MACHINE LEARNING OPERATIONS

WEEK 1

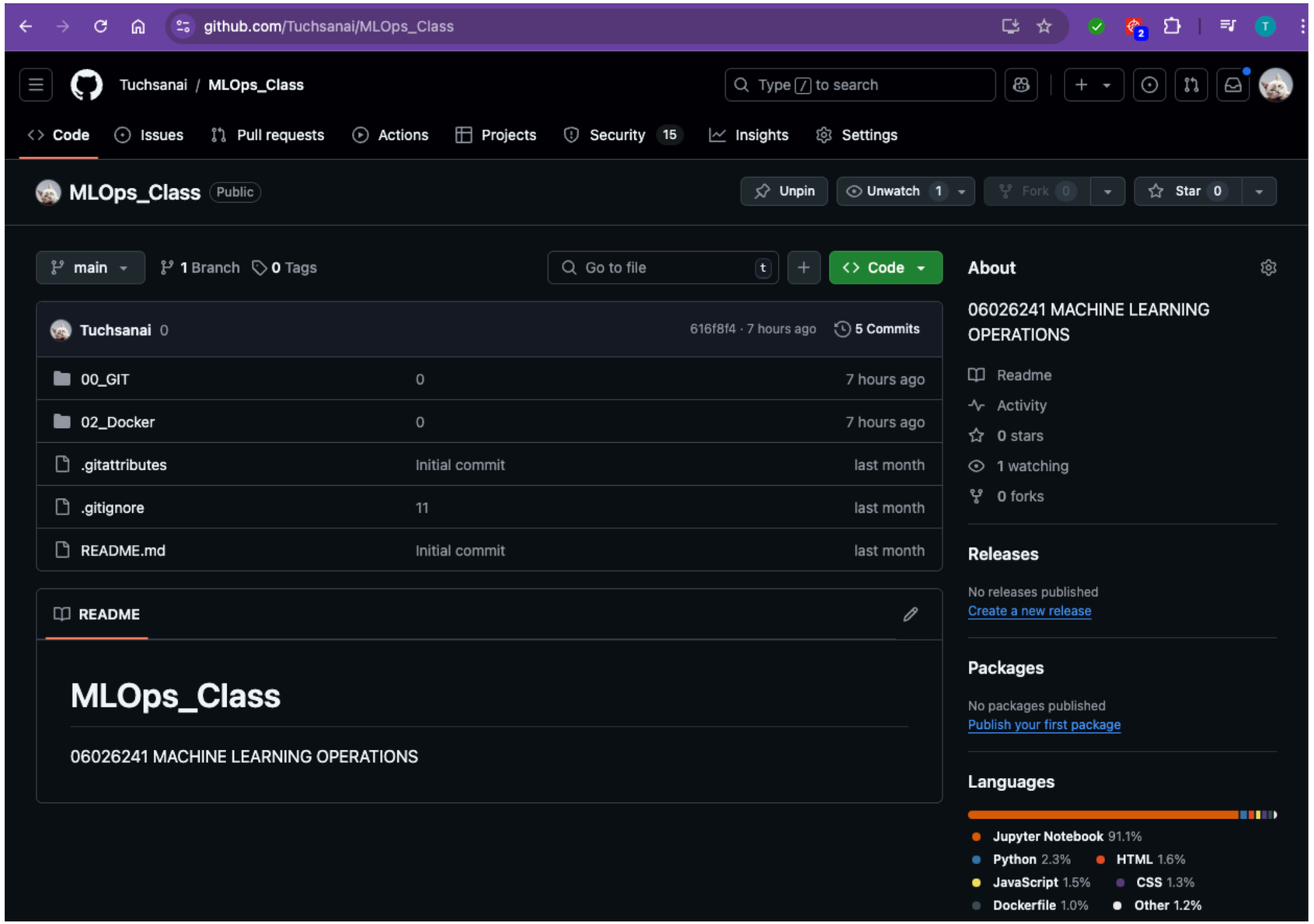
UNLIMITED

Presented by **Asst. Prof. Dr. Tuchsanai Ploysuwan**

MACHINE LEARNING OPERATIONS

Document

Group line


github.com/Tuchsanai/MLOps_Class
Tuchsanai / MLOps_Class
Type / to search
Code
Issues
Pull requests
Actions
Projects
Security 15
Insights
Settings
MLOps_Class
Public
Unpin
Unwatch 1
Fork 0
Star 0
main
1 Branch
0 Tags
Go to file
t
Code
Tuchsanai 0
616f8f4 · 7 hours ago
5 Commits
00_GIT 0 7 hours ago
02_Docker 0 7 hours ago
.gitattributes Initial commit last month
.gitignore 11 last month
README.md Initial commit last month
README
MLOps_Class
06026241 MACHINE LEARNING OPERATIONS
About
06026241 MACHINE LEARNING OPERATIONS
Readme
Activity
0 stars
1 watching
0 forks
Releases
No releases published
Create a new release
Packages
No packages published
Publish your first package
Languages
Jupyter Notebook 91.1%
Python 2.3%
HTML 1.6%
JavaScript 1.5%
CSS 1.3%
Dockerfile 1.0%
Other 1.2%

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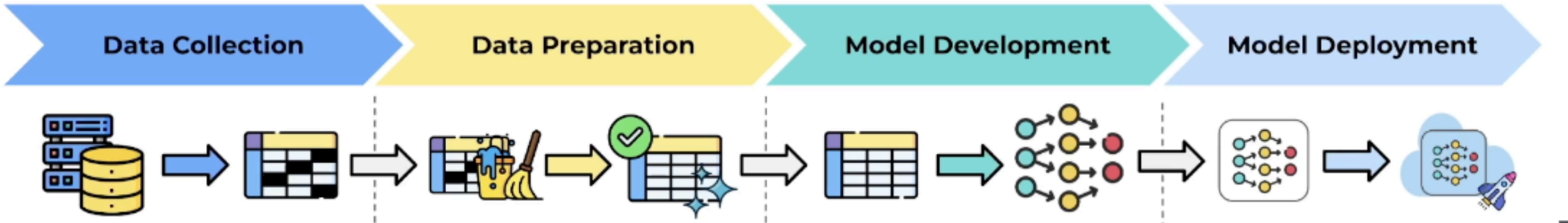
Midterm	35
Final	30
Homework and Exercise LAB	15
Mini project	20

ML Product Lifecycle

Machine Learning Product Lifecycle

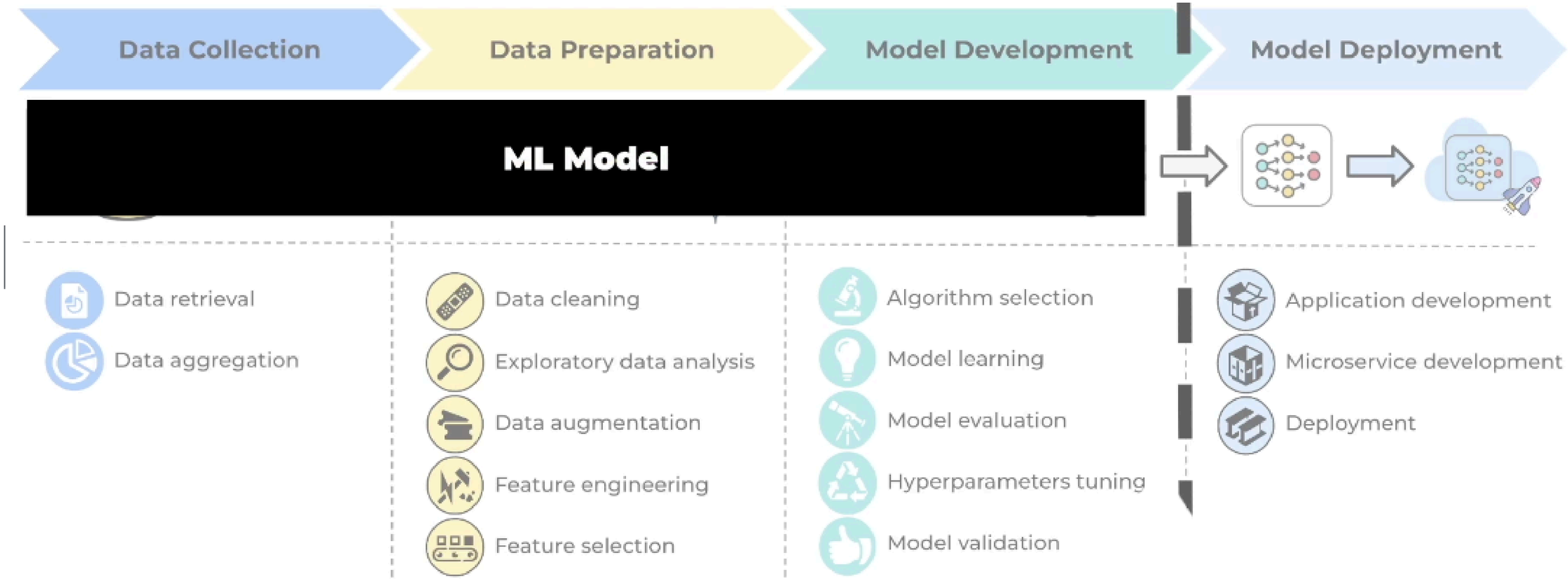


- Data retrieval
- Data aggregation

- Data cleaning
- Exploratory data analysis
- Data augmentation
- Feature engineering
- Feature selection

- Algorithm selection
- Model learning
- Model evaluation
- Hyperparameters tuning
- Model validation

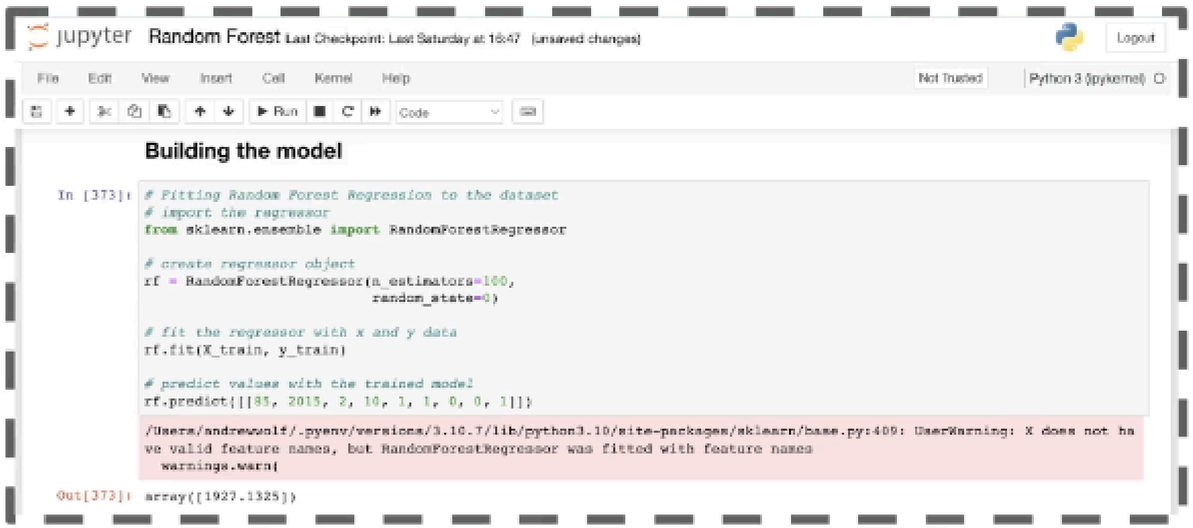
- Model-to-app packaging
- App-to-micro transformation
- Microservice deployment

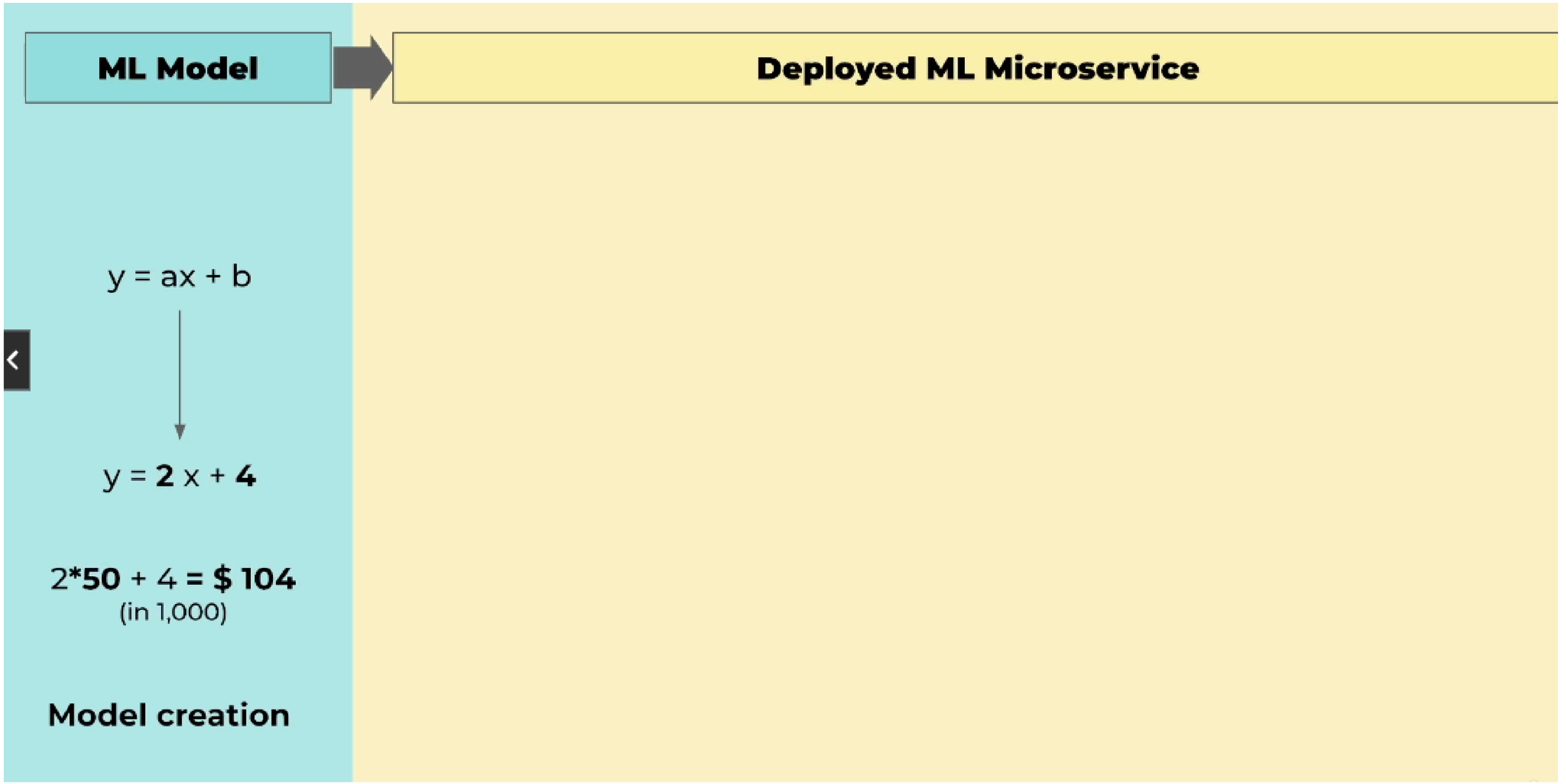

Data Collection
Data Preparation
Model Development
Model Deployment
ML Model
Data retrieval
Data aggregation
Data cleaning
Exploratory data analysis
Data augmentation
Feature engineering
Feature selection
Algorithm selection
Model learning
Model evaluation
Hyperparameters tuning
Model validation
Application development
Microservice development
Deployment

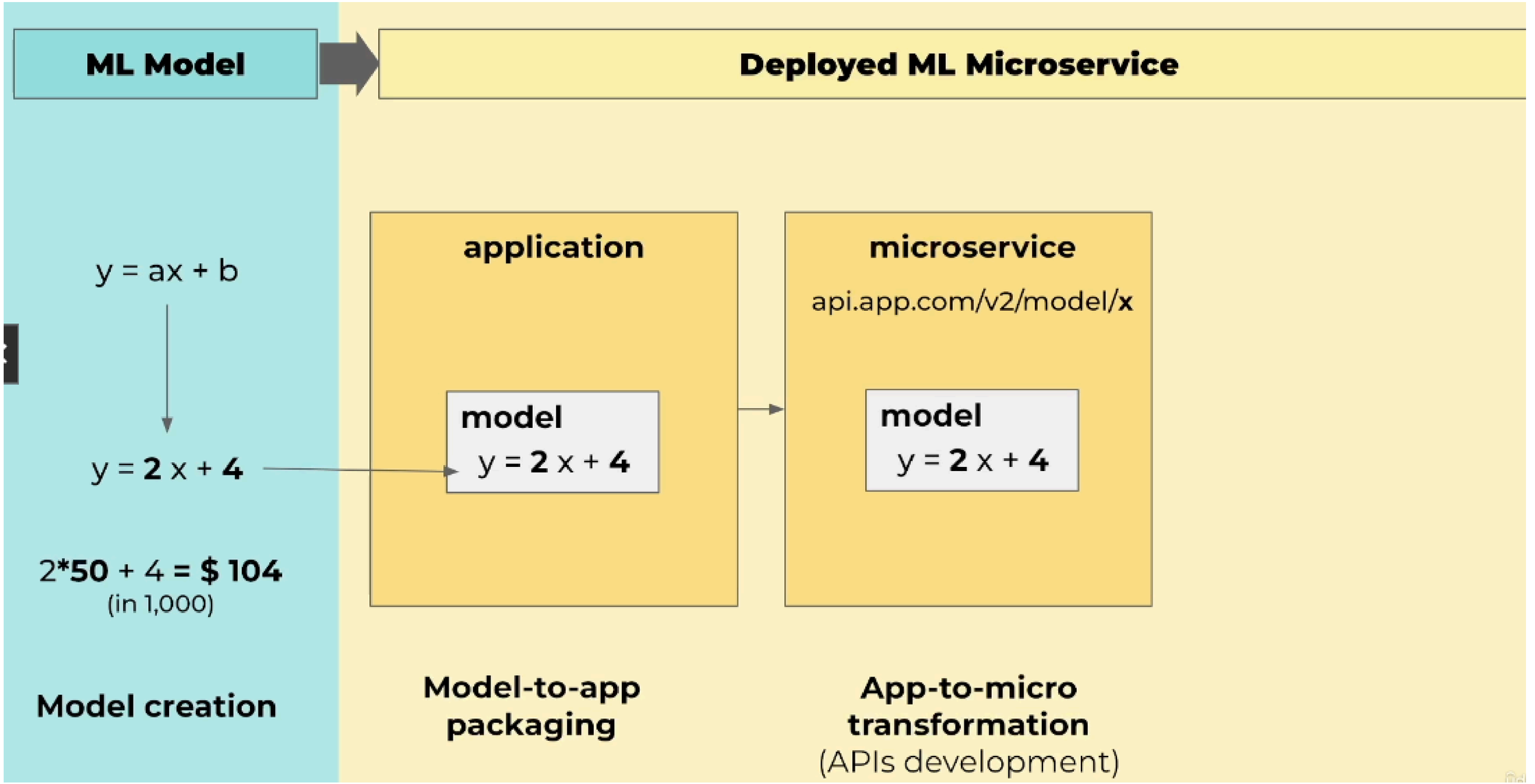
Data Collection → Data Preparation → Model Development → Model Deployment

