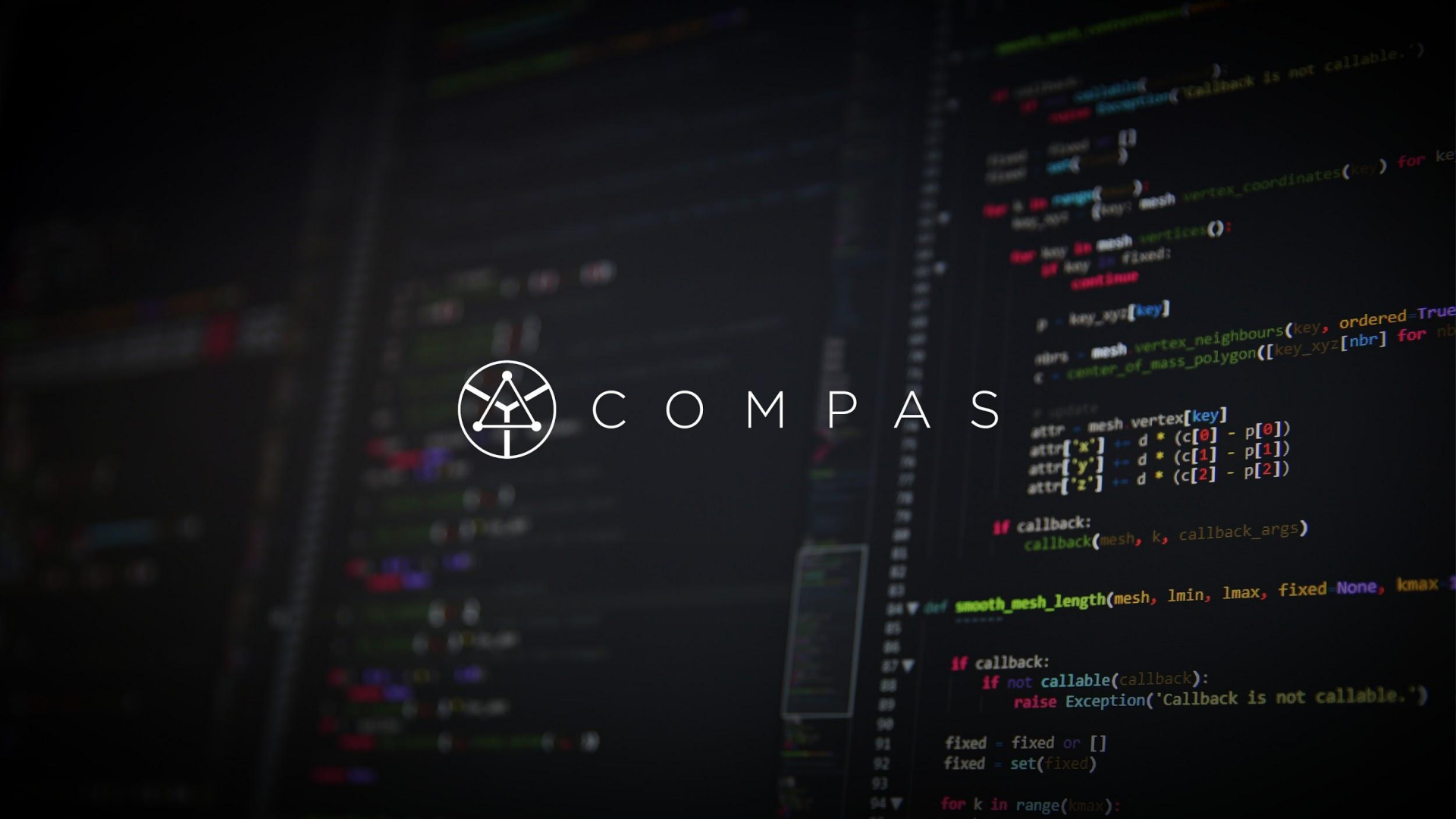

COMPAS

Building blocks
Code management
Python programming
COMPAS programming

Building **blocks**

The Toaster Project, Thomas Thwaites
CC-BY 2.0, Per-Olof Forsberg

The Toaster Project, Thomas Thwaites
CC-BY 2.0, Per-Olof Forsberg

Building blocks in Python

```
def awesome_convex_hull(points):
    # Insert here magical
    # convex hull algorithm

    return faces
```

