Git Branching and Pull Requests

Branches in Source Control Systems

In case of fire

1. git commit
2. git push
3. leave building

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Source Control Systems

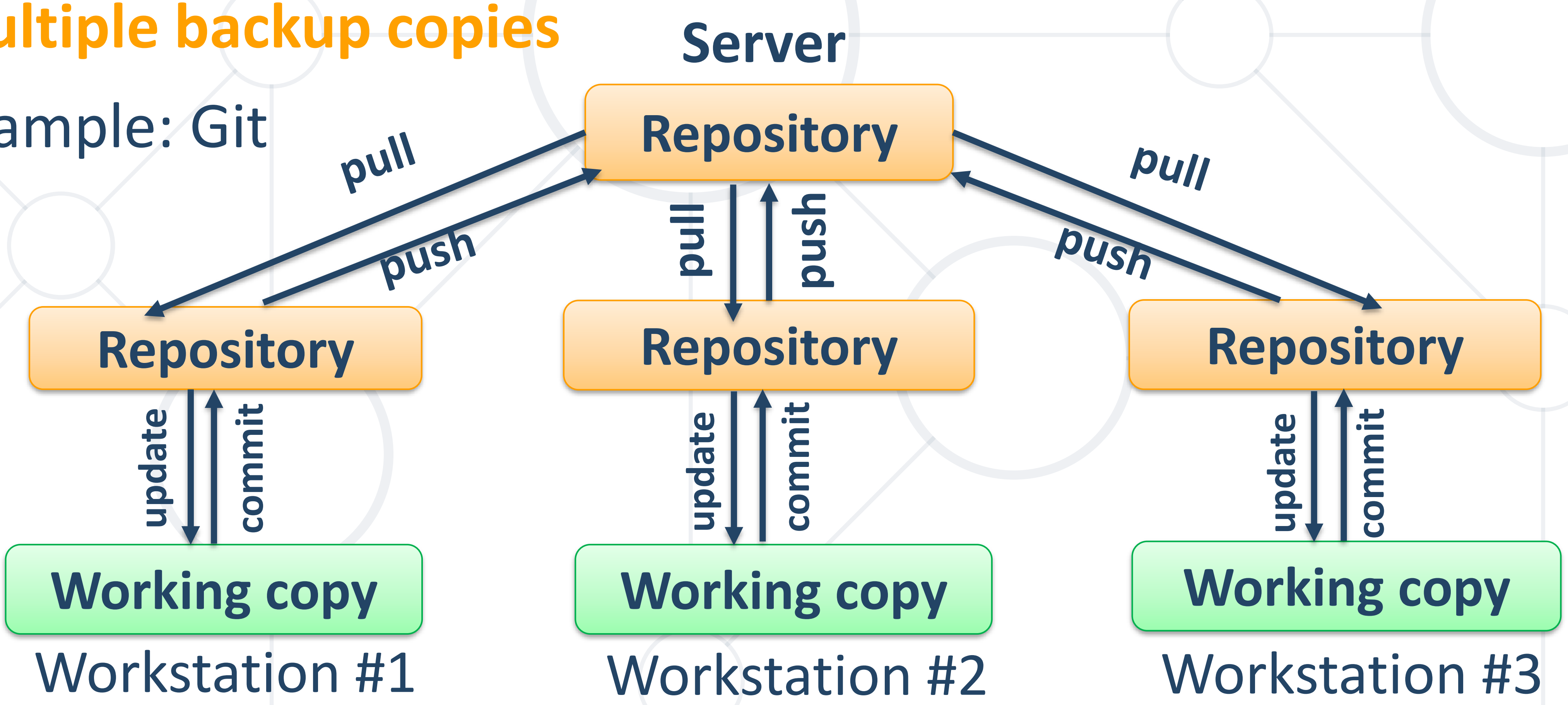
Version Control System

Software Configuration Management (SCM)

- **Version Control System** ≈ **Source Control System**
  - Tool for **managing** the changes during the **development**
  - A **repository** keeps the **source code** and **other project assets**
    - Keeps a **full history** of **all changes** during the time
      - **Change log** shows who, when and why changed what
  - Solves **conflicts** on **concurrent changes**
    - Allows **reverting** of old versions
- Popular **source control systems**
  - **Git** – distributed source control (hierarchical)
  - Subversion (SVN) – central repository (centralized)