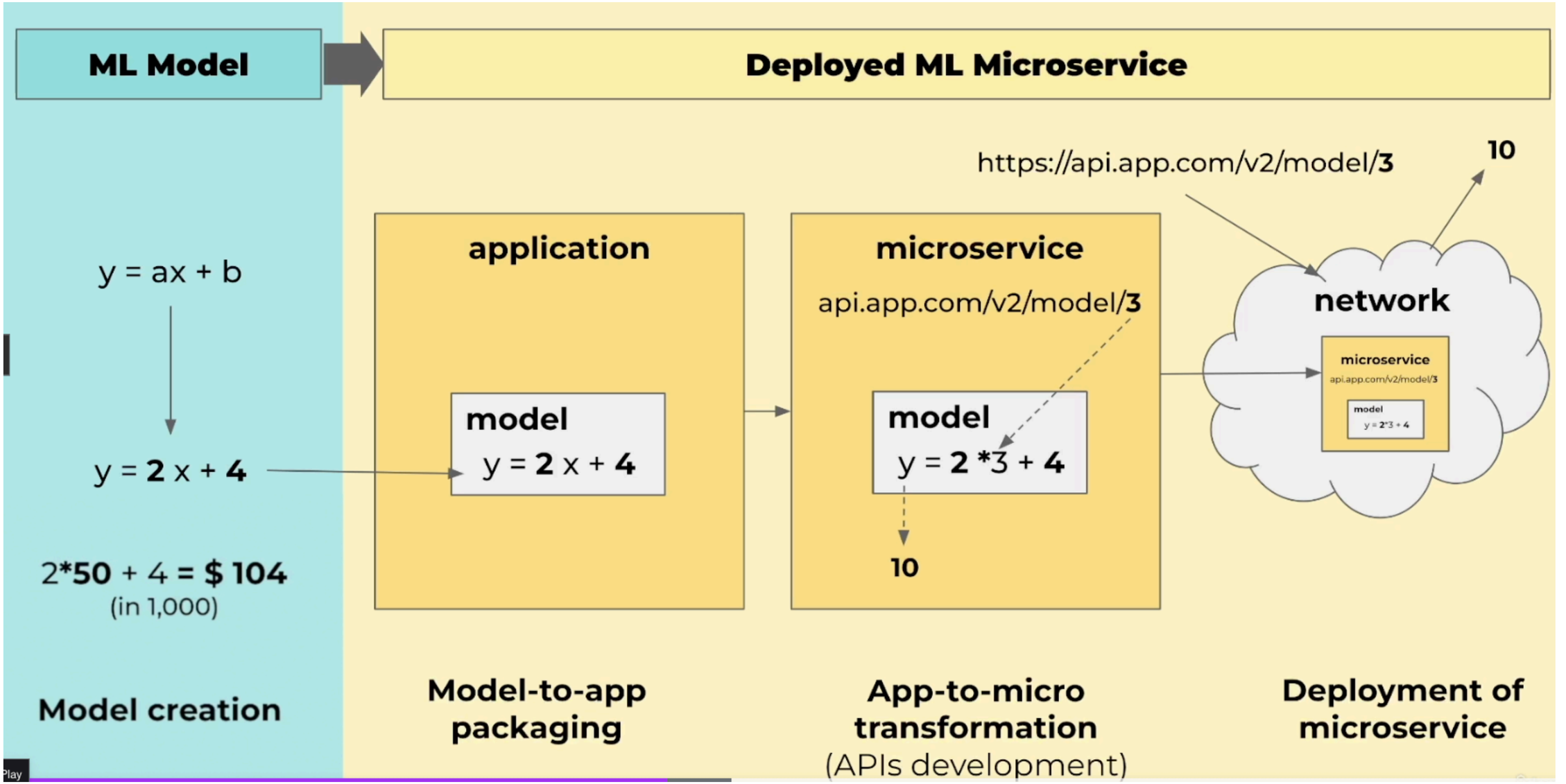
ML Model

Deployed Microservice




ML Model
Deployed ML Microservice
y = ax + b
y = 2 x + 4
2*50 + 4 = $ 104
(in 1,000)
Model creation

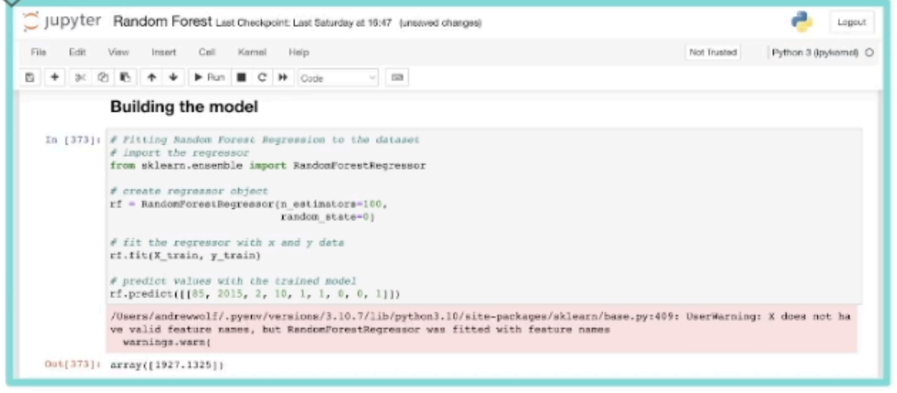

ML Model
Deployed ML Microservice
y = ax + b
y = 2 x + 4
2*50 + 4 = $ 104
(in 1,000)
Model creation
application
model
y = 2 x + 4
Model-to-app packaging
microservice
api.app.com/v2/model/x
model
y = 2 x + 4
App-to-micro transformation
(APIs development)


ML Model
Deployed ML Microservice
https://api.app.com/v2/model/3
10
y = ax + b
y = 2 x + 4
2*50 + 4 = $ 104
(in 1,000)
application
model
y = 2 x + 4
microservice
api.app.com/v2/model/3
model
y = 2 *3 + 4
10
network
microservice
api.app.com/v2/model/3
model
y = 2*3 + 4
Model creation
Model-to-app packaging
App-to-micro transformation
(APIs development)
Deployment of microservice

ML Model

Deployed ML Microservice

1 Model creation in Jupyter Notebook



2 Model-to-app packaging

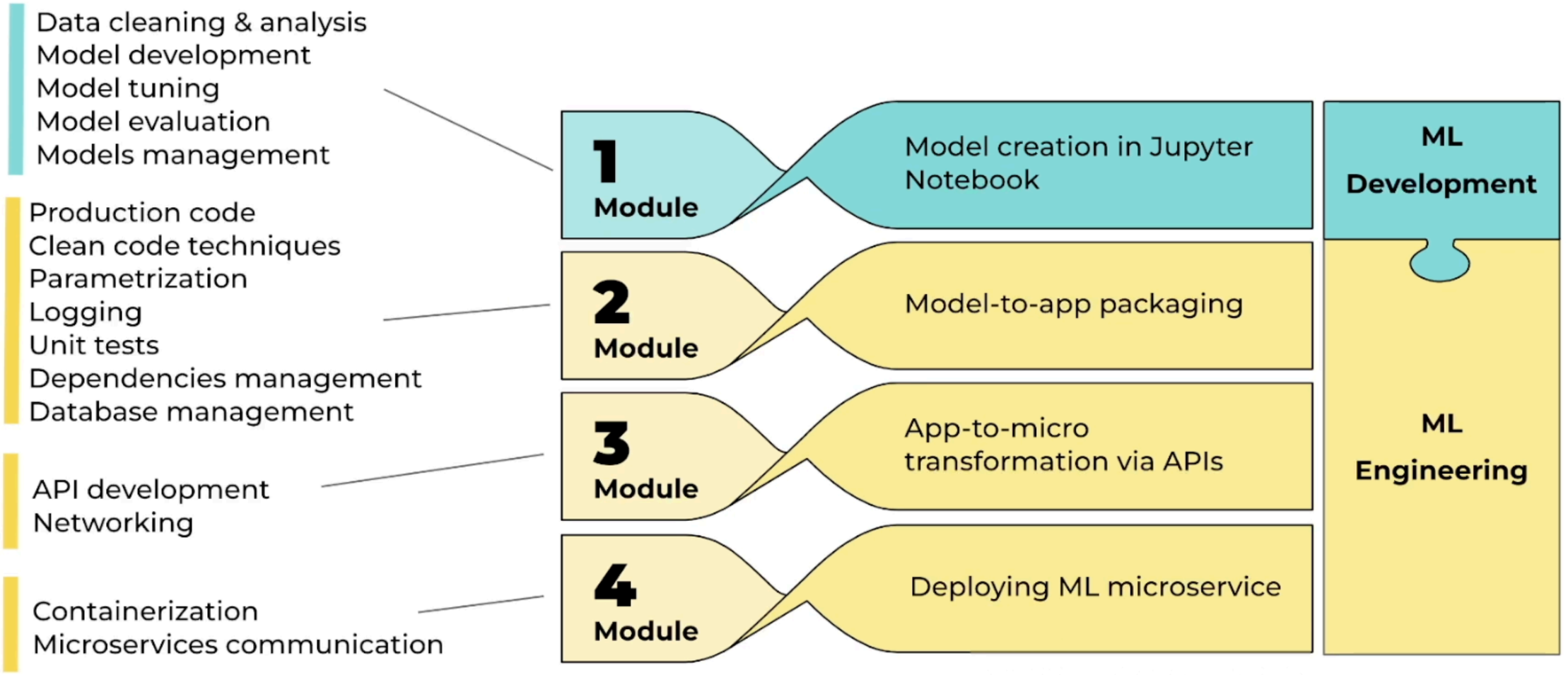
```
application
  api
    fastapi.py
    main.py
  conf
    conf.py
    setting.toml
  db
    client.py
  model
    models
      kneighbors_heart.pkl
      xgboost_heart.pkl
    util
      util.py
    predict.py
```

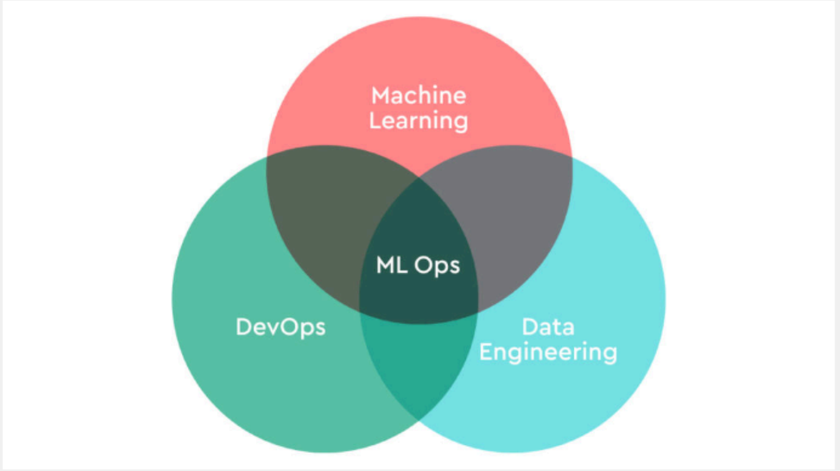
3 App-to-micro transformation via APIs

```
api.app.com/v2/model/84,23,53,43/prediction
```

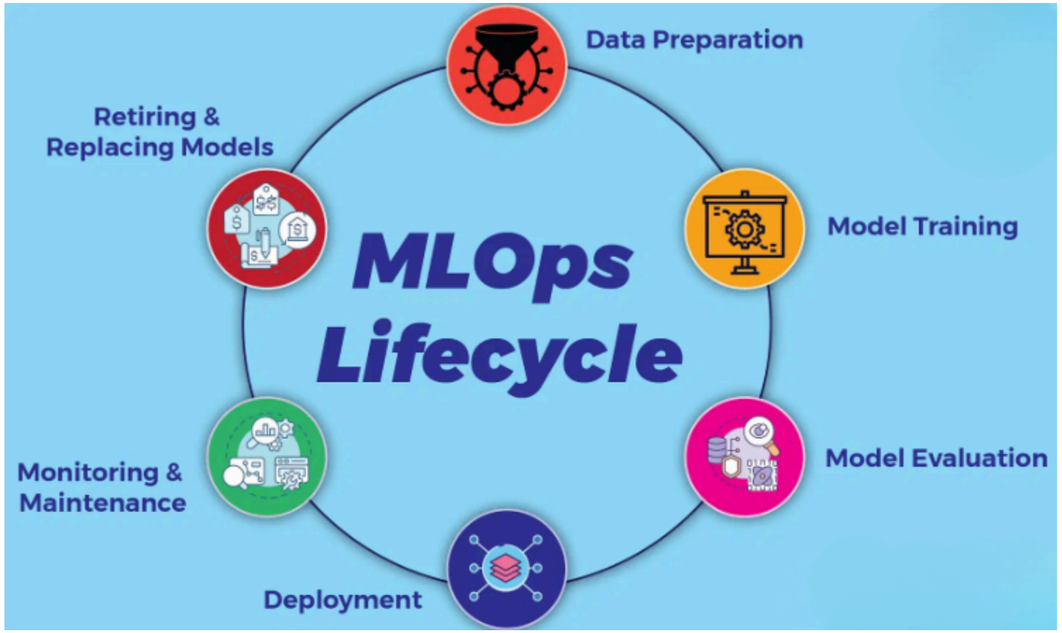
4 Deploying ML microservice

```
version: '3.10'
services:
    app:
        build: app/.
        restart: always
        environment:
        - DOCKER_HOME=/home
        - LOAD_EX=n
        - EXECUTOR=Local
        ports:
        - "5050:5050"
        volumes:
        - ./app:/home
        networks:
        - main_net
```


Data cleaning & analysis
Model development
Model tuning
Model evaluation
Models management
Production code
Clean code techniques
Parametrization
Logging
Unit tests
Dependencies management
Database management
API development
Networking
Containerization
Microservices communication
1 Module
Model creation in Jupyter Notebook
2 Module
Model-to-app packaging
3 Module
App-to-micro transformation via APIs
4 Module
Deploying ML microservice
ML Development
ML Engineering

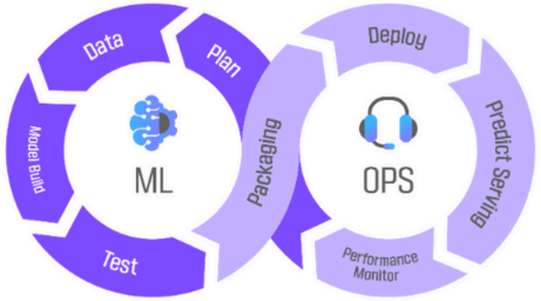


MLOps is to machine learning and data engineering what DevOps is to traditional software development.



What is an MLOps platform?

The MLOps platform provides a collaborative environment for software engineers and data scientists. It enables real-time collaboration and iterative data exploration to facilitate experiment tracking, model management, feature engineering, and more.

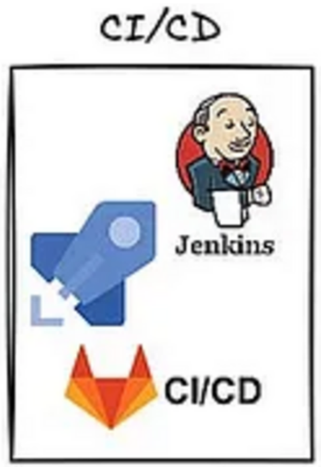


Popular tools for MLOps Process

Version Control

GitHub

MLOPS



LLMOps specifics

Week	Topic	Description
1	Introduction to Git	Learn the basics of Git, including setup, repositories, and basic commands.
2	Branching and Collaboration	Understand branching, merge conflicts, and pull requests for collaborative workflows.
3	Advanced Git	Explore advanced Git features like stashing, rebasing, undoing changes, and managing `.gitignore`.
4	Git Workflows in MLOps	Implement Git workflows such as feature branching and release management.
5	Introduction to Docker	Learn Docker basics, including containerization and writing Dockerfiles.
6	Docker Compose and Networking	Build multi-container applications and understand Docker networking concepts.
7	Docker in MLOps	Containerize machine learning workflows for training and inference.
8	Docker Orchestration	Manage and orchestrate containerized ML workflows effectively.
9	Introduction to MLflow	Learn the components of MLflow and log metrics and parameters in experiments.
10	MLflow Tracking	Track experiments, log custom metrics, and compare ML models.
11	MLflow Models	Package and deploy ML models using MLflow.
12	MLflow Model Registry	Manage the model lifecycle and use MLflow Registry for production workflows.
13	CI/CD in MLOps	Automate ML workflows with Git and integrate MLflow.
14	Monitoring and Scaling	Monitor deployed models, detect data drift, and ensure scalable deployments.
15	MLOps Frameworks	Explore advanced MLOps tools and integrate them with MLflow.
16	Mini Project	Apply learned concepts to create a small MLOps project involving Git, Docker, and MLflow.

- Git was developed in 2005 by **Linus Torvalds**
- Git is **Version control system** is a system that records changes to a file or set file over time so that you. can restore specific version later
- Git is a **Distributed Version Control System**

Git – What and Why

Oh boy, I sure do love playing my video games!

I'm going to save my game now in case I die soon!

Oh jeez, this is going to be a difficult fight!

ughhhhh I died!

Thank heavens I saved my game! I can just revert!

