Version Control and Collaboration with Git and GitHub

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Skip intro — To the contents slide.

I can teach this workshop at your institution — Email me.

Who am I?

Resul Umit

- post-doctoral researcher at the University of Oslo
- interested in representation, elections, and parliaments
    - a recent publication: Parliamentary communication allowances do not increase electoral turnout or incumbents’ vote share
- teaching workshops also on
    - writing reproducible research papers with R
    - working with Twitter data in R
    - creating professional websites with R
- more information available at resulumit.com

The Workshop — Overview

- Half a day, on how to
  - version our academic work
  - store the different versions securely — in multiple places
  - collaborate with co-authors — in writing as well as versioning and storing

- Using Git and GitHub, through
  - command line
  - GitHub Desktop, RStudio

- Most useful for those working with pain text
  - e.g., Markdown, rather than Microsoft Word
  - but not exclusively so
    - projects based on binary files would also benefit
    - you may switch to plain text in the future

The Workshop — Motivation

- Research projects have many versions, as they are typically completed
    - over a long period of time
    - in numerous sittings
    - by multiple authors
    - on multiple computers

- With many versions created over time, in different sittings …, there emerges various challenges
    - keeping track of changes and versions
    - reverting to a previous version when necessary
    - storing versions safely in multiple locations
    - communicating the versions to other authors and/or computers
    - working on the same project with co-authors at the same time

The Workshop — Worklow

The Git-and-GitHub workflow has two steps

- Git creates, saves, and tracks versions
  - on our own machine
  - but also can also save them elsewhere, such as on GitHub
- Github keeps a copy online
  - allowing for safe storage in the cloud
  - but also for collaboration, through a common version

The Workshop — Worklow — Comparison

- The Git-and-GitHub workflow might seem daunting to adopt at first
    - originally designed for software development
        - here, adopted to academic work
    - but offers many benefits over alternatives
        - efficient, free

- Existing workflows might seem easier to keep
    - we all version control and collaborate, one way or another
        - e.g., renaming, saving, and emailing to co-authors
        - using Dropbox, Google Docs, Overleaf
    - but less efficient in the long run

- Give the Git-and-GitHub workflow a chance
    - if you are curious enough to be here on this slide, this is probably the right workflow for you

The Workshop — Contents

Part 1. Introduction

- e.g., getting ready to work together

Part 2. Tools

- e.g., downloading workshop material

Part 3. Version Control

- .e.g, versioning by typing commands

Part 4. What to Version

- e.g., ignoring

Part 5. Collaboration

- e.g., working on the same files

Part 6. Third-Party Applications

- e.g., using GitHub Desktop

The Workshop — Organisation

- ~~Sit in groups of two~~
  - participants learn as much from their partner as from instructors
  - play the role of co-authors

- Type, rather than copy and paste, the code that you will find on these slides
  - typing is a part of the learning process
  - keyboard shortcuts for copy/paste does not work in the shell

- When you have a question
  - ~~ask your partner~~
  - ~~google together~~
  - if it cannot wait, turn your microphone on and ask
  - if it can wait, type it in the chat

The Workshop — Organisation — Slides[*]

01:00

Slides with this background colour indicate that your action is required, for

- setting the workshop up
  - e.g., downloading course material
- completing the exercises
  - e.g., saving a different version of a file
  - there are 30+ exercises
  - these slides have countdown timers

[*] These slides are and will remain available at https://resulumit.com/teaching/git_workshop.html.

The Workshop — Organisation — Slides

- Codes and texts that go in `appear as such — in a different font, on gray background`

- Results that come out in appear as such — in the same font, on green background

- Specific sections are highlighted yellow as such for emphasis

- The slides are designed for self-study as much as for the workshop
  - *accessible*, in substance and form, to go through on your own

The Workshop — Aims

- To make you aware what is possible with Git and GitHub
  - we will cover a large breath of issues, not all of it is for long-term memory
    - one reason why the slides are designed for self study as well
  - awareness of what is possible, `Google`, and perseverance are all we need
- To encourage you to convert into the Git and GitHub workflow
  - practice with a mock project, co-author
  - start converting a real one right after the workshop
    - happy to help via emails afterwards

Part 2. Tools

Back to the contents slide.