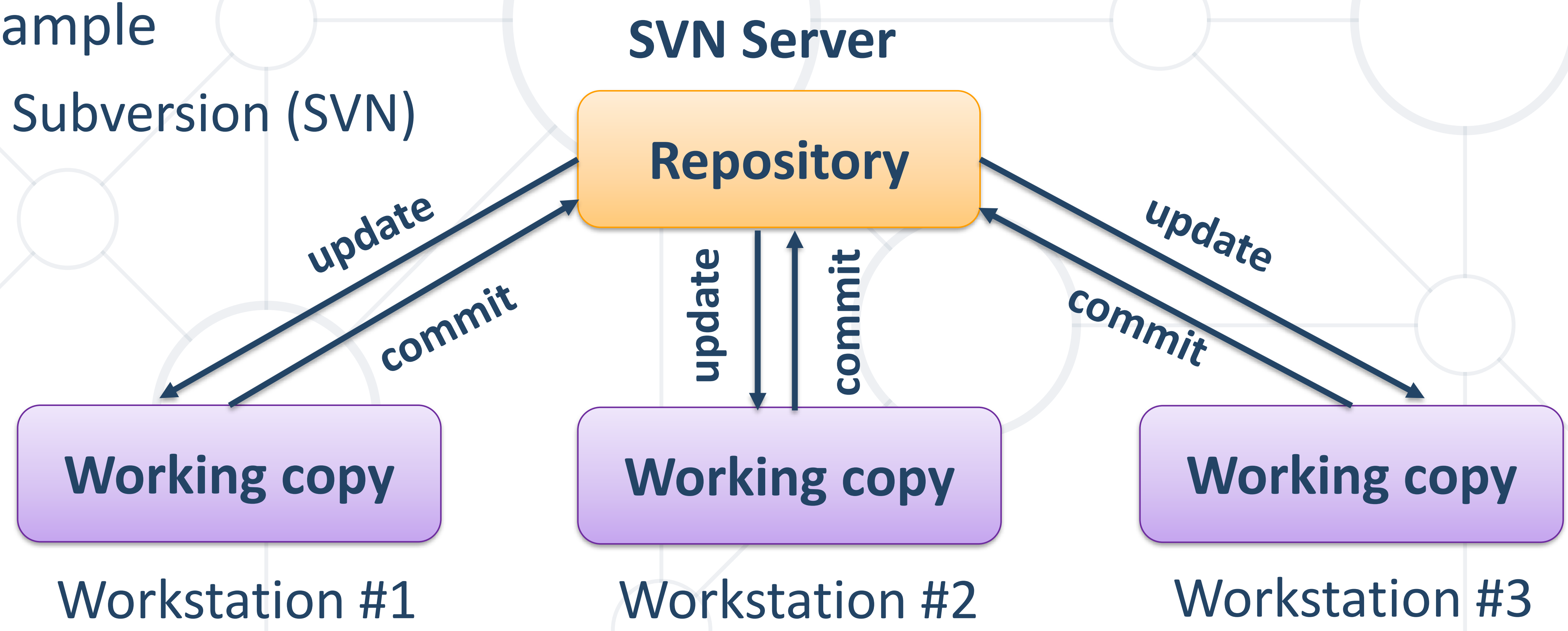
Distributed Version Control (DVC)

- Unlike a CVC system, a DVC doesn't have a **single point** of **failure**
- **Developers clone repositories** on their DVC workstations, creating **multiple backup copies**
- Example: Git



Centralized Version Control (CVC)

- A **CVC system** relies on a **central server** where **developers commit changes**
- Example
  - Subversion (SVN)



Git

Global Information Tracker

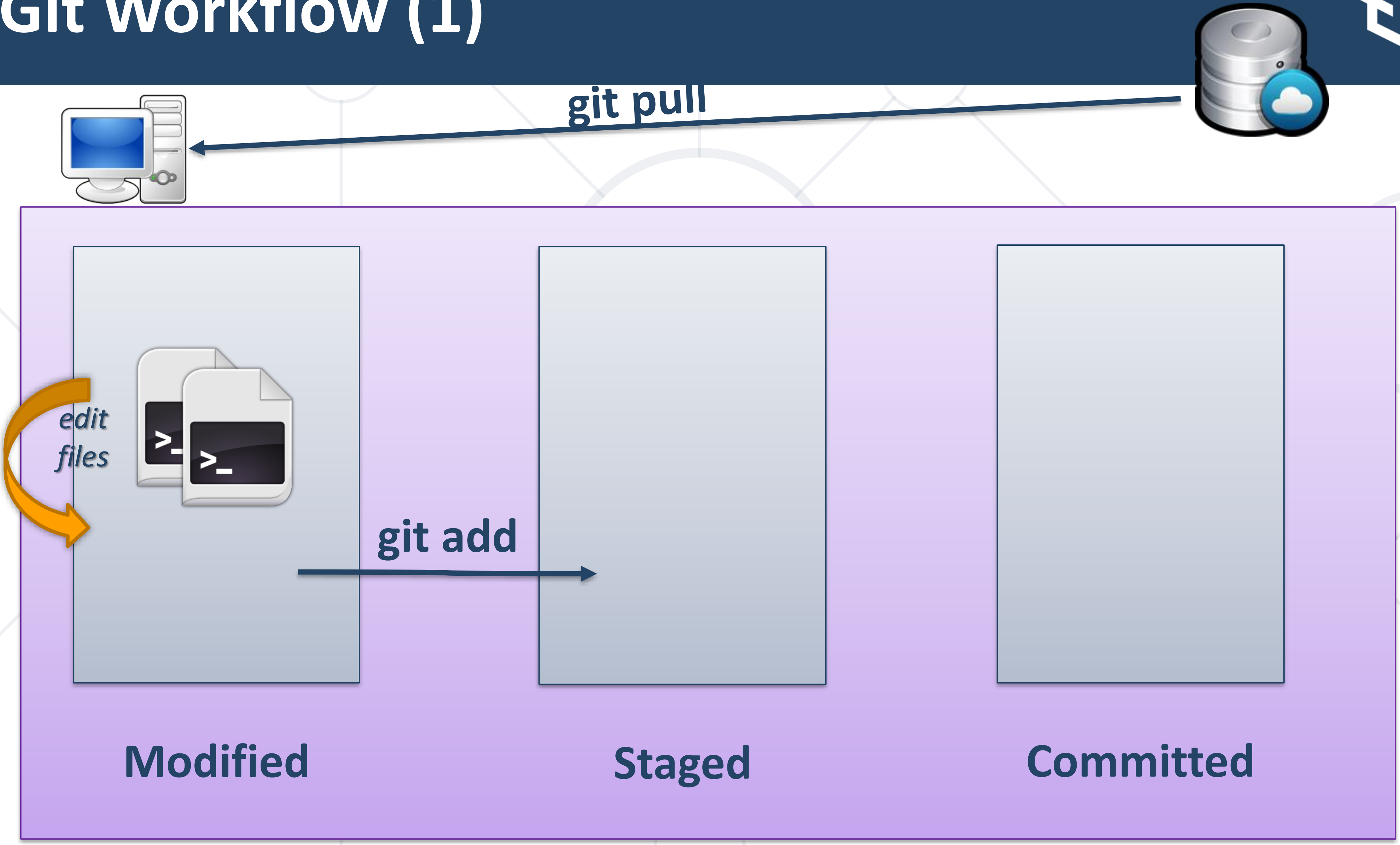
What is Git?

