03
reproducible workflows

teaching data science

> Your turn!

Welcome back!

Turn to your neighbor and discuss:

- What is one evidence-based teaching practice you have adopted in the last five years?
- What is one evidence-based practice you know about but have **not** adopted and why not?

R Markdown

reproducibility	pedagogy	efficiency	key to success
train new analysts whose only workflow is a reproducible one	code + output + prose together syntax highlighting FTW!	consistent formatting → easier grading	knit early and often

Git + GitHub — why?

version control	collaboration	accountability	early introduction
lots of mistakes along the way, need ability to revert	platform that removes barriers to well documented collaboration	transparent commit history	mastery takes time, earlier start the better marketability

Git + GitHub — how?

organization	interface	teams	assessment

one organization per course
 	
one repo per student/team per assignment
	via RStudio
	
	no local git install required since using RStudio Cloud
		for collaboration
		
		for assigning individual students to repos
		
		for graders
			check reproducibility via clone + compile
			
			feedback through issues

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 on that future projects should go on GitHub with PI approval

students need to remember to pull before starting work

impossible (?) to avoid shell intervention every once in a while

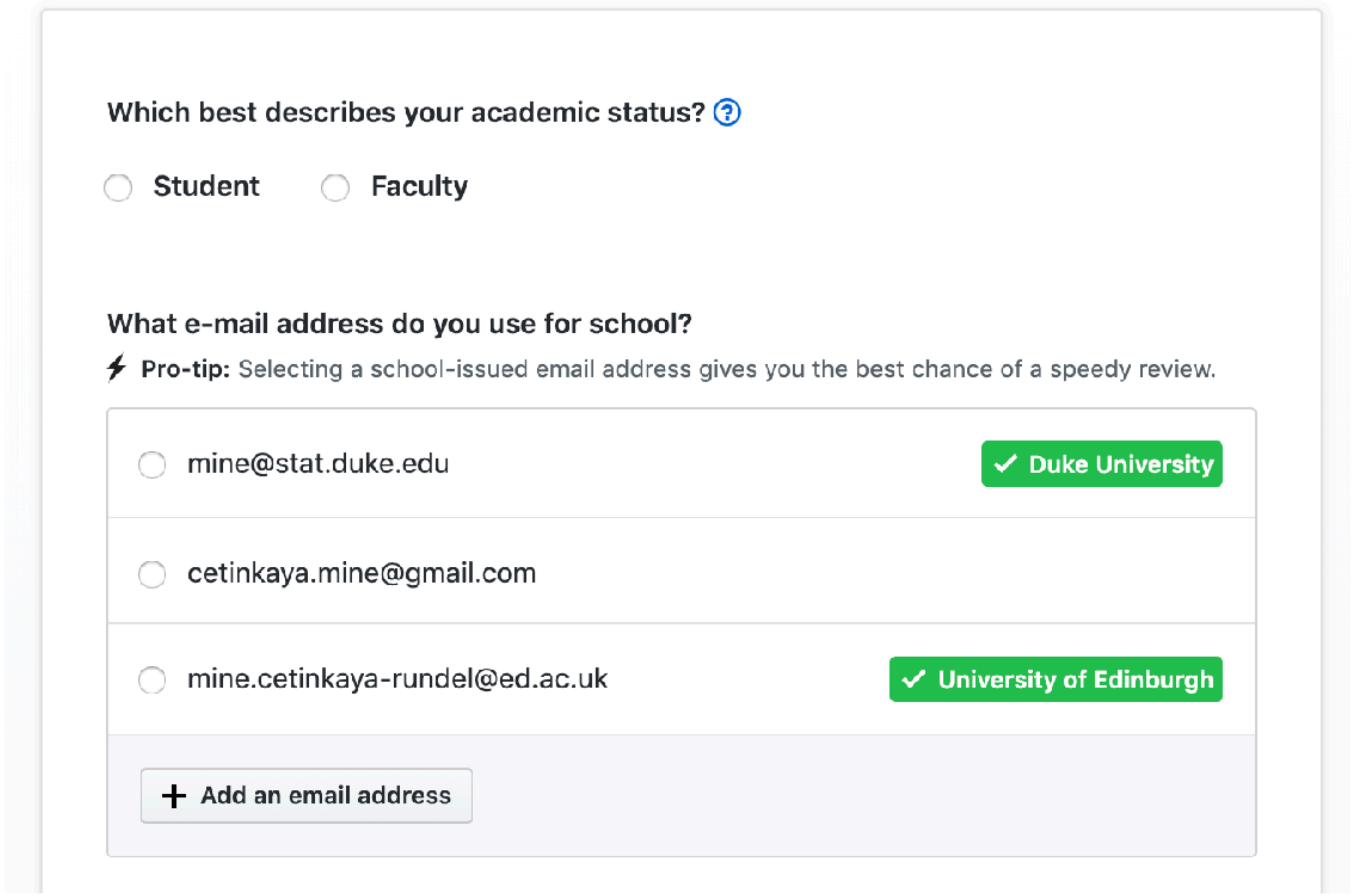
> Your turn!

- If you don't have a GitHub account, create one now at **github.com**
- If you do, confirm your know your username and password by logging in at **github.com**
- Then, enter your name and GitHub username at **rstd.io/teach-ds-form**

setting up a course

1. Request educational discount: education.github.com/discount
2. Create course organization: github.com/organizations/new
3. Upgrade course organization: education.github.com/benefits
4. Invite students to organization
5. Create assignment(s)
6. Collect assignments(s)
7. Grade assignment(s)

1. request educational discount



Which best describes your academic status?

Student Faculty

What e-mail address do you use for school?

Pro-tip: Selecting a school-issued email address gives you the best chance of a speedy review.