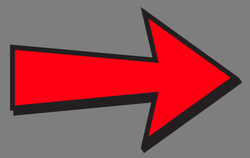
Before Version Control System

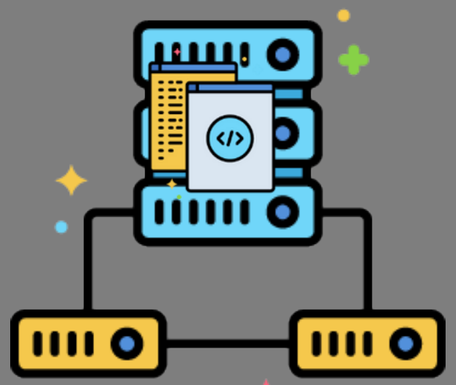
Before Version Control System

Version 1.0

Before Version Control System

Version 1.0





running code version 1.0

Before Version Control System

Version 1.0

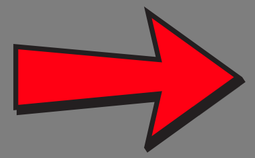
Version 2.0

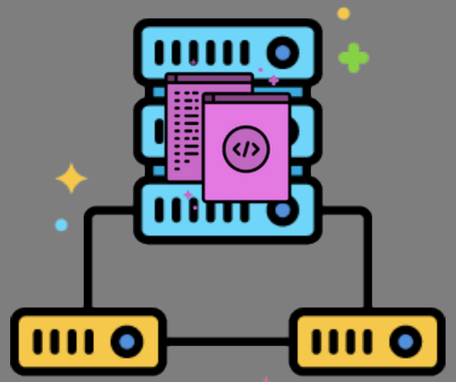
running code version 1.0

Before Version Control System

Version 1.0

Version 2.0





running code version 2.0

Before Version Control System

Version 1.0

Version 2.0

running code version 2.0

Before Version Control System

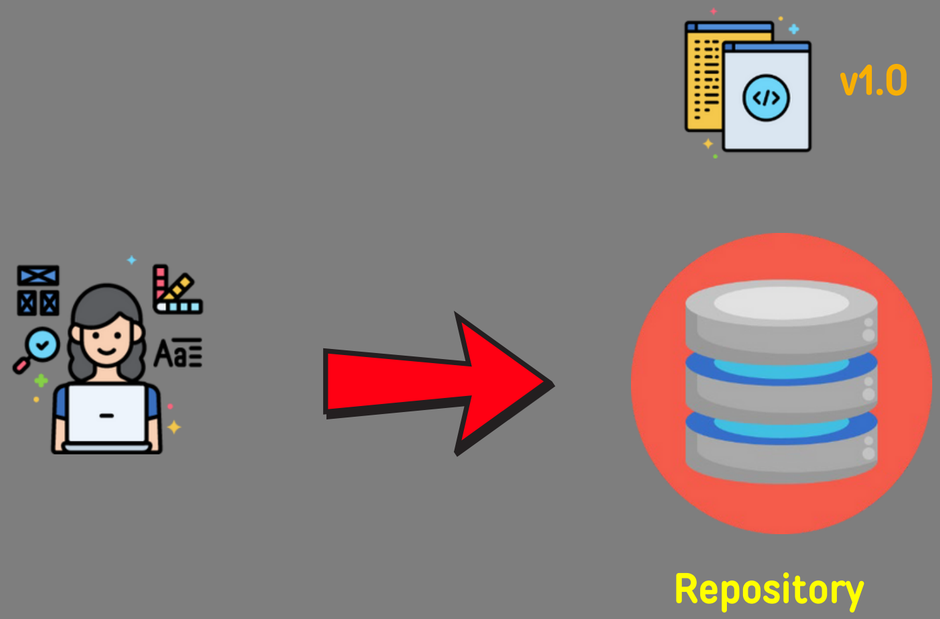
Version 1.0

Version 2.0

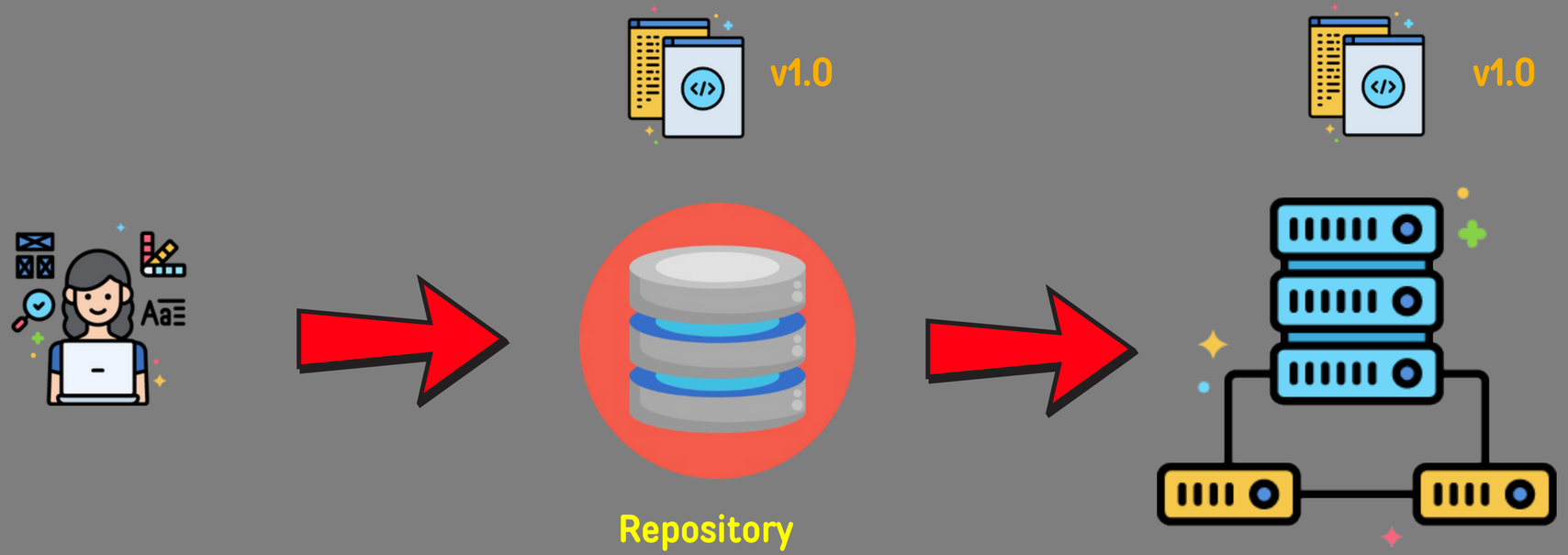
running code version 2.0

- Rollback is time consuming
- No audit tracking
- Not scalable for large teams

Version Control System



Version Control System



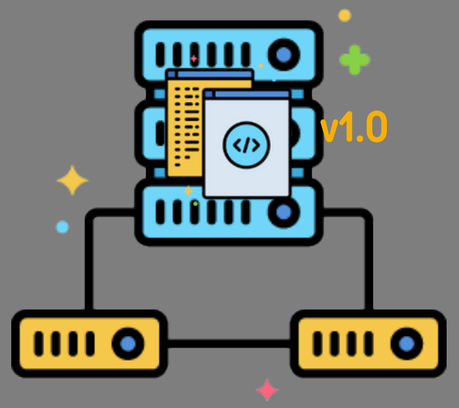
Version Control System

Version Control System

v1.0

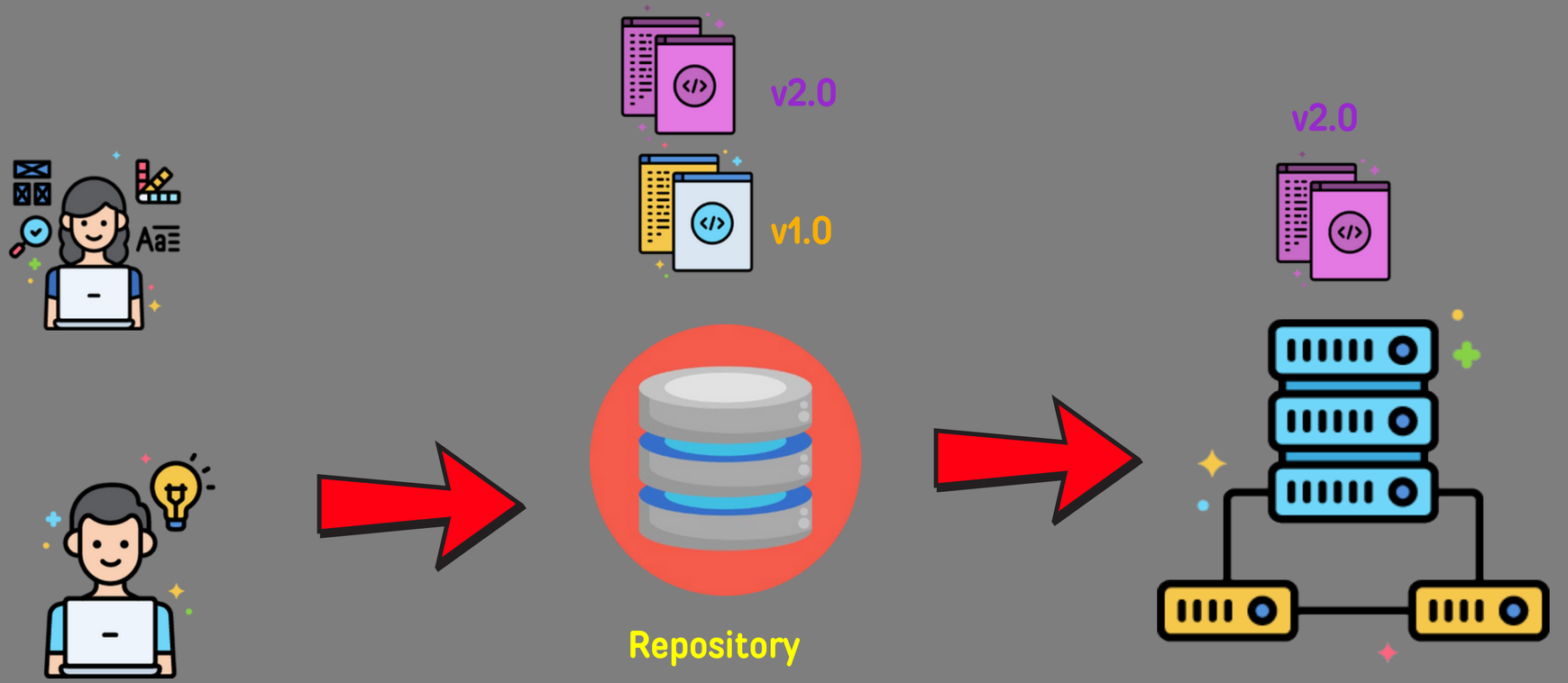
v2.0

Repository



v1.0

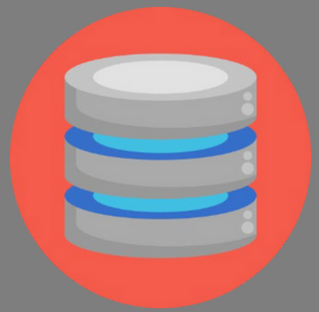
Version Control System



Version Control System

Repository

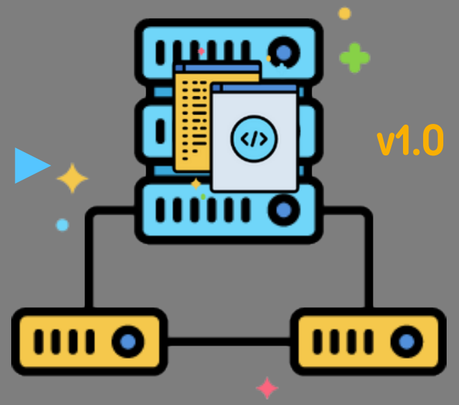
Version Control System



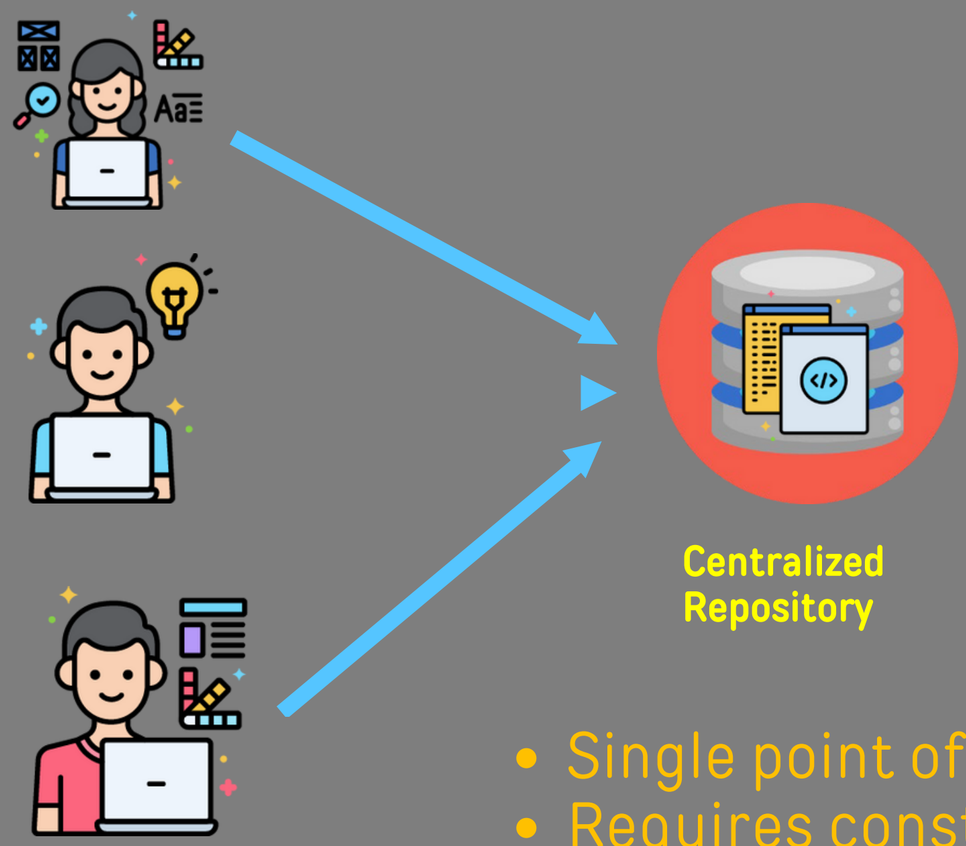
Repository

Why Git?

- Distributed



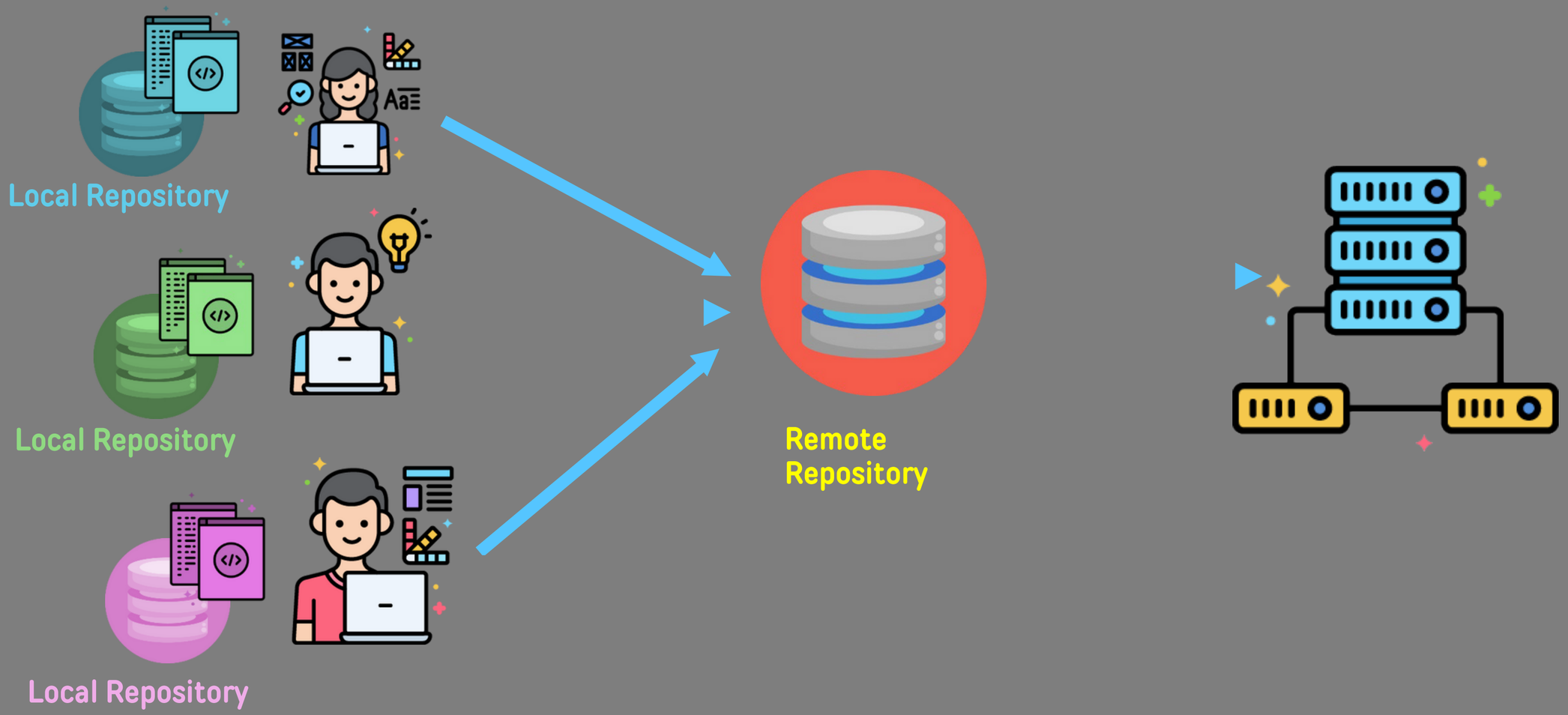
Centralized Version Control System



Centralized Repository

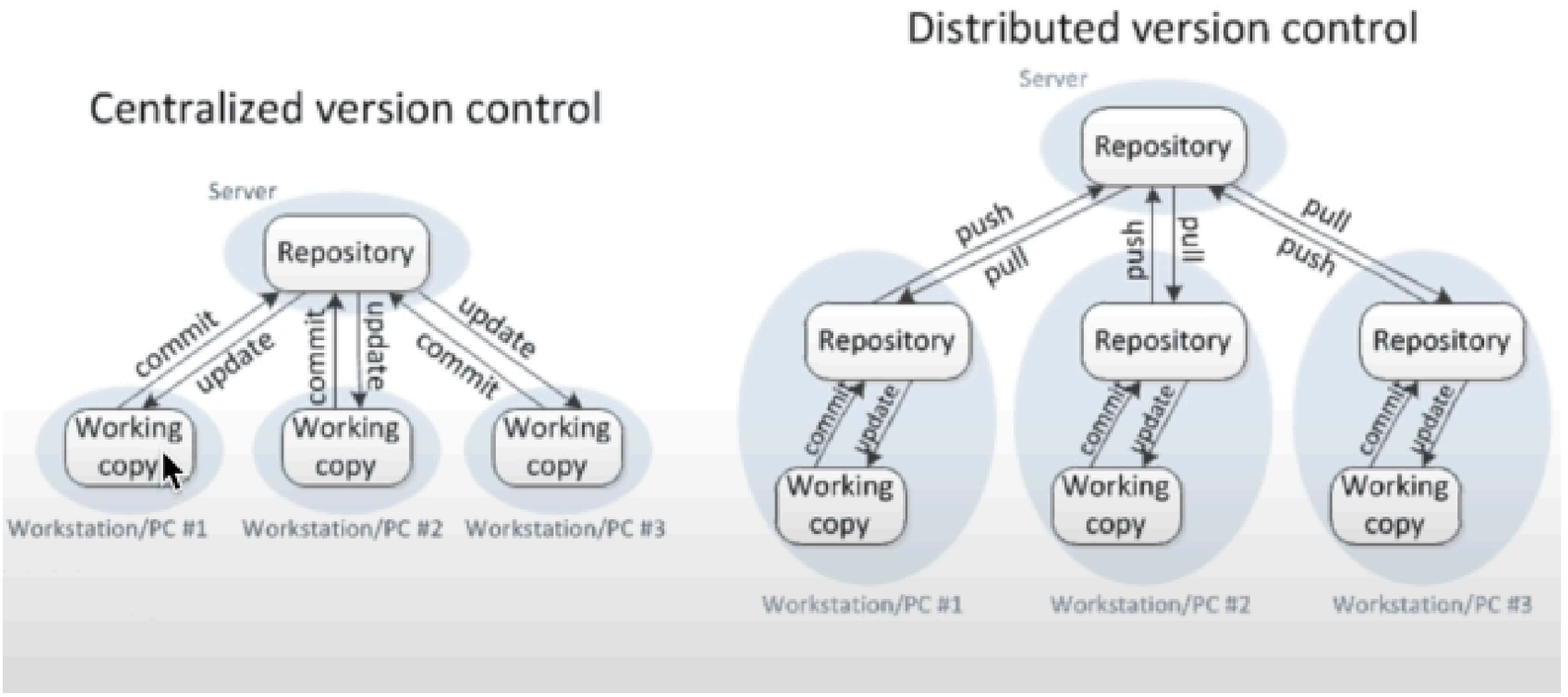
- Single point of failure
- Requires constant connectivity
- E.G – Subversion, Endevor

