Automating Builds in Git on IBM i

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Agenda

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- The Modern Development Lifecycle with Git
- Unlock Automated Builds with ibmi-ci
- ILE Dependency Analysis with Source Orbit
- Practical Use Case
- Demo

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The Modern Development Lifecycle with Git

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What Does Modern Development Look Like?

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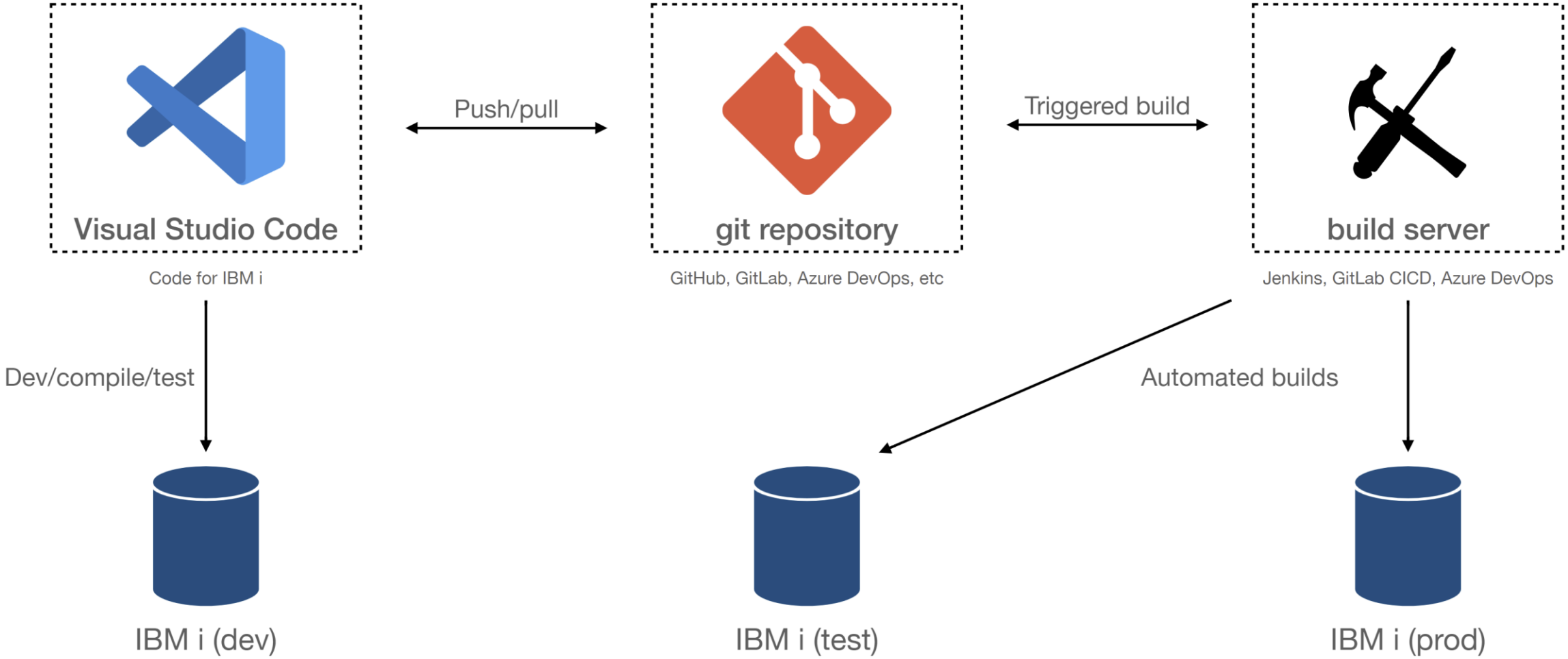

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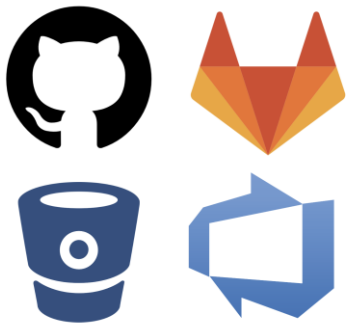
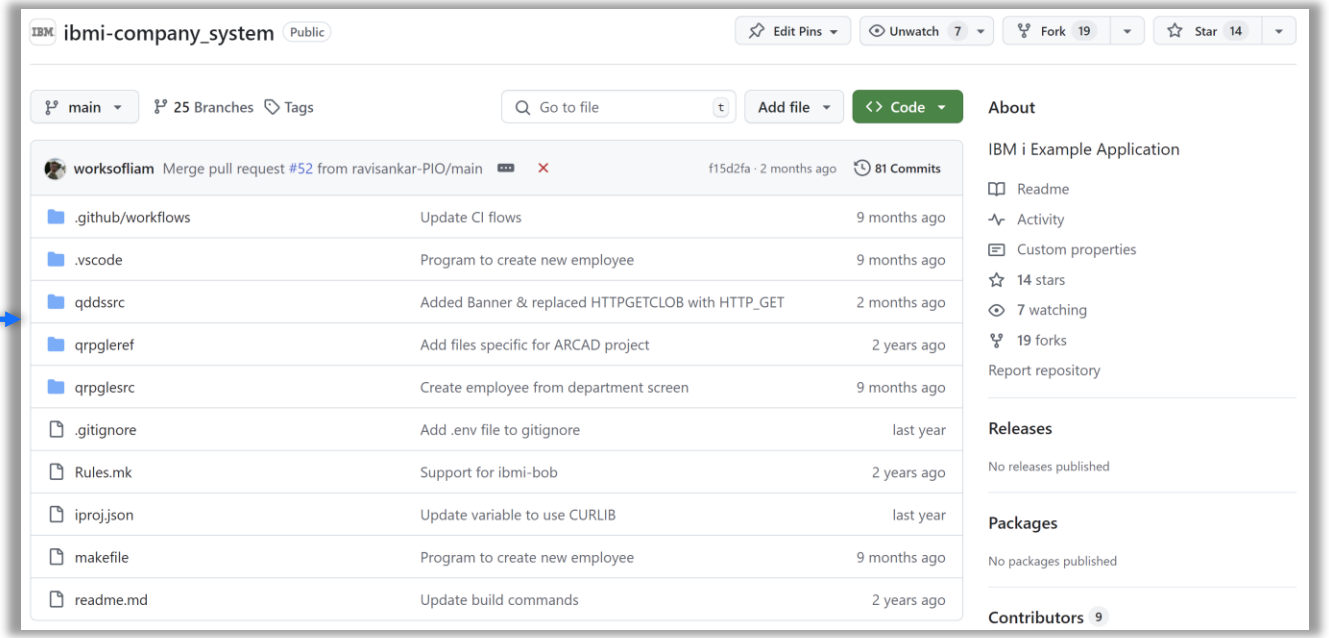
Development with Git

- Source is managed by Git
  - Complete change history
  - Branching and merging capabilities
  - Traceability

- Variety of options for Git hosting services
  - GitHub, GitLab, Azure DevOps, etc

GitHub, GitLab, Azure DevOps, etc





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Why use Git?

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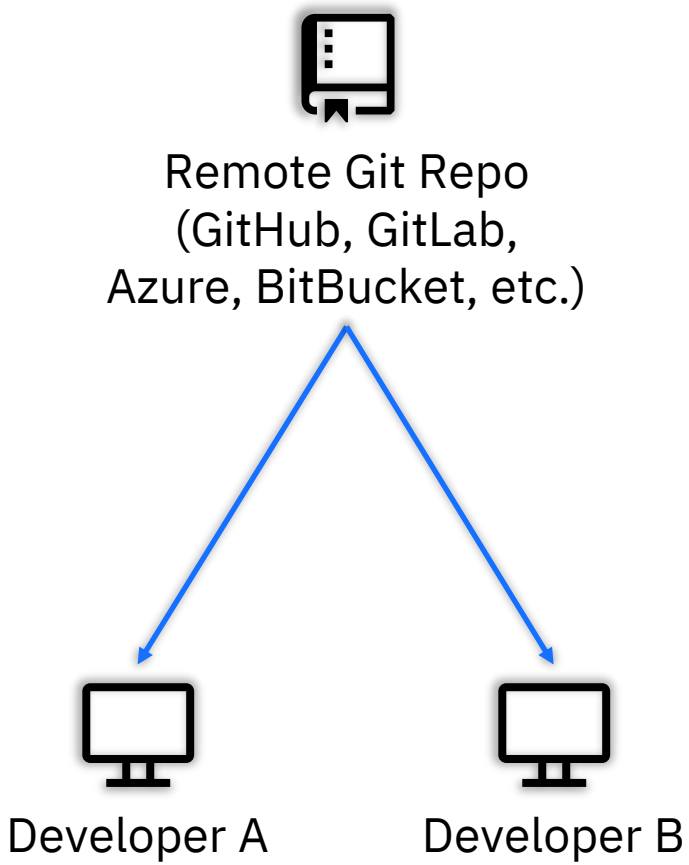
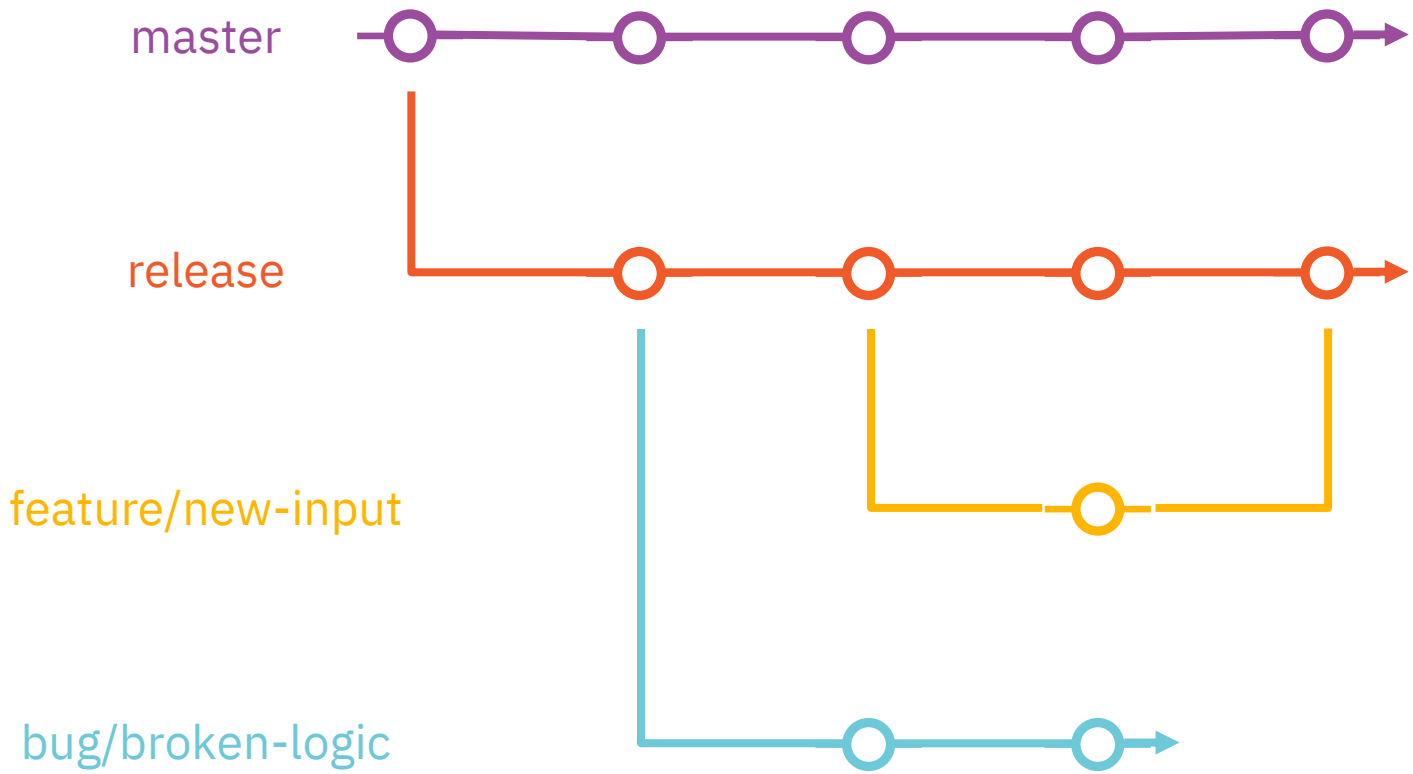
Distributed Development



