Version Control

UBCO Master of Data Science – DATA 541

Today’s Class

Fundamentals of version control

Fundamentals of Git

Useful Git commands

Git workflow

How Do We Share Code

Working in a team, you need to share code

- How?

Email attachments?

Dropbox?

What if two people edit the same file at the same time?

- Google Docs? Dropbox?
  - No merging in Dropbox
  - GoogleDocs not meant for code
    - No syntax highlighting, etc.

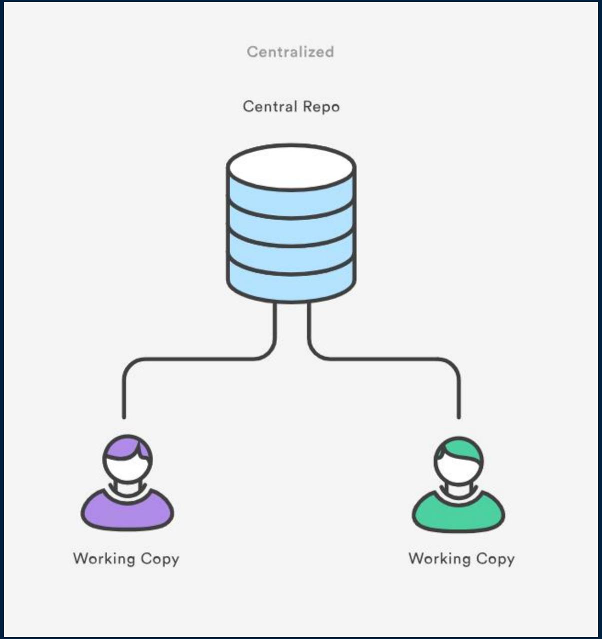
Version Control Systems

Goal of a Version Control System

- Software that manages changes that you make to your files (source code)
- Track versions of each file
- Handles concurrent changes from multiple sources (e.g., different developers working on the same code base)

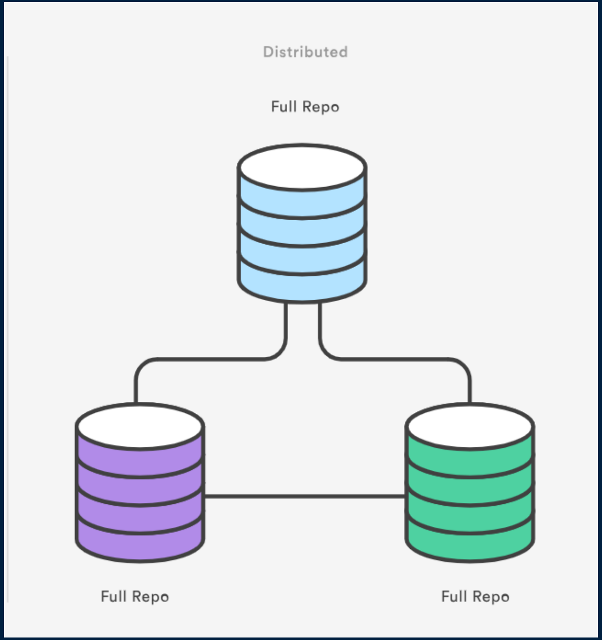
Centralized and Distributed Models

Centralized Model



Example: Subversion

Distributed Model



Example: Git

Distributed Version Control

No central server required

Every user has a copy of every file

Very specific design goals

- Large-scale development
- Distributed

Git doesn't require a server, but it's common to use one for coordination

- Example: GitHub

Git History

Came out of the Linux development community

Linus Torvalds, 2005

Initial goals:

- Support for non-linear development
- Fully distributed
- Speed
- Able to handle large projects

Concepts

Working directory

- Local copy of the files that you're working with
- This area is also known as the "untracked" area of git

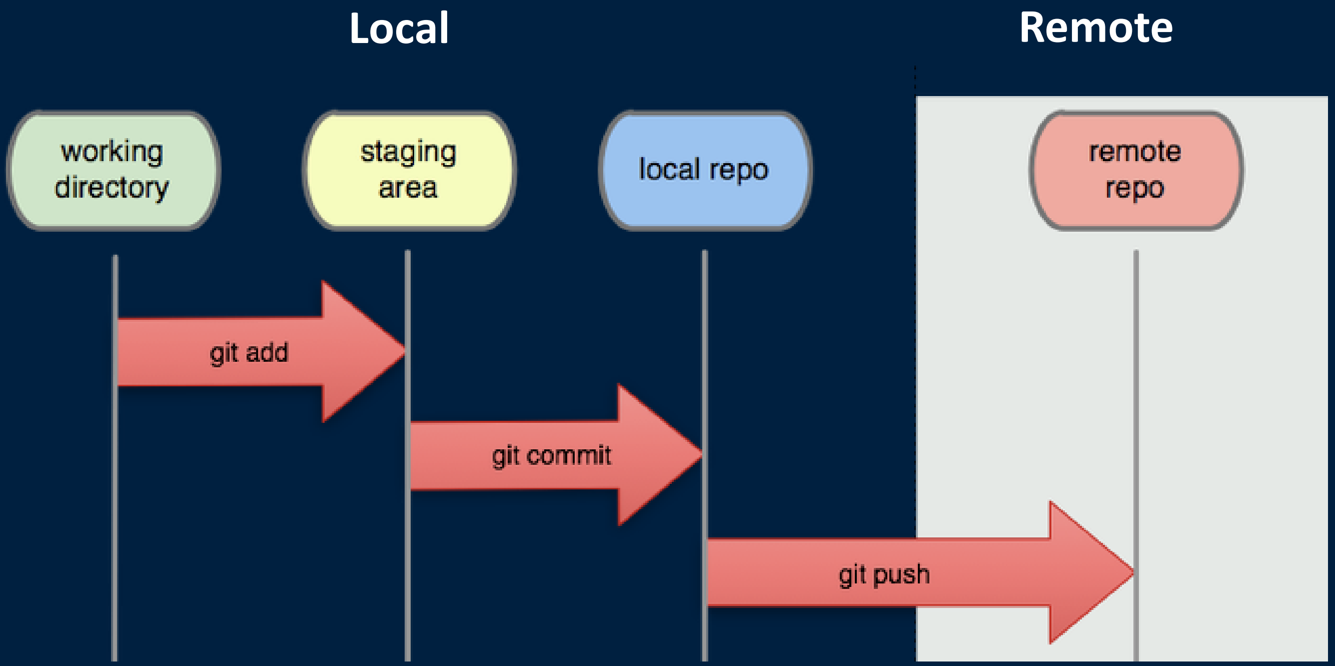
Staging area

- A "place" where you tell Git to hold a set of changes, temporarily

Repository

- A place where Git stores copies of your files and their history
  - Local repository: on your working machine
  - Remote repository: a server (e.g. GitHub)

Concepts


Local
Remote
working directory
staging area
local repo
remote repo
git add
git commit
git push

