

teaching computing with Git & GitHub

 bit.ly/teach-r-online-mats

dr. mine çetinkaya-rundel
dr. colin rundel

Activity

while we wait to get started...

- Go to bit.ly/gh-username
- Enter your GitHub username

you...

- are familiar with R
- are familiar with Git and GitHub
- are interested in teaching version control
- are interested in using GitHub as your learning management system
- might be interested in automation tools offered by GitHub for auto feedback

why

git &
github

Goals for version control with Git & GitHub

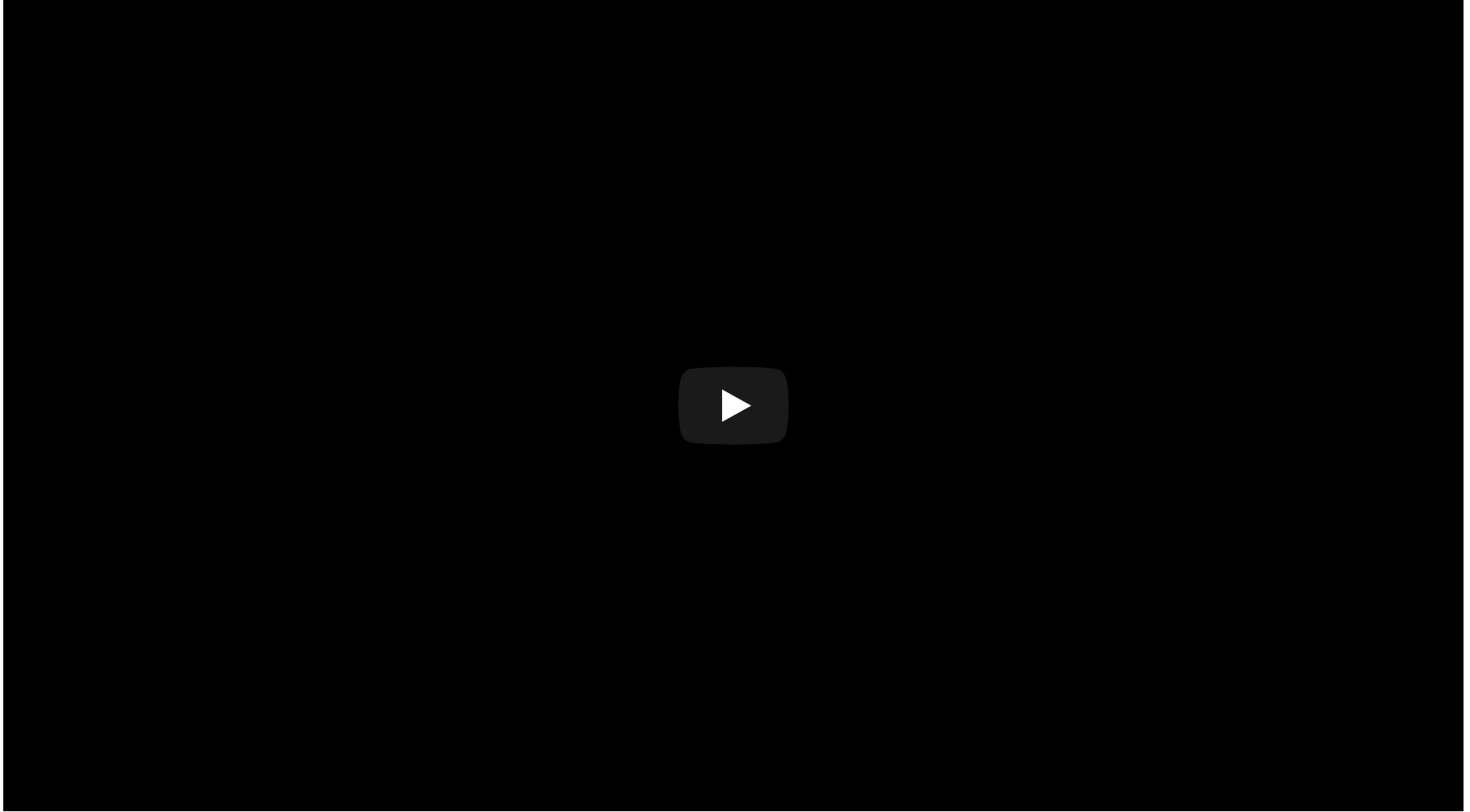
- Centralize the distribution and collection of all student assignments
- Enable students to work collaboratively
- Force students to use (learn) Git & GitHub
 - Version control is a best practice for reproducible research
 - Widely used in industry
 - Publish / share work



github

as a student





Aside - Git credentials

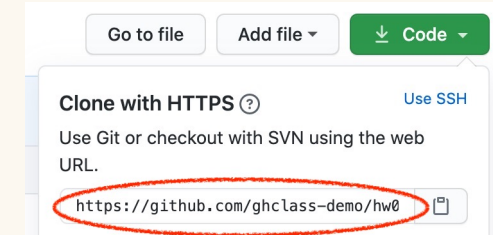
Using *https* for authentication is highly recommended

- Students will have to enter their username and password each time they *clone* or *push*
- Credentials can be cached, see [Happy Git and GitHub for the useR](#)
- [Chapter 10](#)
- Alternatively, see the [credentials](#) package and its [vignette](#).