Version Control and Git Workflow



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Local Development Experience

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- IBM i
  - IBM i integration via open-source extensions
  - Support for RPGLE, COBOL, CL, SQL, and more!
- Git
  - First class Git support
  - Hundreds of Git tools

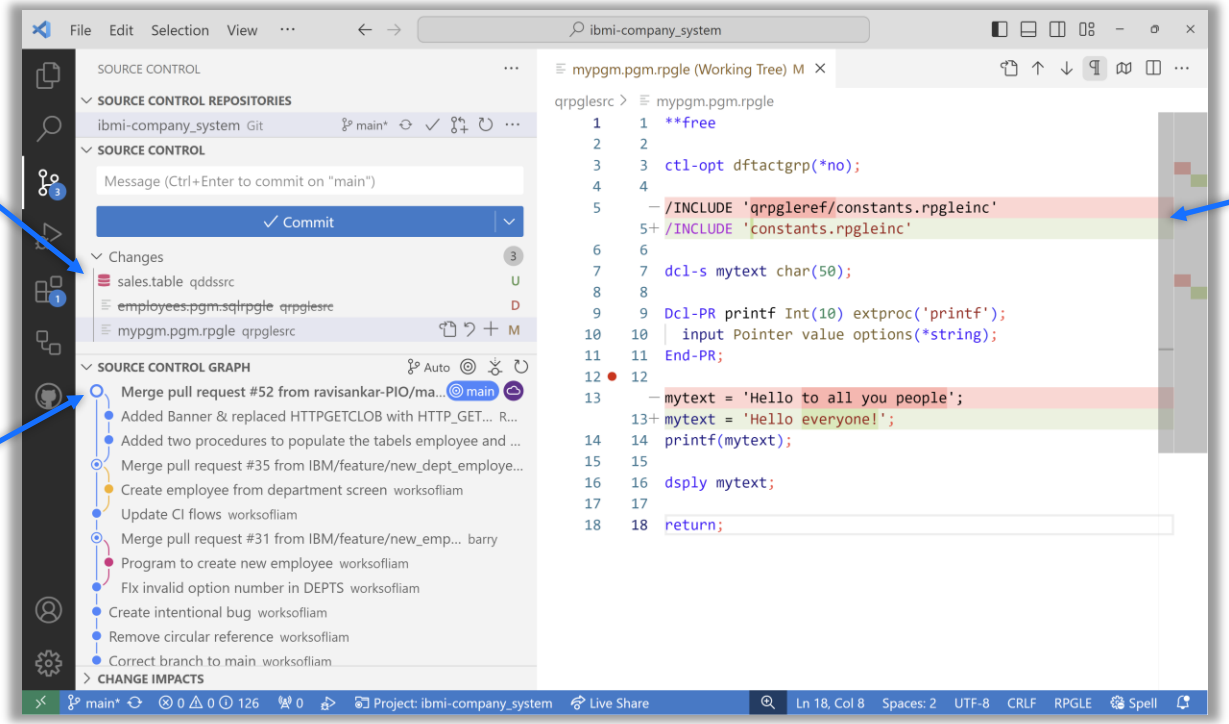
Visual Studio Code

Code for IBM i

View current repository changes

View a graphical representation of incoming and outgoing commits

View changes line by line



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How to work efficiently with these 3 components?

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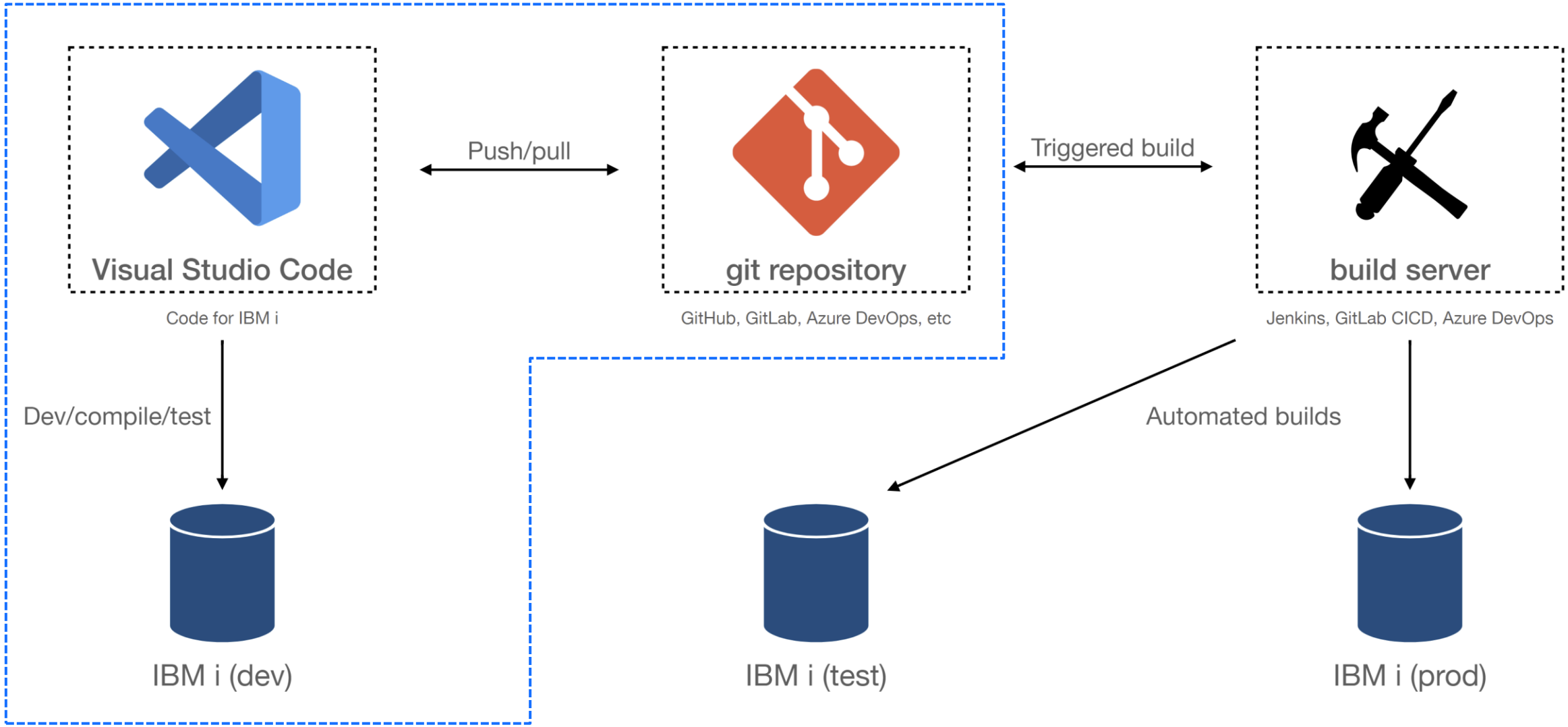

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Map Git branches to libraries on IBM i

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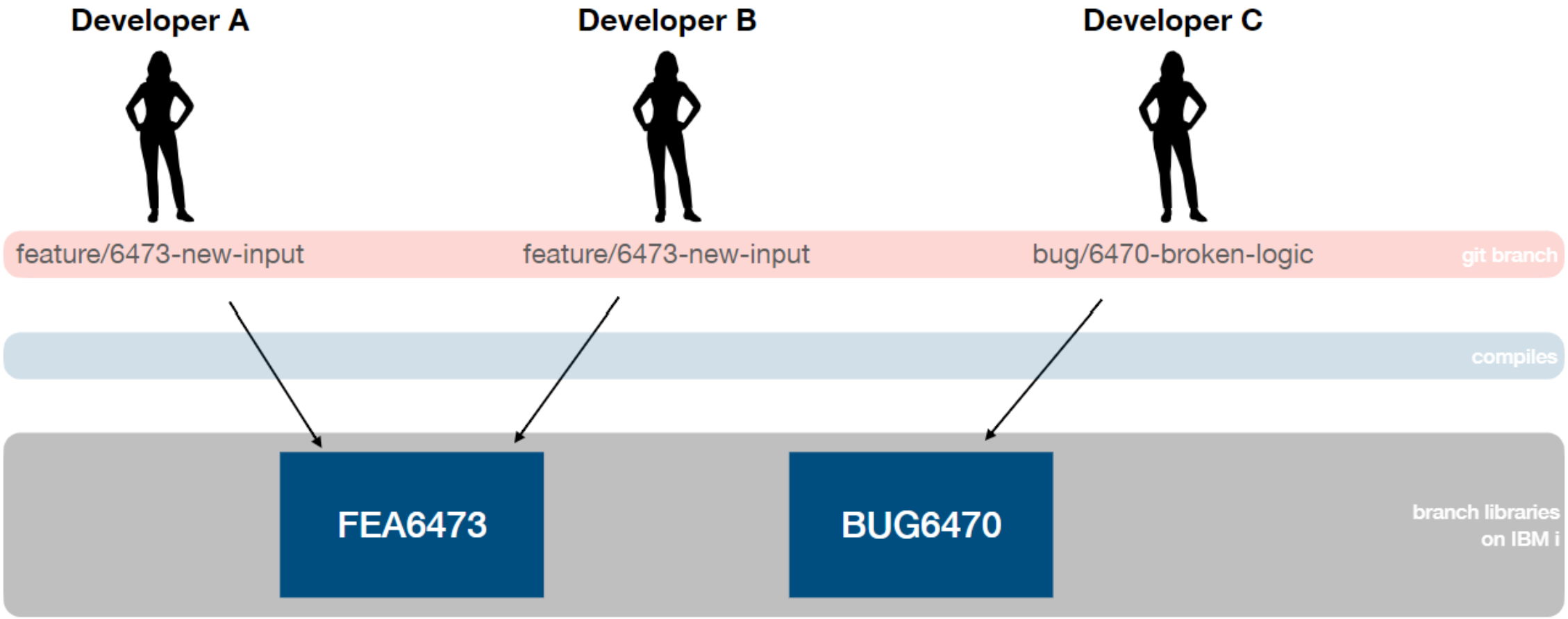

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Build Server

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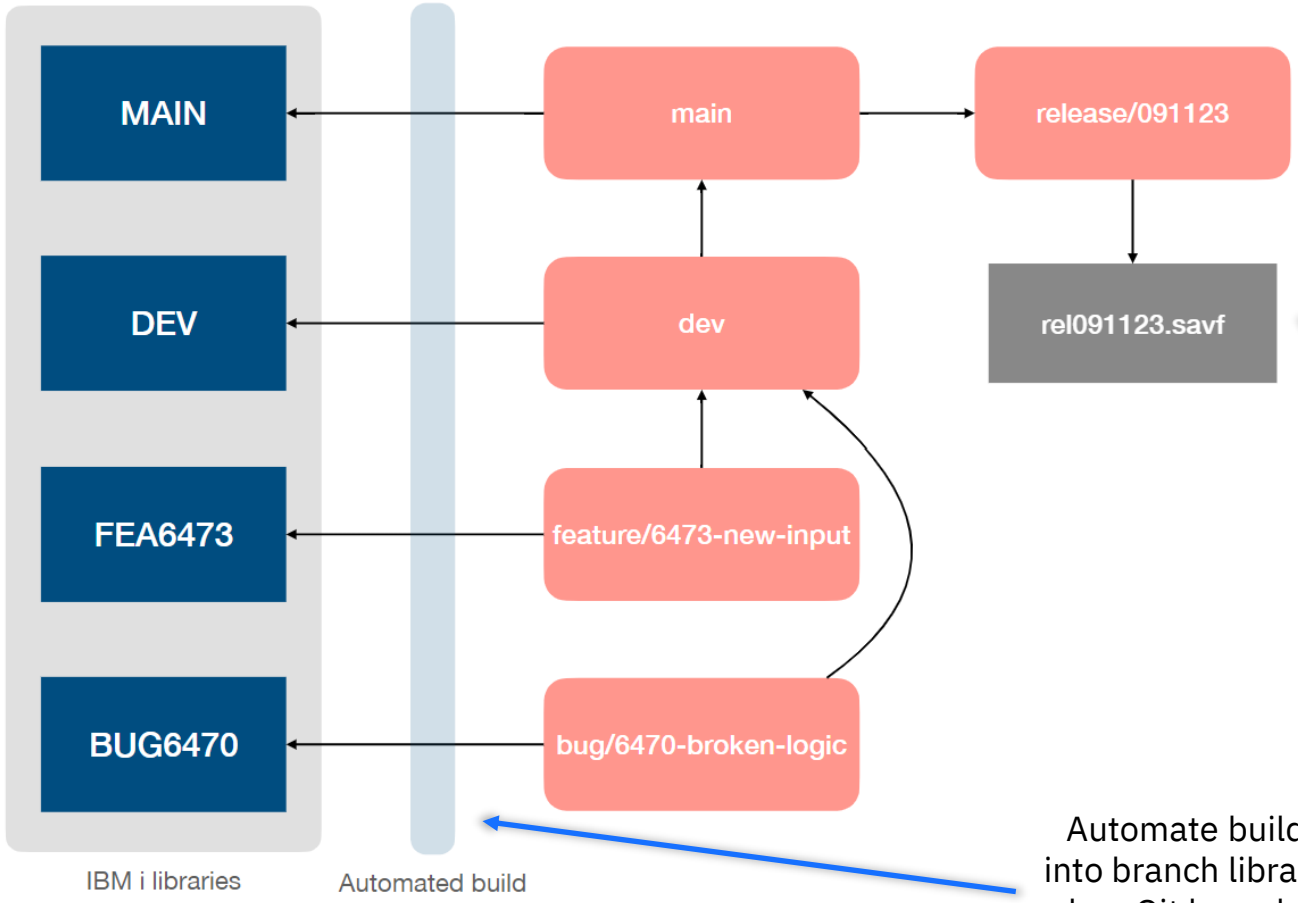
Let's go one step further and automate this process



Jenkins, GitLab CICD, Azure DevOps

Generate save files when releases are created

Automate build into branch library when Git branch is updated

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How to create workflows?

