COMP110: Principles of Computing

Advanced GitHub Usage

Learning outcomes

By the end of this session, you will...

- Appreciate the usefulness and importance of **version control** in collaborative software projects
- Understand how to resolve **merge conflicts**, and how to minimise their occurrence
- Know about **branching**, and how it can fit into your team's workflow

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Version control: the basics

What is version control?

- A system for managing **changes** to source code
- Tracks the **history** of changes
- Allows changes from multiple developers to be **merged**
- Allows for multiple **forks** and **branches** of the same code

Why use version control?

Here's what **life without version control** looks like:

- You need to make **manual backups** of your code
- It's hard (or impossible) to **undo** a change
- Maintaining **multiple copies** of the codebase (e.g. production, development, testing) is a hassle
- Work from **multiple developers** needs to be manually copied and pasted together
- Code needs to be **transferred** around by dropbox / email / flash drive

Version control (used properly!) **takes care of all of the above**

What is Git?

https://xkcd.com/1597/

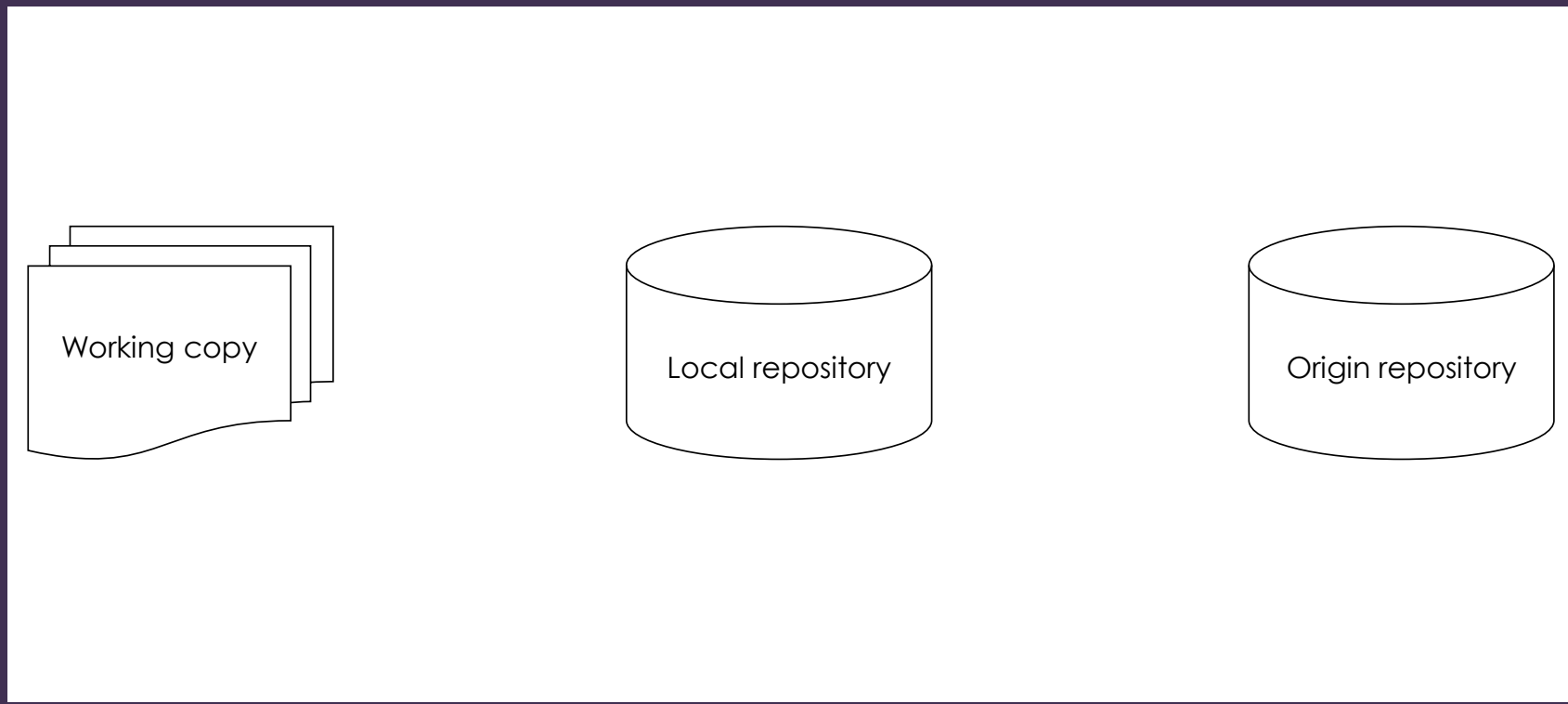
What is Git?

