Principles of Software Construction: Objects, Design, and Concurrency

Software engineering in practice

Configuration management and version control systems

Josh Bloch **Charlie Garrod** Darya Melicher

Carnegie Mellon University
School of Computer Science

institute for SOFTWARE RESEARCH

Administrivia

- Homework 6 due next Wednesday
  - Checkpoint deadline Monday night

Key concepts from Thanksgiving

Key concepts from last Tuesday

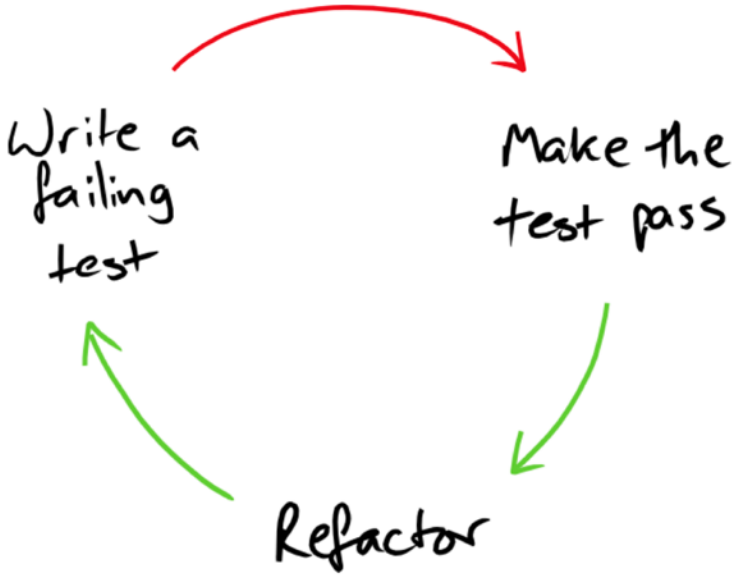
Streams design discussion

- Recall the fundamental API design principles…

Major topics in 17-313 (Foundations of SE)

- Process considerations for software development
- Requirements elicitation, documentation, and evaluation
- Design for quality attributes
- Strategies for quality assurance
- Empirical methods in software engineering
- Time and team management
- Economics of software development

Test-driven development (TDD), informally



From Growing Object-Oriented Software by Nat Pryce and Steve Freeman
http://www.growing-object-oriented-software.com/figures.html

@sebrose

http://cucumber.io

Empirical methods in software engineering

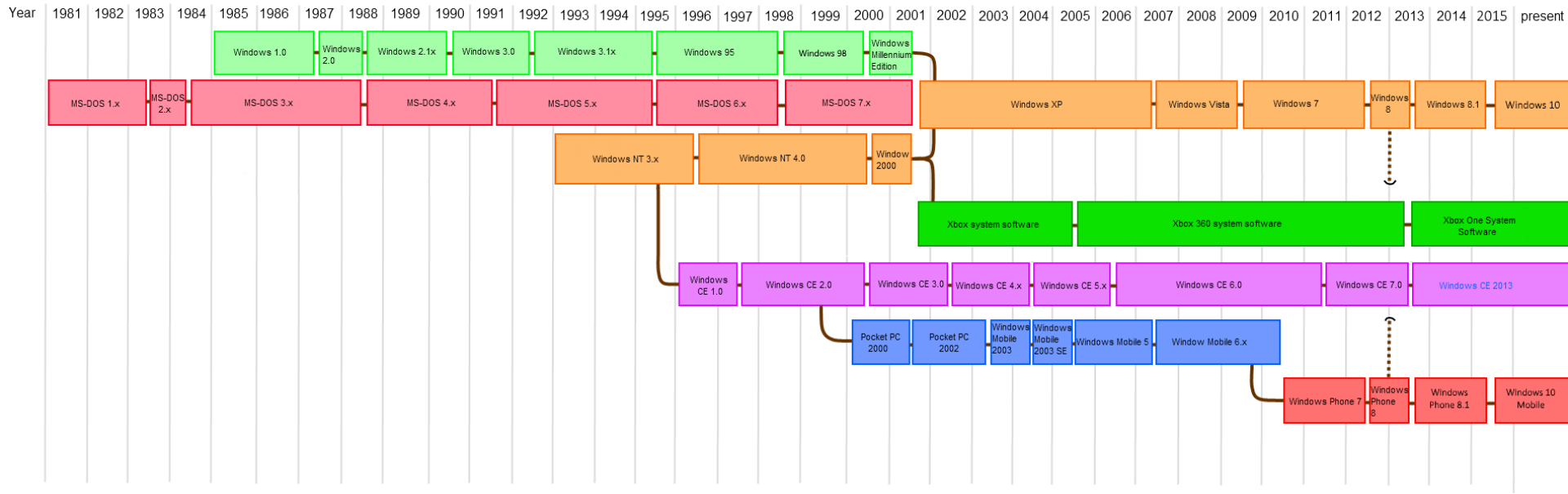
- How do we study the effectiveness of test-driven development compared to other methodologies?

This week: DevOps (Development operations)

