

[320] Version Control (git)

Tyler Caraza-Harter

Review

A running program is called a _____

fruits is a large list. Which will be faster?

1. `fruits.insert(0, "pineapple")` # adds to beginning of list
2. `fruits.pop(-1)` # removes from end of list

What is an example of resource that an operating system might allocate to a process?

what does a Python code usually need to worry more about matching?

1. hardware (especially CPU's instruction set)
2. operating system

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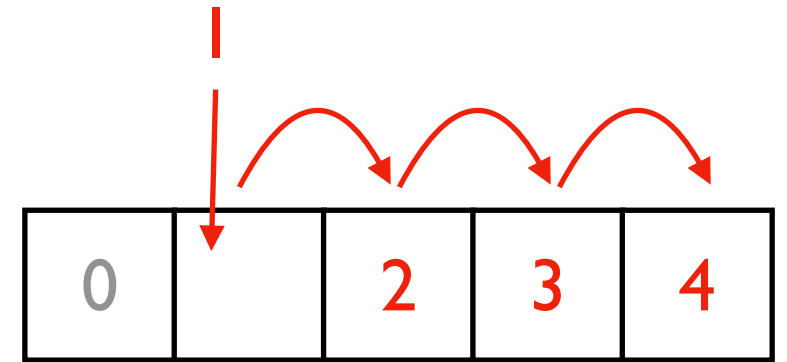
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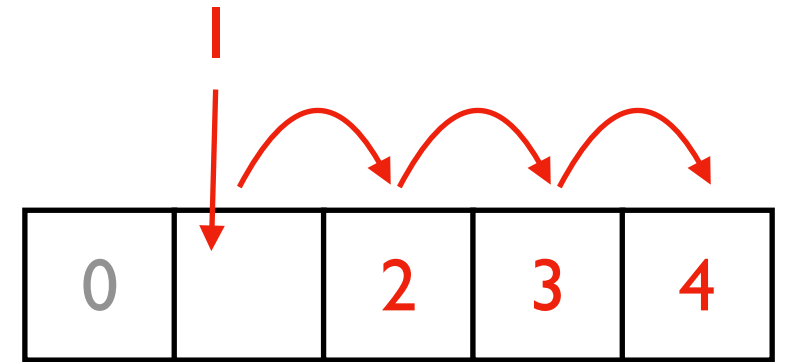
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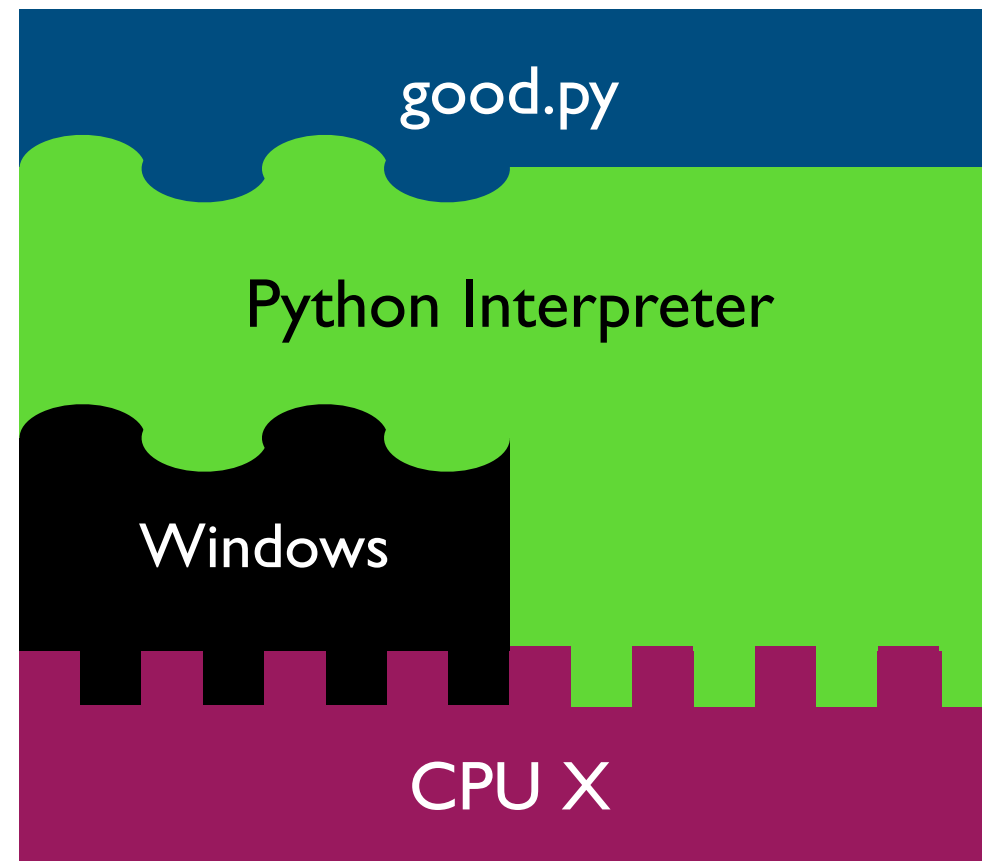
time on CPU, space in memory, space in files, network bandwidth

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Reproducibility

Big question: *will my program run on someone else's computer?*

Things to match:

1

Hardware

← a program must fit the CPU;
`python.exe` will do this, so
`program.py` won't have to

2

Operating System

← we'll use Ubuntu Linux on
virtual machines in the cloud

3

Dependencies

← today: versioning

Dependency Versions

program.py

```
import os, sys, json
import pandas

import pandas

print("Pandas Version:", pandas.__version__)

# code that uses pandas
```

this program "depends" on pandas



you can check a
module version



behavior depends on which release was installed

```
pip install pandas
```

or

```
pip install pandas==0.25.1
```

or

```
pip install pandas==0.24.0
```

or...

Versioning: motivation and basic concepts

Many tools auto-track history (e.g., Google Docs)

The screenshot displays a Google Docs document with a version history sidebar on the right. The document text includes several paragraphs, some of which are highlighted in green. Red handwritten annotations are present: 'what changed' with arrows pointing to the first two paragraphs, 'when it changed' pointing to the March 4, 9:10 PM version, and 'who changed it' pointing to the March 2, 7:45 AM version.

Document Content:

I am so grateful that I get to write for a living. I also really, really, don't want to start writing right now.

That's more- or- less my constant mindset. When I manage to get started ~~I can~~ I get a lot done, but I rarely find myself in the mindset where I *want* to get started ~~on something that I know will take a lot of time or effort~~. This leads to me falling back into the ~~dopamine-rich~~ dopamine-rich environment called "internet," where algorithmically designed distractions devour time until it's 5 o'clock and oh well I'll seize the day tomorrow.

You've been there. We've all been there. ~~There's a Thing you should be doing but for some reason just can't get started on. Maybe the Thing is setting up a website. Maybe the Thing is a coding project you've been putting off. Maybe the Thing is a book you've intended to write. Whatever the Thing is, you just can't get started. And it wouldn't happen if we could only get started. I can relate.~~

Which is why over time I've found ways to force the issue on myself. Here are a few tricks I, and a few of my co-workers, use to start doing a thing, even when we really, really don't want to do the ~~t~~Thing. ~~In other words, how to motivate yourself to start a task when you don't feel motivated.~~

~~## Use Your Calendar to Force You to Get Started~~ ~~Plan Your Day Around Doing The Thing~~

Every workday morning, after breakfast, I plan my day. I look at my to do list, my inbox, and my calendar, ~~and~~ then figure out how I'm going to use my unscheduled time in order to accomplish what needs accomplishing. I then allocate time for each task on my calendar.

This does two things. First: it forces me to see my time as a resource I have to allocate. Second, adding things to my calendar means notifications on my phone and computer throughout the day, reminding me of the intention I set for myself. It's amazing how that ~~reminder~~ little bit of accountability can keep me motivated. The calendar helps you make the most of the time you have available each day. From author Marc Levy, *[If Only It Were True]*(<https://www.amazon.com/Only-Were-True-Marc-Levy/dp/0743276841>):

Version History:

- Only show named versions (toggle)
- Melanie Pinola
- Justin Pot
- THIS MONTH
- March 4, 9:10 PM (Melanie Pinola) - *when it changed*
- March 4, 6:35 AM (Justin Pot)
- March 2, 7:45 AM (Melanie Pinola) - *who changed it*
- March 1, 3:07 PM (Melanie Pinola, Justin Pot)
- March 1, 10:55 AM (Justin Pot)
- FEBRUARY
- February 28, 3:35 PM (Justin Pot)
- February 28, 12:54 PM (Justin Pot)
- February 28, 11:53 AM** (Melanie Pinola, Justin Pot)

Version Control Systems (VCS)

Useful for many kinds of projects

- code, papers, websites, etc
- manages all files for same project (maybe thousands) in a repository