Your turn!

We recommend one person in each group share their screen and everyone work together to work through the document.

- Check your email and accept the invitation
- Obtain the *https* Git url from the GitHub repository
- Open RStudio Cloud and start a new project with this url
- Work through Task 0 in the README



If you did not receive an invite you can make your own copy of the repo using the *Use this template* button here: <https://github.com/rundel/hw1>

15 : 00



github

as an instructor

Basic Structure

On Github,

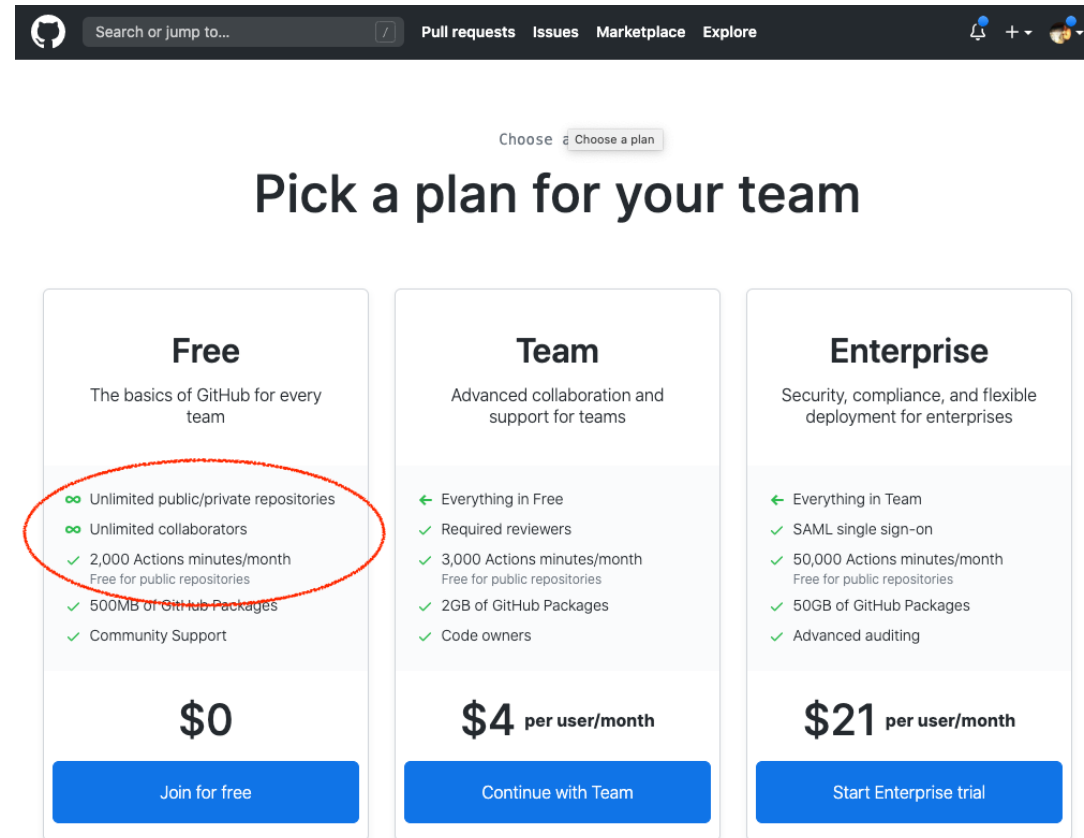
- 1 Organization / class
- 1 repo / (student or team) / assignment
- Student and team repos are all private by default
- Students are added as members
- Tutors / TAs are added as owners (admins)

Basic Workflows

1. Create organization
2. Invite students
3. Create assignment(s)
4. Collect and grade assignments(s)

Create course organization





<https://github.com/organizations/new>



The screenshot shows the GitHub 'Pick a plan for your team' page. The 'Free' plan is circled in red. The page features a dark header with the GitHub logo, a search bar, and navigation links for Pull requests, Issues, Marketplace, and Explore. Below the header, there's a 'Choose a plan' button. The main heading is 'Pick a plan for your team'. Three plan cards are displayed: Free, Team, and Enterprise. The Free plan is highlighted with a red circle around its features list.