- Git
  - Distributed **source-control** system
  - The most popular source control in the world
  - Free open-source software
  - Works with local and remote repositories
  - Runs on Linux, Mac OS and Windows
- GitHub
  - **Social network** for **developers**
  - **Free project hosting** site with **Git repository**

Vocabulary

- **Repo** (repository)
  - Holds the project in a remote server
- **Branch**
  - Parallel development path (separate version of the project)
- **Merge branches**
  - Merge two versions of the same projects
- **Clone**
  - Download a local copy of the remote project
- **Commit**
  - Saves a set of changes locally
- **Pull**
  - Take and merge the changes from the Remote
- **Push**
  - Send local changes to the Remote

Git Workflow (1)



git pull

edit files

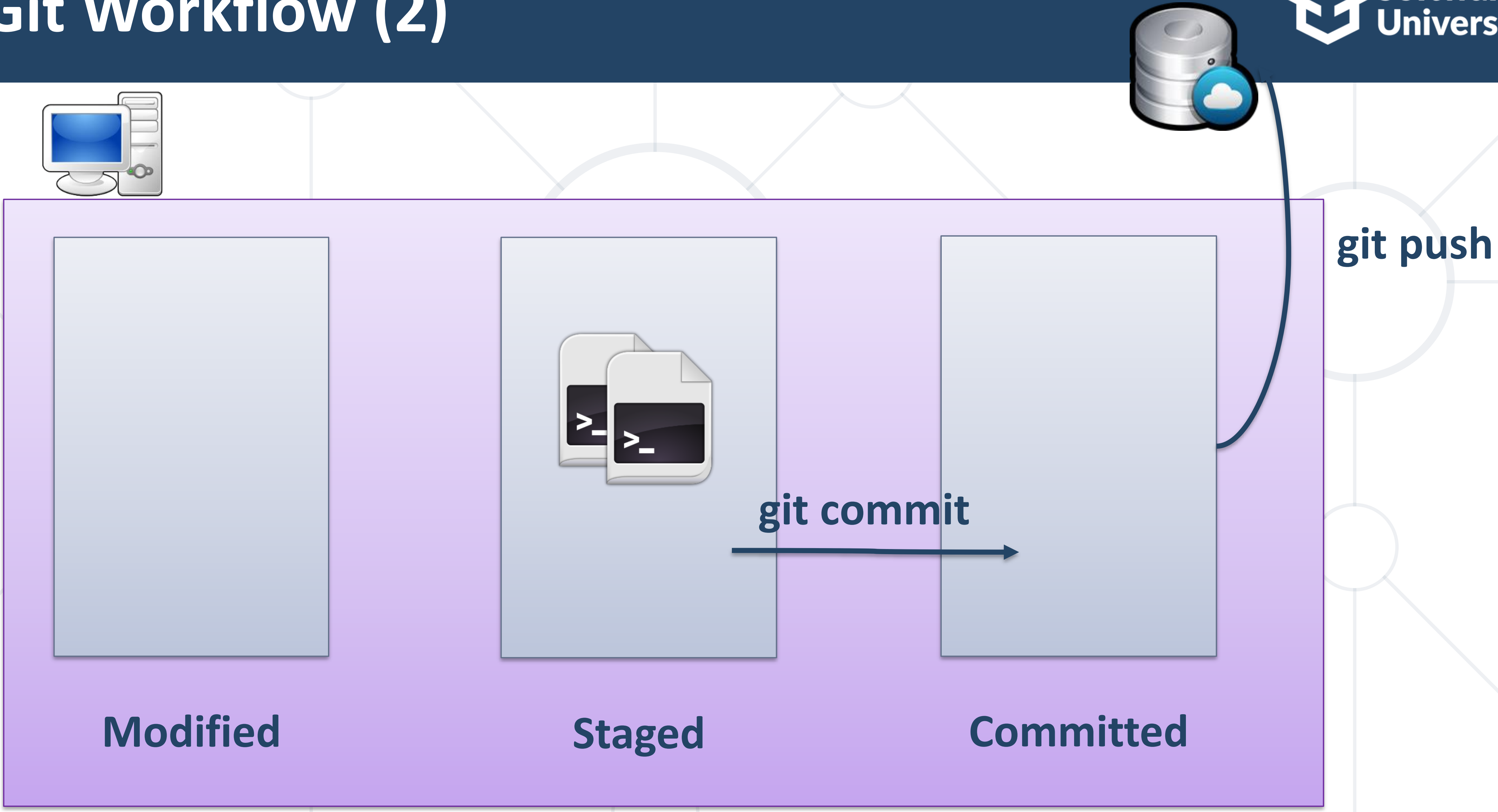
git add

Modified

Staged

Committed

Git Workflow (2)



Modified

Staged

Committed

git commit

git push

GitHub

Source Code Hosting with Git

What is GitHub?

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- **GitHub**
  - Platform and cloud-based service, based on **Git**
  - World's **most** used source code host
  - Used for **software development** and **version control**
    - Free for **open-source projects** and small private projects
    - Paid plans for private repositories with advanced features
- **GitHub Desktop**
  - Enables interacting with **GitHub** using a **GUI instead** of the **command line** or a **web browser**

GitHub Features

- **Access control**
- **Bug tracking** (Issue tracker)
- **Continuous Integration** (Actions)
- **Wiki pages** (Documentation)
- **Software feature request**
- **Task management**
- **Project board** (Kanban style)
- Etc.

