Principles of Software Construction: Objects, Design, and Concurrency

Version control with git

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Administrivia

- Midterm 2 Thursday March 28th
  - Midterm Review March 27 6 pm in **NSH 3305**
- Form teams for HW 5

Intro to Java

Git, CI

UML

GUIs

Static Analysis

Performance

GUIs

More Git

Design

Part 1: Design at a Class Level	Part 2: Designing (Sub)systems	Part 3: Designing Concurrent Systems
Design for Change: Information Hiding, Contracts, Unit Testing, Design Patterns Design for Reuse: Inheritance, Delegation, Immutability, LSP, Design Patterns	Understanding the Problem Responsibility Assignment, Design Patterns, GUI vs Core, Design Case Studies Testing Subsystems Design for Reuse at Scale: Frameworks and APIs	Concurrency Primitives, Synchronization Designing Abstractions for Concurrency

Last week Thursday recap

Characteristics of a Good API

Review

- Easy to learn
- Easy to use, even if you take away the documentation
- Hard to misuse
- Easy to read and maintain code that uses it
- Sufficiently powerful to satisfy requirements
- Easy to evolve
- Appropriate to audience

Try API on at least 3 use cases before release

- If you write one, it probably won't support another
- If you write two, it will support more with difficulty
- If you write three, it will probably work fine
- Ideally, get different people to write the use cases
  - This will test documentation & give you different perspectives
- This is even more important for plug-in APIs
- Will Tracz calls this "The Rule of Threes"
  (Confessions of a Used Program Salesman, Addison-Wesley, 1995)

Names Matter – API is a little language

Naming is perhaps the single most important factor in API usability

- Primary goals
  - **Client code should read like prose** (“easy to read”)
  - **Client code should mean what it says** (“hard to misread”)
  - **Client code should flow naturally** (“easy to write”)
- To that end, names should:
  - be largely self-explanatory
  - leverage existing knowledge
  - interact harmoniously with language and each other

Aside: Software engineering research on names

[Vasilescu et al, ESEC/FSE 2017]

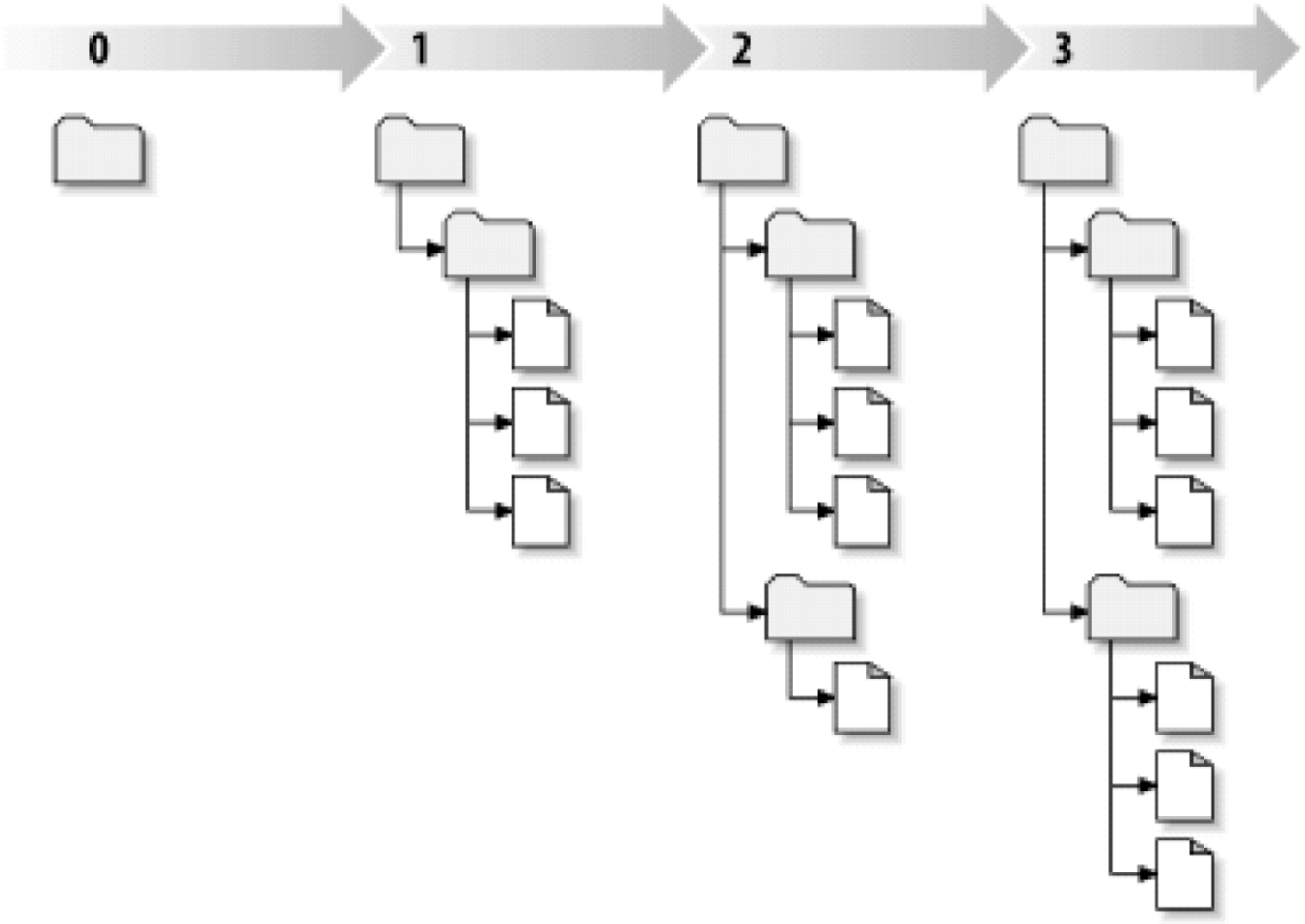
```
var geom2d = function() {
  var t = numeric.sum;
  function r(n, r) {
    this.x = n;
    this.y = r;
  }
  u(r, {
    P: function e(n) {
      return t([ this.x * n.x,
                 this.y * n.y ]);
    }
  });
  function u(n, r) {
    for (var t in r) n[t] = r[t];
    return n;
  }
  return {
    V: r
  };
}();
```

```
var geom2d = function() {
  var sum = numeric.sum;
  function Vector2d(x, y) {
    this.x = x;
    this.y = y;
  }
  mix(Vector2d, {
    P: function dotProduct(vector) {
      return sum([ this.x * vector.x,
                   this.y * vector.y ]);
    }
  });
  function mix(dest, src) {
    for (var k in src) dest[k] = src[k];
    return dest;
  }
  return {
    V: Vector2d
  };
}();
```

Today:

