Exercise: A Journey Through Git

Goal

Learn the fundamentals of Git by working on a Python project that computes prime numbers and generates Fibonacci sequences, while navigating through various Git commands.

Step 1: Initialize a Git Repository

1. **Navigate to desired directory**

   Make sure to make it in a folder that is not synchronized ie. no OneDrive, Google Drive or similar. One safe spot is the user folder which can be navigated to in a **powershell** or a **linux terminal** simply with:

   ```
   cd ~
   ```

2. **Create a new directory**

   ```
   mkdir git_exercise
   cd git_exercise
   ```

3. **Initialize a Git repository**:

   ```
   git init
   ```

4. **Check the status** of your repository:

   ```
   git status
   ```

   At this point, there should be nothing tracked.

Step 2: Write a Python Program to Compute Prime Numbers

1. **Create a Python file** named `prime_numbers.py` and write code that checks if a number is prime **[COPY PASTE]**:

   ```
   def is_prime(num):
    if num < 2:
        return False
    for i in range(2, int(num**0.5) + 1):
   ```

```
            if num % i == 0:
                return False
        return True

    def get_primes(n):
        primes = []
        for i in range(2, n+1):
            if is_prime(i):
                primes.append(i)
        return primes

    if __name__ == "__main__":
        n = int(input("Find primes up to: "))
        print(get_primes(n))
```

2. **Check that the code runs as expected.**

Step 3: Stage and Commit the Changes

1. **Add the file** to the staging area:

```
git add prime_numbers.py
```

2. **Check the status**:

```
git status
```

3. **Commit your changes**:

```
git commit -m "Add prime number computation"
```

4. Now is a good time to **mark** the commit with a `tag` to indicate that up until this commit the stuff is working.

```
git tag prime_number
```

5. Check the history of your repository.

```
git log
```

Step 4: Create a Remote Repository (on GitHub/GitLab)

1. **Create a remote repository** on GitHub/GitLab.
2. **Link your local repository** to the remote repository:

```
git remote add origin https://github.com/username/git_exercise.git
```

3. **Push your code** to the remote repository:

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

Step 5: Clone the Repository to Another Folder

1. **Navigate out** of the current folder and clone the repository to a new location:

```
cd ..
git clone https://github.com/username/git_repo.git clone-folder
```

2. **Move into the cloned repository**:

```
cd clone-folder
```

Step 6: Create a Branch Named "fibonacci"

1. **Create a new branch** named `fibonacci`:

```
git switch -c fibonacci
```

The command `switch` allows you to switch between branches and different commits. When the `-c` flag is used in combination, a new branch will be **created** with a designated name as the last parameter, in this case `fibonacci`.

Step 7: Implement a Fibonacci Sequence Generator

1. **Create a new file `fibo_numbers.py`** to include a function for generating Fibonacci numbers **[COPY PASTE]**:

```
def fibonacci(n):
    fib_sequence = [0, 1]
    while len(fib_sequence) < n:
        fib_sequence.append(fib_sequence[-1] + fib_sequence[-2])
    return fib_sequence

if __name__ == "__main__":
    fib_n = int(input("Generate how many Fibonacci numbers? "))
    print(fibonacci(fib_n))
```

2. **Add and commit the changes**:

Step 8: Merge the "fibonacci" Branch with Main

1. **Merge the `fibonacci` branch** into the main branch:

```
git merge fibonacci
```

2. **Run the code again** to ensure both prime number and Fibonacci functions are present.

Step 9: Make a Change in the Cloned Repository and Push It

1. **Modify `prime_numbers.py`** to compute primes between two input numbers **[COPY PASTE]**:

```
def get_primes(m, n):
    primes = []
    for i in range(m, n+1):
        if is_prime(i):
            primes.append(i)
    return primes

if __name__ == "__main__":
    m = int(input("Start prime search from: "))
    n = int(input("Find primes up to: "))
    print(get_primes(m, n))
```

2. **Add**, **commit**, and **push** the changes:

Step 11: Make Another Change in the Original Repository

1. **Return to the original folder**:

```
cd ../git_exercise
```

2. **Modify** `prime_numbers.py` (don't pull yet) to print the number of primes found **[COPY PASTE]**:

```
print(f"Number of primes found: {len(get_primes(m, n))}")
```

3. **Add and commit the changes to make a merge conflict**:

```
git add prime_numbers.py
git commit -m "Add print statement for number of primes"
```

4. **Push the changes**:

```
git push
```

You will probably see something like this:

```
ap@pc:~/Documents/Git_test/git_exercise$ git push
To https://github.com/anpom21/git_practice
 ! [rejected]        master -> master (non-fast-forward)
error: failed to push some refs to 'https://github.com/anpom21/git_practice'
hint: Updates were rejected because the tip of your current branch is behind
hint: its remote counterpart. If you want to integrate the remote changes,
hint: use 'git pull' before pushing again.
hint: See the 'Note about fast-forwards' in 'git push --help' for details.
```

Now this is something that will happen when you work in teams on bigger projects. And it will especially happen if you dont make branches in your projects. So **remember** to use branches to divide your projects!