Explicit snapshots/checkpoints, called **commits**

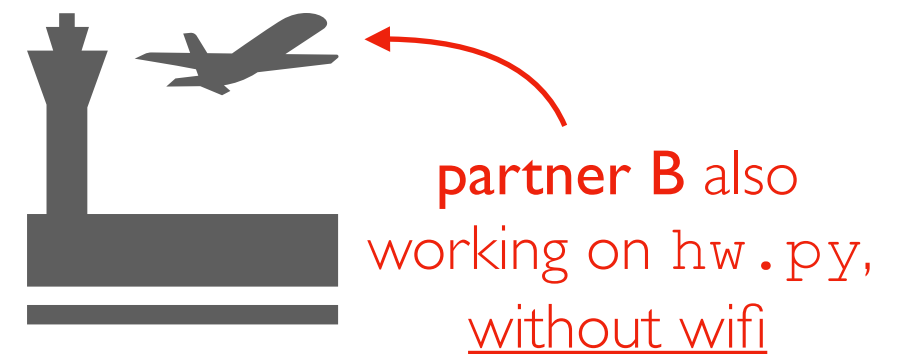
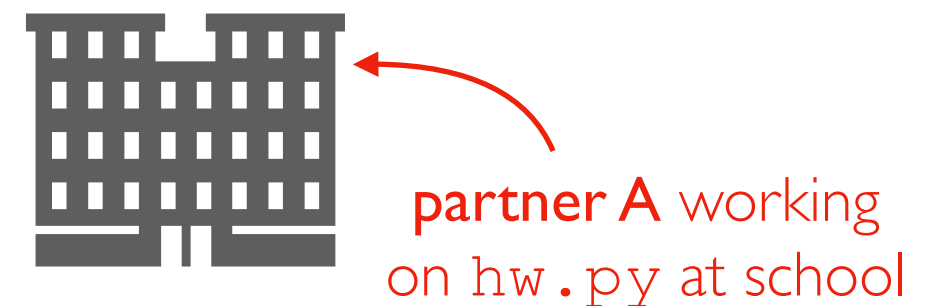
- users **manually** run commands to preserve good versions

Explicit **commit messages**

- who, what, when, **why**

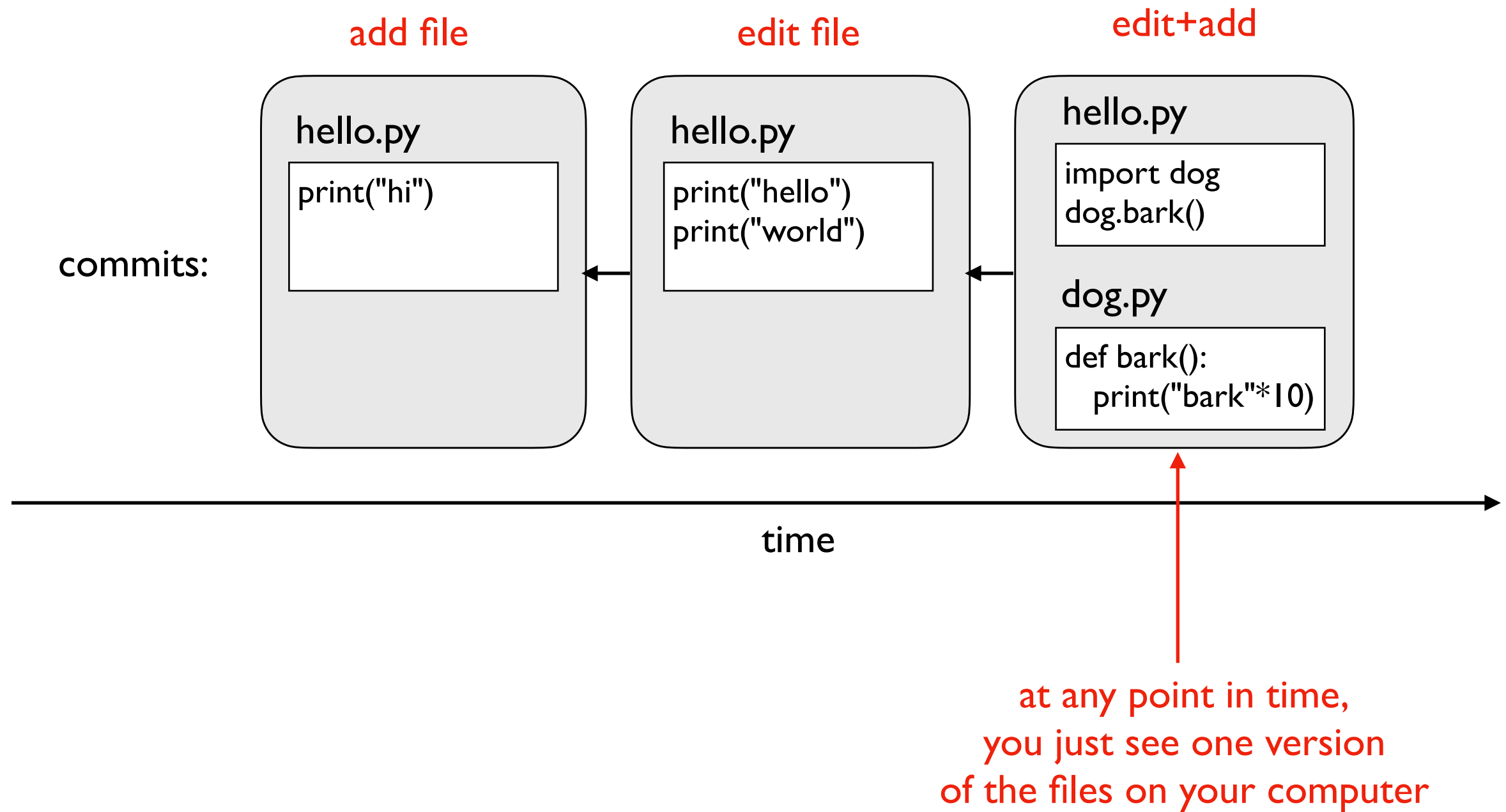
Work can **branch** out and be **merged** back

- people can work offline
- can get feedback before merging
- humans need to resolve **conflicts** when versions being merged are too different

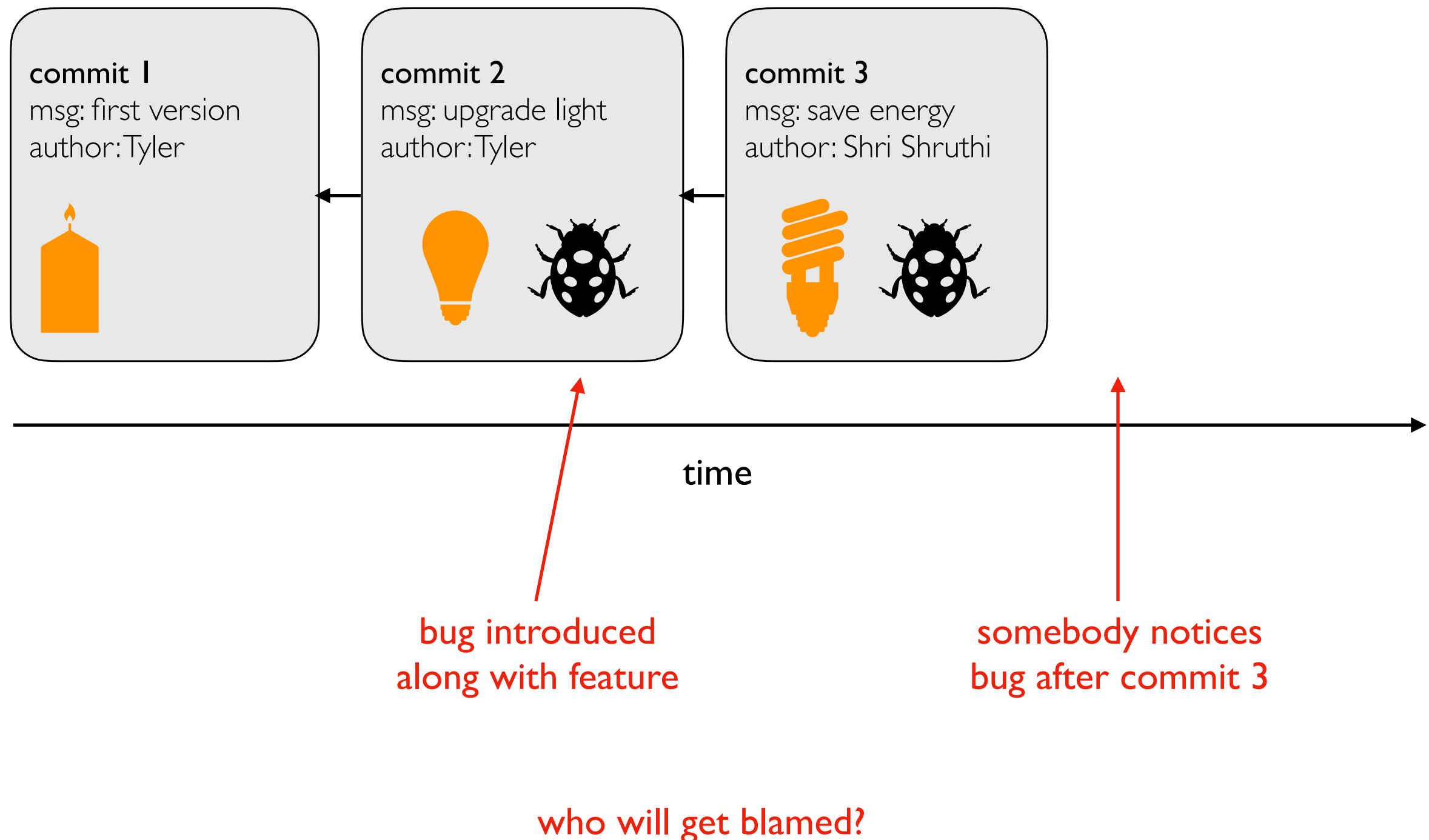


what happens when the plane lands?