mine@stat.duke.edu ✓ Duke University

cetinkaya.mine@gmail.com

mine.cetinkaya-rundel@ed.ac.uk ✓ University of Edinburgh

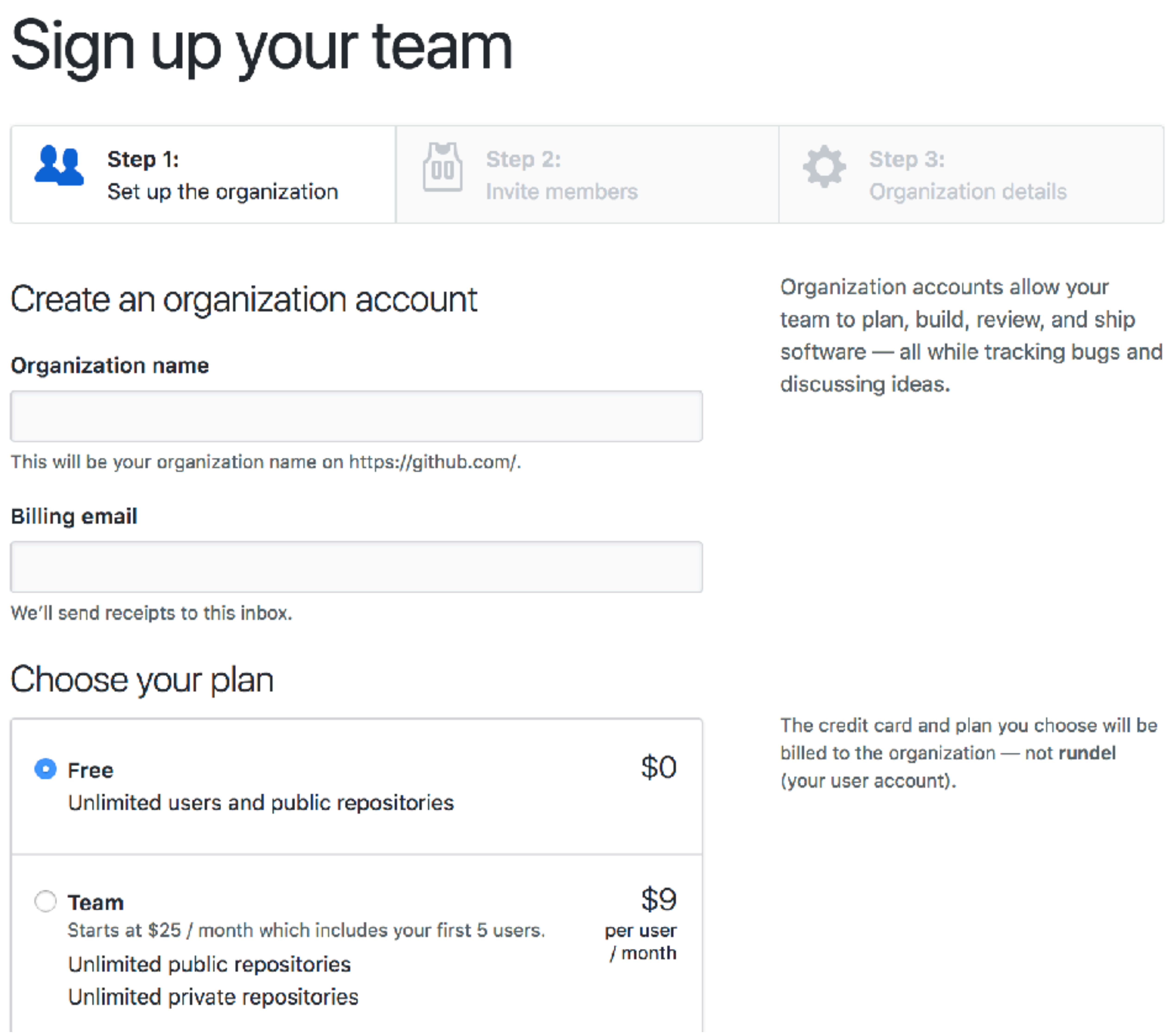
required information

When requesting the discount you will need to provide the following:

- A brief description of the purpose for the GitHub organization and how you plan to use GitHub
- Establishing connection to an academic institution by verifying with an .edu email + photo of your school id.
- Link to relevant website for the class / workshop / research group

Verification is manual and can take between a couple hours to a couple days.

2. create course organization



Sign up your team

Step 1:
Set up the organization

Step 2:
Invite members

Step 3:
Organization details

Create an organization account

Organization accounts allow your team to plan, build, review, and ship software — all while tracking bugs and discussing ideas.

Organization name

This will be your organization name on https://github.com/.

Billing email

We'll send receipts to this inbox.

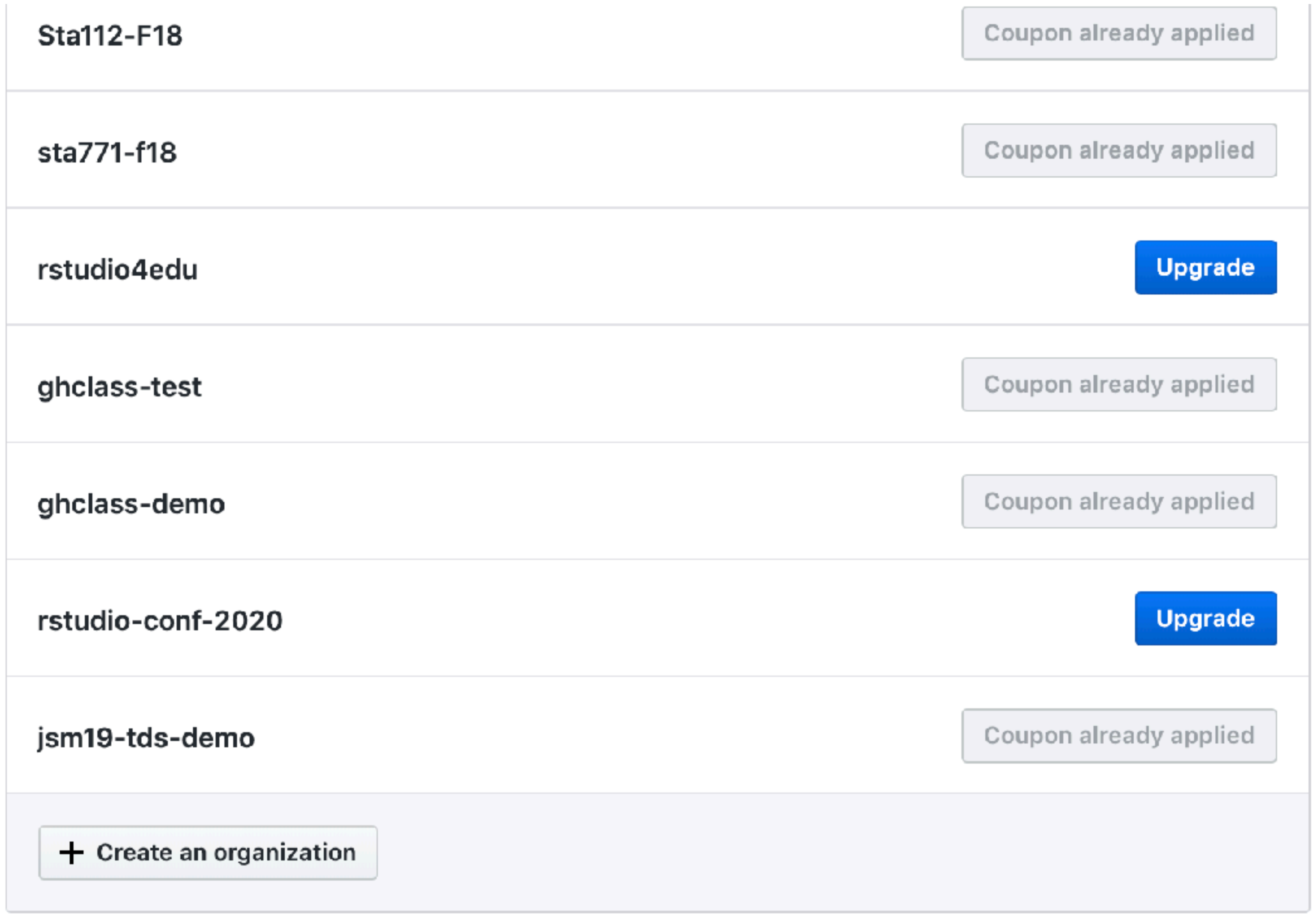
Choose your plan

The credit card and plan you choose will be billed to the organization — not **rundel** (your user account).