Workshop Materials — Overview

- Materials mimic a simple academic project
    - imagined to introduce a new dataset
        - on the Google Scholar rankings of fictitious journals
        - with a short manuscript
    - in the structure shown on the right

```
git_workshop-materials
    |
    |- data
    |   |
    |   |- journals.csv
    |
    |- manuscript
    |   |
    |   |- journals.docx
    |   |- journals.pdf
    |   |- journals.Rmd
    |
    |- README.md
```

Workshop Materials — Download from the Internet

- Download the materials from https://github.com/resulumit/git_workshop/tree/materials
    - on the webpage, follow

> `Code -> Download ZIP`

- Unzip and rename the folder
    - unzip to a location that is not synced
        - e.g., perhaps Documents, but not Dropbox
    - rename the folder as `YOURNAME_git_workshop`
        - e.g., `resul_git_workshop`
        - this renaming will come handy later on

Workshop Materials — Contents — Data

`data\journals.csv`

- a dataset created with the `fabricatr` package (Blair et al., 2019), imagined to explore the `Google Scholar` rankings of fictitious journals

- includes the following variables

  - **name**: journals (1090 random titles)
  - **origin**: geographic origins (five continents)
  - **branch**: major discipline of journals (four branches)
  - **since**: time of first publication (years)
  - **h5_index**: H5 Index (integers)
  - **h5_median**: H5 Median (integers)
  - **english**: English (1) *vs.* other-language (0) journals
  - **subfield**: subfield (1) *vs.* generalist (0) journals
  - **issues**: number of issues published per year (integers)

Workshop Materials — Contents — Manuscript

- `manuscript\journals.docx`
    - the Microsoft Word document, holding the text for the manuscript of the project

- There are two other versions of `paper.docx` in the same folder
    - saved in PDF and R Markdwon formats respectively
        - `manuscript\journals.pdf`
        - `manuscript\journals.Rmd`

Workshop Materials — Contents — README

`README.md`

- a Markdown document, holding the basic information about the project

Git — Download from the Internet and Install

- Git is a software that
  - keeps track of versions of a set of files
  - is *local* to you, the records are kept on your computer
  - is free

- To get this software
  - on Windows, install 'Git for Windows', downloading from https://gitforwindows.org
    - select 'Git from the command line and also from 3rd-party software'
  - on Mac, install 'Git', downloading from https://git-scm.com/downloads

GitHub — Open an Account

- GitHub is a hosting service, or a website, that
    - keeps a copy of the versions created by Git
    - is *remote* to you, like the Dropbox website
    - is, mostly, free

- To sign up for this service
    - register an account at https://github.com
        - registering an account is free
        - usernames are public, editable
            - either choose an anonymous username for now
            - or choose one carefully — it becomes a part of users' online presence

GitHub — Create a new GitHub repository

- Repository is a folder, or directory, which can keep files and other folders containing files under version control
  - a set of files whose records are kept together
  - repo is a popular abbreviation for repository

- To create a repo, on GitHub, follow:

  ```
  Repositories -> New -> Repository name (e.g., "git_workshop") -> Public ->
  Create repository
  ```

- observe that
  - repository URLs have the following structure: https://github.com/USER_NAME/REPOSITORY_NAME
    - this is the address to view the repository online
    - for use in the `Terminal`, the address gets the `.git` extension
      - e.g., https://github.com/USER_NAME/REPOSITORY_NAME.git

GitHub — Create a new GitHub repository — Notes

There are two types of repositories

- public repositories
    - free for all to create
    - free for everyone else to see, copy, *propose* changes
- private repositories
    - in general, a paid service
    - with GitHub Education, it free for academics, students
        - requires a separate application

GitHub — Create a personal access token

- Accessing GitHub through the shell requires using a password
  - not the same password to login to GitHub website
  - personal access token (PAT) is the new generation of passwords

- Generate a PAT at https://github.com/settings/tokens
  - note it down for now
  - on how to caching PATs safely, see https://happygitwithr.com/credential-caching.html

GitHub Desktop — Download from the Internet and Install

- GitHub Desktop is a software that
  - makes working with Git and GitHub easier

- To get this software
  - download the file for your operating system from https://desktop.github.com/
  - and install

Other Resources*

- Git Reference Manual
  - available at https://git-scm.com/docs
- Pro Git (Chacon and Straub, 2021)
  - open access at https://git-scm.com/book/en/v2
- Git Cheat Sheet
  - available at https://training.github.com/downloads/github-git-cheat-sheet.pdf
- Git Visual Cheat Sheet
  - available at https://ndpsoftware.com/git-cheatsheet.html