Free	Team	Enterprise
The basics of GitHub for every team	Advanced collaboration and support for teams	Security, compliance, and flexible deployment for enterprises
<ul style="list-style-type: none">Unlimited public/private repositoriesUnlimited collaborators2,000 Actions minutes/month <small>Free for public repositories</small>500MB of GitHub PackagesCommunity Support	<ul style="list-style-type: none">Everything in FreeRequired reviewers3,000 Actions minutes/month <small>Free for public repositories</small>2GB of GitHub PackagesCode owners	<ul style="list-style-type: none">Everything in TeamSAML single sign-on50,000 Actions minutes/month <small>Free for public repositories</small>50GB of GitHub PackagesAdvanced auditing
\$0	\$4 per user/month	\$21 per user/month
Join for free	Continue with Team	Start Enterprise trial

Create course organization

 Search or jump to...  Pull requests Issues Marketplace Explore  + 

Selected plan: GitHub Free

Tell us about your organization

Set up your team

Organization account name *

This will be the name of your account on GitHub.
Your URL will be: <https://github.com/>

Contact email *

This organization belongs to: *

☐ **My personal account**
i.e., rundel (Colin Rundel)

☐ **A business or institution**
For example: GitHub, Inc., Example Institute, American Red Cross

Next

By creating an account, you agree to the [Terms of Service](#). For more information about GitHub's privacy practices, see the [GitHub Privacy Statement](#). We'll occasionally send you account-related emails.

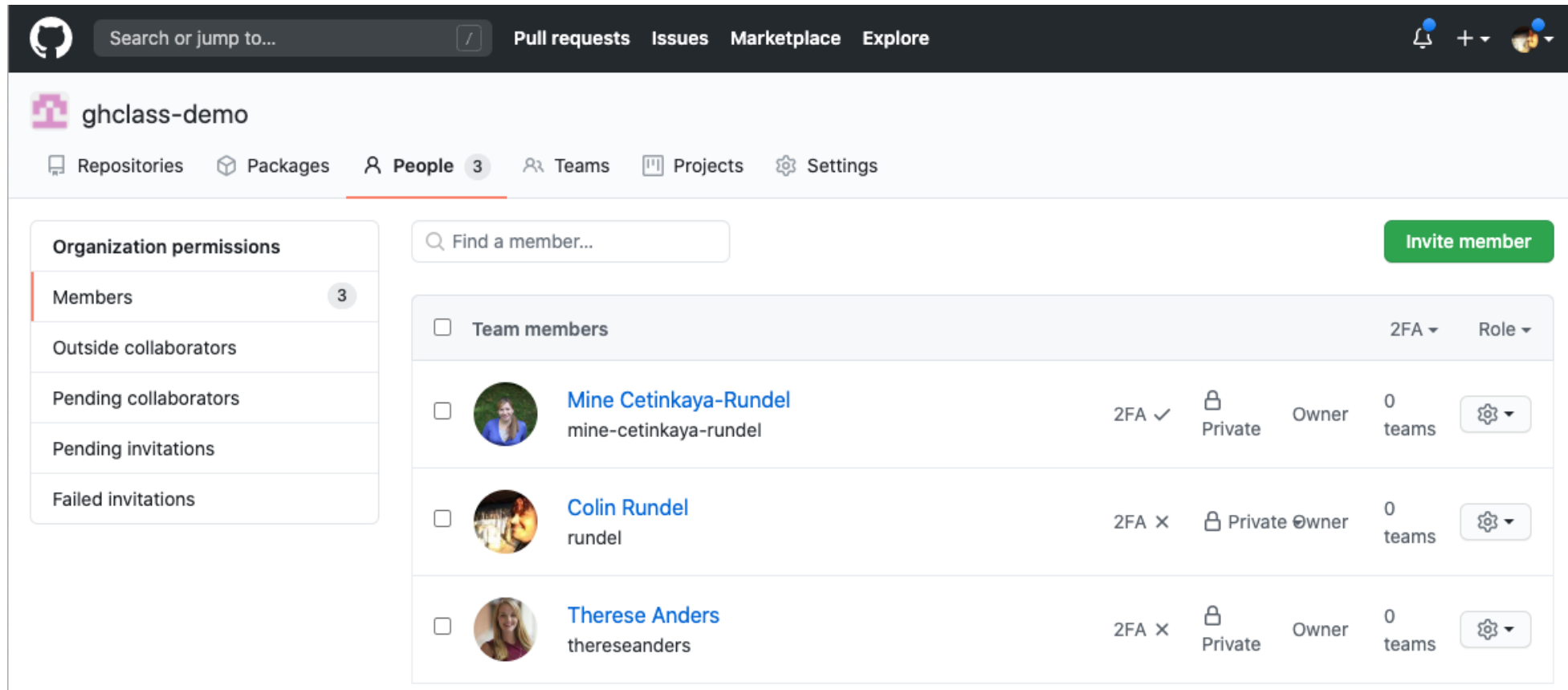
Education discount

While no longer required, GitHub offers a number of education benefits which you can register for here: <https://education.github.com/benefits>.