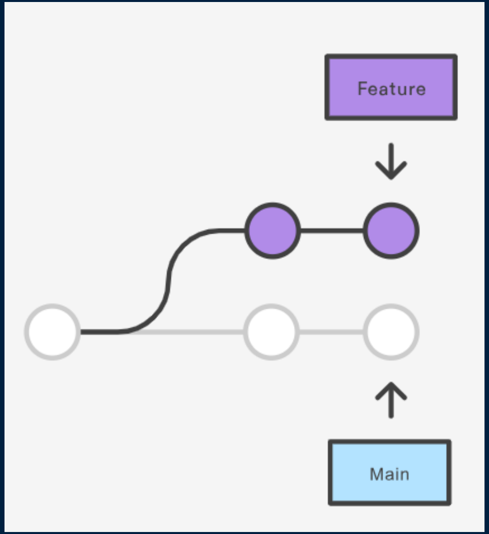
Key Concepts

Repositories

- The act of copying a repository from a remote server is called `cloning`
- Cloning from a remote server allows teams to work together

Branches

- All commits in git live on some branch
- But there can be many, many branches
- The main branch in a project is called the `main` branch



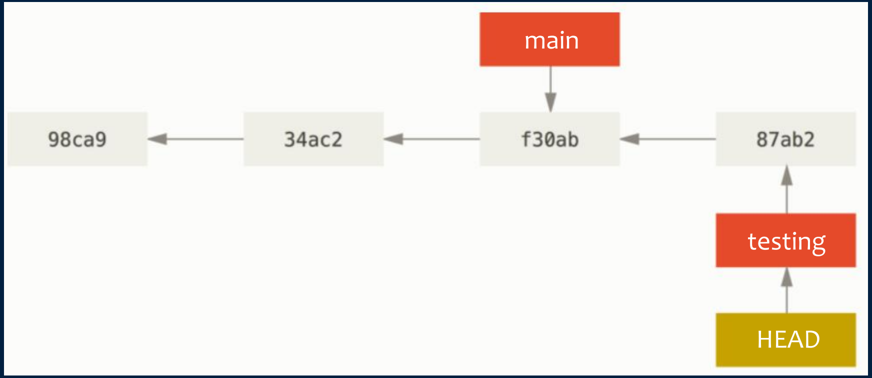
Key Concepts

Main

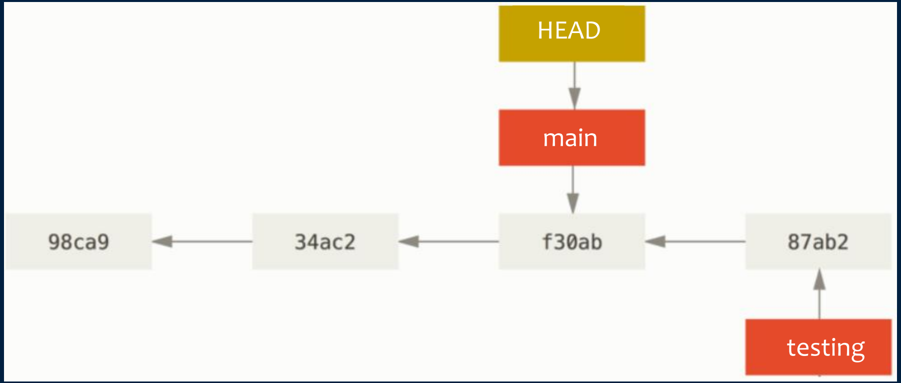
- The main (previously master) branch in your project

Head

- A reference to the most recent commit (in most cases – not always true!)



`git checkout testing`



`git checkout main`

`git status` to see what branch you are on

Commands

You perform these operations using a Git client

- Command-line or GUI

Commands typically move files between working directory, staging area and local or remote repository

Git Basic Question

Question: How many of the following statements are **TRUE**?

1) Git is a is distributed version control system
2) Git is designed to support parallel development
3) Git is a web-based repository Service
4) Git doesn't require a server

A) 0 **B)** 1 **C)** 2 **D)** 3 **E)** 4

Get Ready to Use Git

First, you need to install and configure Git

Install a Git client

- https://git-scm.com/downloads

Set the name and email for Git to use when you commit:

```
$ git config --global user.name “your name”
$ git config --global user.email your_email@email.com
```

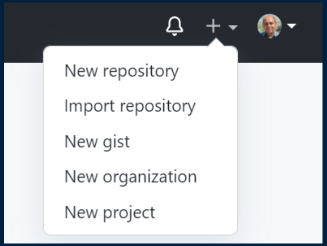
You can call `git config --list` to verify these are set.

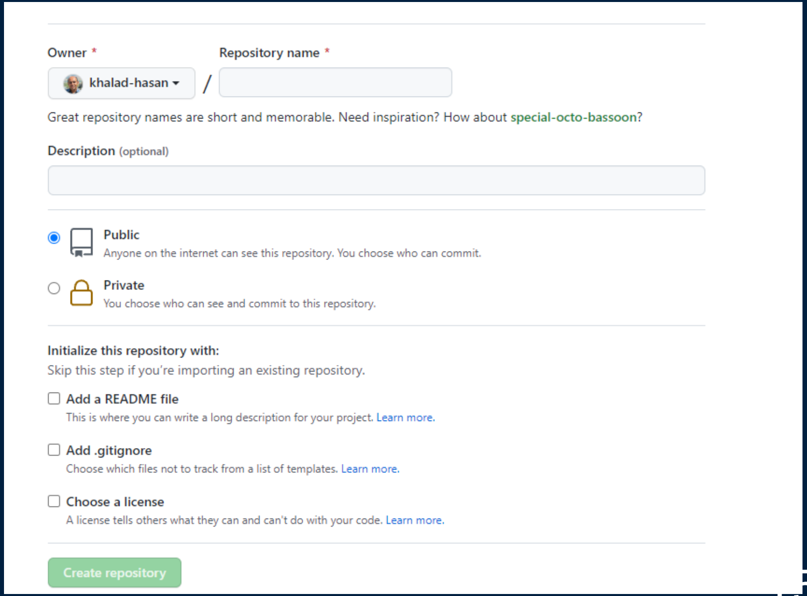
Create a new repository

In the upper right corner, next to your avatar, click and then select **New repository**.

Name your repository

Initialize repository with a README.




Owner * Repository name *

khalad-hasan /

Great repository names are short and memorable. Need inspiration? How about special-octo-bassoon?

Description (optional)

Public
Anyone on the internet can see this repository. You choose who can commit.

Private
You choose who can see and commit to this repository.

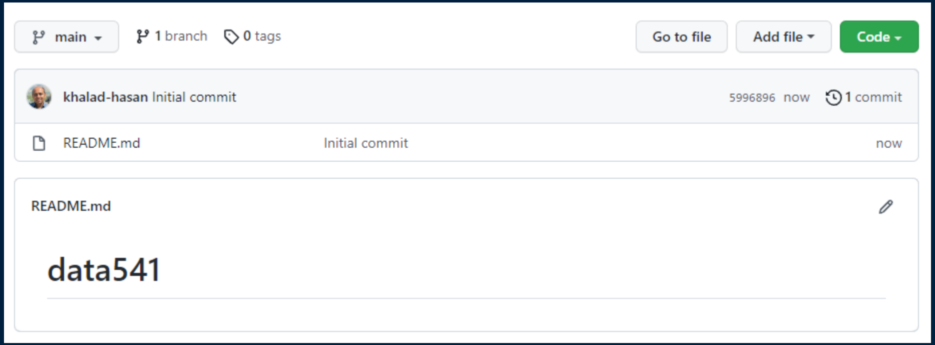
Initialize this repository with:
Skip this step if you're importing an existing repository.