VERSION CONTROL WITH GIT

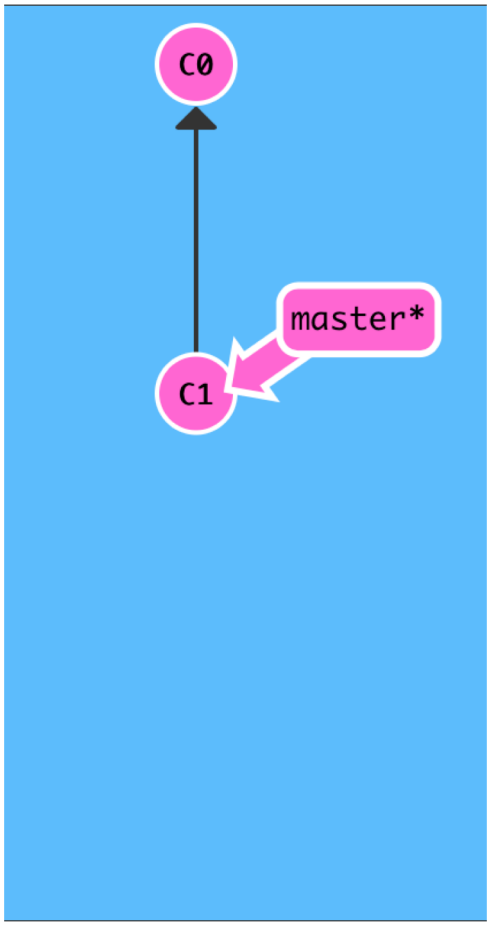
Versioning entire projects

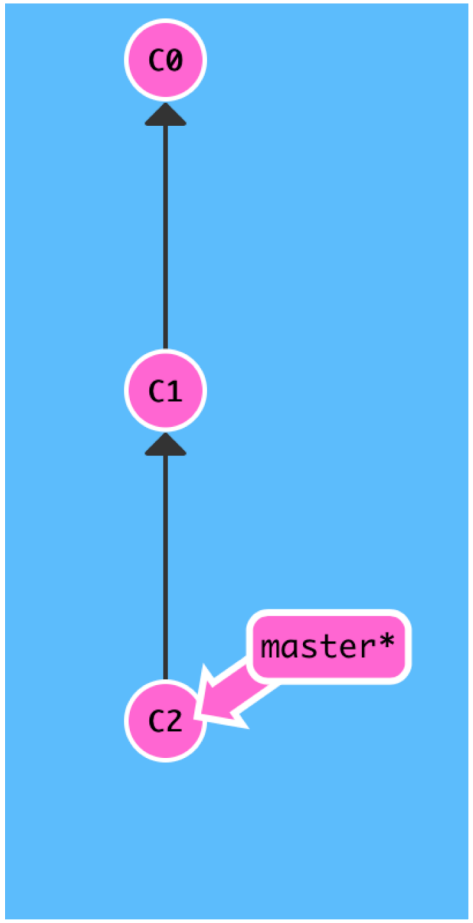


GIT BASICS

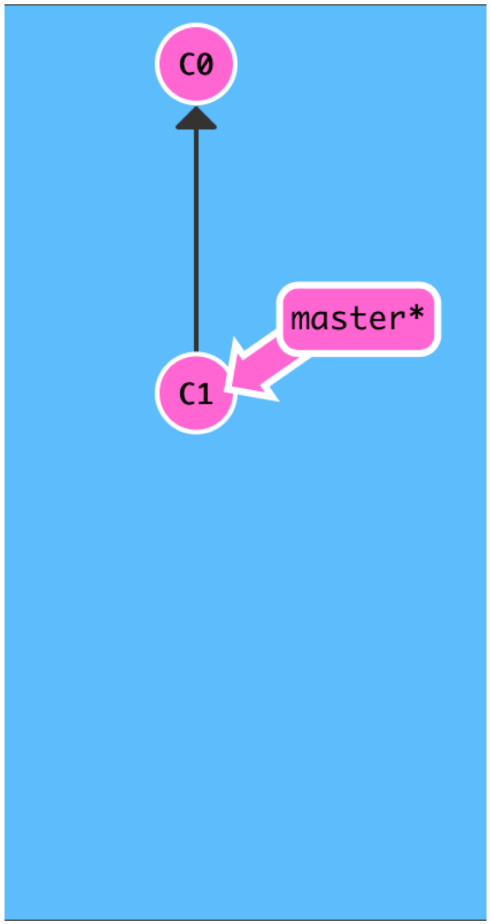
Graphics by https://learngitbranching.js.org