[✓ **Free** Unlimited users and public repositories $0]

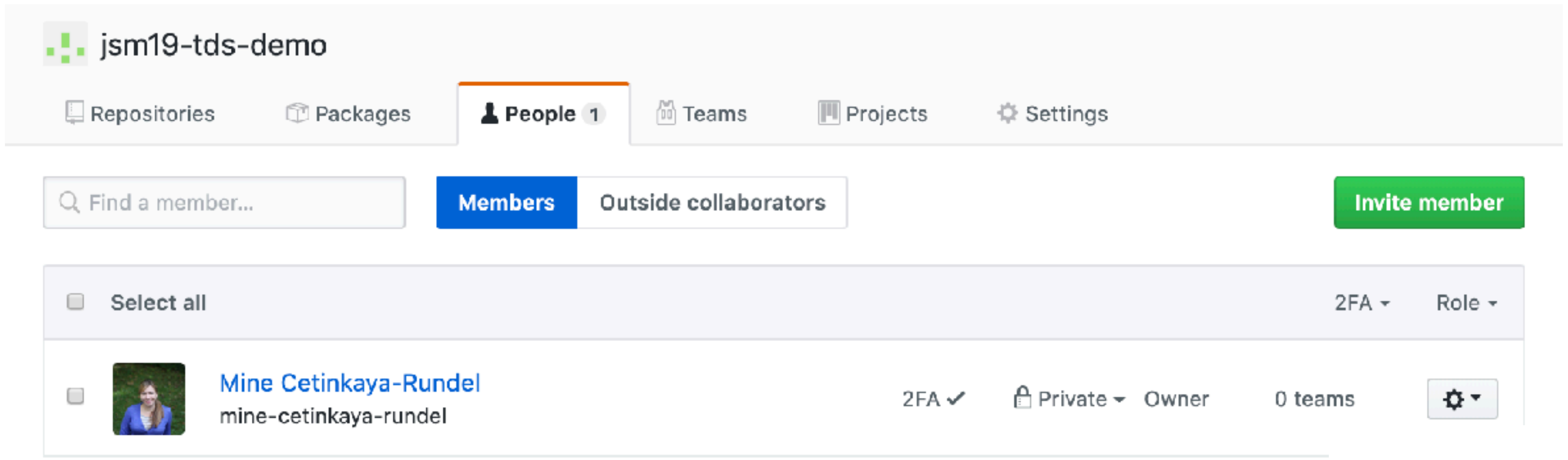
Team $9 per user / month
Starts at $25 / month which includes your first 5 users.
Unlimited public repositories
Unlimited private repositories

3. upgrade course organization

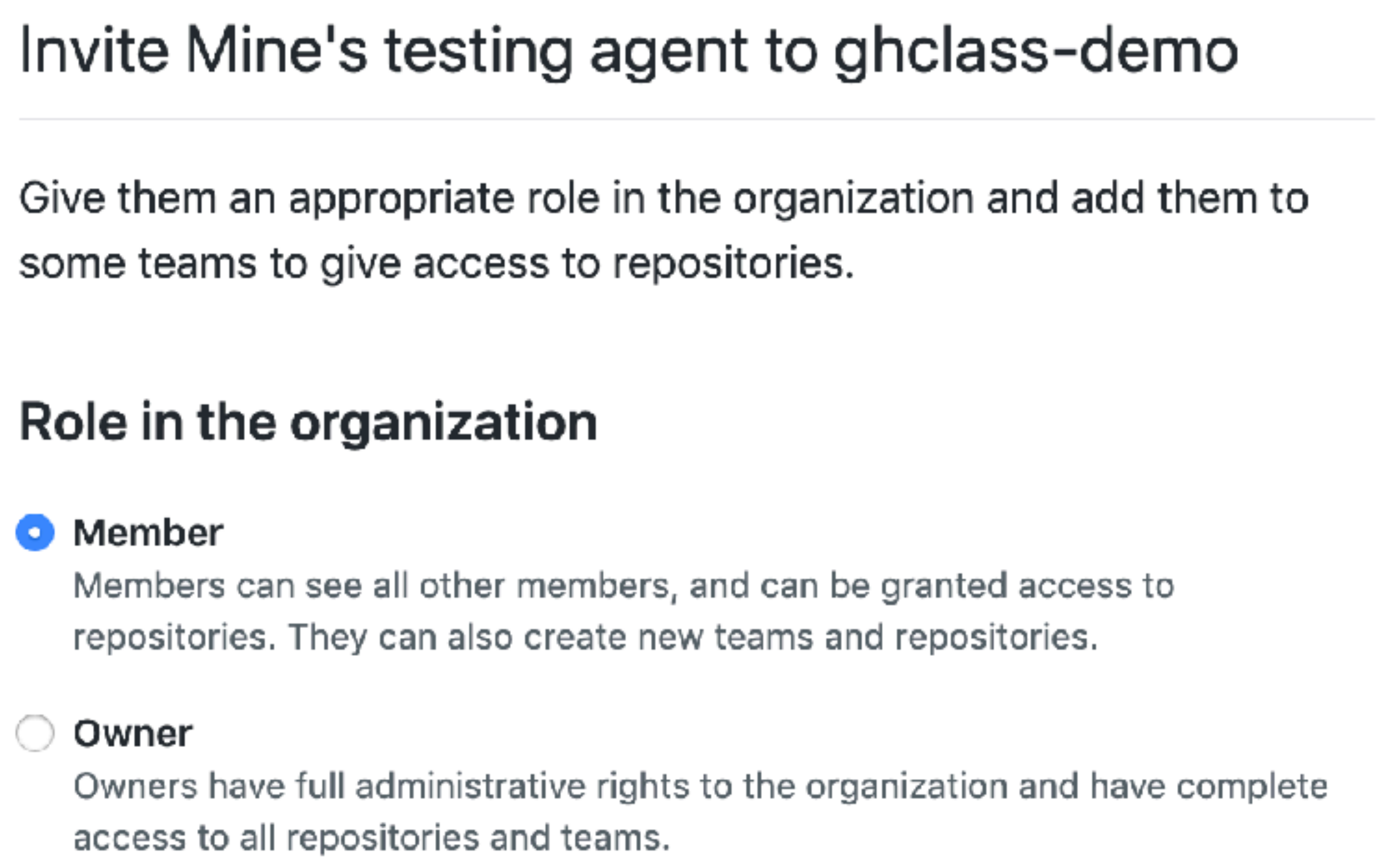


Sta112-F18	Coupon already applied
sta771-f18	Coupon already applied
rstudio4edu	Upgrade
ghclass-test	Coupon already applied
ghclass-demo	Coupon already applied
rstudio-conf-2020	Upgrade
jsm19-tds-demo	Coupon already applied