Basic Git Commands

Clone ⟶ Modify ⟶ Add ⟶ Commit ⟶ Push

Basic Git Commands (1)

- **Clone** an existing Git repository

```
git clone [remote url]
```

- **Fetch** and **merge** the latest changes from the remote repository

```
git pull
```

- **Prepare** (add / select) files for a commit

```
git add [filename] ("git add ." adds everything)
```

- **Commit** to the local repository

```
git commit -m "[your message here]"
```

Basic Git Commands (2)

- Check the **status** of your local repository (see the local changes)

```
git status
```

- Create a **new** local repository (in the current directory)

```
git init
```

- Create a **remote** (assign a short name for remote Git URL)

```
git remote add [remote name] [remote url]
```

- **Push** to a remote (send changes to the remote repository)

```
git push [remote name] [local name]
```

Live Demo

Using Git Commands

Git Conflicts

Merging Git Conflicts

Git Conflict

- **Conflicts** generally arise when two or more people **change** the **same file simultaneously**
  - Or if a developer **deletes** a **file** while another developer is **modifying** it
- In these cases, **Git cannot automatically determine** what is **correct**
- **Conflicts** only **affect** the **developer conducting** the **merge**
- The rest of the team is **unaware** of the **conflict**

Live Demo

Git Conflict Scenario

Branching Concepts & Branching in Git

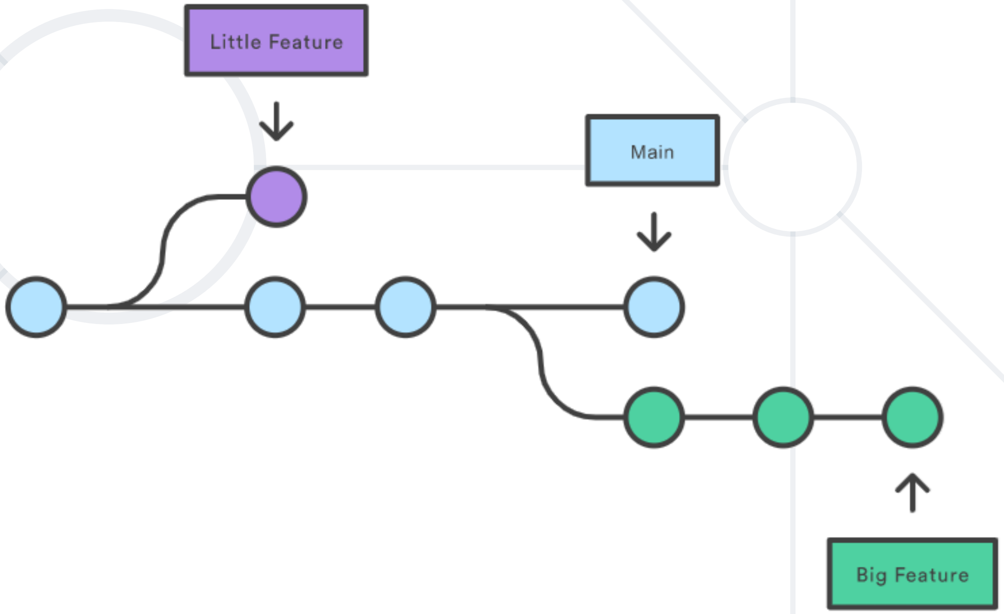
Creating and Merging Branches

What is Branching?

- **Branches** allow you to work on **different parts** of a project without **impacting** the **main / master branch**
  - Serve as an abstraction for the **edit / stage / commit process**
- Represent a way to **request** a **brand new working directory**, staging area, and **project history**
  - Any new **commits** are **recorded** in the **history** for the **current branch**
    - Without impacting the main branch until it's decided to integrate the changes
- You can **switch between branches** and work on different projects without them interfering with each other

Branches == Built-In Feature of Git

- Branching is **available** in most version control systems
  - In **some** version control systems it can be an **expensive operation** in both time and disk space
- In **Git**, **branches** are a part of the **everyday development process**
- **Git branches** are an **effective** pointer to a **snapshot** of a developer's **changes**



Live Demo

Git Branches

Git Branching Commands

View / Switch / Delete Branches

Local vs. Remote Branches

- **Local branch**
  - Branch in your local Git repo
  - Changes tracked only locally
- **Remote branch**
  - Branch inside the remote repository (e.g. in GitHub)
- **Upstream branch**
  - Remote branch, connected to your local branch
  - When you push changes, they are sent to the upstream branch

Git Branching Commands (1)

- **Create** a new local branch

```
git branch {branch-name}
```

- **Switch** to certain existing branch

```
git switch {branch-name}
```

```
git checkout {branch-name}
```

- **Create** a new branch and **switch** to it

```
git checkout -b {branch-name}
```

Git Branching Commands (2)

- **List all** local and remote branches

```
git branch --all
```

```
git branch -a
```

- **List** local together with the last commit message

```
git branch --verbose
```

```
git branch -vv
```

- **List all local** and **remote branches** with the last commit message

```
git branch --all --verbose
```

```
git branch –a -vv
```

Git Branching Commands (3)

- **List local branches**

```
git branch
```

- **Push to a new upstream** (in a new remote branch)

```
git push --set-upstream origin {branch-name}
```

```
git push -u origin {branch-name}
```

- Merge another branch in the active branch

```
git merge {branch-name}
```

Git Branching Commands (5)

- Delete a local branch

```
git branch -d {branch-name}
```

- Delete a remote branch

```
git push origin -d {branch-name}
```

Branching Strategies

Strategy Simple Branch

What is a Branching Strategy?

