Getting started with Git (and LaTeX)

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Almost minimal working example (MWE) of using git. Also included are some examples of using LaTeX for equations, figures, tables, and references. You can see this project on Overleaf with this Overleaf shared link.

1 Git/GitHub

Git is a distributed version control system similar in functionality to earlier incarnations like cvs and svn. It is the de facto standard in software development and for scientific computing. It is used for tracking software changes and for coordinating concurrent work on associated projects amongst multiple people. For most of our class use case, we will deal with the simple workflow of personal use rather than collaborative use.

For each project, we will use GitHub as the remote software repository, and a local Git client like the git command line interface (CLI) on Ubuntu to manage Git transactions.

A pre-requisite is a GitHub account. This includes a username, password and secondary authentication mechanism. For the latter, I use https based authentication using a Personal Access Token (PAT); this is a 40 character automatically generated secondary password. Make sure you do not publish your PAT!

Once you have the above setup, you can create a new remote project repository by going to your github web page (github.com/yourusername), being logged in (with your password and possibly PAT), go to "Repositories" link on the top, and click on the green "New" button. This will create the new repository with the project name you assigned - for example "Projectile-Motion". When you go to that repository, there should be another green button marked "Code". This gives a number of methods for cloning your

remote repository locally on your computer. My preference is to use https, namely,

```
git clone https://github.com/yourusername/ProjectileMotion.git
```

This will copy the entire remote repository named ProjectileMotion to a folder/directory with that name to your current local path. So if you are at `/home/yourusername`, the git directory will be at `/home/yourusername/ProjectileMotion`.

You can then navigate to that folder by doing,

```
cd ProjectileMotion
```

and use the code or add more code content.

It is always a good idea to check the status of your local repository, especially after making changes.

```
git status
```

Especially before, but also after executing git commands.

If you have new or modified files that you want to be included in your next update (commit) of the repository you need to "add" these changes, either one file at a time,

```
git add specific-file.txt
```

or usually all at once (all files at current path and below).

It is OK (and often very desirable) to not have all files under git control. This can be managed using a `.gitignore` hidden file.

Often you will want to add all files all at once (all files at current path and below), one can do this using

```
git add .
```

Another `git status` here would help confirm what got added and this is a good time to undo any mistakes. (The files that were in red should now be in green.

Now we are ready to commit the changes to your local repository, including a short "commit" comment.

```
git commit -m "My commit message"
```

One can also break the changes into smaller thematic chunks.

In order to "publish" or synchronize your local repository changes to the

remote repository (GitHub) one needs to "push" the changes to GitHub. This needs authentication with your GitHub username and PAT (for https). It is possible to cache your GitHub credentials locally for up to 10 hours (so that the username/PAT do not need to be respecified in further local-to-remote transactions).

`git push`

There is of course more functionality (and complications) to Git/GitHub than described above, and various more advanced workflows, but these are some of the essential steps for single person use. For me, some of the main reasons to use this are as a backup, and as a straightforward way to use the same code on different machines.

2 Getting more out of Git

Five additional useful commands are:

1. `git pull - -dry-run` (the two dashes preceding dry should have no space in the middle...). This shows what would happen if you were to update your local repository with any changes made to the remote repository, like for example feedback files I may have added, and serves as a check on whether there are any new changes. If there are no new changes there will be no output from the command.

2. `git pull` This does update your local repository with any changes made to the remote repository. For example if you downloaded the ClassExamples repository last week and want the latest, do git pull from the ClassExamples local directory.

3. `git diff filename.txt` See what changes there are between your locally modified version of the file and the one in the (reference) remote repository.

4. `git log` History of all the commits and commit messages made to this repository.

5. `git config - -global credential.helper 'cache - -timeout=36000'`. This will cache your authentication credentials for up to 10 hours after

initial authentication, meaning you only need to enter your username and password once in a session. (above two-dash remark applies twice here). This works for me on my laptop and the room 2076 Ubuntu system but could be OS and git client dependent.