4. invite students


jsm19-tds-demo

Mine Cetinkaya-Rundel
mine-cetinkaya-rundel
2FA ✓ Private Owner 0 teams


Invite Mine's testing agent to ghclass-demo

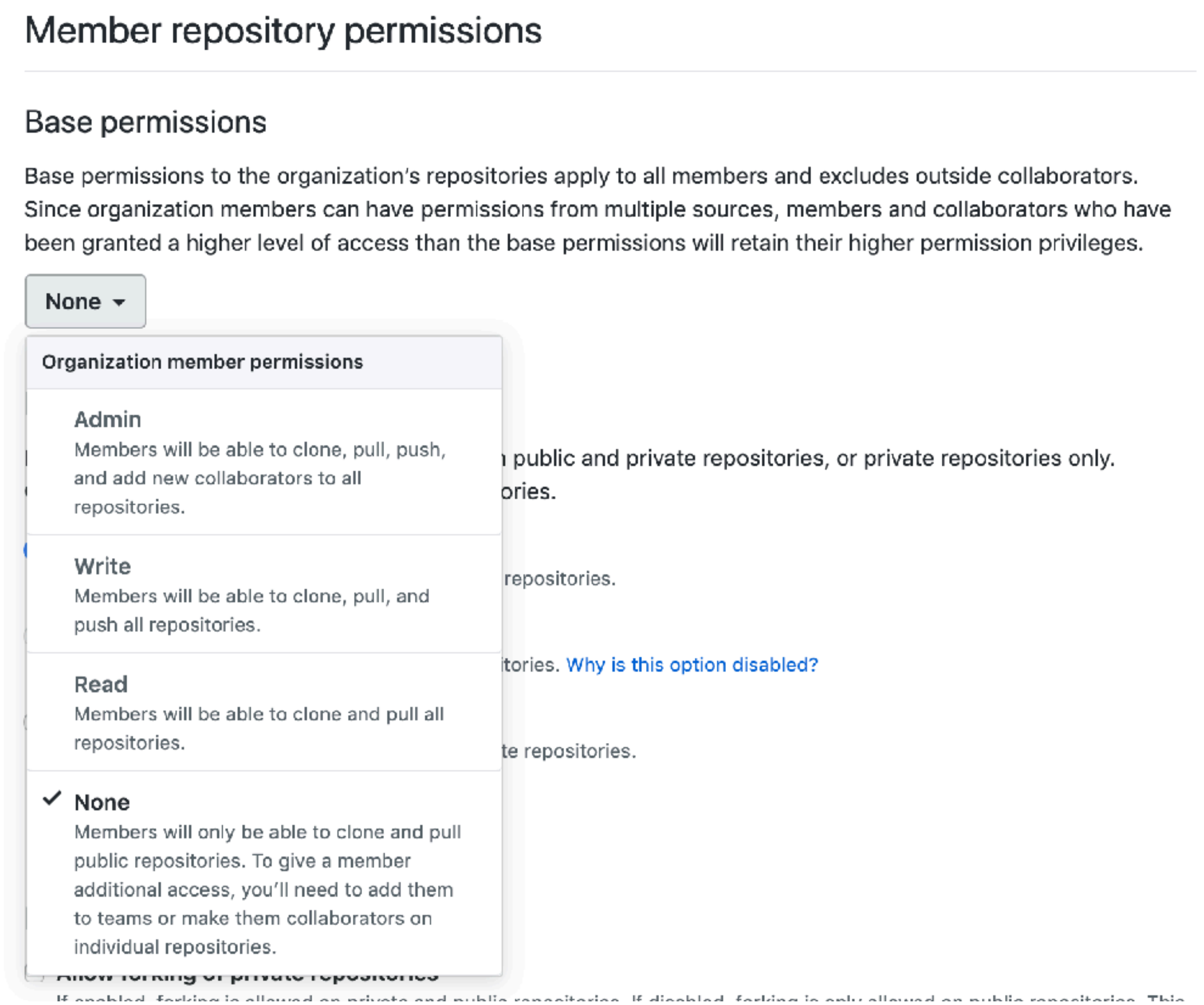
Give them an appropriate role in the organization and add them to some teams to give access to repositories.

Role in the organization

[✓ Member]
Members can see all other members, and can be granted access to repositories. They can also create new teams and repositories.

Owner
Owners have full administrative rights to the organization and have complete access to all repositories and teams.

member privileges



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.

None ▾

Organization member permissions

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

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

Read
Members will be able to clone and pull all repositories.

✓ **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.

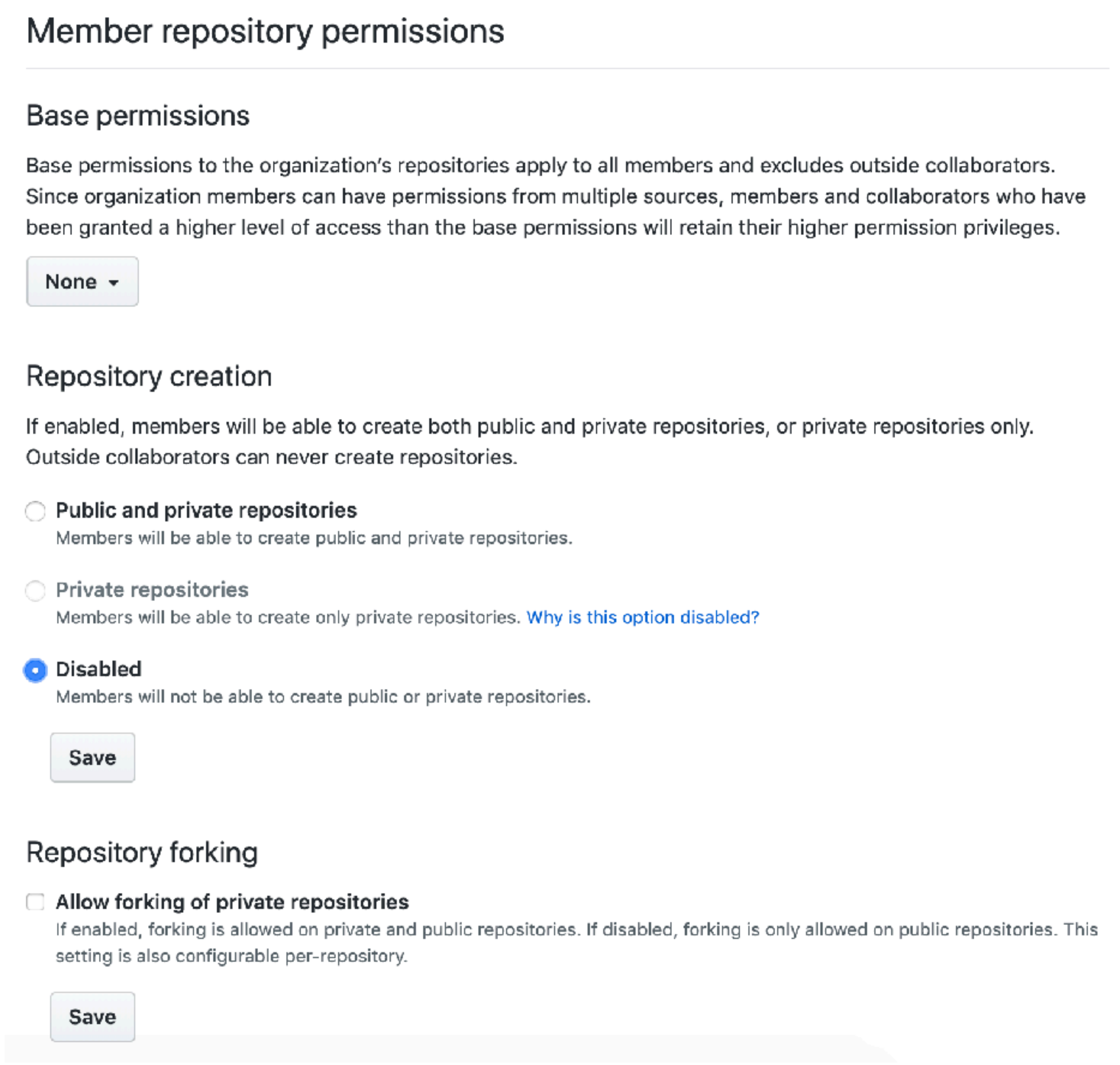
public and private repositories, or private repositories only.
ories.

repositories.

tories. Why is this option disabled?

te repositories.

member privileges



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.

Repository creation

If enabled, members will be able to create both public and private repositories, or private repositories only. Outside collaborators can never create repositories.

○ **Public and private repositories**
Members will be able to create public and private repositories.