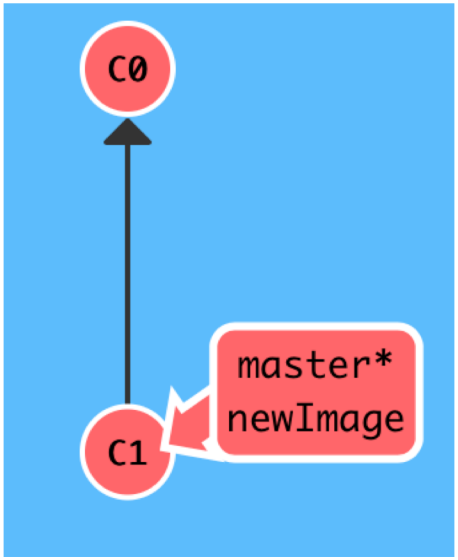
git commit



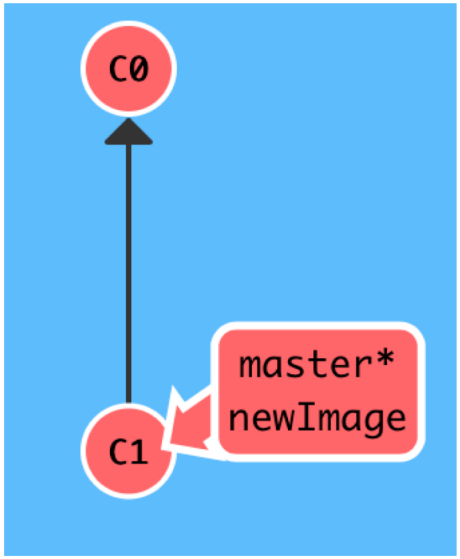


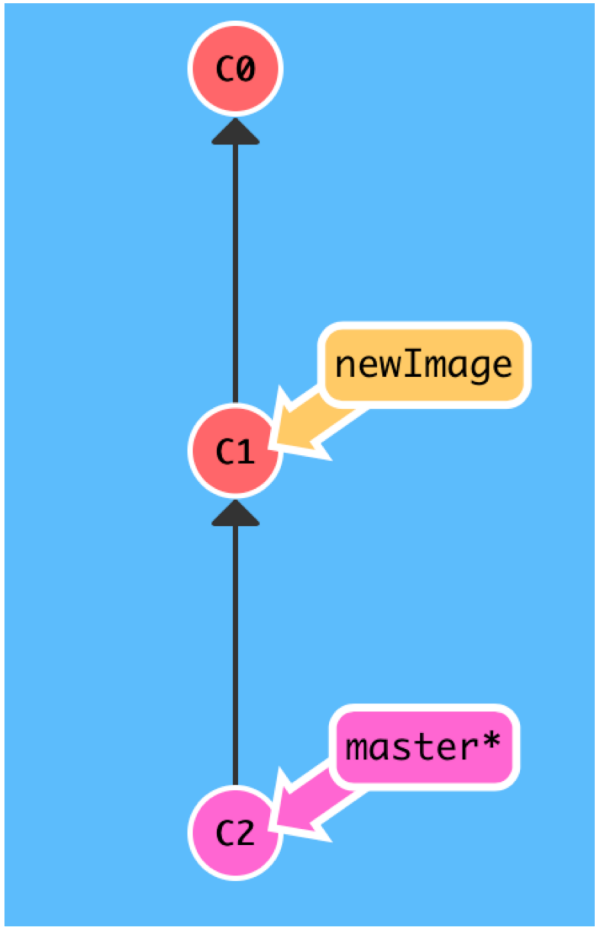
git branch newImage



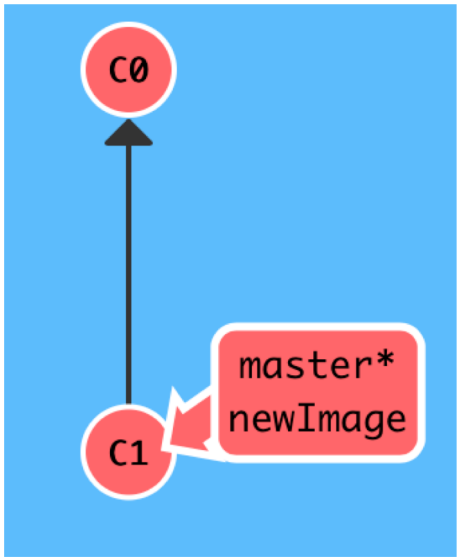


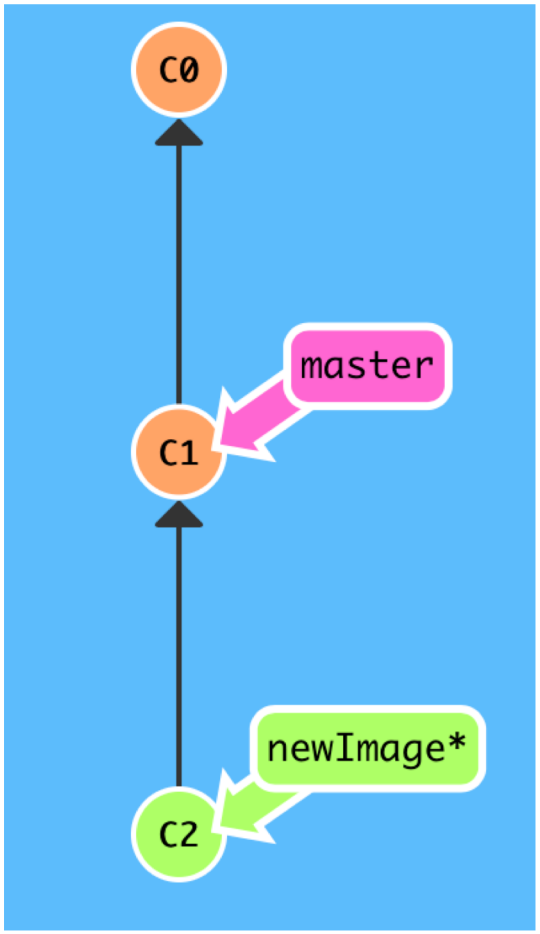
git commit



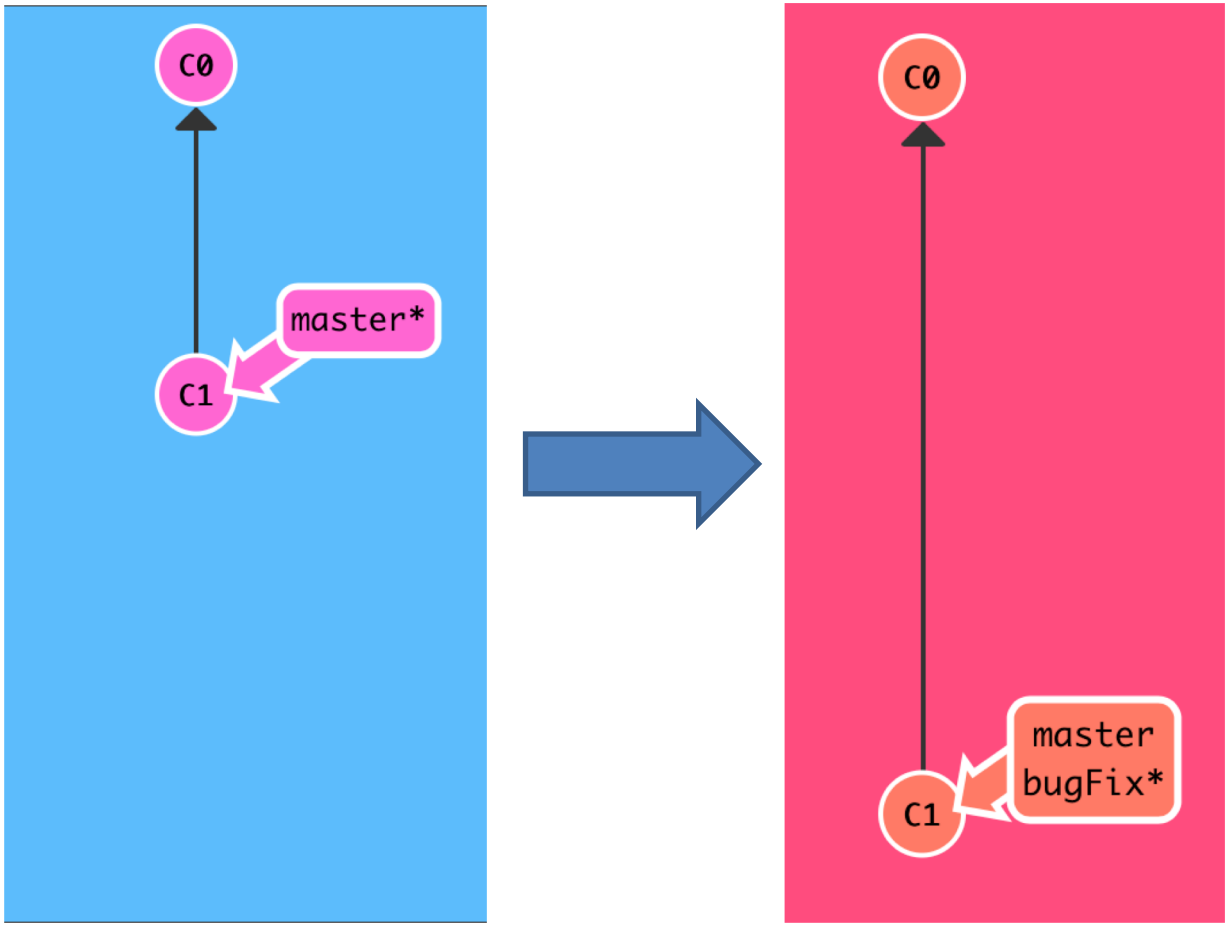


git checkout newImage; git commit



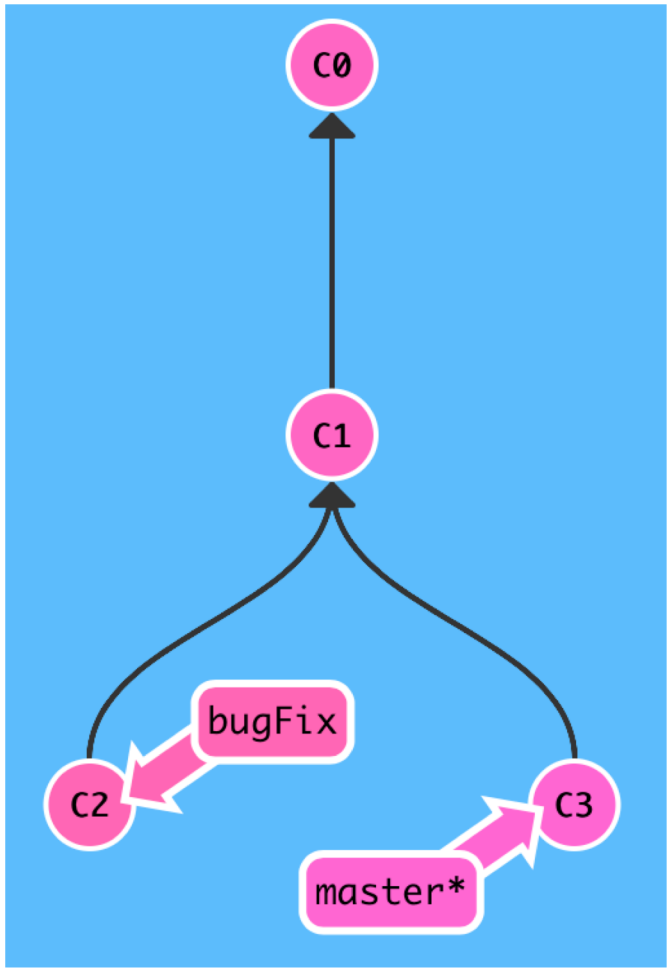


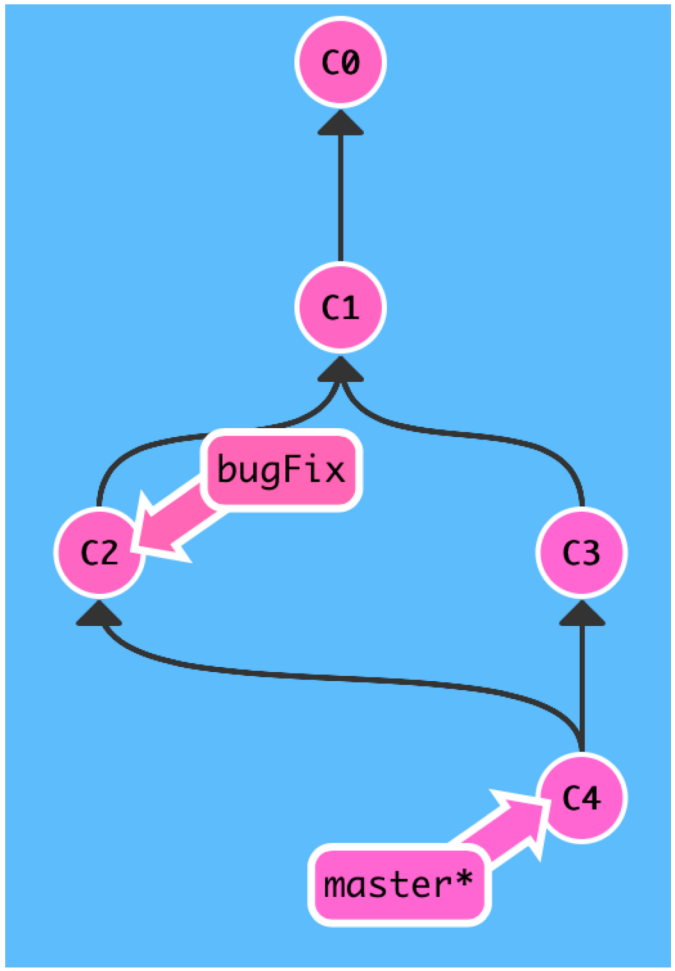
Activity: Make a new branch named bugFix and switch to that branch