Distributed Version Control System

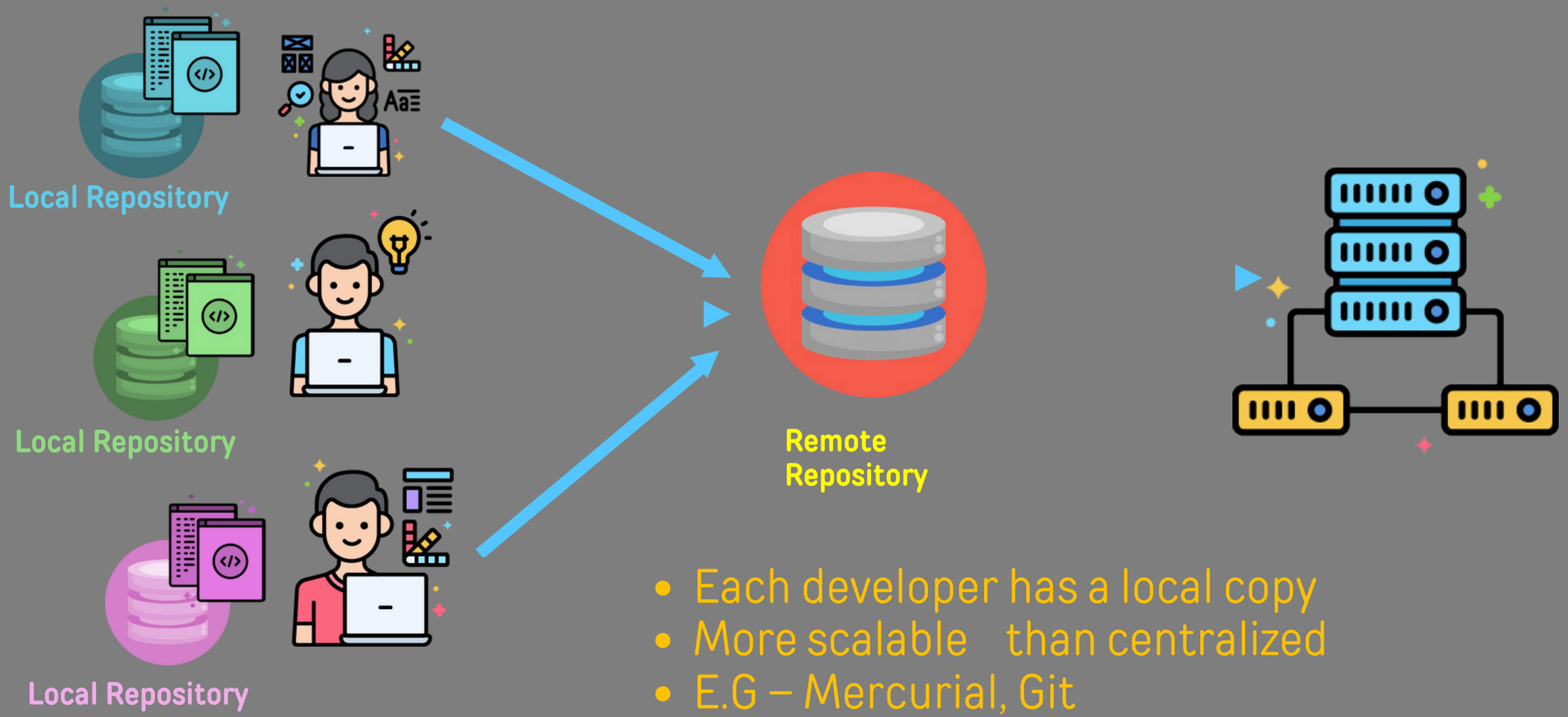


Centralized vs Distributed

Version Control

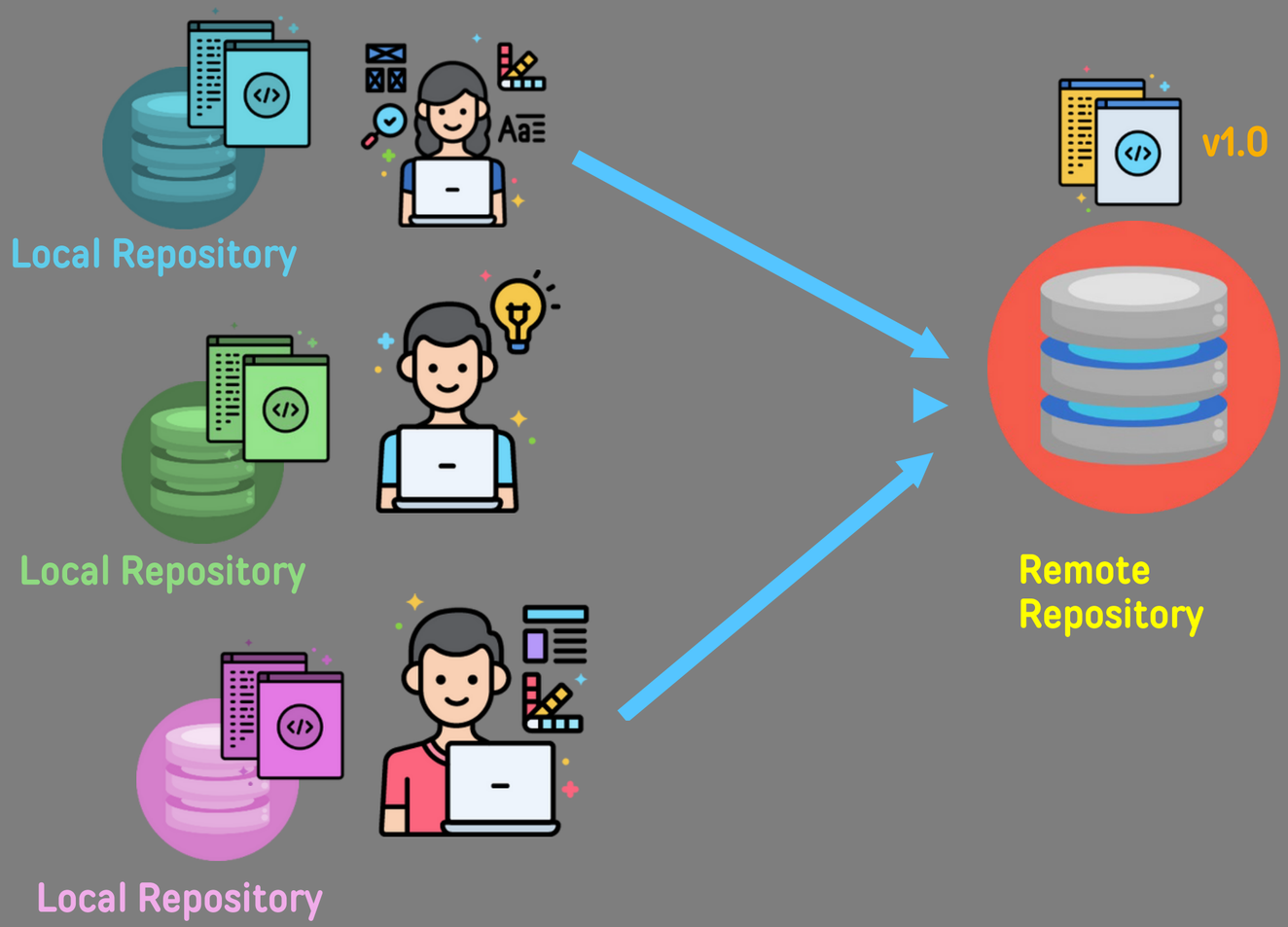


Distributed Version Control System



- Each developer has a local copy
- More scalable than centralized
- E.G – Mercurial, Git

Distributed Version Control System



Version Control System

Why Git?

- Distributed
- Performant
- Detailed audit tracking
- Open source
  - Free!
  - Implemented with Kubernetes GitOps, integration with Jenkins and other DevOps tools
  - GitHub, GitLab, Code Commit are all based on Git

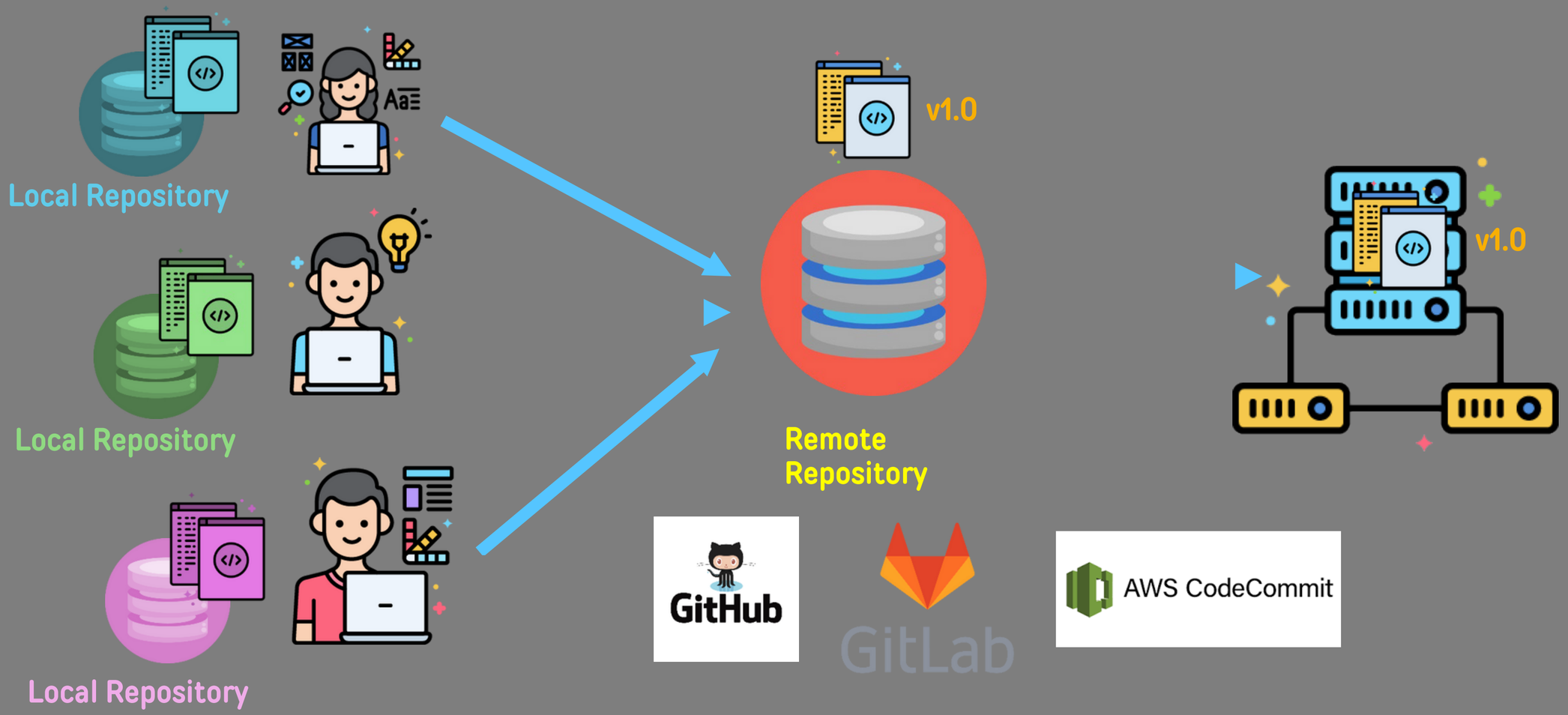
Git vs GitHub

Git Vs. GitHub

- Version Control System
- Installed locally on the system
- Created in 2005, by Linus Torvalds
- Open source, and used in multiple cloud repository services

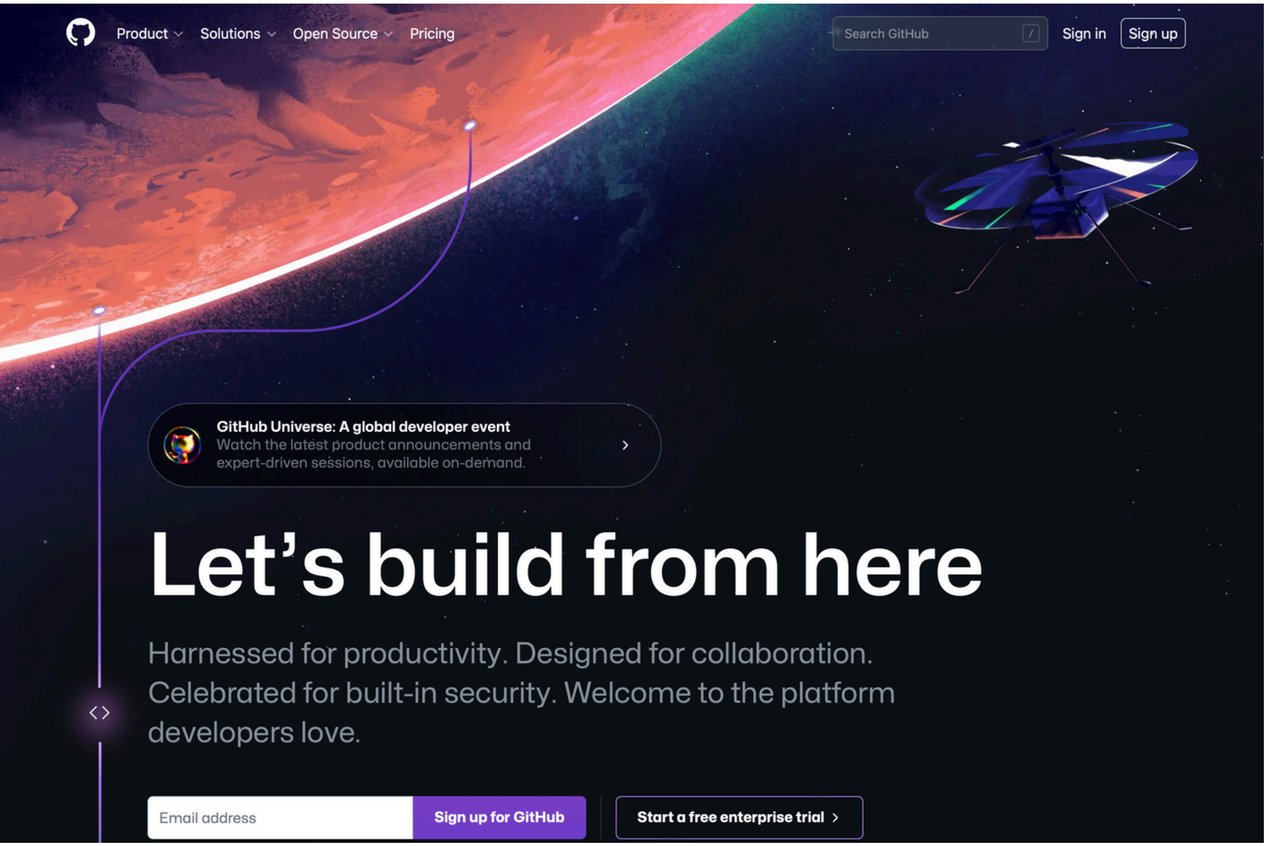
- Git repository hosting services with other features
- Runs on the cloud
- Created in 2008, currently owned by Microsoft
- Not open source, have free and paid tiers

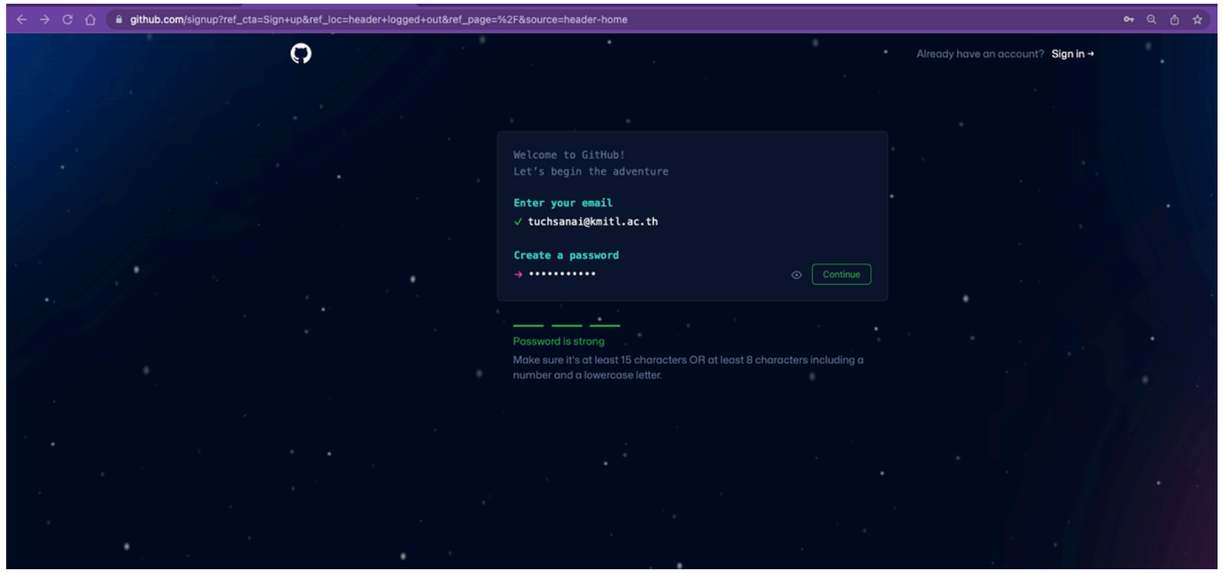
Distributed Version Control System



Week 1 - Starting with Git

Sign Up : https://github.com





https://github.com

Installing Git

Week 1 - Starting with Git

- **MacOS or Linux Users:**
  - Congrats! You already have Git installed on your machine since it comes pre-installed as part of your OS.
  - To confirm this, open up a terminal and type:
    - **git --version**
    - **>> git version 2.25.1 (Apple Git-128)**

Week 1 - Starting with Git

- **MacOS or Linux Users:**
  - If you wish to update or re-install git, you can do this by simply selecting the MacOS or Linux links on the official git website:
    - **https://git-scm.com/downloads**

Week 1 - Starting with Git

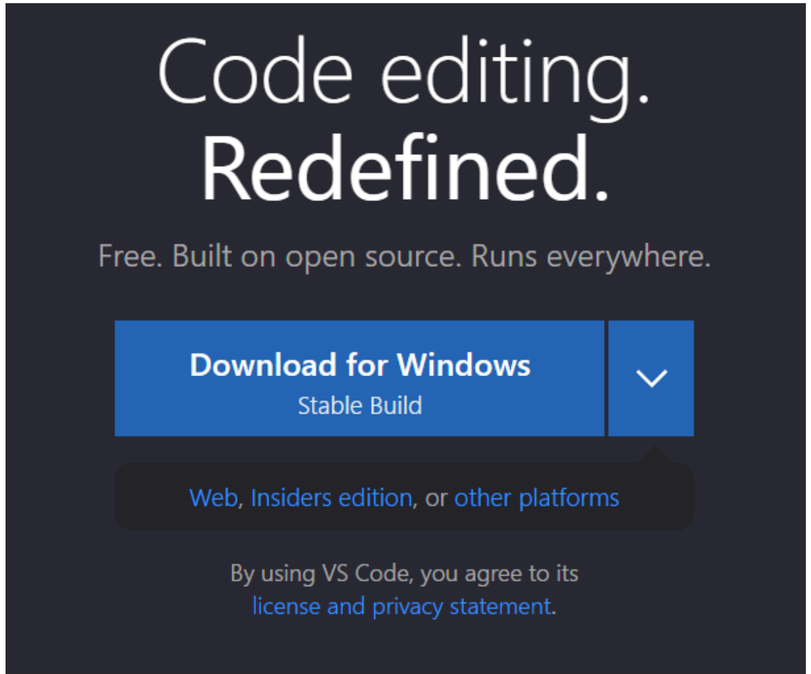
- **MacOS or Linux Users:**
  - Our suggested text editor for this course is VS Code:
    - **https://code.visualstudio.com/**
  - Its created by Microsoft and has direct integrations with GitHub and is one of the most popular text editors today.
  - You can follow along with any text editor you prefer however.