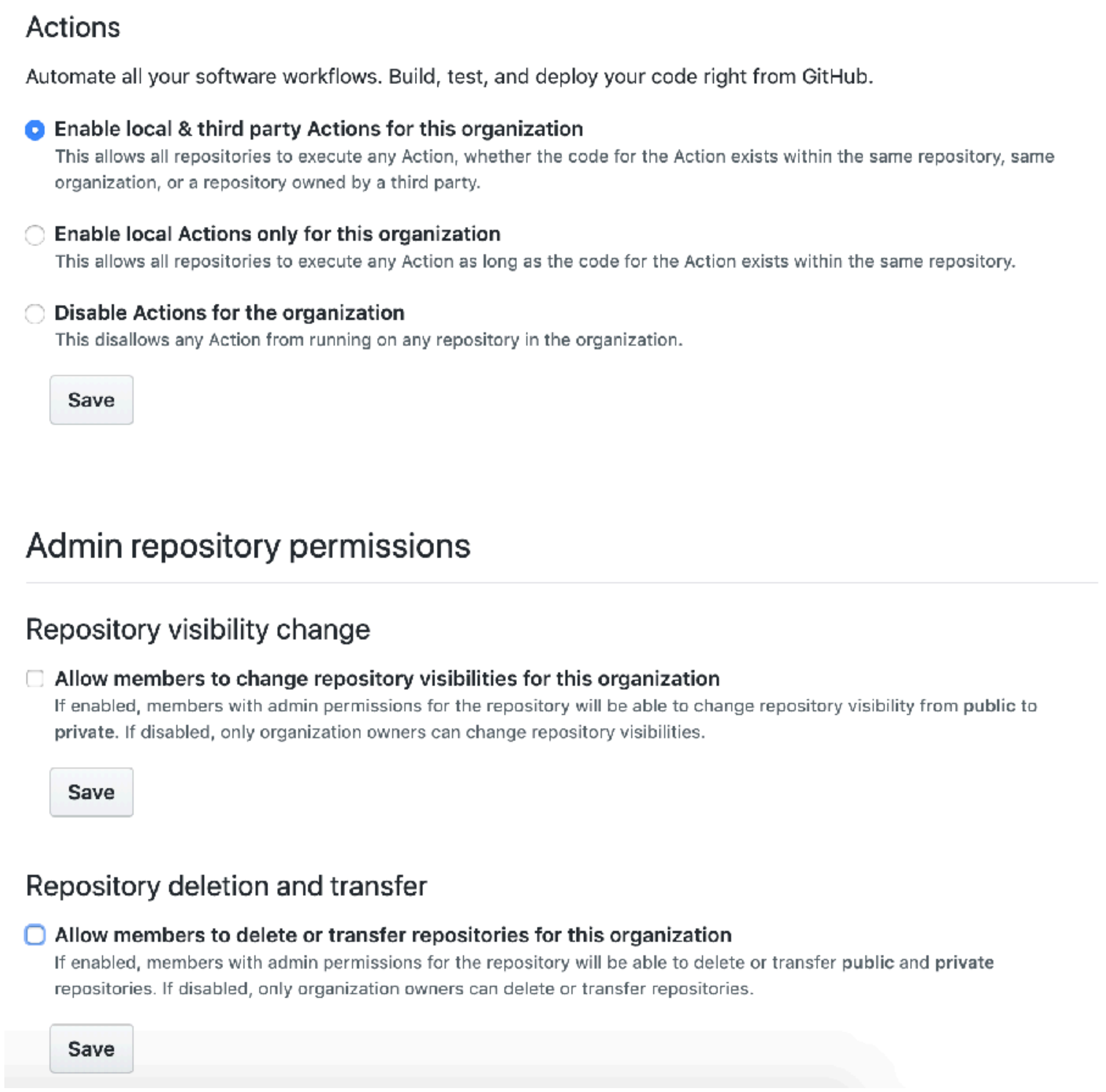
○ Private repositories
Members will be able to create only private repositories. Why is this option disabled?

● Disabled
Members will not be able to create public or private repositories.

Repository forking

☐ **Allow forking of private repositories**
If enabled, forking is allowed on private and public repositories. If disabled, forking is only allowed on public repositories. This setting is also configurable per-repository.

member privileges



Actions

Automate all your software workflows. Build, test, and deploy your code right from GitHub.

[✓ Enable local & third party Actions for this organization]
This allows all repositories to execute any Action, whether the code for the Action exists within the same repository, same organization, or a repository owned by a third party.

Enable local Actions only for this organization
This allows all repositories to execute any Action as long as the code for the Action exists within the same repository.

Disable Actions for the organization
This disallows any Action from running on any repository in the organization.

Admin repository permissions

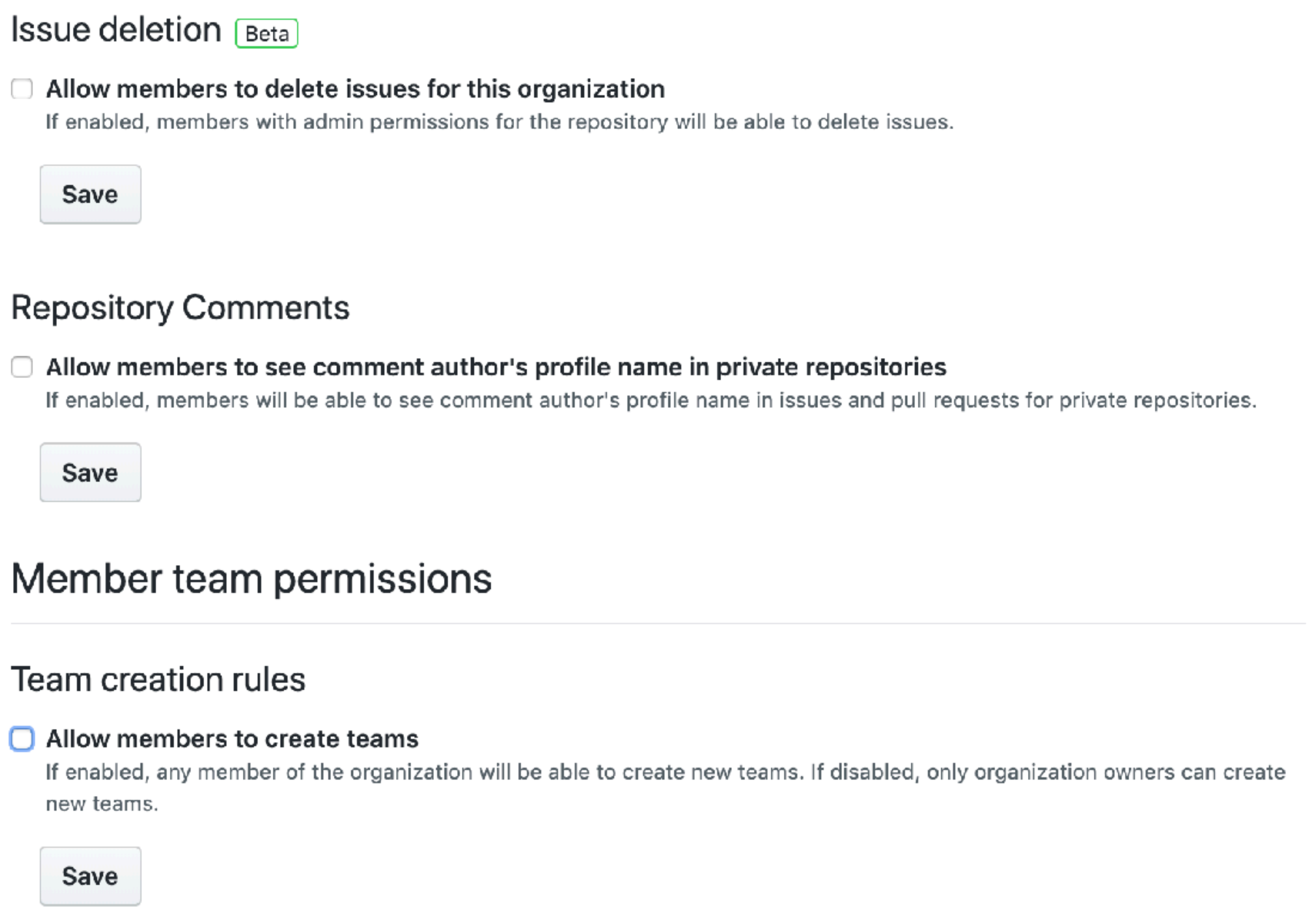
Repository visibility change

☐ Allow members to change repository visibilities for this organization
If enabled, members with admin permissions for the repository will be able to change repository visibility from **public** to **private**. If disabled, only organization owners can change repository visibilities.

Repository deletion and transfer

☐ Allow members to delete or transfer repositories for this organization
If enabled, members with admin permissions for the repository will be able to delete or transfer **public** and **private** repositories. If disabled, only organization owners can delete or transfer repositories.

member privileges



Issue deletion

☐ **Allow members to delete issues for this organization**

If enabled, members with admin permissions for the repository will be able to delete issues.

