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UNIT 1: Git and GitHub

Topics Covered

1. What is version control?
2. Benefits of using Git
3. Git vs other VCS (like SVN)
4. Installing Git
5. Configuring Git (username, email)

1. What is Version Control?

Version Control System (VCS) is software that helps developers manage changes to source code over time. It allows you to:

- **Track changes** to files
- **Revert** to a previous version if something breaks
- **Collaborate** with others on the same codebase
- Avoid **conflicts** when working with teammates

Real-World Analogy:

Imagine writing a book in MS Word. You save a version every time you make edits — VCS automates this. You can go back to any version and see who made what changes.

2. Benefits of Using Git

Benefit	Description
History Tracking	Git keeps a full history of changes made to your files
Experiment Safely	You can create branches to test new features without affecting the main code
Team Collaboration	Multiple people can work on the same code without stepping on each other
Easy Rollback	Broke the app? You can go back to a stable commit
Offline Work	Git works locally; you don't need an internet connection to track changes

3. Git vs Other Version Control Systems

Feature	Git (Distributed VCS)	SVN (Centralized VCS)
Local Repository	Yes	✗ No
Offline Commits	Yes	✗ No
Speed	⚡ Very Fast	🐢 Slower
Branching	✈ Easy and lightweight	😓 Heavy and complex
Dependency on Server	✗ No (unless pushing)	Yes (always)

Conclusion: Git is faster, more flexible, and better suited for modern development workflows.



4. Installing Git

For Windows:

1. Go to <https://git-scm.com/downloads>
2. Download and run the installer
3. Keep the default settings unless you know what you're doing
4. Open Git Bash (you'll use this instead of CMD)

For Ubuntu/Linux:

```
sudo apt update  
sudo apt install git
```

For macOS:

```
brew install git  
# OR use Xcode Command Line Tools:  
xcode-select --install
```

5. Configuring Git

Once Git is installed, set your global identity (used in all repos):

```
git config --global user.name "Your Name"  
git config --global user.email "your@email.com"
```

This information will appear in your commit logs.

Verify Configuration

```
git config --list
```

You should see:

```
user.name=Your Name  
user.email=your@email.com
```

Core Concepts

Distributed Version Control

Every developer has a full copy of the codebase including its entire history. This allows:

- Offline commits
- Local experimentation
- Safer collaboration



Git Architecture

Git works in **three areas**:

Area	Purpose
Working Directory	Where you write/edit files
Staging Area	Where you mark files for commit using git add
Local Repository	Where commits are saved using git commit

Hands-On Practice

Step-by-Step:

```
# Step 1: Install Git

# Step 2: Configure Git
git config --global user.name "Your Name"
git config --global user.email "you@example.com"

# Step 3: Verify settings
git config --list
```

Exercise

Objective: Setup Git on your system

Task 1: Install Git

- Use your OS-specific method to install Git.

Task 2: Configure Your Identity

- Run:
- `git config --global user.name "Your Full Name"`
- `git config --global user.email "youremail@example.com"`

Task 3: Verify Installation

- Run:
- ```
git --version
git config --list
```

✦ **Checkpoint:** If you see Git version and your user info, you're good to go!



## Summary

- Git is a distributed version control system for tracking changes in your code.
- It helps with team collaboration, rollback, and parallel development.
- Setup requires installing Git and configuring your username/email.

# Unit 2: Git Basics

## Topics Covered

1. Initializing a Git repository
2. Tracking files
3. Adding & committing changes
4. Writing good commit messages

## 1. Initializing a Git Repository

When you're starting a new project, you need to tell Git to track changes in that directory.

 **Command:**

```
git init
```

This creates a **.git/ hidden folder**, which stores all metadata and version history. Once initialized, the folder is officially a Git repository.

## 2. Tracking Files

When you create or modify a file, Git doesn't track it **automatically**.

You need to:

- Check the file's status
- Add it to the staging area

**Check File Status:**

```
git status
```

You'll see:

- **Untracked files** → Not being tracked yet
- **Modified files** → Changed after last commit
- **Staged files** → Ready to be committed



### 3. Adding Files to Staging Area

Git uses a two-step commit process:

1. Stage the files
2. Commit them



**Add a single file:**

```
git add filename.txt
```

**Add all files in the directory:**

```
git add .
```

This moves files to the **Staging Area** (like a "preview basket" before committing).