Stand-alone script

`hull.py`

File

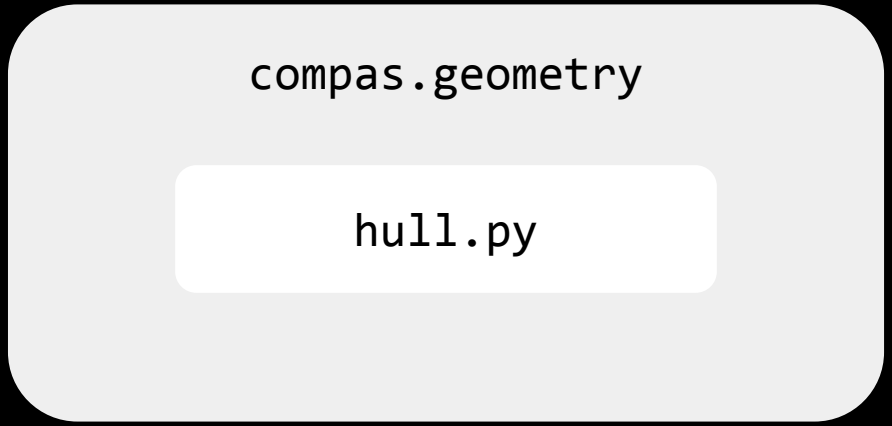
Module

`hull.py`

File

Package

Module



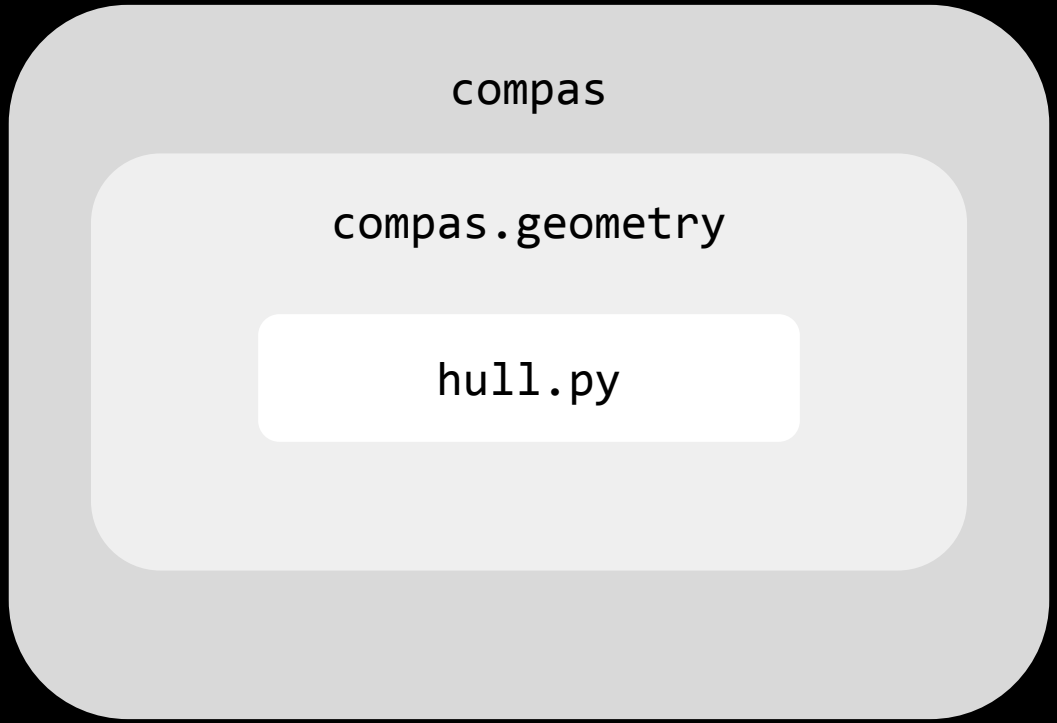
Folder

File

Library

Package

Module



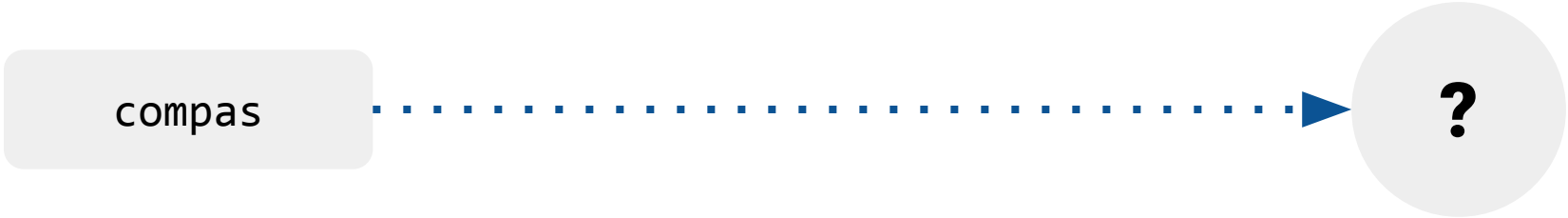
Installable folders

Folders

File

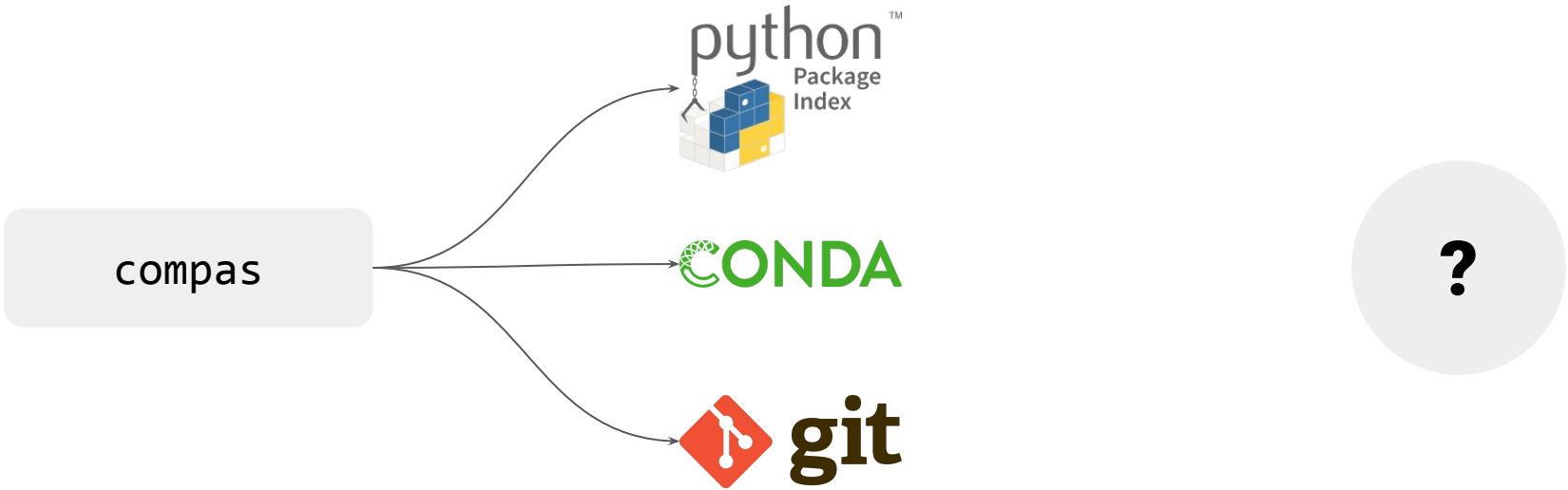
Developer’s laptop

User’s laptop



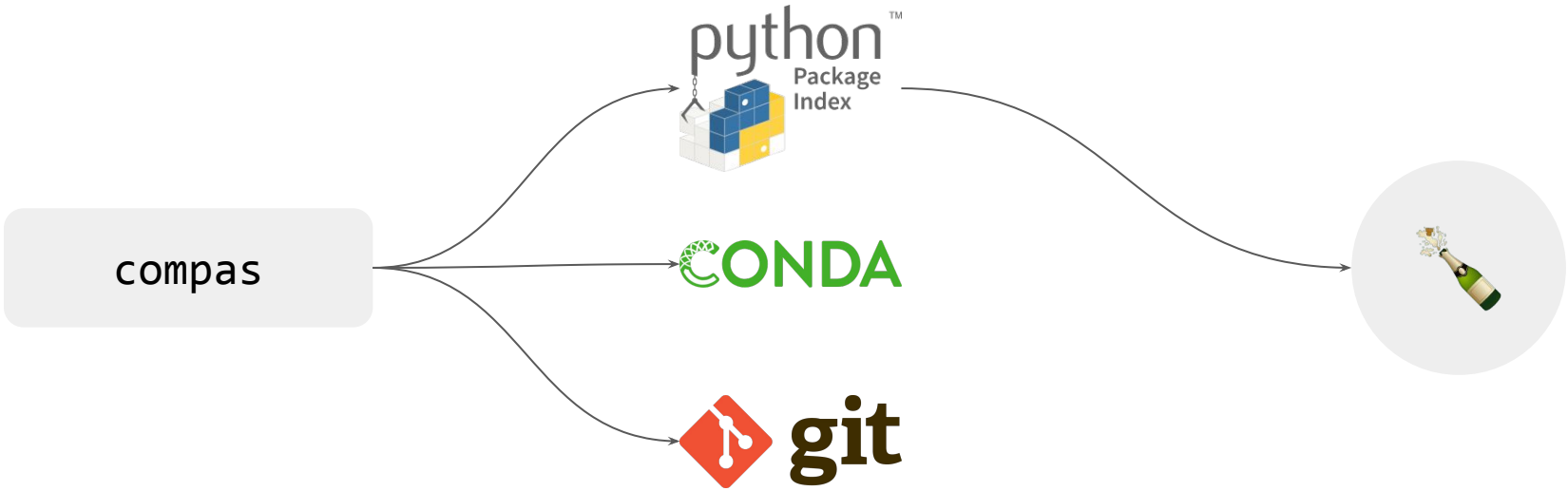