Add a README file
This is where you can write a long description for your project. Learn more.

Add .gitignore
Choose which files not to track from a list of templates. Learn more.

Choose a license
A license tells others what they can and can't do with your code. Learn more.

Create repository



khalad-hasan Initial commit 5996896 now 1 commit

README.md Initial commit now

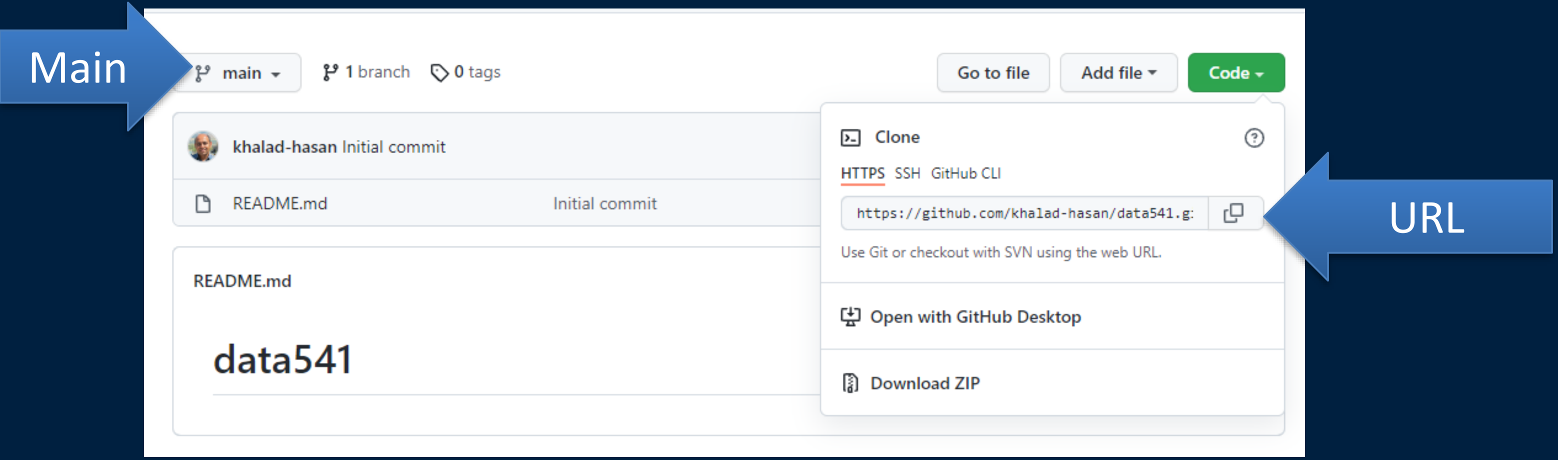
README.md

data541

Setting Up a Repository

Cloning an existing repository: Make a copy from remote repo to working directory

```
git clone <URL>
```



```
https://github.com/khalad-hasan/data541.g:
```

Use Git or checkout with SVN using the web URL.

Inspecting a Repository

The `git status` command displays the state of the working directory and the staging area

The `git log` command displays committed snapshots. It let you see a list of the project history and search for specific changes.

`git log` or

```
git log --oneline
```

```
a1e8fb5 Updated hello.txt
435b61d Created hello.txt
9773e52 Initial commit
```

Note: changes will be listed by commitID

Saving Changes

To add a file from working directory to staging area

```
$ git add file
$ git add directory
$ git add .
```

To Commit changes from staging area to repo

```
git commit -m "commit message"
```

Repo-to-Repo Collaboration

To push changes from local repo to remote repo. This enables other team members to access a set of saved changes.

```
$ git push
```

To pull (merge) changes from remote repo to working directory

```
$ git pull
```

Git Basic Question

Question: Which of the following command creates a copy of a remote repository to your local machine.

A) `git add`

B) `git commit`

C) `git clone`

D) `git pull`

E) `git push`

Setting Up a Repository

To set up a project locally then create the repository on GitHub and push it to remote.

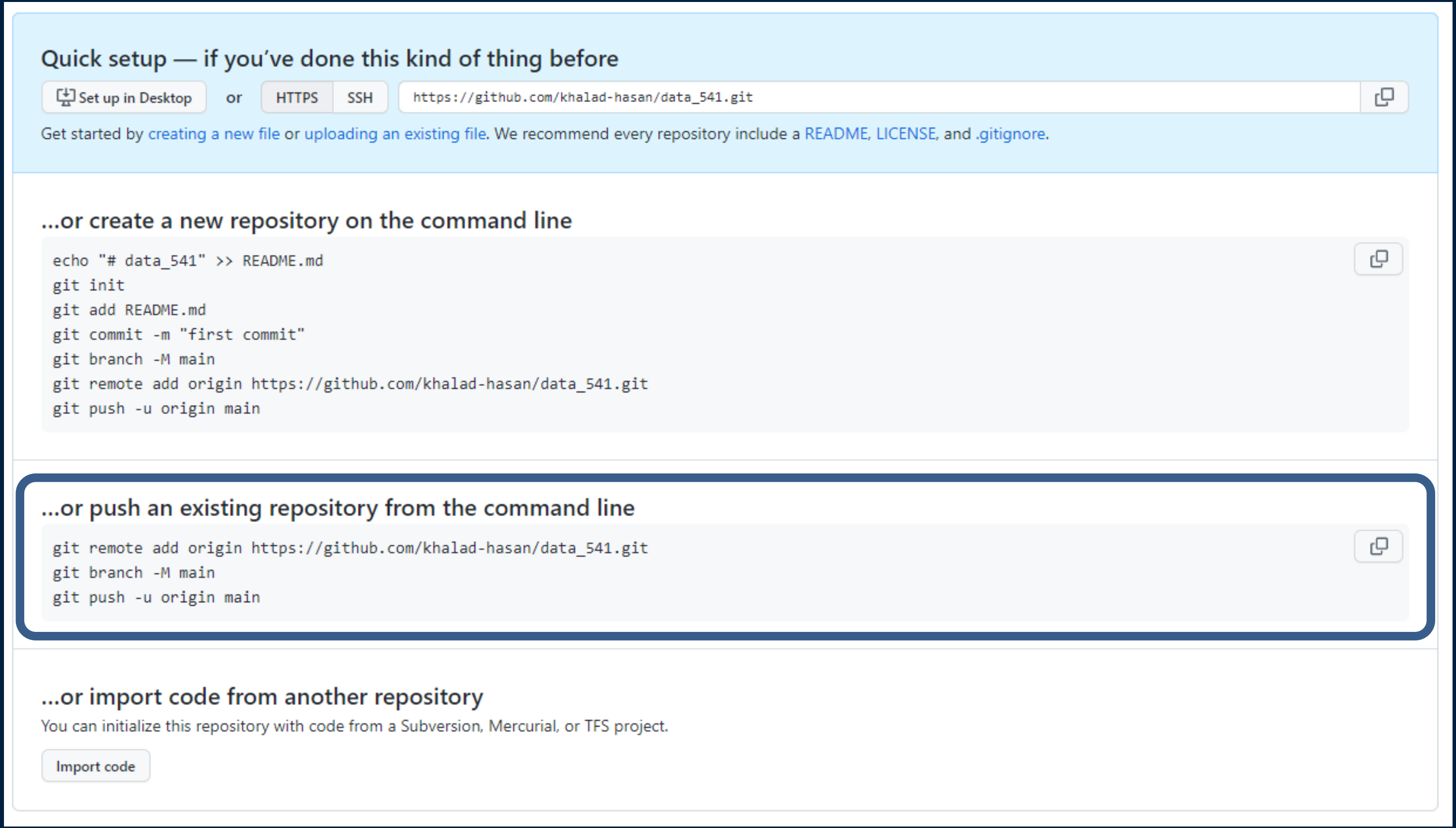
Initializing a new repository:

```
$ git init <project directory>
```