Of particular note are:

- Free GitHub swag here
 - https://education.github.com/toolbox/offers#github_swag
- Free Team plans for academic organizations and Pro plan for educators
 - <https://education.github.com/toolbox/offers#github>

Org Setup



The screenshot shows the GitHub interface for an organization named 'ghclass-demo'. The top navigation bar includes the GitHub logo, a search bar, and links to 'Pull requests', 'Issues', 'Marketplace', and 'Explore'. The organization's name 'ghclass-demo' is displayed, along with tabs for 'Repositories', 'Packages', 'People' (with a count of 3), 'Teams', 'Projects', and 'Settings'. On the left, a sidebar lists 'Organization permissions' with sub-items: 'Members' (3), 'Outside collaborators', 'Pending collaborators', 'Pending invitations', and 'Failed invitations'. The main content area features a search bar 'Find a member...' and a green 'Invite member' button. Below this is a table of team members.

<input type="checkbox"/>	Team members	2FA	Role
<input type="checkbox"/>	 Mine Cetinkaya-Rundel mine-cetinkaya-rundel	2FA ✓	Private Owner 0 teams
<input type="checkbox"/>	 Colin Rundel rundel	2FA ×	Private Owner 0 teams
<input type="checkbox"/>	 Therese Anders thereseanders	2FA ×	Private Owner 0 teams

Member Privileges

Organization settings

Profile

Member privileges

Billing

Security

Verified domains

Audit log

Webhooks

Third-party access

Installed GitHub Apps

Repository topics

Repository labels

Deleted repositories

Projects

Teams

Developer settings

OAuth Apps

GitHub Apps

Member repository permissions

Base permissions

Base permissions to the organization's repositories apply to all members and excludes outside collaborators. Since organization members can have permissions from multiple sources, members and collaborators who have been granted a higher level of access than the base permissions will retain their higher permission privileges.

Read

Organization member permissions

None

Members will only be able to clone and pull public repositories. To give a member additional access, you'll need to add them to teams or make them collaborators on individual repositories.

✓ Read

Members will be able to clone and pull all repositories.

Write

Members will be able to clone, pull, and push all repositories.