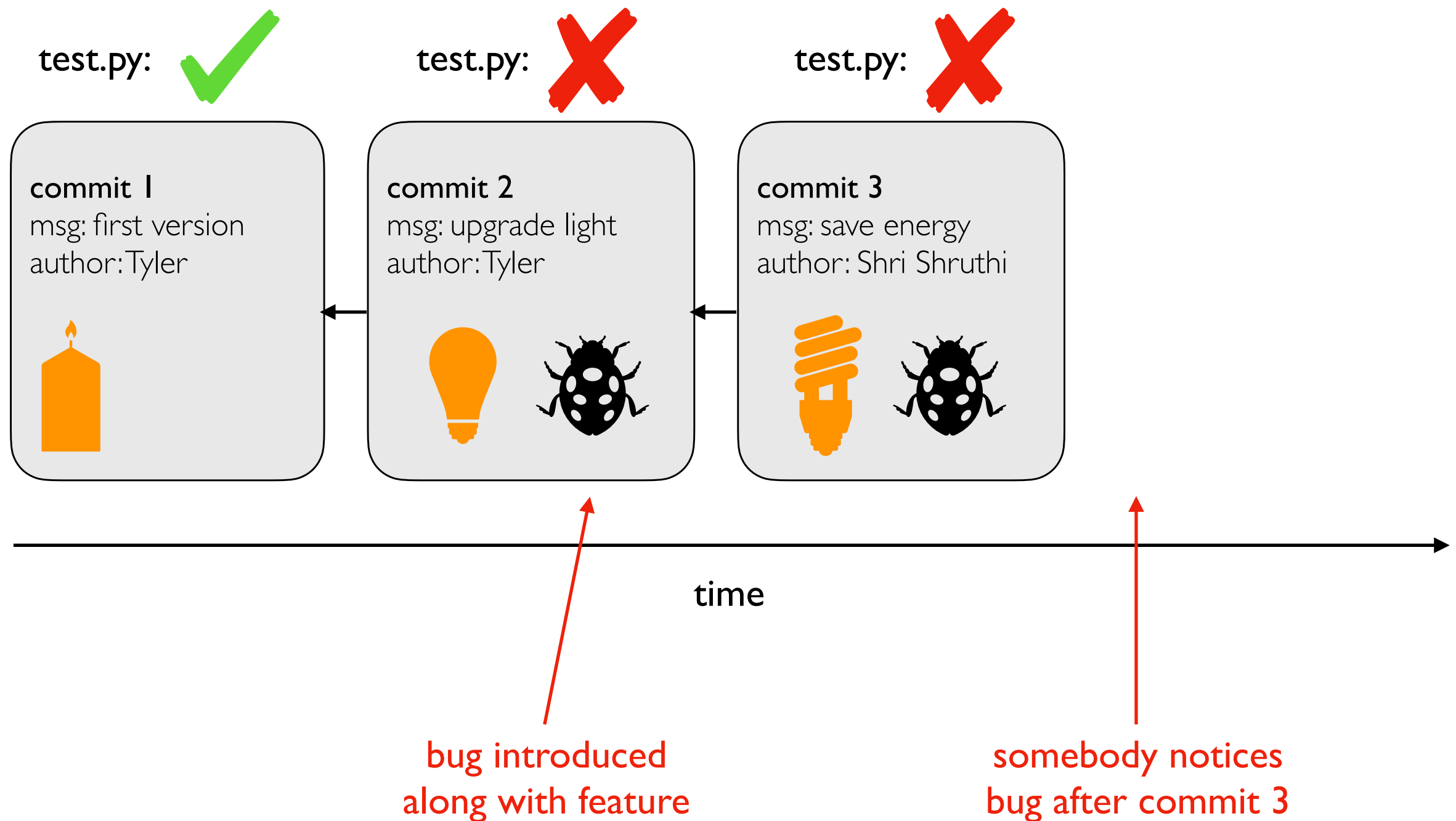
Example



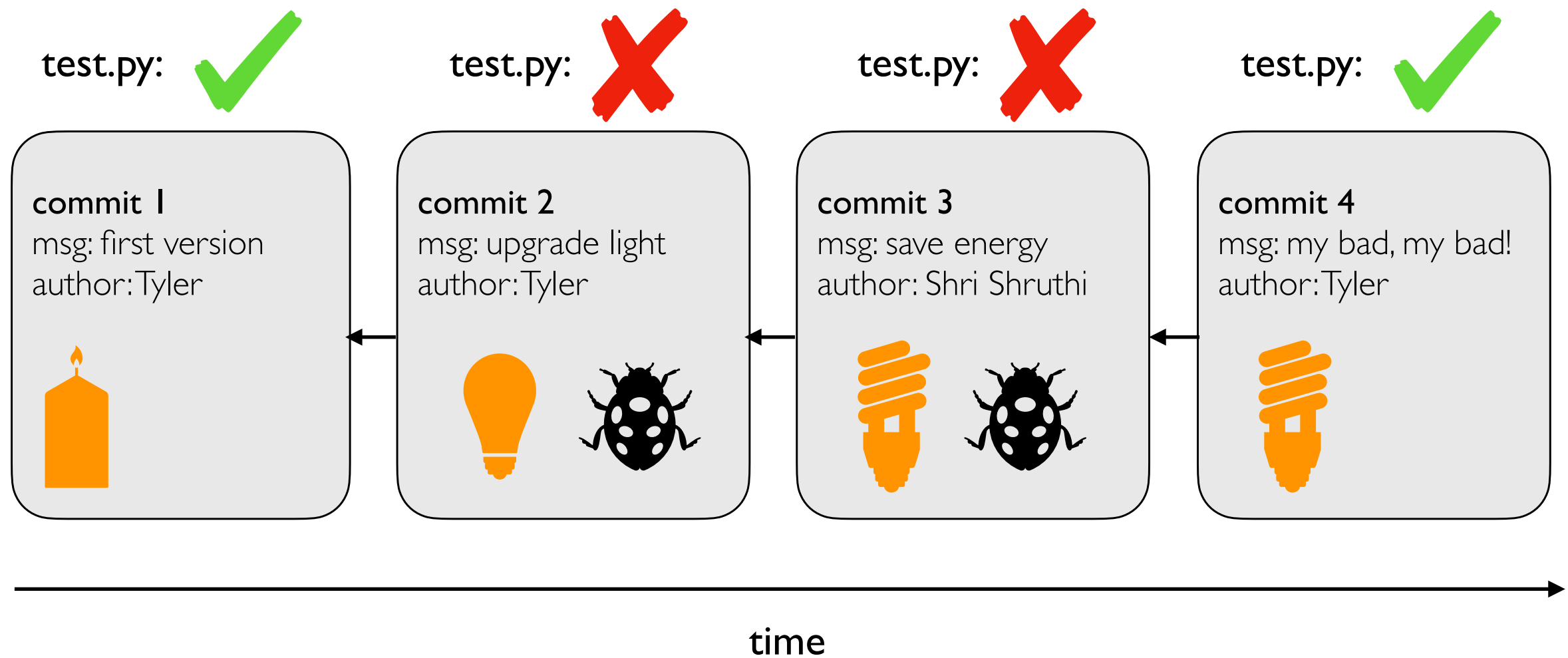
Use case 1: troubleshooting discovered bug



