Automate Database Deployments with Azure DevOps

SQL Saturday Atlanta 2024

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Erin Dempster

Microsoft® MVP Most Valuable Professional

Data Operations Team Lead

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- SQL Server DBA
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Speaker – PASS Summit, SQLBits +

Author – SQLServerCentral.com

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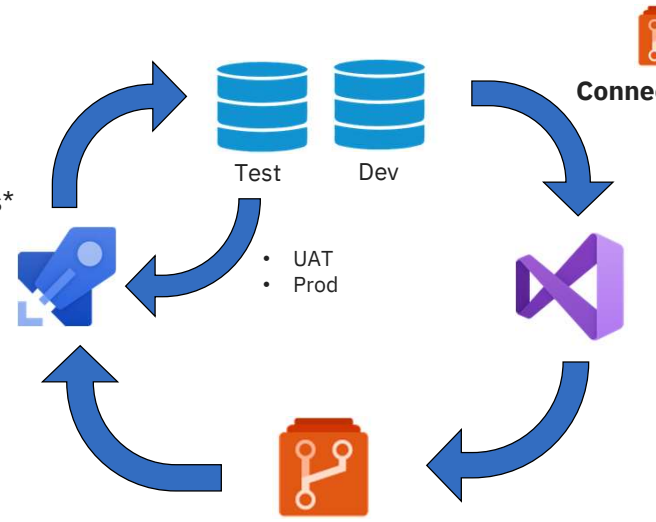
Agenda

Azure Pipelines

1. Build
2. Automated Tests*
3. Approve
4. Deploy
5. Repeat 2&3



Connect to Git

Visual Studio

- Reverse Engineer
- Develop Changes
- Publish to Dev
- Commit Changes

Azure Repos
Git Repositories

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Release 1.0

- Sprint 0 – Major Tools Landscape
- Sprint 1 – The Basics
- Release Review

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Release 2.0

- Sprint 2 – Code Branching/Build Validations
- Sprint 3 – More Visual Studio Features
- Sprint 4 – Securing Deployments
- Release Review

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Sprint 0 – Tools Landscape

Who are the major players in Database DevOps?

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Main Vendors

Developer Tools

Microsoft	Red Gate
Visual Studio	Flyway
Visual Studio Code	SQL Source Control (EOL announced)
Azure Data Studio	

Source Control Solutions

Microsoft	Others
Azure DevOps	Bitbucket Cloud
GitHub	GitLab
	Subversion

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Installed Tools Used Today

- Visual Studio 2022 Community Edition
  - https://aka.ms/vs2022
  - Current Version - 17.9.x (bi-weekly updates)
  - Community Edition is freely available TO EVERYONE
- SQLPackage.exe – used for deployments
  - https://aka.ms/sqlpackage

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Azure DevOps vs GitHub

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Azure DevOps vs GitHub

	Azure DevOps	GitHub
Git Repositories	Yes!	Of course!!
Continuous Deployment	Azure Pipelines	GitHub Actions
Sprint/Kanban Boards	Yes	No (Issue Tracking)
Manual/Automated Testing	Available (different license)	No

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Azure DevOps vs GitHub

Easy, peasy!!

	Azure DevOps	GitHub		
Authentication Method	**All Levels**	**Free**	**Team**	**Enterprise**
"Standard"	Guest Access (external users)	Email address/password		
"Enhanced"	Entra ID	N/A		Managed Users SAML

Major bummer!

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Costs for Source Control and CI/CD

	Azure Pipelines		GitHub Actions		
Pricing (per month)	Up to 5 Users	Over 5 Users	**Free**	**Team**	**Enterprise**
	FREE	$6/user	**FREE**	$4/user	$21/user
Service-hosted Agents					
Private Projects	1st – Free (1,800 min)	$40 each/mo	2,000 min	3,000 min	50,000 min
Public Projects	Up to 10 **FREE** parallel jobs		**FREE & Unlimited**		
Self-hosted Agents					
Private Projects	1st – Free (unlimited)	$15 each/mo	**FREE & Unlimited**		
Public Projects	**FREE & Unlimited**		**FREE & Unlimited**		

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Sprint 1 – The Basics

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Sprint 1 – The Basics

- Git Client Overview and Demo
- Visual Studio SQL Server Database Projects
- Azure Repos
- Azure Pipelines