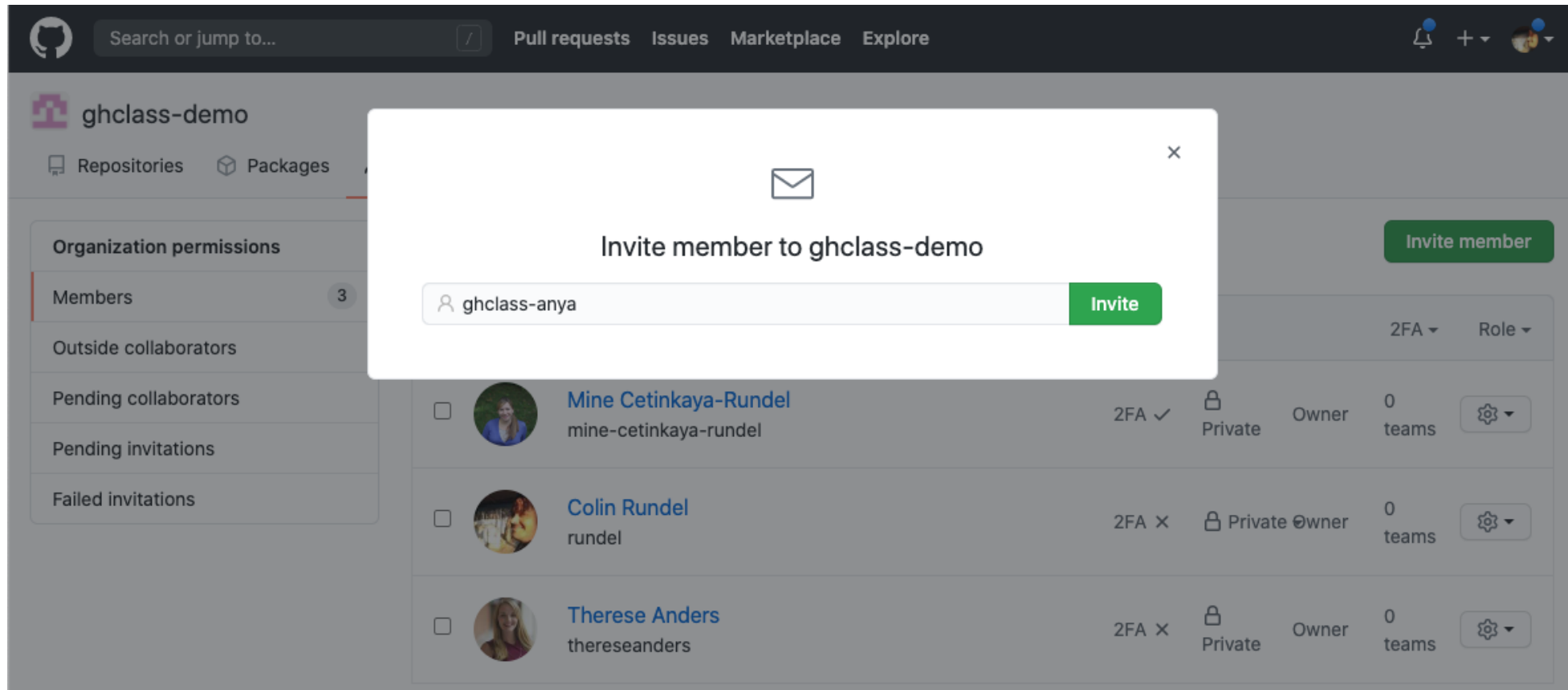
Admin

Members will be able to clone, pull, push, and add new collaborators to all repositories.

Save

Actions

Invite students



x 150 students ...

at this scale, doing anything with the Github UI starts to get quite tedious...



ghclass



- Design to automate interactions with GitHub (via its API) for class management
- The package is ~4 years old and still under active development
- Detailed introduction and documentation available on the package website: <http://rundel.github.io/ghclass>
- The package is not on CRAN (but will be imminently), for now it can be installed from GitHub using:

```
devtools::install_github("rundel/ghclass")  
library(ghclass)
```



Some design principals behind the package:

1. All functions are prefixed to indicate what they operate on (e.g. `org`, `repo`, `team`, `local_repo`, etc.)
2. Most functions are vectorized over their parameters, allowing related operations to be grouped
3. Most actions are non-destructive or backed by Git, the handful of dangerous operations will warn you

Aside - GitHub tokens

`ghclass` uses the GitHub API to interact with your organization and repos - the API verifies your identity using a personal access token which must be created and saved in such a way that `ghclass` can find and use it.

- Create a token at github.com/settings/tokens
- Once created, assign it to the `GITHUB_TOKEN` as an environmental variable in R by,
 - Run `usethis::edit_r_environ()`
 - Add `GITHUB_PAT="alphanumeric string of your GitHub token"` to the opened `.Renviron` file.
 - Save, close, restart R for changes to take effect

Checking tokens

If the token is found and works correctly the following code should run without error

```
github_test_token()
```

```
## ✓ Your GitHub PAT authenticated correctly.
```

If instead the token is invalid or not found, you will see something like the following

```
github_test_token("BAD_TOKEN")
```

```
## x Your GitHub PAT failed to authenticate.  
## └─GitHub API error (401): 401 Unauthorized  
##   └─API message: Bad credentials  
##   └─API docs: https://developer.github.com/v3
```

Invite students

- Collect student account names (and an email or other identifier)

```
students = c("ghclass-anya", "ghclass-bruno", "ghclass-celine", "ghclass-diego")
org_invite(org = "ghclass-demo", user = students)
```

```
## ✓ Invited user 'ghclass-anya' to org 'ghclass-demo'.
## ✓ Invited user 'ghclass-bruno' to org 'ghclass-demo'.
## ✓ Invited user 'ghclass-celine' to org 'ghclass-demo'.
## ✓ Invited user 'ghclass-diego' to org 'ghclass-demo'.
```

Rate limits

From GitHub's API docs,

To prevent abuse, an authenticated user is limited to 50 organization invitations per 24 hour period. If the organization is more than one month old or on a paid plan, the limit is 500 invitations per 24 hour period.

Applying the education discount to an org => paid plan

Check member status

Who is already in?

```
org_members(org = "ghclass-demo")
```

```
## [1] "mine-cetinkaya-rundel" "rundel" "thereseanders"
```

Who has not accepted their invitation?

```
org_pending(org = "ghclass-demo")
```

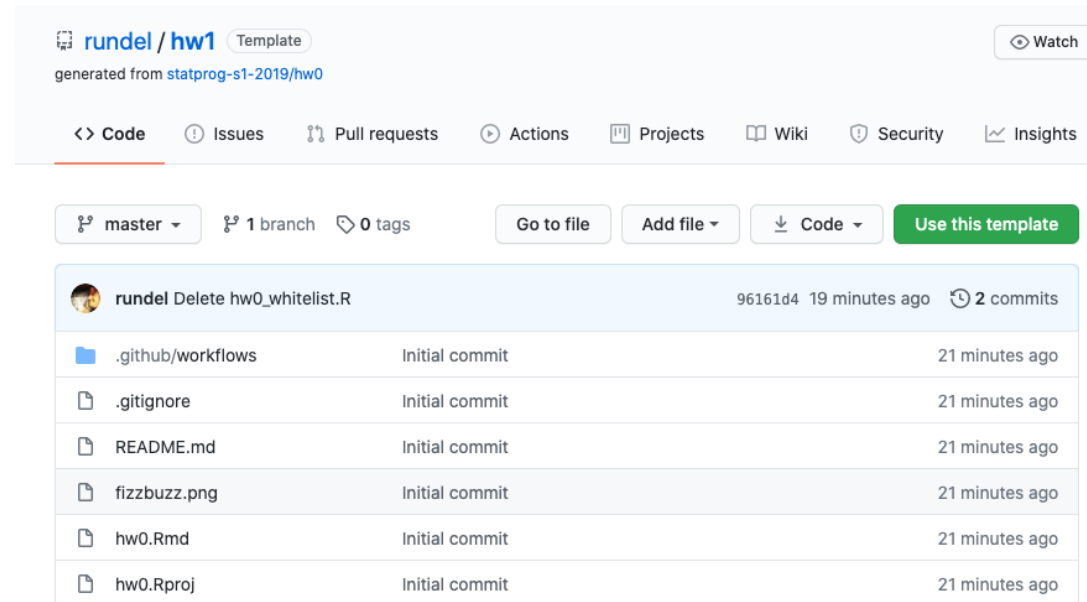
```
## [1] "ghclass-anya" "ghclass-bruno" "ghclass-diego" "ghclass-celine"
```