- **Branching strategy**
  - A strategy that programmers adopt while **writing**, **merging** and **deploying code** when using a **VCS**
- It is essentially a **set** of **rules** that **developers** can **follow** to stimulate how they **interact** with a **shared codebase**
- It enables teams to **work** in **parallel** to achieve **faster releases** and **fewer conflicts**
  - By creating a **clear process** when making changes to **source control**

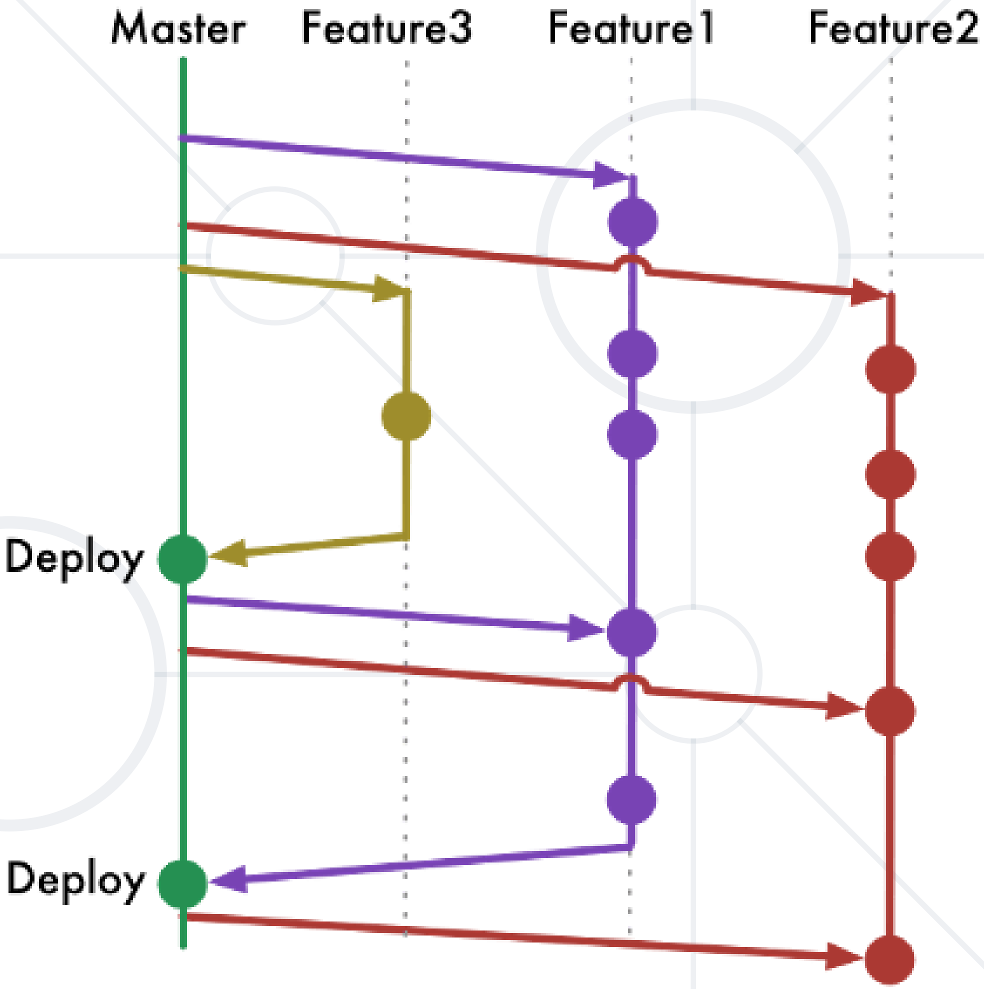
Purposes of Branching Strategy

- Enhance **productivity** by ensuring proper coordination among developers
- Help **organize** a series of **planned**, structured releases
- Map a **clear path** when making changes to **software** through to **production**
- Maintain a **bug-free code**
- Enable **parallel development**

Common Git Branching Strategies

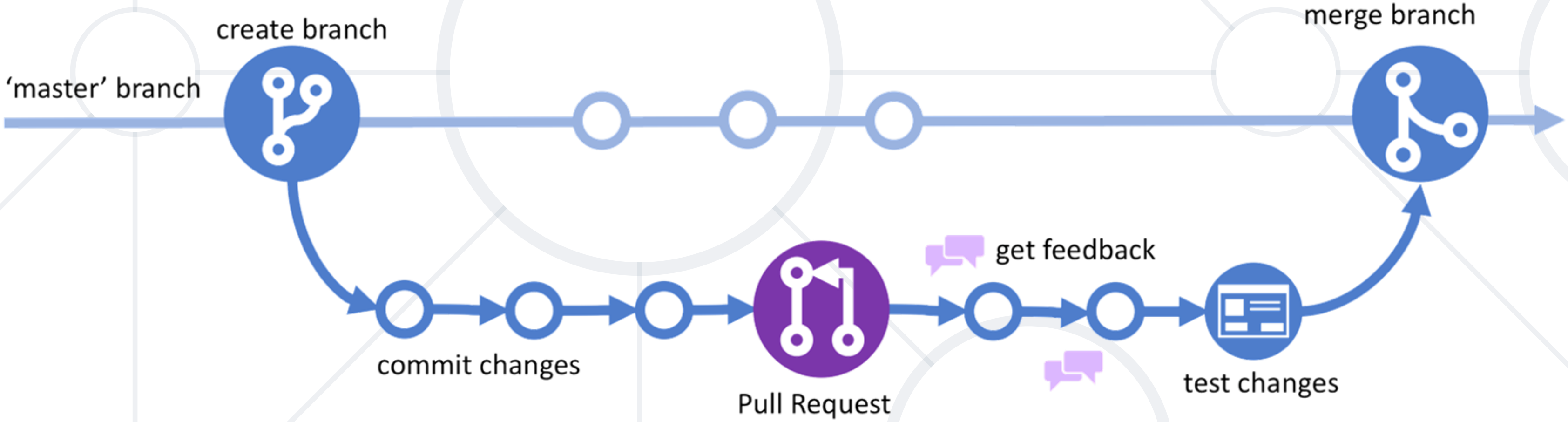
Trunk-Based Development

- **Trunk-based development**
  - "**No branches**" strategy
  - **Developers** integrate their **changes** into a **shared trunk** at **least once** a **day**
- Make smaller **changes** more **frequently and** commit **directly** into the **trunk** (without the **use** of branches)
  - This shared **trunk** should be ready for **release anytime**
- This **strategy** is **suited** to more **senior developers**