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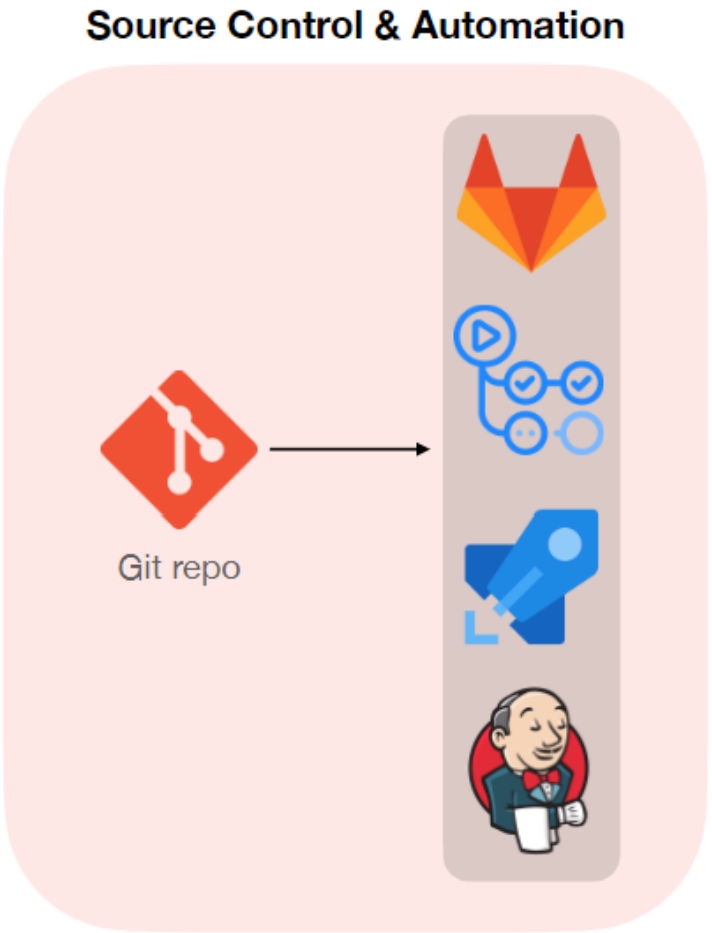

GitLab	`.gitlab-ci.yml`
Azure DevOps	`azure-pipeline.yml`
GitHub	`anything.yml`
Jenkins	`Jenkinsfile`

yml can also be yaml

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How to achieve automation with IBM i?

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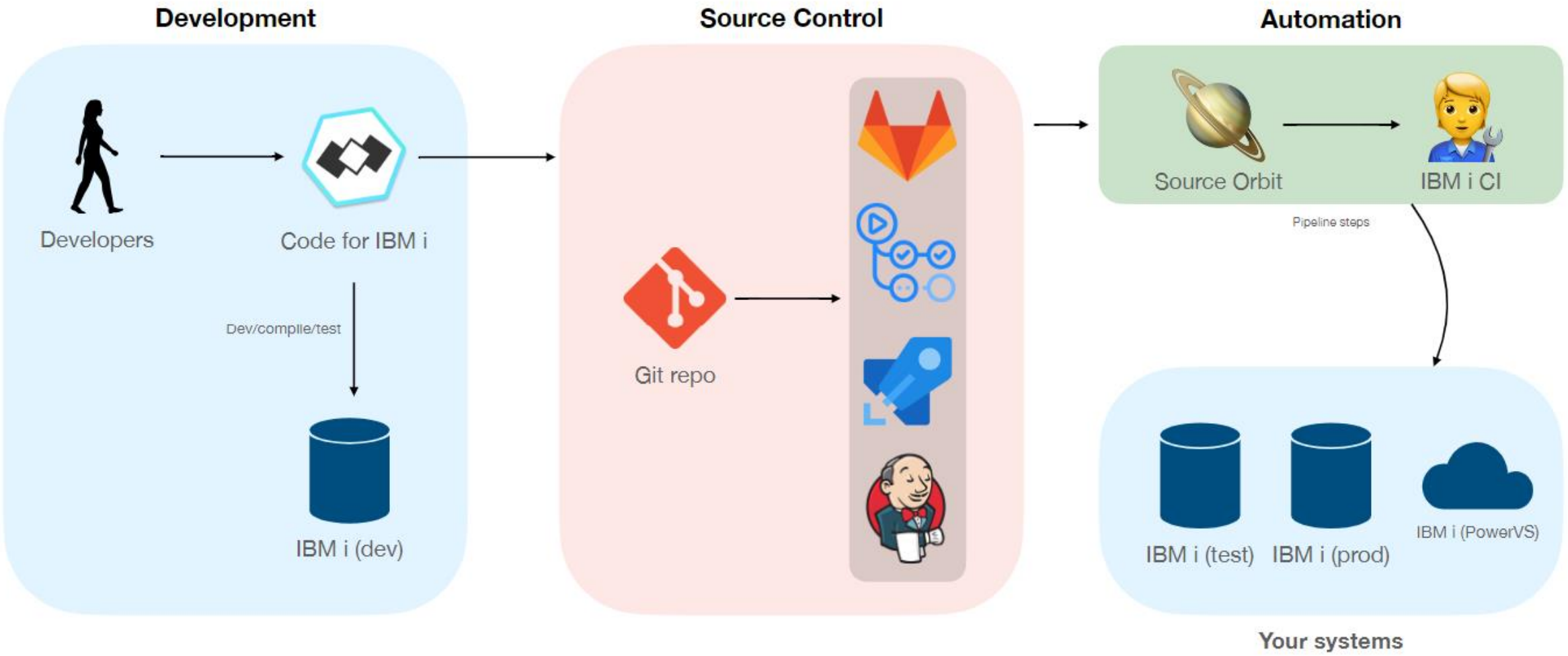

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Unlock Automated Builds with ibmi-ci

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Overview

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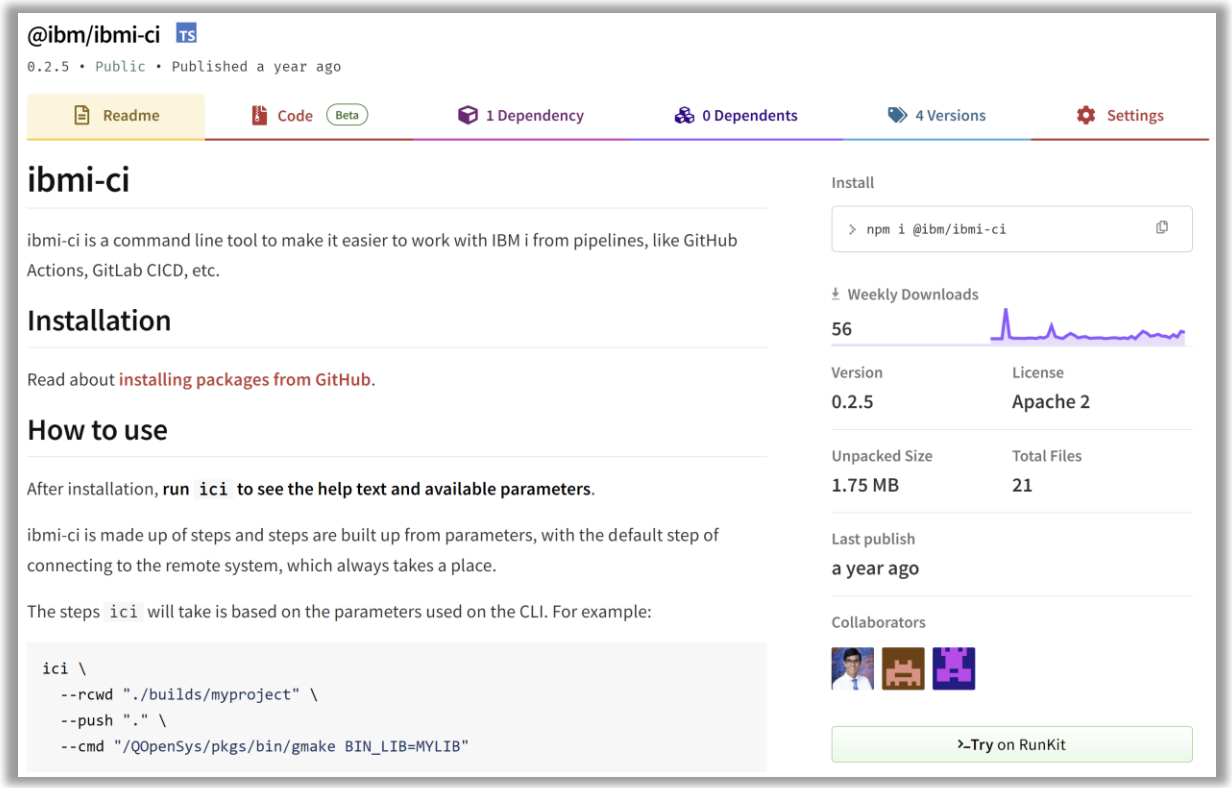
- A CLI tool to simplify working with IBM i from pipelines (ex. GitHub Actions, GitLab CICD, etc.)

- Outline a series of steps to perform with the first default step being to connect to an IBM i

- Requirements
  - SSH server is running on IBM i
  - Node.js needs to be installed

- Installation
  - npm i -g @ibm/ibmi-ci

- Establishing IBM i connection
  - Required
    - IBMI_HOST
    - IBMI_USER
    - IBMI_SSH_POST
  - At least one required
    - IBMI_PASSWORD
    - IBMI_PRIVATE_KEY



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CLI Usage

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--lcwd <localDirectory>	Sets the current working directory on the local system
--rcwd <remoteDirectory>	Sets the current working directory on the remote system. It will be created if it does not exist.
--push <remoteRelativeDirectory>	Pushes the current working directory to a chosen directory on the IBM i
--pull <remoteRelativeDirectory>	Pulls a directory from IBM i to the local current working directory
--get <remoteRelativeDirectory> <localRelativePath>	Gets a specific file from IBM i
--cmd <shellCommand>	Execute a command on the remote system
--cl <clCommand>	Execute a CL command on the remote system

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Simplistic Example

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```
ici \
  --rcwd "./builds/myproject" \
  --push "." \
  --ignore --cl "CRTLIB LIB(MYLIB)"
  --cmd "/QOpenSys/pkgs/bin/gmake BIN_LIB=MYLIB"
```

Upload the local working directory to the remote working directory (.)

Build project with gmake

Suppress errors and continue execution

Set the remote working directory to ./builds/myproject

Create build library if it does not exist

⭐ IBM i connection is specified as environment variables

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GitHub Action Example

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```yaml
jobs:
  ibmi-build:
    environment: COMMON1
    runs-on: ubuntu-latest
    steps:
      # Checkout repository and setup node steps omitted

      - name: Install Dependencies
        run: npm i -g @ibm/ibmi-ci

      - name: Deploy to IBM i
        run: |
          ici \
            --cmd "mkdir -p './builds/ics_${GITHUB_HEAD_REF}'" \
            --rcwd "./builds/ics_${GITHUB_HEAD_REF}" \
            --push "." \
            --cmd "/QOpenSys/pkgs/bin/gmake BIN_LIB=CMPSYS"
        env:
          IBMI_HOST: ${{ secrets.IBMI_HOST }}
          IBMI_USER: ${{ secrets.IBMI_USER }}
          IBMI_PASSWORD: ${{ secrets.IBMI_PASSWORD }}
          IBMI_SSH_PORT: ${{ secrets.IBMI_SSH_PORT }}
```

GITHUB_HEAD_REF is the head ref or source branch of the pull request

IBM i connection is specified as environment variables

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Why use environments?