- Introduction to devops
- Configuration management and version control

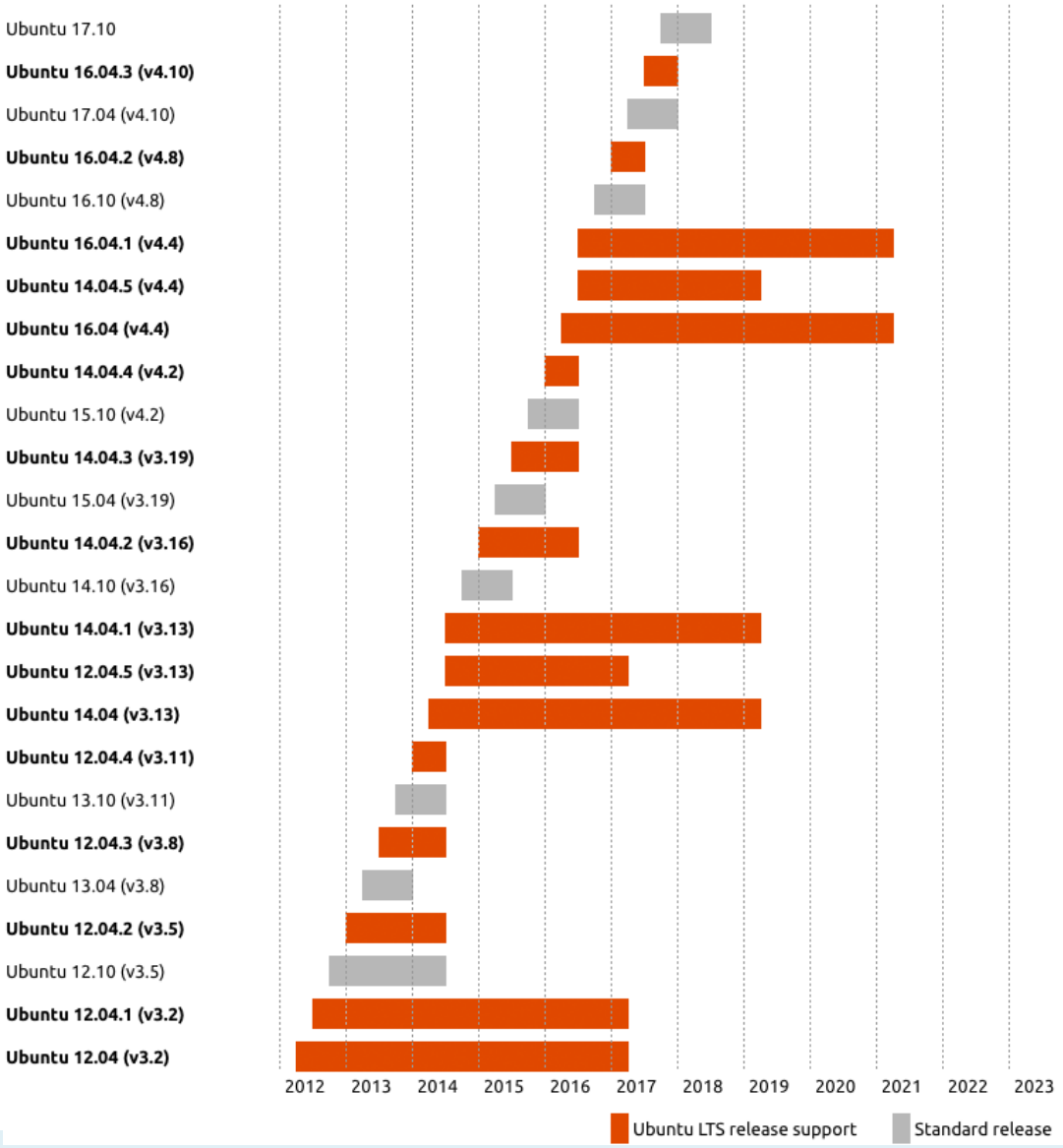
Consider: timelines of traditional software development

e.g., the Microsoft* OS development history

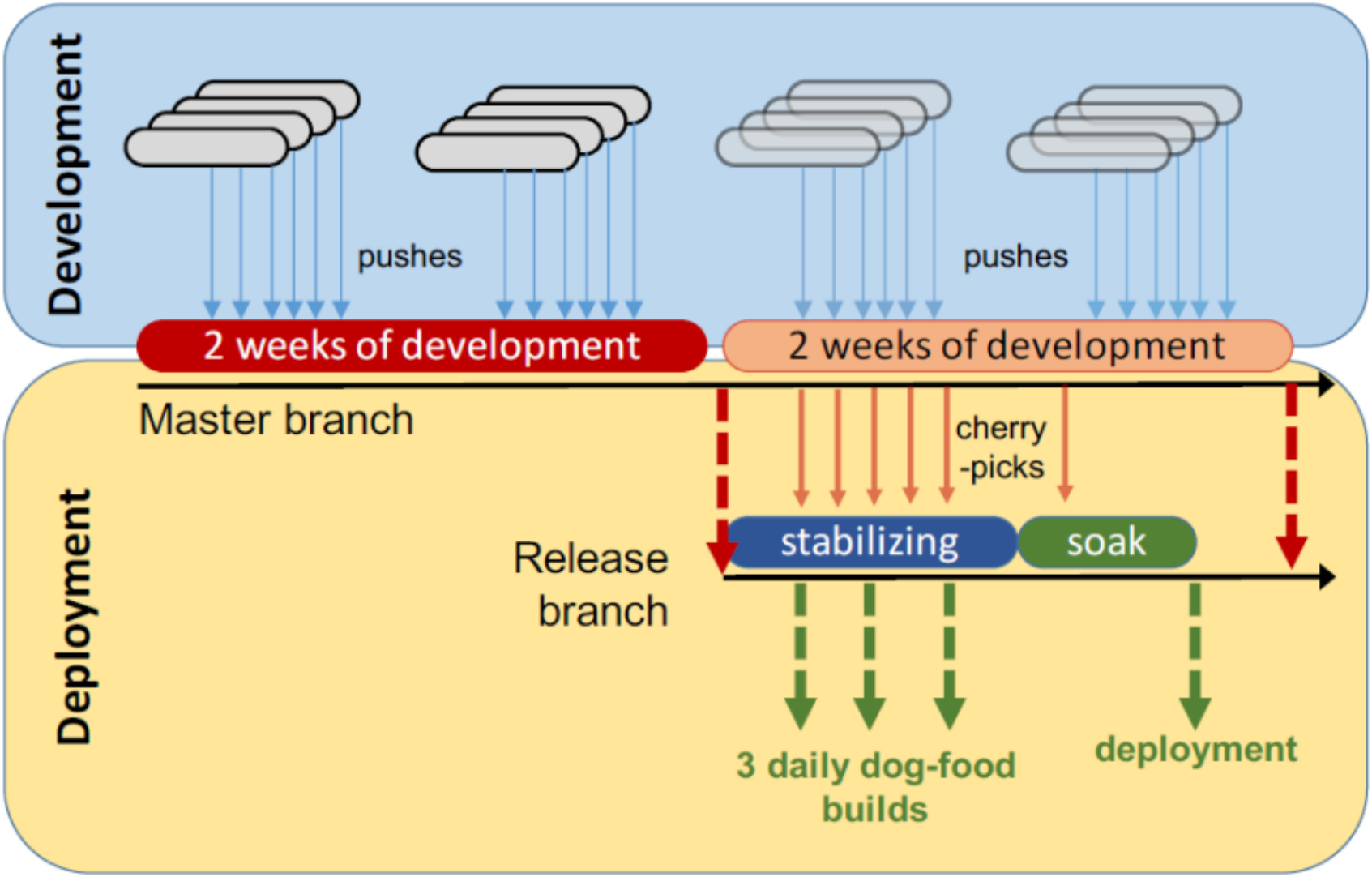


Source: By Paulire - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=46634740