- **Git** is an open-source **distributed version control system**
- Originally developed by Linus Torvalds and other Linux kernel developers
- **GitHub** is a site that provides free Git hosting

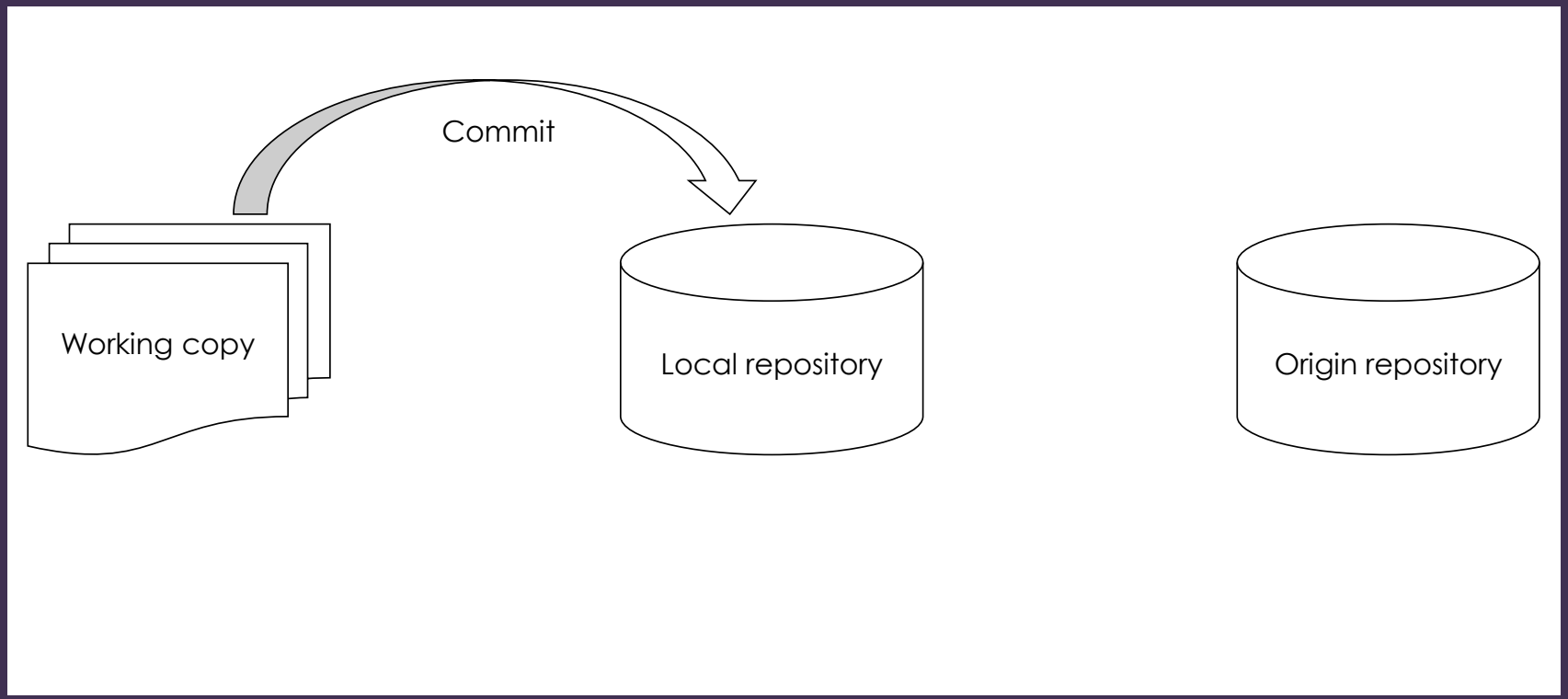
Basic Git workflow

- **Origin repository**: the repository on GitHub's servers
- **Local repository**: a copy of the repository on your local machine (usually stored in a folder named `.git`)
- **Working copy**: the source files you are editing