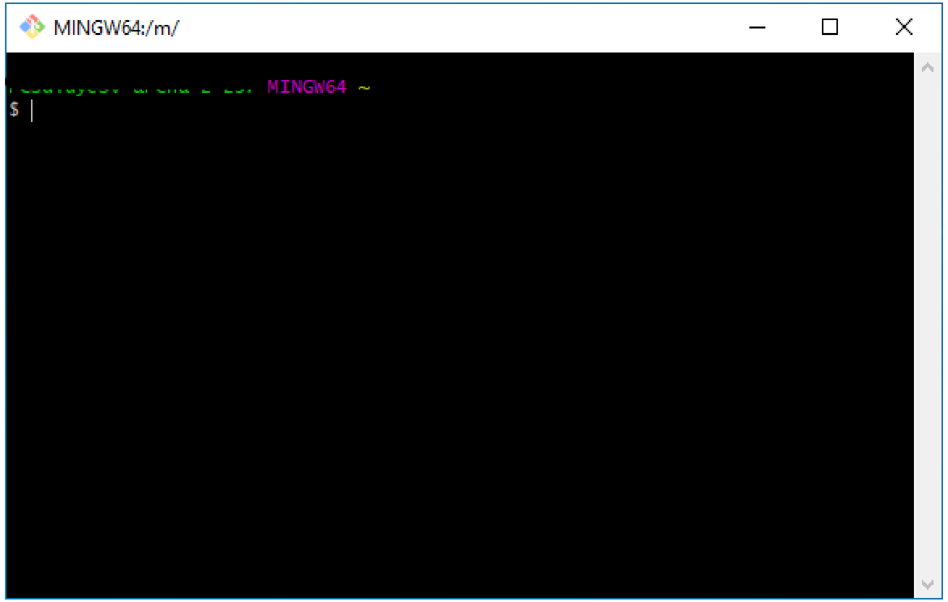
Part 3. Version Control

Back to the contents slide.

Version Control — Shell

Type, and enter, your commands into the shell

- also called command line interpreters
- depends on your operating system
  - on Windows, use the Git Bash app
  - on Mac, use the Terminal
- does not accept keyboard shortcuts
  - e.g., `ctrl + v` will not paste into shell
  - but mouse buttons and clicks will work



```
[illegible] MINGW64 ~
$ |
```

Version Control — Git Command Structure

Git commands

- start with the pre-fix `git`

```
$ git
```

Version Control — Git Command Structure

Git commands

- start with the pre-fix `git`
- might continue with
  - a command

```
$ git push
```

Version Control — Git Command Structure

Git commands

- start with the pre-fix `git`
- might continue with
    - a command
    - an option

```
$ git --version
```

Version Control — Git Command Structure

Git commands

- start with the pre-fix `git`
- might continue with
  - a command
  - an option
- might take
  - one or more arguments

```
$ git push origin master
```

Version Control — Git Command Structure

Git commands

- start with the pre-fix `git`
- might continue with
  - a command
  - an option
- might take
  - one or more arguments
  - one or more flags

```
$ git commit -m "I revised the abstract"
```

Version Control — config

- Use the `config` command to introduce yourself to Git
  - with the email address that you have used to sign up for GitHub

```
git config --global user.name "YOUR-NAME"
git config --global user.email "YOUR-EMAIL-ADDRESS"
```

- enter the following line in the shell, to observe whether the previous step was successful

```
git config --global --list
```

Version Control — cd

Use the cd command to

- see which directory are you currently in

```
$ cd
```

```
/m
```

Version Control — cd

Use the cd command to

- see which directory are you currently in
- move into a directory that you prefer

Note that

- cd is not a git command
  - it does not start with git
- you can drag and drop the directory onto the shell
  - instead of typing the full path

```
$ cd ../pc/Desktop/resul_git_workshop
```

../pc/Desktop/resul_git_workshop

Version Control — `ls`

Use the `ls` command to list the contents of

- the current directory

```
$ ls
```

```
data/   manuscript/   README.md
```

Version Control — `ls`

Use the `ls` command to list the contents of

- the current directory
- a sub-directory

```
$ ls data/
```

```
journals.csv
```

Exercises

02:00

1) Move into the directory holding the workshop materials

- using the `cd` command
- hint: after a space, drag and drop the folder onto the shell

2) See the contents of the folder in the shell

- using the `ls` command

Version Control — `git init`

Use the `git init` command to turn a directory into a git repository directory

```
$ git init
```

```
Initialized empty Git repository in ../resul_git_workshop/.git/
```

Version Control — `git init` — Notes

The `git init` command creates a hidden `.git` subdirectory, with the structure on the right

- currently mostly empty
  - as nothing is being tracked yet
- not visible with `ls`
  - but visible with `ls -al`
  - on, on Windows, follow

    > ```
    > File Explorer -> View -> Hidden
    > items
    > ```
- hidden, so that it is harder to delete or alter by mistake

```
.git
  ├── refs
  │   ├── tags
  │   └── heads
  ├── objects
  │   ├── pack
  │   └── info
  ├── info
  │   └── exclude
  ├── hooks
  │   (12 files)
  ├── HEAD
  ├── config
  └── description
```

Version Control — `git add`

Use the `git add` command to start tracking

- a specific file

```
$ git add README.md
```

```
.git
 |
 ...
 ├── objects
 │     ├── pack
 │     ├── info
 │     └── 8f
 │          └── ec6eb5b06dc535825227bd0e6883882075639b
 │
 ├── index
 ...
```

Version Control — `git add`

Use the `git add` command to start tracking

- a specific file
- multiple files

```
$ git add README.md  data/journals.csv
```

Version Control — `git add`

Use the `git add` command to start tracking

- a specific file
- multiple files
- everything in the directory

```
$ git add .
```

Version Control — `git add` — Notes

- The `git add` command alone does not create a version
    - it must be followed by the `git commit` command, without which
        - there is no version saved yet
        - the tracked files are said to be .yellow-h[staged], or in the .yellow-h[staging area]