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Introduction to Local Source Control

Git Client

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Git Client

- Local source control repository
- Command Line-based
- Works with hosted Git
  - Azure DevOps
  - GitHub
  - …WHERE Name LIKE 'Git%'

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Git Client

Integrated into Popular Developer Tools

- Visual Studio
- Azure Data Studio
- Eclipse
- …many others

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Git Client

- Download URL
  - https://git-scm.com/downloads
- Choose your platform
  - Windows
  - macOS
  - Linux/Unix

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Common Git Commands

- Clone – copy a remote repo locally (1-time)
- Fetch – syncs local metadata from remote
- Pull – syncs local files from remote
- Add/Rm – add or remove files/folders
- Commit – check-in changes
- Push – syncs remote files from local
- Branch – manage code branches
- Checkout – switch branches

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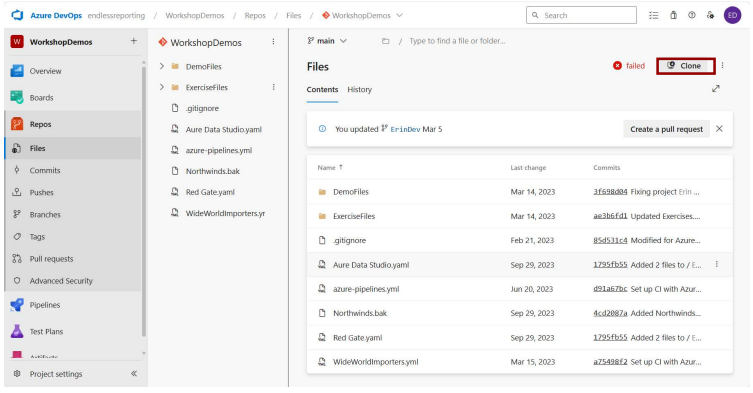
Azure Repos

- Clone – copy a remote repo locally (1-time)



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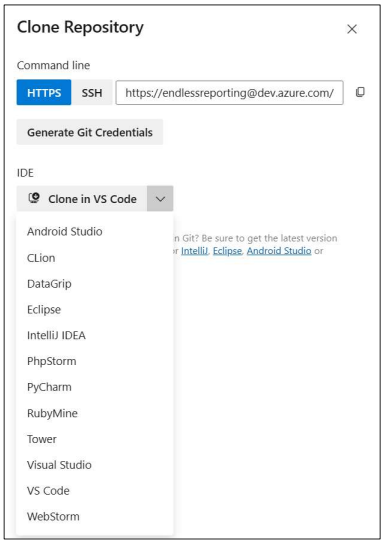
Azure Repos



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Demo

Local Git Repository Setup

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Git Client Tips

At the Command Prompt…

- Navigate to the correct subfolder
- Fetch remote repo metadata with ‘git fetch’
- Then run ‘git pull’ to download changes
- Develop code in a branch (more to come)

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Visual Studio 2022

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Visual Studio 2022

Microsoft's flagship development ecosystem

- C++/C#/VB development
- SQL Server
- Node.js
- Python

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Visual Studio 2022

- Azure Development
- Multi-platform UI development
- Game development
- Office/SharePoint development

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Visual Studio 2022

- Integration Services and Reporting Services
- SQL Server Databases

Total Install Size – 35+ GB

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SQL Server Database Project

Currently supports

- SQL Server 2005 – 2022
- Azure SQL DB and Managed Instance
- Azure SQL Data Warehouse (Synapse)
- Azure Synapse Analytics Serverless Pools

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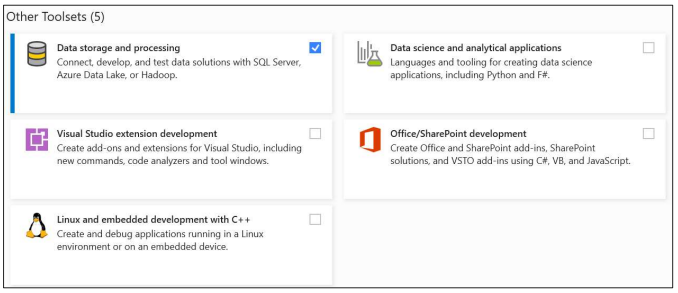
Installing SQL Database Projects