Developer’s laptop

User’s laptop



Developer's laptop

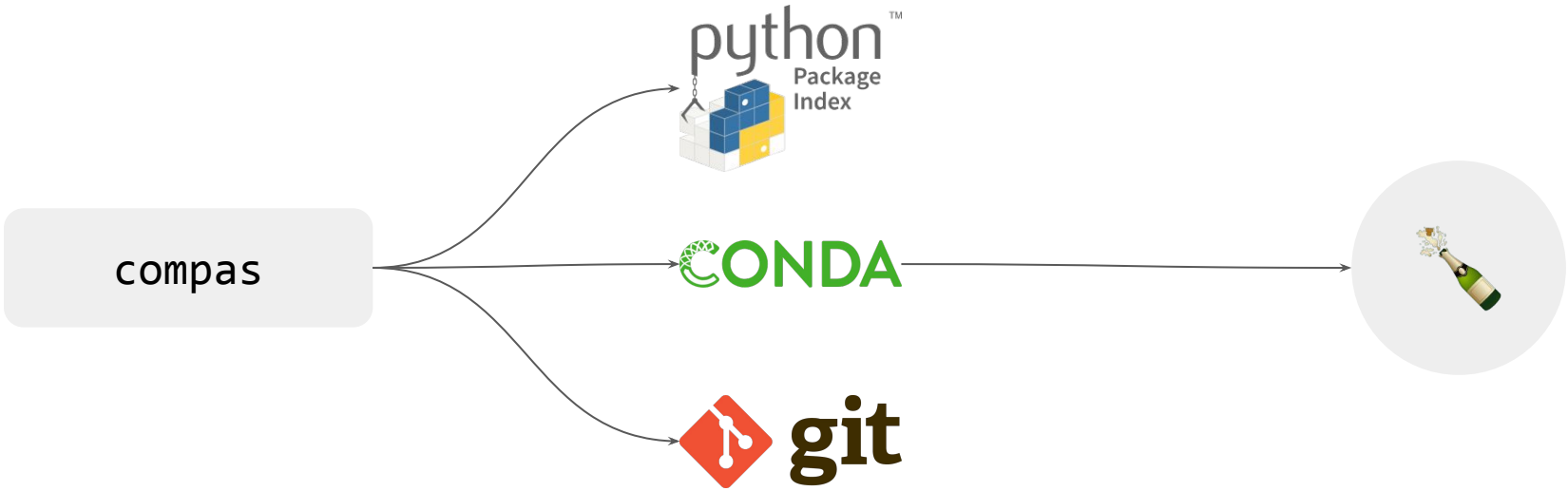
User's laptop




```
pip install compas
```

Developer's laptop

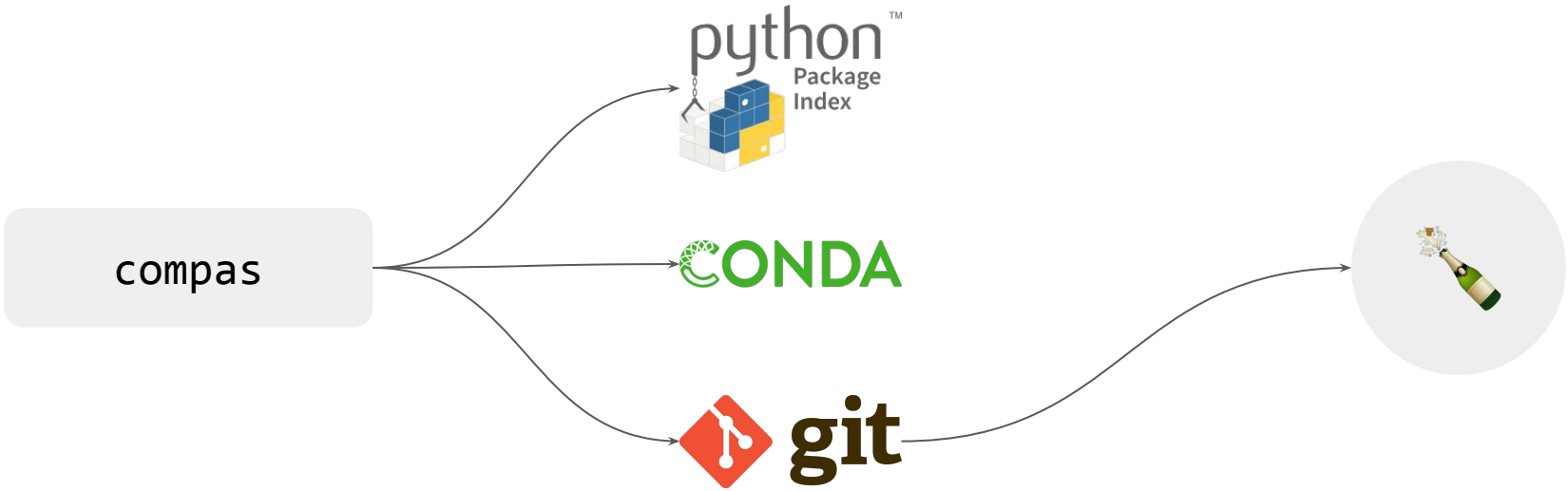
User's laptop




```
conda install compas
```

Developer's laptop

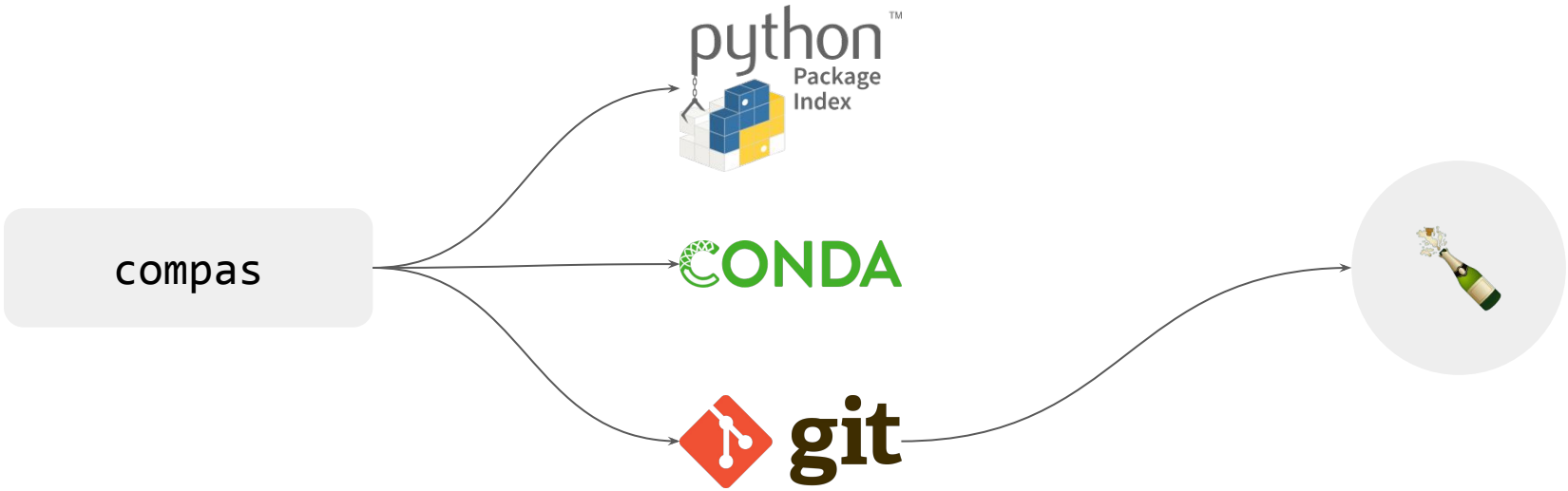
User's laptop




```
pip install git+https://github.com/compas-dev/compas.git
```

