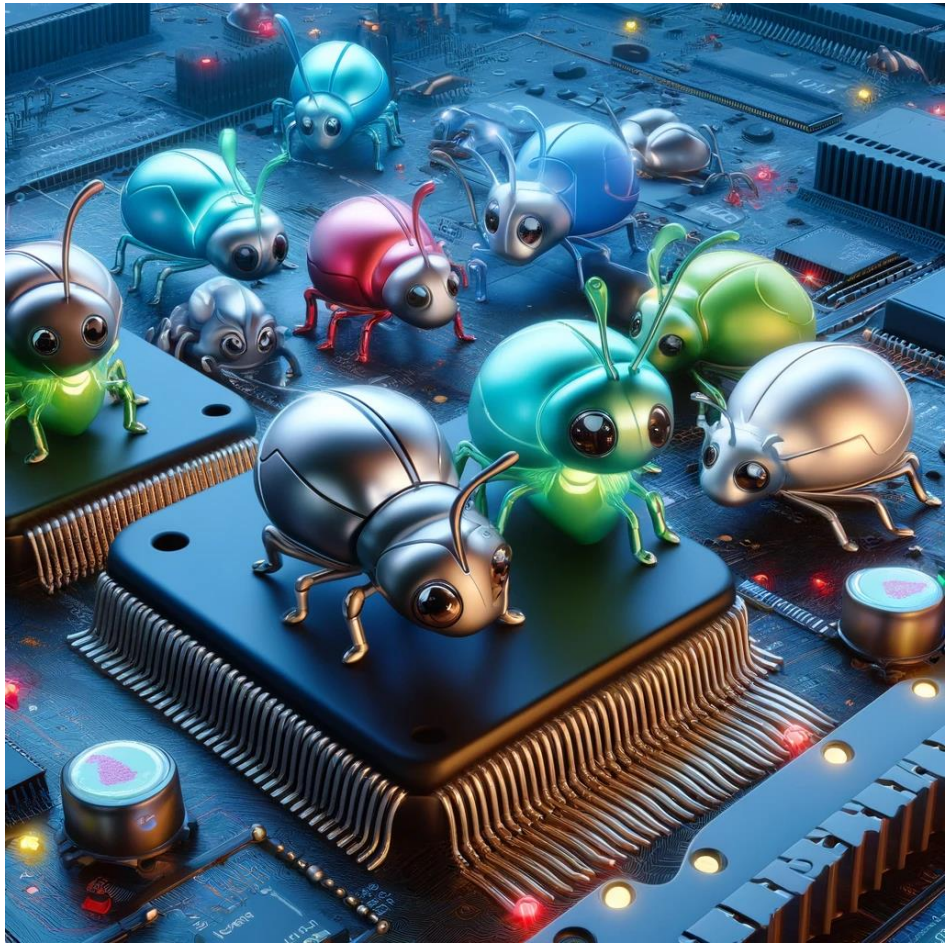


Feature Branch:



Lots of PRs:
What about Reliability?

- Small PRs == Easy rollback
- Bugs are the top priority
- Automated testing



ChatGPT 4

Complex Features with Dependencies

- Spikes
- Chunks
- Exceptions (like setup)

So we just wait around with PRs?