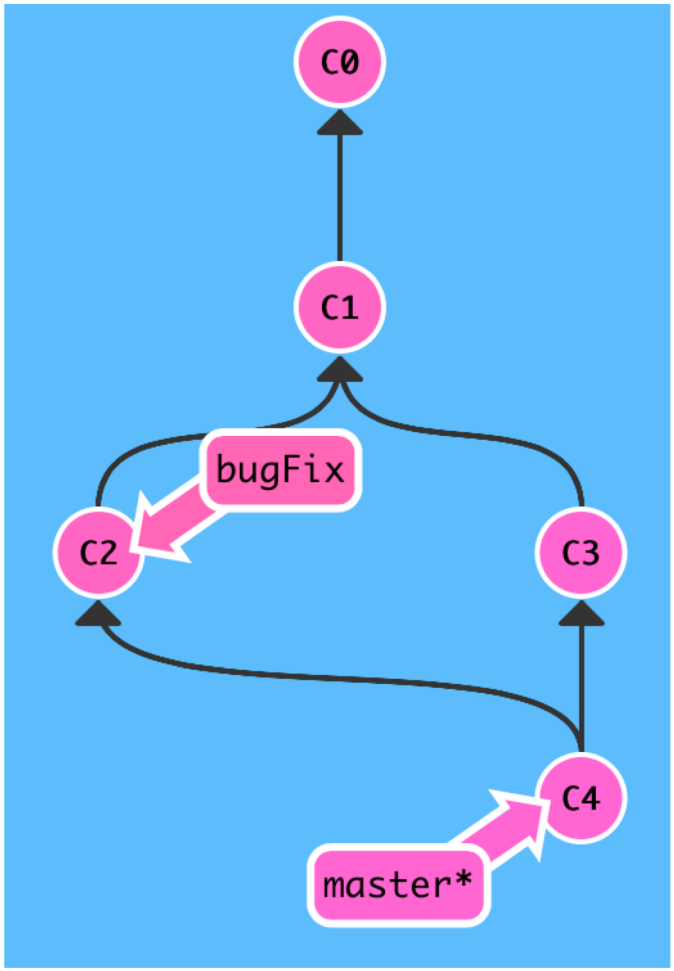
Three ways to move work around between branches

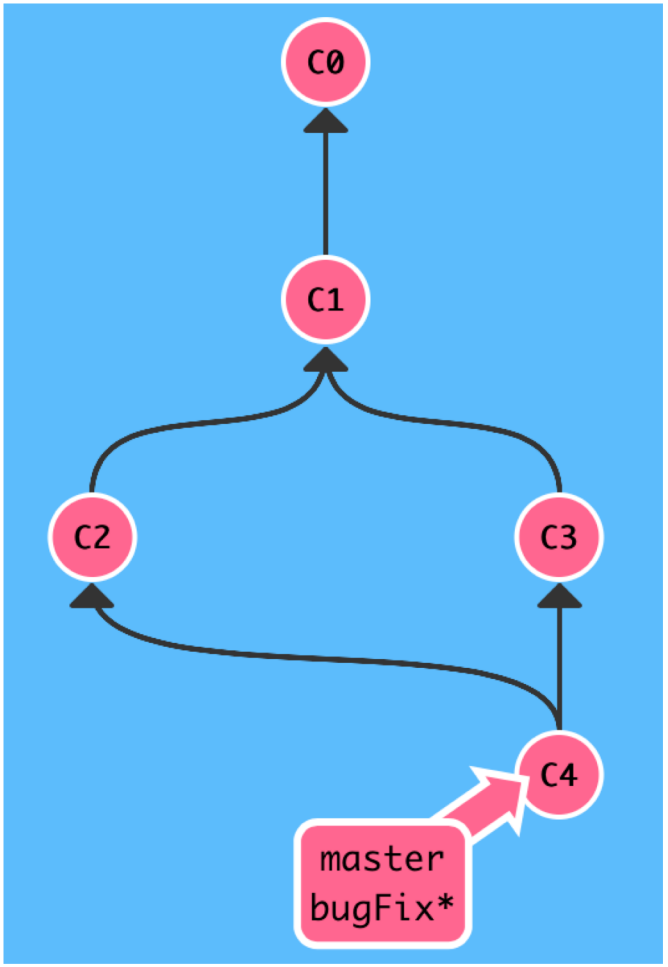
1) `git merge bugFix` (into `master`)



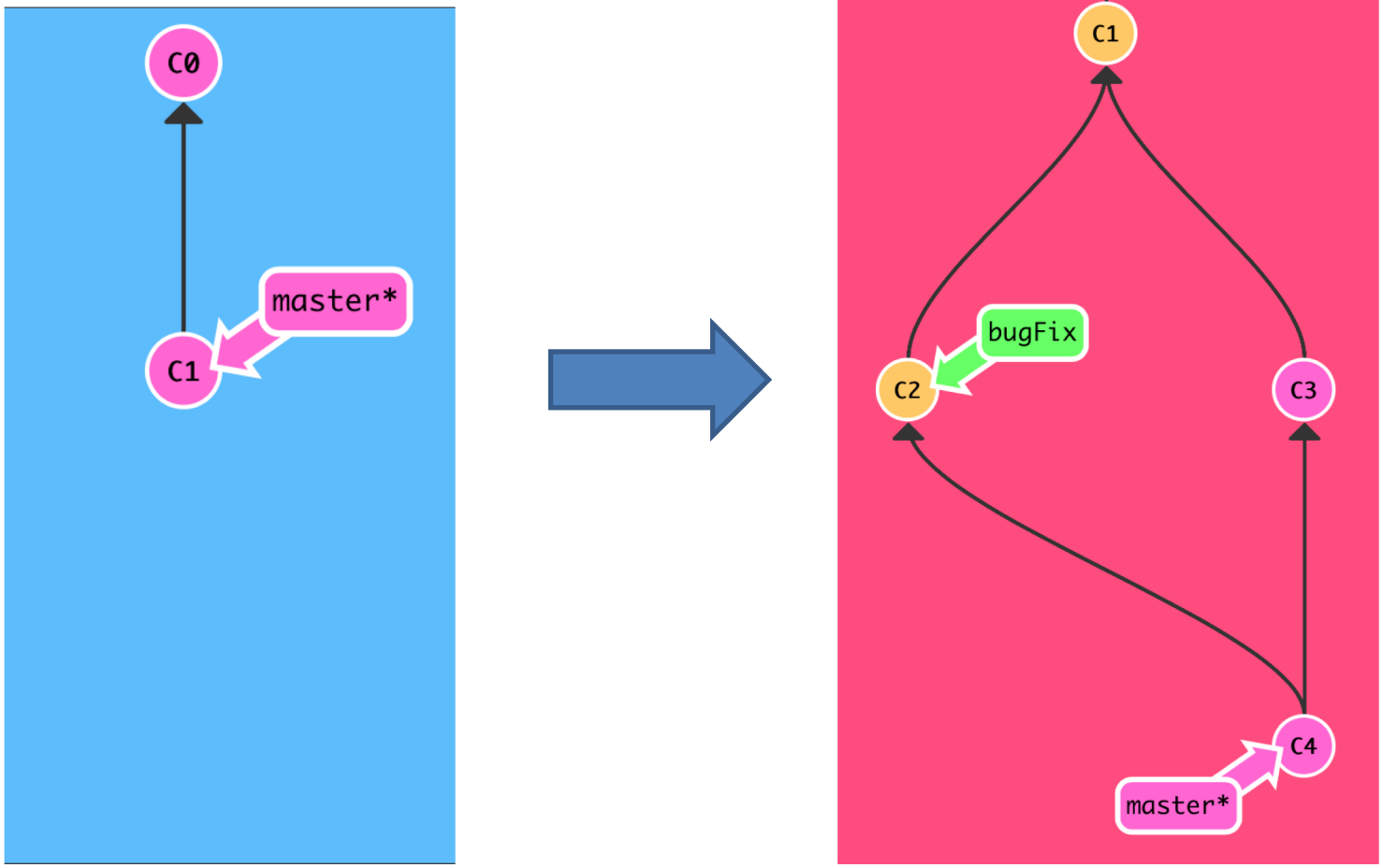


`git checkout bugfix; git merge master` (into bugFix)