Developer's laptop

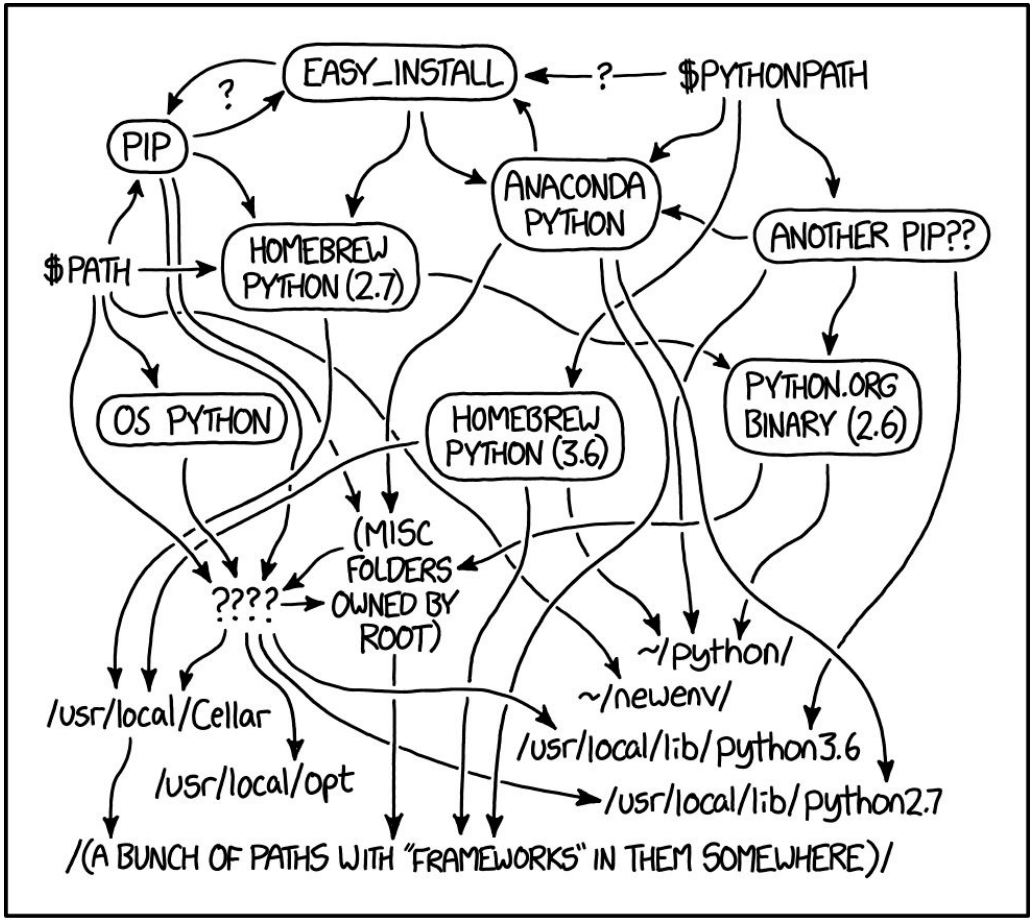
User's laptop




```
pip install -e .
```

“I’ll install into **base env**, *it’ll be fine*”

-A formerly happy user



MY PYTHON ENVIRONMENT HAS BECOME SO DEGRADED
THAT MY LAPTOP HAS BEEN DECLARED A SUPERFUND SITE.

CONDA

User's laptop with virtual environments

ita19

python=3.6

compas=0.8

User's laptop with virtual environments

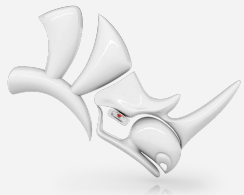
`ita19`	`python=3.6`	`compas=0.8`
`ita19-dev`	`python=3.6`	`compas@master`
`my-slack-bot`	`python=3.8`	`slackclient=..`

CONDA

User's laptop with virtual environments

ita19	python=3.6	compas=0.8
ita19-dev	python=3.6	compas@master
my-slack-bot	python=3.8	slackclient=..

CPython



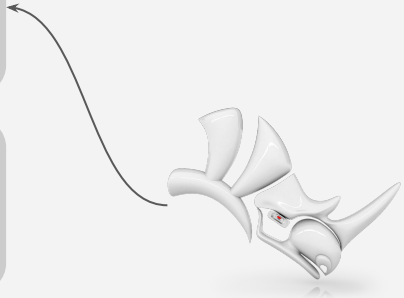
IronPython

CPython ≠ IronPython

CONDA

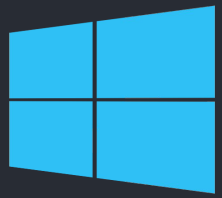
User's laptop with virtual environments

ita19	python=3.6	compas=0.8
ita19-dev	python=3.6	compas@master
my-slack-bot	python=3.8	slackclient=..



```
python -m compas_rhino.install -v 6.0
```

⌘ + SPACE



Terminal

Anaconda Prompt

```
(base)  conda activate ita19
(ita19) python -m compas_rhino.install -v 6.0
```

```
(base)  conda activate ita19
(ita19) python -m compas_rhino.install -v 6.0
```

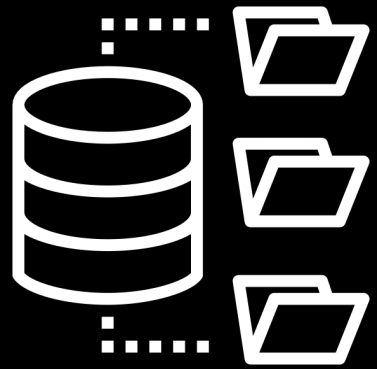
Don’t type this part!

Code **management**


git


GitHub

Git



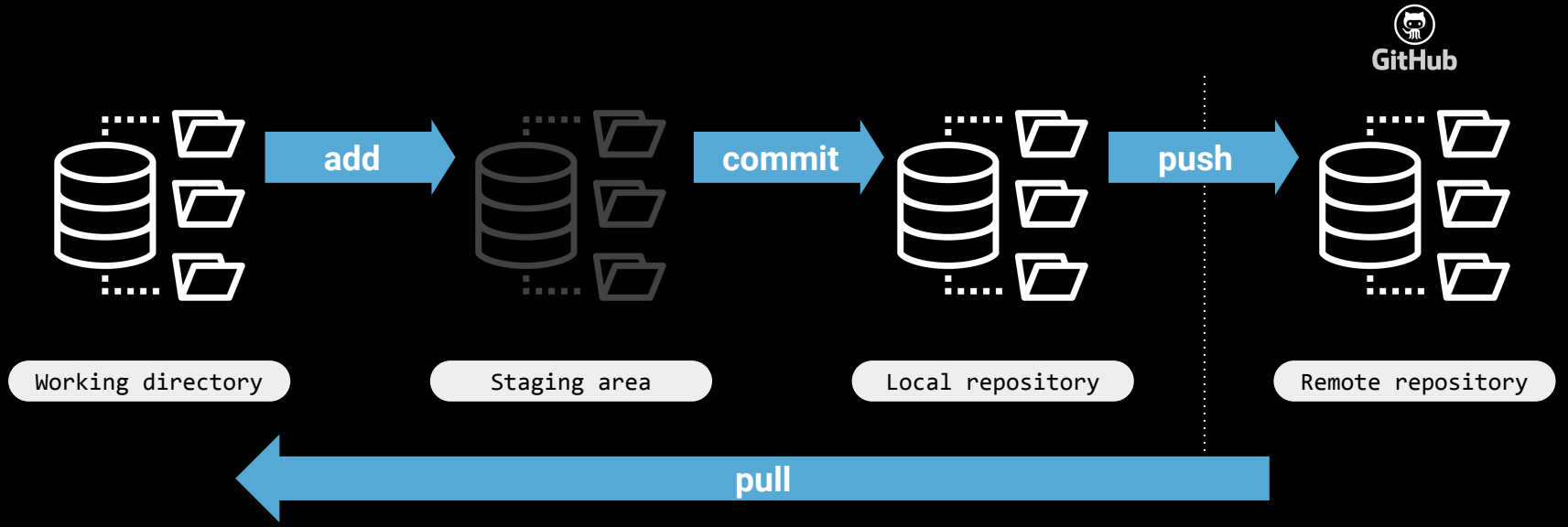
Working directory

Git

Working directory

Remote repository

Git


GitHub
add
commit
push
pull
Working directory
Staging area
Local repository
Remote repository

Better **personal workflow**

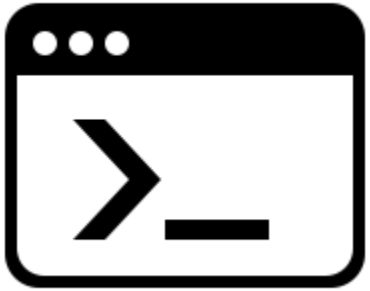
Friction-less **collaboration**

Better personal workflow

- Entire local history of changes
- Ability to jump back and forth in time
- Removes file clutter
- Add extra safety and traceability