- Use the `git add` command (and then, the `git commit` command)
    - not only to add a new file to be versioned
    - but also, once that file changes, to snapshot a new version of that file every time

- A file in the staging area can be taken back, before its commit
    - by one of the following, depending on whether they have been versioned before

```
$ git rm --cached README.md
```

```
$ git rm --staged README.md
```

Version Control — `git commit`

Use the `git commit` command to take a snaphot of, or to version, a repository

```
$ git commit -m "adding the README file"
```

```
.git
 |
 ...
 ├── objects
 |      ├── pack
 |      ├── info
 |      ├── 8f
 |      |    └── ec6eb5b06dc535825227bd0e6883882075639b
 |      |
 |      ├── b2
 |      |    └── 1ac00c3e97d186c3797908a79846dcde0b305a
 |      |
 |      └── fd
 |           └── cb0ad247419c81076c8aec4021091f3ed630b0
 ...
```

Version Control — `git commit`

Use the `git commit` command to take a snaphot of, or to version, a repository

- with the changes in the staging area

```
$ git commit -m "adding the README file"
```

Note that

- committing requires registering a message
  - to yourself and to co-authors to indicate what has changed

Version Control — `git commit`

Use the `git commit` command to take a snaphot of, or to version, a repository

- with the changes in the staging area

```
$ git commit -m "adding the README file"
```

Note that

- committing requires registering a message
    - to yourself and to co-authors to indicate what has changed
    - typed after the –m flag

Recall that

- committing requires one or more files in the staging area in the first place
    - staged with the `git` add command

Exercises

03:00

3) Start tracking the README.md file

- using the `git add` command

4) Take a snapshot of the current version of the file

- using the `git commit` command

Version Control — `git status`

Use the `git status` command to check the status of your repository

- e.g., are there any untracked, modified, deleted, staged etc. files?

```
$ git status
```

```
On branch master

Untracked files:
  (use "git add ..." to include in what will be committed)
        data/
        manuscript/

no changes added to commit (use "git add" and/or "git commit -a")
```

Exercises

07:30

5) Check the status of your repository

- using the `git status` command

6) Make a change to the `README.md` file, and save

- e.g., edit the first sentence on the list

7) Check the status of your repository again

8) Commit the new version

- recall the combination of commands needed

Version Control — `git log`

Use the `git log` command to see the changes in reverse order

```
$ git log
```

```
commit 241b7285a00d47d69655d4a4afcd50989d5b50a8 (HEAD -> master)
Author: Resul Umit <resulumit@gmail.com>
Date: Sat Mar 6 09:27:32 2021 +0100

    correct the maths error

commit fdcb0ad247419c81076c8aec4021091f3ed630b0
Author: Resul Umit <resulumit@gmail.com>
Date: Sat Mar 6 08:55:21 2021 +0100

    adding the README file
```

Version Control — `git log`

Use the `git log` command to see the changes in reverse order

- the `oneline` flag returns a summary

```
$ git log --oneline
```

```
241b728 (HEAD -> master) correct the maths error
fdcb0ad adding the README file
```

Note that

- commit hash is abbreviated to the first 7 digits, enough to uniquely identify each commit
  - i.e., 241b728 from 241b7285a00d47d69655d4a4afcd50989d5b50a8
- `HEAD` refers to the snapshot of your last commit
- `master` is the default branch name
  - we have only one branch at the moment, but can have multiple
  - think of a branch as a version of versions, or a copy of the whole repository

Version Control — git branch

Use the `git branch` command to create a copy of your repository, on your local machine

```
$ git branch coding_branch
```

```
              add &          add &
             commit         commit
master: c1 ----------> c2 ----------> c3
                                      |
                                      |
                                     b|
                                     r|
                                     a|
                                     n|
                                     c|
                                     h|
                                      |
                                      v
                      coding_branch:  c3
```

Version Control — `git branch`

Use the `git branch` command to create a copy of your repository, on your local machine

```
$ git branch coding_branch
```

Note that

- this line takes an argument for branch name
  - the default repository is called master

Version Control — `git branch`

Use the `git branch` command to create a copy of your repository, on your local machine

```
$ git branch coding_branch
```

Note that

- this line takes an argument for branch name
  - the default repository is called master
- we are still in the master branch
  - check which branch are you in with the following command

```
$ git branch -v
```

Version Control — `git branch` — Notes

- Branches can be developped
  - one at a time

```
              add &          add &
             commit         commit
master: c1 ----------> c2 ----------> c3
                                      |
                                      |
                                     b|
                                     r|
                                     a|
                                     n|
                                     c|
                                     h|
                                      |    add &          add &
                                      v   commit         commit
                     coding_branch:   c3 ----------> c4 ----------> c5
```