GitHub Flow

- **GitHub Flow**
  - **Lightweight** and **flexible** development **workflow**

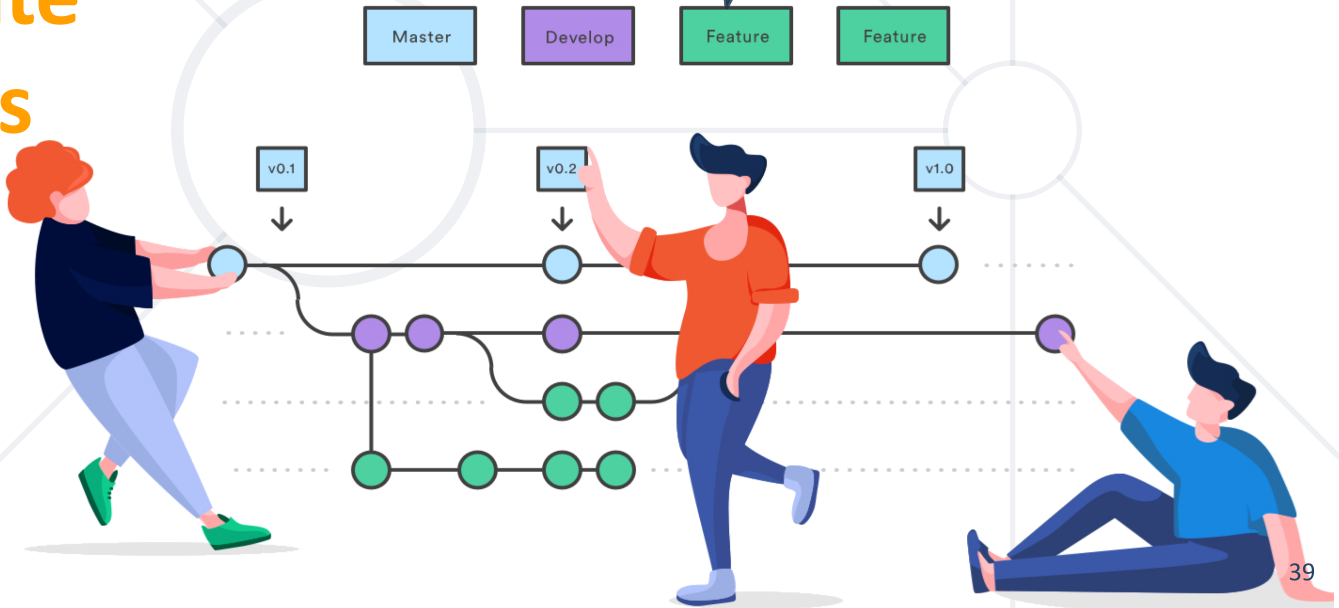


  - **Each feature** is implemented in its **own branch**
  - **Keep** the **master code** in a **constant deployable state**
- **Before merging**, each branch comes through a **Pull Request** and **code review**, then the **changes are tested** and integrated

GitFlow

- **GitFlow**
  - Enables **parallel development**
  - Devs can work **separately** from the **master branch** on **features**
- This **strategy contains separate** and **straightforward branches** for **specific purposes**
  - Ideal to **handle multiple versions** of the **product**