- Data storage and processing
- Scroll to the bottom



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Visual Studio 2022

- Current Version - 17.9.x
- 17.10 Preview 2
- Weekly or Bi-weekly Updates

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Visual Studio & SQL Support

Several DB-related updates since Aug ’22 (17.3.x)

- Schema Comparison hangs on compare
- Schema Drift after changing branches

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Demo

Visual Studio SQL Database Project

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Azure DevOps Overview

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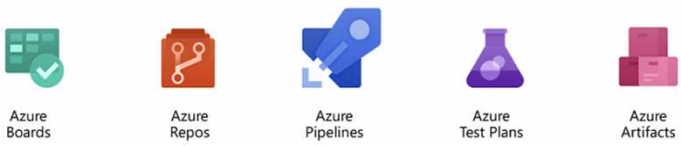
Azure DevOps – Key Components



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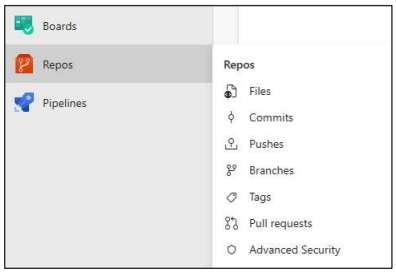
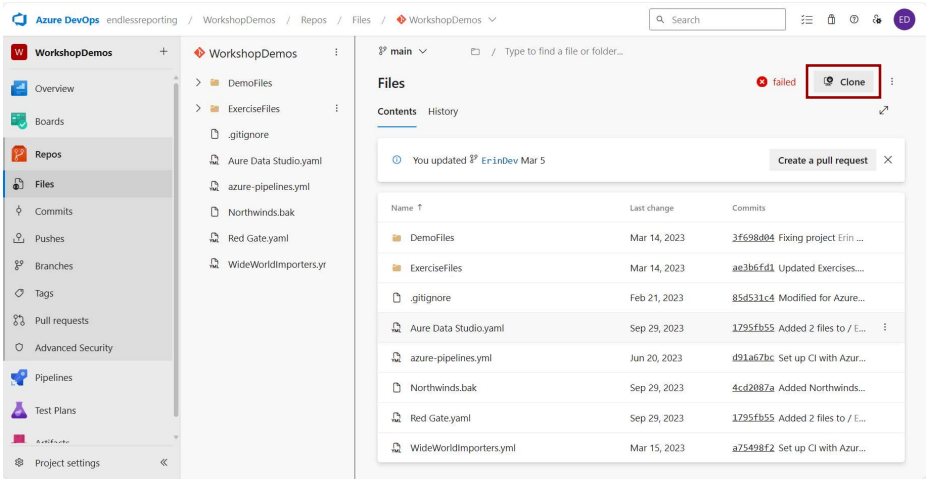
Azure Repos

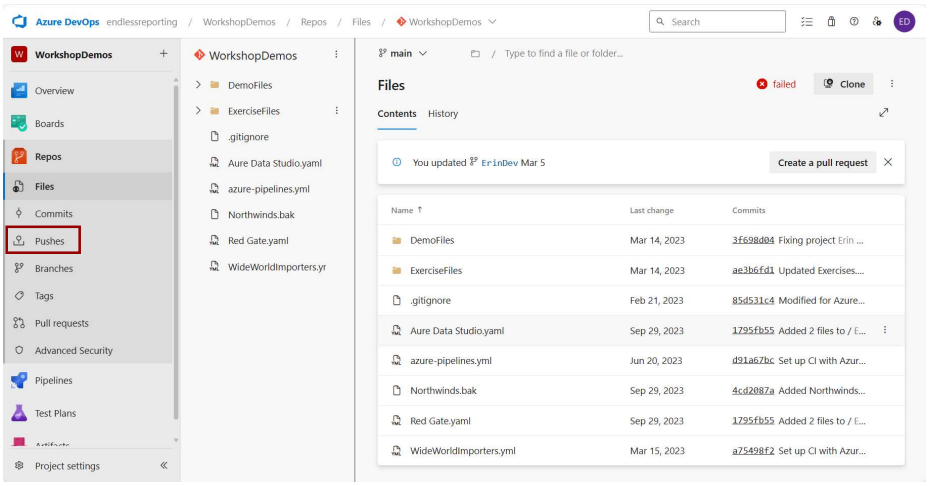
- Centralized Git Repository
- Manage
  - History (Commits)
  - Branches
  - Pull Requests