Version Control — `git branch` — Notes

- Branches can be developped
    - one at a time
    - at the same time

```
              add &          add &          add &
             commit         commit         commit
master: c1 ----------> c2 ----------> c3 ----------> c5
                                      |
                                      |
                                     b|
                                     r|
                                     a|
                                     n|
                                     c|
                                     h|
                                      |    add &          add &
                                      v   commit         commit
                     coding_branch:   c3 ----------> c4 ----------> c5
```

Version Control — `git diff`

Use the `git diff` command to see what has changed, for changes

- not staged or committed yet

```
$ git diff
```

```
diff --git a/README.md b/README.md

…

--- a/README.md
+++ b/README.md

…

-1. Two times two makes five.
+1. Two times two makes four.
```

Version Control — `git diff`

Use the `git diff` command to see what has changed, for changes

- not staged or committed yet
- staged but not committed yet

```
$ git diff --staged
```

Version Control — `git diff`

Use the `git diff` command to see what has changed, for changes

- not staged or committed yet
- staged but not committed yet
- committed since a specific commit

```
$ git diff fdcb0ad
```

```
$ git diff HEAD~2
```

Version Control — `git diff`

Use the `git diff` command to see what has , for changes

- not staged or committed yet
- staged but not committed yet
- committed since a specific commit
- between different commits

```
$ git diff 241b728 1dfb2a5
```

```
$ git diff HEAD~1 HEAD~2
```

Version Control — `git diff`

Use the `git diff` command to see what has changed, for changes

- not staged or committed yet
- staged but not committed yet
- committed since a specific commit
- between different commits
- between different commits in one or more specific files

```
$ git diff 241b728 1dfb2a5 README.md
```

```
$ git diff HEAD~1 HEAD~2 README.md
```

Version Control — `git diff`

Use the `git diff` command to see what has changed, for changes

- not staged or committed yet
- staged but not committed yet
- committed since a specific commit
- between different commits
- between different commits in one or more specific files
- between different branches

```
$ git diff master..coding_branch
```

Version Control — `git checkout`

Use the `git checkout` command to switch to

- a different version off all files in the same branch

```
$ git checkout 241b728
```

```
$ git diff HEAD~1
```

Version Control — `git checkout`

Use the `git checkout` command to switch to

- a different version off all files in the same branch
- a different version of one ore more specific files

```
$ git checkout 241b728 README.md
```

```
$ git checkout HEAD~1 README.md
```

Version Control — `git checkout`

Use the `git checkout` command to switch to

- a different version off all files in the same branch
- a different version of one ore more specific files
- a different branch

```
$ git checkout coding_branch
```

Exercises

07:30

9) Make sure there is nothing to commit in the master branch

   - using the `git status` command to see

10) Make a new branch and switch to it

   - using the `git branch` and `git checkout` commands

11) Start tracking the `data/journals.csv` file in this new branch

12) Commit the new version to this branch

13) Rename the first variable of the dataset, stage, and commit

   - e.g., from `name` to `journal_name`
   - both in `README.md` and `data/journals.csv`

14) Switch back to the master branch

15) Check the differences between the branches

   - using the `git diff` command

Version Control — `git merge`

Use the `git merge` command to integrate different versions of your repository into a single version

```
$ git merge coding_branch
```

```
              add &          add &
             commit         commit
master: c1 ----------> c2 ----------> c3 ------------------------> c6
                                      |                             ^
                                      |                             |
                                     b|                             |m
                                     r|                             |e
                                     a|                             |r
                                     n|                             |g
                                     c|                             |e
                                     h|                             |
                                      |    add &          add &     |
                                      v   commit         commit     |
                     coding_branch:   c3 ----------> c4 ----------> c5
```

Version Control — `git merge`

Use the `git merge` command to integrate different versions of your repository into a single version

```
$ git merge coding_branch
```

Note that

- this line includes one argument
  - from where to merge

Version Control — `git merge`

Use the `git merge` command to integrate different versions of your repository into a single version

```
$ git merge coding_branch
```

Note that

- this line includes one argument
  - from where to merge

- this merges into the current branch
  - move into the desired branch first
    - using the `git checkout` command

Version Control — `git merge` — Conflicts

- Merge is done automatically if there are no conflicts
    - conflicts emerge when versions to be merged include edits *on the same line of the same file*
    - edits on different lines are not a problem as changes are tracked line by line

- Merge conflicts require human intervention
    - by editing the conflicting lines
        - after the merge attempt
        - marked in the document with the conflict
    - and commiting the corrected file

```
<<<<<<<< HEAD
1. Two times two makes five.
=======
1. Two times two makes tree.
>>>>>>>> new_branch
```

Exercises

07:30

16) Merge the coding_branch into the master branch

17) Make a change on the same line of the README.md in both branches

18) Try to merge the coding_branch into the master branch

- hint: this will lead to a merge conflict

19) Solve the conflict and commit

Version Control — `git remote add`

Use the `git remote add` command to define a different place, to save an backup of your repositories