Repository Comments

☐ **Allow members to see comment author's profile name in private repositories**

If enabled, members will be able to see comment author's profile name in issues and pull requests for private repositories.

Member team permissions

Team creation rules

☐ **Allow members to create teams**

If enabled, any member of the organization will be able to create new teams. If disabled, only organization owners can create new teams.

automate invitations

Inviting students to the organization only needs to be done once be class, but the process gets tedious for more than a handful of students.

We have developed an R package that automates this (and other class related tasks) called **ghclass**.

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

GitHub tokens

ghclass uses the GitHub API to interact with your course 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.

These tokens can be created here and once created should be saved to `~/.github/token` or assigned to the `GITHUB_TOKEN` environmental variable.

check tokens

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

```
library(ghclass)
test_github_token()
```

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

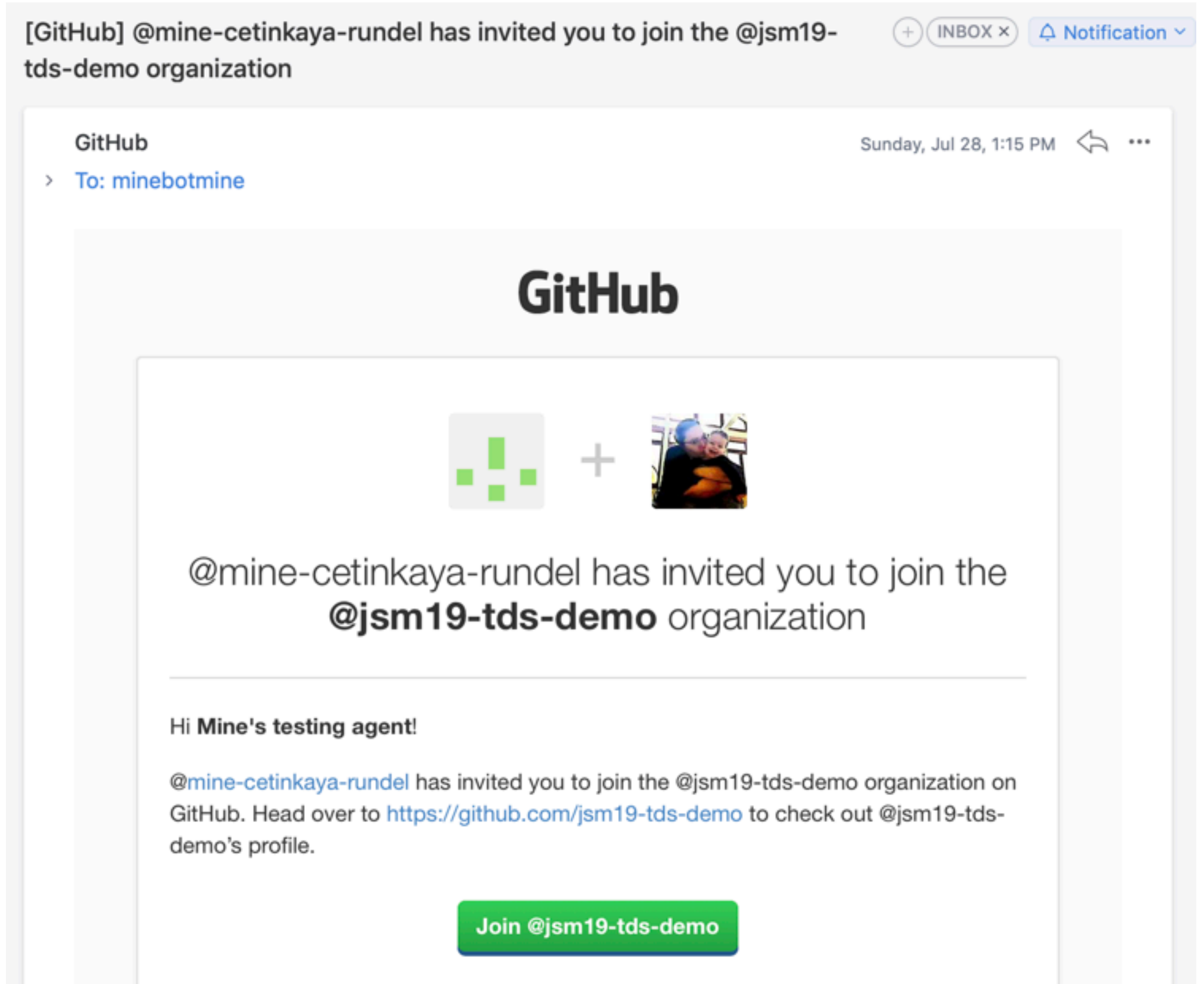
```
test_github_token("MADE_UP_TOKEN")
```

```
## Error in gh("/user", .token = token): GitHub API error (401): 401 Unauthorized
##   Bad credentials
```

invite students

```
org_invite("jsm19-tds-demo", roster$ghname)
```

```
✔ Invited user 'minebotmine' to org 'jsm19-tds-demo'.
```



[GitHub] @mine-cetinkaya-rundel has invited you to join the @jsm19-tds-demo organization

GitHub

Sunday, Jul 28, 1:15 PM

To: minebotmine

GitHub

@mine-cetinkaya-rundel has invited you to join the **@jsm19-tds-demo** organization

Hi **Mine's testing agent**!

@mine-cetinkaya-rundel has invited you to join the @jsm19-tds-demo organization on GitHub. Head over to https://github.com/jsm19-tds-demo to check out @jsm19-tds-demo's profile.

check student status

```r
org_members("jsm19-tds-demo")
```

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

```r
org_pending_members("jsm19-tds-demo")
```