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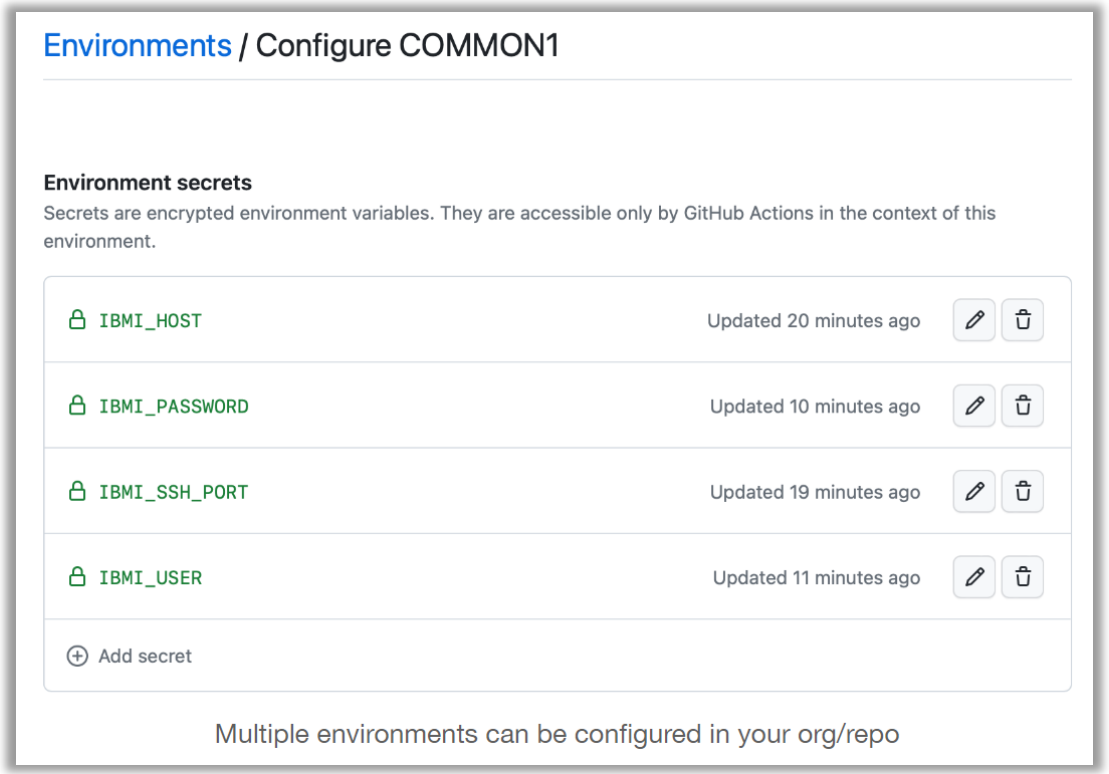

Use a matrix to run a workflow on multiple IBM i machines

```yaml
jobs:
  ibmi-build:
    strategy:
      matrix:
        environment: [COMMON1, OSSBUILD]
    environment: ${{ matrix.environment }}
    runs-on: ubuntu-latest
```

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How do GitHub Actions work?

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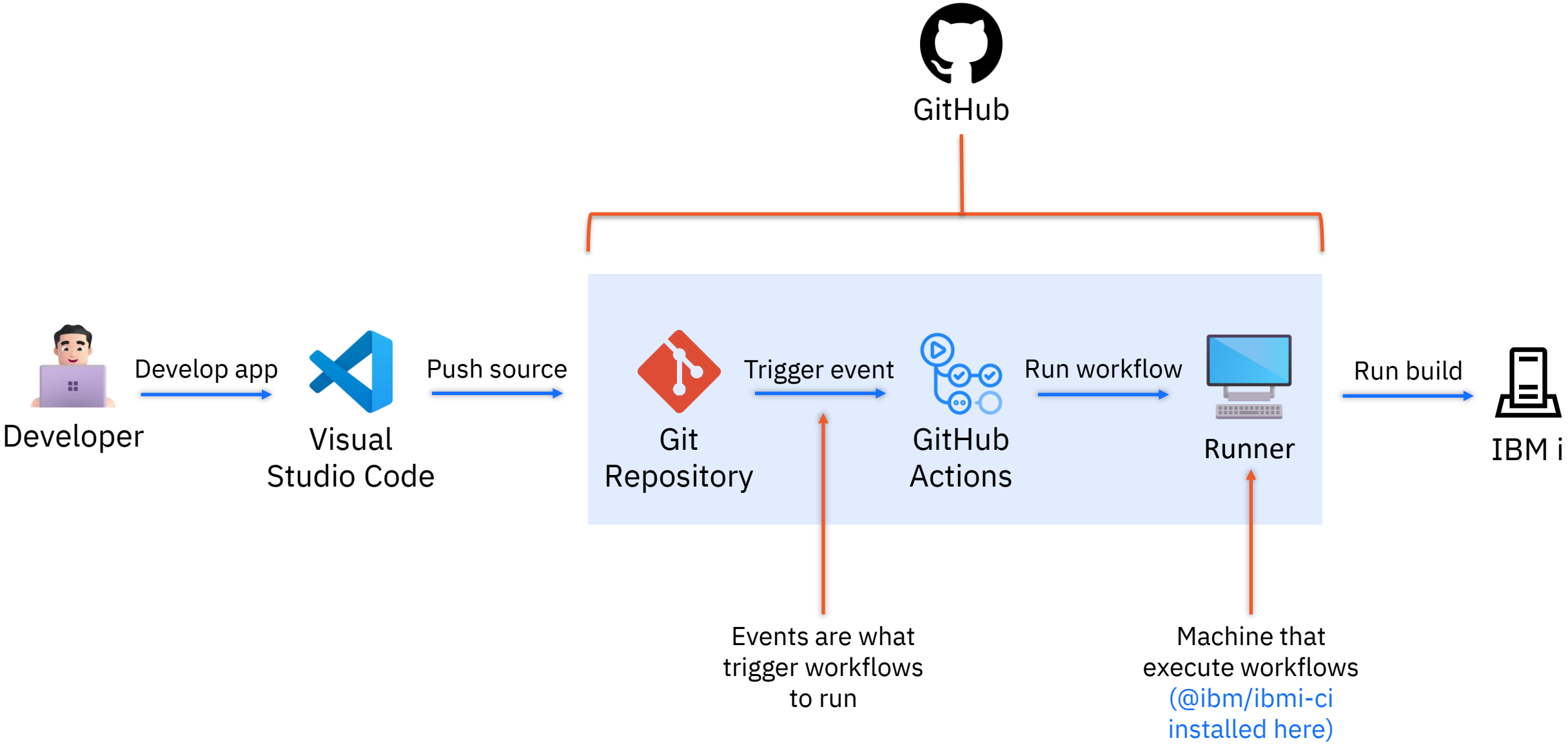

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What are Events and Runners?

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Events

↓

Workflow triggers that cause a workflow to run

```yaml
on:
  push:
    branches: [ main ]

  pull_request:
    branches: [ main ]
    types: [opened]

  release:
    types: [created]

  workflow_dispatch:
```

Runners

↓

Machines that execute jobs in a workflow

Virtual Machine	Processor (CPU)	Memory (RAM)	Storage (SSD)	Workflow label
Linux	4	16 GB	14 GB	`ubuntu-latest`, `ubuntu-24.04`, `ubuntu-22.04`, `ubuntu-20.04`
Windows	4	16 GB	14 GB	`windows-latest`, `windows-2022`, `windows-2019`
macOS	3	14 GB	14 GB	`macos-12`
macOS	4	14 GB	14 GB	`macos-13`
macOS	3 (M1)	7 GB	14 GB	`macos-latest`, `macos-14`, `macos-15` [Public preview]

-latest runner images are the latest stable images that GitHub provides, and might not be the most recent version of the operating system

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ILE Dependency Analysis with Source Orbit

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Overview

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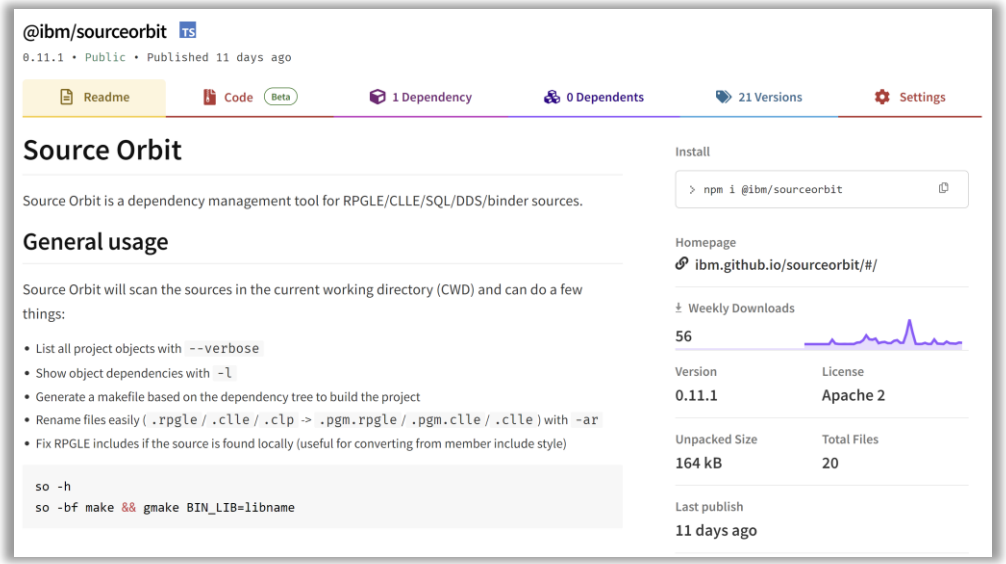
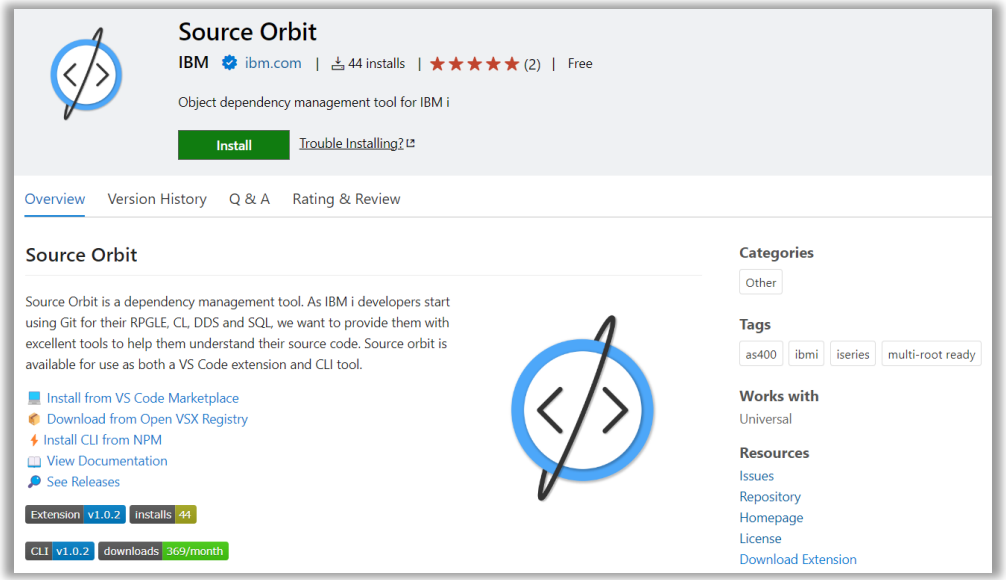
- A dependency management tool (CLI and VS Code extension!)
  - Build dependency tree for RPGLE, DDS, SQL, CL, etc.
  - Generates impact analysis information
  - Generate scripts to automate builds
  - Clean up your project
- Requirements
  - Node.js needs to be installed
- CLI Installation
  - npm i -g @ibm/sourceorbit
- Extension Installation
  - https://marketplace.visualstudio.com/items?itemName=IBM.vscode-sourceorbit