Friction-less collaboration

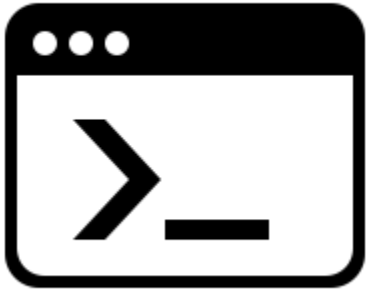
- Branching and merging is simple
- Allows async collaboration
- Improves project visibility



Command line

Visual Client
e.g. SourceTree, GitHub Desktop

IDE Integration
e.g. VS Code



Command line

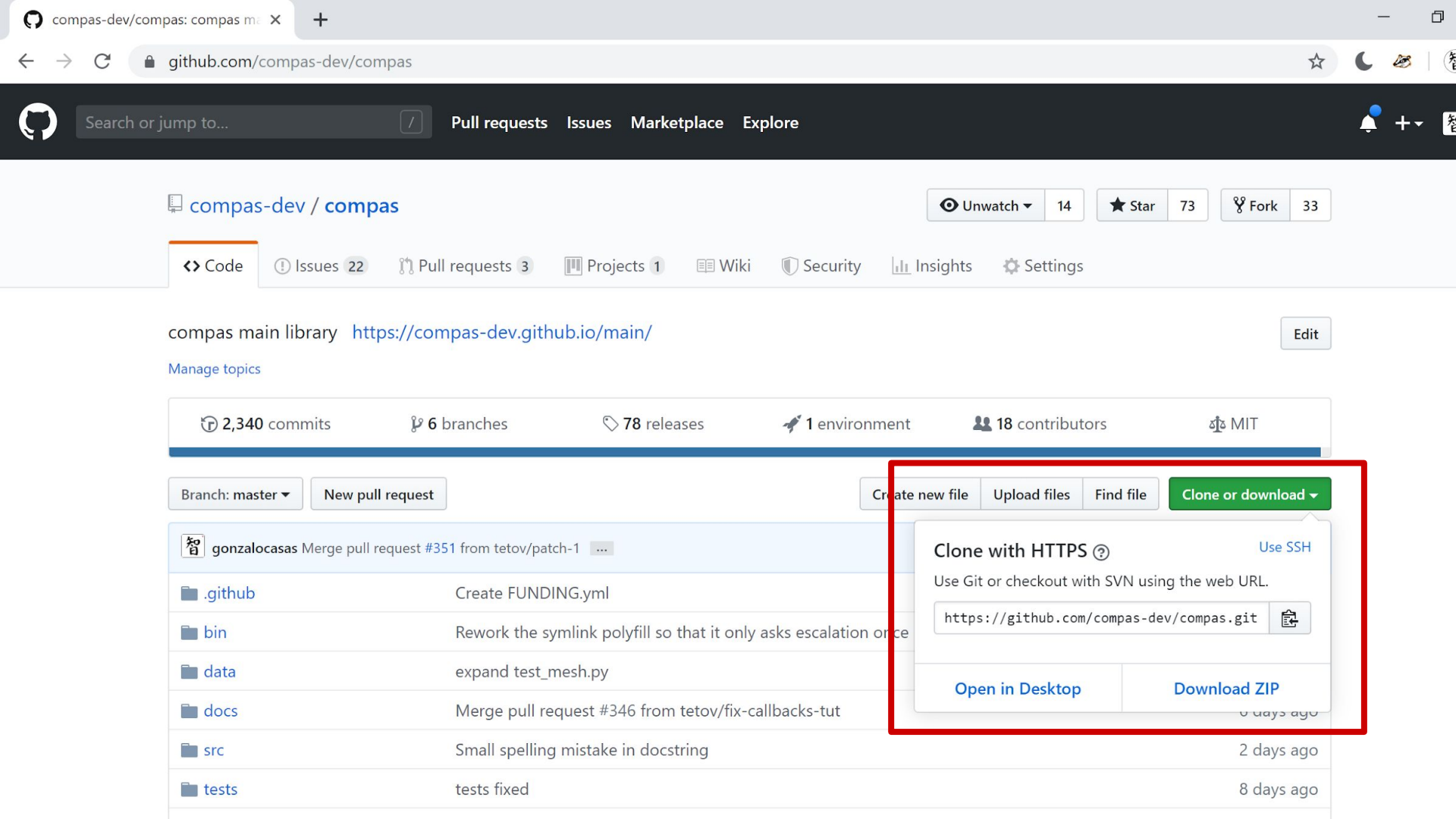
Visual Client
e.g. SourceTree, GitHub Desktop

IDE Integration
e.g. VS Code

Download **at least one** of them

Let’s do a simple exercise

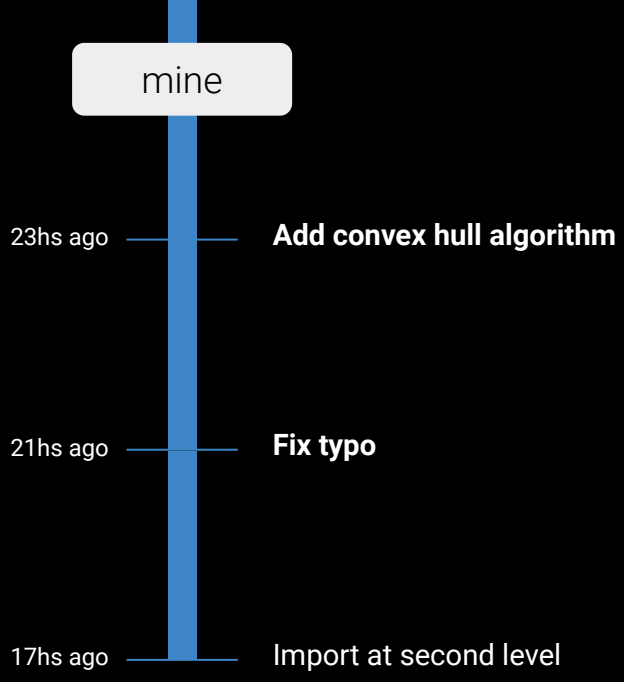
1. Clone **compas** repository
2. Create a new **conda environment**
3. Install **compas** from source code


compas-dev/compas: compas ma
github.com/compas-dev/compas
Search or jump to...
Pull requests
Issues
Marketplace
Explore
compas-dev / compas
Unwatch 14
Star 73
Fork 33
Code
Issues 22
Pull requests 3
Projects 1
Wiki
Security
Insights
Settings
compas main library https://compas-dev.github.io/main/
Edit
Manage topics
2,340 commits
6 branches
78 releases
1 environment
18 contributors
MIT
Branch: master
New pull request
Create new file
Upload files
Find file
Clone or download
gonzalocasas Merge pull request #351 from tetov/patch-1
.github Create FUNDING.yml
bin Rework the symlink polyfill so that it only asks escalation once
data expand test_mesh.py
docs Merge pull request #346 from tetov/fix-callbacks-tut
src Small spelling mistake in docstring 2 days ago
tests tests fixed 8 days ago
Clone with HTTPS
Use SSH
Use Git or checkout with SVN using the web URL.
https://github.com/compas-dev/compas.git
Open in Desktop
Download ZIP