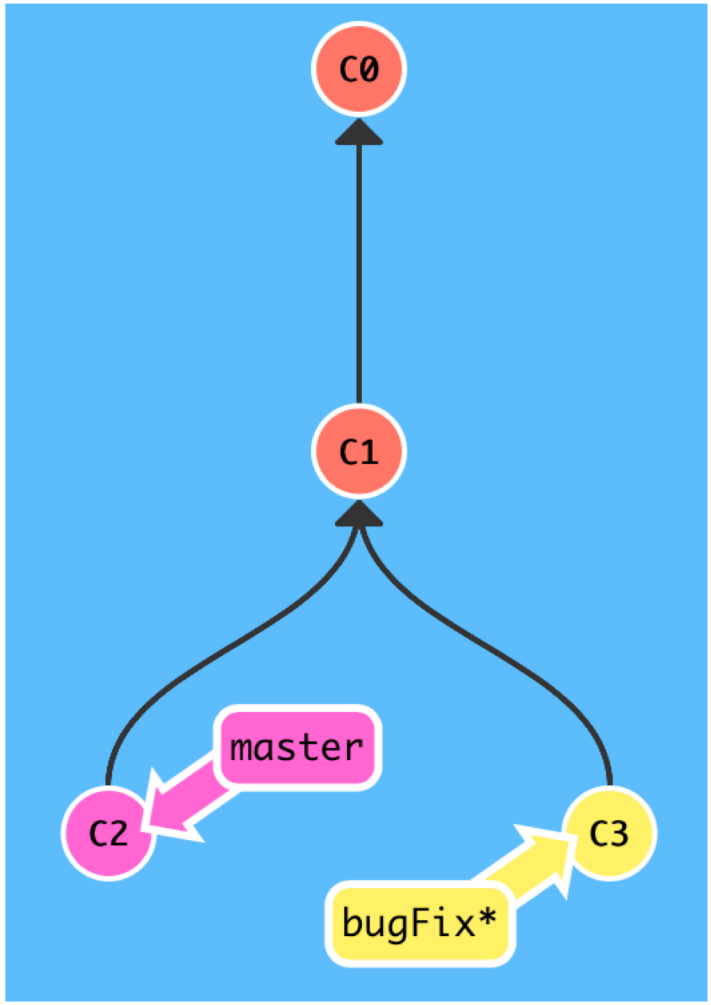


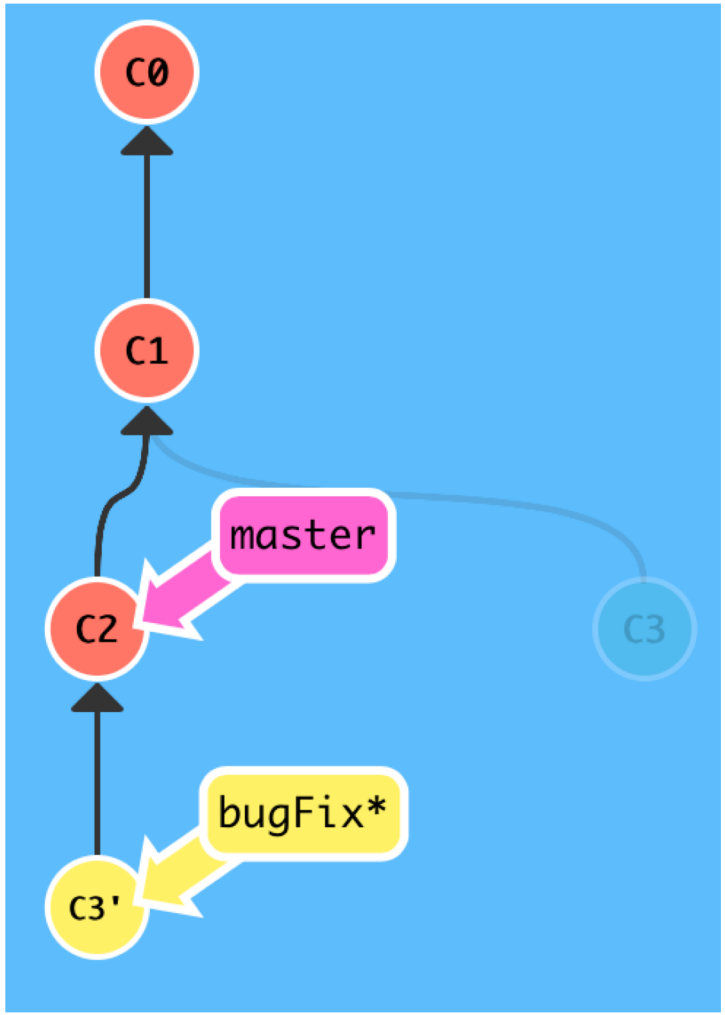
Activity:



Move work from bugFix directly onto master

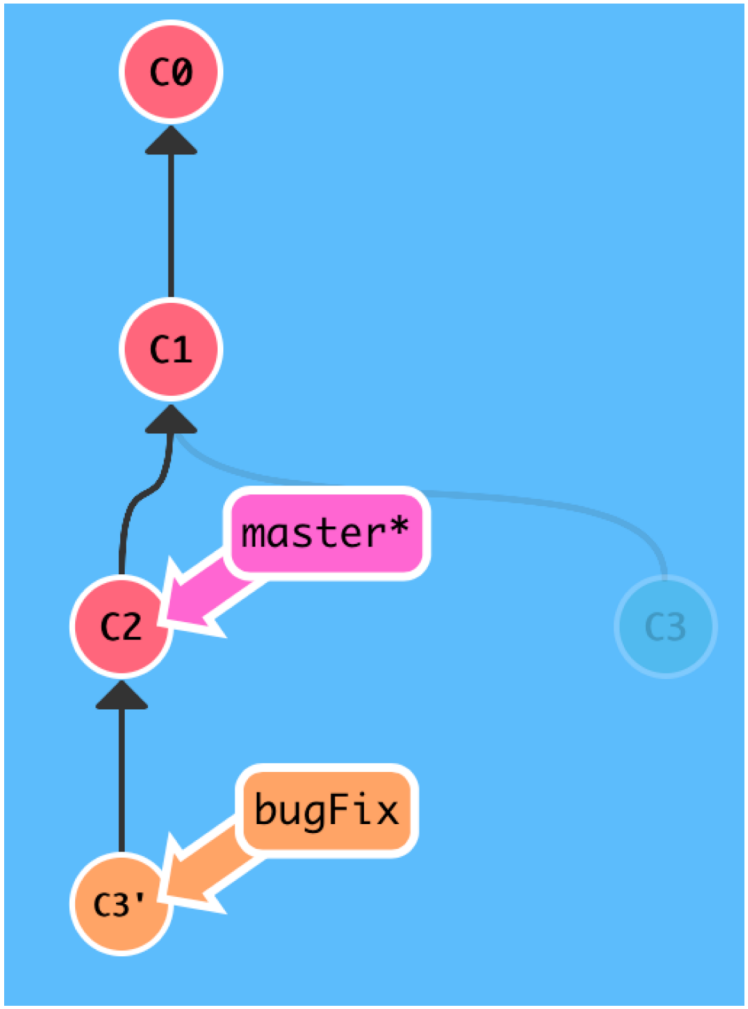
```
2) git rebase master
```

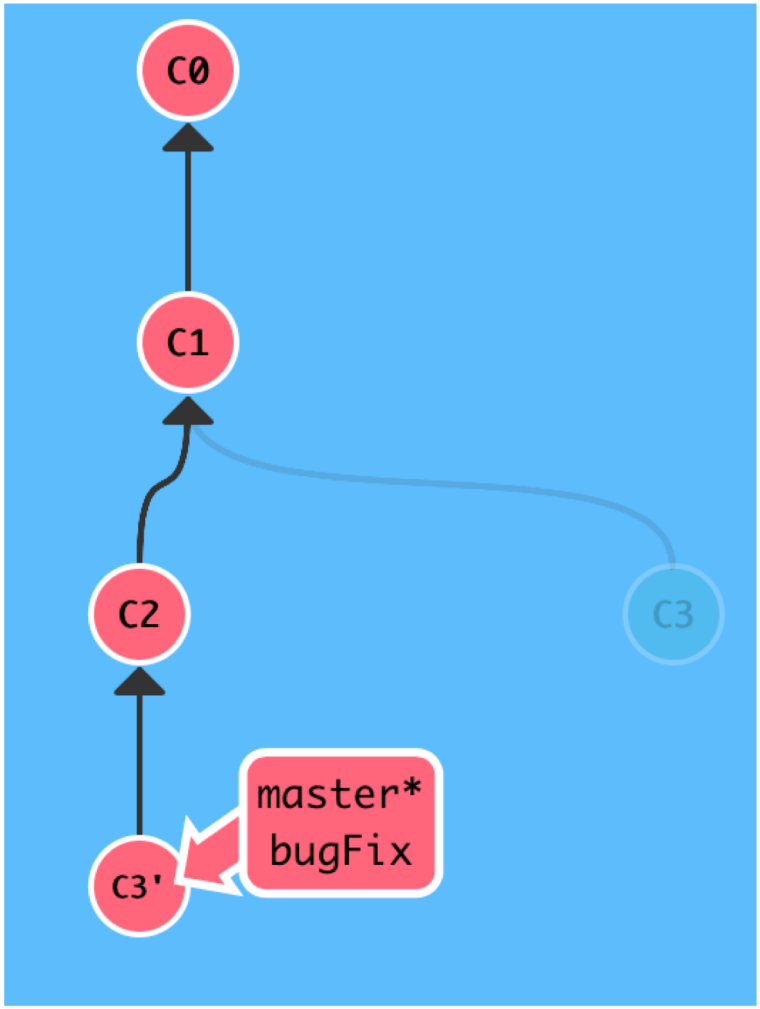




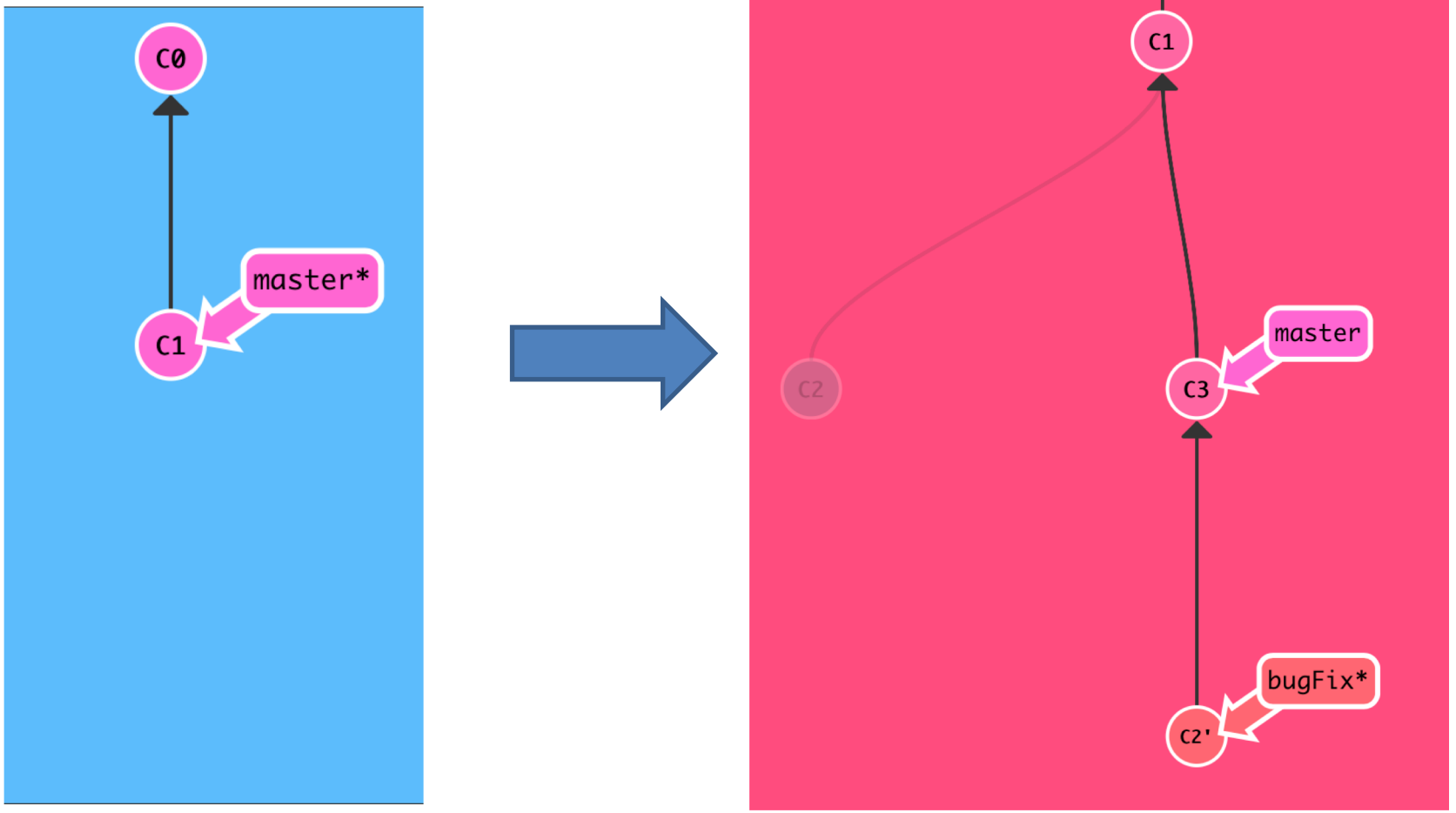
But master hasn't been updated, so:

```
git checkout master; git rebase bugFix
```



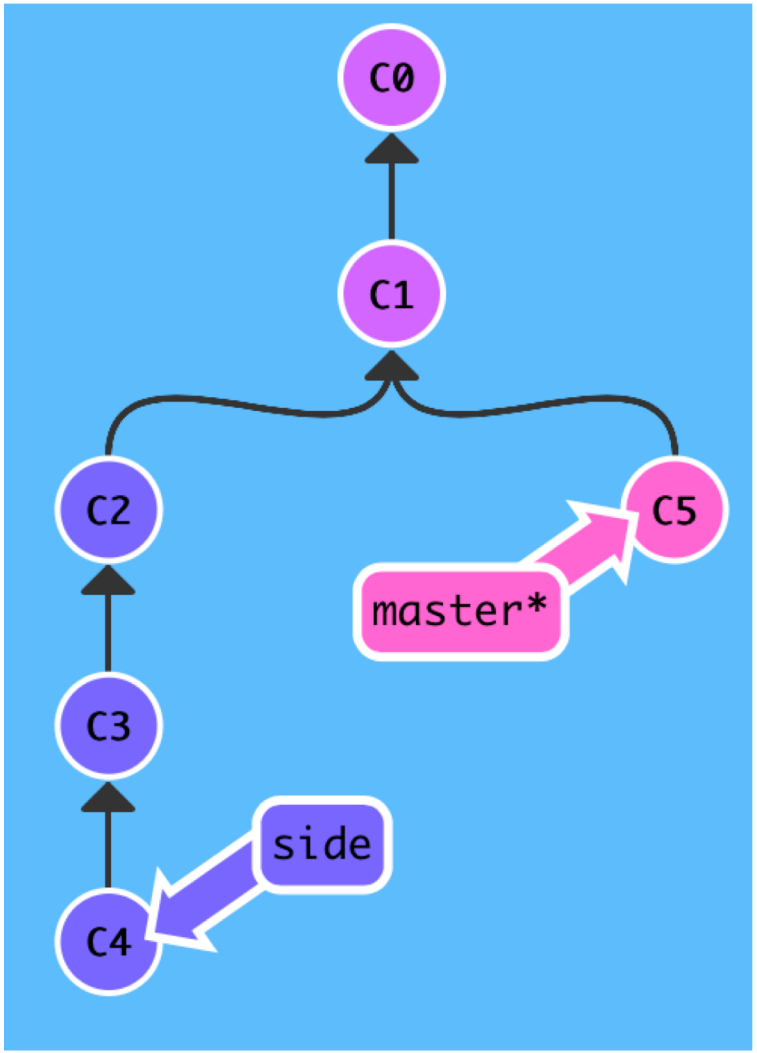


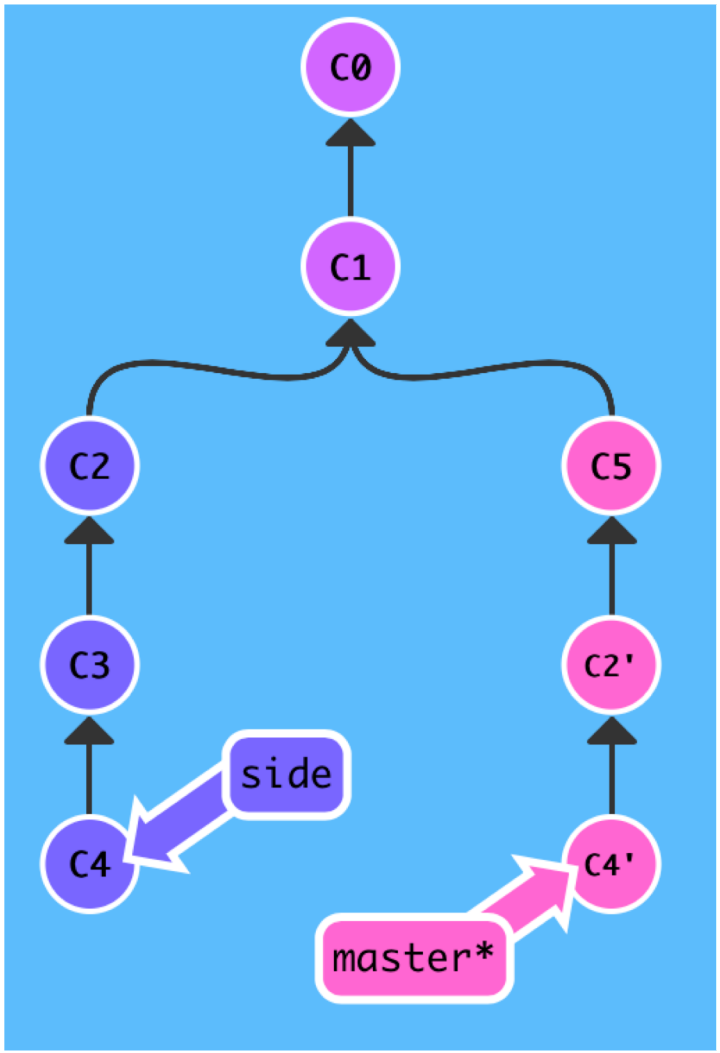
Activity:



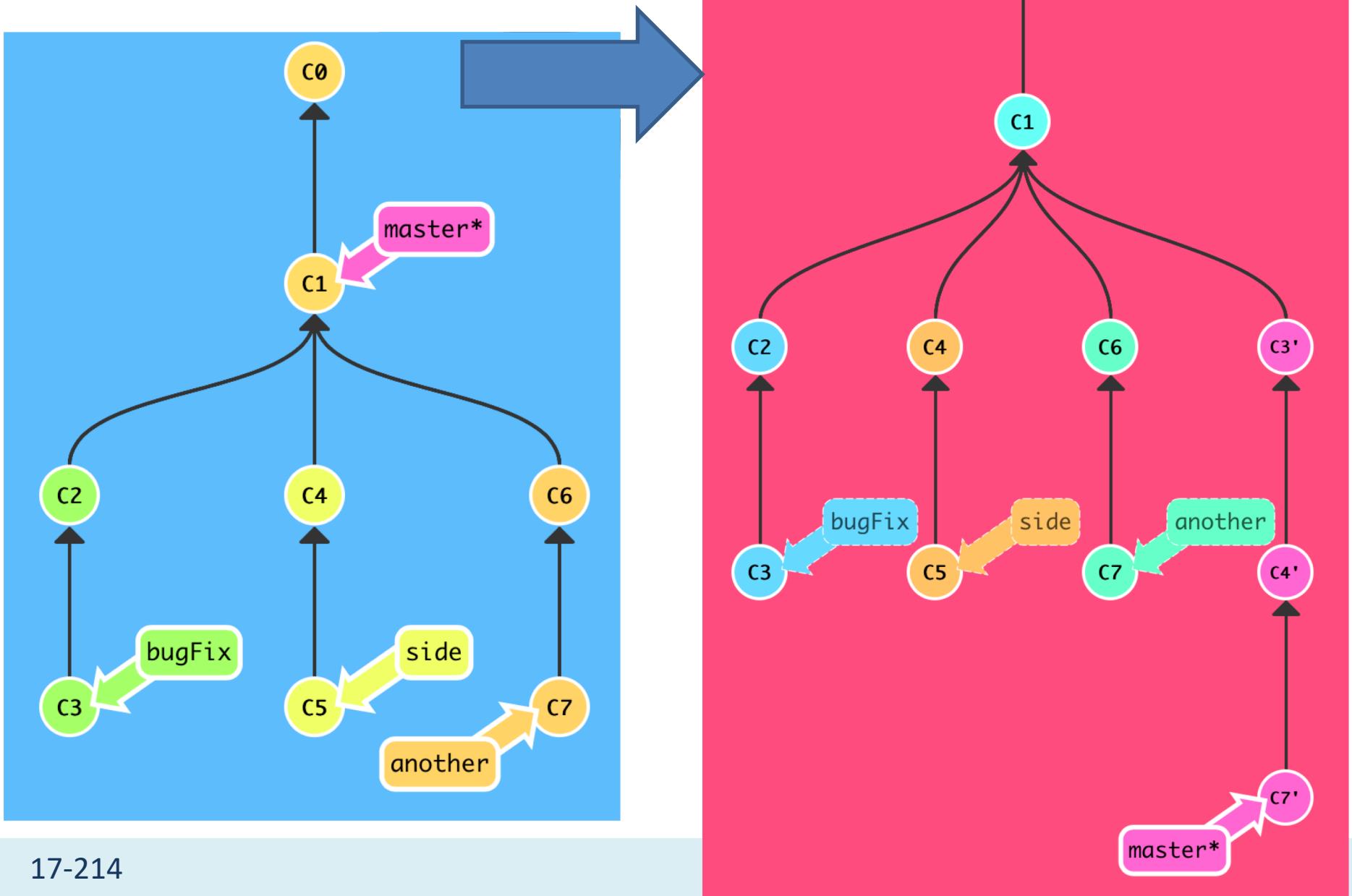
Copy a series of commits below current location

```
3) git cherry-pick C2 C4
```





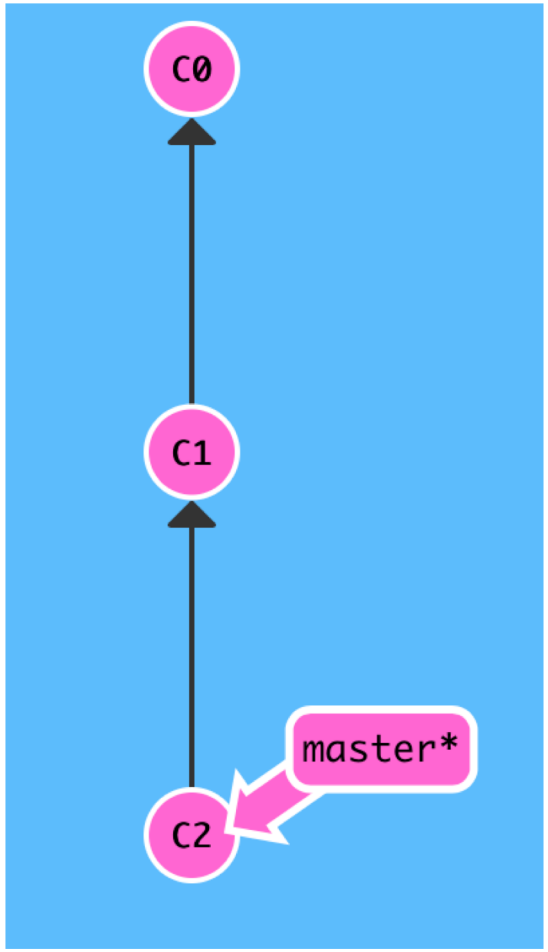
Activity:

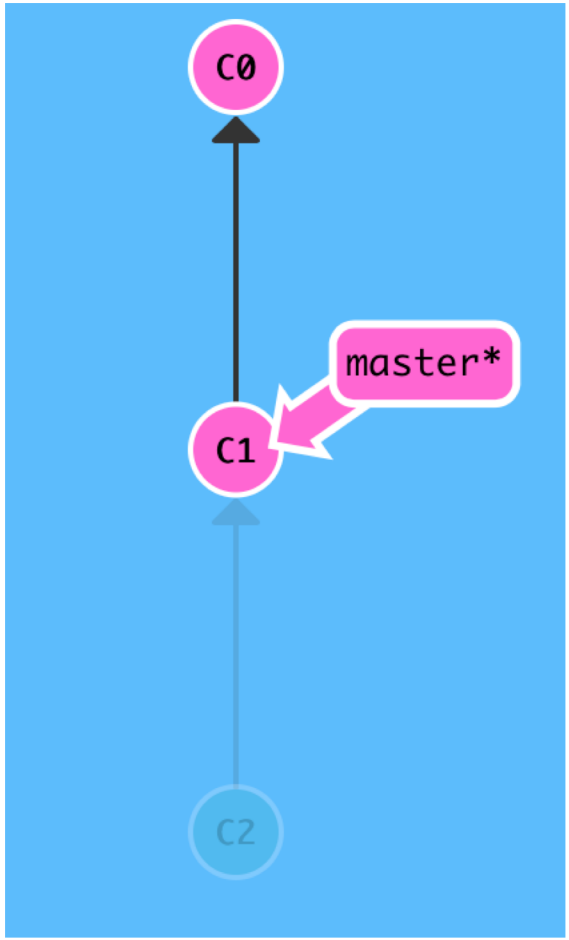

C0
master*
C1
C2
C4
C6
bugFix
side
C3
C5
C7
another
C0
C1
C2
C4
C6
C3'
bugFix
side
another
C3
C5
C7
C4'
C7'
master*

Ways to undo work (1)

```
git reset HEAD~1
```

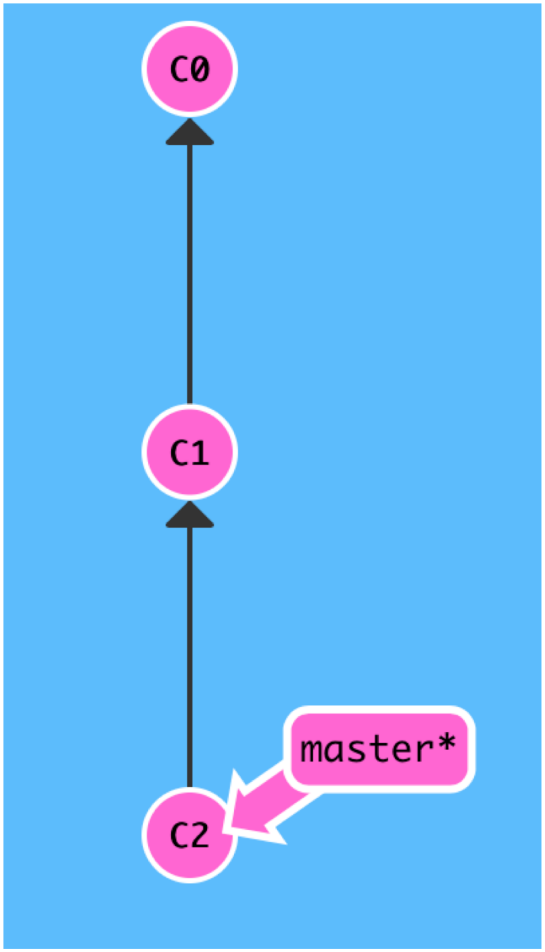
HEAD is the symbolic name for the currently checked out commit