Feature branch is created from the master branch

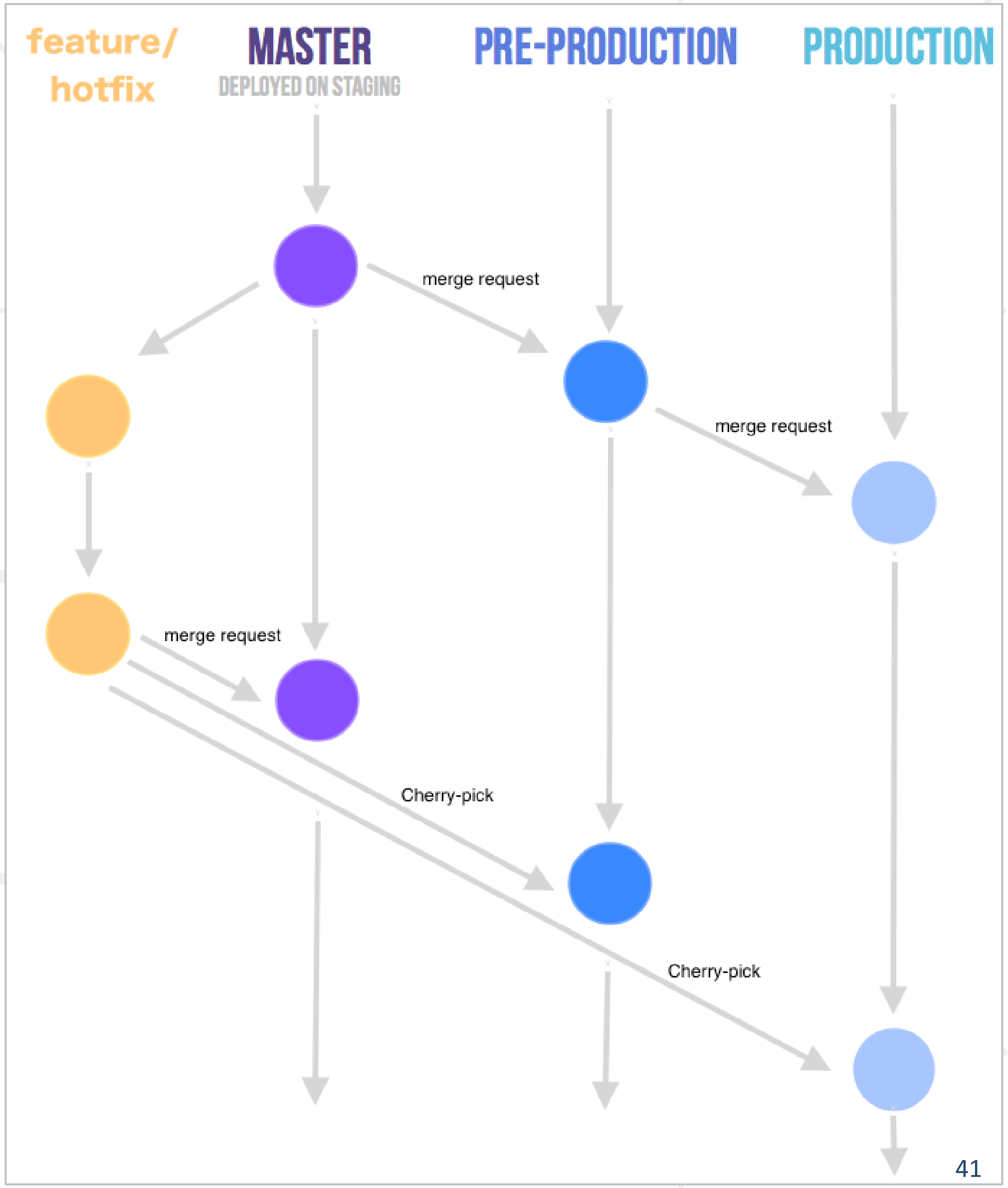


GitFlow Branches

- **Master** (**main**)
  - Holds the active production code
- **Release**
  - **Help** prepare a **new production release**
- **Hotfix**
  - Hotfix branches arise from a **bug** that has been **discovered** and must be **resolved**
- **Develop**
- **Feature**
  - Develop **new features**

GitLab Flow

- **GitLab Flow**
  - Combines **feature-driven development** and **feature branching** with **issue tracking**
  - Each **feature** is implemented in its **own branch**
  - Developers work with the **main branch right away**
  - The **main** branch is deployed to **production** (manually or auto)



Best Branching Strategy for Your Team

Product type and its release method	Team size	Collaboration maturity	Applicable mainstream branch mode
All	**Small team**	High	**Trunk-based Dev**
Products that support continuous deployment and release	**Middle**	Moderate	**GitHub-Flow** and **Trunk-based Dev**
Products with a definite release window and a periodic version release cadence	**Middle**	Moderate	**Git-Flow** and **GitLab-Flow** with **release branch**
Basic platform products	**Middle**	Moderate	**GitLab-Flow**
Products demanding product quality and have a long maintenance cycle for released versions	**Large**	Moderate	**Git-Flow**

No Standard for "Branching Strategy"

- Different organizations use **different branching strategies** for each different team / project
  - There is no "***best branching strategy***"
  - How to use branches highly depends on
    - The **team**
    - The **project** under development

Pull Requests in GitHub

Show Changes You’ve Pushed

Pull Requests in GitHub

- **Pull requests**
  - A **mechanism** for developers to **notify** their team members that they have **completed** a **feature**
- The **pull request** is more than just a **notification**—it's a **code review process**, including **discussions** on the **proposed feature**
- If there are any **problems** with the **changes**, **teammates** can **post feedback** in the **pull request**
- This **activity** is **tracked** directly **inside** of the **pull request**

Pull Requests

- **Pull requests** let you tell others about **changes** you want to **push** to a **branch** in a **repository** on GitHub
- Once a **pull request** is **opened**, you can **discuss** and **review** the **potential changes** with **collaborators**
- You can **create pull requests** on **GitHub.com**, in **GitHub Desktop** or in other GitHub tools

Branch Protection Rules

- You can create a **branch protection rule** in a repo
  - Can be created for
    - A **specific branch**
    - All **branches**
    - Any branch that **matches** a **name pattern** you specify with **`fnmatch` syntax**
- For example, you can create a branch protection rule to prevent **contributors from merging to a branch** without an **approved pull request**