Azure Repos



Azure Repos



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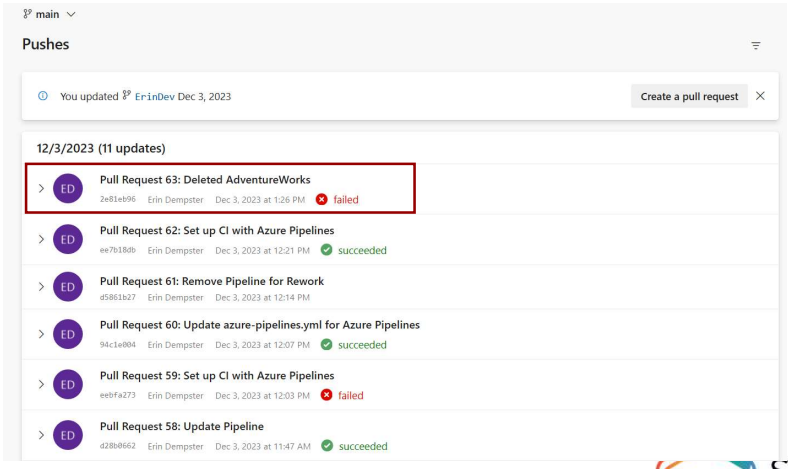
Azure Repos – Code Pushes



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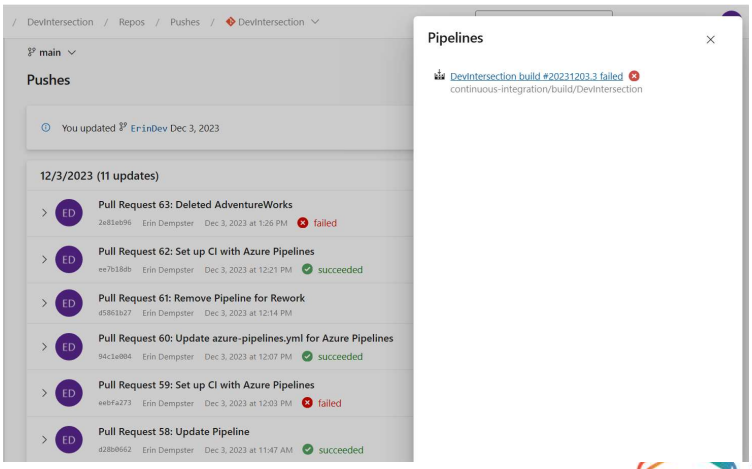
Pipeline Integration



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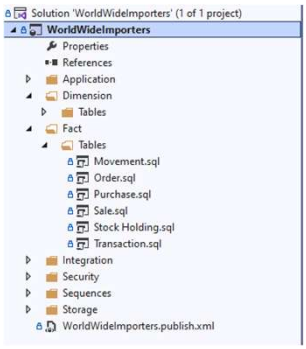
Azure Pipelines

Azure Pipelines

- Manages code builds and deployments
- Triggered by source code check-ins
- Define **YOUR** workflow



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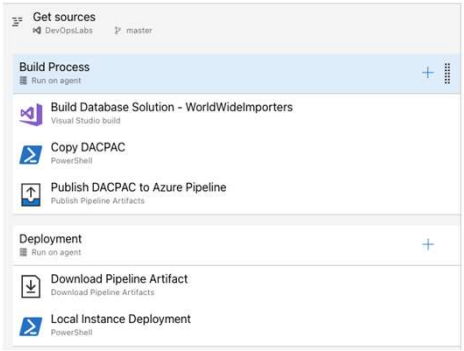
Azure Pipelines

- Many pre-defined tasks
  - Visual Studio Build
  - Publish & Download Artifacts
- Scripting tasks
  - PowerShell
  - BASH scripts
- Orchestrate in YAML



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Azure Pipelines

- YAML Schema - https://tinyurl.com/4z7x3mkw
- Task Index - https://tinyurl.com/56vf436z
- Pipeline Variables - https://tinyurl.com/ye2ypvum

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YAML Primer for Azure DevOps

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What is YAML?