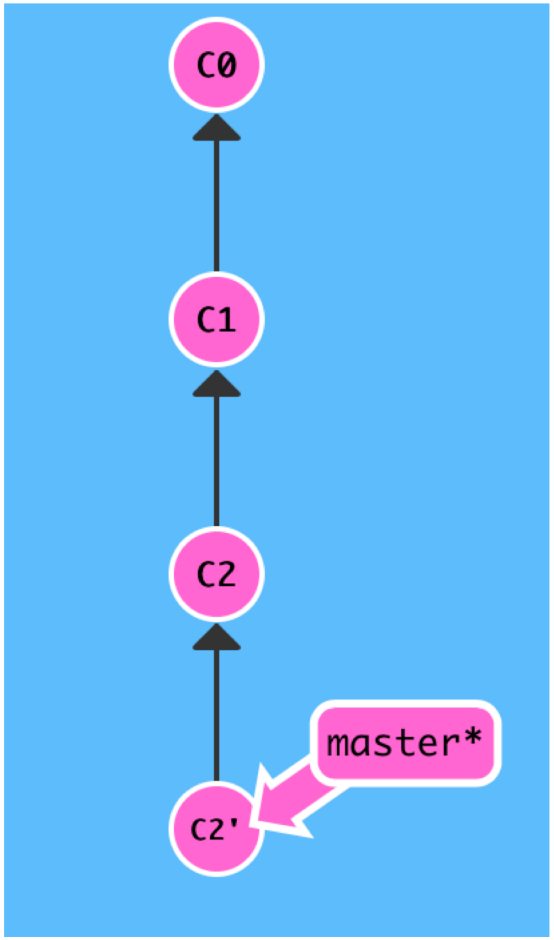


Ways to undo work (2)

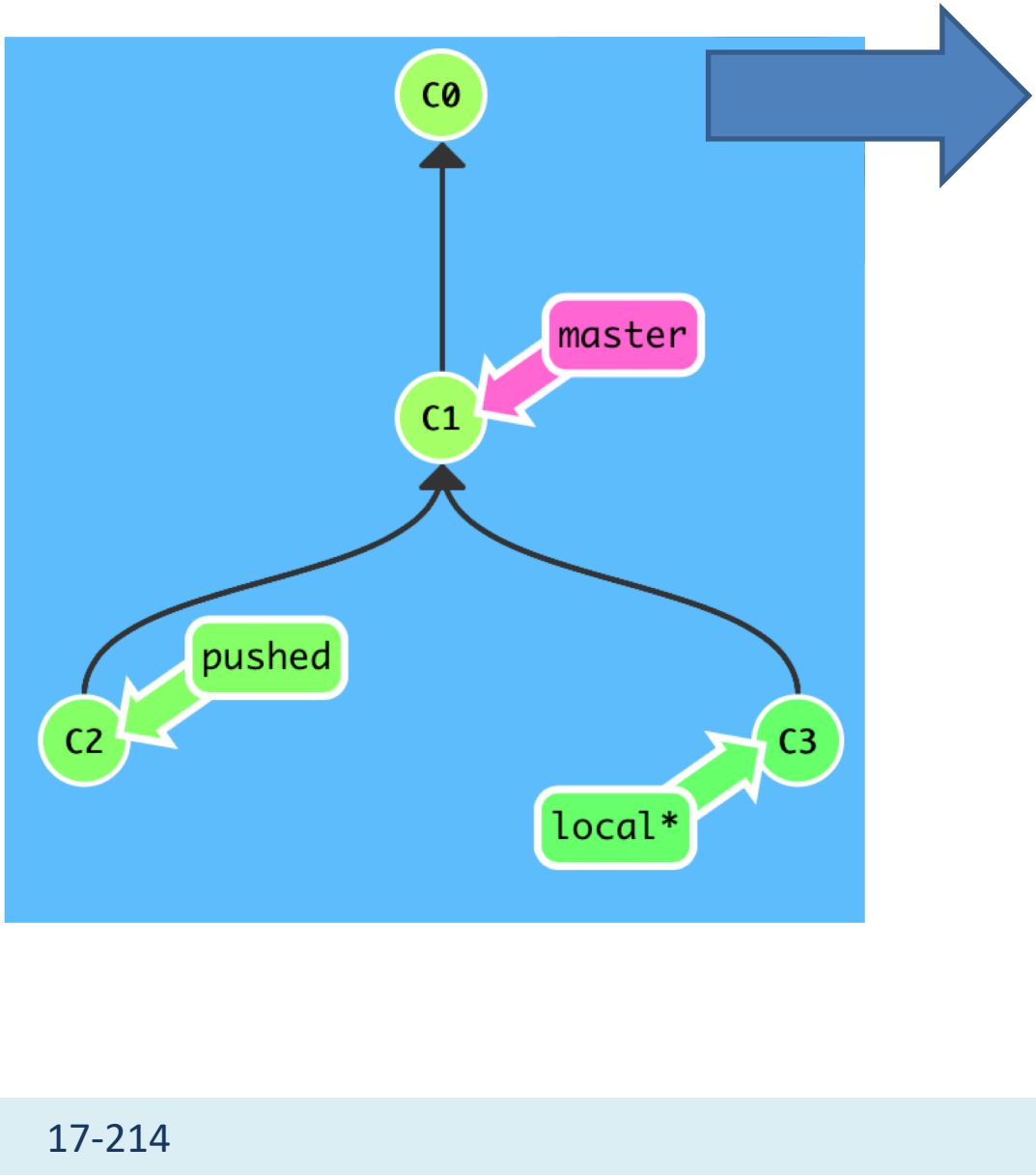
```
git revert HEAD
```



git reset does not work for remote branches

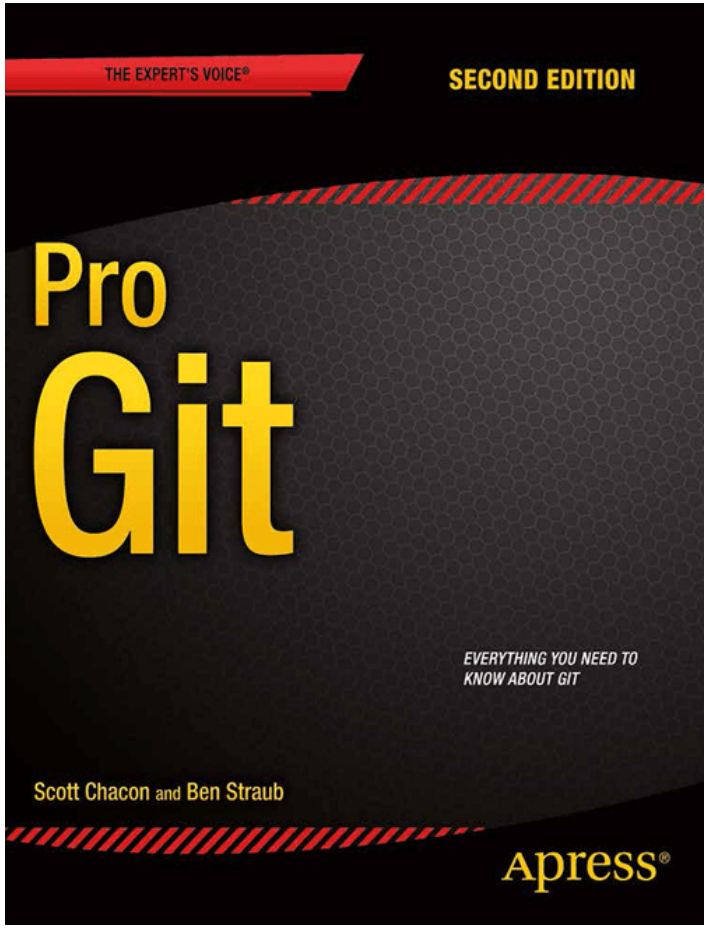


Activity:


C0
master
C1
pushed
C2
C3
local*
C0
master
local
C1
C2
C3
pushed*
C2'

Highly recommended

- (second) most useful life skill you will have learned in 214



https://git-scm.com/book/en/v2

Summary

- Version control has many advantages
  - History, traceability, versioning
  - Collaborative and parallel development
- Collaboration with branches
  - Different workflows
- From local to central to distributed version control