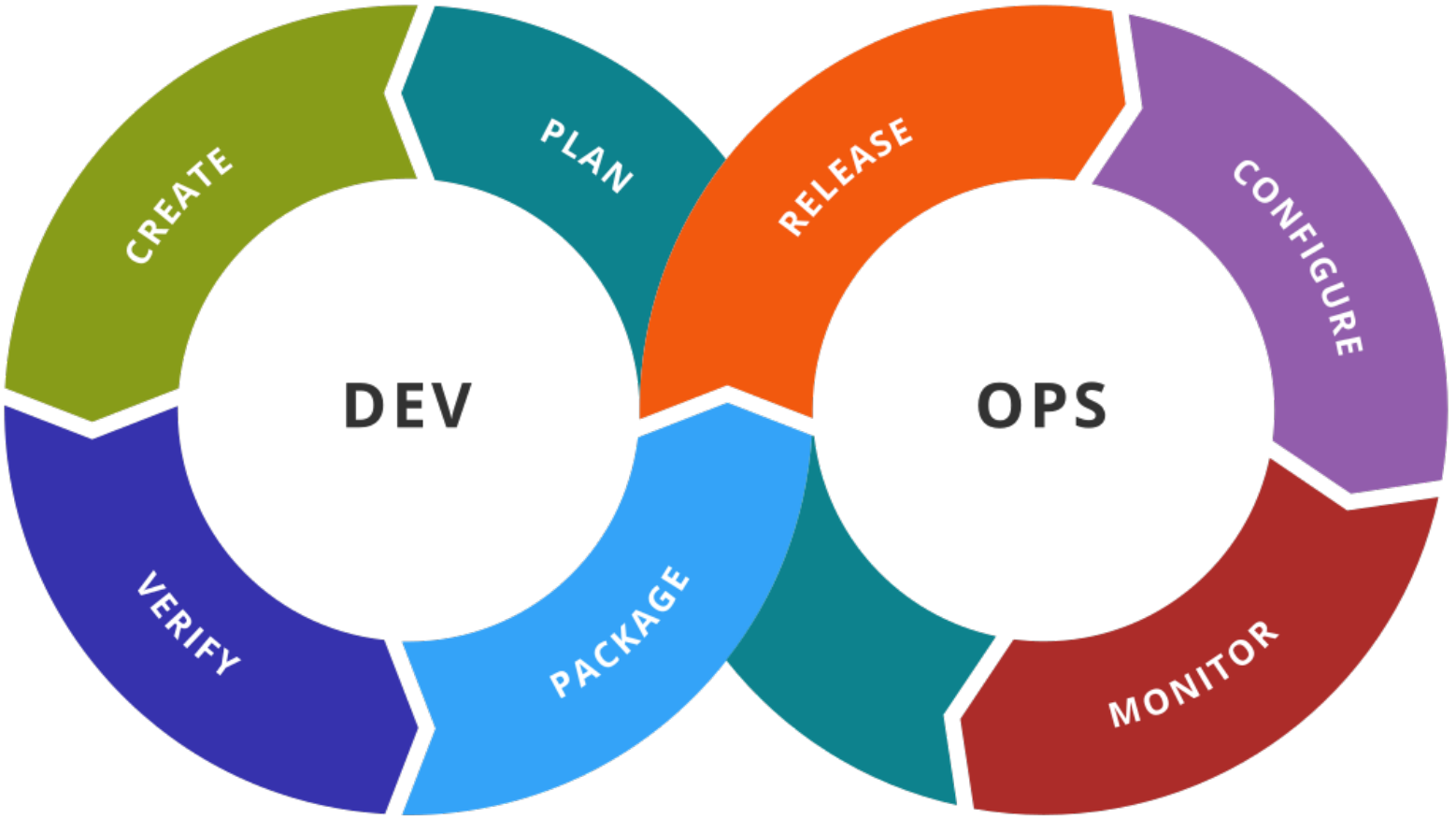
Compare to the Ubuntu release cycle



Compare to the Facebook release cycle

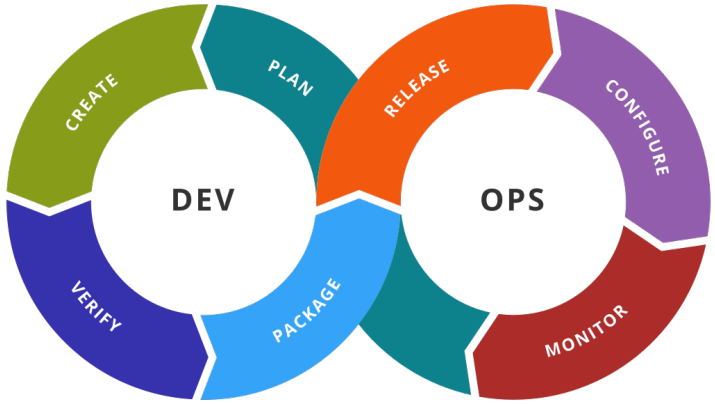


DevOps: Development / Operations

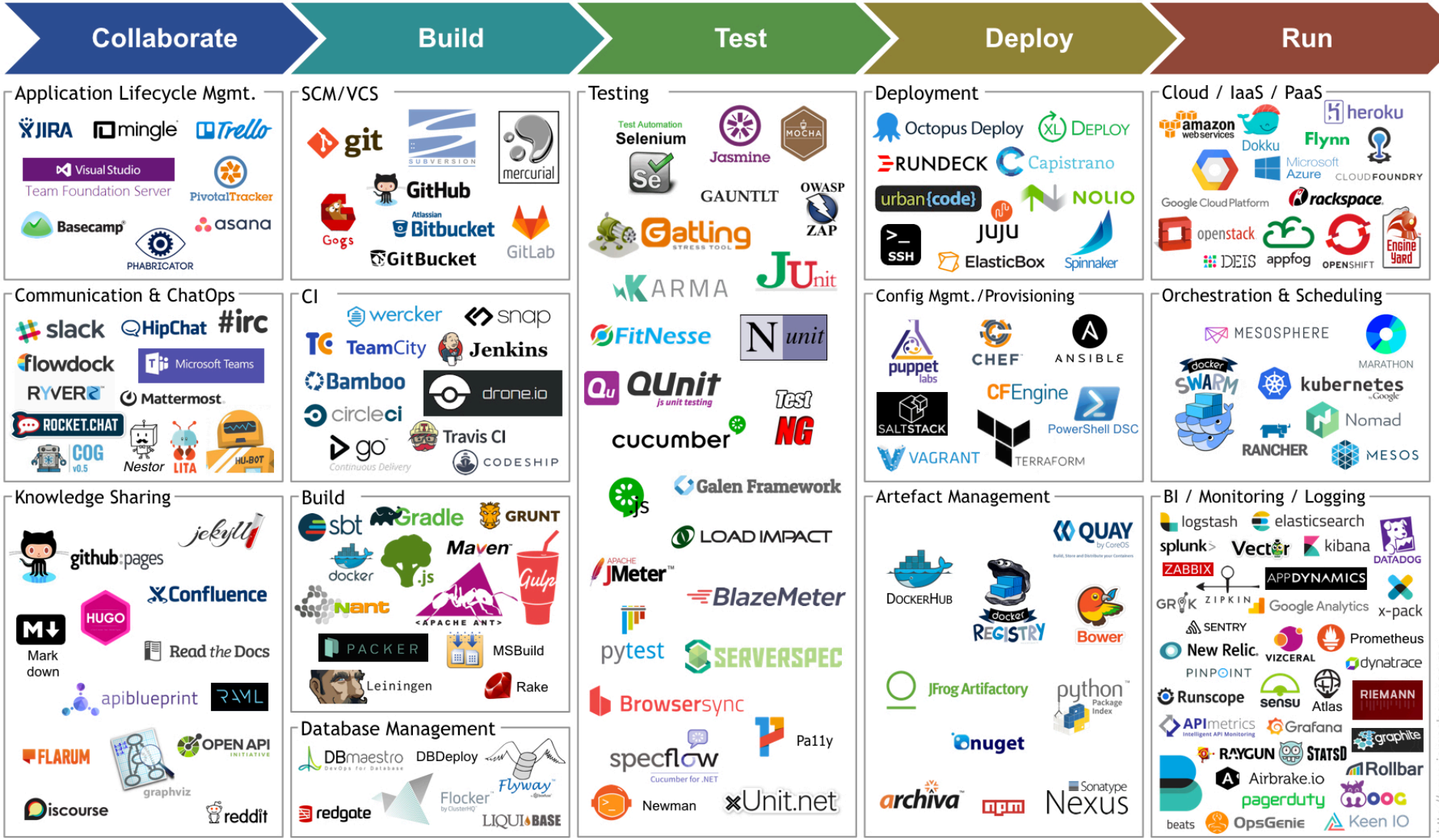


DevOps toolchain

- Code: code development and review, source code management tools
- Build: continuous integration tools, build status
- Test: continuous testing tools provide feedback