## 4. Committing Changes

Once files are staged, you **commit** them — this means saving a snapshot to the repository.

**Commit:**

```
git commit -m "Short but clear message"
```

Git creates a commit object with:

- Author info
- Commit message
- Timestamp
- Snapshot of all staged files

Git best practice: **Commit often, in small logical chunks.**

## 5. Best Practices for Commit Messages

Writing clear commit messages is crucial for team collaboration and debugging later.

**Golden Rules:**

- Use the **imperative** mood: "Add login button", not "Added" or "Adding"
- Keep it short and meaningful (ideally < 50 characters)
- Describe **why** something changed (not just what)

**Examples:**

- Add user registration form
- Fix typo in README
- ✗ Changed something
- ✗ Final commit lol

## Hands-On Exercise

**Objective:** Create a simple project folder, track a file, and make your first commit.

**Step-by-step:**

```
1. Create a folder and navigate to it
mkdir my-first-repo
cd my-first-repo

2. Initialize Git
git init

3. Create a file
echo "Hello Git!" > hello.txt

4. Check the status
git status

5. Stage the file
git add hello.txt

6. Commit it
git commit -m "Add hello.txt with welcome message"
```

Congrats! You've made your first Git commit.

## Troubleshooting Tips

| Problem                            | Solution                           |
|------------------------------------|------------------------------------|
| <b>fatal: not a git repository</b> | Run git init first                 |
| <b>nothing to commit</b>           | Add files using git add            |
| <b>File not showing in commit</b>  | Ensure it's staged with git status |

## Summary

- git init initializes a Git repository.
- Use git add to stage changes and git commit to save them.
- Use git status often to see what's staged/untracked.
- Write clear, short, and action-based commit messages.

## Challenge Yourself

Try doing this for 3 files, then update one and commit only that specific change. Explore how Git tracks each file.



# Unit 3: Working with Remote Repositories

## Topics Covered

1. Setting up a GitHub account
2. Creating a GitHub repository
3. Connecting local repo to remote (GitHub)
4. Push/pull workflow
5. Cloning repositories

## 1. GitHub Account Setup

### Steps:

1. Visit <https://github.com/>
2. Sign up with an email, username, and password
3. (Optional) Enable 2FA (two-factor authentication) for security
4. Personalize your profile (name, bio, profile pic)

You'll need a GitHub account to **host remote repositories** and collaborate with others.

## 2. Create a Repository on GitHub

### Steps:

1. After logging in, click the "+" icon at the top-right → **New repository**
2. Enter a **repository name**
3. Choose **Public** or **Private**
4. *Do NOT* initialize with README, .gitignore, or license (for now)
5. Click **Create repository**

💡 GitHub now shows you instructions to link a local project — follow them or continue with the guide below.

## 3. Connect Local Repo to Remote

Assume you've already created a local repo using:

```
git init
```

### Step 1: Add the remote origin

```
git remote add origin https://github.com/your-username/your-repo-name.git
```

💡 This tells Git *where* to push and pull from.

### Step 2: Push local code to GitHub



```
git push -u origin main
```

-u sets origin as the default remote for main branch, so next time you can just do git push.

## 4. Push/Pull Workflow

| Action               | Command              | Description                               |
|----------------------|----------------------|-------------------------------------------|
| <b>Push changes</b>  | git push origin main | Uploads local commits to GitHub           |
| <b>Pull changes</b>  | git pull origin main | Downloads latest changes from GitHub      |
| <b>Check remotes</b> | git remote -v        | Displays current remote URL(s)            |
| <b>Rename branch</b> | git branch -M main   | Rename current branch (e.g., from master) |

🔗 **Pull before you push** if you're working on a team — this prevents conflicts.

## 5. Cloning a Remote Repo

If someone already created a GitHub repo and you want to work on it:

```
git clone https://github.com/username/repo-name.git
```

This:

- Downloads all the files
- Sets up the .git folder
- Connects to the remote origin

Now you can cd repo-name and start working immediately.