- e.g., a repository on GitHub
    - could also be a directory on an external hard drive

```
$ git remote add origin https://github.com/resulumit/git_workshop.git
```

Version Control — `git remote add`

Use the `git remote add` command to define a different place, to save an external copy of your repositories

- e.g., a repository on GitHub
    - could also be a directory on an external hard drive

```
$ git remote add origin https://github.com/resulumit/git_workshop.git
```

Note that this includes

- a valid address for the external copy
    - e.g., there is a repository on my GitHub account called `git_workshop`

Version Control — `git remote add`

Use the `git remote add` command to define a different place, to save an external copy of your repositories

- e.g., a repository on GitHub
  - could also be a directory on an external hard drive

```
$ git remote add origin https://github.com/resulumit/git_workshop.git
```

Note that this line includes

- a valid address for the external copy to be saved
  - e.g., there is a repository on my GitHub account called `git_workshop`
- an arbitrary name for this external repository
  - traditionally called `origin`, could also be anything else

Version Control — `git push`

Use the `git push` command to save a copy of your local repository to its remote repository

```
$ git push origin master
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        - already defined with the `git remote add` command

Version Control — `git push`

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Note that

- this line includes two arguments
    - where and what to push
        - could be any branch

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- this line includes two arguments
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    - necessitating a pull first

Version Control — `git push`

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Note that

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    - where and what to push

- pushing will be rejected if the remote repository has edits that the local repository does not
    - necessitating a pull first

- if this is your first time using GitHub, you will be prompted to authenticate
    - follow the instructions on your screen and in your email
        - using the PAT that you created in Part 2

Version Control — `git pull`

Use the `git pull` command to get a copy of the remote repository, and merge it into the local repository

```
$ git pull origin master
```

Version Control — `git pull`

Use the `git pull` command to get a copy of the remote repository, and merge it into the local repository

```
$ git pull origin master
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Note that

- this line includes two arguments
    - where to pull from
        - already defined with the `git remote add` command

Version Control — `git pull`

Use the `git pull` command to get a copy of the remote repository, and merge it into the local repository

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$ git pull origin master
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Note that

- this line includes two arguments
    - where and what to pull from
        - could be any branch

Version Control — `git pull`

Use the `git pull` command to get a copy of the remote repository, and merge it into the local repository

```
$ git pull origin master
```

Note that

- this line includes two arguments
    - where and what to pull from
- pulling involves fetching and merging
    - might lead to conflicts, and necessitate solving them manually

Exercises

07:30

20) Add a remote repository

- e.g., the GitHub repository that you have already created
- using the `git remote add` command

21) Push the master branch to GitHub

- using the `git push` command
- observe the repository on GitHub

22) Commit a change to the README.md file on GitHub

- by clicking on the pen symbol

23) Pull the changes to the local repository

- using the `git pull` command

Part 4. What to Version

Back to the contents slide.

What to Version — Overview

There might be good reasons to exclude some others from versioning

- for local-only repositories
    - files that we (re-)create automatically as outputs
        - e.g., `paper.pdf`, as opposed to paper.Rmd
- for repositories that are also on GitHub
    - files that contain information that we do not want others to see
        - e.g., personal API keys
    - files that we do not have the right to share with others
        - e.g., secondary data with user agreements otherwise
    - files that are too large
        - individual files cannot be larger than 100MB

What to Version — `.gitignore`

- `.gitignore` specifies which file(s) and/or folder(s) should be excluded from version control
    - is a file itself, to be saved in the root directory
    - allowing for us to use the `git add .` shortcut

- `.gitignore` lists one item per line
    - each line has a pattern, which determines whether one or more files or folders are to be ignored

- See these
    - documentation at https://git-scm.com/docs/gitignore
    - templates at https://github.com/github/gitignore

What to Version — `.gitignore` — Examples

You can ignore, for example,

- a specific folder, relative to the root directory

```
/manuscript/
```

What to Version — .gitignore

You can ignore, for example,

- a specific folder, relative to the root directory
- a specific file in a specific folder, relative to the root directory

```
/manuscript/
/manuscript/paper.pdf
```

What to Version — `.gitignore`

You can ignore, for example,

- a specific folder, relative to the root directory
- a specific file in a specific folder, relative to the root directory
- a specific file in any folder

```
/manuscript/
/manuscript/paper.pdf
paper.pdf
```

What to Version — `.gitignore`

.pull-left[

You can ignore, for example,

- a specific subdirectory, relative to the root directory

- a specific file in a specific subdirectory, relative to the root directory

- a specific file in any subdirectory

- all files with a specific extension, anywhere in the repository

```
/manuscript/
/manuscript/journals.pdf
journals.pdf
*.pdf
```

What to Version — `.gitignore` — Notes

- There are many other pattern formats
  - see the documentation at https://git-scm.com/docs/gitignore
- Starting to ignore a file or folder that is already being tracked requires clearing the cache
  - after changing and saving `.gitignore`, enter the following line in the shell
  - with your speficic `/path/to/file`

```
git rm --cached /path/to/file
```

- The following command clears *all* cache
  - might be useful after changes to `.gitignore` that involves several files or folders
  - but should be used with care, on an otherwise up-to-date repository

```
git rm -r --cached .
```

Exercises

07:30

24) Create a `.gitignore` file on GitHub

- to ignore the paper.pdf file
- save and commit

25) Pull the changes to the local repository

- using the `git pull` command

26) Start tracking everything

- using the `git add .`
- and commit

27) Push the canges to the remote repository

- observe the repository on GitHub to confirm `.gitignore` work as intended

Part 5. Collaboration

Back to the contents slide.

