

APT Session 3: Version control and testing



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What to expect from this session

- 1 What is version control?
- 2 `git` essentials.

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- 2 `git` essentials.
- 3 Testing.

Prerequisites

You should have:

- 1 Created a [github account](#).
- 2 Downloaded and installed git 2.19.x from <http://git-scm.com/downloads>
- 3 Downloaded and installed Python 3.7.x from <https://www.python.org/downloads/>
- 4 Ensured your laptop can connect to one of the College's wireless networks.

Version control

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- Allows multiple people to edit a single system – even a single file – in a predictable manner.
- Without version control, working in teams is torture.

An incomplete history of version control

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- 1990: CVS.
- 2000: SVN.
- 2005: git / mercurial.
- My advice: use git or (if you have to) Mercurial. Ignore the rest.
- Free hosting sites: [github](#) (Git), [Bitbucket](#) (Git, Mercurial, multiple free private repos).

Distributed version control

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- Typical scenario: a 'central' repository:
 - from which everyone *pulls* other people's changes.
 - to which everyone *pushes* changes they have made.
- Best practice: regularly push and pull (at least daily, in general).
- **But don't:**
 - push half-finished changes.
 - pull if you're in the middle of something.

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- Fearsome complexity if you go looking for it. Relatively simple, if you keep it that way.
- All commands are of the form `git <cmd> [options]`

Cloning

- To work with someone else's repository, we first *clone* it, to get a local copy.
- Use: `git clone <repo>`
- Note: once cloned, you can edit the repository as much as you want. No changes make their way back to the 'central' repository until you explicitly tell git to do so — don't be shy about trying things out on your local computer!

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Exercises:

- 1 Clone the repository <https://github.com/ltratt/apt2018/>
- 2 Run `python3 old.py 150`; enter whole numbers (on the same line) and press return. Quit with Ctrl-D.

diff

- `diff -u <old file> <new file>` shows you what changes you would need to apply to `old file` to change it into `new file`. A vital part of software development.
- Lines beginning with:
 - `---` or `+++` tell you the old / new filenames.
 - `@@` tells you where within the file you're looking.
 - `_` (i.e. a space) are lines that are unchanged.
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Exercises:

- 1 Can you spot the difference between `old.py` and `new.py`?
- 2 Run `python3 simplediff.py old.py new.py` to see output equivalent to running `diff -u` (or `git diff`).

Pushing

- `git add x` makes git track the file `x`.
- `git commit --all` records all changes to tracked files into a *commit*.
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Exercises:

- 1 Join up into pairs. Choose one person to create a new repository.
- 2 Login to your github account, click on the 'repositories' tab and click 'new'. Name it 'apptest'. Make sure 'Initialize this repository with a README' is checked then press 'create repository. Go to 'Settings > Collaborators' and add the other person's username.
- 3 Both clone the repository.
- 4 One person: copy `old.py`, add it, commit, and push. Other person: pull.

Pulling

- To integrate all changes other people have made since you cloned/pulled, `git pull`. Local changes require you to `git stash` before pulling, then `git stash pop` afterwards.
- You can see which files you've modified with `git status`.
- You can permanently remove your local changes with `git checkout <file>`.

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Exercises:

- 1 One at a time: edit the file, commit, push; and have the other person pull. Swap roles.
- 2 Both edit the file. One commits and pushes, the other pulls. Swap.
- 3 Both add a print statement at line 4 (i.e. immediately after the `import` statement) `print("Enter numbers")`. Then pull, and read the instructions carefully.
- 4 Remove your local changes to `old.py`.

Merges and conflicts

- If two people both modify the same file, the first to push 'wins'. The second person will have to pull and merge before pushing.
- Changes in different parts of a file are automatically merged.
- Changes in the same part of a file cause conflicts (between <<<=== >>>) and require the user to manually resolve them. Can select either HEAD (your changes) or remote, or a mix of the two.
- Two merging cases: have / haven't committed.