## Hands-On Exercise

🎯 **Objective:** Create a GitHub repository and connect it to a local project

### Step-by-Step Instructions:

```
1. Create a local folder
mkdir github-demo
cd github-demo
git init

2. Create a file
echo "# My GitHub Demo" > README.md
git add README.md
git commit -m "Initial commit"

3. Create a remote repo on GitHub (via web browser)

4. Add remote origin
git remote add origin https://github.com/YOUR_USERNAME/github-demo.git
```



```
5. Push to GitHub
git branch -M main # Optional: rename default branch to 'main'
git push -u origin main
```

#### From another device:

```
git clone https://github.com/YOUR_USERNAME/github-demo.git
```

Now you can cd github-demo and start working from there.

## Tips

- You can have multiple remotes (e.g., origin, upstream)
- Use SSH URLs for better authentication (git@github.com:user/repo.git)
- Always pull before pushing on team projects to prevent merge issues

## Summary

| Concept                    | Command                          |
|----------------------------|----------------------------------|
| <b>Add remote</b>          | git remote add origin <repo-url> |
| <b>Push code</b>           | git push -u origin main          |
| <b>Pull latest changes</b> | git pull origin main             |
| <b>Clone repo</b>          | git clone <repo-url>             |
| <b>Check remote URL</b>    | git remote -v                    |



# Unit 4: Branching Basics

## 1. Why Use Branches?

In Git, a **branch** is a lightweight movable pointer to a commit. It allows developers to:

- Work on **new features** or **bug fixes** without affecting the main code
- Try experimental ideas safely
- Collaborate without interfering with others' work

### Example Use Cases:

```
main → Production-ready code
feature/login → New login system
bugfix/navbar → Fixing broken navbar
```

Think of branches as separate "sandboxes" — you can experiment freely without breaking the original code.

## 2. Creating and Switching Branches

### Create a new branch:

```
git branch new-feature
```

This creates a branch **but doesn't switch** to it yet.

### Switch to a branch:

```
git switch new-feature
```

OR

```
git checkout new-feature # Older syntax, still works
```

💡 When switching, Git updates your working directory with that branch's latest state.

## 3. List All Branches

To see which branches exist:

```
git branch
```

- The current active branch will have a \* next to it.
- Use descriptive names like:
  - feature/signup-page
  - hotfix/logout-crash
  - bugfix/registration-username-validation



- experiment/image-compression

## Hands-On Exercise

**Objective:** Create a new branch, make changes, and switch between branches.

**Step-by-step:**

### 1. Create a working repo

```
mkdir branch-demo
cd branch-demo
git init
echo "This is main branch" > index.html
git add .
git commit -m "Add index.html on main"
```

### 2. Create a new branch

```
git branch new-feature
```

### 3. Switch to the new branch

```
git switch new-feature
```

### 4. Modify the file in this branch

```
echo "This is new-feature branch" >> index.html
git add index.html
git commit -m "Update index.html in new-feature branch"
```

### 5. Switch back to main branch

```
git switch main
```

### 6. View the difference in content

```
cat index.html # Should show only main branch content
```

You've now experienced **independent development** across branches!

## Best Practices

- Always **create a branch for each feature or fix** — never commit experimental code directly to main.
- Use **short, descriptive names** (feature/, fix/, experiment/ prefixes help).
- Switch branches only after committing your current changes.

## Summary

| Task                         | Command                    |
|------------------------------|----------------------------|
| <b>Create a branch</b>       | git branch new-branch-name |
| <b>Switch to a branch</b>    | git switch new-branch-name |
| <b>List all branches</b>     | git branch                 |
| <b>Rename current branch</b> | git branch -m new-name     |



# Unit 5: Branch Management & Merging

## 1. What is Merging?

**Merging** combines changes from one branch into another.

**Common use case:**

Merge feature-branch into main after completing a feature.

 **Command:**

```
git merge feature-branch
```

This command means: “Take the changes from feature-branch and apply them on top of the current branch.”