Next steps

- Add files and commit
- Go to GitHub first
- Create a new repository and name it whatever you want to store it in GitHub.

Setting Up a Repository



Quick setup — if you've done this kind of thing before

```
https://github.com/khalad-hasan/data_541.git
```

Get started by creating a new file or uploading an existing file. We recommend every repository include a README, LICENSE, and .gitignore.

...or create a new repository on the command line

```
echo "# data_541" >> README.md
git init
git add README.md
git commit -m "first commit"
git branch -M main
git remote add origin https://github.com/khalad-hasan/data_541.git
git push -u origin main
```

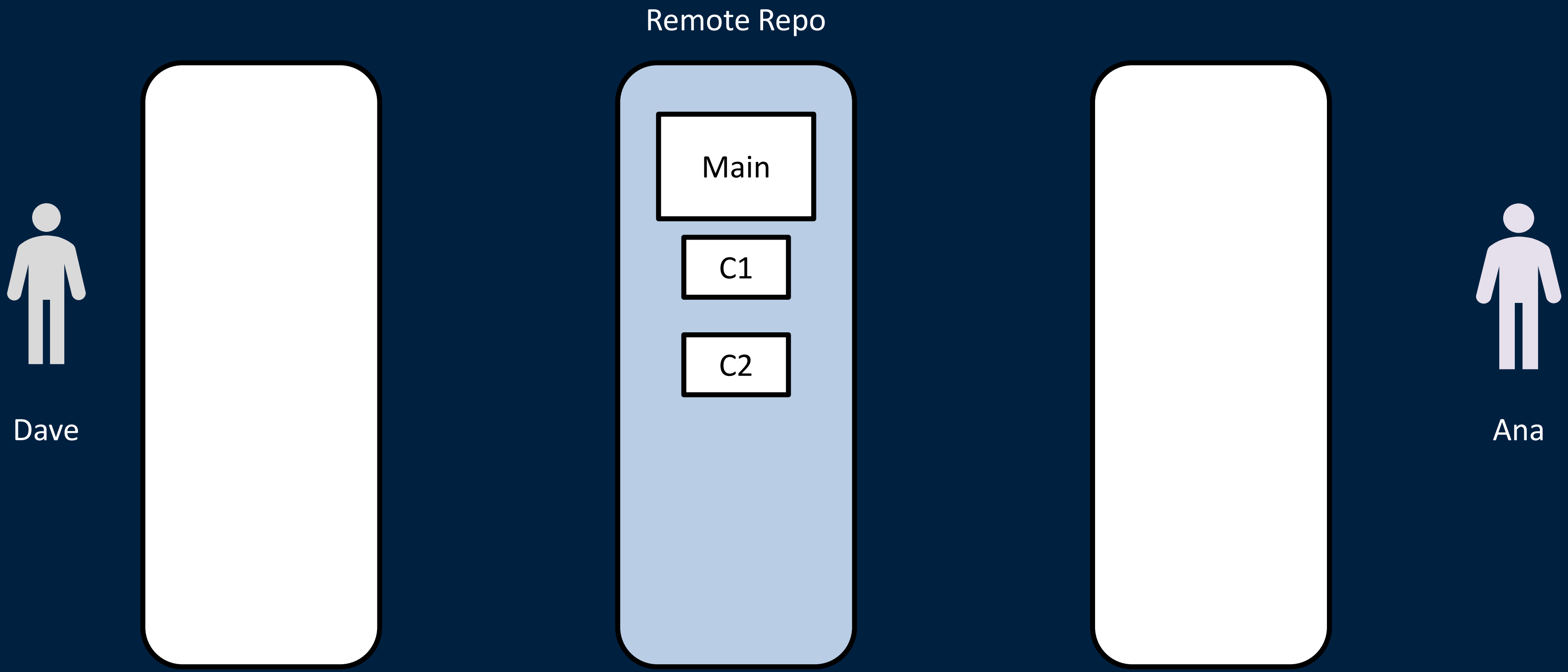
...or push an existing repository from the command line

```
git remote add origin https://github.com/khalad-hasan/data_541.git
git branch -M main
git push -u origin main
```

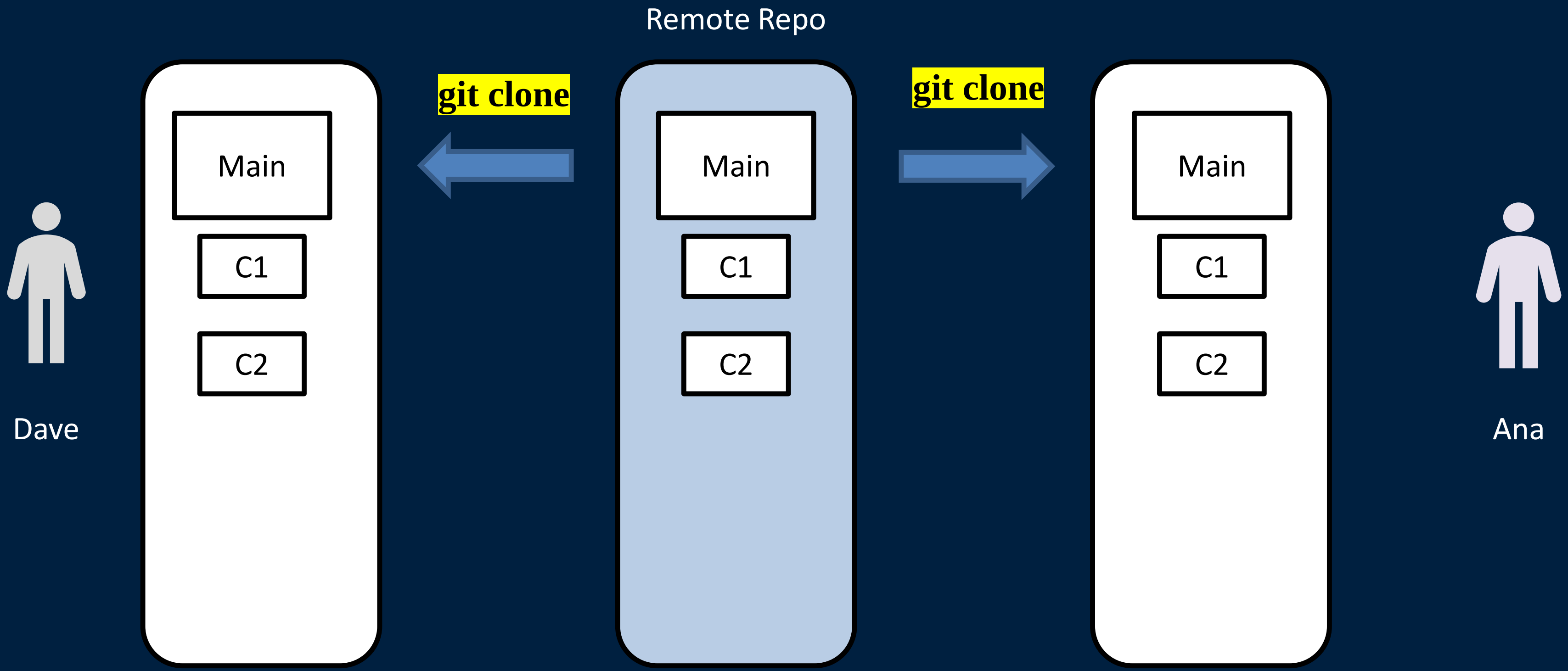
...or import code from another repository