- Package: artifact repository, application pre-deployment staging



DevOps ecosystems…



Consider: Continuous integration (CI)

- Advantages and disadvantages of CI?

Real-world software development challenges

- Imagine: You discover a bug in version 8.2.4 of your software
  - You want to discover, fix, and deploy updates to old versions
  - You want to fix the bug for new versions in ongoing development

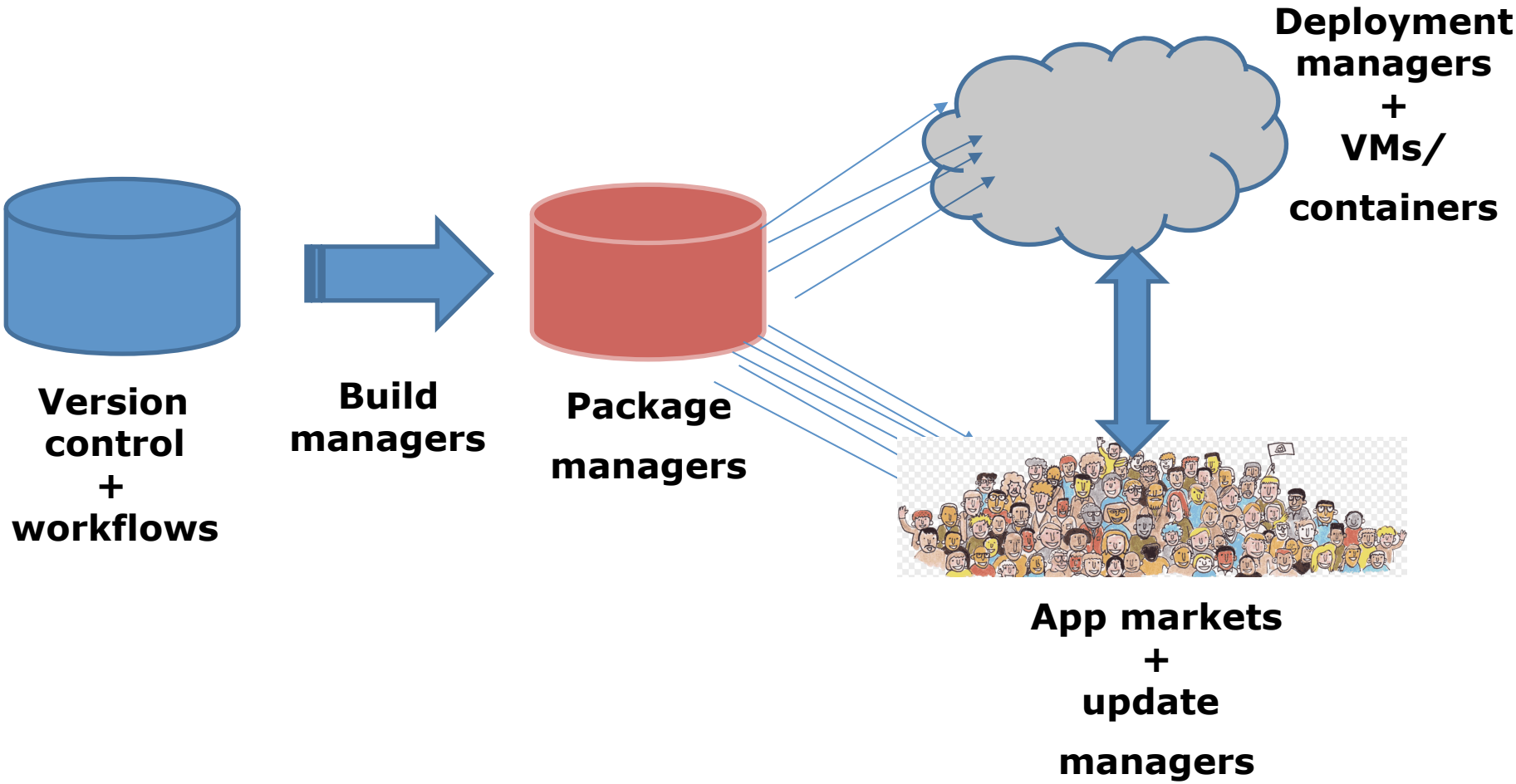
Configuration management (CM)