- "**Y**AML **A**in't **M**arkup **L**anguage"
- Configuration Layout
- Used by both Azure DevOps and GitHub Actions

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YAML - Azure Pipelines vs GitHub Actions

```yaml
trigger:
- main

pool:
  vmImage: windows-latest

jobs:
- job: buildDACPAC
  displayName: Build Azure Data Studio DACPAC
  steps:
  Settings
  - task: DotNetCoreCLI@2
    inputs:
      command: 'build'
      projects: '**/Adventureworks.sqlproj'
```

```yaml
name: deploy-northwinds
run-name: Deploy Northwinds database
on: [push]
jobs:
  build:
    runs-on: windows-latest
    steps:
    - uses: actions/checkout@v3
    - uses: azure/sql-action@v2.2
      with:
        connection-string: ${{ secrets.AZURE_SQL_CONNECTION_STRING }}
        path: './Northwinds.sqlproj'
        action: 'publish'
        build-arguments: '-c Release'
        arguments: '/p:DropObjectsNotInSource=true'
```

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Configuration Layout

Whitespace-sensitive

```yaml
18    steps:
      Settings
19    - task: DotNetCoreCLI@2
20      inputs:
21        command: 'build'
22        projects: '**/AdventureWorks.sqlproj'
23
```

4 spaces (Implied job)

≠

```yaml
18    steps:
      Settings
19    - task: DotNetCoreCLI@2
20      inputs:
21        command: 'build'
22        projects: '**/AdventureWorks.sqlproj'
23
```

6 spaces (Defined job)

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Configuration Layout

Hierarchical

<Pipeline>

Stages

Jobs

Steps

Task

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Basic Pipeline

```yaml
trigger:
- main

pool:
  vmImage: windows-latest

steps:
Settings
- task: DotNetCoreCLI@2
  inputs:
    command: 'build'
    projects: '**/Adventureworks.sqlproj'
Settings
- task: SqlAzureDacpacDeployment@1
  inputs:
    azureSubscription: 'MVP Community'
    AuthenticationType: 'servicePrincipal'
    ServerName: '
    DatabaseName: 'AdventureWorks'
    deployType: 'DacpacTask'
    DeploymentAction: 'Publish'
    DacpacFile: 'Adventureworks.dacpac'
    IpDetectionMethod: 'AutoDetect'
```

Implied Single Stage with one job

1st task – builds the project

2nd task – deploys the DACPAC using SQLPackage.exe

Both tasks run in the same agent instance

When to use this scenario?
- Proof of concept
- Testing connections
- Build Validation/Automated Testing

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Explicit Job Definitions

```yaml
trigger:
- main

pool:
  vmImage: windows-latest

jobs:
- job: buildDACPAC
  displayName: Build Azure Data Studio DACPAC
  steps:
  Settings
  - task: DotNetCoreCLI@2
    inputs:
      command: 'build'
      projects: '**/Adventureworks.sqlproj'
- job: deployDACPAC
  displayName: Deploy DACPAC to Azure SQL DB
  steps:
  Settings
  - task: SqlAzureDacpacDeployment@1
    inputs:
      azureSubscription: 'MVP Community'
      AuthenticationType: 'servicePrincipal'
      ServerName: '
      DatabaseName: 'AdventureWorks'
      deployType: 'DacpacTask'
      DeploymentAction: 'Publish'
      DacpacFile: 'Adventureworks.dacpac'
      IpDetectionMethod: 'AutoDetect'
```

Two Jobs each with one task

1st job – builds the project

2nd job – deploys the DACPAC using SQLPackage.exe

Each job runs in a separate agent instance

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Explicit Job Definitions

```yaml
trigger:
- main

pool:
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jobs:
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      projects: '**/Adventureworks.sqlproj'
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      deployType: 'DacpacTask'
      DeploymentAction: 'Publish'
      DacpacFile: 'Adventureworks.dacpac'
      IpDetectionMethod: 'AutoDetect'
```

What's wrong with this pipeline?