https://en.wikipedia.org/wiki/File:Aiga_waitingroom.svg

Syncronous, Lightweight PR Review

- Team effort
- Needs supporting culture
- Train reviewers

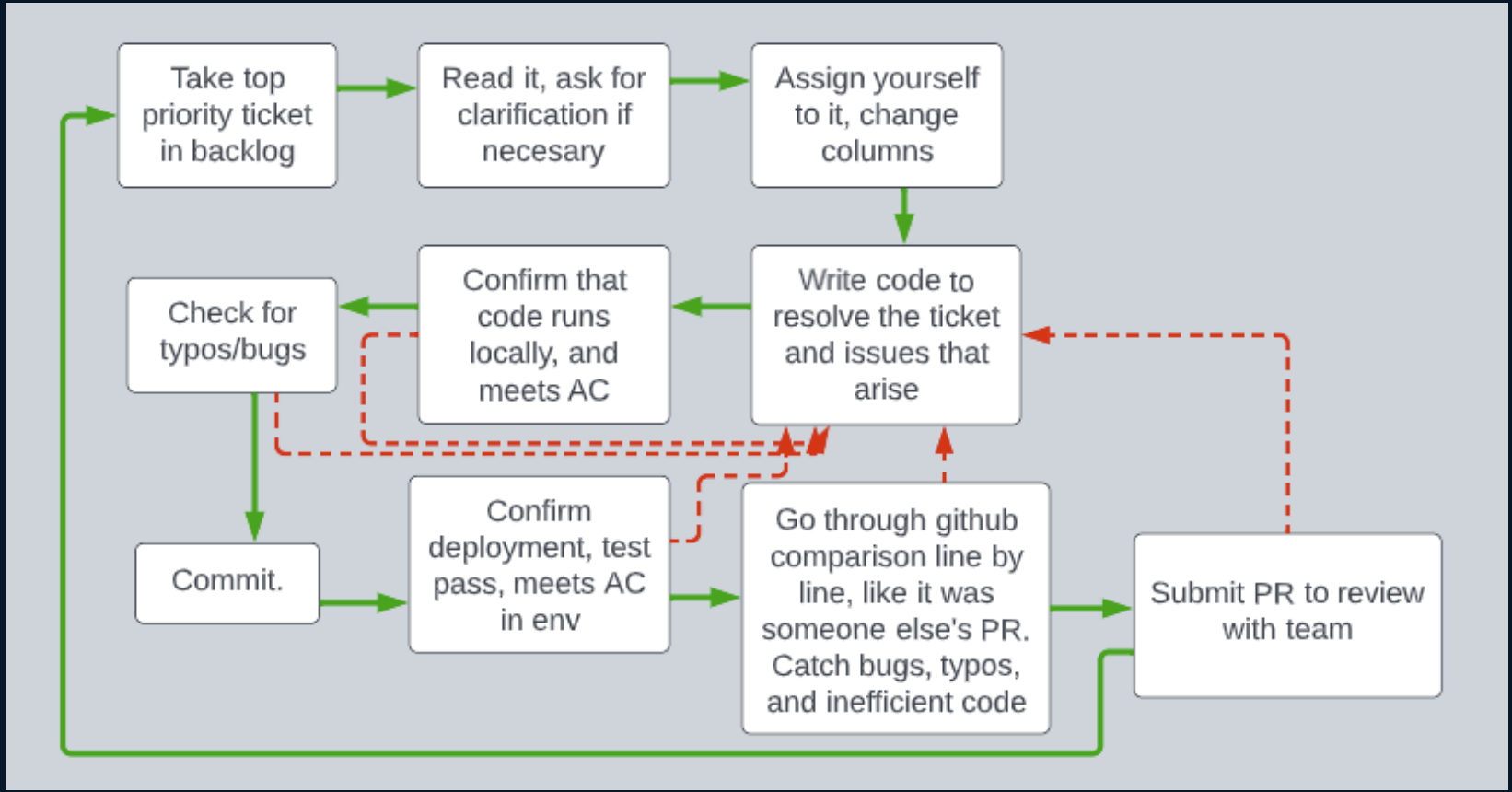
https://altaworld.tech/duck-creek-technologies-and-copart-to-sign-a-collaboration-for-providing-better-service-together/

Tasks/Ticket Best Practices

- Clear acceptance criteria
- Vertical slices
- Single source of truth

https://www.vectorstock.com/royalty-free-vector/yellow-ticket-with-stars-vector-1269849