- Definition (Pressman): *Configuration management "is a set of tracking and control activities that are initiated when a software engineering projects begins and terminates when software is taken out of operation."*

Reasons for configuration management

- Software evolution
- Separate development
- Audits (legal, regulatory)
- Product lines
- Market variation (e.g., U.S., Europe, Asia)
- Platform variation (e.g., Android, iOS)

Configuration management in the modern world

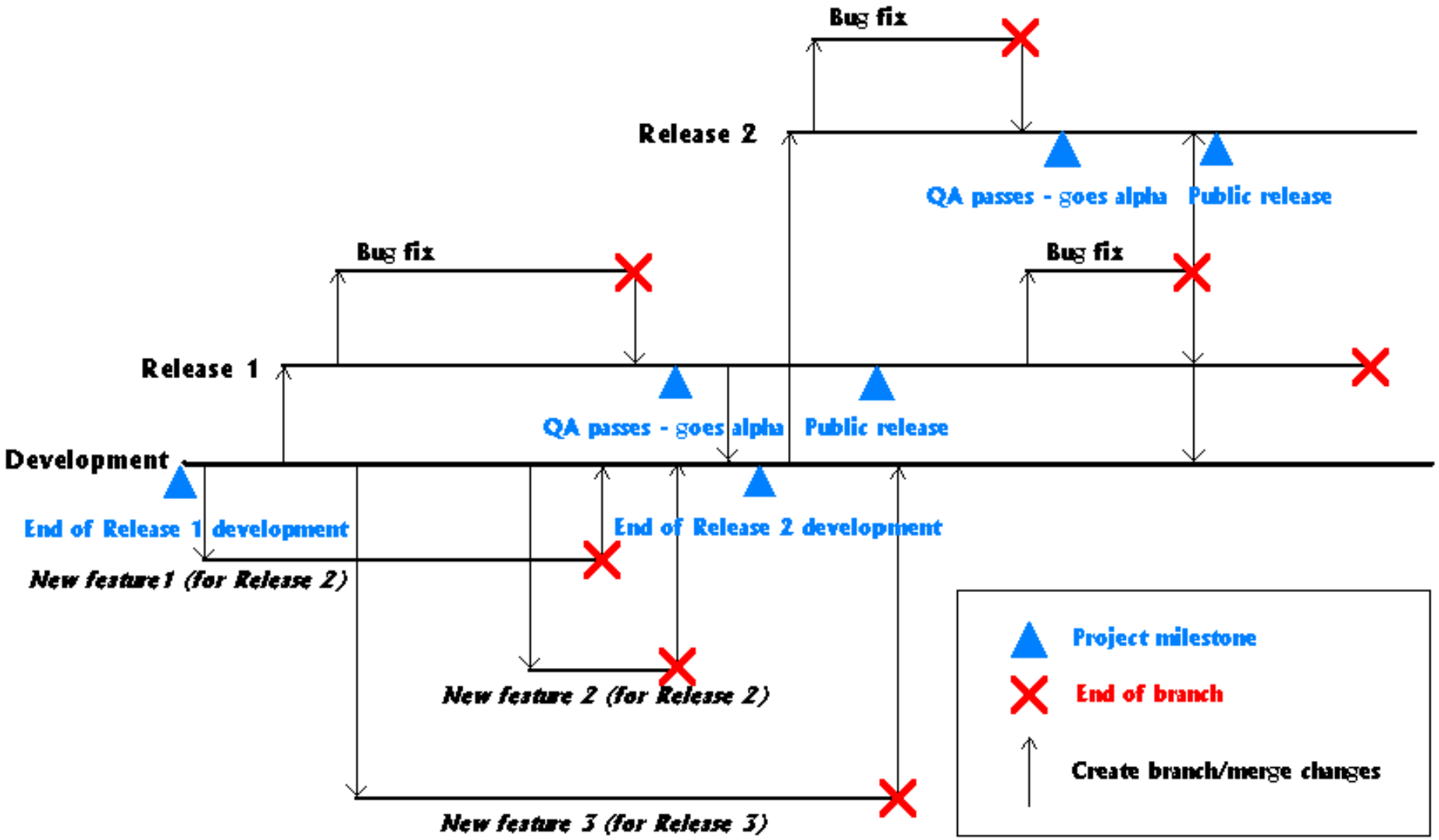


Aside: Semantic versioning for releases

- Given a version number MAJOR.MINOR.PATCH, increment the:
  - MAJOR version when you make incompatible API changes,
  - MINOR version when you add functionality in a backwards-compatible manner, and
  - PATCH version when you make backwards-compatible bug fixes.
- Additional labels for pre-release and build metadata are available as extensions to the MAJOR.MINOR.PATCH format.