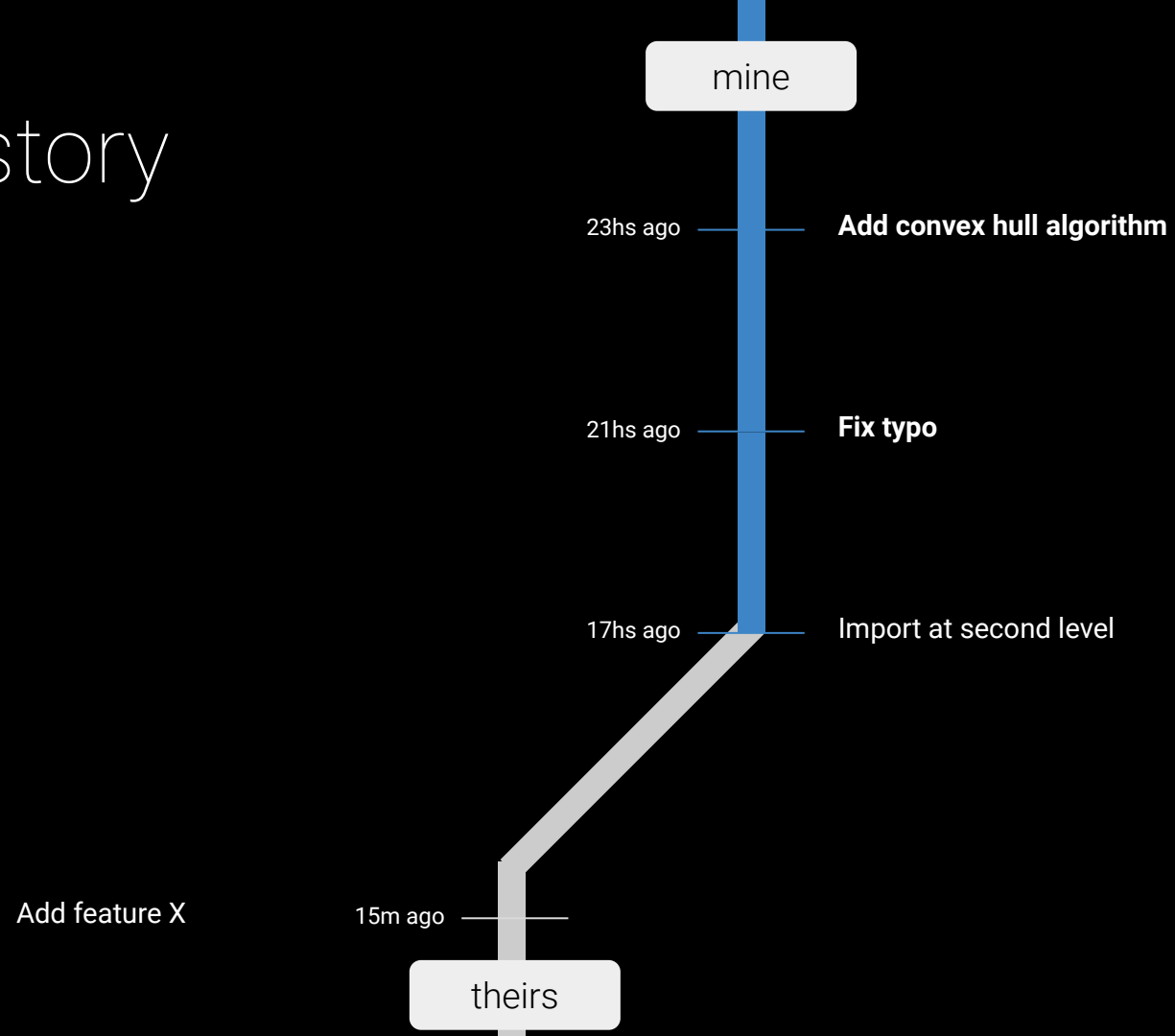
```
conda create -n ita19-dev python=3.6 python.app COMPAS=0.8.1 --yes
```