DACPAC is not shared between jobs

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Publish DACPAC as a Pipeline Artifact

```yaml
- job: buildDACPAC
  displayName: Build Azure Data Studio DACPAC
  steps:
  Settings
  - task: DotNetCoreCLI@2
    inputs:
      command: 'build'
      projects: '**/Adventureworks.sqlproj'
  Settings
  - task: PublishPipelineArtifact@1
    inputs:
      targetPath: '$(Pipeline.Workspace)\AdventureWorks\bin\debug\Adventureworks.dacpac'
      artifact: 'Databases'
      publishLocation: 'pipeline'
```

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Explicit Job Definitions

```yaml
trigger:
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pool:
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      AuthenticationType: 'servicePrincipal'
      ServerName: '
      DatabaseName: 'AdventureWorks'
      deployType: 'DacpacTask'
      DeploymentAction: 'Publish'
      DacpacFile: 'Adventureworks.dacpac'
      IpDetectionMethod: 'AutoDetect'
```

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Demo – Deploy AdventureWorks

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Release 1.0 Review

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Release 1.0 Review

- Git Client
  - Synchronizes code between remote repo and local PC
  - Command-line or built into tools
- Visual Studio SQL Projects
  - Reverse engineering from existing databases
  - Check-in code to local Git repo and push to Azure DevOps
  - Manage code versions

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Release 1.0 Review

- Azure DevOps
  - Azure Repos – centralized source control
  - Azure Boards – manage the team's work
  - Azure Pipelines – orchestrate work triggered by check-ins
- Azure Pipelines
  - Use

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Sprint 2 – Code Branching

Working on teams larger than 2

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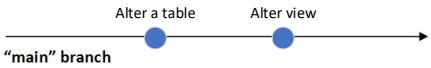
Branching Strategy

- main branch



- Harder to determine automations
  - Trigger after table change or view change?

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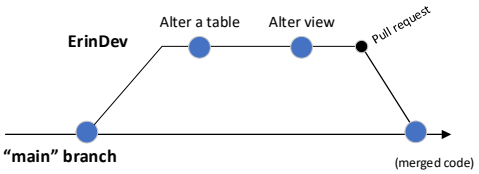
Branching Strategy

- Developer branch and main



- Changes are merged into main together
- Pull Request (PR) can start automations

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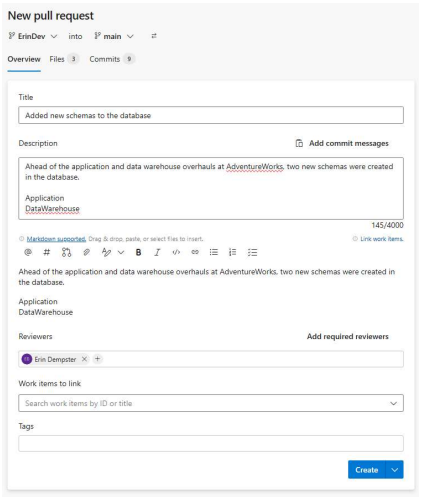
Pull Request

- Developer believes code is finished
- Changes are grouped together
- Associate work items
  - Requirements
  - Bugs
- Require approval by another team member



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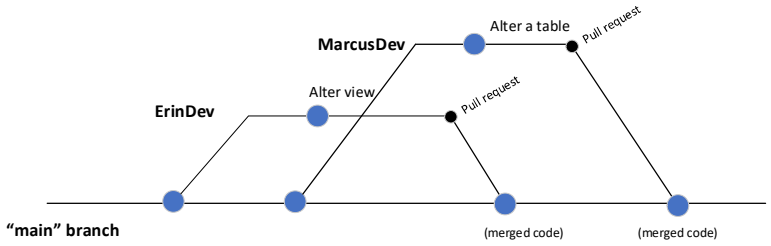
Branching Strategy

- Multiple Developers



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(Potential) Issues

- Marcus also changed Erin's view
- Does Erin's view have syntax errors?

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Merge Conflict

- Updates in multiple branches
- Whose changes go to main?
- What happens to the other branch's changes?

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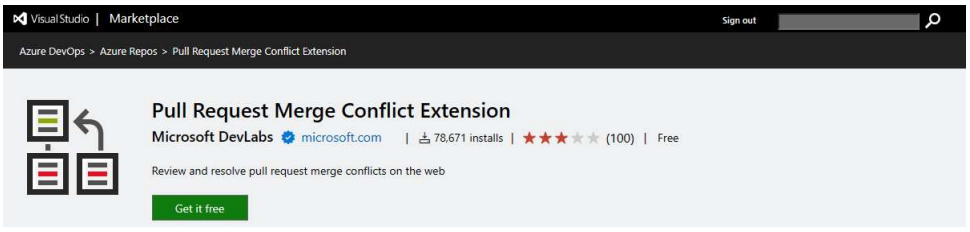
Merge Conflict and Resolution

- Not included by default
- Pull Request Merge Conflict Extension



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Demo

Pull Requests in Azure DevOps

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Code Validation

- Does the code build?
- Does it meet basic tests?