You can initialize this repository with code from a Subversion, Mercurial, or TFS project.

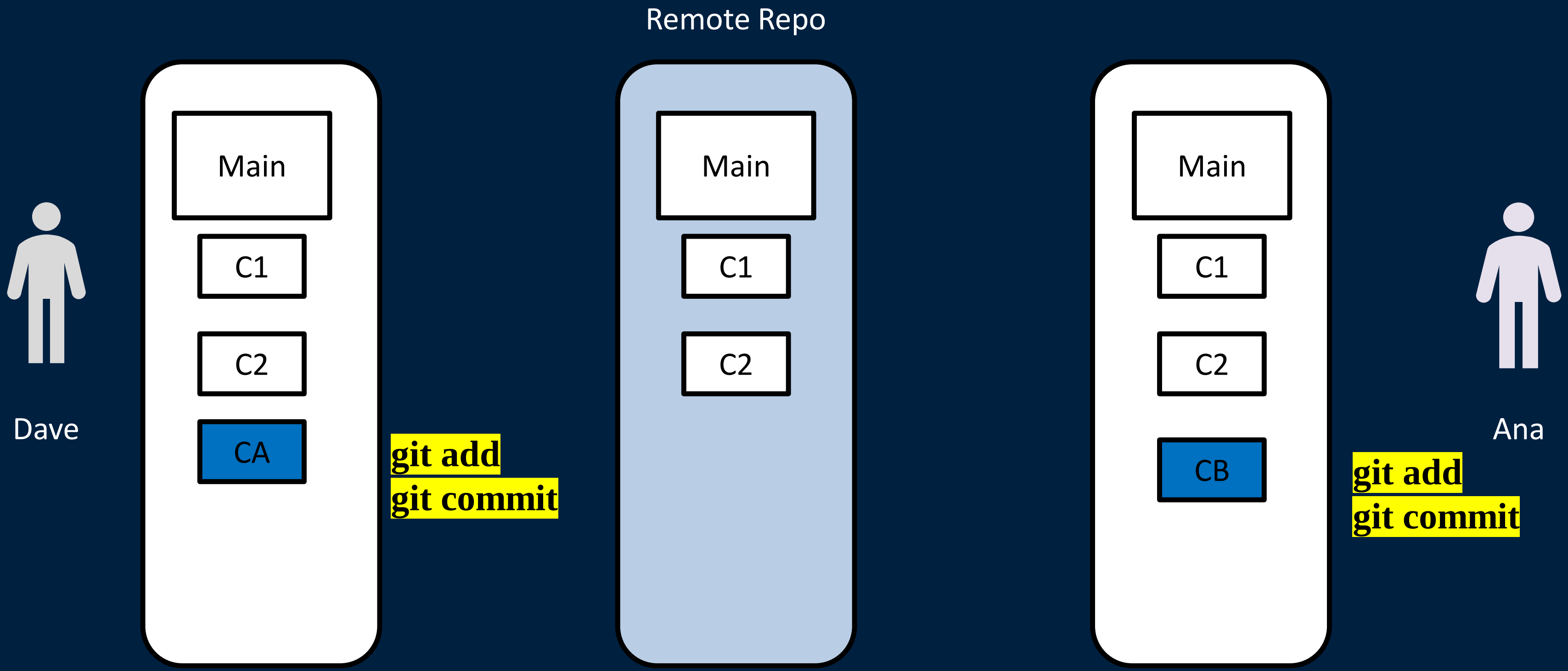
Collaboration with GitHub



Collaboration with GitHub



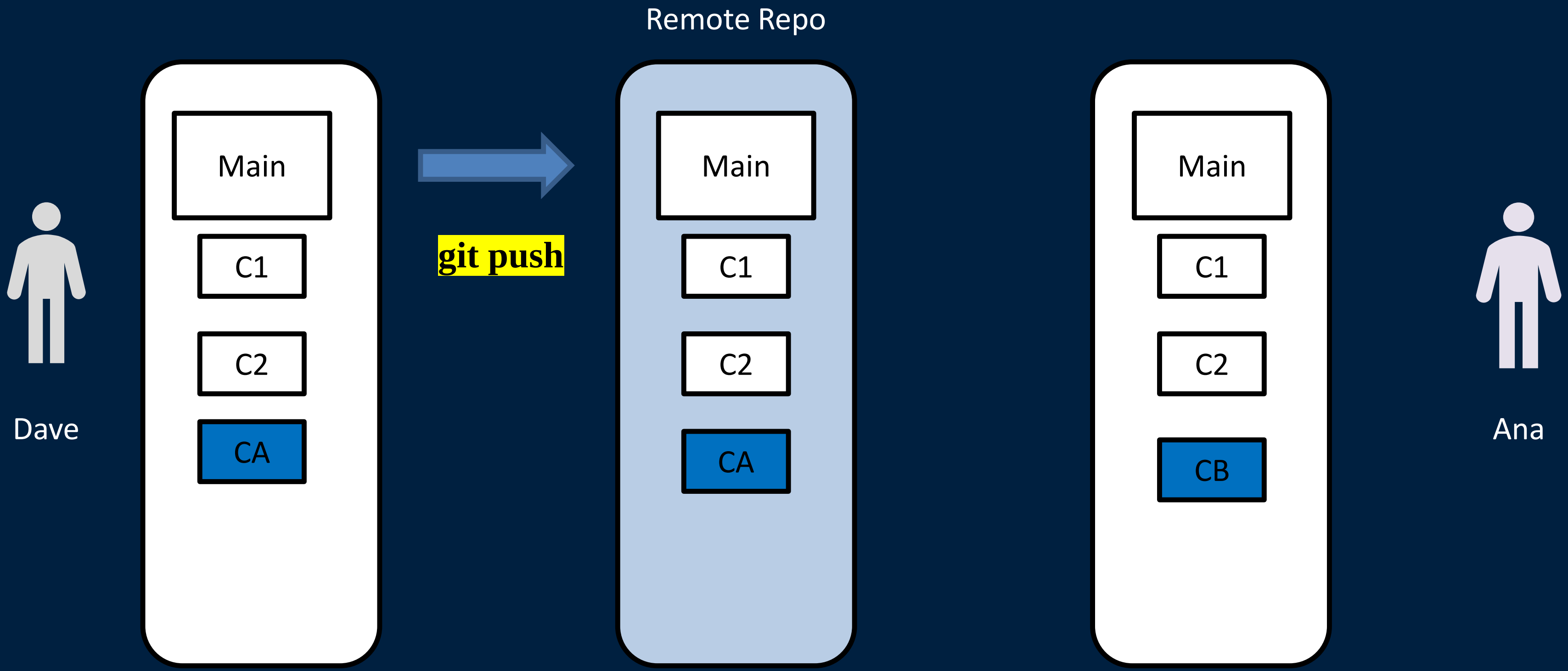
Collaboration with GitHub



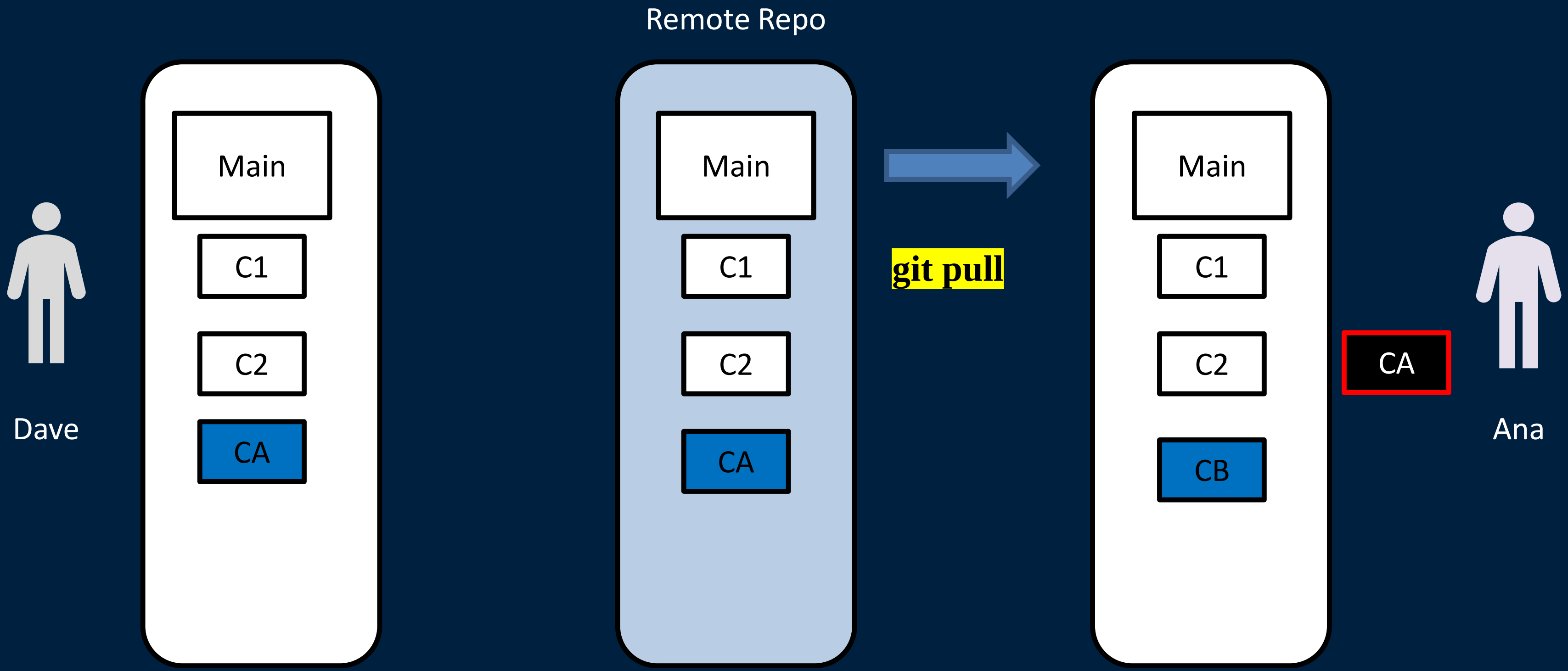
git add
git commit

git add
git commit

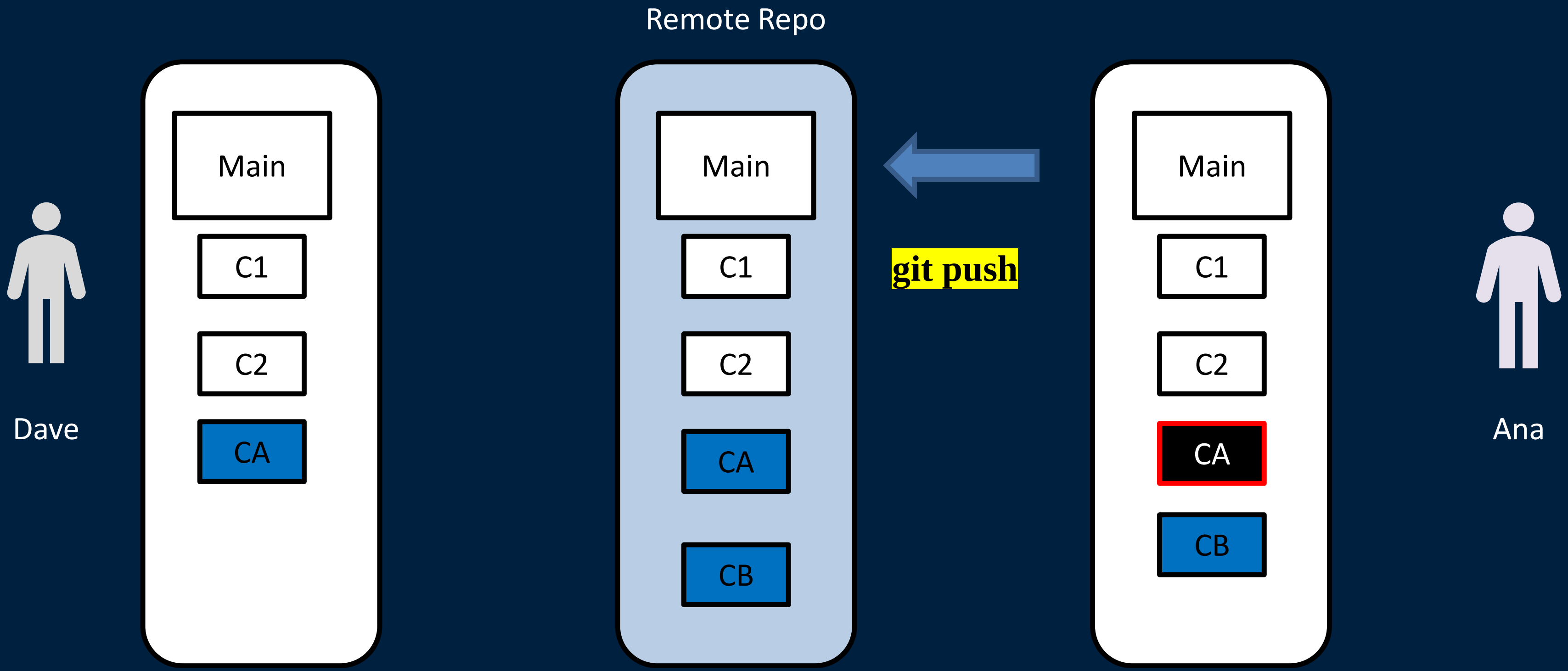
Collaboration with GitHub



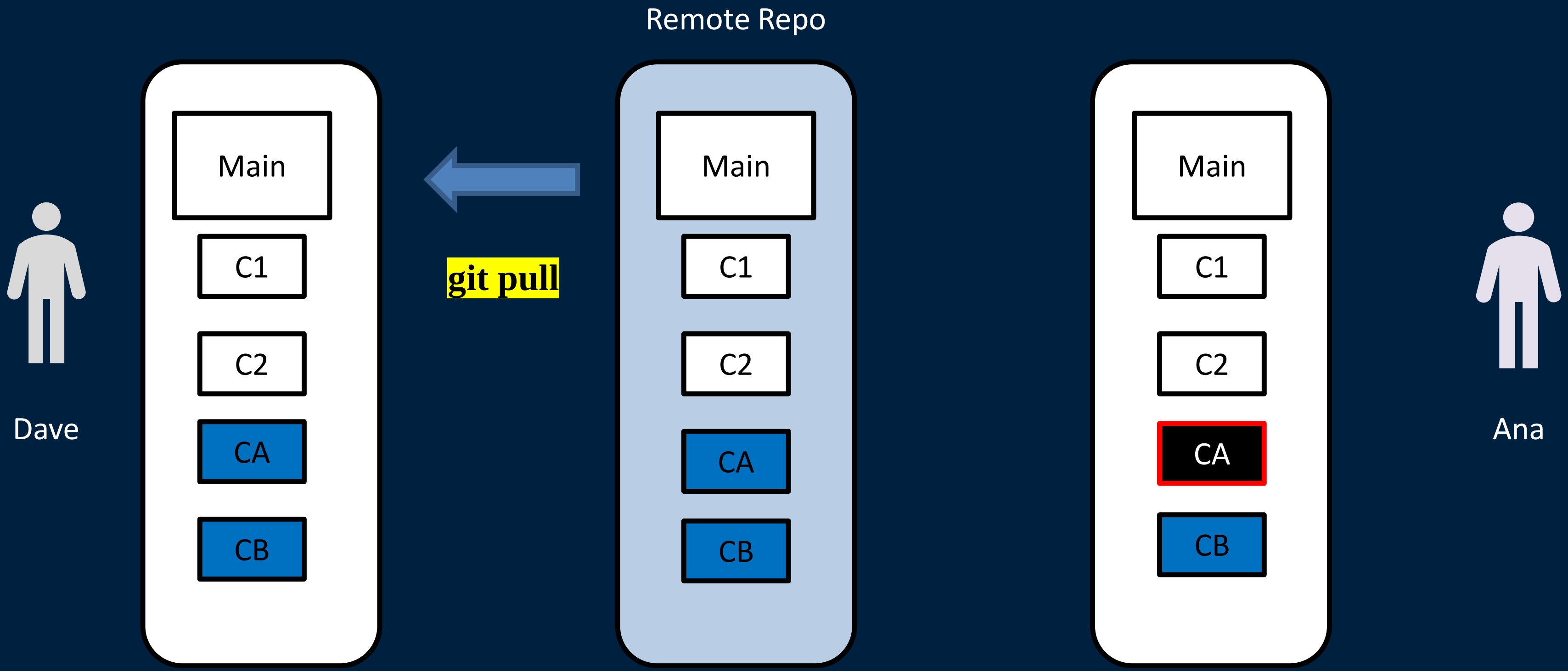
Collaboration with GitHub