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Exercises:

- 1 Person A: edit `old.py` so that line 1 is `#!/usr/bin/python3`.
Person B: edit line 1 to `#!/usr/local/bin/python3`. Both commit and push.
- 2 Whoever 'loses': try `git pull` and follow its suggestions carefully until you have successfully pulled and integrated your changes. [Arbitrarily chose which version of line 1 will 'win'.]

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Exercises:

- 1 Run `gitk` (if you don't have that, try `git log --graph`).
- 2 Use `git diff` to see the differences between your latest version of `old.py` and the first version in the repository. [You will need to lookup the documentation for `git-diff`; you may want to use commit hashes.]

Branches

- A repository (local and remote) can have explicit branches.
- The default branch is called `master`.
- Create branches with `git branch <name>`; switch branches with `git checkout <branch name>`.
- To merge branch `X` into `Y`, checkout `Y` and run `git merge X` (i.e. you say “I want to merge another branch into me”).
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Exercises:

- 1 Create a new branch in the `apt` repository called `floats`.
- 2 In the new branch, edit `old.py` so that `int(num)` becomes `float(num)`. Commit your change.
- 3 Switch back to `master`, and merge in the `floats` branch.

Code review and pull requests

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Exercises:

- 1 In your pairs, choose one person (*A*) to create a new branch in their clone of the other person's (*B*) repository. Edit the file `old.py` so that blank lines are deleted; commit; push (notice the message!).
- 2 Go to *B*'s github page for that repository, and open a pull request (there is a button for this – look carefully for it).
- 3 *B* will have received a pull request by email. Review the pull request and merge it in once you're happy with it.

Regression testing (1)

...as a consequence of the introduction of new bugs, program maintenance requires far more system testing per statement written than any other programming. Theoretically, after each fix one must run the entire batch of test cases previously run against the system, to ensure that it has not been damaged in an obscure way. In practice, such regression testing must indeed approximate this theoretical idea, and it is very costly.

-Fred Brooks, The Mythical Man Month (1975), p. 122

Regression testing (2)

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- Every time a bug is found, a test *must* be added to the test suite to stop it ever reappearing.
- Whenever a change is made to the system, the relevant parts of the regression suite are run again.
- Regression testing builds confidence when modifying a system.
- Without regression testing, sensible people will tend to become nervous about modifying a large system for fear of breaking it.

Unit testing

- The *xunit* family of libraries are available for nearly every language.
- They allow us to easily write and run tests.
- Let's try a few Python examples.

Travis CI (1)

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Exercises:

- 1 Copy the file `t.py` from my repository into your repository, commit, and push it.
- 2 Go to GitHub's marketplace and enable Travis (the \$0 option!). Go to <https://travis-ci.org/> > Settings > Repositories and tick the box next to your repository name.
- 3 Create a file `.travis.yml` with the following content:

```
language: python
script: python -m unittest t
```

add, commit, and push it. View your build at <https://travis-ci.org/>

Travis CI (2)

- Travis CI automates checking of unit tests in pull requests.
-

Exercises:

- 1 Go to your GitHub repository > Settings > Branches > Add rule > Require status checks to complete before merging, and then enable 'Travis CI - branch'.
- 2 Make a new branch; make a test fail; then open a pull request against your partner's repository.

Fixing tests

- 'Testing shows the presence, not the absence of bugs' (Dijkstra).

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Exercises:

- 1 There is a missing test case in `t.py`. In pairs find it and fix the resulting error. Then one of you raise a PR and the other – after Travis has completed – can merge it in.

Post-session exercises

Try these (no particular order):

- Experiment with committing parts of a file with `git gui`.
- Experiment with rebasing, particularly squashing small commits into bigger ones before merging (I set `rebase=true` in my `.gitconfig`). Be careful: you can go badly wrong if you rebase commits that have been pushed to another repository.
- Make your editor display which lines have been changed in a file relative to your last commit (e.g. in [Vim](#), I use the [vim-signify](#) plugin).
- Download and use [JUnit](#) for Java.