## 2. Merge Conflicts

Conflicts happen when:

- The same line of a file was changed differently in two branches
- Git can't decide which version to keep

 **What it looks like in a file:**

```
<<<<<<< HEAD
This is the main branch version
=====
This is the feature branch version
>>>>>>> feature-branch
```

You must **manually edit** this to decide what stays.

**Resolving a conflict:**

1. Open the file and delete the conflict markers (<<<<<<<, =====, >>>>>>>)
2. Keep the correct content
3. Stage the resolved file:

```
git add .
```

4. Finalize with:

```
git commit
```

## 3. Fast-forward vs No-fast-forward Merge

◆ **Fast-forward:**



If main hasn't moved ahead, Git can just “move the pointer”:

main → same as feature-branch

Looks like:

A → B → C ← main, feature-branch

Git applies no new merge commit — it just moves main forward.

### No-fast-forward (merge commit):

When main and feature-branch have diverged:

```

 → C (main)
 /
A → B
 \
 → D (feature)

```

Git **creates a new merge commit** with both histories:

```
git merge feature-branch
```

You'll get a commit like:

Merge branch 'feature-branch' into main

## Hands-On Exercise

🎯 **Goal:** Create two branches, introduce a conflict, resolve it, and merge into main.

### ✂ Step-by-step:

```

1. Set up a repo and commit a file
mkdir merge-demo && cd merge-demo
git init
echo "Hello from main" > file.txt
git add . && git commit -m "Initial commit on main"

2. Create and switch to feature branch
git checkout -b feature
echo "Hello from feature branch" > file.txt
git add . && git commit -m "Edit in feature branch"

3. Switch back to main and edit same line
git switch main
echo "Hello from main branch updated" > file.txt
git add . && git commit -m "Edit in main branch"

4. Try merging (will cause a conflict)
git merge feature

```



Now you'll see a **merge conflict** in file.txt.

### Resolve the conflict:

Open file.txt, you'll see:

```
<<<<<< HEAD
Hello from main branch updated
=====
Hello from feature branch
>>>>>> feature
```

✎ Edit to something like:

Hello merged version!

Then finalize:

```
git add file.txt
git commit -m "Resolve conflict and merge feature into main"
```

Done! You've completed a manual merge with conflict resolution.

## Best Practices

| Tip                       | Why it matters                          |
|---------------------------|-----------------------------------------|
| <b>Commit often</b>       | Smaller changes = fewer merge headaches |
| <b>Pull before merge</b>  | Keeps your branch up-to-date            |
| <b>Use clear messages</b> | Understand what the merge was for later |

## Summary

| Task                    | Command                         |
|-------------------------|---------------------------------|
| <b>Merge branches</b>   | git merge branch-name           |
| <b>Resolve conflict</b> | Edit file manually, then commit |
| <b>List branches</b>    | git branch                      |
| <b>See history</b>      | git log --oneline --graph       |

## Extra Tip

To avoid merge conflicts on teams:

- Communicate which files you're editing
- Keep branches short-lived and frequently merged





# Unit 6: Advanced Branching & Collaboration

## 1. Rebase Basics

### What is Rebase?

Rebasing takes your feature branch and **replays your commits on top of another branch**, like main.

**Use Case:** You want your feature branch to stay up-to-date and have a clean linear history.

### Rebase vs Merge

| Operation     | What it does                              | History    |
|---------------|-------------------------------------------|------------|
| <b>Merge</b>  | Combines histories, creates merge commits | Graph tree |
| <b>Rebase</b> | Rewrites history, avoids merge commits    | Linear     |

### Rebase Syntax:

```
git switch feature
git rebase main
```

This applies your feature branch commits **after the latest commit in main**.

### If conflicts occur:

1. Git will pause on conflict
2. Manually resolve the conflict in files
3. Run:
4. `git add .`
5. `git rebase --continue`

## Exercise 1: Rebase a Feature Branch

```
On main branch
echo "main version" > app.js
git add . && git commit -m "Main edit"

On feature branch (after some initial commit)
git switch feature
echo "feature version" > app.js
git add . && git commit -m "Feature edit"

Now try rebasing
git rebase main
If conflict occurs: resolve, then
git add app.js
git rebase --continue
```



## 2. Pull Requests (PRs)

### What is a PR?

A **Pull Request** (on GitHub) is a way to:

- Review code
- Discuss changes
- Approve and merge into main

### Steps to create a PR:

1. Push your feature branch to GitHub:
2. git push origin feature
3. On GitHub:
  - Click "**Compare & pull request**"
  - Add title and description
  - Submit PR to main branch
4. Team members can:
  - Review
  - Comment
  - Request changes
  - Approve & merge

PRs = safer & cleaner collaboration!