Creating assignments

Starter repo

All assignments are just repositories on GitHub

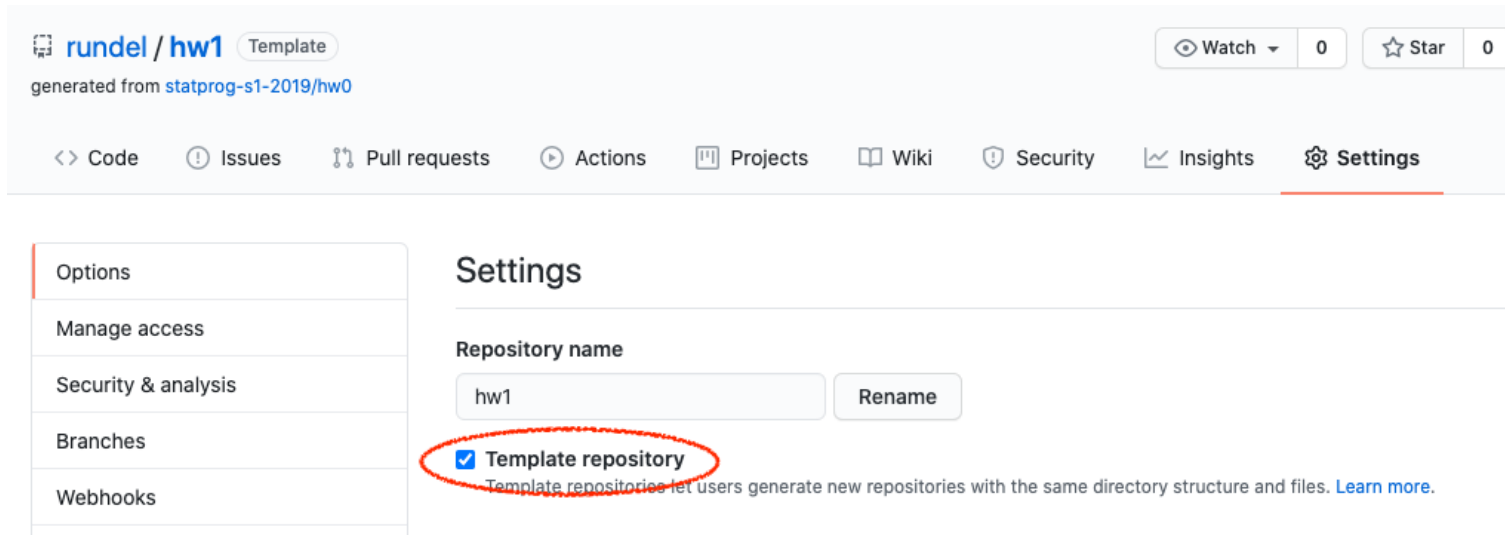
- each is made up of a collection of files necessary for that assignment (e.g. README, templated Rmd, Rproj file, etc.)
- repos can be public or private and belong to any org



The screenshot shows the GitHub interface for a repository named 'rundel / hw1'. The repository is a template generated from 'statprog-s1-2019/hw0'. The main navigation bar includes links for Code, Issues, Pull requests, Actions, Projects, Wiki, Security, and Insights. Below the navigation bar, there are buttons for 'master' branch, '1 branch', '0 tags', 'Go to file', 'Add file', 'Code', and a green 'Use this template' button. The commit history table shows a single commit by 'rundel' titled 'Delete hw0_whitelist.R' with hash '96161d4' and '2 commits'.