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CLI Usage

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- so –ar
  - Scan all source code and fix extensions
    - Rename programs to have *.pgm.*
    - Rename include files to use *.rpgleinc*
    - Rename SQL source to use extension based on *CREATE* statement

- so –fi
  - Fix include/directory directives to use UNIX style paths if found in local source

- so -bf <type>
  - Generate build and dependency files
    - make: Generate single makefile with targets and rules
    - bob: Generate Rules.mk files for Bob
    - imd: Generate impact analysis for branches
    - json: Generate dependency info as JSON

- so –bl <name>
  - Generate a deterministic library name given a branch name

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Repository Cleanup

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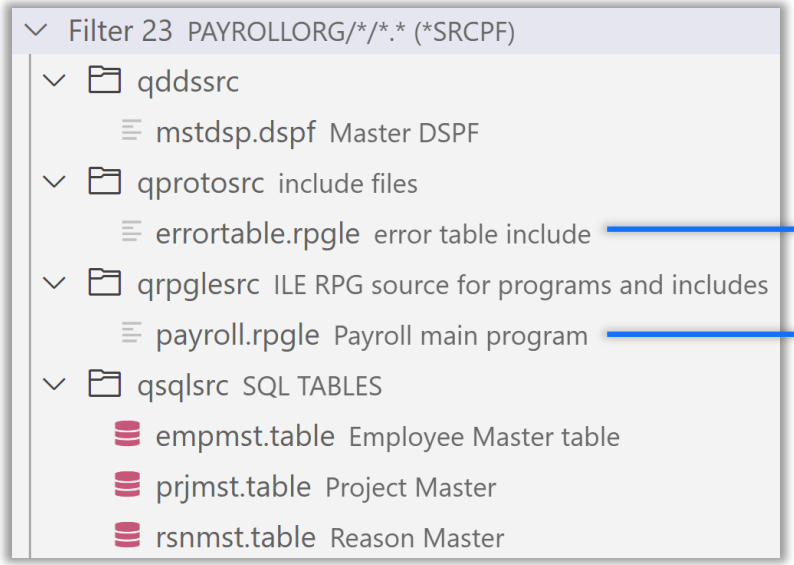
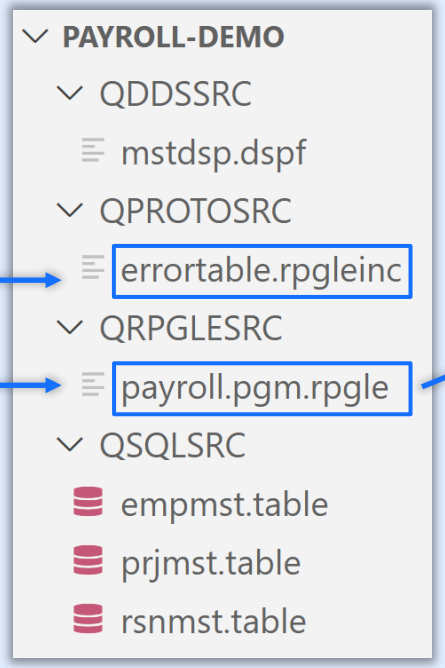
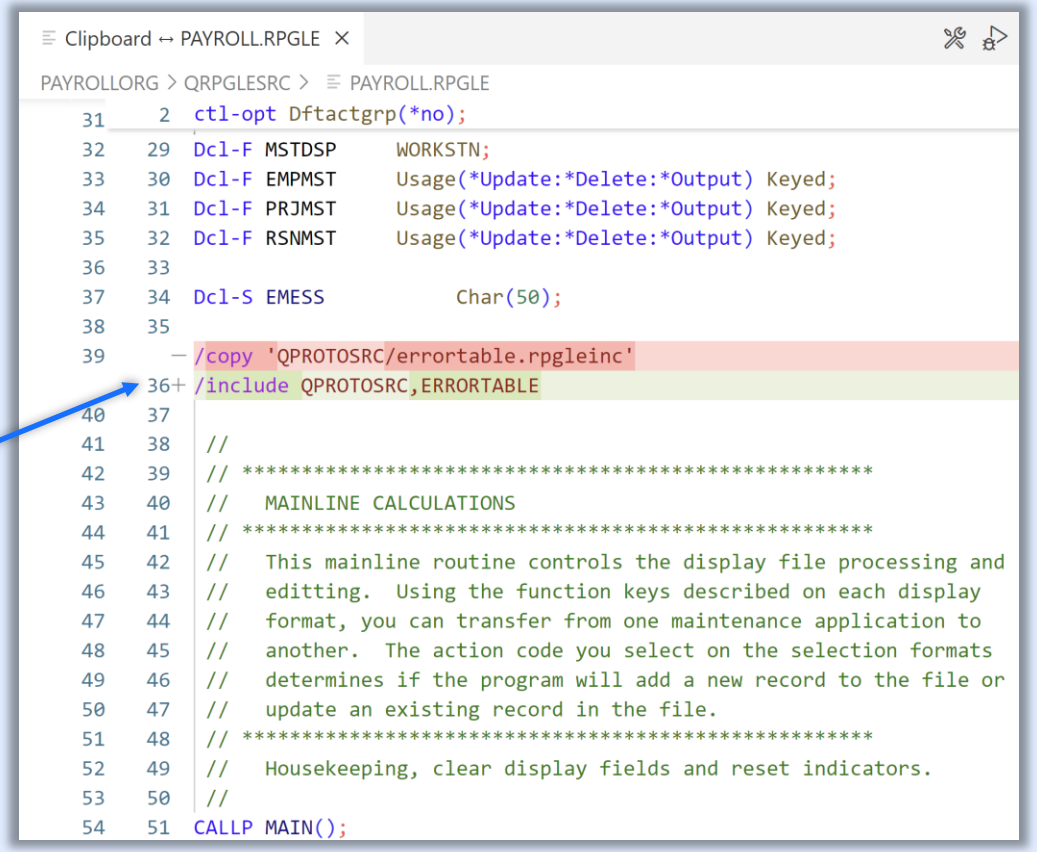
Source Locally



Original source in QSYS



Cleaned up file extensions



Cleaned up source code

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Impact Analysis...What Objects Am I Affecting?

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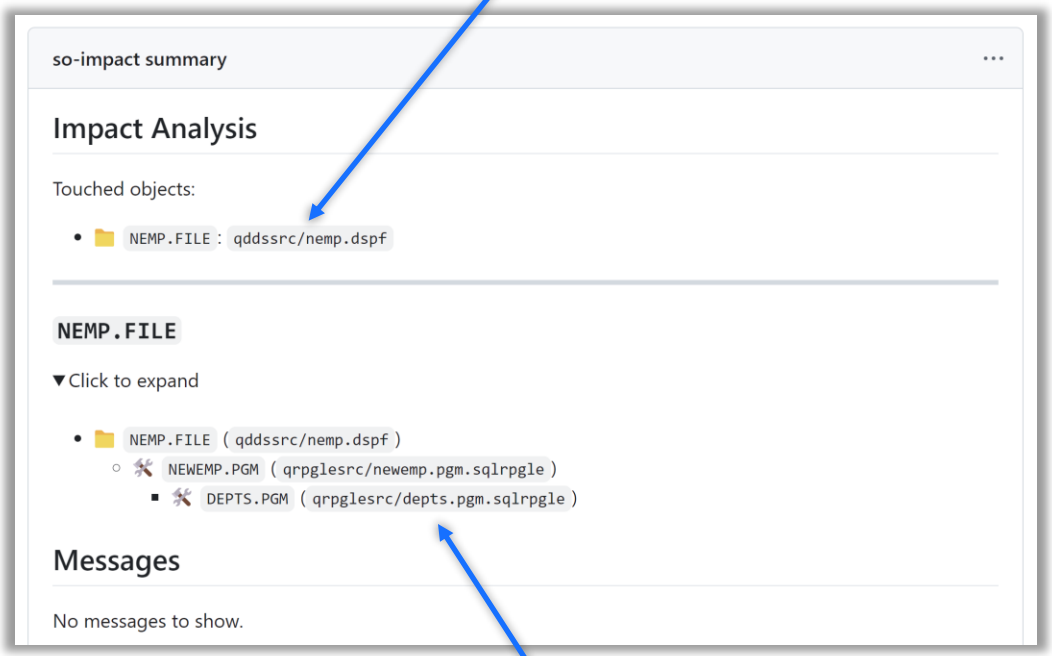
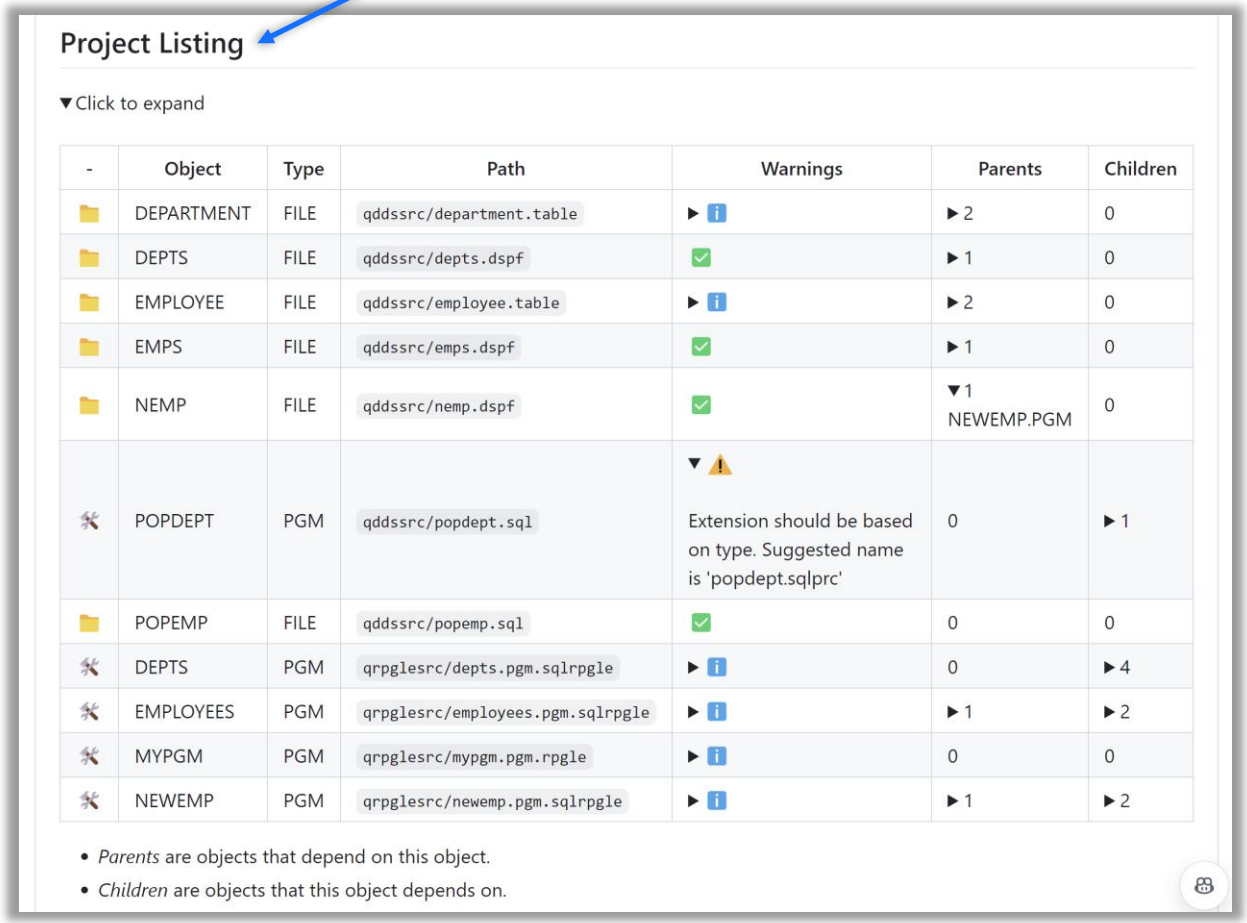
Impacted objects based on source changes