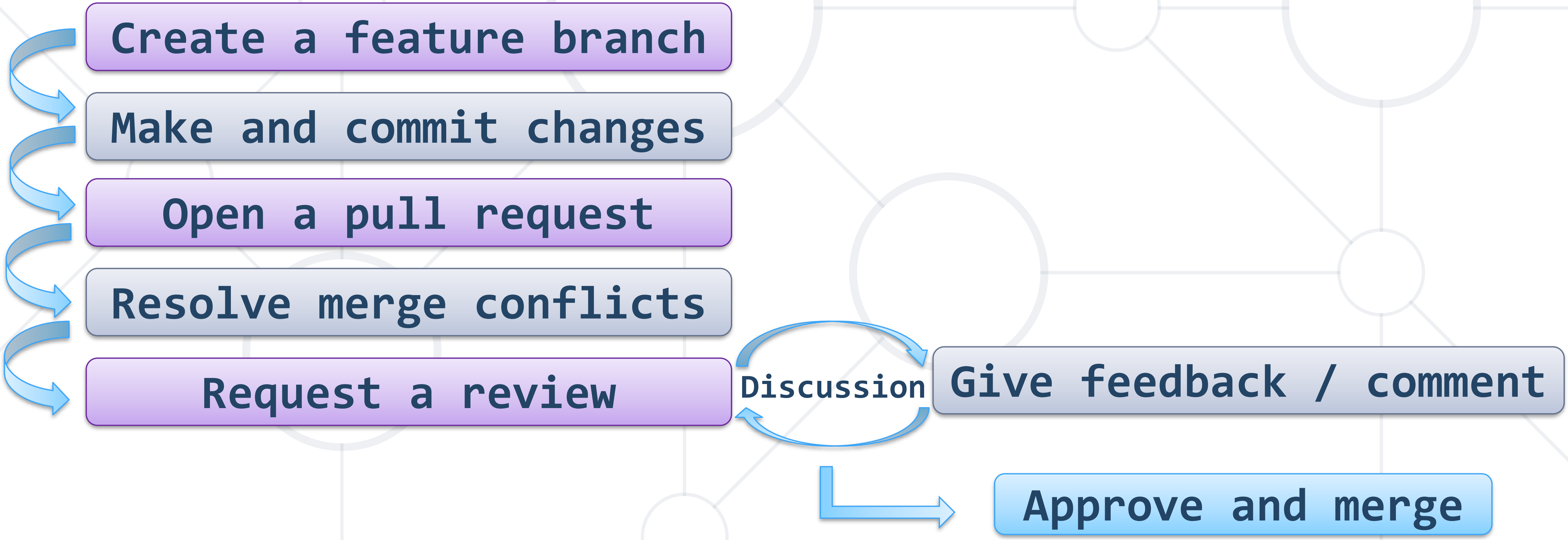
The Pull Request Process

Notify Team for a Completed Feature

Pull Request: The Process

Programmer

Senior Developer



Create a feature branch

Make and commit changes

Open a pull request

Resolve merge conflicts

Request a review

Give feedback / comment

Approve and merge

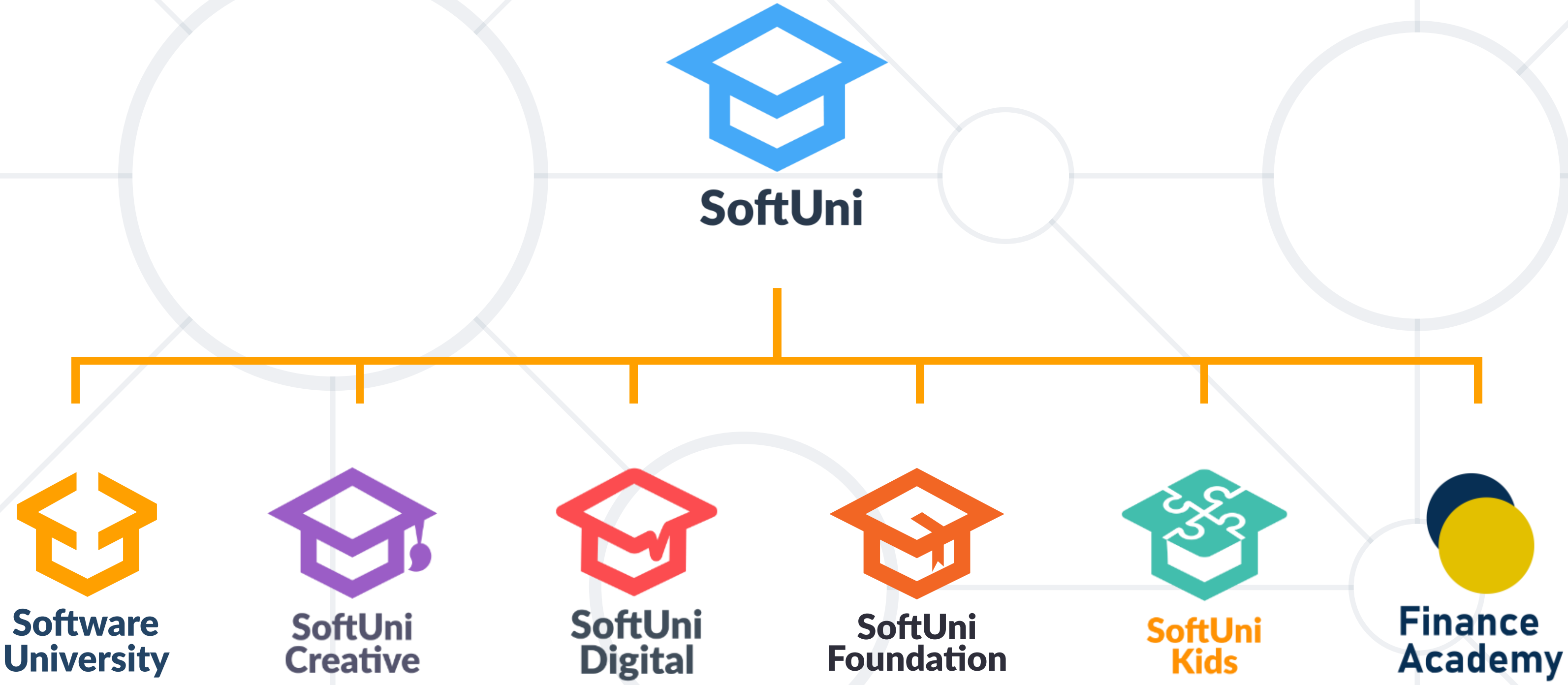
Live Demo

Creating a Pull Request

Summary

- **Git** == distributed source control system
- **GitHub** == platform and cloud-based service, based on **Git**
- **Branch** == a new separate version of the main repository
- Build your **branching strategy** from several main concepts
- **Pull requests** let you tell others about changes you've pushed to a **branch** in a **repository** on **GitHub**
- **Conflicts** may appear when **merging** two **branches**

Questions?



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