Collaborative workflows

Code history

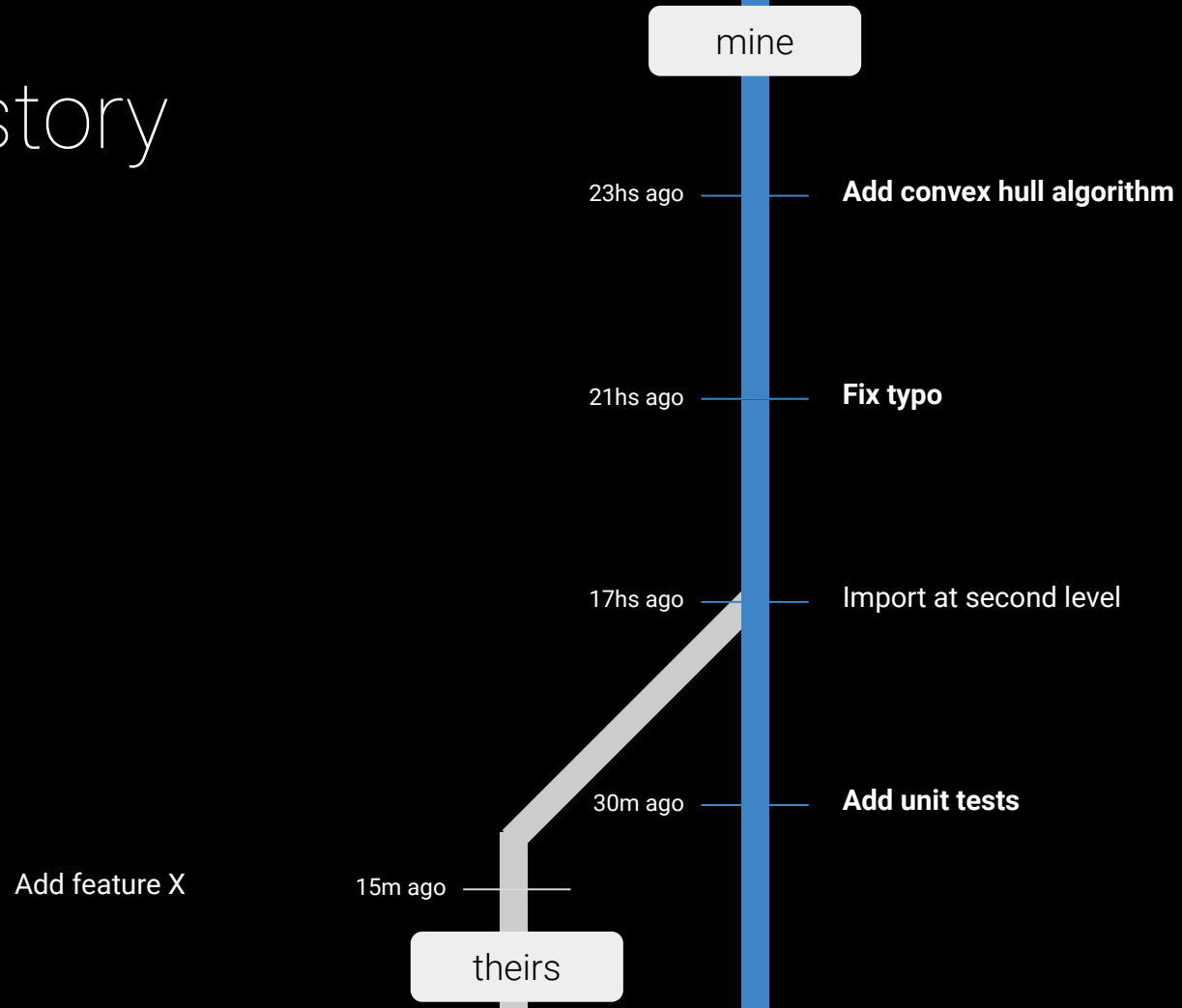


Code history



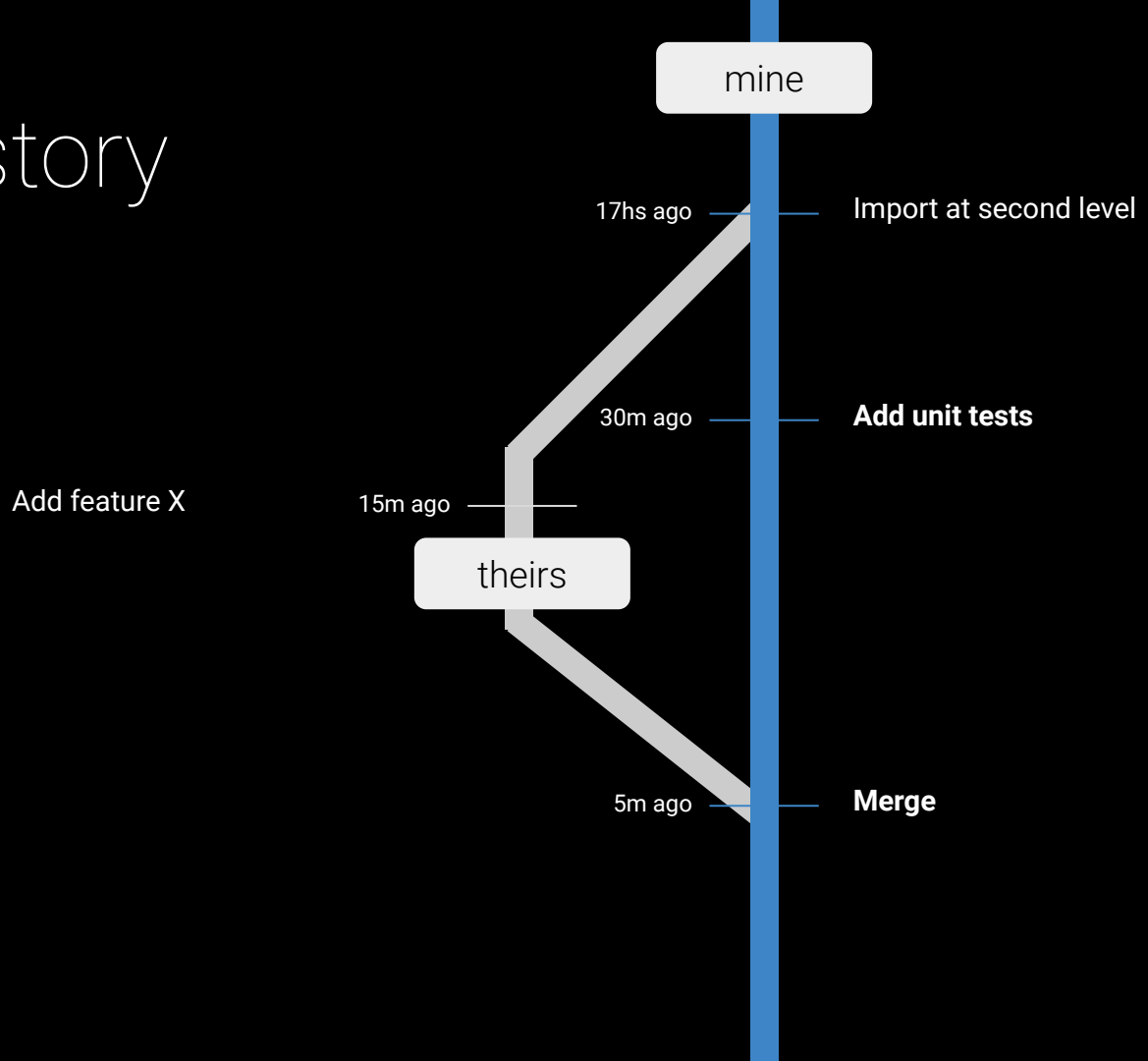
Code history

Branches

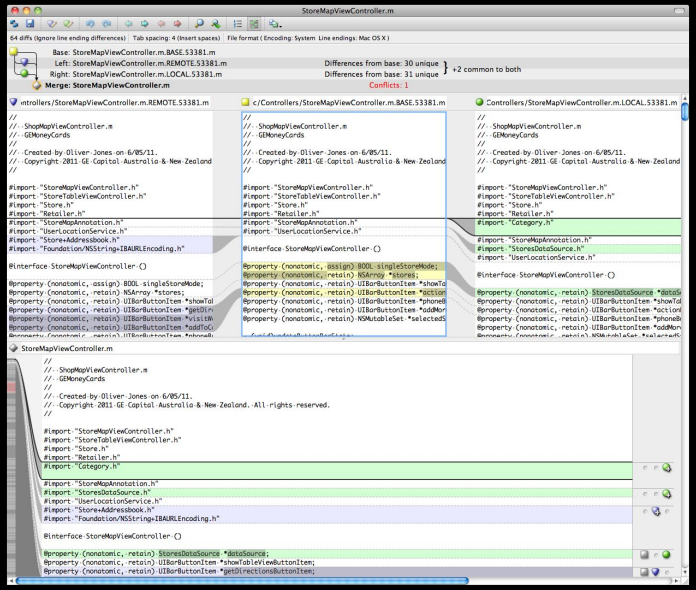


Code history

Merge



Use a visual merge tool



P4Merge

Issue management

Reporting issues

- File bugs, feature requests, enhancements as **Github Issues**
- Describe them properly:
  Single-sentence reports are worthless
- Add issue templates (for your repos)
- Ideally, add test demoing the error

Fixing issues

- Refer to it in the commit message
  eg. `fix #42: resolving age-old question`
- Add tests to avoid regressions

Question instead of issue?
Maybe a **Forum** is best

```
cd path/to/your/clone/of/compas/compas
conda activate ita19-dev
pip install -e .
python
```

Change to match your selected folder!

```
cd path/to/your/clone/of/compas/compas
conda activate ita19-dev
pip install -e .
python
```

Python programming

Data containers

Control flow

Best practices

Data containers

- Basic data types
- Lists vs dictionaries vs sets vs tuples
- OOP: Classes & objects

examples

```
value = 42
```

```
name = 'Adam'
```

```
years = [79, 80, 82, 84, 92]
```

```
point = (10, 20, 15)
```

```
{'x': 10, 'y': 20, 'z': 15}
```

```
bunny = Mesh()
```

Data containers

- Mutability: by ref vs by value
- Context managers
- File operations
- Decorators

examples

```
with Serial() as serial
   # do something:
```

```
with open('filepath', 'r') as f:
   f.readlines()
```

```
@property
def name(self):
   return self._name
```

Python programming

Control flow

- Conditionals & loops
- Function calls & recursion
- Unhappy code paths
- Generators
- Variable scope & shadowing
- Callbacks

examples

```
if value >= 42: print('ok')
```

```
for i in 'hi ITA': print(i)
```

```
def calculate_answer(q):
```

```
def factorial(n):
```

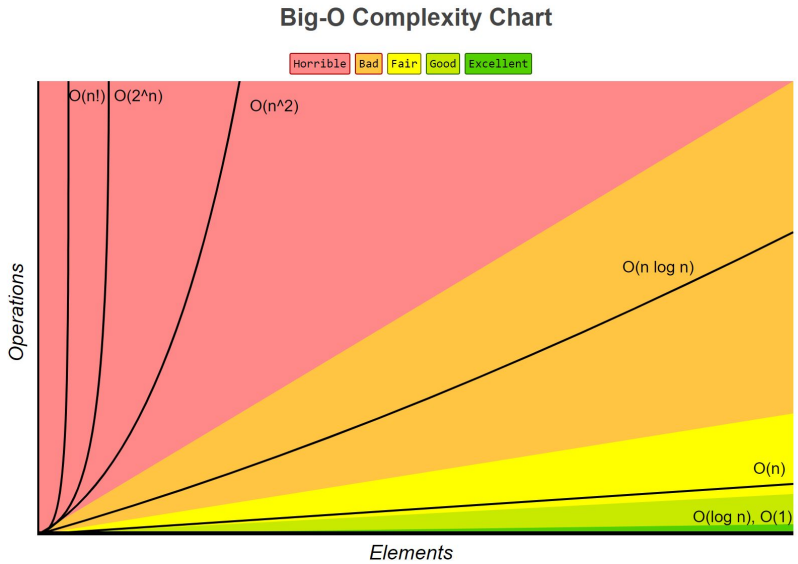
```
try..except..finally
```

Always **reduce** complexity

Which complexity?