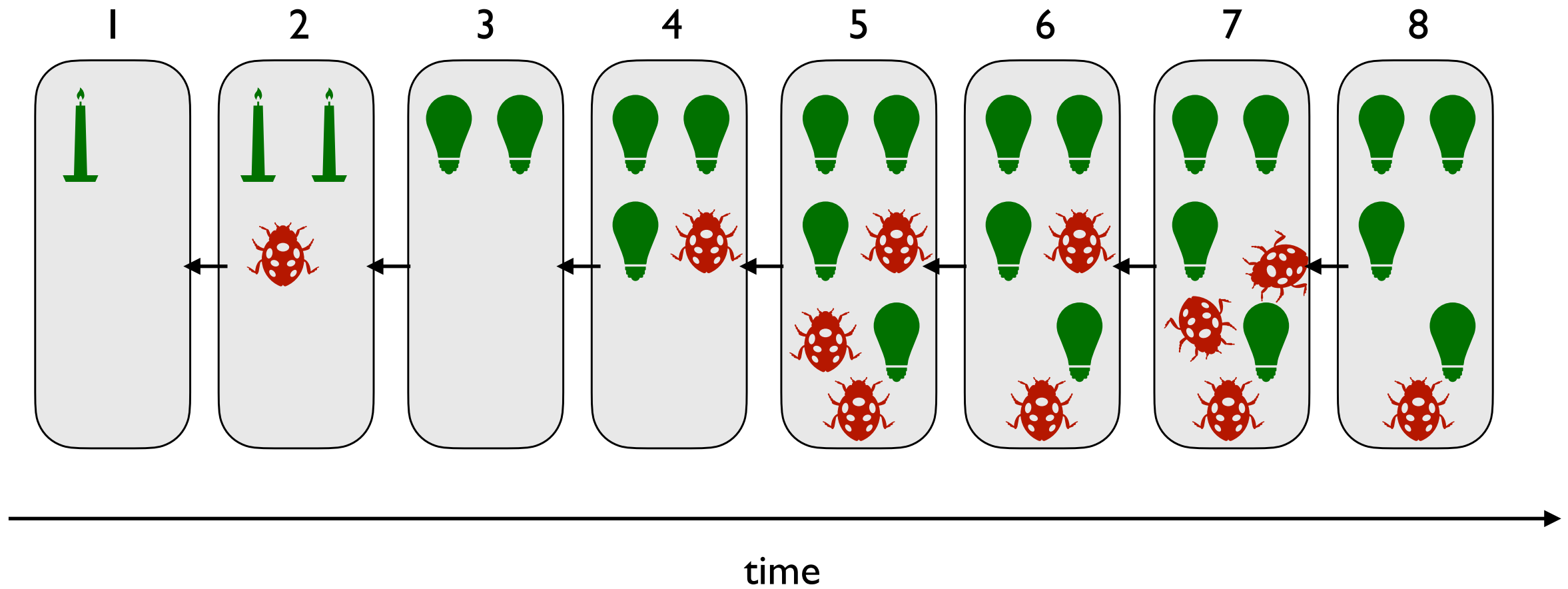
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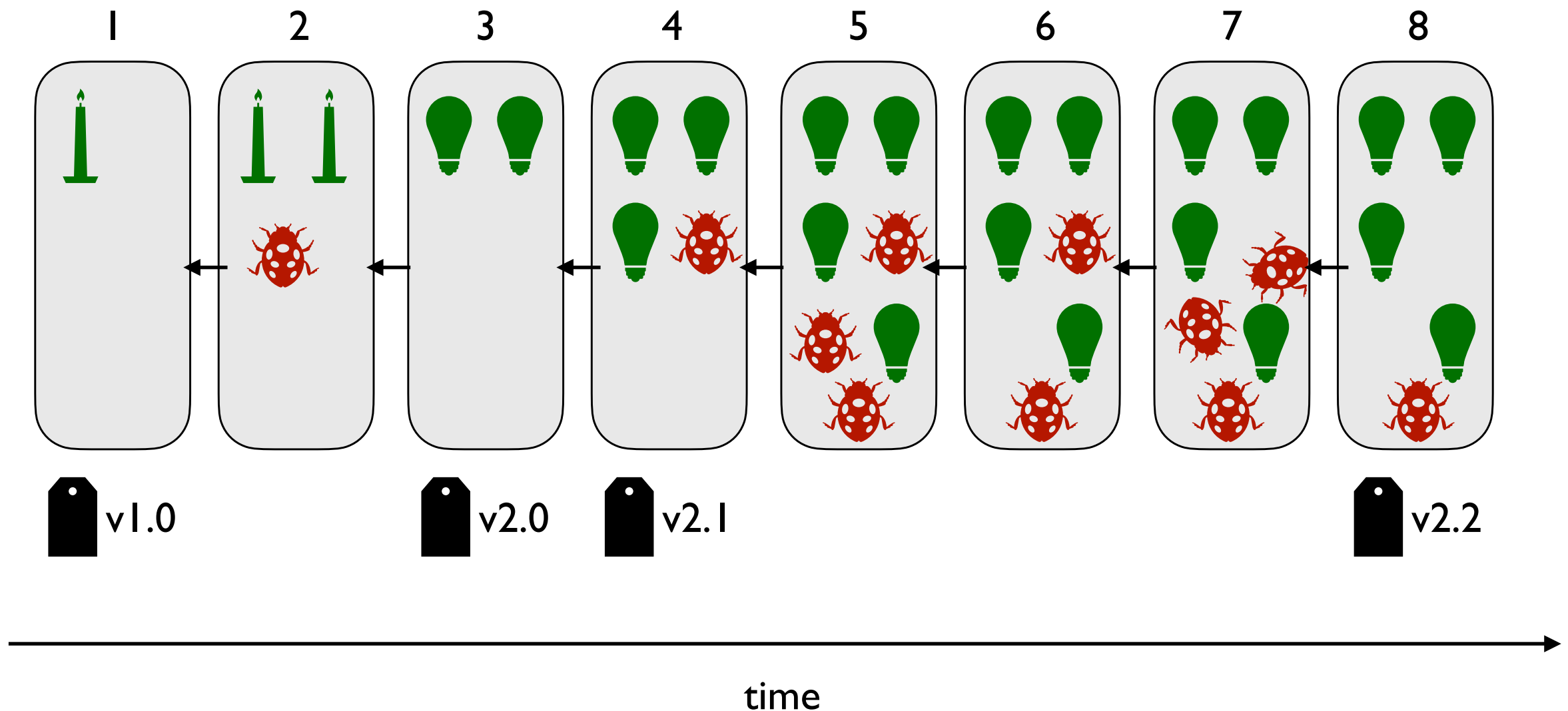


Use case 2: versioned releases



which version would you use?