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Code Validation

Fix it before it gets to QA!

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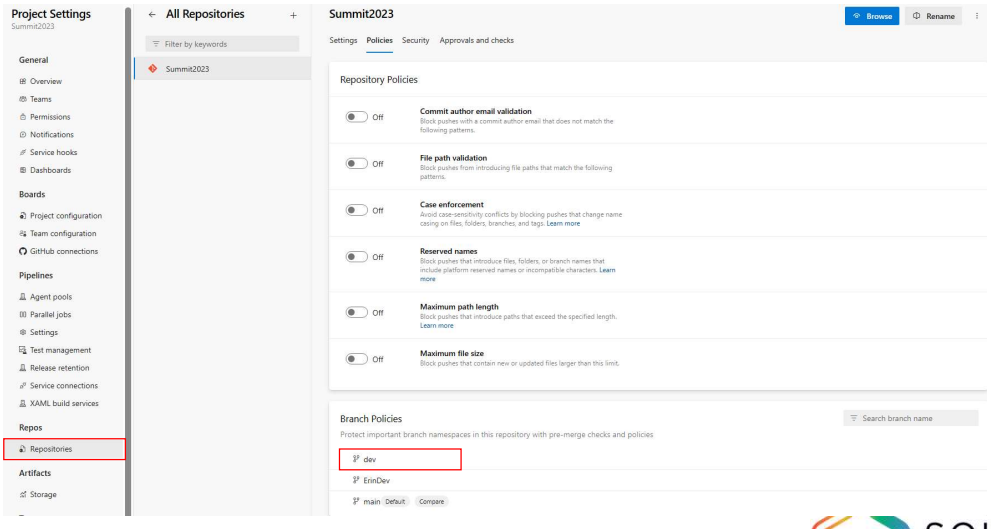
Branch Policies



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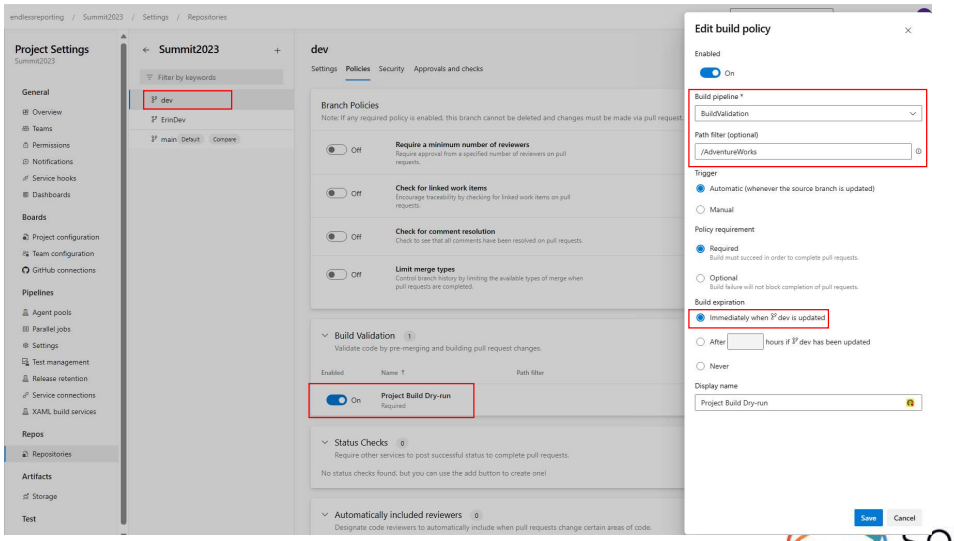
Branch Policies



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Validation Build Pipeline

Build and Deployment Pipeline

```yaml
trigger:
- main

pool:
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  steps:
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  - task: DotNetCoreCLI@2
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      DatabaseName: 'AdventureWorks'
      deployType: 'DacpacTask'
      DeploymentAction: 'Publish'
      DacpacFile: 'Adventureworks.dacpac'
      IpDetectionMethod: 'AutoDetect'
```