ALGORITHMS	+	**DATA STRUCTURES**	=	**PROGRAMS**
time & space complexity				code complexity

Time & space complexity



Source: http://www.bigocheatsheet.com

- Big-O notation
- Quantifies amount of time and space required in relation to the input

Time complexity: O(n)

```
def search(items, target):
  for i in range(len(items)):
    if items[i] == target:
      return i
  return -1
```

Time complexity: $O(n^2)$

```
def has_duplicates(items):
  for outer in range(len(items)):
    for inner in range(len(items)):
      if inner == outer: continue

      if items[inner] == items[outer]:
        return True

  return False
```

Code complexity

- **Lots of metrics:**
  - Cyclomatic complexity
  - Line count 🤷‍♂️
  - Object coupling
  - Class hierarchy level
  - Method cohesion
  - etc.

But no definitive model to quantify it.

Code complexity: strategies

- **Always optimize for readability**
- Follow naming & style conventions (PEP8)
- Naming is hard, take your time
- Encapsulate complexity: solve it just once
- Don’t reinvent the wheel, reuse encapsulated code
- Less code is always more
- Leverage tools to assist your coding (linters, formaters, static analyzers, etc)
- Refactor continuously

Coding and style conventions

- **PEP8**: Official style guide for Python
- Conventions are not spaces vs tabs, are about **signal versus noise**
- Use linters, formatters, config files to auto-enforce conventions
- Use project templates using cookiecutter

Zen of Python

1. Beautiful is better than ugly.
2. Explicit is better than implicit.
3. Simple is better than complex.
4. Complex is better than complicated.
5. Flat is better than nested.
6. Sparse is better than dense.
7. Readability counts.
8. Special cases aren't special enough to break the rules.
9. Although practicality beats purity.
10. Errors should never pass silently.
11. Unless explicitly silenced.
12. In the face of ambiguity, refuse the temptation to guess.
13. There should be one-- and preferably only one --obvious way to do it.
14. Although that way may not be obvious at first unless you're Dutch.
15. Now is better than never.
16. Although never is often better than *right* now.
17. If the implementation is hard to explain, it's a bad idea.
18. If the implementation is easy to explain, it may be a good idea.
19. Namespaces are one honking great idea -- let's do more of those!

- PEP 20: The Zen of Python
- 20 aphorisms / guidelines

```
import this
```

Best practices

Principles

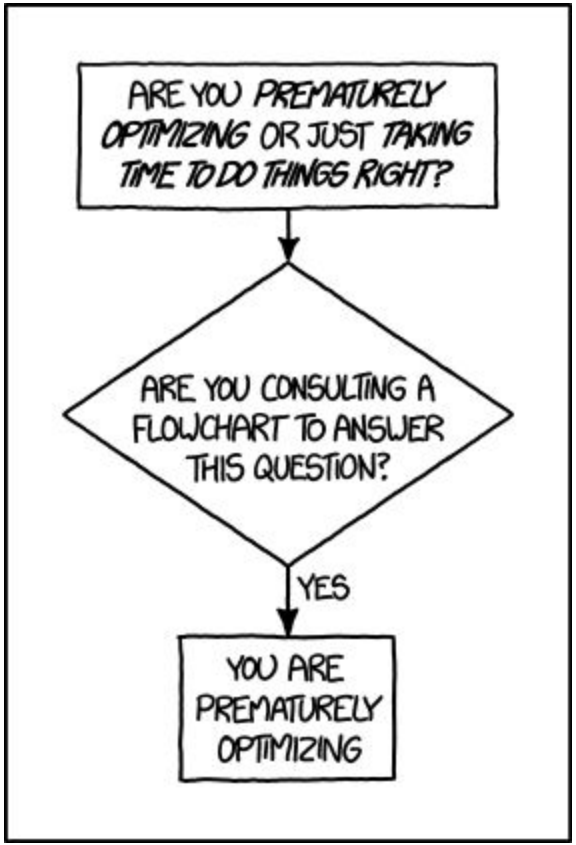
- **DRY:** Don’t repeat yourself
- **YAGNI**: You ain’t gonna need it
- **KISS**: Keep it simple stupid
- **SOLID**:
  - **S**: Single Responsibility Principle
  - **O**: Open-Closed Principle
  - **L**: Liskov Substitution Principle
  - **I**: Interface Segregation Principle
  - **D**: Dependency Inversion Principle

Refactoring

- Refactoring is a state of mind
- Refactoring is a constant process
- Detecting “code smells”:
  - Duplicate Code
  - Long Method
  - Primitive Obsession
  - Speculative Generality
  - Premature Optimization
  - etc.

“Changing software without altering external behavior but improving internal structure”

-- Martin Fowler



https://xkcd.com/1691/

Design patterns

- **Blueprints**
- General, reusable solutions to a commonly occurring problem.

github.com/faif/python-patterns

examples

```
Decorator
Singleton
Builder
Factory Method
Lazy evaluation
Circuit breaker
etc
```

Best practices

Open source source

Use

Learn

Contribute

Publish

Agile Manifesto

Individuals and interactions over processes and tools

Working software over comprehensive documentation

Customer collaboration over contract negotiation

Responding to change over following a plan

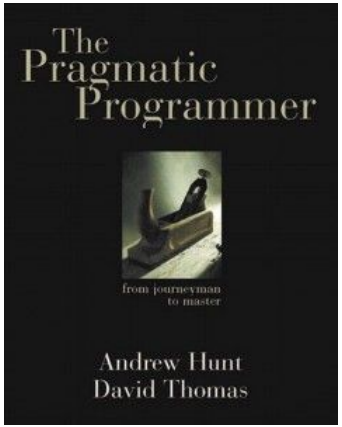
Read other people's code

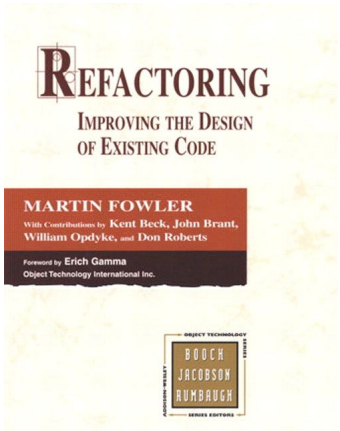
Pull Requests

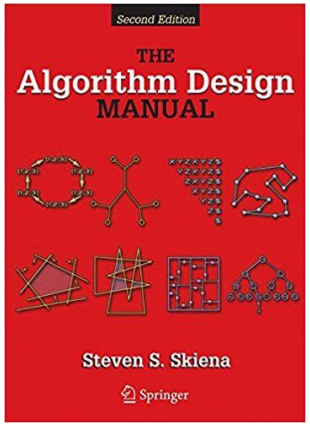
Open Source

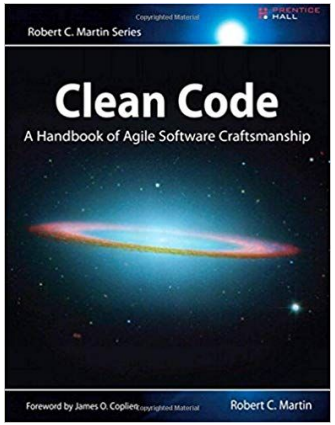
Pair Programming

Reference material









COMPAS programming

COMPAS programming

- Always import (max) second level
- Geometric keys
- Implementation-specific suffixes
- Using COMPAS inside Rhino
    - RPC
    - XFunc
    - Module unload
    - Script engine reset

Slides & Assignment

u.nu/ita19

Join Slack

https://tinyurl.com/yxse82a7