Collaboration with GitHub



Collaboration with GitHub



Identifying Conflicts

A conflict message appears to tell you that you need to integrate the remote changes before pushing

To do this you can do a pull request

Pull request shows information on what files the conflict resides in

```
remote: Counting objects: 16, done.
[...]
   6385a287..52d5a  master      -> origin/master
Auto-merging <file>
CONFLICT (content): Merge conflict in <file>
Automatic merge failed; fix conflicts and then commit the
result.
```

Resolving Conflicts

The markup follows a specific pattern.

```
<<<<<<< <pointer>
<local version>
=======
<pulled version>
>>>>>>> <pulled commit id>
```

When the conflict has been resolved, you can make the push to the remote repository

You can also use `mergetool` in command line.

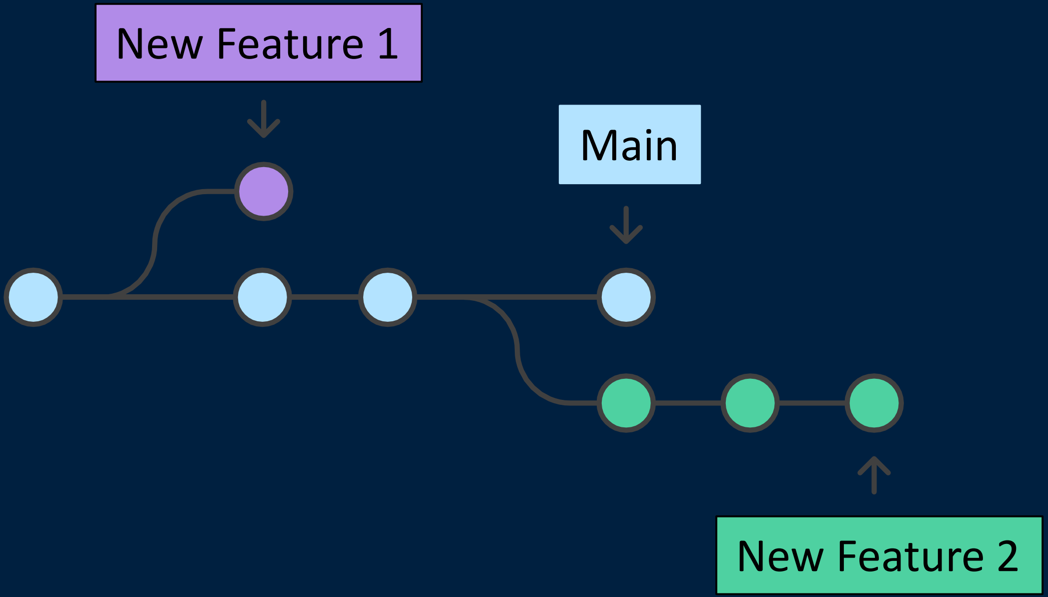
```
git mergetool
```

It will open files that has a conflict and let you choose a solution.