Full project dependency tree



Dependencies of impacted objects



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GitHub Action Example

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```yaml
jobs:
  so-impact:
    runs-on: ubuntu-latest
    steps:
      # Checkout repository and setup node steps omitted

      - name: Install Dependencies
        run: npm i -g @ibm/ibmi-ci

      - name: Generate impact information
        run: so -bf imd -l `git diff --name-only origin/main origin/${GITHUB_HEAD_REF}`

      - name: Adding markdown
        run: cat impact.md >> $GITHUB_STEP_SUMMARY
```

Generate impact analysis for changed files (compare main branch with pull request branch)

Redirect output to GITHUB_STEP_SUMMARY to create a custom Markdown job summary

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What is built into the Source Orbit VS Code extension?

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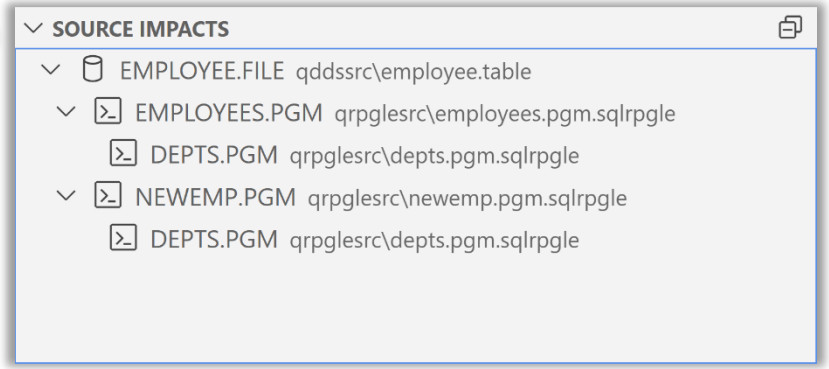
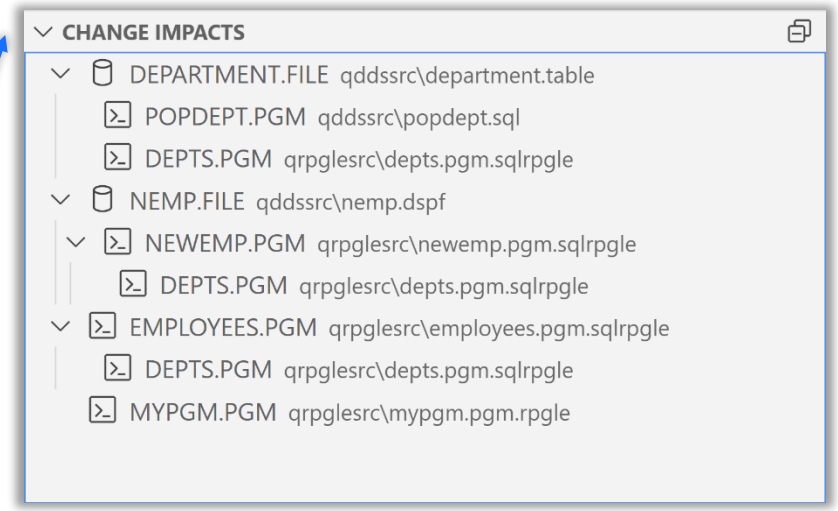
View impacted objects for the current active editor

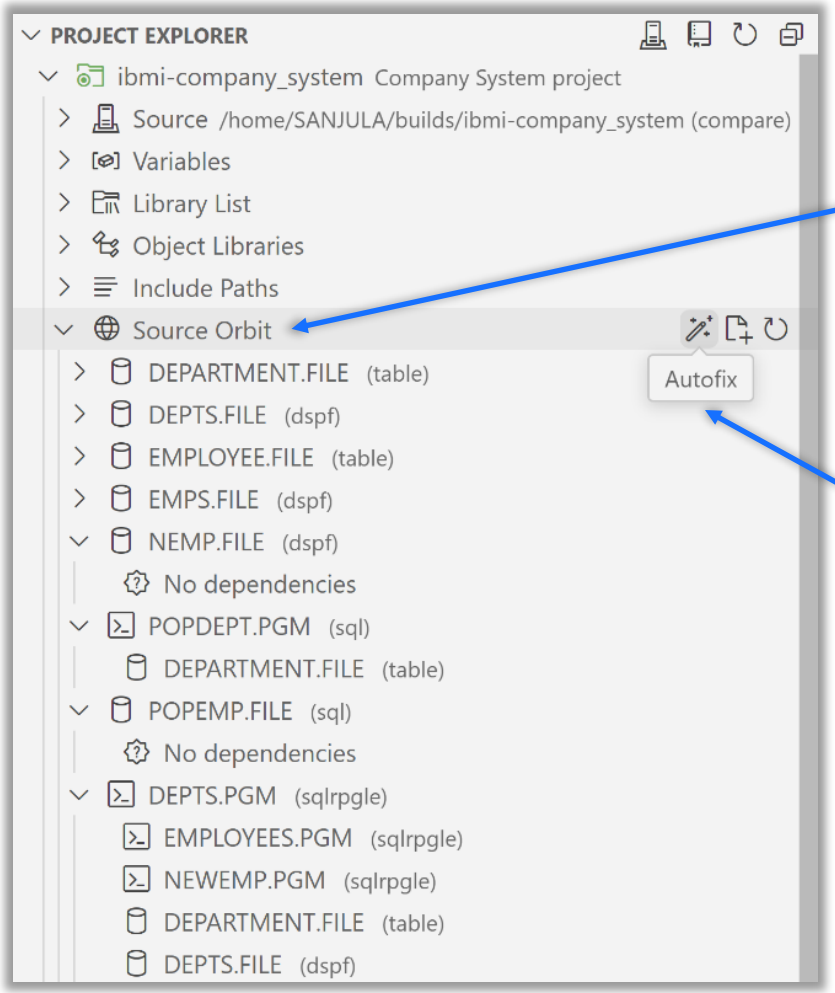


View impacted objects for any changed files detected by Git



View project's dependency tree with integration in IBM i Project Explorer

Actions to "Autofix" and "Generate Build Files"



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Source migration made easy

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CVTSRCPF from BOB

QSYS members in source physical files

↓

Properly encoded, terminated, and named source files in an IFS directory

↓

Download to local project

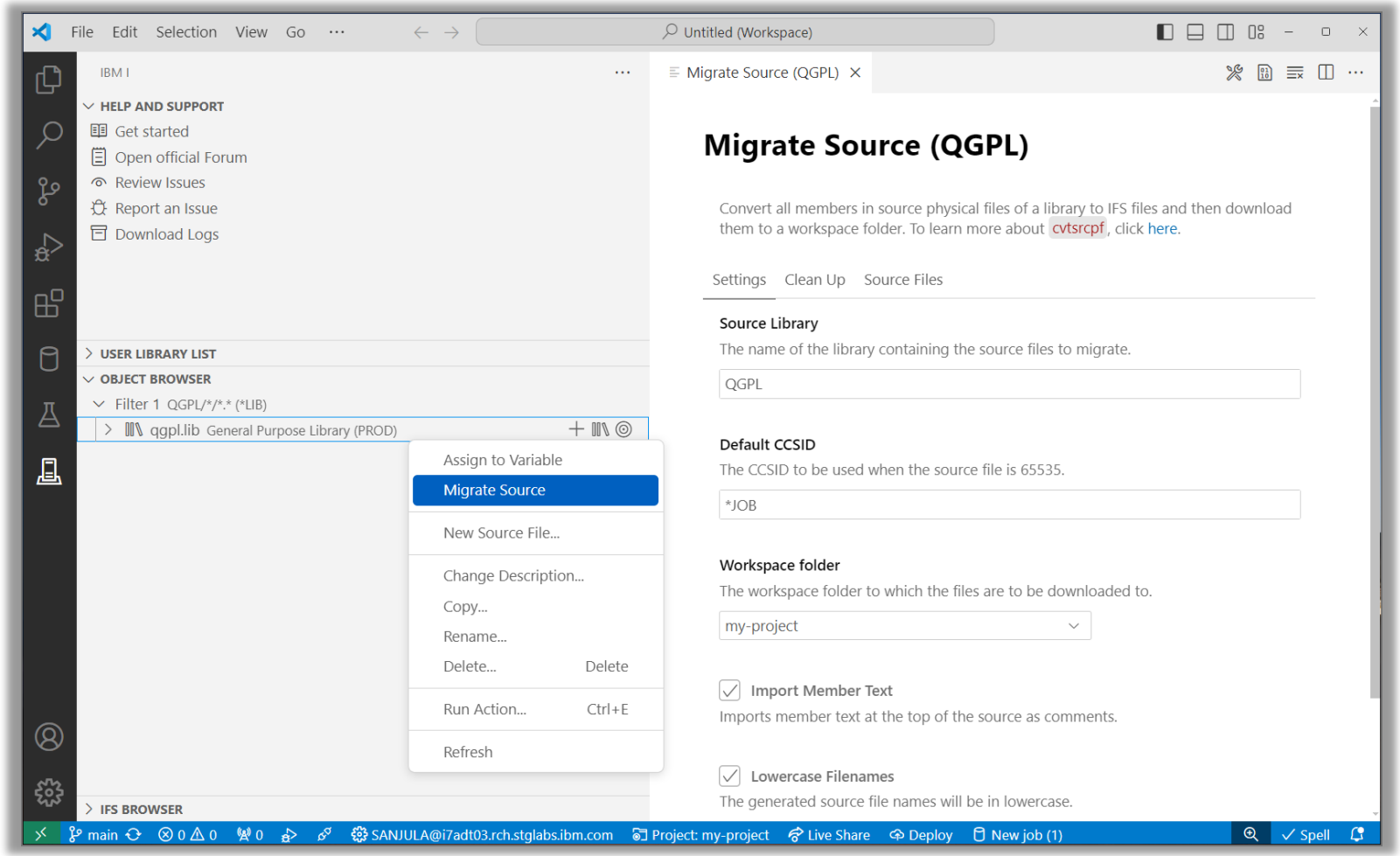
↓

Source Orbit

Rename extensions

↓

Convert includes/copy directives to Unix style paths



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Source Code Rules – Supported Extensions

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Extension	Extension meaning	Notes
`sqlrpgle`	RPGLE (SQL)	Can use `.pgm` notation
`rpgle`	RPGLE	Can use `.pgm` notation
`clle`	CLLE	Can use `.pgm` notation
`cl`	CLLE	Can use `.pgm` notation
`clp`	CL (OPM)	Should be renamed to `clle`
`pf`	Physical File	Table
`lf`	Logical File	View/Index
`dspf`	Display File	
`prtf`	Printer File	
`msgf`	Message filee	
`sql`	Any SQL object	Type determined by create statement
`table`	SQL table	Expects `CREATE TABLE`
`view`	SQL view	Expects `CREATE VIEW`
`index`	SQL index	Expects `CREATE INDEX`
`alias`	SQL alias	Expects `CREATE ALIAS`
`sqlalias`	SQL alias	Expects `CREATE ALIAS`
`sqlprc`	SQL procedure	Expects `CREATE PROCEDURE`
`sqludf`	SQL function	Expects `CREATE FUNCTION`
`sqludt`	SQL table function	Expects `CREATE FUNCTION`
`sqltrg`	SQL trigger	Expects `CREATE TRIGGER`
`sqlseq`	SQL sequence	Expects `CREATE SEQUENCE`
`bnd`	Binder source	
`binder`	Binder source	Should be renamed `bnd`
`cmd`	Command	

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Source Code Rules – Object Names

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- Base name of source file becomes object name
- If source includes *.pgm*, then it will become a program
- If source does not include .pgm, then it will become a module, cmd, dtaara, etc.
- Assumes binder source (*.bnd*/*.binder*) is a service program

Source name	Resulting object
`LCUS.LF`	`LCUS.FILE`
`CUS.PF`	`PCUS.FILE`
`dothing.cmd`	`DOTHING.CMD`
`pos123.dspf`	`POS123.FILE`
`faq500.rpgle`	`FAQ500.MODULE`
`faq401.pgm.sqlrpgle`	`FAQ401.PGM`
`faq500.bnd`	`FAQ500.SRVPGM`

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Source Code Rules – Long File Names

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Source Orbit will generate a deterministic object name based on the file name

Source name	Resulting object	Note
`abcd.rpgle`	`ABCD.MODULE`	No change
`ab_cd.pgm.rpgle`	`AB_CD.PGM`	No change
`thisIsASuperLongName.pgm.clle`	`TIASLN.PGM`	First character plus following capitals
`FetchUserData.cmd`	`FUD.CMD`	All capitals from file name
`ua_fetchUserData.sqlrpgle`	`UAFUD.MODULE`	Prefix, followed by first post-prefix character plus following capitals
`ART200D-Work_with_Article.DSPF`	`ART200D.FILE`	Support for ibmi-bob file name

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Source Code Rules – Unresolved Objects

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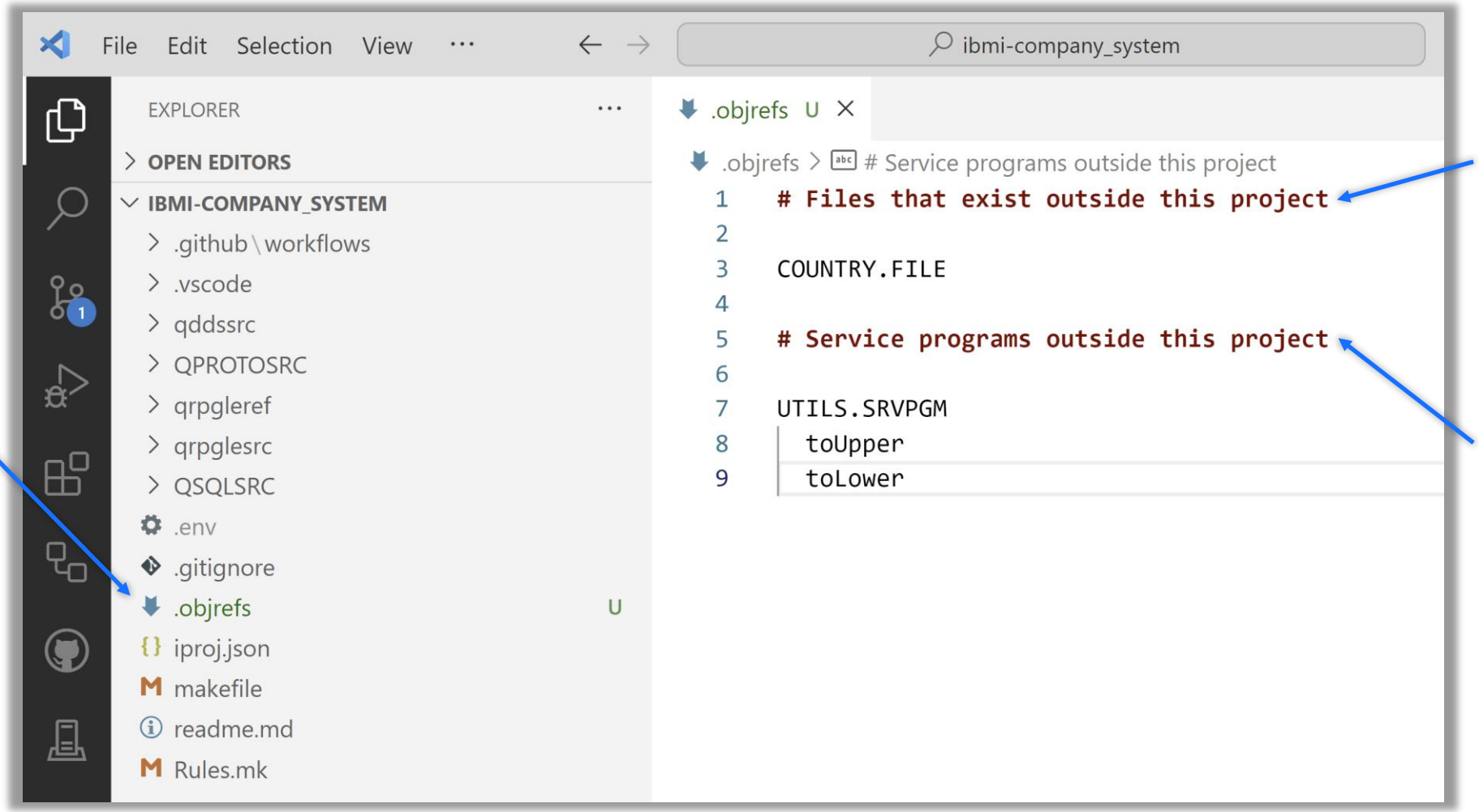
Source Orbit will complain about unresolved objects