Use case 2: versioned releases

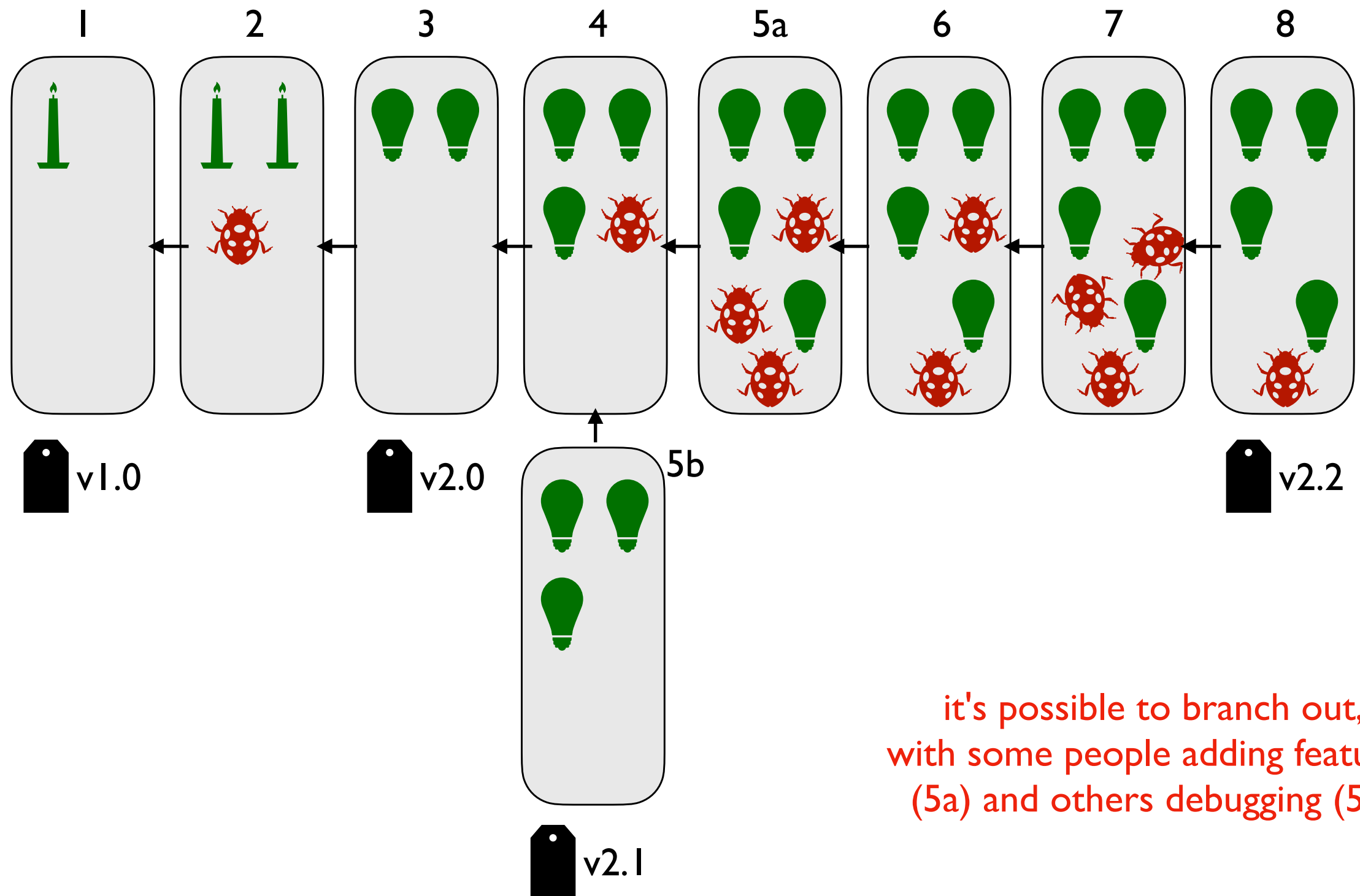


tag "good" commits to create releases

<https://pypi.org/project/pandas/#history>

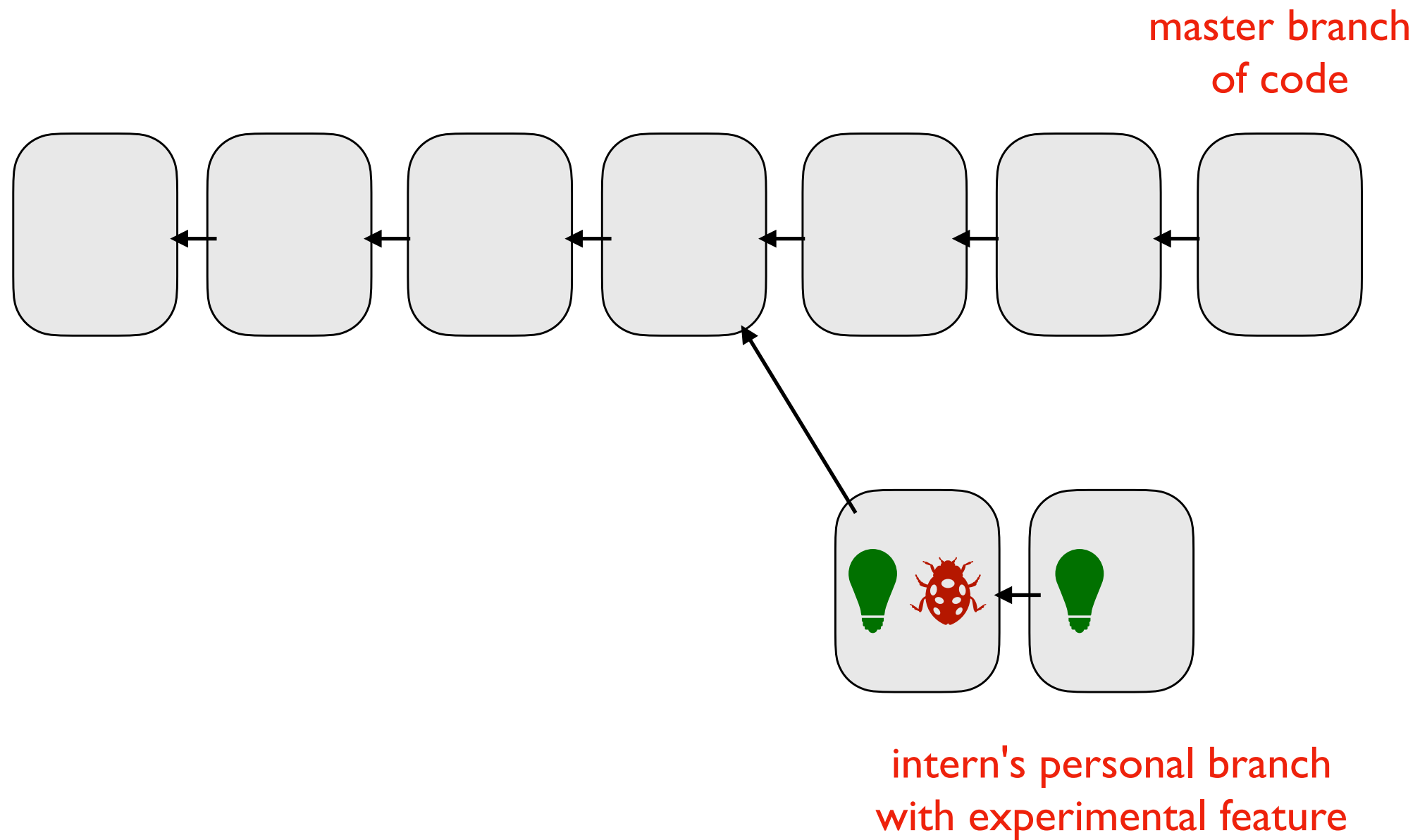
<https://github.com/pandas-dev/pandas/releases>

Use case 2: versioned releases

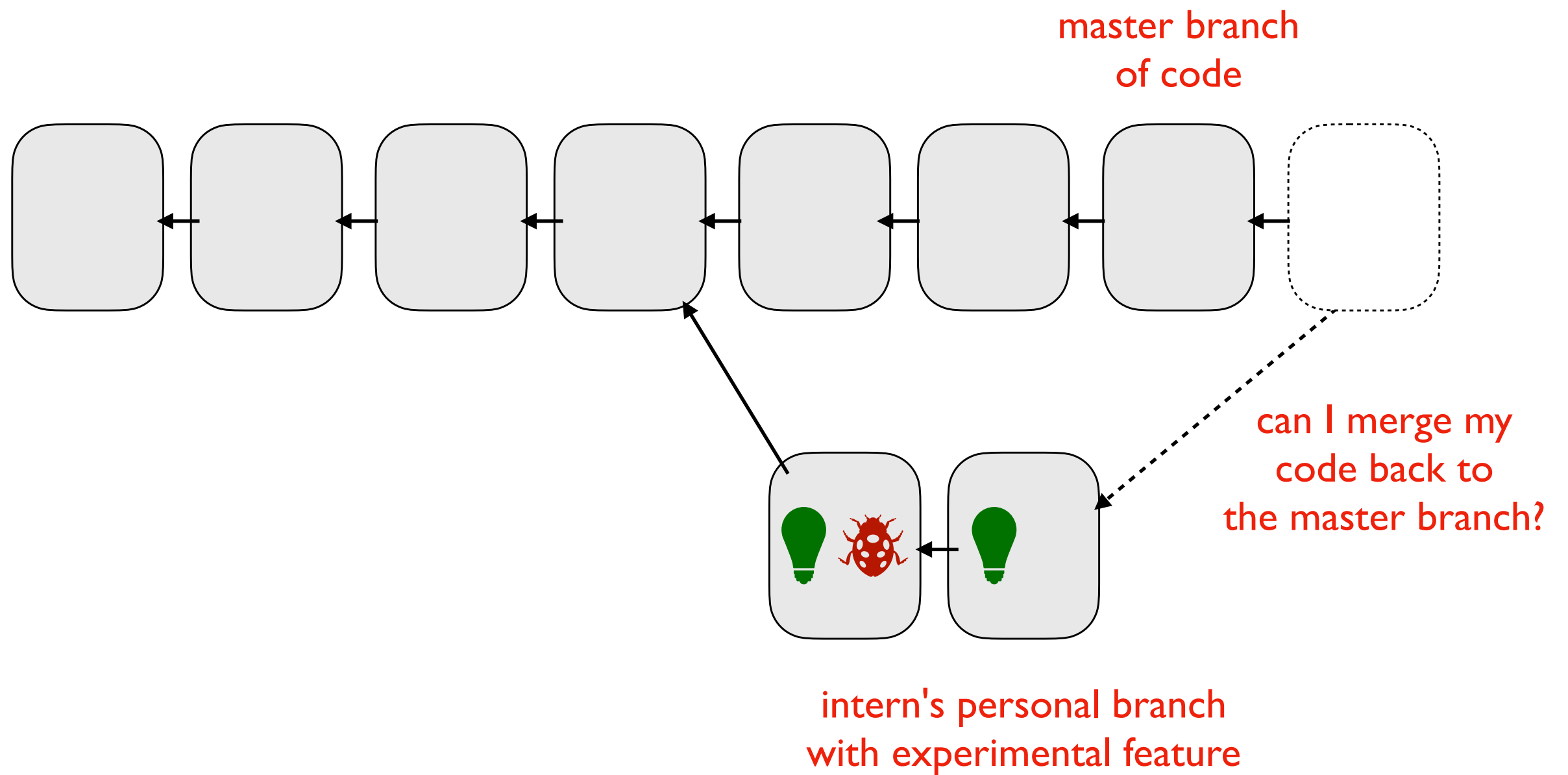


it's possible to branch out,
with some people adding features
(5a) and others debugging (5b)

Use case 3: feedback



Use case 3: feedback



git

Version Control System Tools

tools

svn

git

Mercurial

TeamFoundation

git providers

GitLab

BitBucket

GitHub: signup for a free account for next weeks lab

- **do** choose a name that won't embarrass you on a resume
- **do not** post course work



Linus Torvalds developed git to manage Linux as a BitKeeper replacement

Viewing Commits

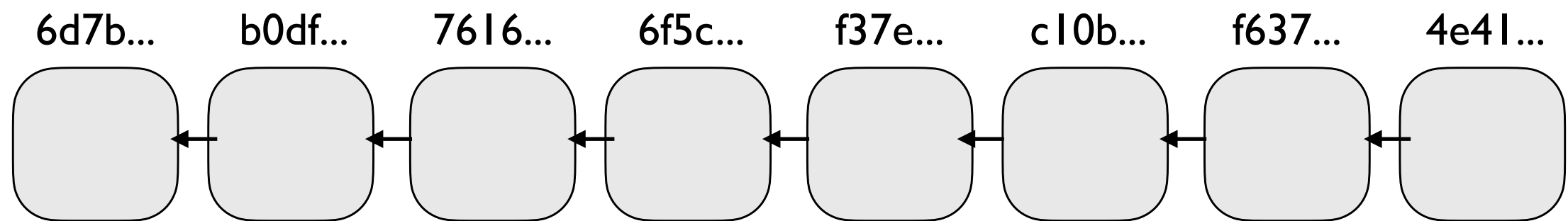
Download P1 repo (<https://github.com/tylerharter/cs320-p1>):

```
git clone https://github.com/tylerharter/cs320-p1.git
cd cs320-p1
```