## 3. GitFlow & Feature Branch Strategies

These are **branching models** for teams:

### Git Flow:

- main → Production
- develop → Active development
- feature/xyz → Individual features
- release/1.0, hotfix/urgent-fix branches when needed

### Feature Branch Strategy (simpler for beginners):

- Always work on new branches:
  - feature/navbar-redesign
  - bugfix/login-error
  - refactor/db-models

Merge into main only after review/approval.

## 4. .gitignore Essentials

Use .gitignore to **skip unnecessary or sensitive files** from being tracked by Git.



**Common use cases:**

```
.env (API keys, secrets)
node_modules/
dist/, build/ folders
```

**Add .gitignore file:**

```
touch .gitignore
```

**Example .gitignore content:**

```
node_modules/
.env
secret.env
.DS_Store
```

**Track it:**

```
git add .gitignore
git commit -m "Add .gitignore"
```

## Exercise 2: Create and Use .gitignore

```
Create sensitive or temp file
touch secret.env
echo "API_KEY=12345" > secret.env

Add to .gitignore
echo "secret.env" >> .gitignore

Try adding files
git add .
git status # secret.env will be ignored
```

## Exercise 3: Create a Pull Request

1. Create a GitHub repo
2. Clone it locally and create a branch:
3. `git checkout -b feature/readme`
4. `echo "# GitHub Demo" > README.md`
5. `git add . && git commit -m "Add README"`
6. `git push origin feature/readme`
7. Go to GitHub → Open a PR from feature/readme to main

## Best Practices

| Tip                     | Reason          |
|-------------------------|-----------------|
| <b>Rebase before PR</b> | Cleaner history |



|                                      |                                     |
|--------------------------------------|-------------------------------------|
| <b>Use .gitignore</b>                | Prevent leaking sensitive files     |
| <b>Create PRs, not direct merges</b> | Enables review & feedback           |
| <b>One feature per branch</b>        | Easier to test and revert if needed |

## Summary

| Task                            | Command / UI Action                    |
|---------------------------------|----------------------------------------|
| <b>Rebase a branch</b>          | git rebase main                        |
| <b>Continue after resolving</b> | git rebase --continue                  |
| <b>Create .gitignore</b>        | touch .gitignore + list unwanted files |
| <b>Push feature branch</b>      | git push origin feature-name           |
| <b>Create PR</b>                | GitHub UI: Compare & pull request      |

## Unit 1: Introduction to Git

1. **What is Git?**
  - A. Programming language
  - B. Centralized version control system
  - C. Distributed version control system
  - D. Text editor
2. **Which of the following is a primary benefit of version control?**
  - A. Automatic software testing
  - B. Tracking code changes
  - C. Compiling code
  - D. Hosting websites
3. **Which command is used to configure a Git user's email globally?**
  - A. git user.email
  - B. git config email
  - C. git config --global user.email
  - D. git set email
4. **Which of these is *not* a Git area?**
  - A. Working Directory
  - B. Staging Area
  - C. Remote Server
  - D. Build Cache
5. **Git is classified as which type of version control system?**
  - A. Centralized
  - B. Distributed
  - C. Local-only
  - D. Hybrid

## Unit 2: Git Basics

6. **Which command initializes a new Git repository?**
  - A. git start
  - B. git init
  - C. git new
  - D. git create
7. **What does git status show?**
  - A. Current GitHub issues
  - B. Status of remote repositories
  - C. Modified and staged files
  - D. Running processes
8. **Which command stages all files in the directory?**
  - A. git add -all
  - B. git add /