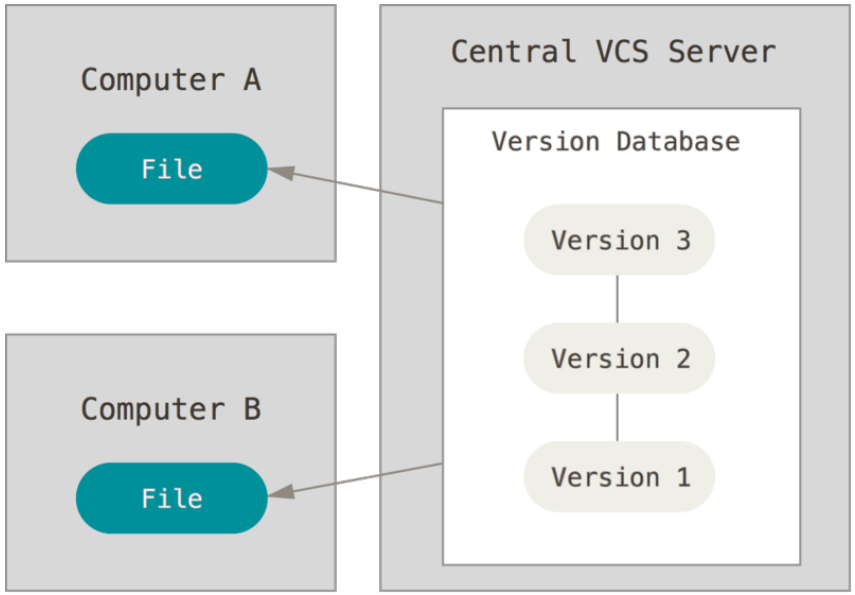
http://semver.org/

Branches within software repositories



Centralized version control

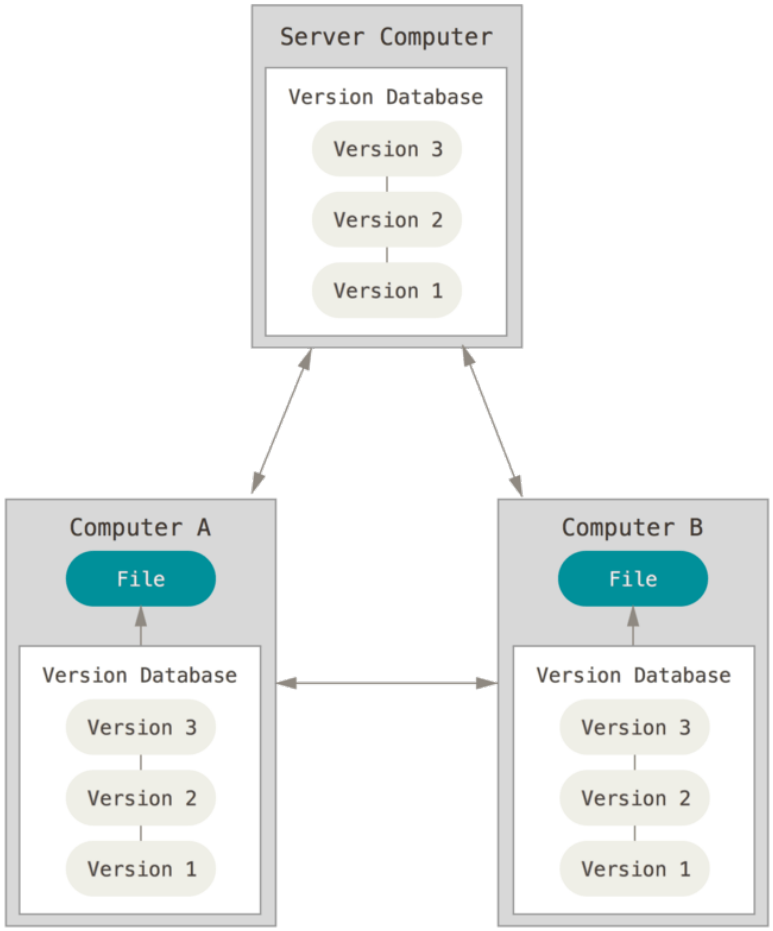
- Single server contains all the versioned files
- Clients check out/in files from that central place
- E.g., CVS, SVN (Subversion), and Perforce



https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

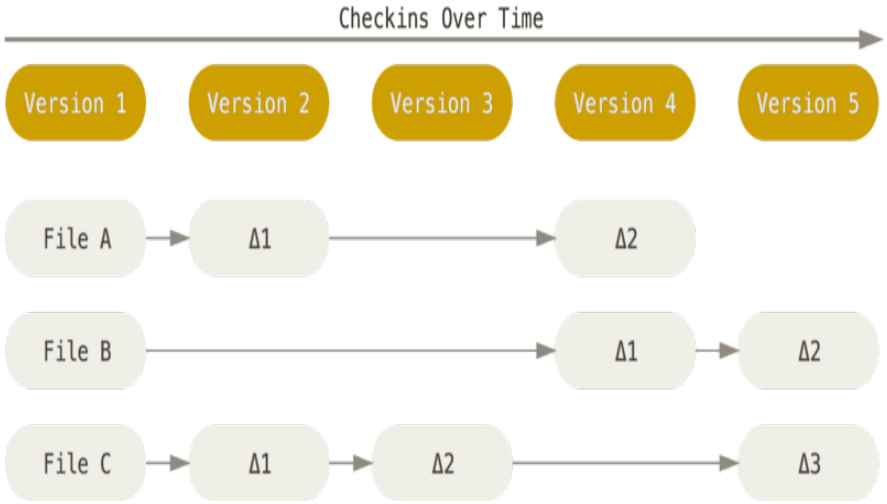
Distributed version control

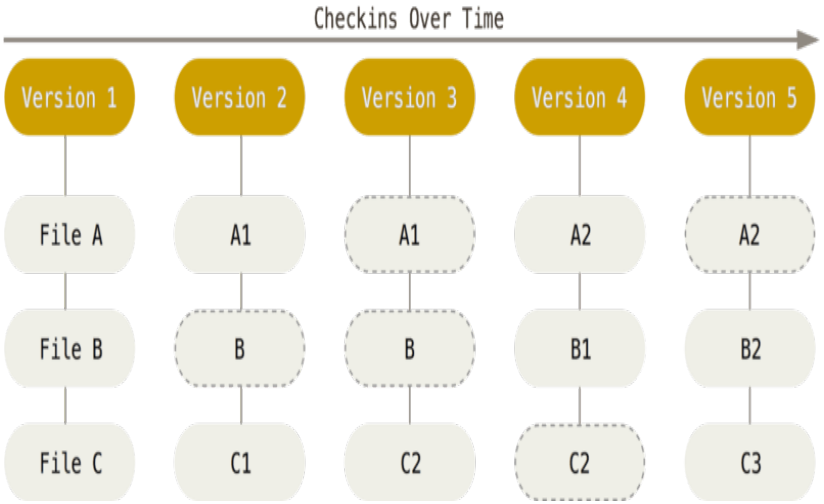
- Clients fully mirror the repository
  - Every clone is a full backup of all the data
- E.g., Git, Mercurial, Bazaar



https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

SVN (left) vs. Git (right)