Week 1 - Starting with Git

- **Windows Users:**
  - Our *HIGHLY recommend* text editor for this course is VS Code:
    - **https://code.visualstudio.com/**
  - Why *HIGHLY* recommended?
    - Windows + VS Code + GitHub
    - Upon installing git you will be asked to select a default editor, you'll need VS Code installed to select it as default

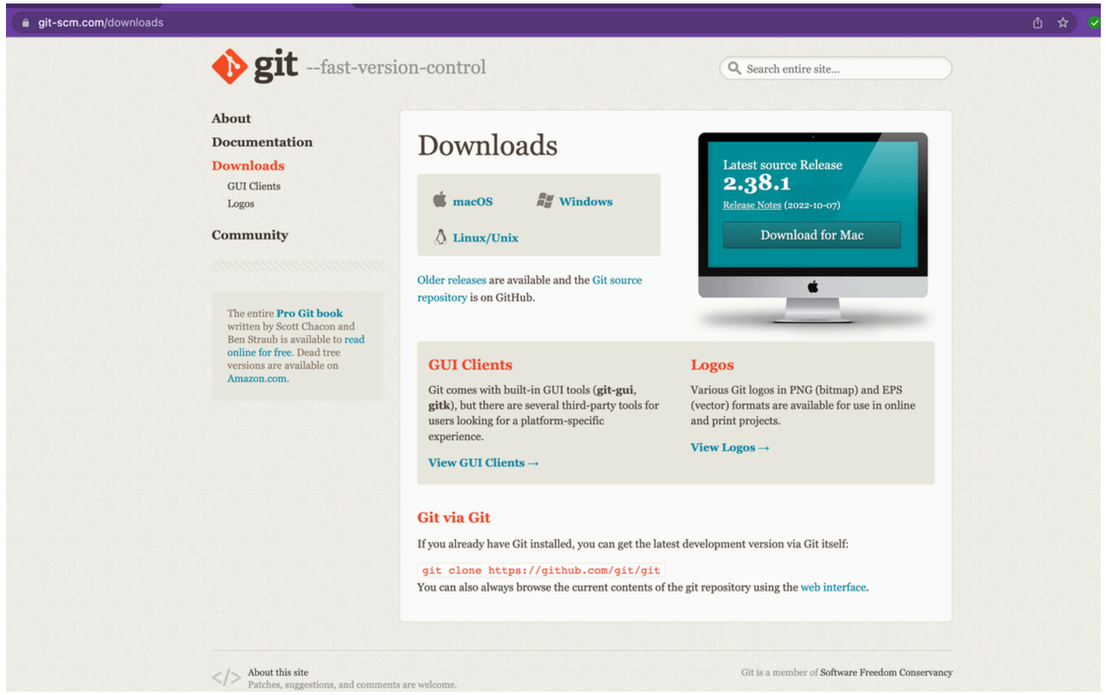
Week 1 - Starting with Git

- **Windows Users:**
  - Go to:
    - https://code.visualstudio.com/
  - Download with Default Settings:



Week 1 - Starting with Git

- **Windows Users:**
  - Next we'll download git, go to:
    - **https://git-scm.com/**



DAY 1
Configure Git

Week 1 - Starting with Git

- You can check the current configuration with the commands:

- The configuration commands will be:
  - **git config --global user.name “user”**
  - **git config --global user.email “email”**
- If switch with another github account
  - **git config --global user.name “user”**
  - **git config --global user.email “email”**
  - **git config --global credential.username “user”**

- -- ลบ config เก่า --
- git config --global --unset user.name
- git config --global --unset user.email
- git config --global --unset credential.username

- -- ลบ origin คนเก่า ถ้า commit ไม่ได้ --
- git remote remove origin

Show global Git configuration?

```
git config --list  or   git config -l
```

or look at your ~/.gitconfig file. The local configuration will be in your repository's .git/config file.

```
git config --list --show-origin
```

Week 1 - Starting with Git

- Let’s head over to our command line interface to set-up our Git configuration:
  - Git Bash
  - Terminal
  - Command Prompt

DAY 1
Creating a Git Repository

Day 1 - Starting with Git

- How can we create a Git Repository?
  - **git init**
    - This command initializes a Git Repository on your local machine.
    - You only need to run this command once per project.
  - **git status**
    - This command will report back the status of your Git repository.

Day 1 - Starting with Git

- How can we create a Git Repository?
  - Upon creating a repository with **git init** you will create a hidden .git file.
  - The .git file is a hidden file that manages the versioning of the files inside the Git repository.

Day 1 - Starting with Git

- Git inside a Folder/Directory:
  - Upon creating a Git Repository, all the folders/directories inside the top level Git Repository will also be part of that Repository, meaning all the changes are tracked.

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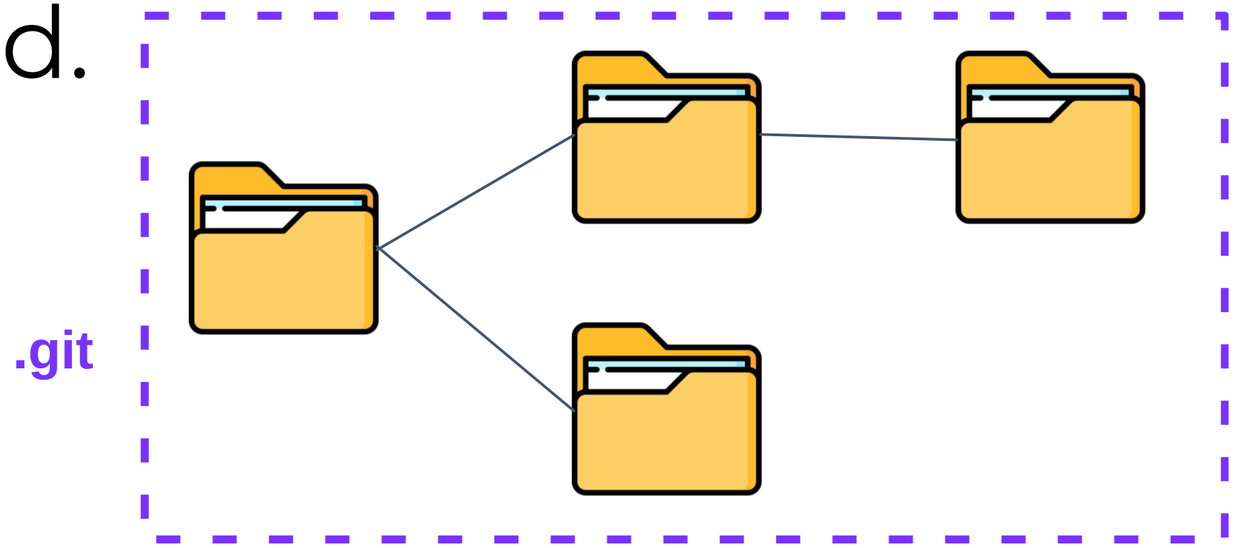

Day 1 - Starting with Git

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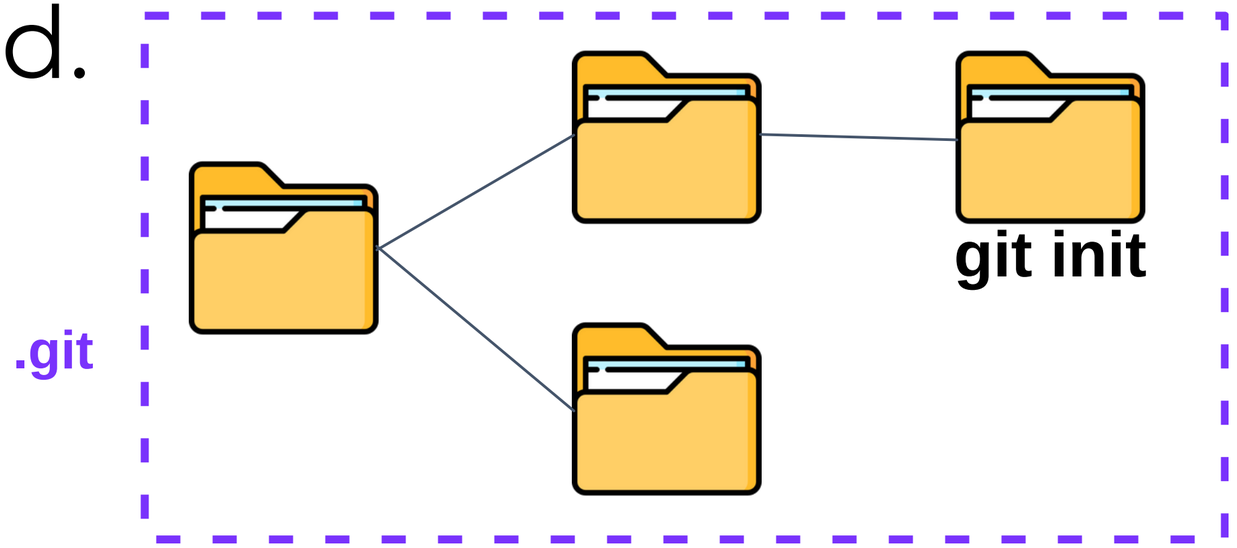

Day 1 - Starting with Git

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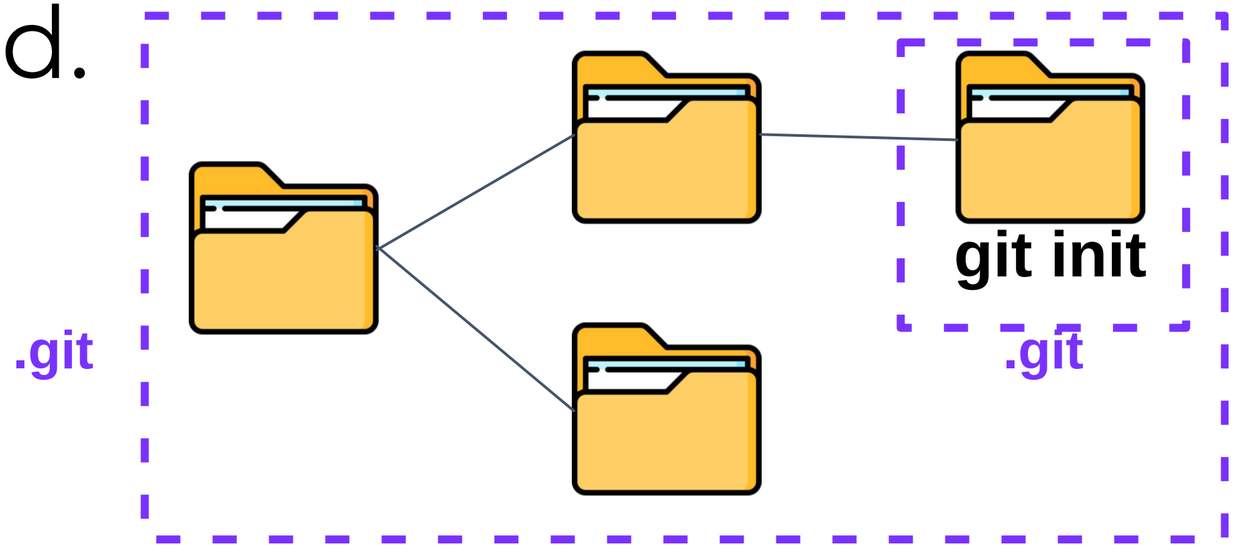

Day 1 - Starting with Git

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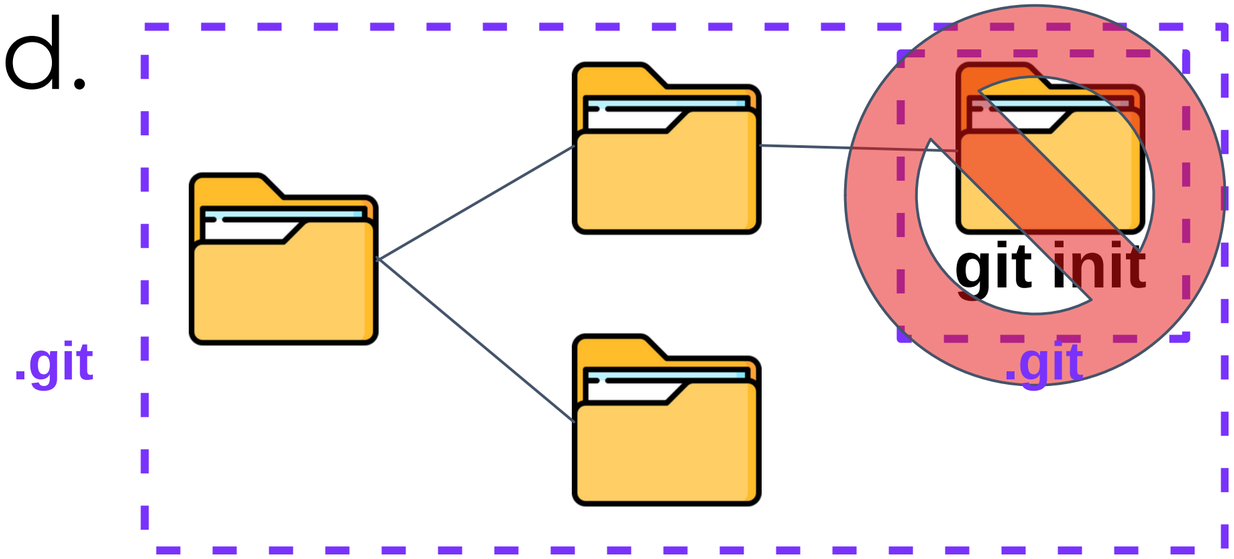

Day 1 - Starting with Git

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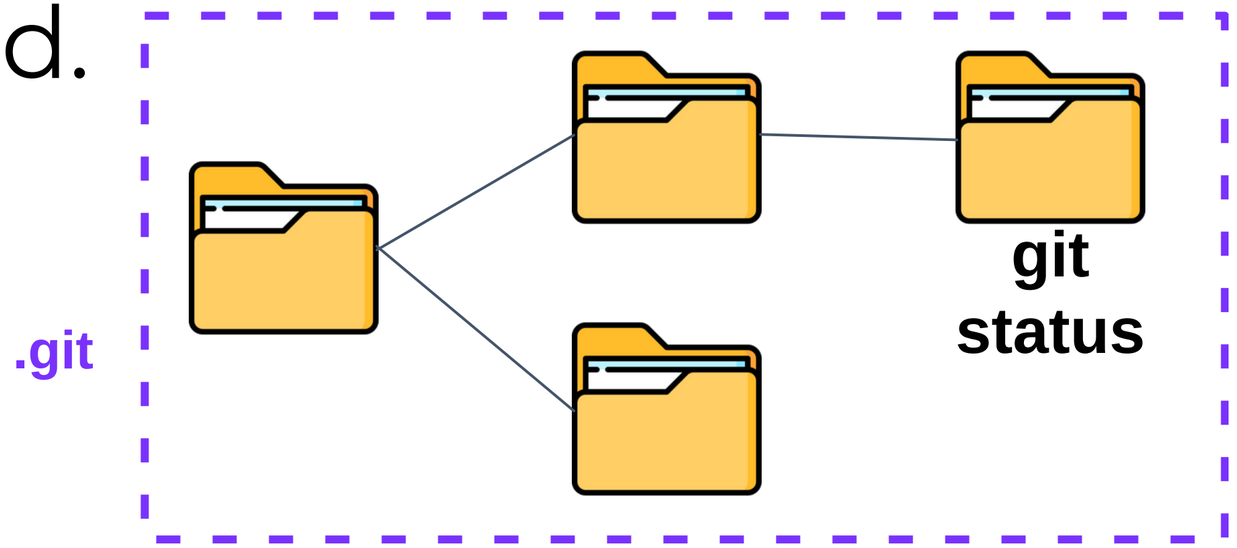


Ignoring Files

We can tell Git which files and directories to ignore in a given repository, using a .gitignore file. This is useful for files you know you NEVER want to commit, including:

- Secrets, API keys, credentials, etc.
- Operating System files (.DS_Store on Mac)
- Log files
- Dependencies & packages

.gitignore

Create a file called .gitignore in the root of a repository. Inside the file, we can write patterns to tell Git which files & folders to ignore:

- .DS_Store will ignore files named .DS_Store
- folderName/ will ignore an entire directory
- *.log will ignore any files with the .log extension

https://www.toptal.com/developers/gitignore

DAY 1
Private Repositories and Tokens

Day 1 - Starting with Git

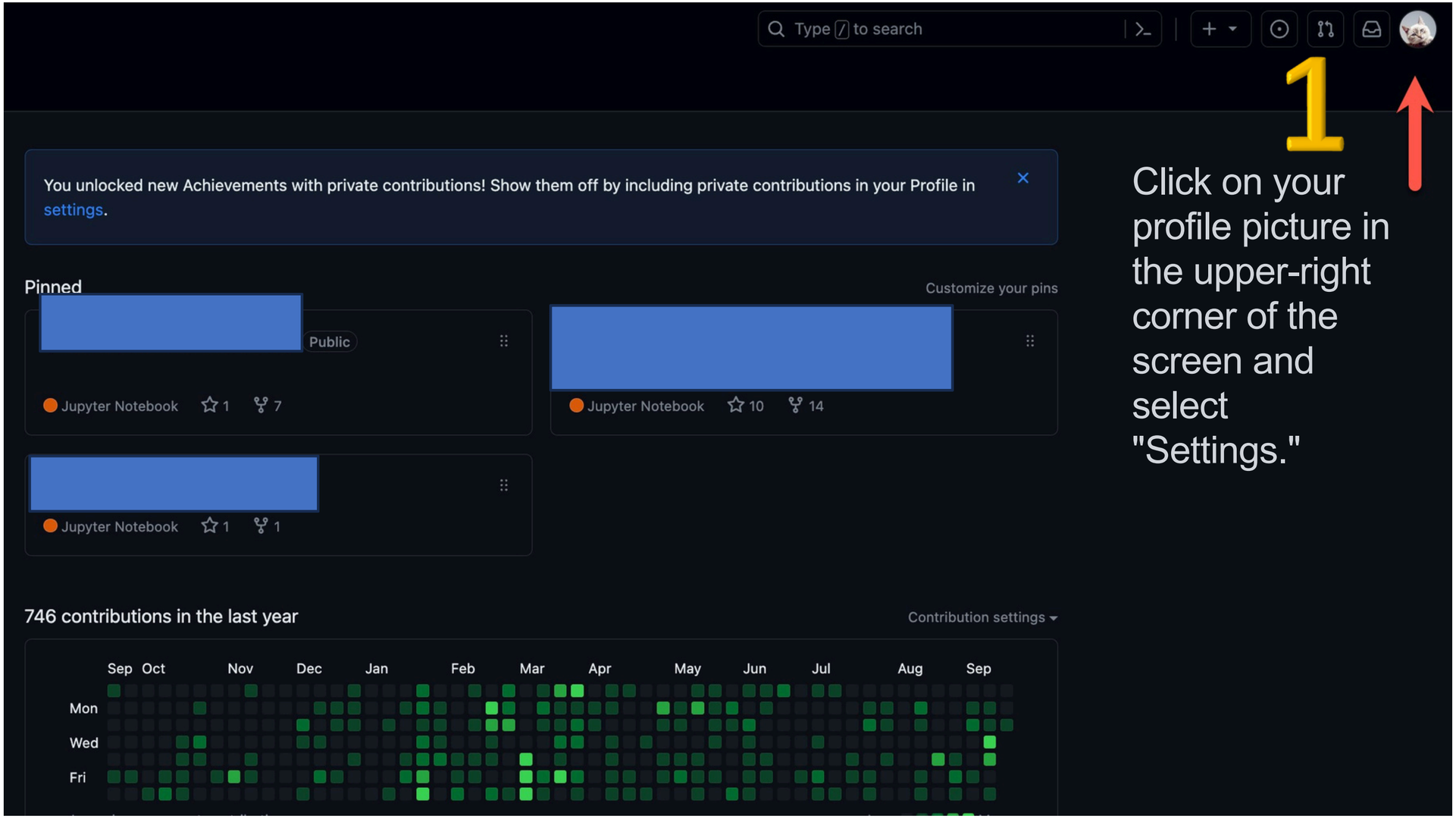
- Clone Syntax with PAT:

git clone https://username:YOUR_TOKEN@github.com/username/repo.git

- Previously we used:

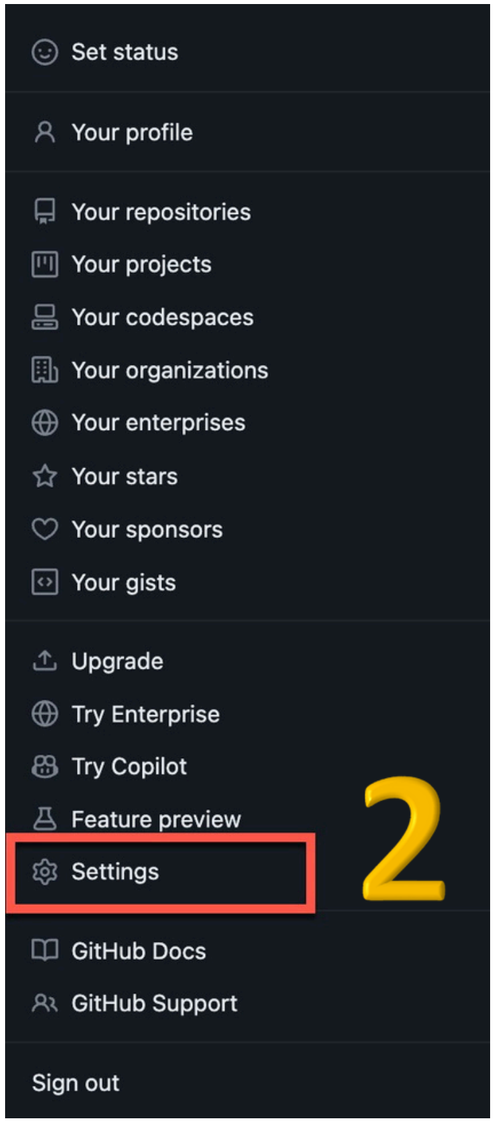
git clone https://github.com/account/repo.git

Create a Personal Access Token



1

Click on your profile picture in the upper-right corner of the screen and select "Settings."



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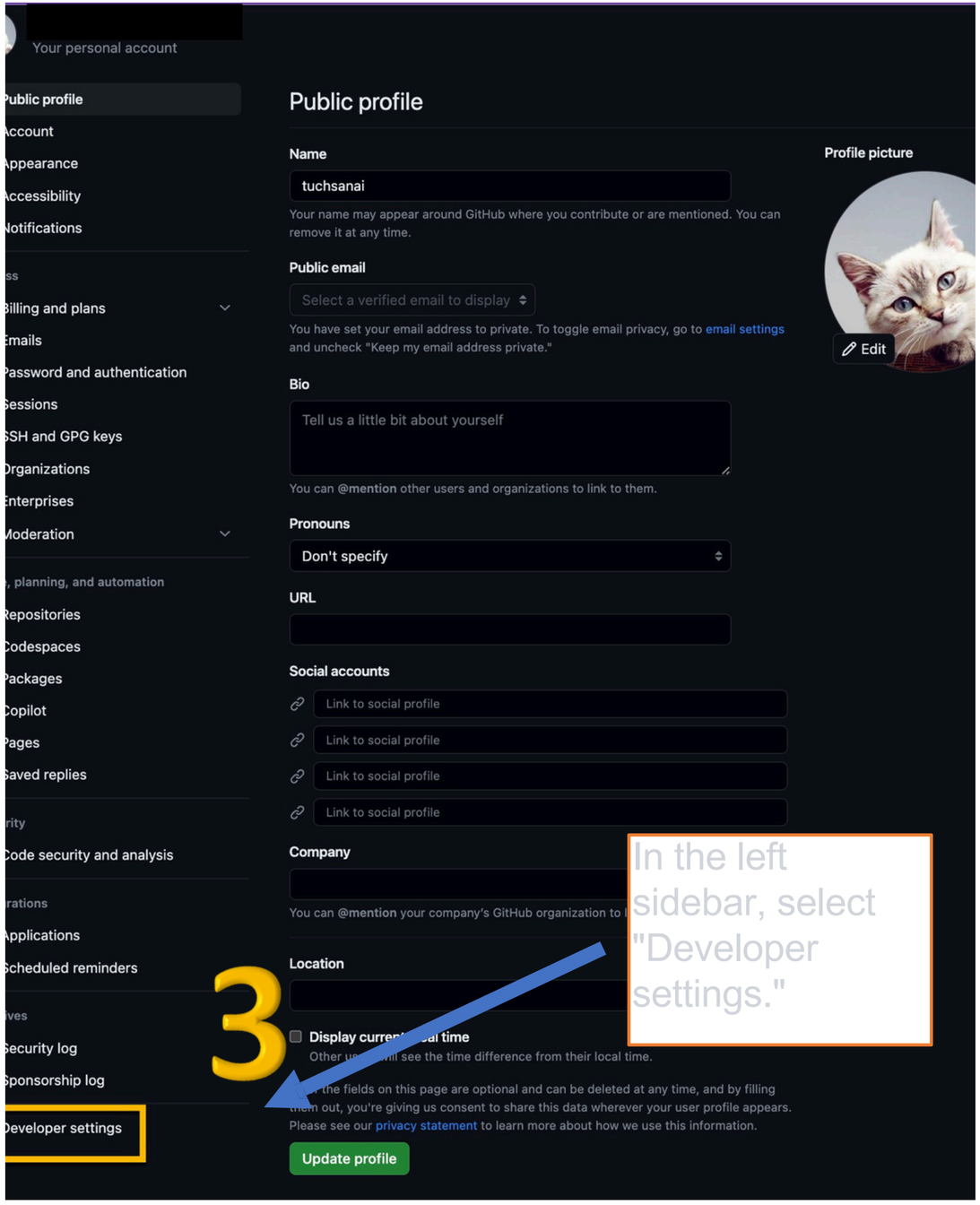
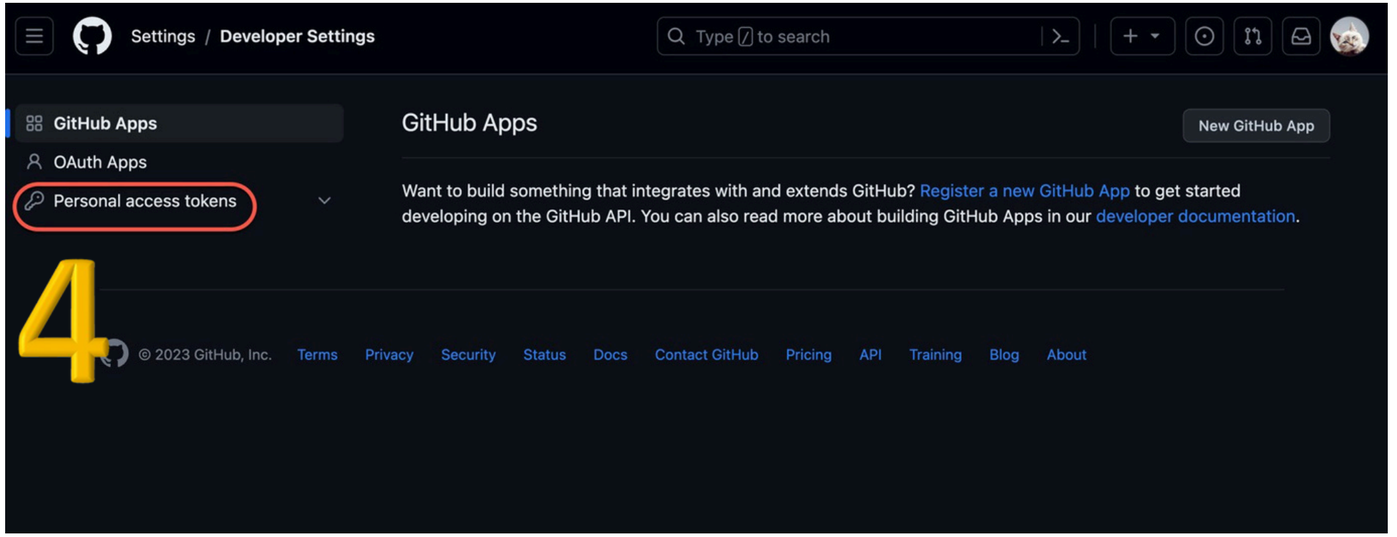

Your personal account
Public profile
Account
Appearance
Accessibility
Notifications
Billing and plans
Emails
Password and authentication
Sessions
SSH and GPG keys
Organizations
Enterprises
Moderation
Repositories
Codespaces
Packages
Copilot
Pages
Saved replies
Code security and analysis
Applications
Scheduled reminders
Security log
Sponsorship log
Developer settings
Public profile
Name
tuchsanai
Your name may appear around GitHub where you contribute or are mentioned. You can remove it at any time.
Public email
Select a verified email to display
You have set your email address to private. To toggle email privacy, go to email settings and uncheck "Keep my email address private."
Bio
Tell us a little bit about yourself
You can @mention other users and organizations to link to them.
Pronouns
Don't specify
URL
Social accounts
Link to social profile
Link to social profile
Link to social profile
Link to social profile
Company
You can @mention your company's GitHub organization to
Location
Display current
Other us
the fields on this page are optional and can be deleted at any time, and by filling them out, you're giving us consent to share this data wherever your user profile appears. Please see our privacy statement to learn more about how we use this information.
Update profile
Profile picture
Edit
3
In the left sidebar, select "Developer settings."


Settings / Developer Settings
Type / to search
GitHub Apps
OAuth Apps
Personal access tokens
GitHub Apps
New GitHub App
Want to build something that integrates with and extends GitHub? Register a new GitHub App to get started developing on the GitHub API. You can also read more about building GitHub Apps in our developer documentation.
4
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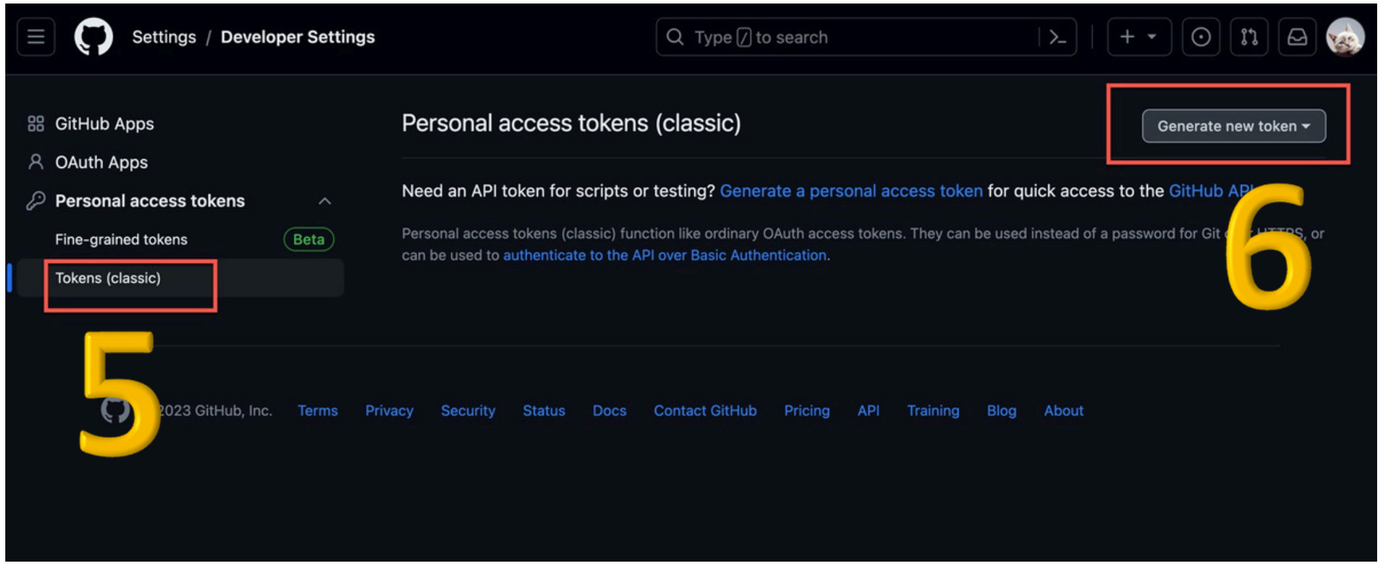

Settings / Developer Settings
Type / to search
GitHub Apps
OAuth Apps
Personal access tokens
Fine-grained tokens
Beta
Tokens (classic)
Personal access tokens (classic)
Generate new token
Need an API token for scripts or testing? Generate a personal access token for quick access to the GitHub API.
Personal access tokens (classic) function like ordinary OAuth access tokens. They can be used instead of a password for Git
can be used to authenticate to the API over Basic Authentication.
5
6
2023 GitHub, Inc. Terms Privacy Security Status Docs Contact GitHub Pricing API Training Blog About

New personal access token (classic)

Personal access tokens (classic) function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to authenticate to the API over Basic Authentication.

Note

test

7

What's this token for?

Expiration *

7 days

The tok… expire on Tue, Sep 26 2023

8

Select scopes

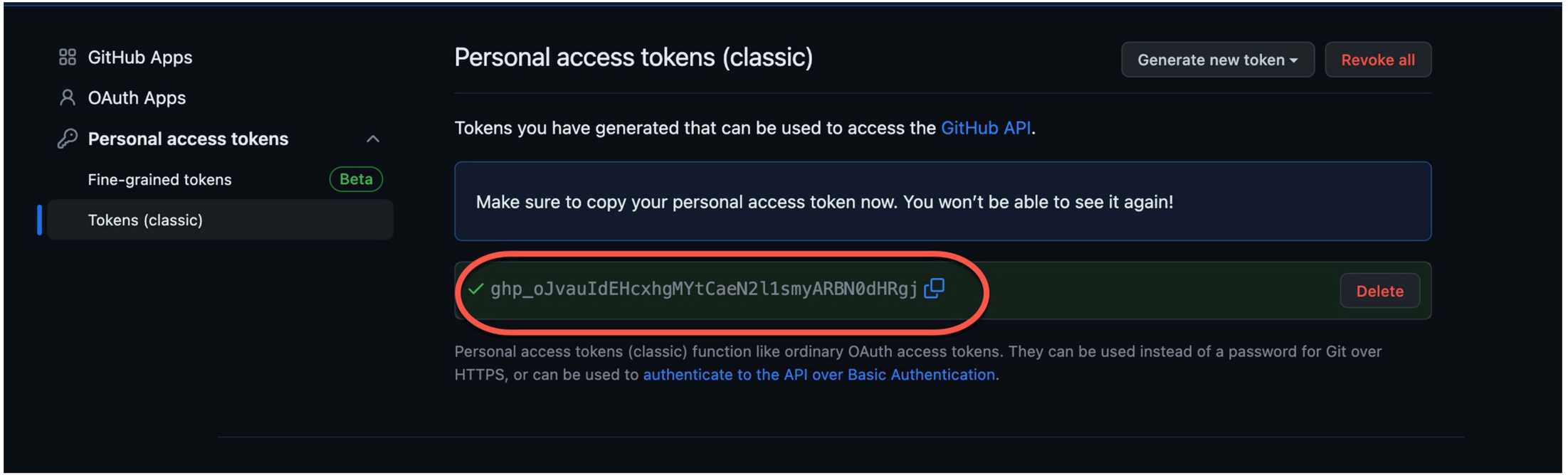
Scopes define the access for personal tokens. Read more about OAuth scopes.

repo	Full control of private repositories
repo:status	Access commit status
repo_deployment	Access deployment status
public_repo	Access public repositories
repo:invite	Access repository invitations
security_events	Read and write security events

9

repo	Full control of private repositories
repo:status	Access commit status
repo_deployment	Access deployment status
public_repo	Access public repositories
repo:invite	Access repository invitations
security_events	Read and write security events
workflow	Update GitHub Action workflows
write:packages	Upload packages to GitHub Package Registry
read:packages	Download packages from GitHub Package Registry
delete:packages	Delete packages from GitHub Package Registry
admin:org	Full control of orgs and teams, read and write org projects
write:org	Read and write org and team membership, read and write org projects
read:org	Read org and team membership, read org projects
manage_runners:org	Manage org runners and runner groups
admin:public_key	Ful… ontrol of user public keys
write:public_key	Wr… user public keys
read:public_key	R… d user public keys
admin:repo_hook	Full control of repository hooks
write:repo_hook	Write repository hooks
read:repo_hook	Read repository hooks
admin:org_hook	Full control of organization hooks
gist	Create gists
notifications	Access notifications
user	Update ALL user data
read:user	Read ALL user profile data
user:email	Access user email addresses (read-only)
user:follow	Follow and unfollow users