View Commits (newest on top)

```
git log
```

```
git checkout ??????
```



```
commit 6d7beafb8e79b7a92fed8e67673a33bb7f607dbe
Author: Ada <ada@example.com>
Date: Thu Jan 9 13:53:20 2020 -0600
```

commit number in hexadecimal (hexsha)

committer → count a specific word
message

binary: 0,1

decimal: 0,1,2,3,4,5,6,7,8,9

hex: 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F

Creating Commits

Configure your name/email

```
git config --global user.name "Tyler"
```

```
git config --global user.name "tharter@wisc.edu"
```

View status of files

```
git status
```

Move file to **staging**

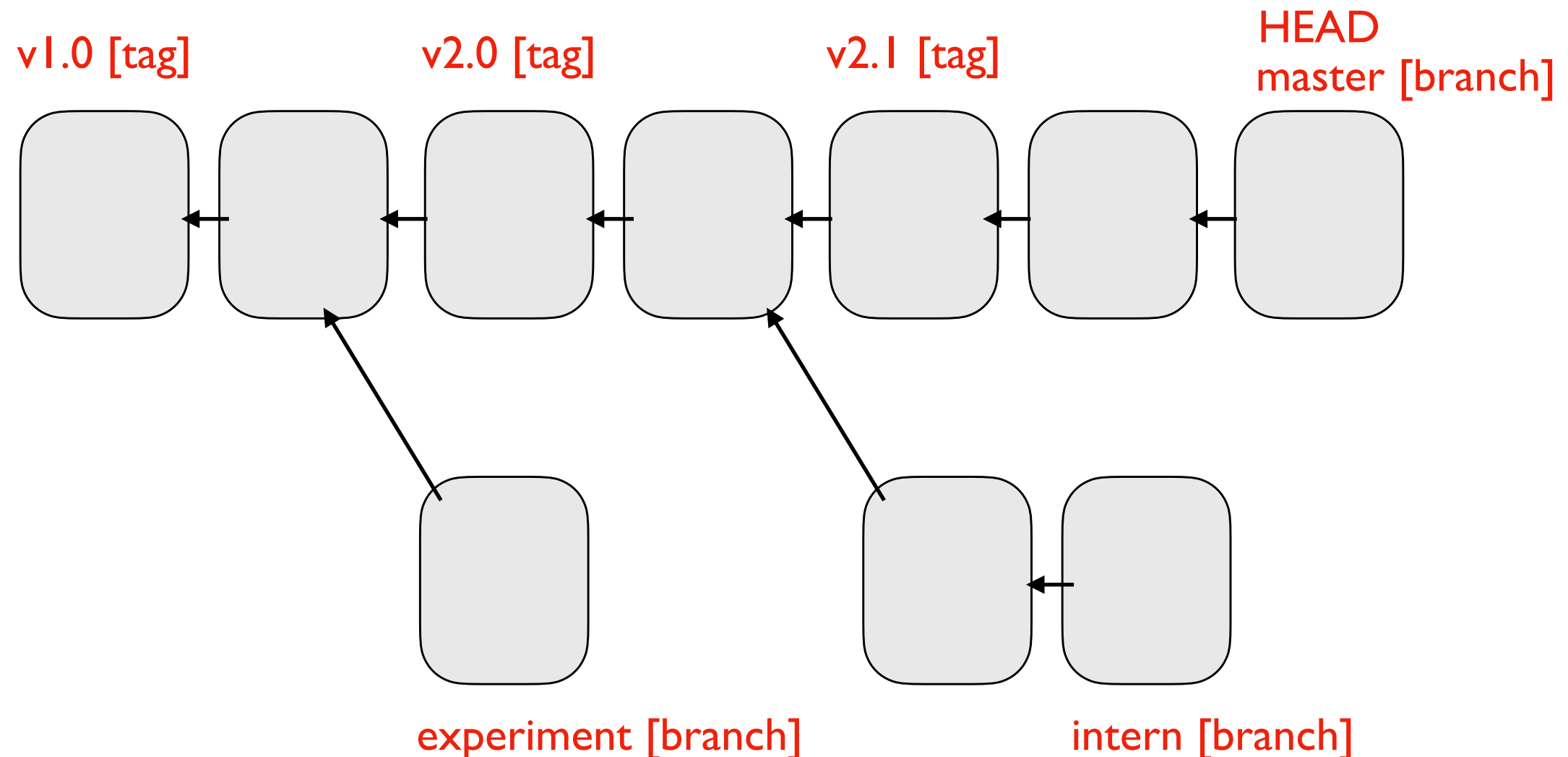
```
git add file.txt
```

Create a commit (take a snapshot of **staged** changes)

```
git commit -m "I made a change!"
```

HEAD, Branches, and Tags

Remembering commit numbers is a pain! Various kinds of labels can serve as easy-to-remember aliases



HEAD: wherever you currently are (only one of these)

tag: label tied to a specific commit number

branch: label tied to end of chain (moves upon new commits)

HEAD, Branches, and Tags

What branch are we on?

```
git branch
```

Create new branch

```
git branch branchname
```

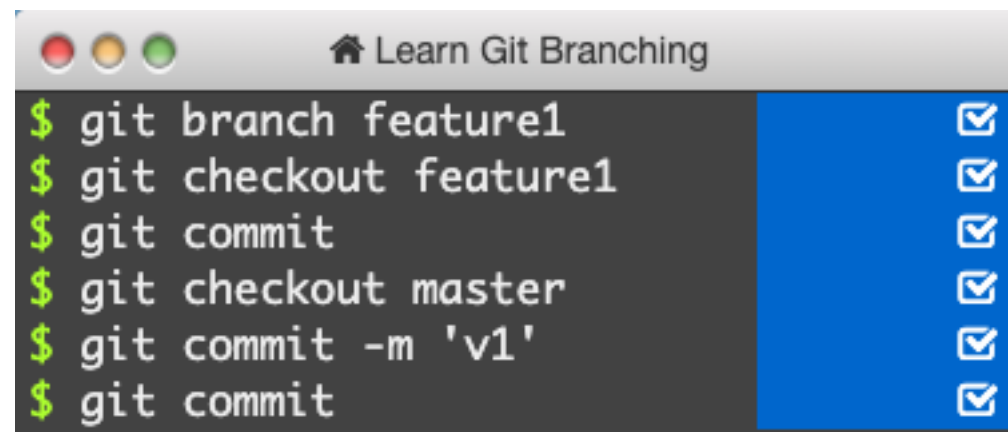
Switch branch

```
git checkout branchname
```

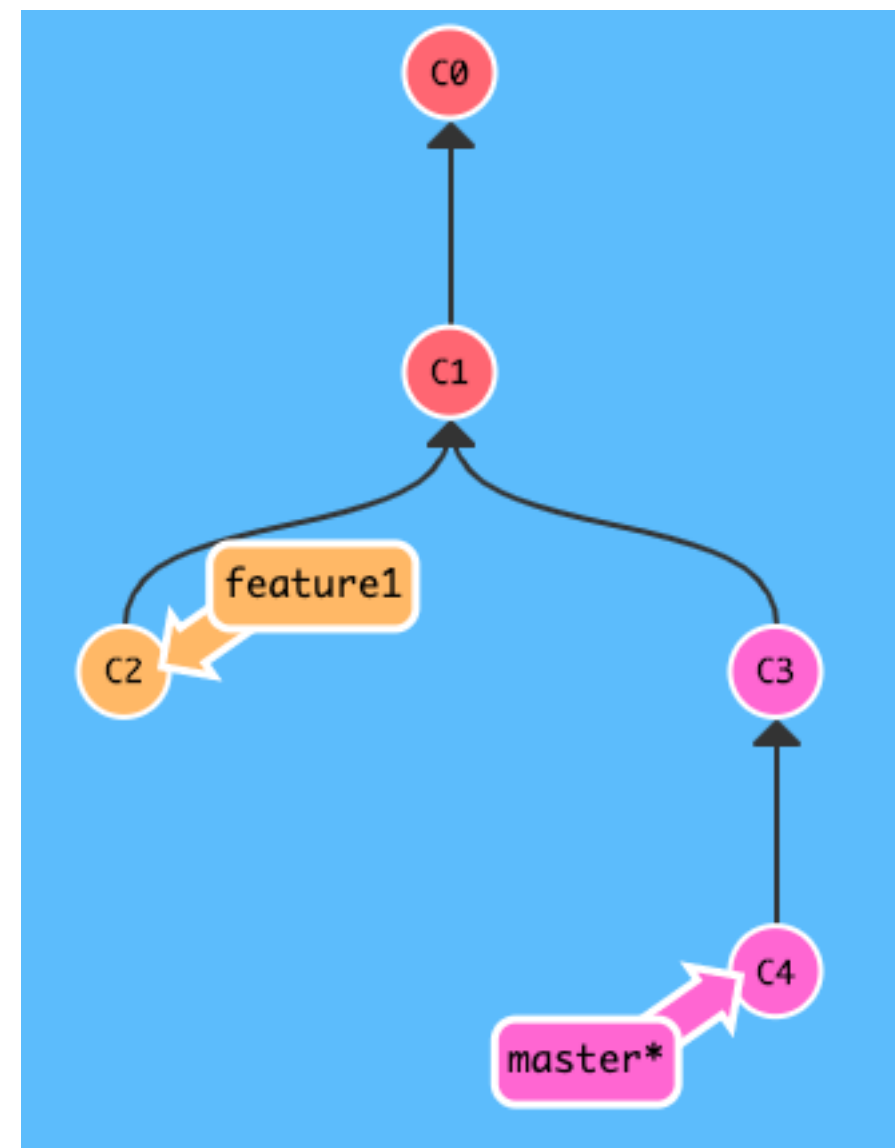
Practice Branching

Git equivalent of PythonTutor:

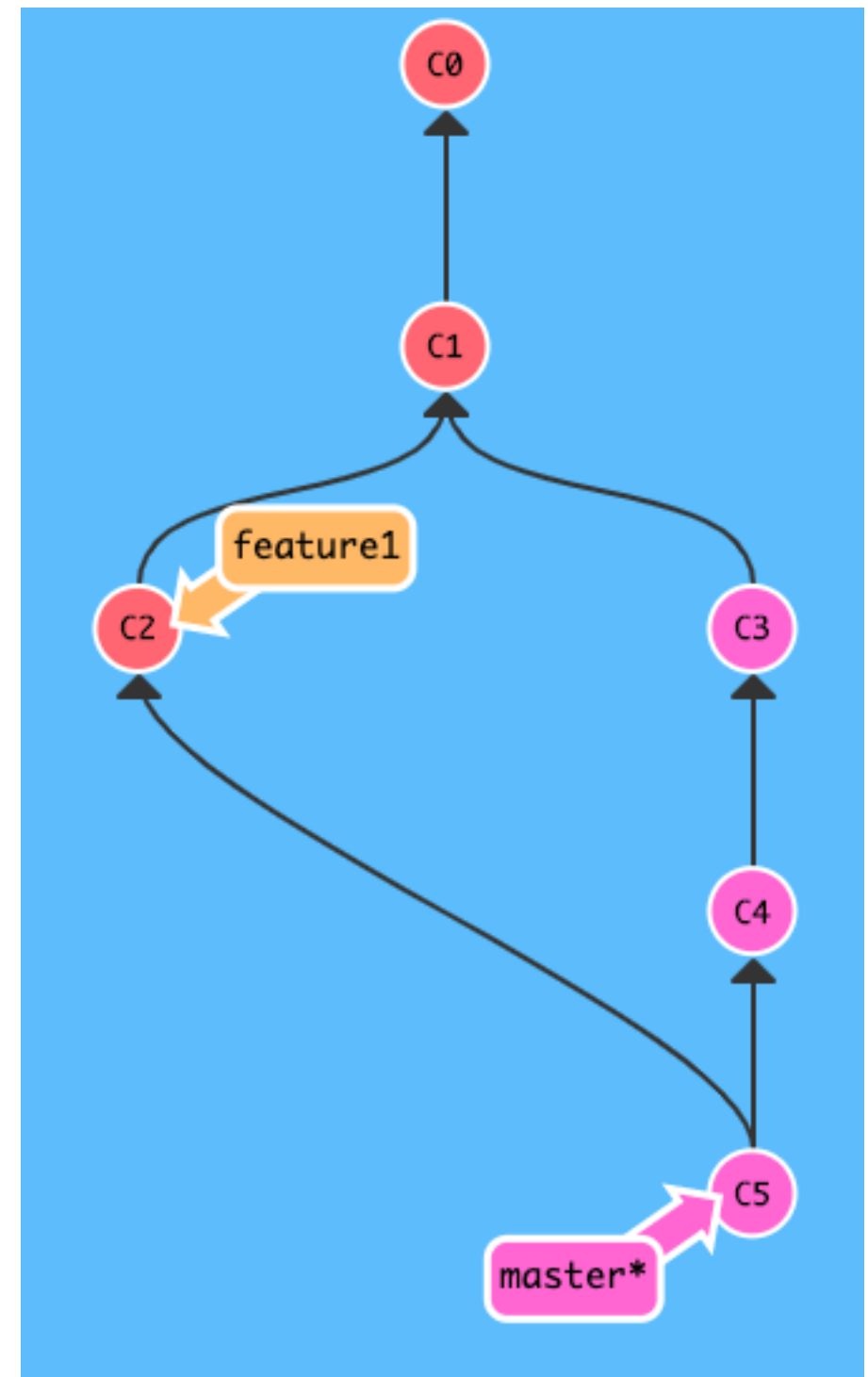
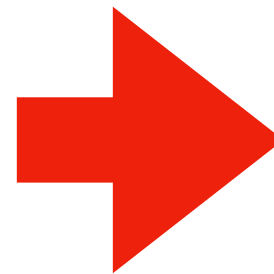
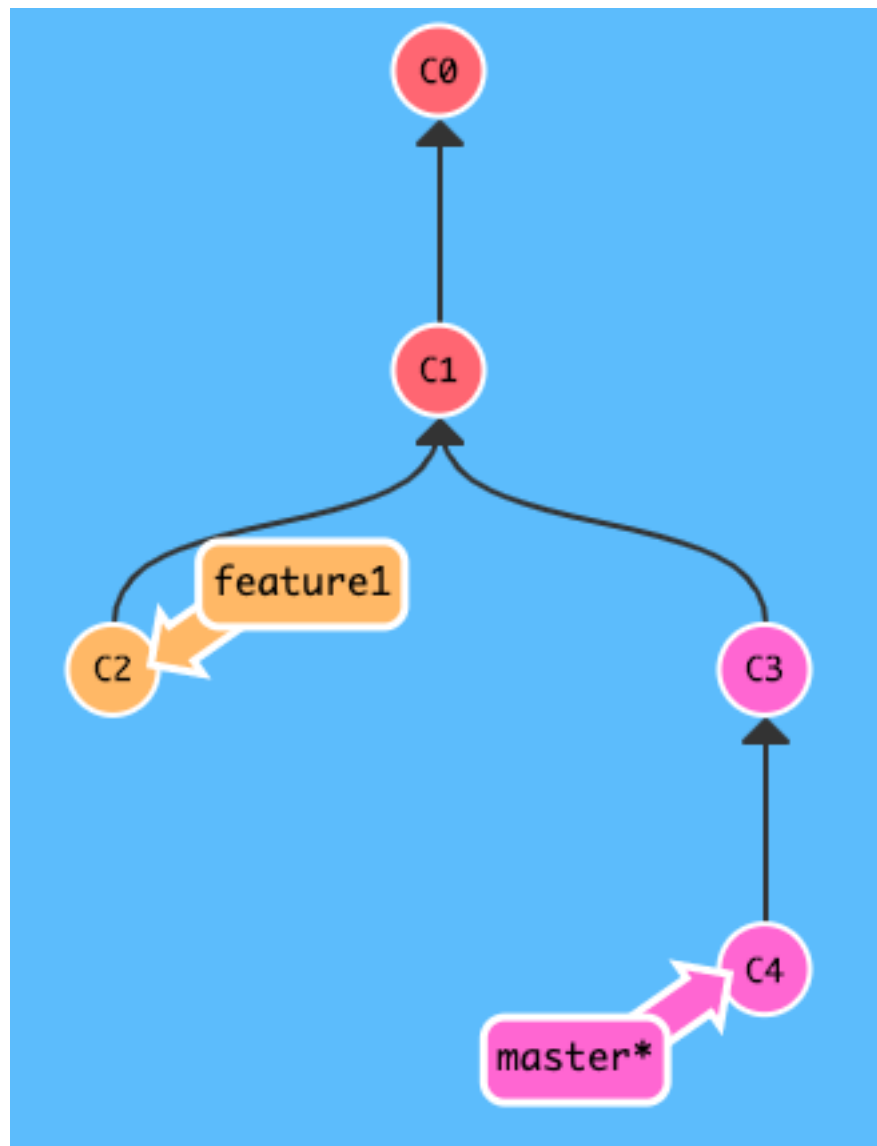
<https://learngitbranching.js.org/?NODEMO>



```
$ git branch feature1
$ git checkout feature1
$ git commit
$ git checkout master
$ git commit -m 'v1'
$ git commit
```



Merging without Conflicts



Switch branch

`git merge frombranch`

add whatever is there to the current branch

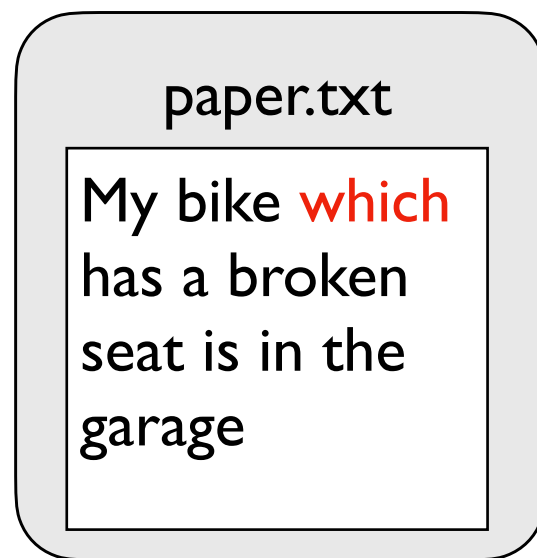
tip (or learn vim):

`export EDITOR=nano`

Merging with Conflicts

What happens when two people try to fix the same issue, in two different (incompatible) ways?