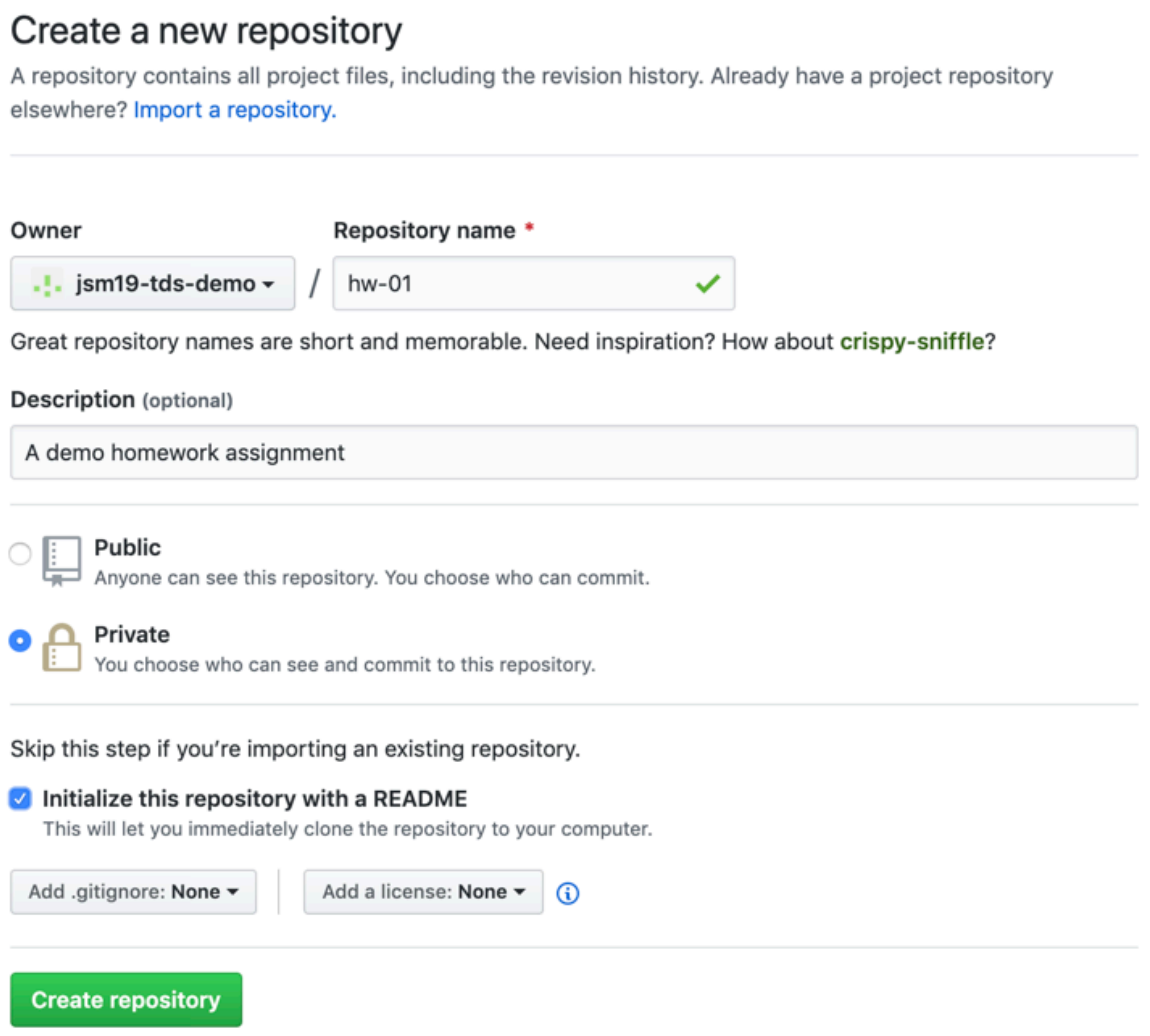
```
[1] "minebotmine"
```

4. create assignments

There are a few moving parts here, so we will break it down into several steps. For each assignment we do the following:

1. Create a template repository that contains starter documents for an assignment
2. Create assignment

4.1 create template repository



Create a new repository

A repository contains all project files, including the revision history. Already have a project repository elsewhere? Import a repository.

Owner: jsm19-tds-demo / Repository name *: hw-01

Great repository names are short and memorable. Need inspiration? How about crispy-sniffle?

Description (optional): A demo homework assignment

Public — Anyone can see this repository. You choose who can commit.

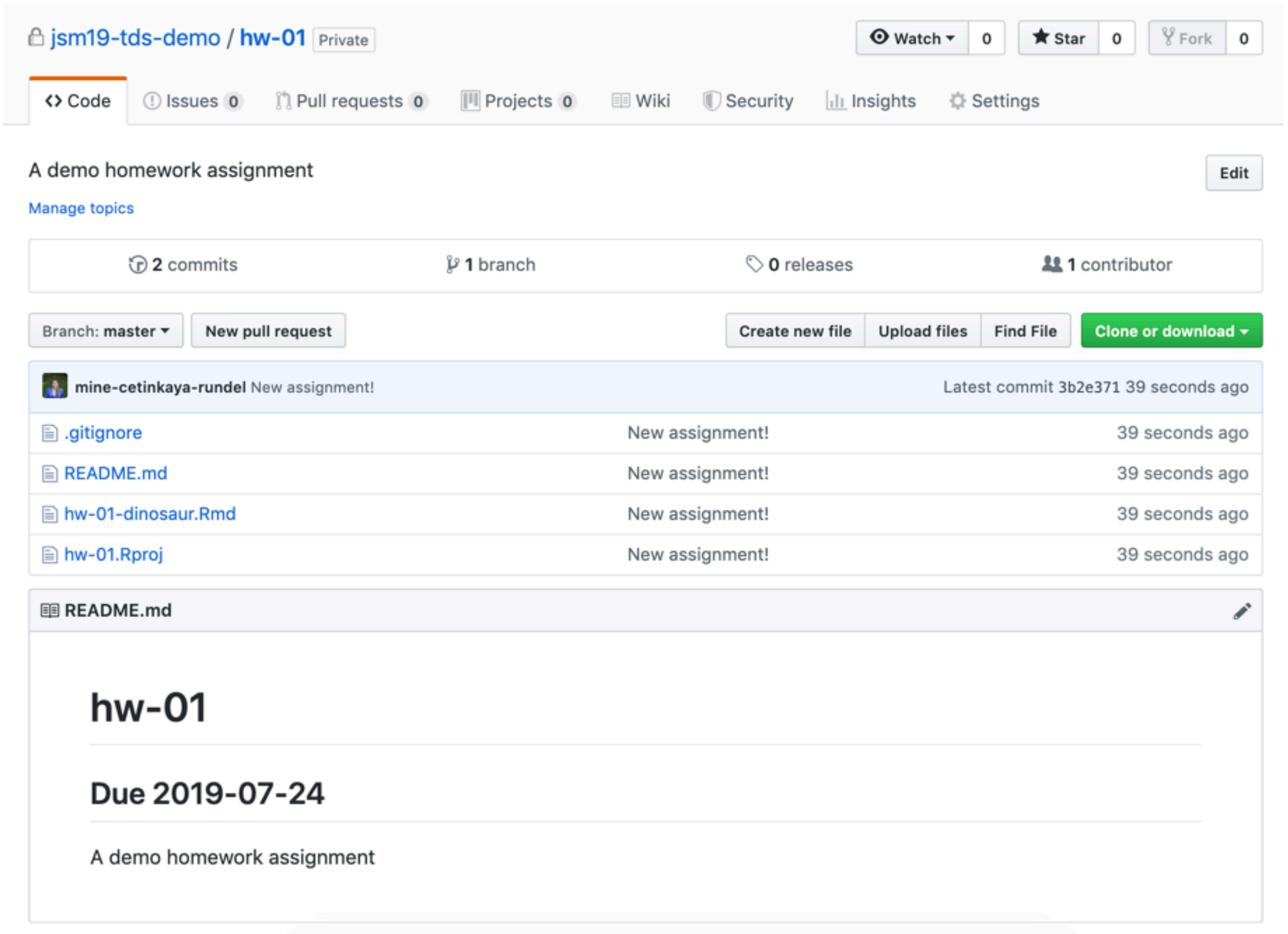
[✓ Private] — You choose who can see and commit to this repository.

Skip this step if you're importing an existing repository.

[✓] Initialize this repository with a README

This will let you immediately clone the repository to your computer.

Add .gitignore: None | Add a license: None



jsm19-tds-demo / hw-01 Private

Watch 0 | Star 0 | Fork 0
Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Security | Insights | Settings

A demo homework assignment

2 commits | 1 branch | 0 releases | 1 contributor

Branch: master | New pull request | Create new file | Upload files | Find File | Clone or download

mine-cetinkaya-rundel New assignment! — Latest commit 3b2e371 39 seconds ago

.gitignore	New assignment!	39 seconds ago
README.md	New assignment!	39 seconds ago
hw-01-dinosaur.Rmd	New assignment!	39 seconds ago
hw-01.Rproj	New assignment!	39 seconds ago

README.md

hw-01

Due 2019-07-24

A demo homework assignment

4.2 create assignment

```r
org_create_assignment(org = "jsm19-tds-demo",
                      repo = paste0("hw-01-", roster$ghname),
                      user = roster$ghname,
                      source_repo = "jsm19-tds-demo/hw-01")
```

```
✔ Created repo 'jsm19-tds-demo/hw-01-minebotmine'.
✔ Added user 'minebotmine' to repo 'jsm19-tds-demo/hw-01-minebotmine'.
✔ Cloned 'jsm19-tds-demo/hw-01'.
✔ Pushed (mirror) 'hw-01' to repo 'jsm19-tds-demo/hw-01-minebotmine'.
✔ Removed local copy of 'jsm19-tds-demo/hw-01'
```

> Your turn!