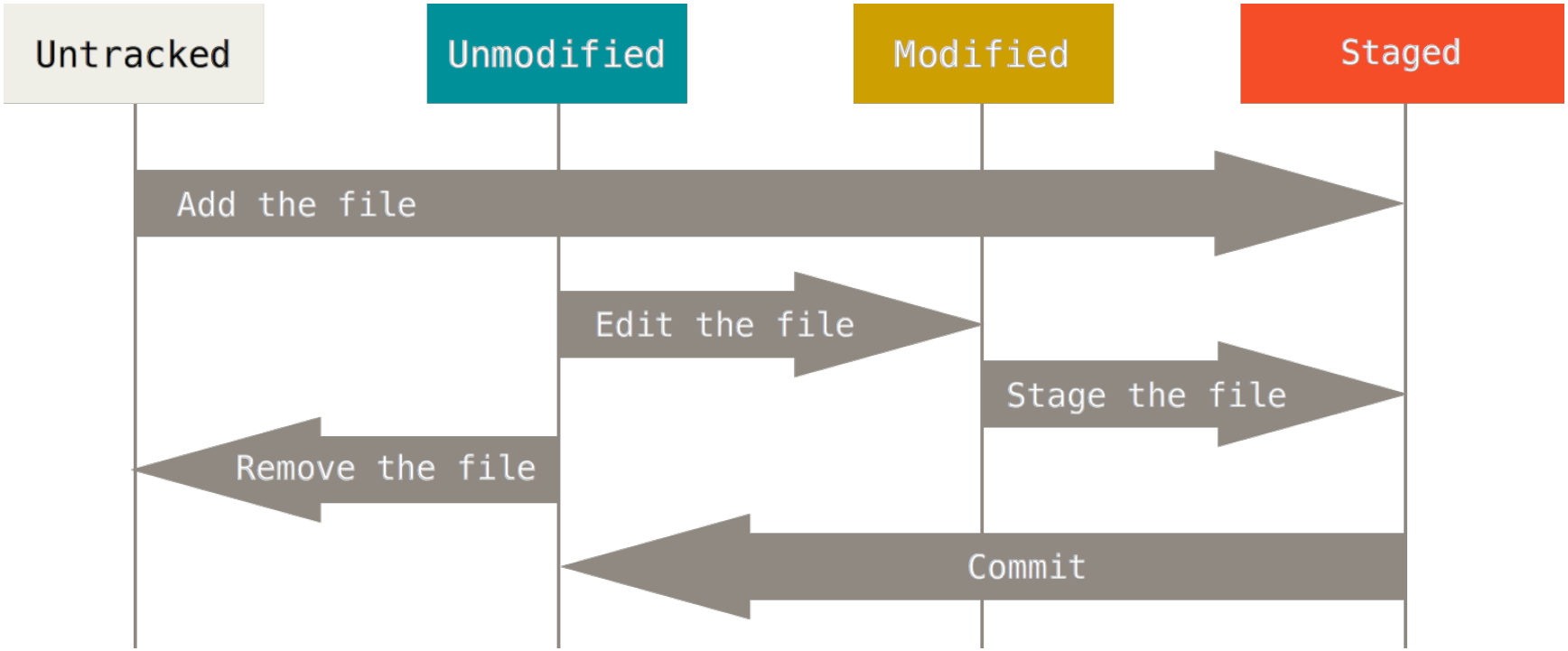


- SVN stores changes to a base version of each file
- Version numbers (1, 2, 3, …) are increased by one after each commit

- Git stores each version as a snapshot
- If files have not changed, only a link to the previous file is stored
- Each version is referred by the SHA-1 hash of the contents