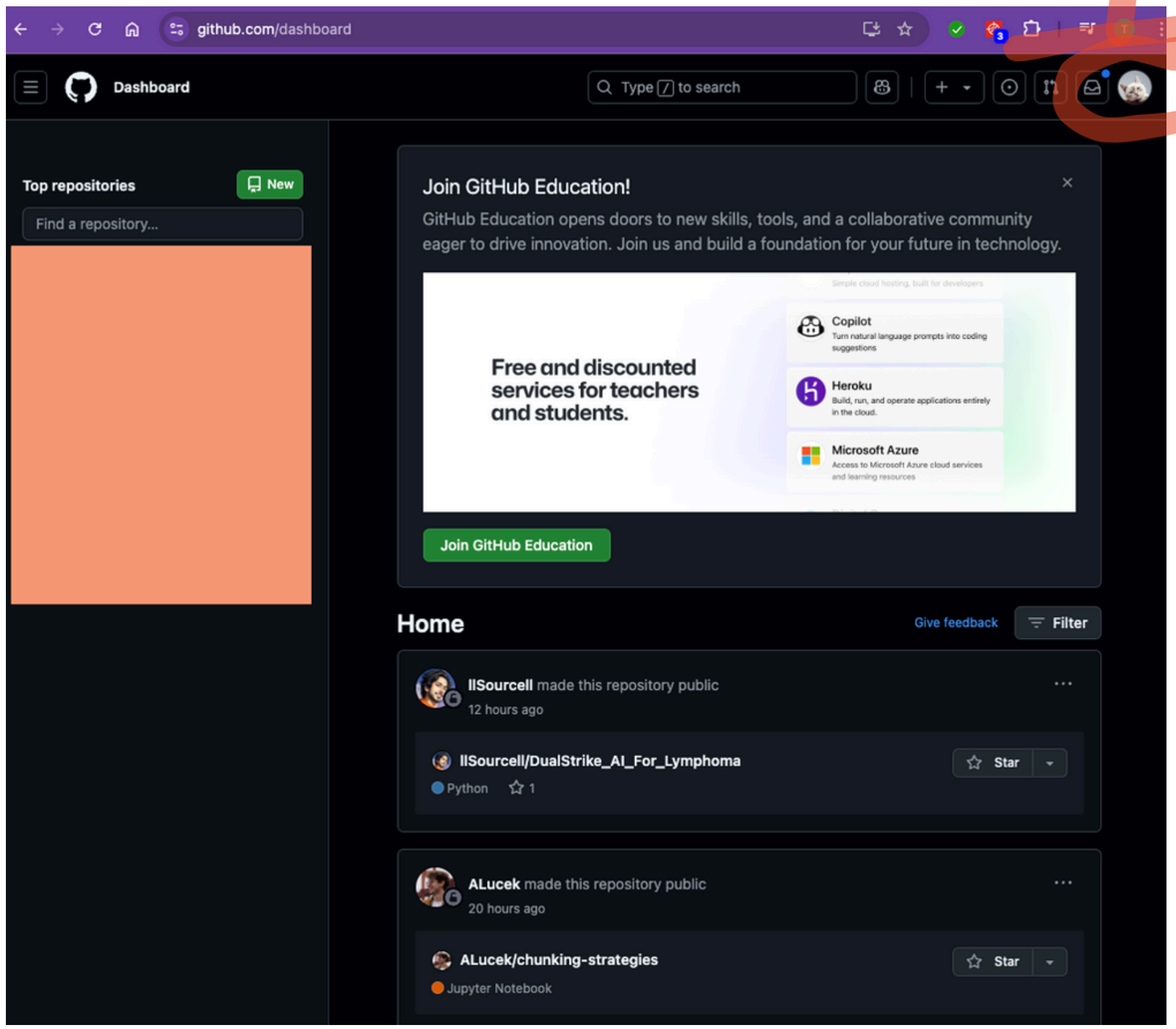
10

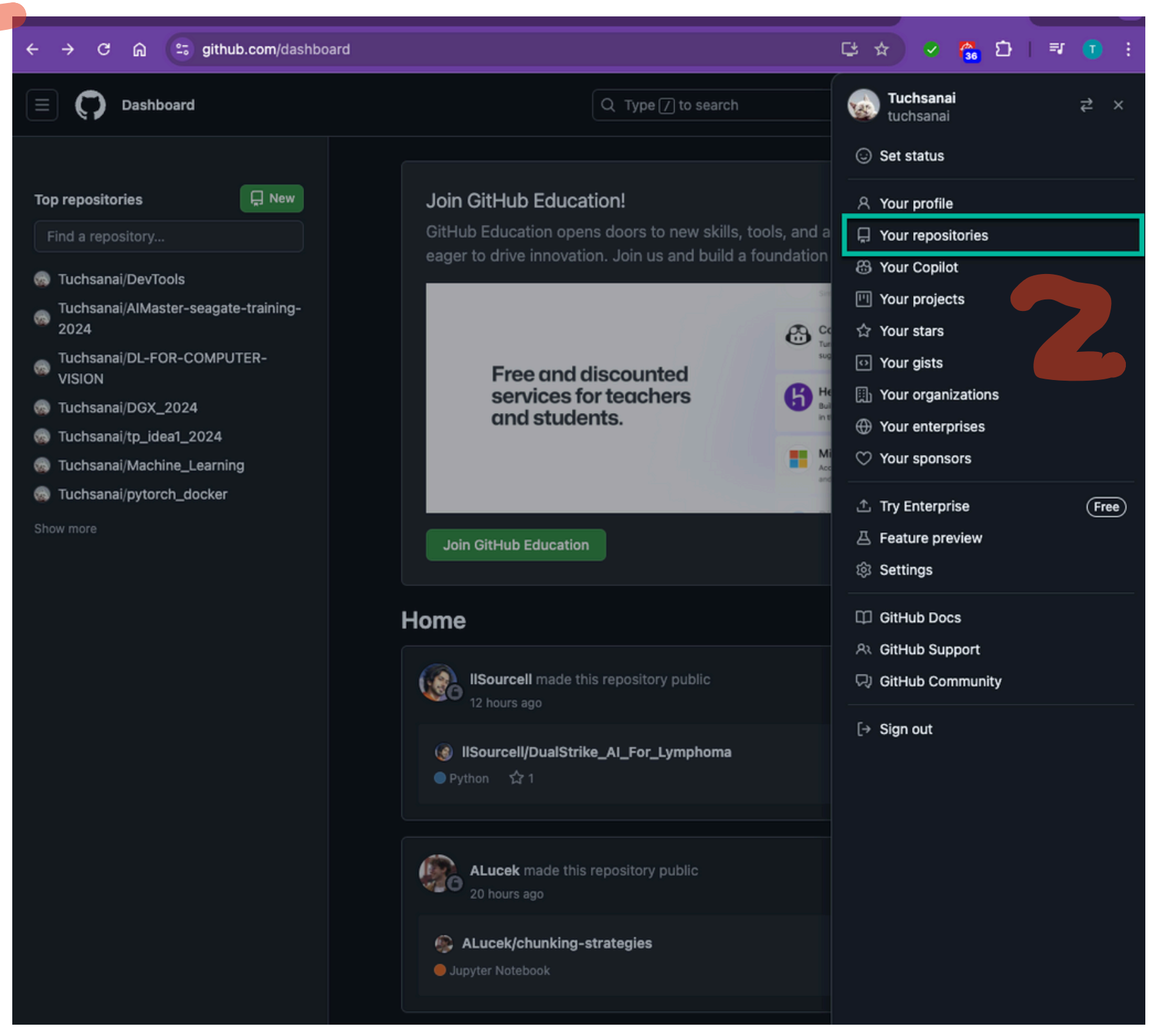

GitHub Apps
OAuth Apps
Personal access tokens
Fine-grained tokens
Beta
Tokens (classic)
Personal access tokens (classic)
Generate new token
Revoke all
Tokens you have generated that can be used to access the GitHub API.
Make sure to copy your personal access token now. You won't be able to see it again!
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
Delete
Personal access tokens (classic) function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to authenticate to the API over Basic Authentication.

DAY 1
Exercise

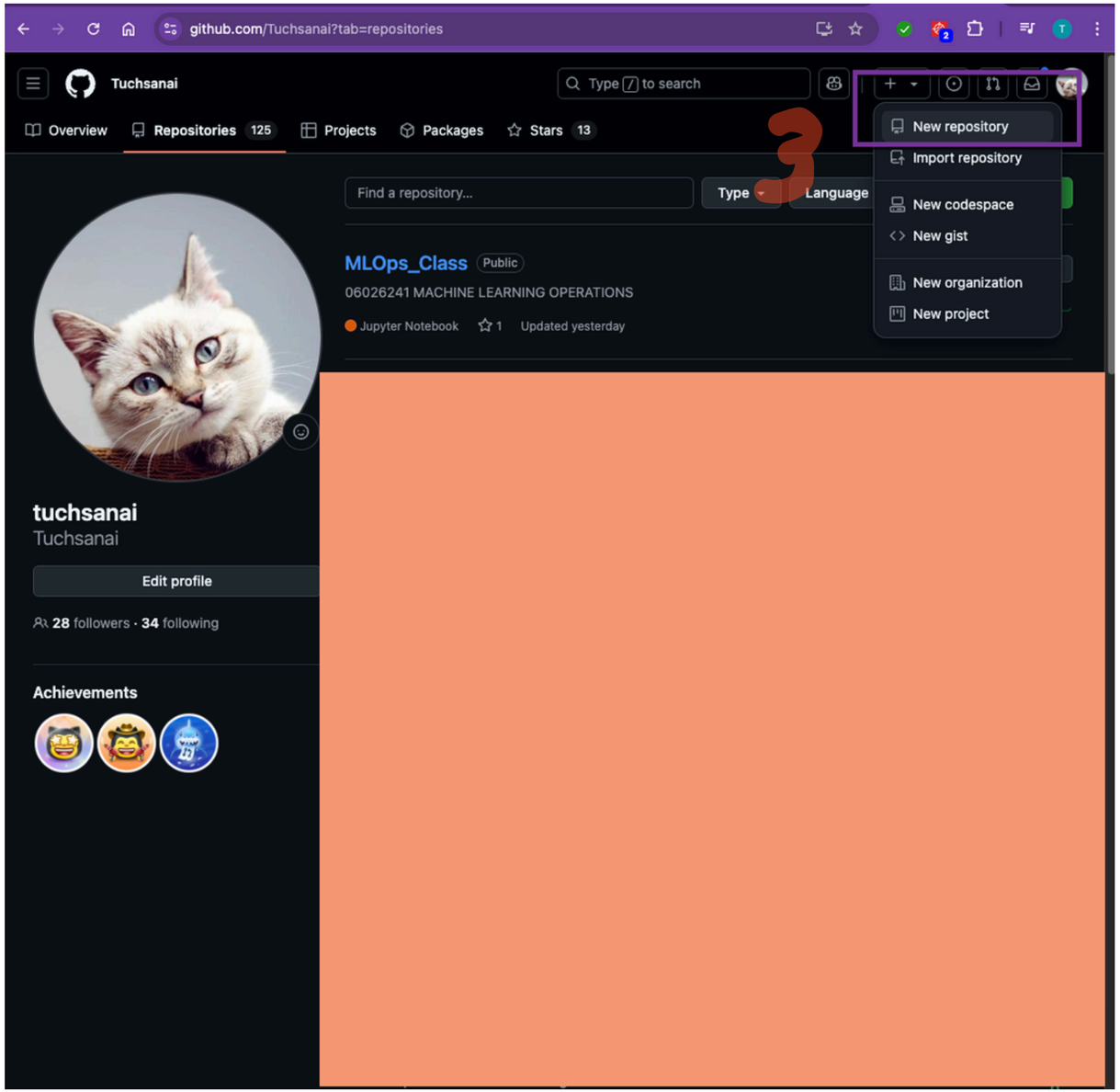
Day 1 - Starting with Git

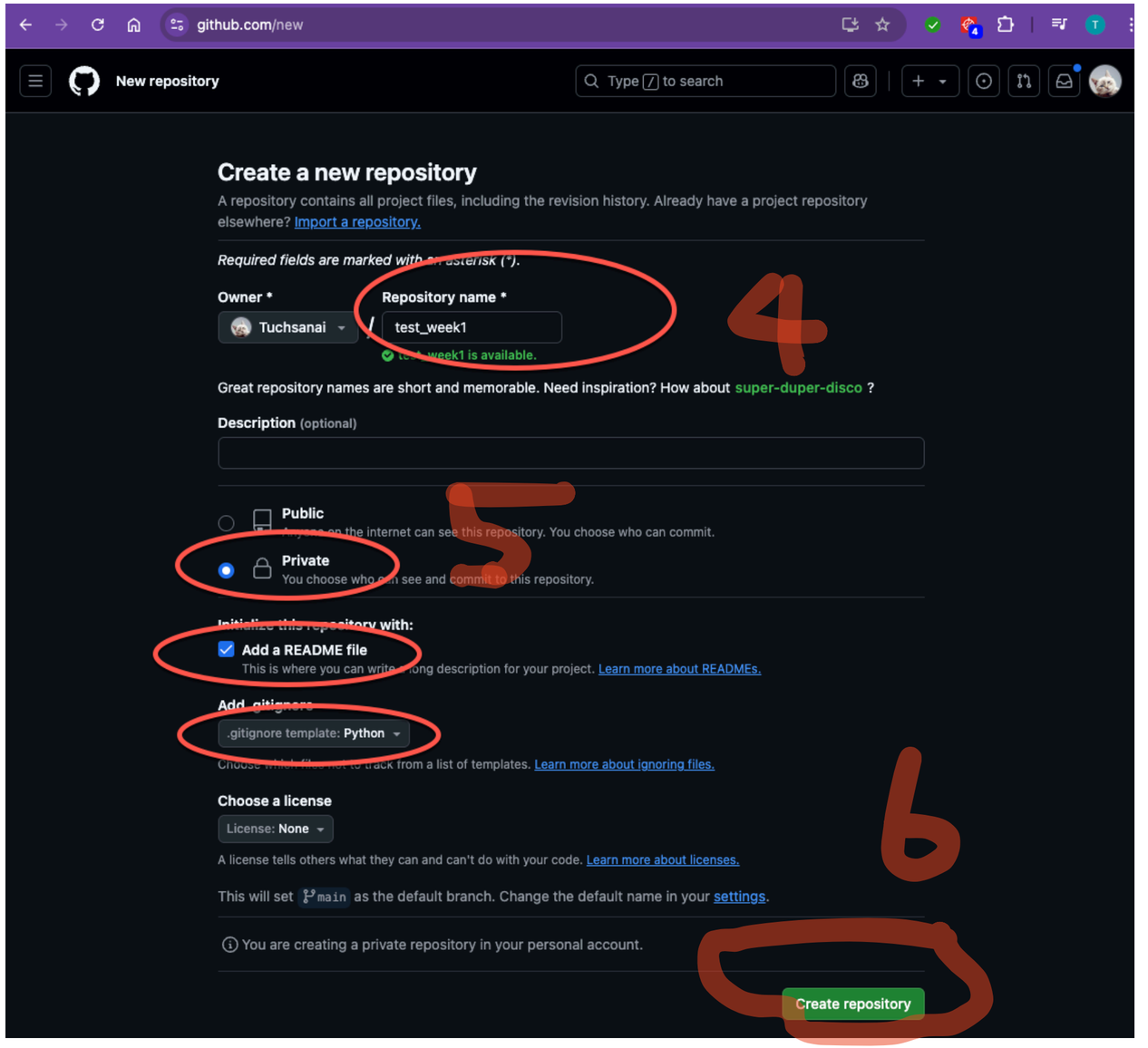
- **Exercise Tasks:**
  - Create a new Private Repository on GitHub.
  - Initialize your repository with README, license and gitignore.
  - create new test.txt with random data
  - Clone your Repository using the Command Line .


github.com/dashboard
Dashboard
Type / to search
Top repositories
New
Find a repository...
Join GitHub Education!
GitHub Education opens doors to new skills, tools, and a collaborative community eager to drive innovation. Join us and build a foundation for your future in technology.
Free and discounted services for teachers and students.
Copilot
Turn natural language prompts into coding suggestions
Heroku
Build, run, and operate applications entirely in the cloud.
Microsoft Azure
Access to Microsoft Azure cloud services and learning resources
Join GitHub Education
Home
Give feedback
Filter
llSourcell made this repository public
12 hours ago
llSourcell/DualStrike_AI_For_Lymphoma
Python
1
Star
ALucek made this repository public
20 hours ago
ALucek/chunking-strategies
Jupyter Notebook
Star

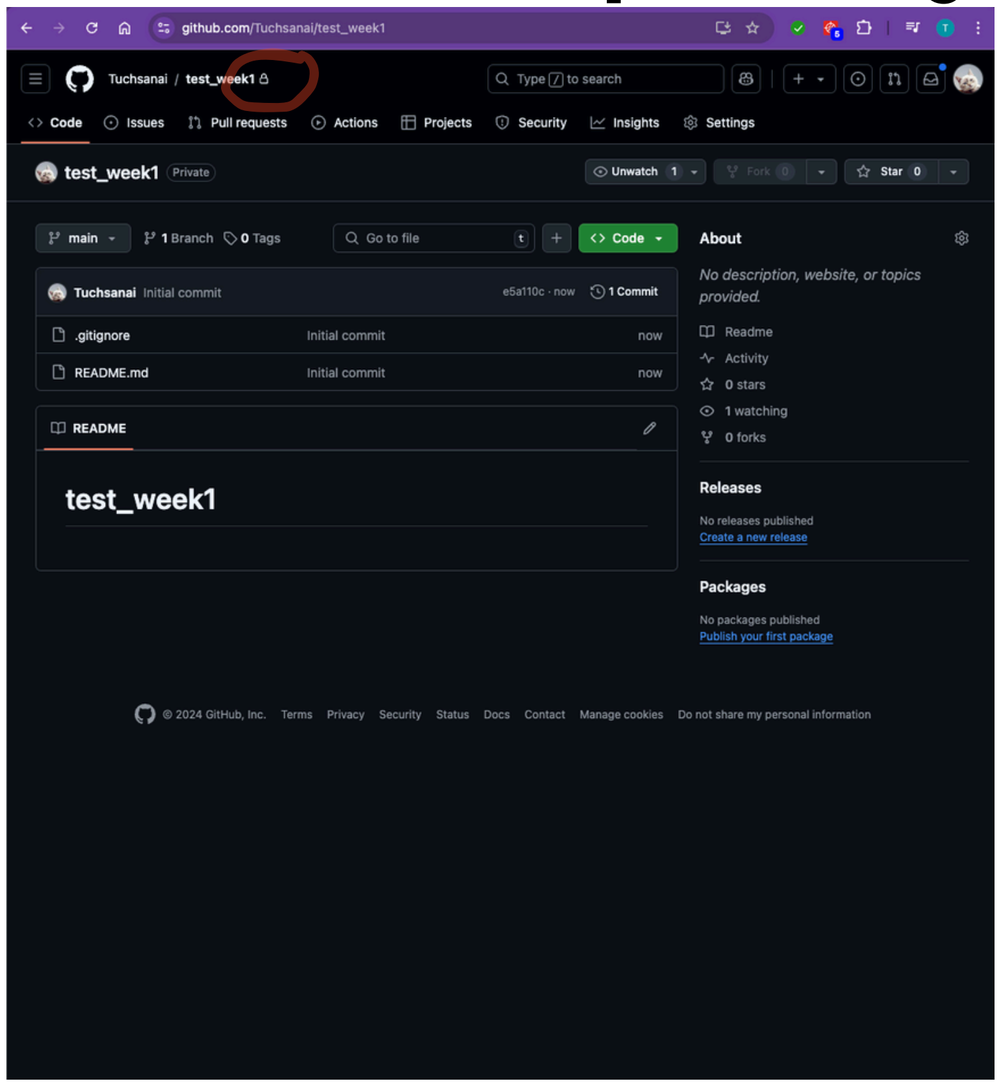

github.com/dashboard
Dashboard
Type / to search
Top repositories
New
Find a repository...
Tuchsanai/DevTools
Tuchsanai/AIMaster-seagate-training-2024
Tuchsanai/DL-FOR-COMPUTER-VISION
Tuchsanai/DGX_2024
Tuchsanai/tp_idea1_2024
Tuchsanai/Machine_Learning
Tuchsanai/pytorch_docker
Show more
Join GitHub Education!
Free and discounted services for teachers and students.
Join GitHub Education
Home
llSourcell made this repository public
12 hours ago
llSourcell/DualStrike_AI_For_Lymphoma
Python
1
ALucek made this repository public
20 hours ago
ALucek/chunking-strategies
Jupyter Notebook
Tuchsanai
tuchsanai
Set status
Your profile
Your repositories
Your Copilot
Your projects
Your stars
Your gists
Your organizations
Your enterprises
Your sponsors
Try Enterprise
Free
Feature preview
Settings
GitHub Docs
GitHub Support
GitHub Community
Sign out