File	Commit	Time
.github/workflows	Initial commit	21 minutes ago
.gitignore	Initial commit	21 minutes ago
README.md	Initial commit	21 minutes ago
fizzbuzz.png	Initial commit	21 minutes ago
hw0.Rmd	Initial commit	21 minutes ago
hw0.Rproj	Initial commit	21 minutes ago

Template Repos



```
repo_set_template("rundel/hw1")
```

✓ Changed the template status of repo 'rundel/hw1' to TRUE.

```
repo_is_template("rundel/hw1")
```

TRUE

Create assignments

```
org_create_assignment(  
  org = "ghclass-demo",  
  repo = paste0("hw01-", students),  
  user = students,  
  source_repo = "rundel/hw1"  
)
```

```
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-anya'.  
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-bruno'.  
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-celine'.  
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-diego'.  
## ✓ Added user 'ghclass-anya' to repo 'ghclass-demo/hw01-ghclass-anya'.  
## ✓ Added user 'ghclass-bruno' to repo 'ghclass-demo/hw01-ghclass-bruno'.  
## ✓ Added user 'ghclass-celine' to repo 'ghclass-demo/hw01-ghclass-celine'.  
## ✓ Added user 'ghclass-diego' to repo 'ghclass-demo/hw01-ghclass-diego'.
```


Create team assignments

```
students = c("ghclass-anya", "ghclass-bruno", "ghclass-celine", "ghclass-diego")
teams = c("team01", "team01", "team02", "team02")

org_create_assignment(
  org = "ghclass-demo",
  repo = paste0("hw01-", teams),
  team = teams,
  user = students,
  source_repo = "rundel/hw1"
)
```

```
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-anya'.
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-bruno'.
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-celine'.
## ✓ Mirrored repo 'rundel/hw1' to repo 'ghclass-demo/hw01-ghclass-diego'.
## ✓ Added user 'ghclass-anya' to repo 'ghclass-demo/hw01-ghclass-anya'.
## ✓ Added user 'ghclass-bruno' to repo 'ghclass-demo/hw01-ghclass-bruno'.
## ✓ Added user 'ghclass-celine' to repo 'ghclass-demo/hw01-ghclass-celine'.
## ✓ Added user 'ghclass-diego' to repo 'ghclass-demo/hw01-ghclass-diego'.
```

Fixing mistakes

```
repo_modify_file(  
  repo = org_repos("ghclass-demo", filter = "hw01-"),  
  path = "README.md",  
  pattern = "Due 20/00/00 by 5:00 pm",  
  content = "Due 2020/07/17 by 5:00 pm",  
  method = "replace"  
)
```

```
## ✓ Modified file 'ghclass-demo/hw01-ghclass-anyay/README.md'.  
## ✓ Modified file 'ghclass-demo/hw01-ghclass-bruno/README.md'.  
## ✓ Modified file 'ghclass-demo/hw01-ghclass-celine/README.md'.  
## ✓ Modified file 'ghclass-demo/hw01-ghclass-diego/README.md'.  
## ✓ Modified file 'ghclass-demo/hw01-team01/README.md'.  
## ✓ Modified file 'ghclass-demo/hw01-team02/README.md'.
```

```
repo_get_readme("ghclass-demo/hw01-team01", include_details = FALSE) %>%  
  substr(1, 80) %>%  
  cat()
```

```
##  
## Statistical Programming - Homework 1  
## -----  
##  
## Due 2020/07/17 by 5:00 pm.
```

These changes are tracked by Git - to get them students will need to pull.

Collecting and Grading

Repo details

```
org_repos("ghclass-demo")
```

```
## [1] "ghclass-demo/hw01-ghclass-anya" "ghclass-demo/hw01-ghclass-bruno"  
## [3] "ghclass-demo/hw01-ghclass-celine" "ghclass-demo/hw01-ghclass-diego"  
## [5] "ghclass-demo/hw01-team01" "ghclass-demo/hw01-team02"
```

```
org_repos("ghclass-demo", filter = "hw01-team")
```

```
## [1] "ghclass-demo/hw01-team01" "ghclass-demo/hw01-team02"
```

```
org_repo_stats("ghclass-demo")
```

```
## # A tibble: 6 x 6
```

##	repo	private	commits	last_update	open_issues	closed_issues
##	<chr>	<lgl>	<int>	<dtm>	<int>	<int>
## 1	ghclass-demo/hw01-team02	TRUE	2	2020-07-17 08:42:50	0	0
## 2	ghclass-demo/hw01-team01	TRUE	2	2020-07-17 08:42:48	0	0
## 3	ghclass-demo/hw01-ghclass-diego	TRUE	2	2020-07-17 08:42:47	0	0
## 4	ghclass-demo/hw01-ghclass-anyar	TRUE	2	2020-07-17 08:42:41	0	0
## 5	ghclass-demo/hw01-ghclass-bruno	TRUE	2	2020-07-17 08:42:43	0	0
## 6	ghclass-demo/hw01-ghclass-celine	TRUE	2	2020-07-17 08:42:45	0	0

Collecting

```
local_repo_clone(  
  repo = org_repos("ghclass-demo", filter = "hw01-team"),  
  local_path = "hw1/"  
)
```