3 LaTeX

LaTeXis a document preparation system that can handle documents ranging from basic notes, to lab reports, to technical documents, scientific papers and textbooks. It is especially strong in focusing the author on the content and the structure of the document, rather on details of typesetting and what ends up on specific pages. It is the tool of choice for documents with equations.

It used to have a reasonably steep learning curve, because it needs to be compiled rather being WYSIWYG (what-you-see-is-what-you-get). Now there are LaTeX integrated development environments (IDEs) like Overleaf that allow one to add content and visualize the type-set document essentially instantaneously. Overleaf has become particularly powerful for working in a team on a common document. To get started with Overleaf you will need an account.

4 Some LaTeX examples

The Rayleigh distribution has the following probability density function,

$$p(r;\sigma) = \frac{r}{\sigma^2}\exp(-r^2/(2\sigma^2) \tag{1}$$

where $r \geq 0$ and σ is known as the scale parameter. It relates to the magnitude of a bi-variate uncorrelated Gaussian distribution. An example of random numbers drawn from this distribution is shown in Fig. 1.

An environment tabularx, an extension of tabular, creates a paragraph-like column whose width automatically expands so that the declared width of the environment is filled. Table 1 shows a minimal working example.

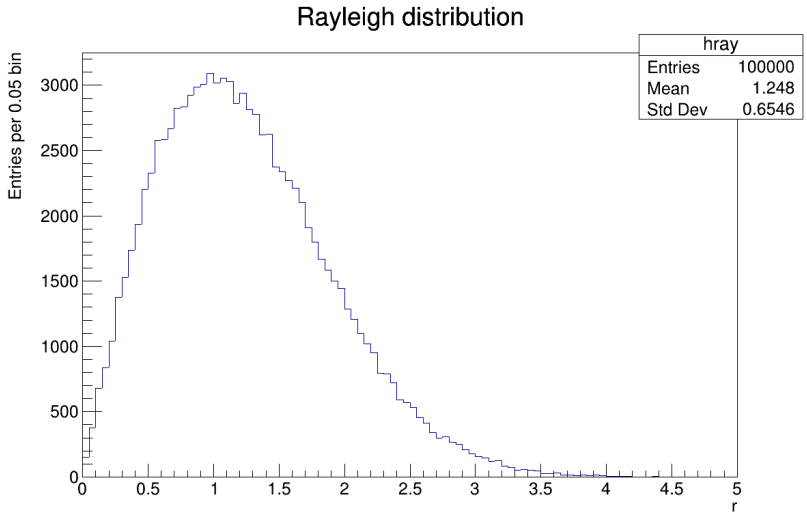

Figure 1: Random numbers following the Rayleigh distribution with scale parameter, $\sigma = 1$.

Table 1: Example table.

Case	Method#1	Method#2	Method#3
1	50	837	970
2	47	877	230
3	31	25	415
4	35	144	2356
5	45	300	556

5 Previous work

There are many ways to reference bibliographic information. Here I used a style file from the CMS experiment. The references below are taken verbatim from an Overleaf template.

A simple LaTeX example of one author was written by [1] and several authors by [2]. A book can be cited by [3]. A much longer LaTeX example was written by [4]. An example of a technical report was written by [5].

References

[1] A. C. Moretti, "A weighted projection centering method", *Computational & Applied Mathematics* **22** (2003) 19–36.

[2] J. J. B. Bechara and R. D. Galvão, "The use of interactive computing for vehicle routing", in *Recent Advances in System Modelling and Optimization*, pp. 22–32. Springer, 1986.

[3] L. Kleinrock, "Queueing systems: theory". John Wiley, 1975.

[4] N. Maculan, G. Plateau, and A. Lisser, "Integer linear models with a polynomial number of variables and constraints for some classical combinatorial optimization problems", *Pesquisa Operacional* **23** (2003) 161–168.

[5] H. H. Yanasse, "An exact algorithm for the tree case of the minimization of open orders problem", technical report LAC-001/97, INPE, 1997.