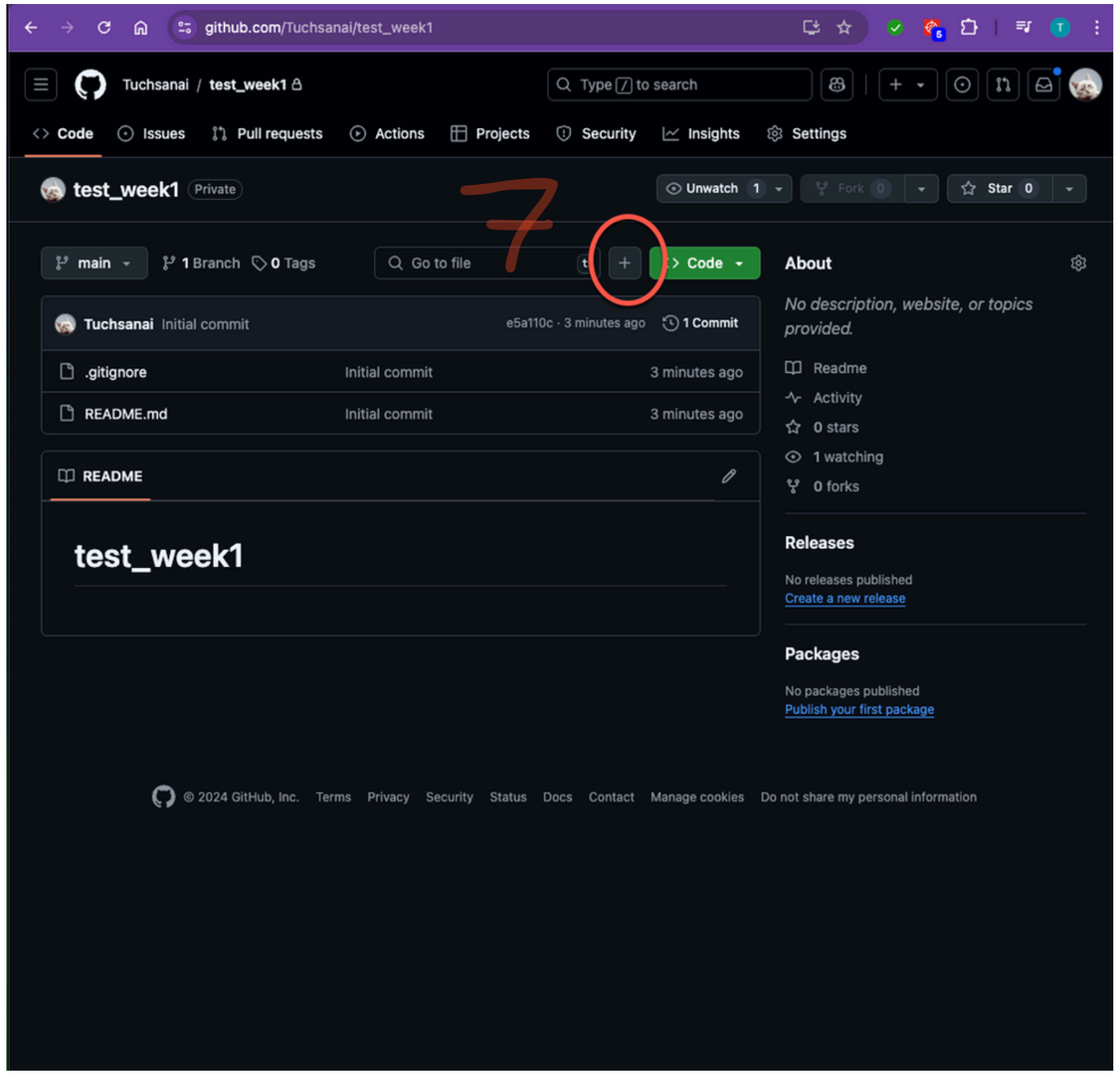
Click New repository



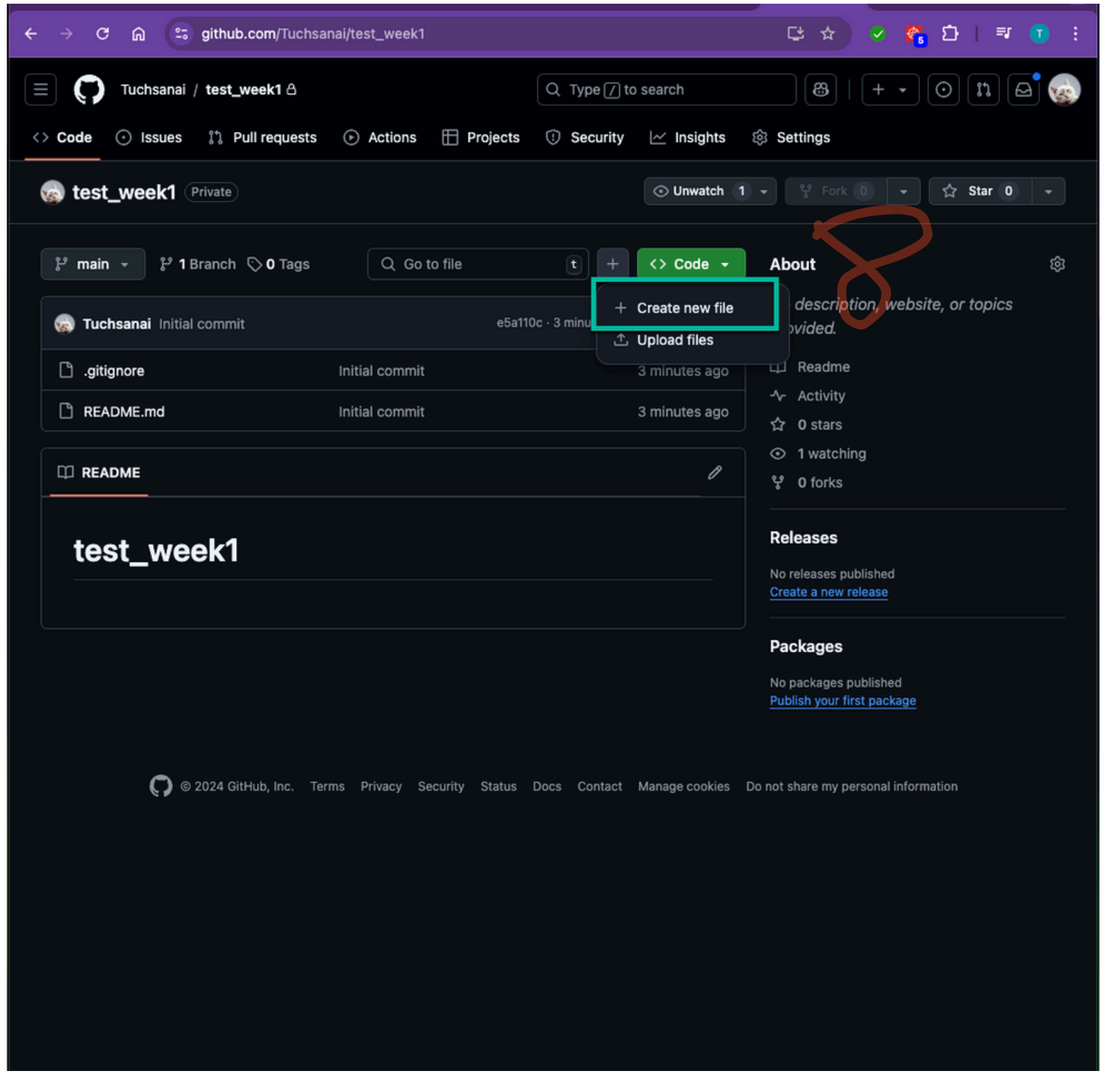


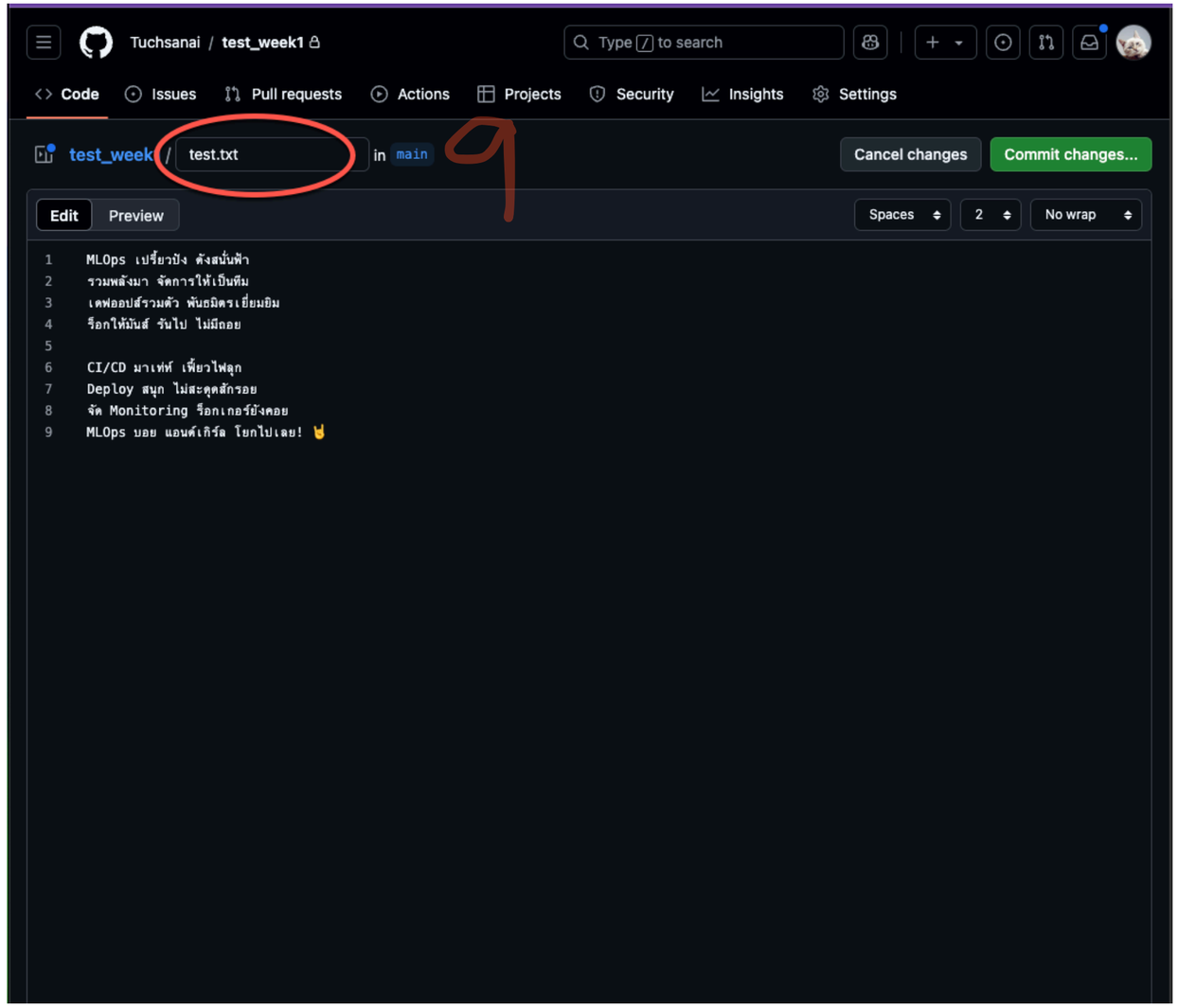
Privated repository

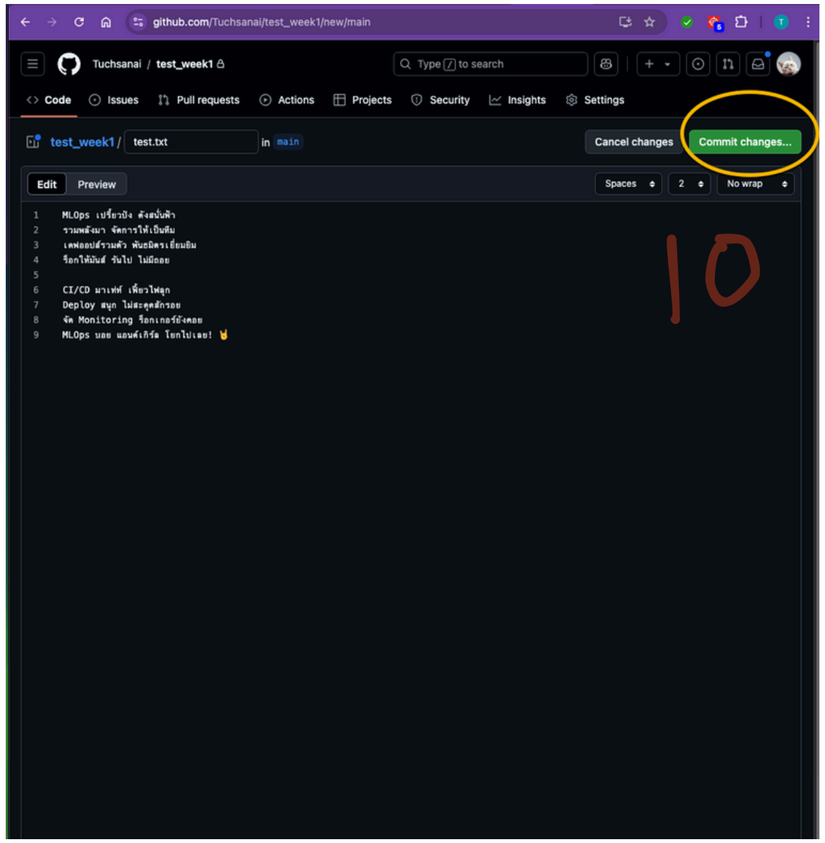


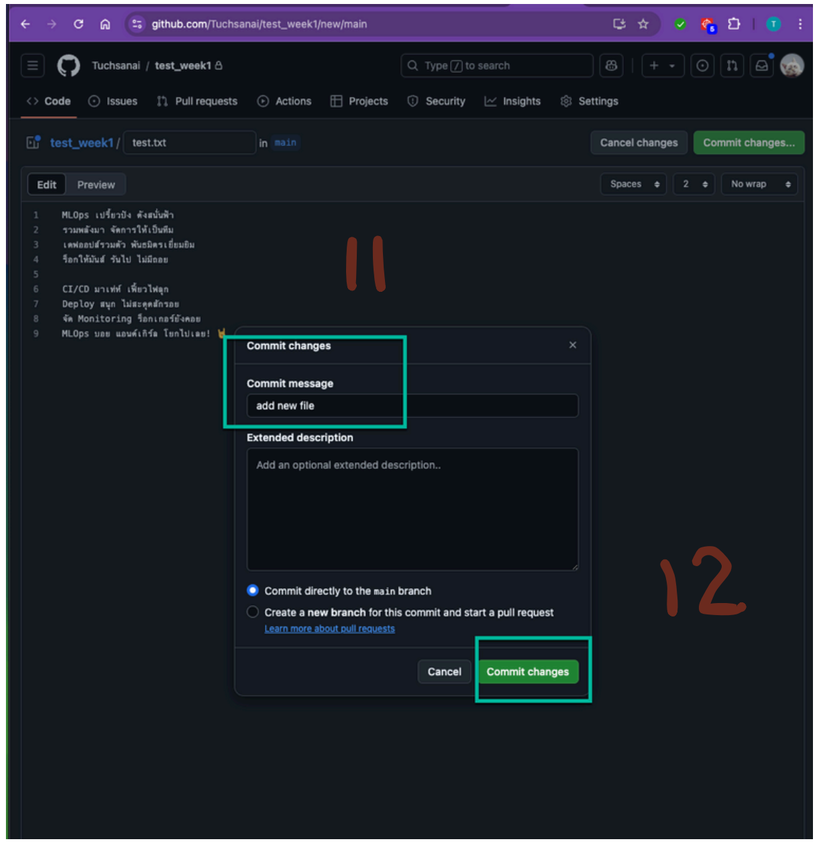


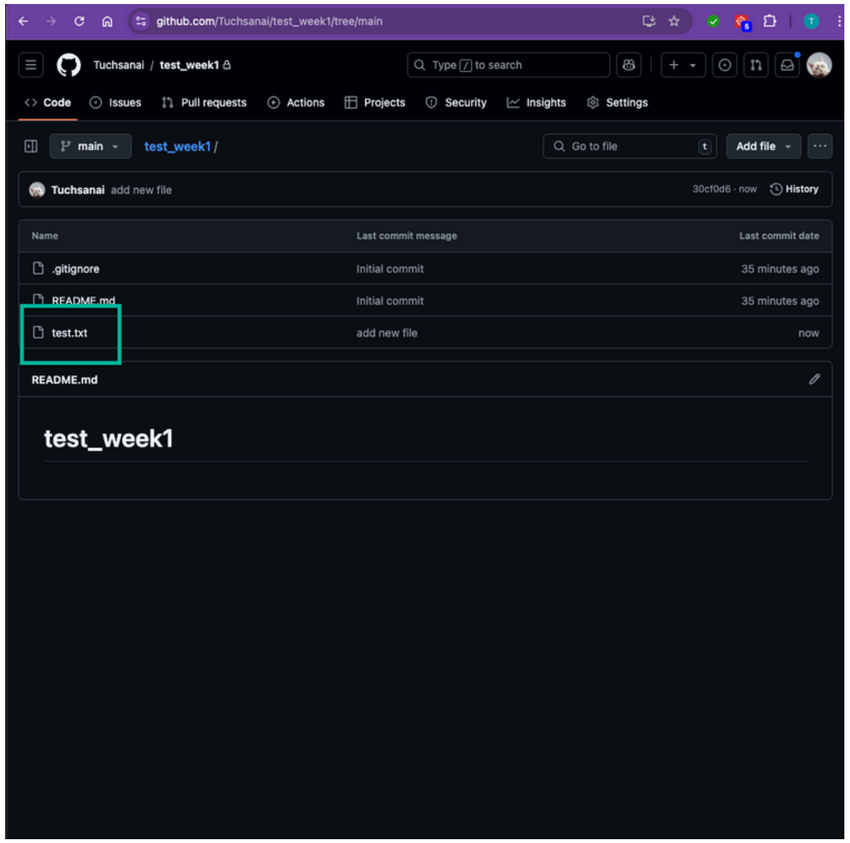
สร้าง file : test.txt











- Clone private respository:

git clone https://username:YOUR_TOKEN@github.com/username/repo.git