```
no object found for reference 'COUNTRY'
```



List objects/source that are in another repository or already exist in a library

Create file in project root

For service programs, list exports by indenting after reference

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Practical Use Cases

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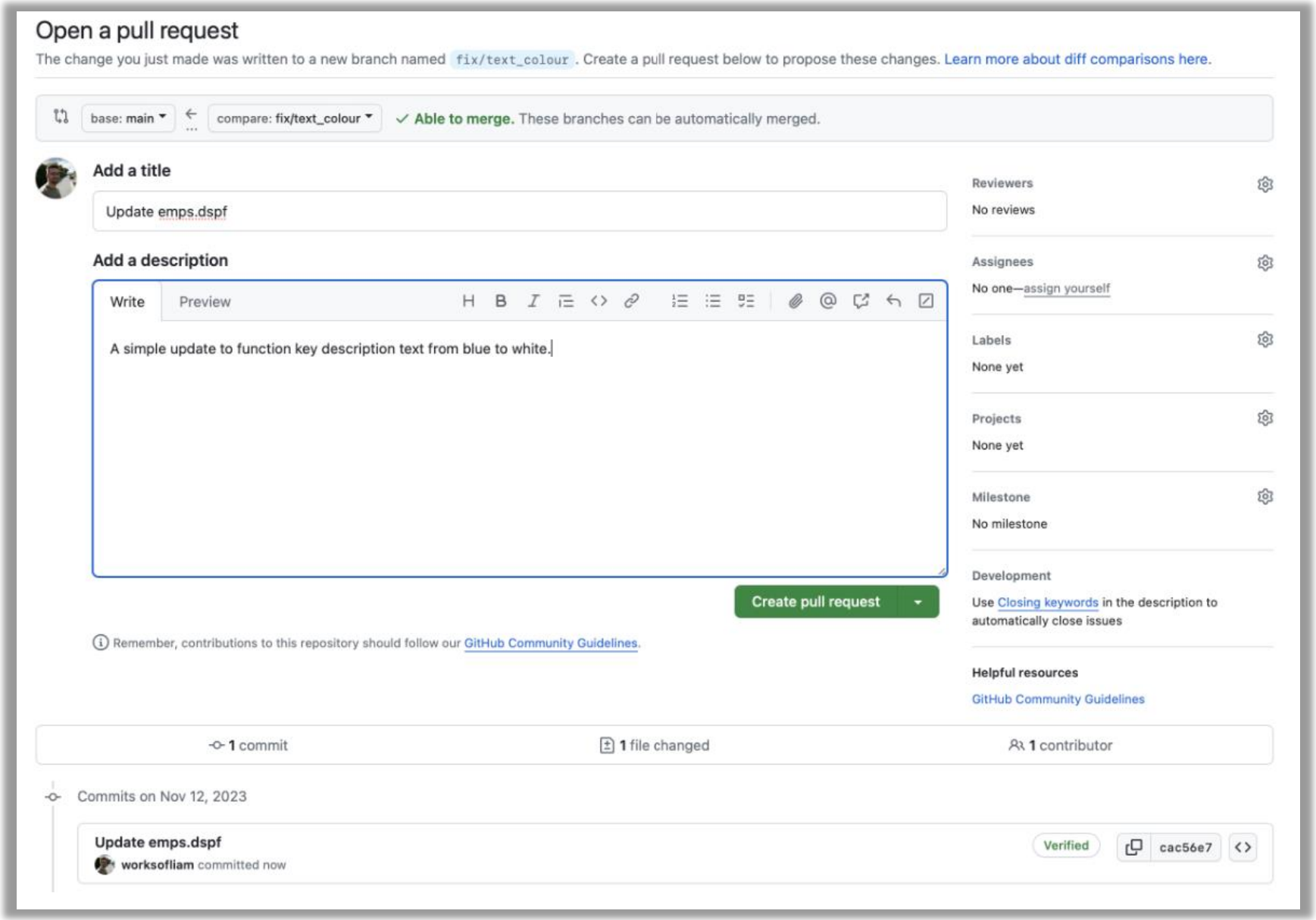
Create New Pull Request...



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Trigger a Workflow...

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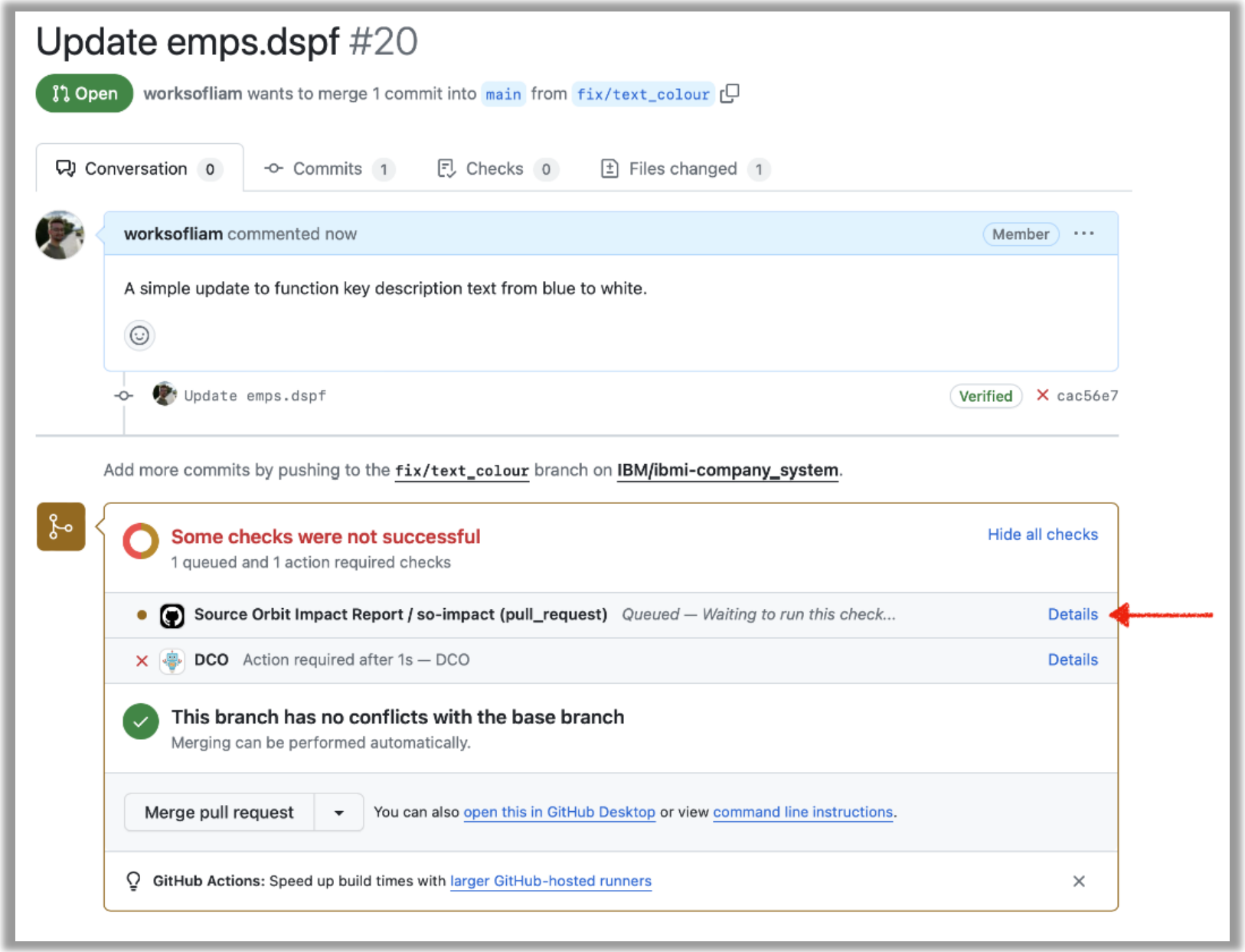

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Post a Comment...

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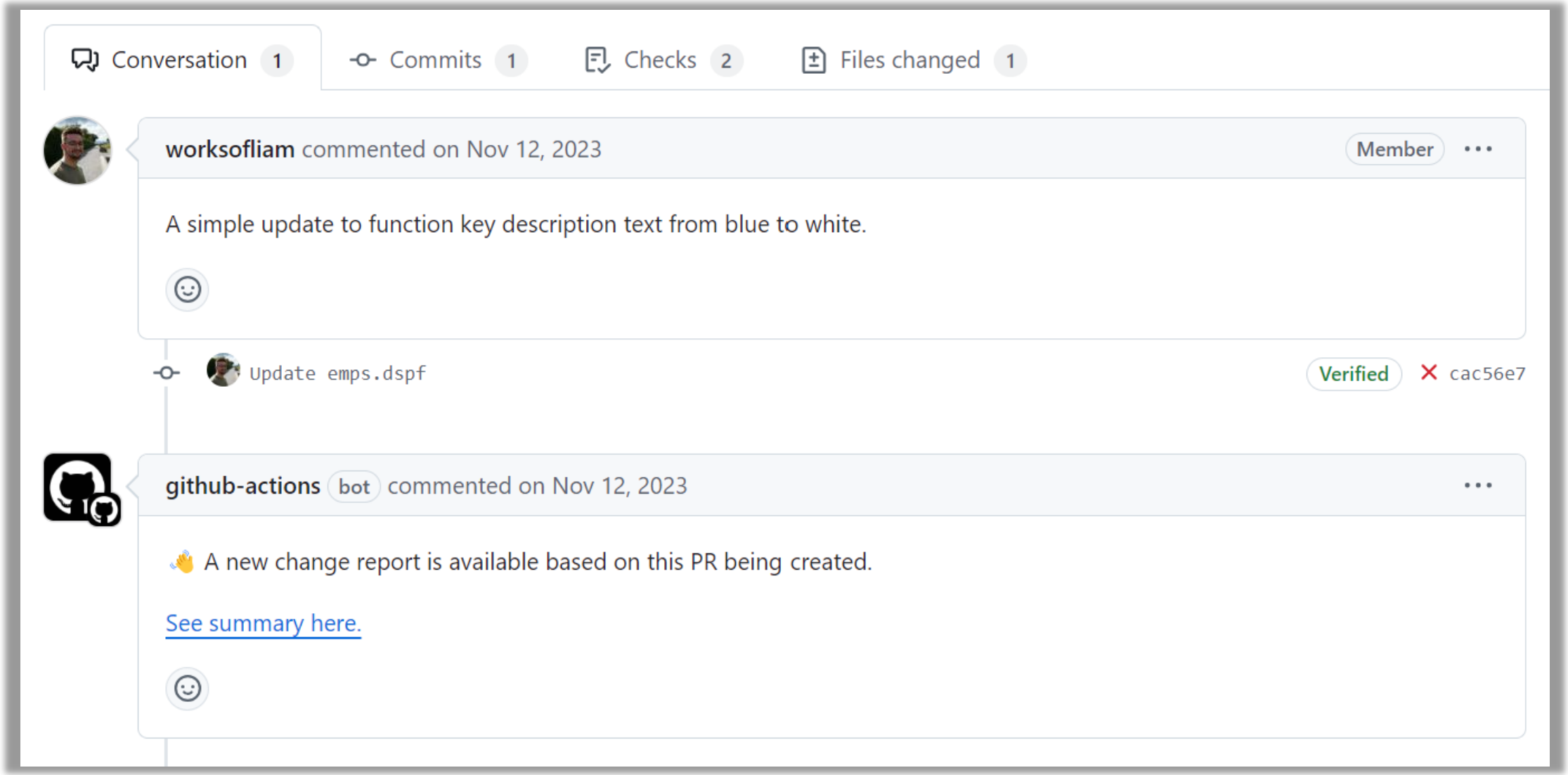

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View Impact Analysis....

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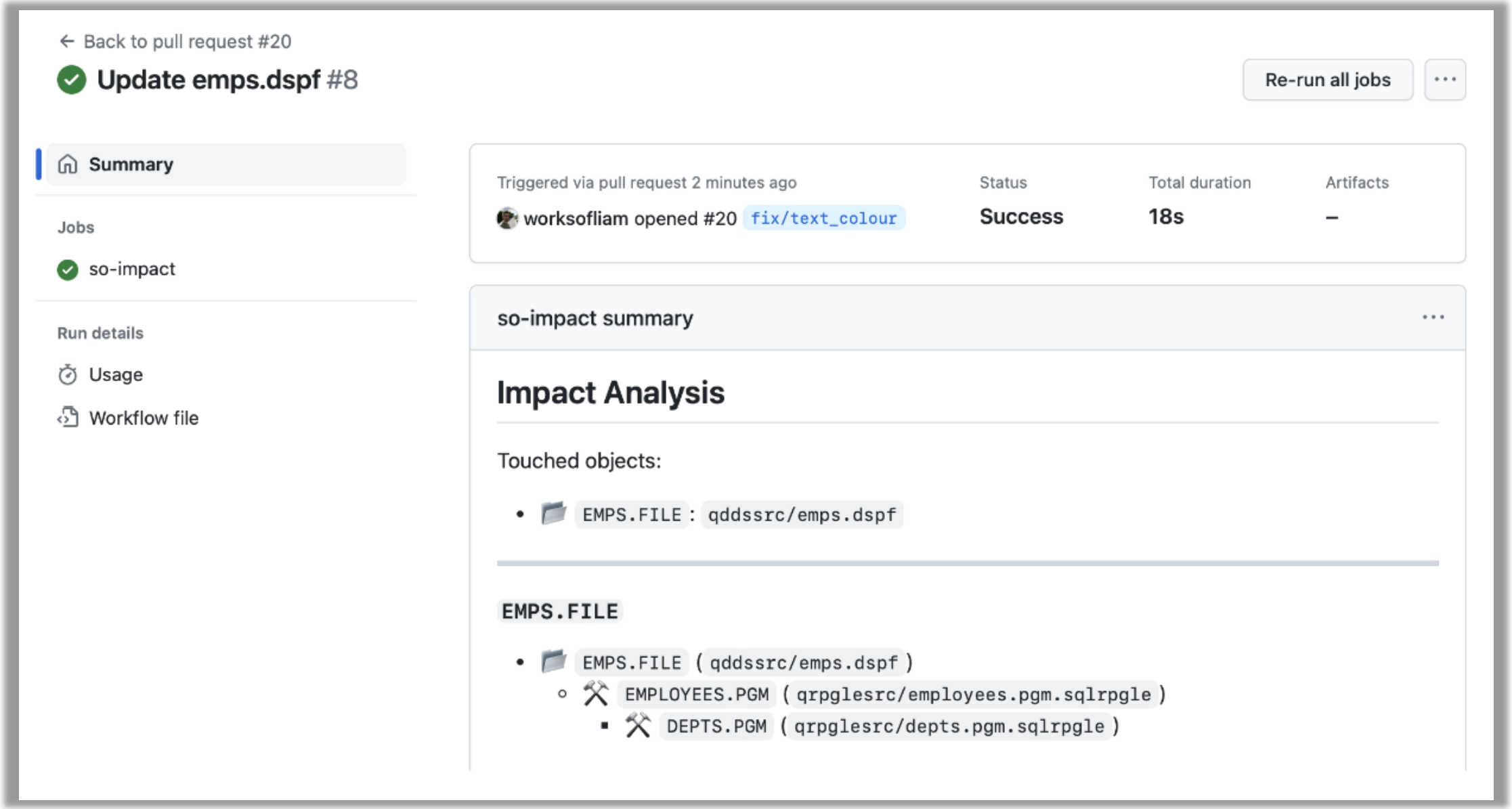

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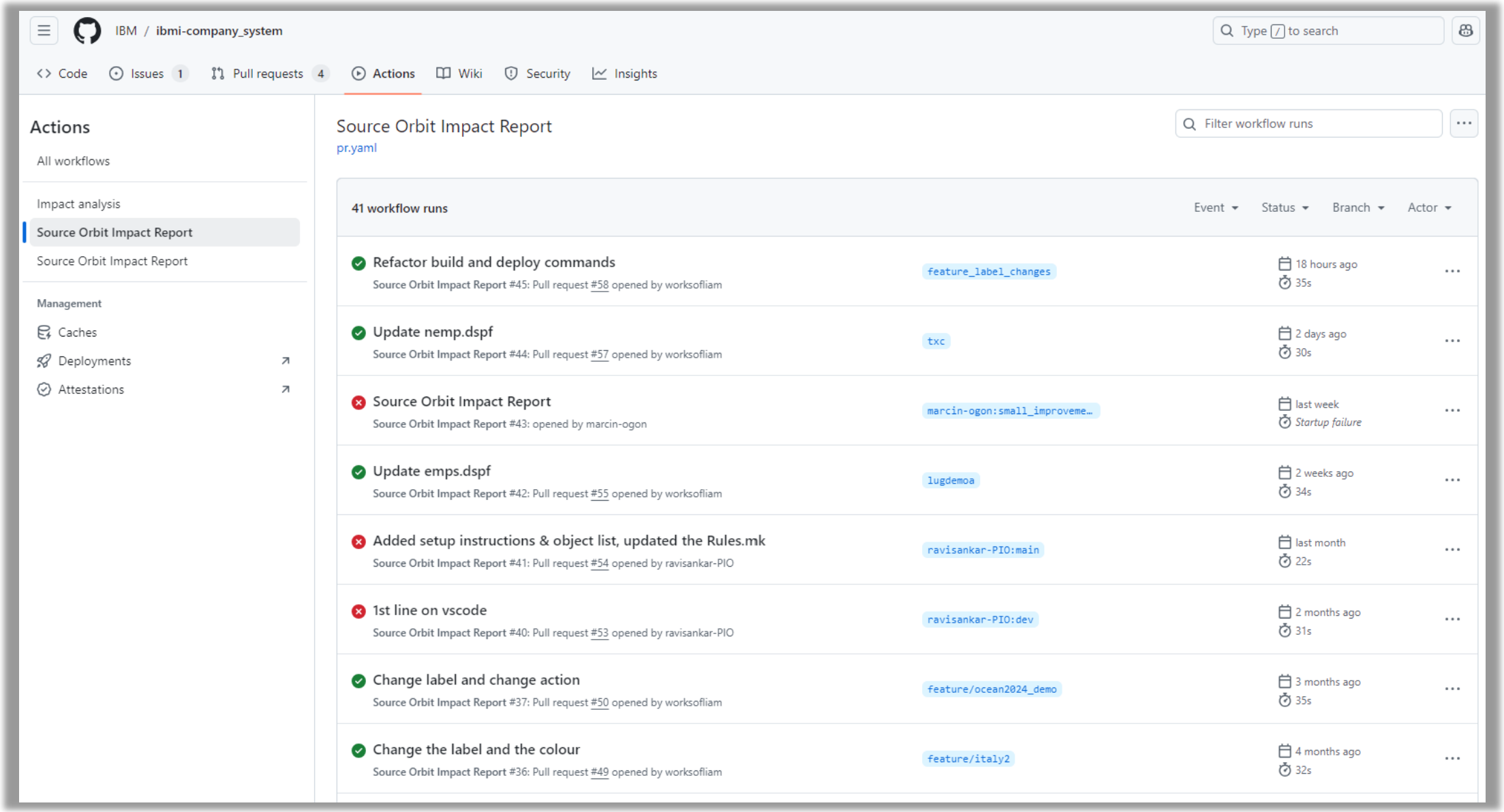

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Demo

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Any Questions?

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Important Links

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ibmi-ci

- NPM https://www.npmjs.com/package/@ibm/ibmi-ci
- GitHub Repository https://github.com/IBM/ibmi-ci

Source Orbit

- NPM https://www.npmjs.com/package/@ibm/sourceorbit
- Extension https://marketplace.visualstudio.com/items?itemName=IBM.vscode-sourceorbit
- Documentation https://ibm.github.io/sourceorbit/#/
- GitHub Repository https://github.com/IBM/sourceorbit

SSH on IBM i

- Setup Instructions https://www.seidengroup.com/how-to-configure-and-use-ssh-on-ibm-i/

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For More Information

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Automating Builds in Git on IBM i - Sanjula Ganepola

Please take the last minute of this session to complete the evaluation. A direct link to the evaluation can be found using the QR code below.

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