Branching and Merging in Git

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Introduction

Branching and merging in Git are fundamental concepts that allow multiple people to work on a project simultaneously without interfering with each other's work. Here's a detailed explanation:

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Branching

Branches are pointers to a specific commit in the project history. They allow you to develop features, fix bugs, or safely experiment with new ideas in isolation from the main project.

Key Points:

- Master/Main Branch: The default branch when you create a Git repository. It's the stable version of your project.
- Creating a New Branch: You can create a new branch to work on a feature or a fix without affecting the master branch.

```sh
git branch feature-branch
```

- Switching to a Branch: You can switch to the new branch to start working on it.

```sh
git checkout feature-branch
```

- Creating and Switching: A shortcut to create and switch to a new branch.

```sh
git checkout -b feature-branch
```

- Listing Branches: You can list all the branches in your repository.

```sh
git branch
```

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Merging

Merging is the process of combining the changes from one branch into another. This is usually done to integrate the work done in a feature branch back into the main branch.

Key Points:

- Fast-Forward Merge: If the main branch has not moved since the branch was created, Git simply moves the main branch pointer forward.

  ```sh
  git checkout main
  git merge feature-branch
  ```

- Three-Way Merge: When the main branch has progressed since the branch was created, Git uses a three-way merge to combine the histories.

  ```sh
  git checkout main
  git merge feature-branch
  ```

- Merge Conflicts: Sometimes Git can't automatically merge changes and will require you to resolve conflicts manually.

  ```sh
  # Edit the conflicting files to resolve conflicts
  git add <resolved-files>
  git commit
  ```

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Rebase

Rebase is another way to integrate changes from one branch into another. It allows you to move or combine a sequence of commits to a new base commit.

Key Points:

- Rebase Command:

  ```sh
  git checkout feature-branch
  git rebase main
  ```

- Interactive Rebase: Allows you to modify commits as they are moved to the new base.

  ```sh
  git rebase -i main
  ```

- Rebase vs. Merge: Rebasing can create a cleaner project history, but merging preserves the complete history of all changes.

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Best Practices

- Feature Branches: Use feature branches for all new features and bug fixes.
- Pull Requests: Use pull requests to review and discuss code before merging it into the main branch.
- Frequent Commits: Commit frequently to save your work and make it easier to resolve conflicts.
- Descriptive Branch Names: Use descriptive names for your branches, like `feature/login` or `bugfix/issue-123`.