5. **If push didn't work try pulling first**:

```
git pull
```

If you see this:

```
ap@pc:~/Documents/Git_test/git_exercise$ git pull
hint: You have divergent branches and need to specify how to reconcile them.
hint: You can do so by running one of the following commands sometime before
hint: your next pull:
hint:
hint:   git config pull.rebase false  # merge
hint:   git config pull.rebase true   # rebase
hint:   git config pull.ff only       # fast-forward only
hint:
hint: You can replace "git config" with "git config --global" to set a default
hint: preference for all repositories. You can also pass --rebase, --no-rebase,
hint: or --ff-only on the command line to override the configured default per
hint: invocation.
fatal: Need to specify how to reconcile divergent branches.
```

You can basically handle your divergent paths in different ways, I prefer merging as it is simple, and works.

```
git config pull.rebase false  # merge
```

Now try to pull again.

```
git pull
```

Now you should get a merge conflict.

```
ap@pc:~/Documents/Git_test/git_exercise$ git pull
Auto-merging prime_numbers.py
CONFLICT (content): Merge conflict in prime_numbers.py
Automatic merge failed; fix conflicts and then commit the result.
```

Step 12: Resolve the Merge Conflict

Merge conflicts are very common when working on projects and files which are frequently edited. Therefore it is important to know what a **merge conflict** entails and how you can quickly be on with your day. A merge conflict happens in Git when two branches have conflicting changes to the same part of a file, and git doesn't know how to automatically merge them. This requires manual intervention to resolve.

1. **Understanding** the merge conflict.

The first place you will see the merge conflict is in the terminal as mentioned before. Here it state all the files in which a merge conflict occured. In our instance it will look something like this:

```
ap@pc:~/Documents/Git_test/git_exercise$ git pull
Auto-merging prime_numbers.py
CONFLICT (content): Merge conflict in prime_numbers.py
Automatic merge failed; fix conflicts and then commit the result.
```

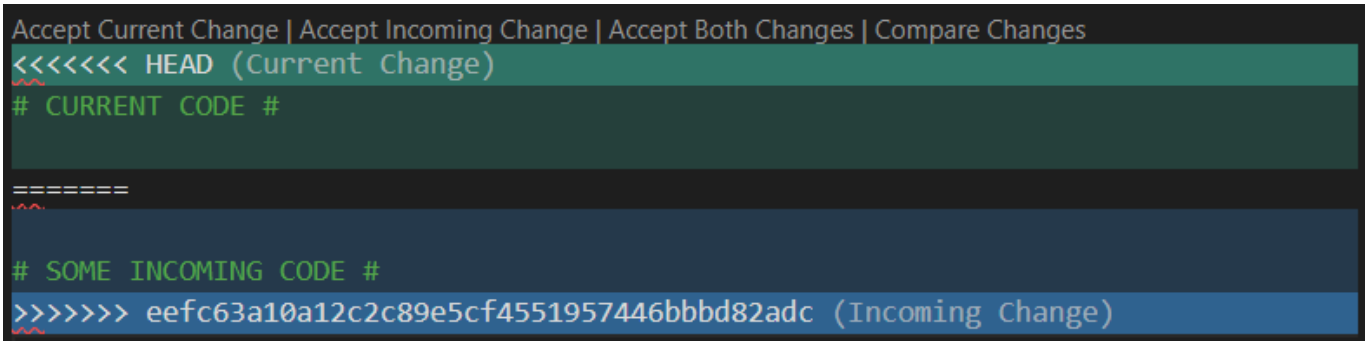
You can see that a merge conflict occured in `prime_numbers.py` from the line: `CONFLICT (content): Merge conflict in prime_numbers.py`

Now go to `prime_numbers.py` to resolve the merge conflict.

A merge conflict is not dangerous fear not! Lets disect it together.

- A merge conflict will begin with a `<<<<<<< HEAD` statement to indicate the changes of the current branch.
- Following this statement will be some `# CURRENT CODE #` of the current branch.
- Then some divider signs `=======` to seperate the **current** and **incoming** code.
- Then `# SOME INCOMING CODE #`.
- Finally the end of the merge conflict will be shown with some arrows and the commit id `>>>>>>> eefc6...2adc`. This is convenient if you should want to investigate the commit that casued the merge conflict further.

If you are using VScode the merge conflict will look like this:



It can be resolved either by only keeping the code you want and deleting the rest or simply clicking one of the bottoms at the top.

2. **Resolve the merge conflict** in `prime_numbers.py`. Combine the changes
3. **Stage and commit** the resolved file.
4. **Push** the resolved changes.

Final Thoughts

This exercise covers the complete workflow of using Git in a project: initializing a repository, working with remotes, cloning, resolving conflicts, branching, and merging.

A common work/ project situation

Often when working on projects in a team merge conflicts, changing files, deleted files and name changes are common. We should be able to handle all of these situations in git.