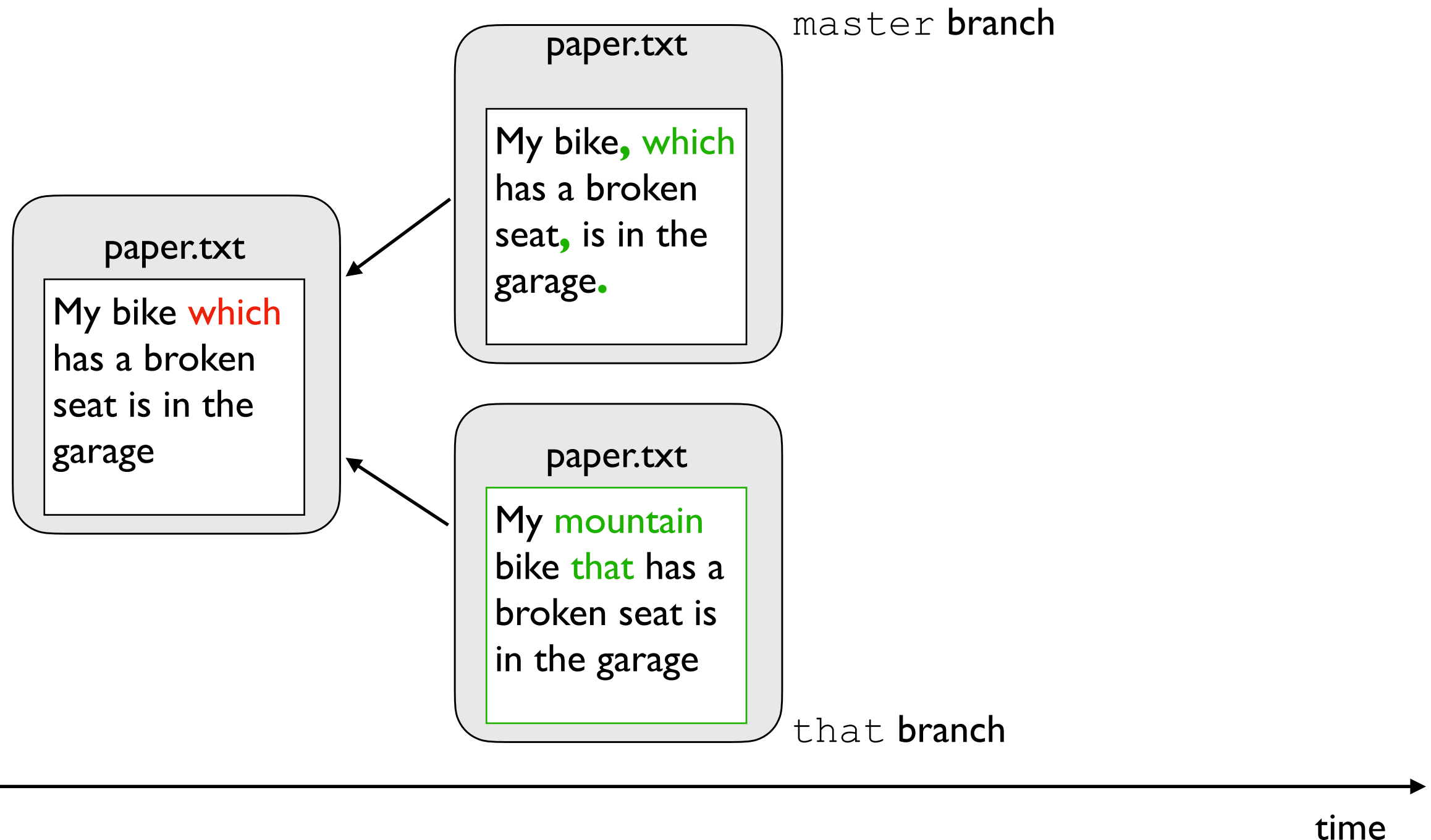
master branch



time

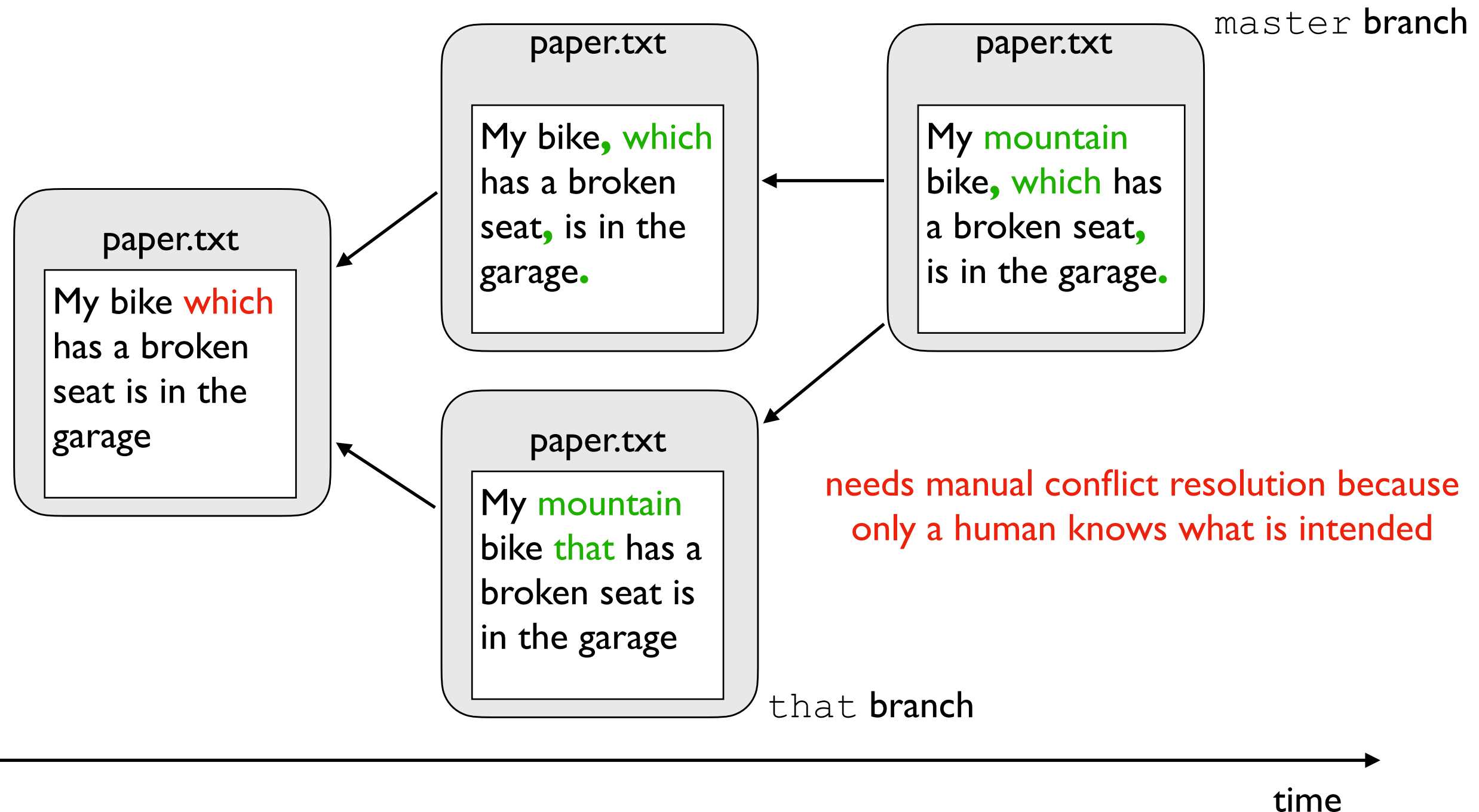
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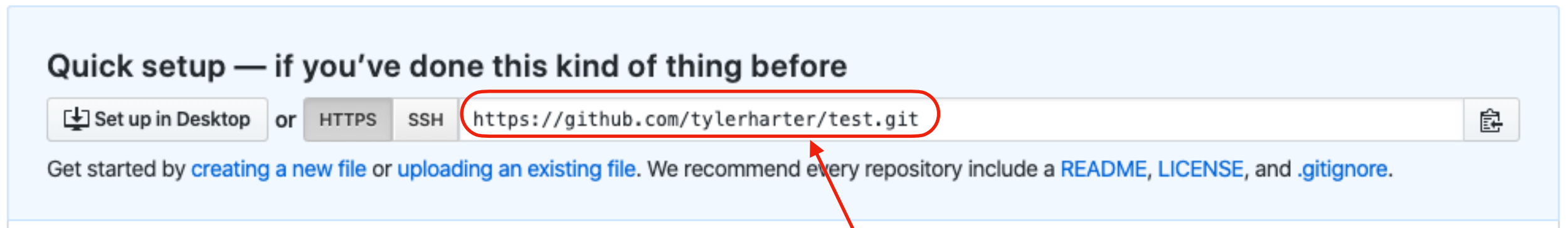
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Remotes

We will often want to work on our laptops, but also have our repositories on GitHub (or similar)

Create GitHub account, go here: <https://github.com/new>



Pushing a branch to GitHub

```
git remote add github https://github.com/tylerharter/test.git
```

```
git push github master
```

remote
name

branch
name

see reading about naming in software

Summary of Terms

commit: a snapshot of files at a point in time

HEAD: a convenient label for the current commit

tag: a long-term label associated with a commit

branch: a label attached to a commit that re-attaches to new commits

merge: to combine changes on another branch into the current branch

conflict: differences that cannot automatically be merged

Challenges: <https://learngitbranching.js.org/?NODEMO>