Collaboration — Project Setup

- The setup depends on the users' role, on whether they are
  - the *owner* who creates the GitHub repository, or
  - the *collaborator* who is then added to that repository

- Once the project is setup
  - it continues to be associated with the owner's GitHub profile
  - at the same time, it is listed under the collaborator's profile as well
  - both the owner and the collaborator have the same rights, unless otherwise restricted

Collaboration — Project Setup — Owner

- The setup for the owner is largely the same as in any single-author, single-computer scenario
    - introduce version control to a local project with Git,
    - create a remote repository for that project on GitHub, and
    - associate the local project with the remote repository

- As an additional step, the owner needs to invite their collaborator(s) to the project
- following, from the relevant GitHub repository,

> `Settings -> Manage access -> Invite a collaborator`

Collaboration — Project Setup — Collaborator

- Notice that the remote part of the setup is done by the owner for the collaborator
  - subject to acceptance of the invitation
    - invitations are available directly at https://github.com/notifications, but also sent via email
    - on acceptance, projects appear among the repositories of the collaborator

- The local part of the setup still needs to be done
  - by using the `git clone` command with the repository address

```
$ git clone https://github.com/USER_NAME/REPOSITORY_NAME.git
```

Exercises

10:00

28) Prepare for collaboration

- by assuming the role of first and second co-authors in your group
- Owners:
  - invite your activity party ion to collaborate
  - hint: you will need their username, full name, or email address to do so
- Collaborators:
  - accept the invitation from your co-author
  - clone the project to your a local repository
    - using the `git clone` command

Colloboration — Workflow

1) Pull

- on the Git tab in RStudio, click `Pull` to move the up-to-date records from GitHub to your computer
  - if your collaborator has not pushed anything since your last pull, you will be noticed that `Already up-to-date`.
  - collaborative projects require pulling as well as pushing because your collaborator(s) might have pushed their commits to GitHub
  - pulling frequently minimises the risk of merge conflicts

2) Edit and save; commit and push

- the same procedure as in any single-author, single-computer scenario
  - as described on this slide forward
- pushing frequently minimises the risk of merge conflicts

Exercise

05:00

29) Non-simultaneous Collaboration

- take in turns with your partner to work on the same document (of the same project)
  - *owner*: edit the first header in the document (i.e., "R Markdown"), save, commit, and push
  - *owner and collaborator*: observe the changes, if any, on your own `.Rmd` file, and/or on your GitHub repository
    - click on the relevant commit message on GitHub and observe the commit
  - *collaborator*: pull, revert the header back to original, save, commit, and push

- notice that you have not encountered any errors and/or merge conflicts
  - because everyone edited and merged with an up-to-date document
  - this is the default scenario in single-author, multiple computer scenario

Exercise

10:00

30) Simultaneous Collaboration — Different Lines

- work on the same document at the same time
    - *owners*: edit the first header in a document, save, commit, and push
    - *collaborators*: edit the second header in the document (i.e., "Including Plots"), save, commit, and push
        - observe the error message that the last pusher will receive, follow the instructions on RStudio to solve the problem
- notice that you have encountered an error but not a merge conflict
    - pulling before pushing solves the problem because the edits are not on the same line
    - the merge takes place automatically, on the *local* repository of the last pusher

Exercise

10:00

31) Simultaneous Collaboration — Same Line

- work on the same document at the same time
    - *owners*: edit the first header in the document again, save, commit, and push
    - *collaborators*: edit the first header in the document as well, save, commit, and push
        - observe the error message that the last pusher will receive, follow the instructions on RStudio to solve the problem

- notice that you have encountered not only an error but also a merge conflict
    - pulling before pushing alone does not solve the problem because the edits are on the same line
        - the conflict cannot be solved automatically — it needs human intervention
        - by pulling first, you can view the conflict directly on the file
            - marked between less than `<` and greater than `>` signs, divided by the equal signs
            - solution is to accept the remote version, by deleting your edit and or moving that edit to a different line
    - merging takes place on the *local* repository of the last pusher