- C. git add .
  - D. git push .
9. **Which of these is a good commit message?**
- A. "done"
  - B. "Fix: correct login validation logic"
  - C. "update"
  - D. "stuff added"
10. **What is the default branch name in Git (after 2020)?**
- A. master
  - B. head
  - C. main
  - D. origin

## Unit 3: Remote Repos

11. **Which command connects your local repo to a GitHub repo?**
- A. git connect
  - B. git remote add origin <url>
  - C. git link
  - D. git push origin
12. **What does git clone do?**
- A. Deletes the repo
  - B. Creates a backup
  - C. Copies a remote repo to local
  - D. Forks the repo
13. **What does git push do?**
- A. Pulls from remote
  - B. Sends commits to remote
  - C. Stages changes
  - D. Creates a PR
14. **To pull changes from GitHub, which command is used?**
- A. git send
  - B. git update
  - C. git pull origin main
  - D. git upload
15. **What is required to push to a GitHub repo?**
- A. Docker
  - B. Python
  - C. Remote URL and access
  - D. Web server

## Unit 4: Branching Basics

16. **What is the purpose of branching in Git?**
- A. To store credentials
  - B. To experiment without affecting main
  - C. To download updates
  - D. To access GitHub



17. **Which command creates a new branch named dev?**
- A. git add dev
  - B. git new branch dev
  - C. git branch dev
  - D. git create dev
18. **Which command switches to a branch called login-feature?**
- A. git change login-feature
  - B. git move login-feature
  - C. git switch login-feature
  - D. git jump login-feature
19. **Which command lists all branches?**
- A. git branches
  - B. git list-branch
  - C. git show-branches
  - D. git branch
20. **What happens if you commit on a new branch?**
- A. It updates the main branch
  - B. It only affects that branch
  - C. It syncs with GitHub
  - D. It discards previous commits

## Unit 5: Merge & Conflicts

21. **What does git merge do?**
- A. Deletes a branch
  - B. Applies changes from one branch to another
  - C. Conflicts branches
  - D. Creates a PR
22. **Merge conflicts occur when:**
- A. Same files exist in two branches
  - B. You clone a repo
  - C. You use .gitignore
  - D. You rename a branch
23. **Which marker is shown in a conflict file?**
- A. +++ CONFLICT
  - B. =====>
  - C. <<<<<<< HEAD
  - D. !conflict
24. **After resolving a conflict, you must:**
- A. Commit the resolution
  - B. Run git merge --abort
  - C. Delete the branch
  - D. Clone again
25. **Fast-forward merge means:**
- A. Merging two unrelated histories
  - B. Git creates a new merge commit
  - C. Git moves branch pointer ahead
  - D. Git discards changes



## Unit 6: Advanced Topics

26. **What does git rebase main do (on a feature branch)?**
  - A. Deletes main
  - B. Creates a PR
  - C. Reapplies feature commits on top of main
  - D. Pushes to main
27. **What is the purpose of .gitignore?**
  - A. Hide folders from GitHub
  - B. Avoid tracking unwanted files
  - C. Delete local files
  - D. Encrypt credentials
28. **Which file should be in .gitignore?**
  - A. index.html
  - B. main.js
  - C. .env
  - D. README.md
29. **Pull Request (PR) is used to:**
  - A. Push directly to main
  - B. Start a Git repo
  - C. Propose changes and get them reviewed
  - D. Track issues
30. **Which is a good Git strategy for team collaboration?**
  - A. Everyone commits on main
  - B. Rebase to hide mistakes
  - C. Use feature branches and PRs
  - D. Push untested code quickly

## MCQ Answer Key (1–30)

|        |        |        |        |
|--------|--------|--------|--------|
| Q1. C  | Q2. B  | Q3. C  | Q4. D  |
| Q5. B  | Q6. B  | Q7. C  | Q8. C  |
| Q9. B  | Q10. C | Q11. B | Q12. C |
| Q13. B | Q14. C | Q15. C | Q16. B |
| Q17. C | Q18. C | Q19. D | Q20. B |
| Q21. B | Q22. A | Q23. C | Q24. A |
| Q25. C | Q26. C | Q27. B | Q28. C |
| Q29. C | Q30. C |        |        |