Validation Build Pipeline

```yaml
trigger: none

pool:
  vmImage: windows-latest

steps:
Settings
- task: DotNetCoreCLI@2
  inputs:
    command: 'build'
    projects: '**/AdventureWorks.sqlproj'
```


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Demo – Build Validations

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Sprint 3 – More Visual Studio Features

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Sprint 3 – More Visual Studio Features

- Publish Settings
- Handling Cross-Database References
- Working with Vendor Databases

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Publish Settings

- Defines the behavior of SQLPackage.exe
- Turn behaviors on or off
- Creates an XML file for reuse
- Add to pipeline artifacts for deployment

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Demo – Database Publish Settings

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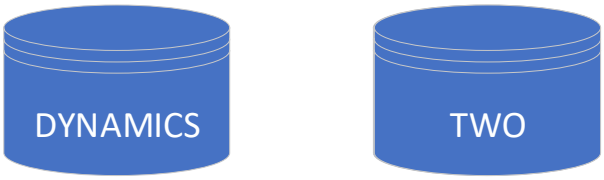
Handling Cross-Database References



- DYNAMICS stores reusable code
- Views in TWO use DYNAMICS functions
- Visual Studio can't validate TWO w/out DYNAMICS

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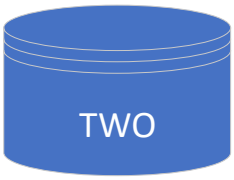
Managing Vendor Databases



- Contains hundreds of objects; performance drain
- Want to define a Reporting schema
- Visual Studio needs to know about all objects

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Demo – Using Multiple Databases

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Sprint 4 – Securing the Pipeline

Beyond YAML in Azure Pipelines

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Azure Pipelines Library – Variable Groups

- Variables hold info outside of Pipeline
- Securely store credentials
- 2 Methods
  - Defined in the Library
  - Linked to Azure Key Vault secrets

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Demo – Pipeline Variables

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Pipeline Agents

Doing the work for you

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Pipeline Agent

- Manages the execution of pipeline jobs
- Azure-hosted
  - Windows
  - Ubuntu
  - MacOS
- Self-hosted

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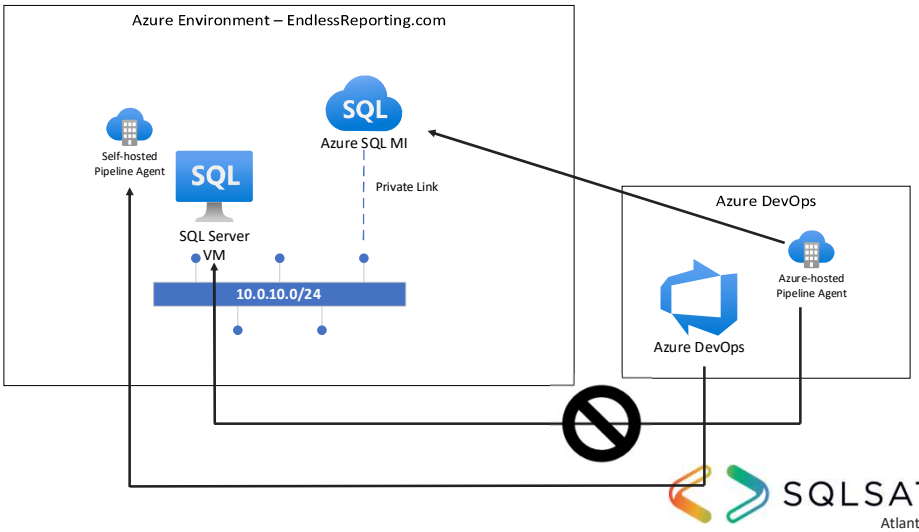
Pipeline Agents



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Release Retrospective

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Release 2.0 Review

- Branching Code
  - Harder to conceptualize in Shared Dev DBs
  - Features are easier to test and release
- Visual Studio SQL Database Projects
  - Database References w/2 scenarios
    - Different databases
    - Same database but divided into multiple projects

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Release 2.0 Review

- Azure Pipelines
  - YAML is 100% clear text – not secure
  - Pipeline Variables
  - Azure Pipelines Library – Variable Groups
  - Self-hosted Pipeline Agents

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Questions?

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Thank you

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