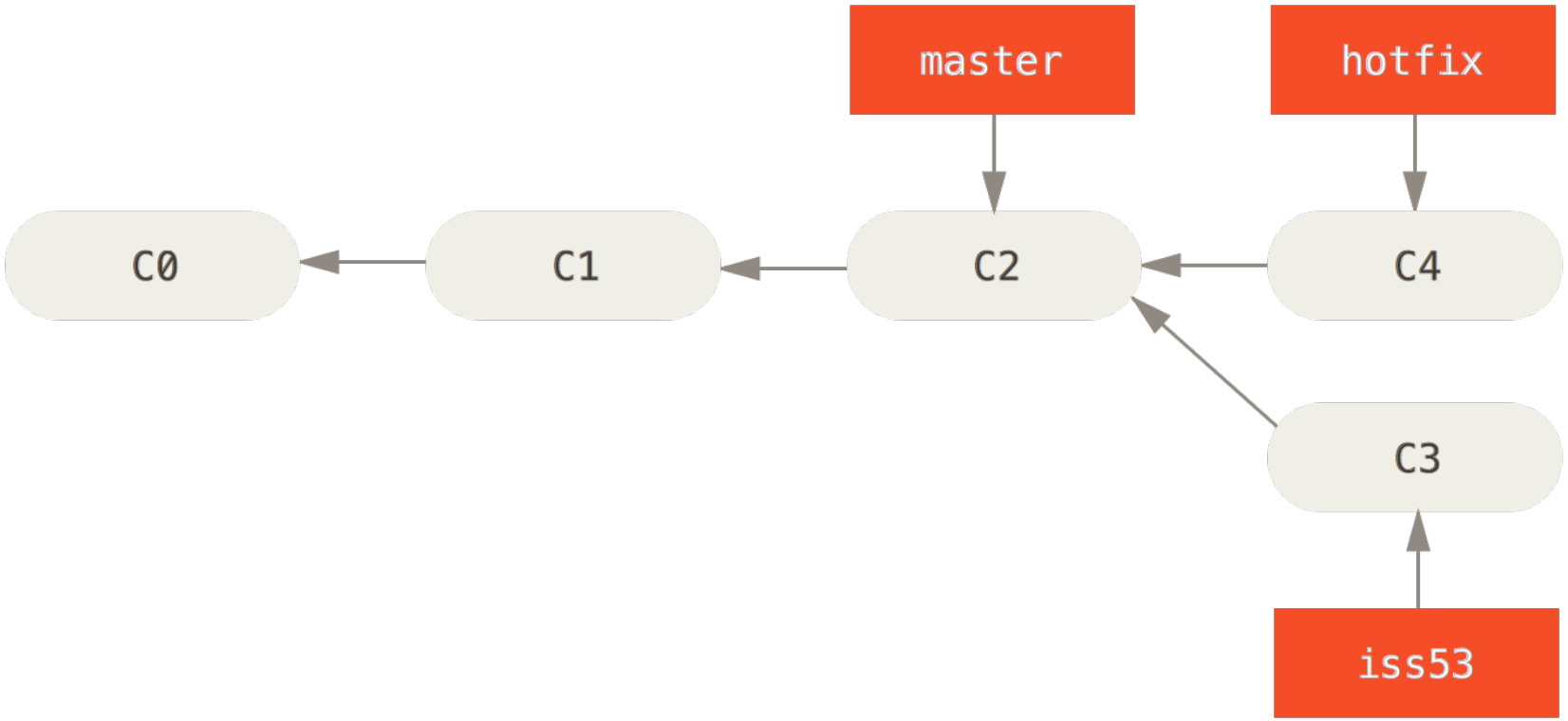
https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

Aside: Git file status



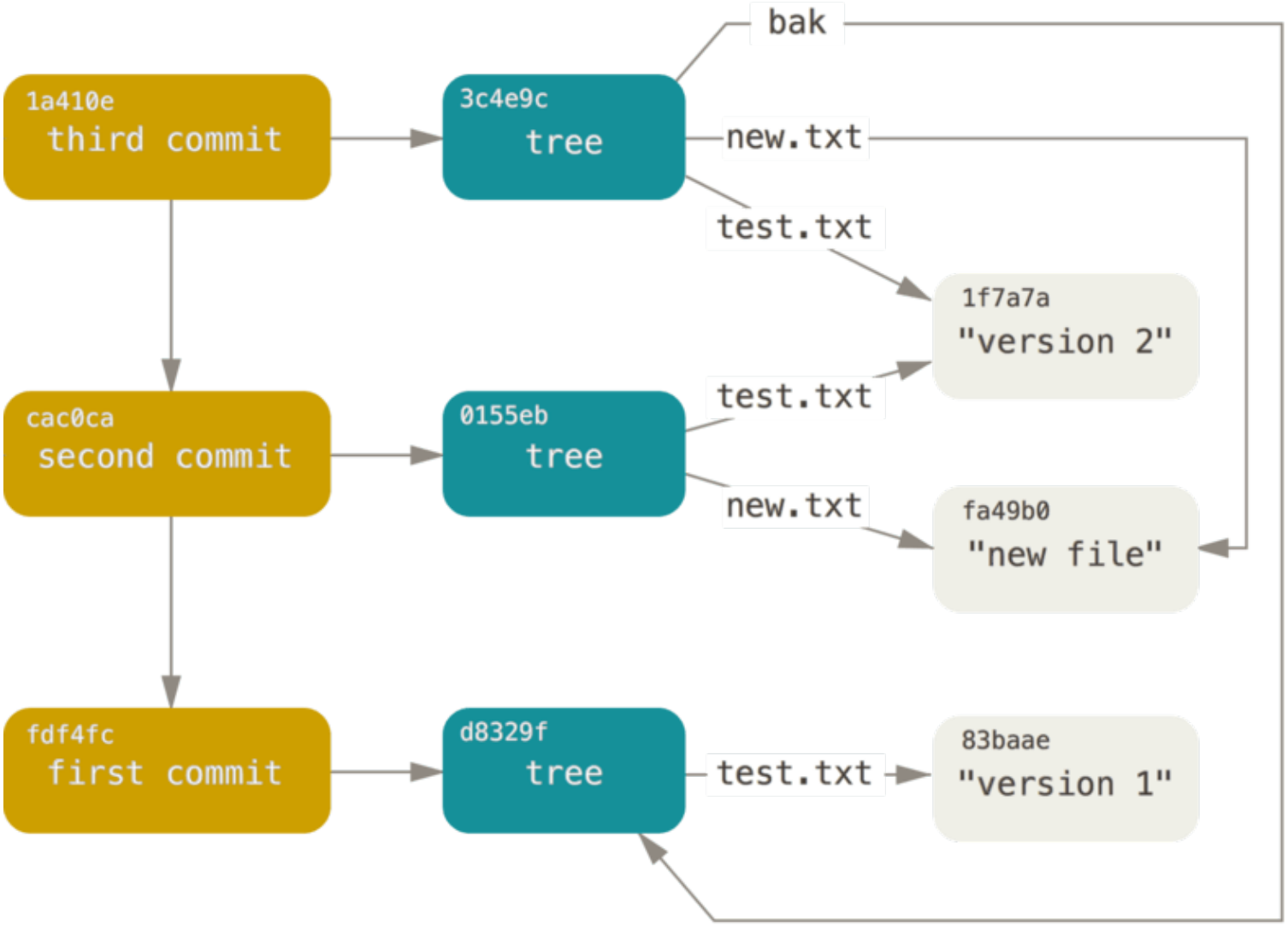
© Scott Chacon "Pro Git"

Aside: Git internals



© Scott Chacon “Pro Git”

Aside: Git object graph



© Scott Chacon "Pro Git"

Aside: Which files to manage?

- All code and noncode files
  - Java code
  - Build scripts
  - Documentation
- Exclude: generated files (.class, …)
  - Most version control systems have a mechanism to exclude files (e.g., .gitignore)

Next time…

- Practical Git