First, I will create your repositories…

You're the student:

- Go to **github.com/jsm19-tds-demo** and locate your HW 01 repository.
- Create a new project from GitHub in the RStudio Cloud workspace for this workshop: **rstd.io/teach-ds-cloud**
- In the **Console**, run the following:

```
library(usethis)
use_git_config(user.name = "Jane", user.email =
"jane@example.org")
```

- Make changes to the Rmd file, stage, commit, push

create teams

GitHub supports the creation of teams within an organization, these teams can then be assigned a shared repository.

We can use ghclass to create these teams and add students to them.

```r
team_create(org = "jsm19-tds-demo", unique(teams))
```

```
✔ Created team 'team4' in org 'jsm19-tds-demo'.
```

```r
team_invite(org = "jsm19-tds-demo",
            user = roster$ghname,
            team = roster$team)
```

```
✔ Added 'minebotmine' to team 'team4'.
```

create team assignments

GitHub supports the creation of teams within an organization, these teams can then be assigned a shared repository.

```r
org_create_assignment(org = "jsm19-tds-demo",
                      repo = paste0("hw-02-", roster$team),
                      user = roster$ghname,
                      team = roster$team,
                      source_repo = "jsm19-tds-demo/hw-02")
```

```
✔ Created repo 'jsm19-tds-demo/hw-02-team4'.
✔ Added 'minebotmine' to team 'team4'.
✔ Added team 'team4' to repo 'jsm19-tds-demo/hw-02-team4'.
✔ Cloned 'jsm19-tds-demo/hw-02'.
✔ Pushed (mirror) 'hw-02' to repo 'jsm19-tds-demo/hw-02-team4'.
✔ Removed local copy of 'jsm19-tds-demo/hw-02'
```

> Your turn!

You’re the student:
Make some more changes to your HW 01 and “submit” by making one last push.

Let’s review the collecting process together.

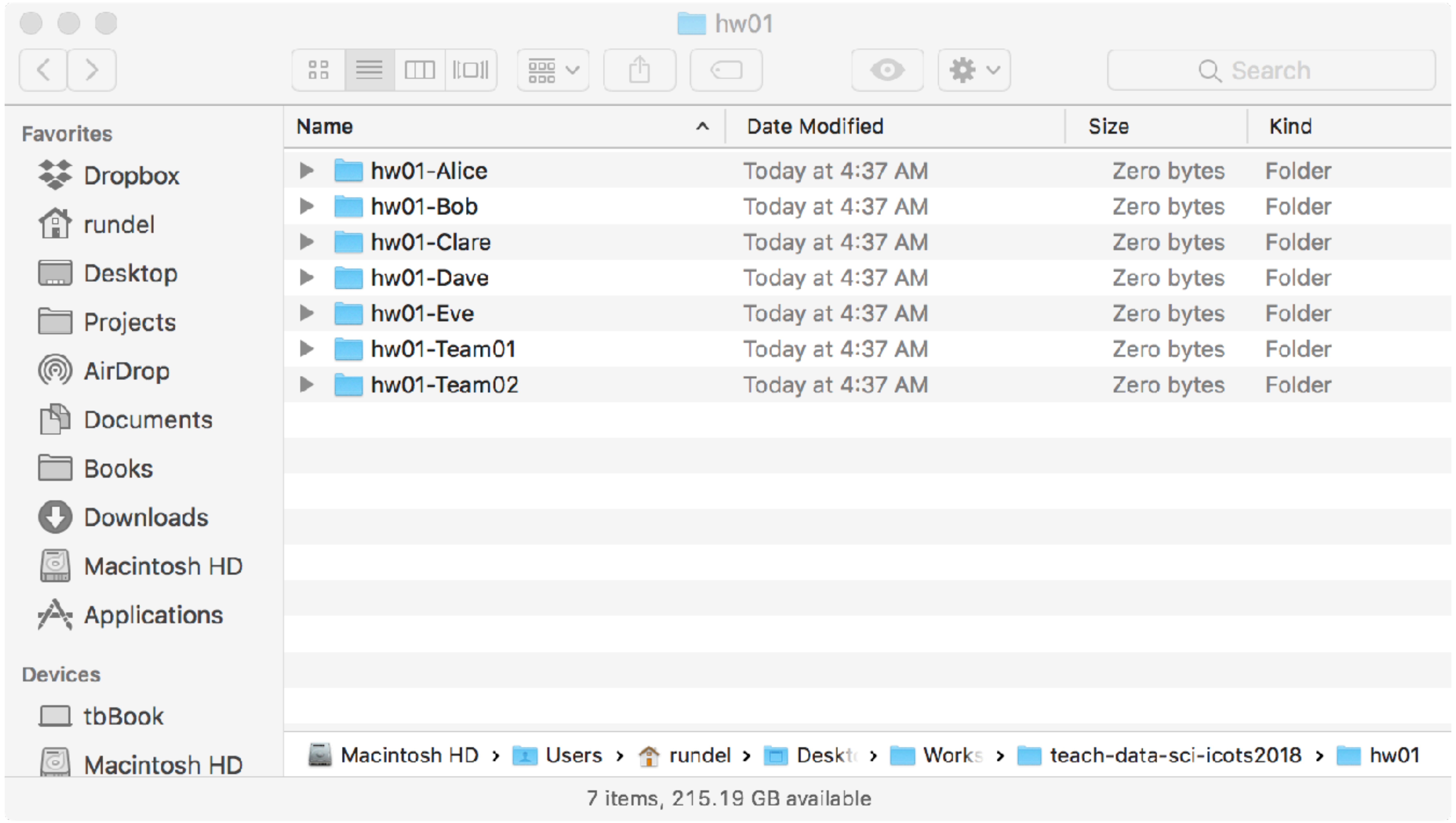
5. collect assignments

```
hw01_repos ← org_repos(org = "jsm19-tds-demo", filter =
“hw-01-")

local_repo_clone(repo = hw01_repos,
                 local_path = "hw-01-collect")
```

```
✔ Cloned 'jsm19-tds-demo/hw-01-minebotmine'.
```

6. grade assignments



hw01

Favorites: Dropbox, rundel, Desktop, Projects, AirDrop, Documents, Books, Downloads, Macintosh HD, Applications

Devices: tbBook, Macintosh HD

Name	Date Modified	Size	Kind
hw01-Alice	Today at 4:37 AM	Zero bytes	Folder
hw01-Bob	Today at 4:37 AM	Zero bytes	Folder
hw01-Clare	Today at 4:37 AM	Zero bytes	Folder
hw01-Dave	Today at 4:37 AM	Zero bytes	Folder
hw01-Eve	Today at 4:37 AM	Zero bytes	Folder
hw01-Team01	Today at 4:37 AM	Zero bytes	Folder
hw01-Team02	Today at 4:37 AM	Zero bytes	Folder

Macintosh HD › Users › rundel › Deskt › Works › teach-data-sci-icots2018 › hw01

7 items, 215.19 GB available

feedback - issues

Instructors (and TAs) can view all repositories within the course organization:

- You can open issues in a repository with feedback for the students.
- Use the blame view to get specific line references.
- Make sure to @ mention the student so that they are notified when an issue is opened.

Note: You might want to consider keeping points out of issues.

feedback - 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.

feedback - pull requests

- Another option is to open pull requests for your students' work where you directly edit their work and ask them to approve the edits.
- This can be effective as students will see your corrections and review them before accepting them.
- However this also does mean that you're directly correcting their work as opposed to giving them higher level instructions on how to correct it.