- ✓ Cloned 'ghclass-demo/hw01-team01'.
- ✓ Cloned 'ghclass-demo/hw01-team02'.

```
fs::dir_tree("hw1/", recurse = TRUE)
```

```
hw1/  
├── hw01-team01  
│   ├── README.md  
│   ├── hw1.Rmd  
│   └── hw1.Rproj  
└── hw01-team02  
    ├── README.md  
    ├── hw1.Rmd  
    └── hw1.Rproj
```

Options for giving feedback on GitHub

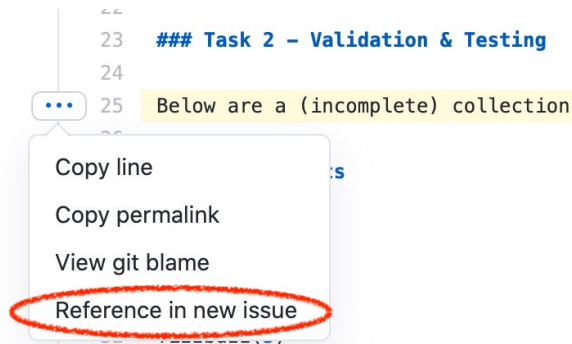
- Use the GitHub UI to review and add issues to each repo
- Use the `issue_create()` function to post issues to all repos at once
- Create pull requests with explicit revisions to student code
- Clone repos locally and add feedback in a file, push back to GitHub

More on giving feedback in issues

- Instructors (and TAs) can view all repositories within the course organization.
- Builtin tools for referencing specific commits, lines of code, etc.
- @ mention students so that they are notified when an issue is opened.
- You may want to consider keeping grades / marks out of issues.

Your turn!

- Pick one person from the team to be the "instructor" and share their screen.
- Go to <https://github.com/ghclass-demo/hw01-everyone> (public repo)
- Go to the issues tab, open a new issue, and provide mock feedback. Tag someone from your team by using the @ sign in front of their GitHub.
- Go to `hw1.Rmd`, pick a line of code, click on the `...` next to the numbers, click on *Reference in new issue*, and add a comment on the issue that links to this line of code.



10:00

Peer review

- Once an assignment is completed you can let other students/teams into a repository and they can provide peer review.
- Peer review is an incredibly effective learning experience for both the reviewers and the reviewees, however it does require coordination and being able to carve out sufficient time in the course schedule.
- Tip: Do not solely count on peer review for feedback as some reviewers might be less diligent than others. Teams reviewing teams, as opposed to individual reviewing individuals, might address this issue partially.
- Functionality for coordinating this has been implemented in ghclass, and will be available in the next release. Available in the `peer_review` branch for the adventurous.

Automated feedback

```
action_workflows("ghclass-demo/hw01-team01")
```

```
## # A tibble: 1 x 4
##   name          path          state badge_url
##   <chr>         <chr>         <chr> <chr>
## 1 check_knit .github/workflows/knit.y... active https://github.com/ghclass-demo/hw01-team01/...
```

```
action_add_badge(
  repo = org_repos("ghclass-demo", "hw01-")
)
```

```
## ✓ Modified file 'ghclass-demo/hw01-ghclass-anya/README.md'.
## ✓ Modified file 'ghclass-demo/hw01-ghclass-bruno/README.md'.
## ✓ Modified file 'ghclass-demo/hw01-ghclass-celine/README.md'.
## ✓ Modified file 'ghclass-demo/hw01-ghclass-diego/README.md'.
## ✓ Modified file 'ghclass-demo/hw01-team01/README.md'.
## ✓ Modified file 'ghclass-demo/hw01-team02/README.md'.
```

closing thoughts

Git + GitHub lessons learned

- If you plan on using Git in class, start on day one, don't wait until the "right time"
- First assignment should be individual, not team based to avoid merge conflicts
- Remind students to remember to pull before starting work
- You will likely need to do shell intervention at some point - make it a teachable moment and remember, there is a terminal pane in RStudio
- Remind students on that future projects should go on GitHub with PI approval

Q: What about data protection regulations (FERPA, GDPR)?

- Consider data privacy rules of institution / country (e.g. you may need to enter a data protection agreement for GDPR compliance)
- Make everything private by default (ghclass opts for this)
 - Private repos
 - Hidden team and org memberships
 - Disallow forking of private repos

Q: What about GitHub Classroom?

This is education tool created by GitHub manage repository sharing and collection.

- It is great and very usable and they continue to improve it
- ghclass and GitHub Classroom work together, pick the workflow that is best for you
- Different "membership" models

Q: How do you introduce Git & GitHub to students?

Introduce it early and often, and make it required.

Example materials:

- Git and GitHub intro - <https://introds.org/labs/lab-01/lab-01-hello-r>
- merge conflict activity - <https://introds.org/labs/lab-04/lab-04-ugly-charts.html#merge-conflicts>

thank you!

All materials at bit.ly/teach-r-online-mats