Git Branch

A branch represents an independent line of development

It can be viewed as a way to request a brand new working directory, staging area, and project history

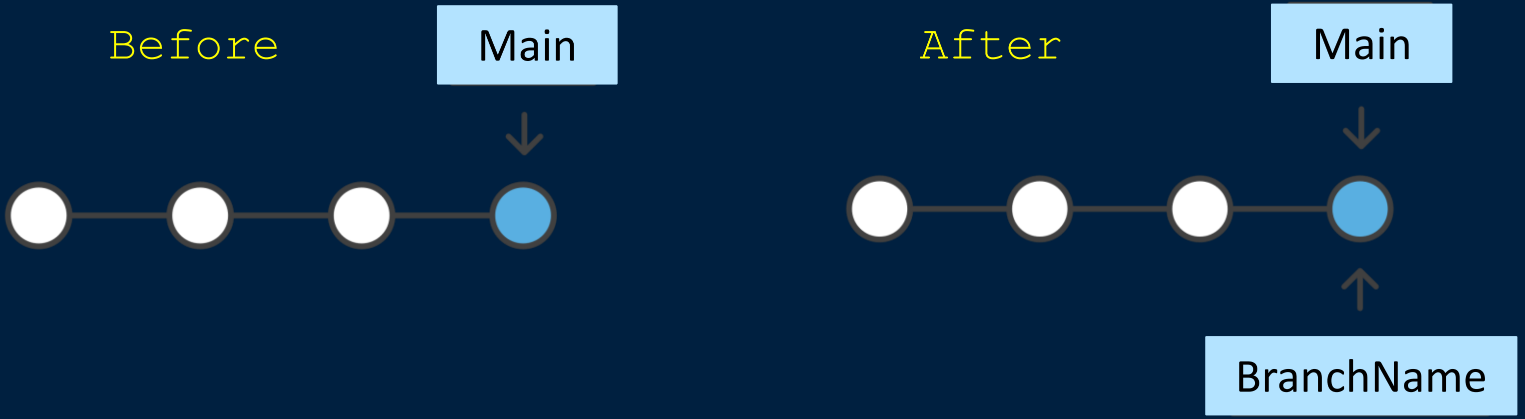


Git Branch

New commits are recorded in the history for the current branch

To show a list of branches: `git branch`

To create a new branch: `git branch BranchName`



Checking Out Branches

The `git checkout` command lets you navigate between the branches created by `git branch`

Checking out a branch updates the files in the working directory

The `git checkout` command accepts a `-b` argument that acts as a convenience method which will create the new branch and immediately switch to it.

```
git checkout -b <new-branch>
```

Checking Out Branches

`git checkout` vs. `git clone`:

- `clone` works to fetch code from a remote repository
- `checkout` works to switch between versions of code already on the local system.

Try it: Branching with GitHub

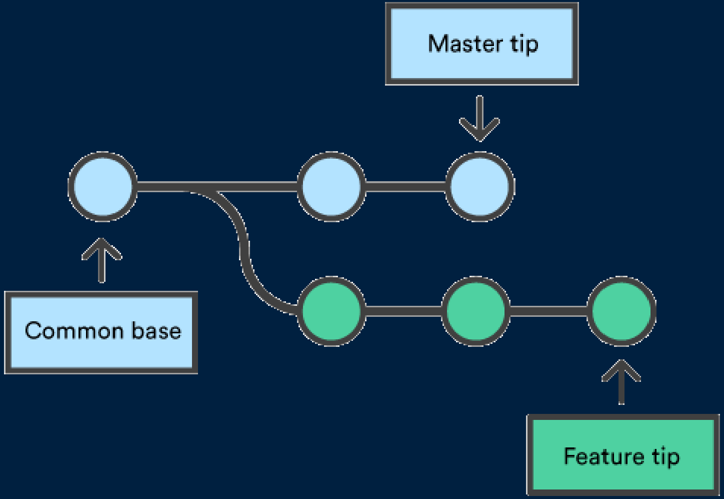
Tasks

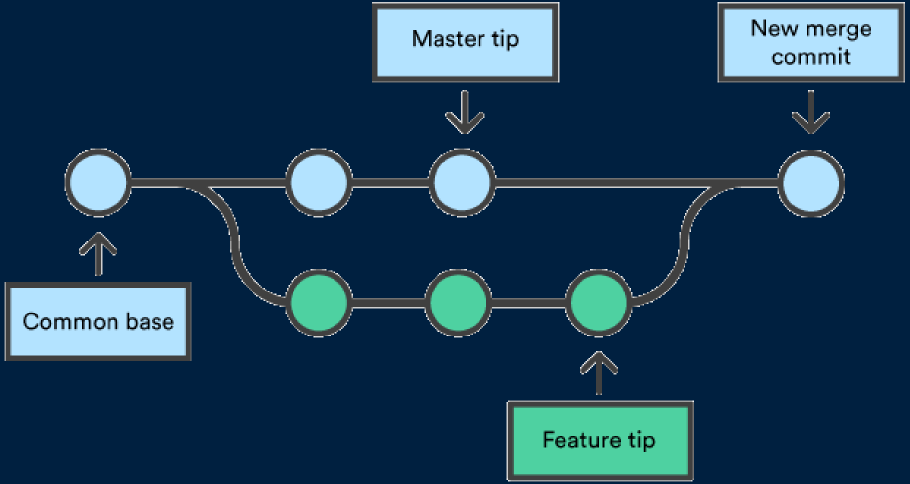
- Create a new repository in your GitHub account
- Clone the repository on your local machine
- Add a text file (e.g., touch master.txt) to the local repository
- Create a new branch and then checkout to the new branch
- Add another text file (e.g., touch branch.txt) to the new branch and commit the changes
- Navigate back to the main branch and merge the new branch back to the main

Git Merge

The `git merge` command lets you take the independent lines of development created by `git branch` and integrate them into a single branch.

Merge a branch into main branch: `git merge BranchName`





Deleting Branches

Once you've finished working on a branch and have merged it into the main code base, you can delete the branch:

```
git branch -d BranchName
```

To force delete a specified branch, even if it has unmerged changes:

```
git branch -D BranchName
```

Push to remote

Push any commits you have made locally on the `main` branch to the remote repository on `origin`

```
git push
git push origin main
```

Push any commits you have made locally on the `BranchName` branch to the remote repository on `origin`

```
git push origin BranchName
```

For branch, first time, you may need to create upstream reference

```
git push --set-upstream origin BranchName
```

Deleting Branches – Remote repos

To delete a remote branch execute the following.

```
git push origin --delete BranchName
```

Viewing an Old Revision

The `git log` command displays committed snapshots.

```
git log -oneline
```

Output:

```
b7119f2 Updated World
872fa7e Created World.txt
a1e8fb5 Updated hello.txt
435b61d Created hello.txt
9773e52 Initialed import
```

Now find the ID of the revision you want to see and issue the following command:

```
git checkout a1e8fb5
```

To continue developing, you need to go back to the current state of your project:

```
git checkout main
```

Git Branch Question

Question: How many of the following statements are **TRUE**?

1) `git branch NewBranch` creates a new branch

2) `git branch NewBranch` does not check out to the `NewBranch`

3) `git branch` is tightly integrated with the `git checkout` and `git merge` commands

4) `git branch -d NewBranch` can be used to force delete the branch called `NewBranch`

A) 0 **B)** 1 **C)** 2 **D)** 3 **E)** 4

Objectives

- Set up a Git repository
- Perform repository-to-repository collaboration
- Resolve Git conflicts
- Create, check out and merge branches
- Git branching models

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