Colloboration — Workflow — Alternative

- The workflow above is rather simple, but has some disadvantages, including
    - not easy, albeit still possible, to see the edits of the collaborators
    - not clear who is in charge of the overall progress
    - not possible to discuss edits
    - not possible to compromise on conflicting edits
- An alternative workflow exits
    - work on different branches of the same project
    - version control to your own branch
    - create pull requests with comments
    - merge the branch into master

Colloboration — Workflow — Alternative

1) Branch

- using the `git branch` command to create a branch

2) Edit and save; commit and push

- the same procedure as in any single-author, single-computer scenario
- except that now pushing into a branch
- notice, on GitHub, that your commit is in the new branch, while *master* remains unchanged

3) Pull request

- On GitHub, click

  > `Pull requests -> New pull request`

- choose what is to be pulled, and write a note to your collaborator who can accept or reject the merge
  - if there are merge conflicts, the collaborator solves them on GitHub before merging

Exercises

10:00

32) Pull request

- create a pull request for your collaboration project
  - create a branch for yourself
  - edit any line, save, commit, and push
  - request your branch to be merged

33) Merging

- view the pull request of your collaborator on GitHub
- merge it to *master*

Part 6. Third-Party Applications

Back to the contents slide.

Applications — RStudio

Integrating RStudio into the workflow requires

1. initial setup, done once*
   - unless for a new computer or, if ever, a new GitHub account
   - a bit technical, but worth the hassle
2. project setup, repeated for every project
   - shorter, less complicated

* We have started this process already, in Part 1 of the workshop, by downloading and installing Git and signing up for GitHub. Back to the relevant slide.

Applications — RStudio — Inital Setup

1) Enable version control with RStudio

- from the RStudio menu, follow:

  > `Tools -> Global Options -> Git/SNV -> Enable version control interface for RStudio projects`

- RStudio will likely find Git automatically. In case it cannot, Git is likely to be at
  - `c:/Program Files/Git/bin/git.exe` on Windows
  - `/usr/local/git/bin/git` on Mac

Applications — RStudio — Inital Setup

2) Set Git Bash as your shell (Windows-only step)

- from the RStudio menu, follow:

  > `Tools -> Global Options -> Terminal -> New terminals open with: Git Bash`

Applications — RStudio — Inital Setup*

3) Introduce yourself to Git

- from the RStudio menu, follow:

> `Tools -> Terminal -> New Terminal`

- enter the following lines in the Terminal, with the email address that you have used to sign up for GitHub

```
git config --global user.name "YOUR-NAME"
git config --global user.email "YOUR-EMAIL-ADDRESS"
```

- enter the following line in the Terminal, to observe whether the previous step was successful

```
git config --global --list
```

* This repeats the process on this slide in Part 3. Repeating it is unnecessary, but will not cause any problems.

Applications — RStudio — Project Setup

1) Create an RStudio project

- RStudio allows for dividing your work with R into separate projects, each with own history etc.
    - this page has more information on why projects are recommended

- Create a new RStudio project, following from the RStudio menu:

  > `File -> New Project`

Applications — RStudio — Project Setup

2) Initiate local version control with Git

- from the RStudio menu, follow:

  > `Tools -> Version Control -> Project Setup... -> Version Control System -> Git`

- after confirming your new repository, and restarting the session, observe that
  - now there is now a Git tab in RStudio, with buttons for various git commands
  - your project now includes a `.gitignore` file
    - untracking some project-specific files

Applications — RStudio — Project Setup

3) Create a new GitHub repository

- on GitHub, follow:

  > `Repositories -> New -> Repository name (e.g., "git_workshop") -> Public -> Create repository`

- observe that
  - repository URLs have the following structure: https://github.com/USER_NAME/REPOSITORY_NAME
    - this is the address to view the repository online
    - for use in the `Terminal`, the address gets the `.git` extension
      - e.g., https://github.com/USER_NAME/REPOSITORY_NAME.git

Applications — RStudio — Project Setup

3) Push an existing repository for the first time

- from the RStudio menu, follow:

  > `Tools -> Terminal -> New Terminal`

- enter the following lines in the `Terminal`, with your username and repository name

```
git remote add origin https://github.com/USER_NAME/REPOSITORY_NAME.git
git add .
git commit -m "first commit"
git push -u origin master
```

- if this is your first time using GitHub with RStudio, you will be prompted to authenticate
  - follow the instructions on your screen and in your email
- observe that your project files are now online, listed on the GitHub repository

Applications — RStudio — Notes

- The principles covered in Part 3 to Part 5 remain the same
    - e.g., add, commit, and push

- There are now two alternative ways to proceed
    - typing git commands in the Terminal
    - as opposed to in a stand alone shell
    - clicking the buttons on the Git tab
    - e.g., Diff, Commit

References

Back to the contents slide.

References

Blair, G., Cooper, J., Coppock, A., Humphreys, M., Rudkin, A. and Fultz, N. (2019). fabricatr: Imagine your data before you collect it. R package, version 0.10.0.

The workshop ends here.

Congratulations for making it this far, and

thank you for joining me!

Back to the contents slide.