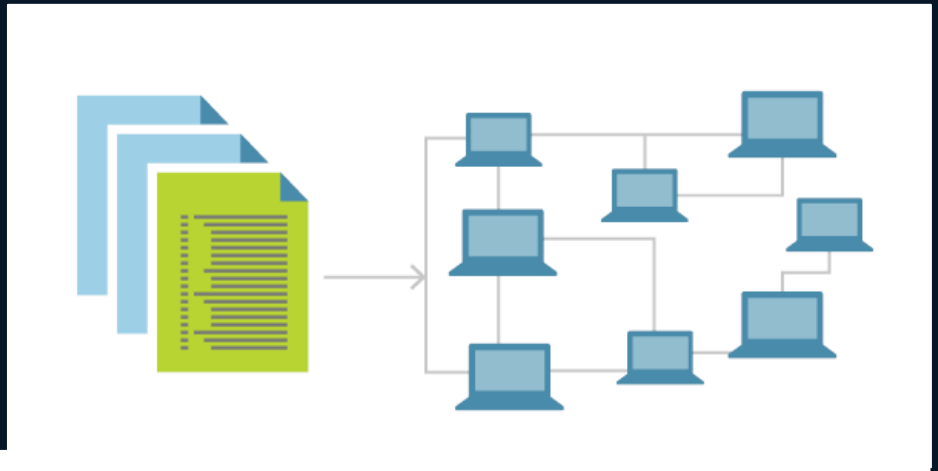
Development Flow Diagram

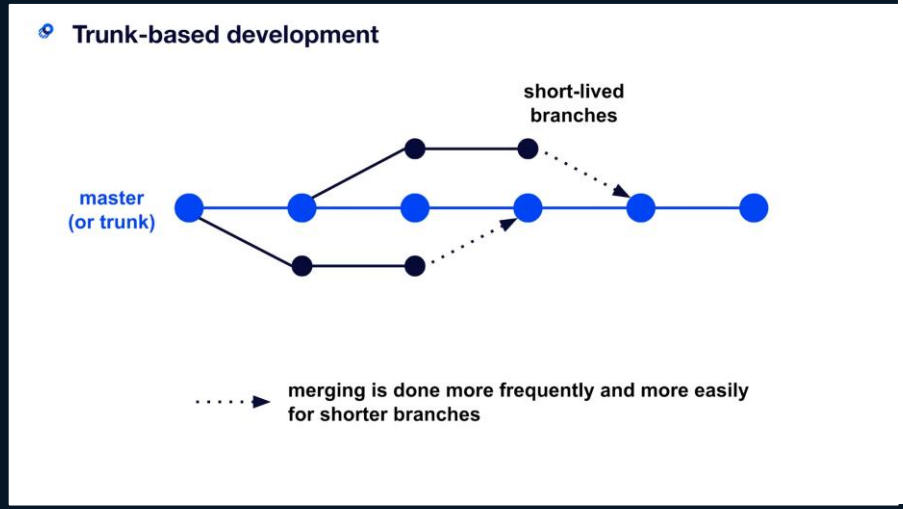


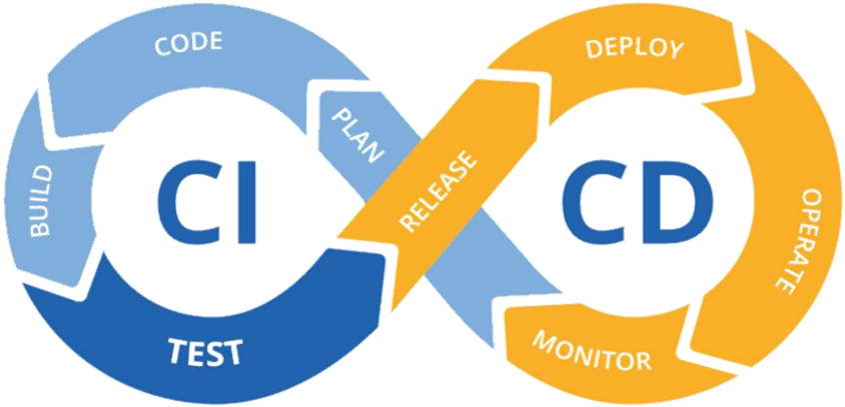
Don’t Merge Breaking Code

Trunk + CICD + IaC

It all works together



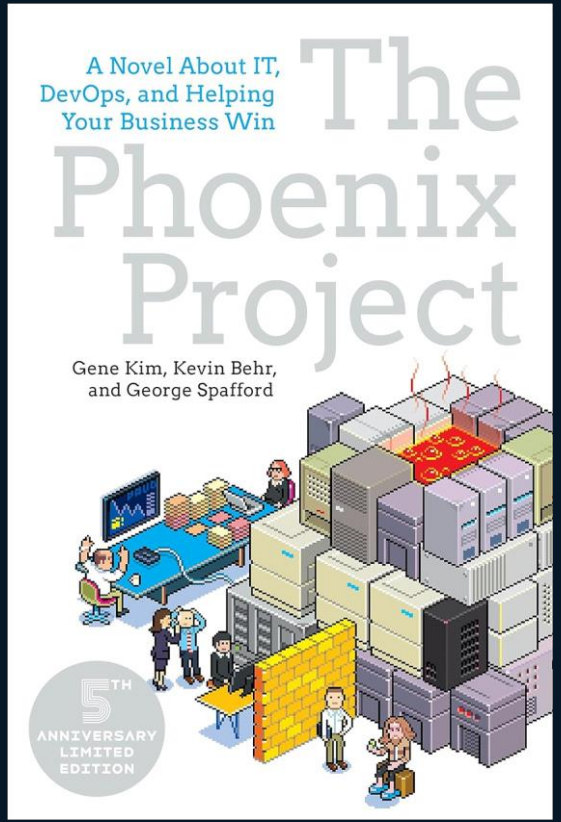


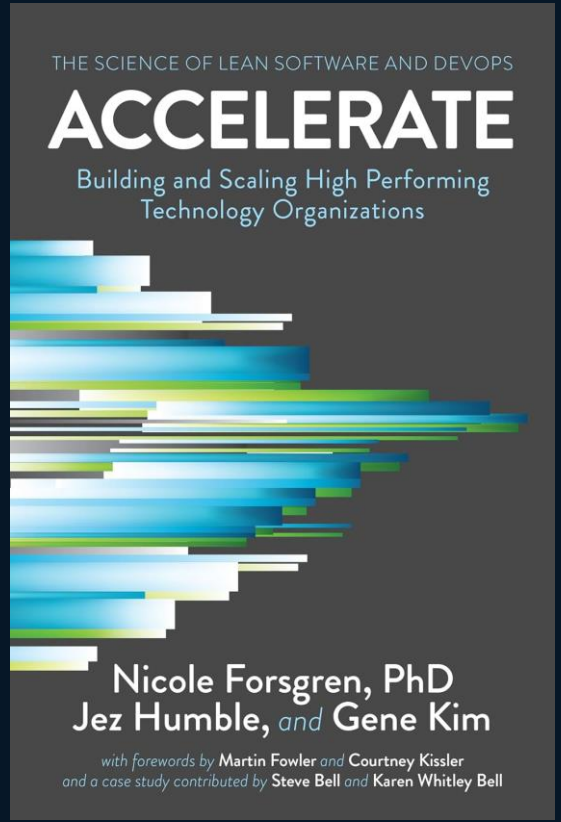


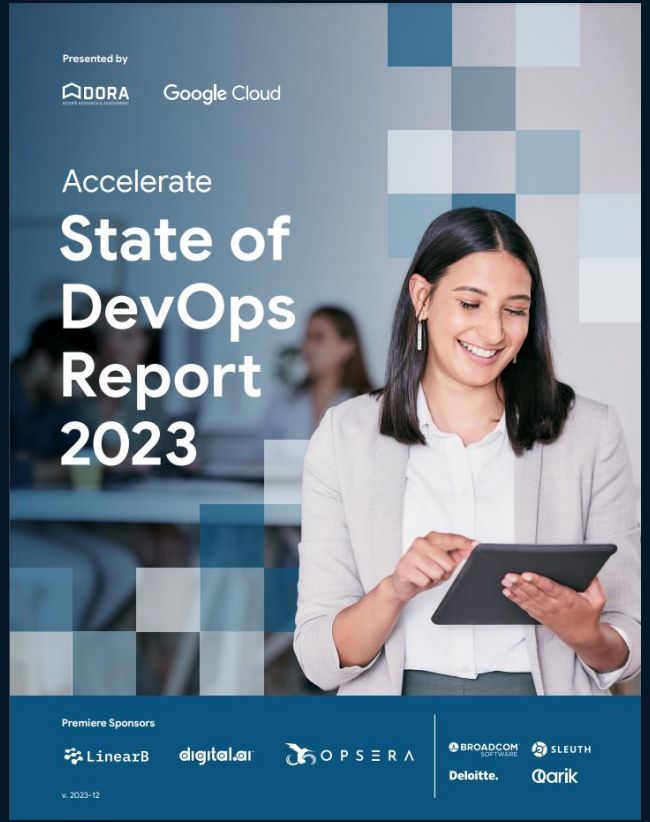
Then everything changed when
DevOps was implemented

Where Do I Learn More?

https://dora.dev







https://mcc.gse.harvard.edu/whats-new/gratitude-is-more-than-just-saying-thank-you

Questions?

IaC:

- Manage infrastructure with a replicable, iterable system

CICD:

- Iterate frequently in small chunks
- Test in the real environment

Trunk Based Development:

- Apply the same lessons to development work