Basic Git workflow

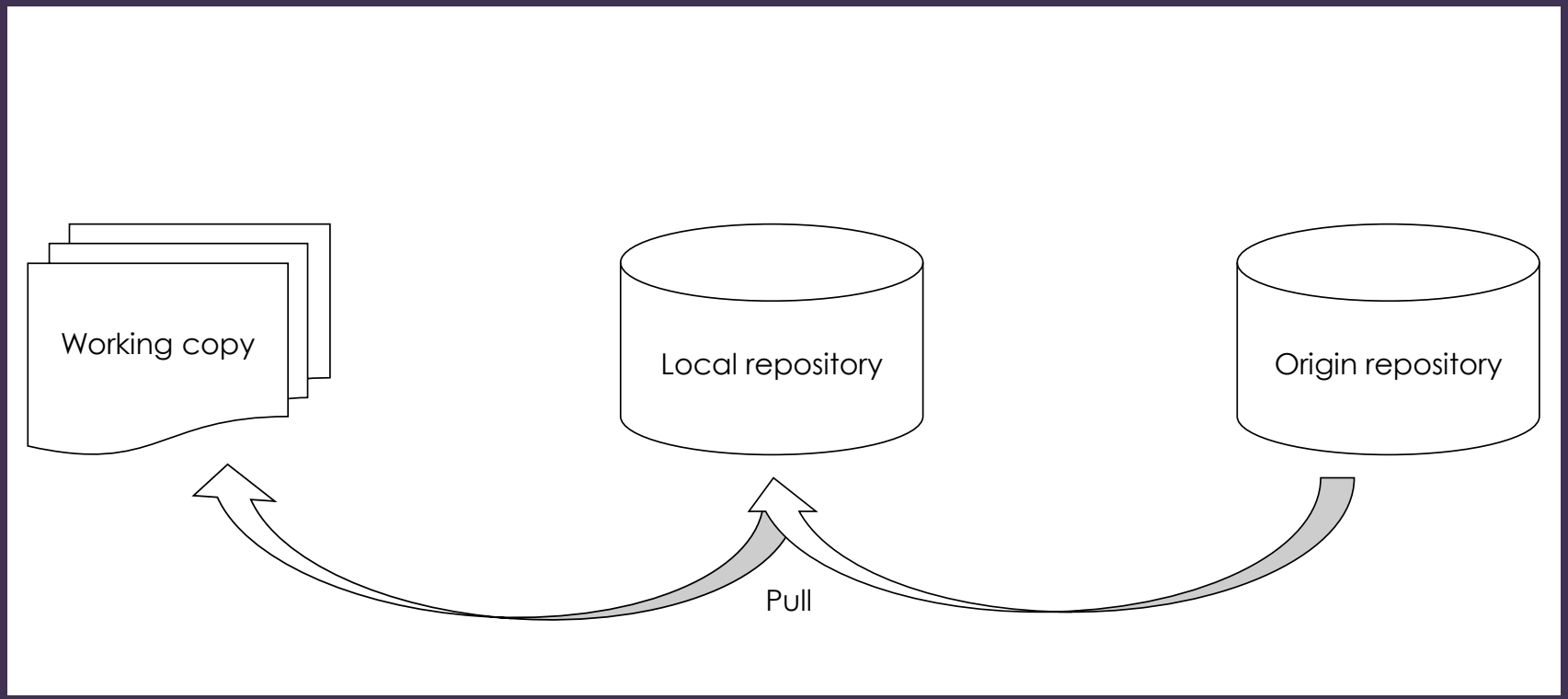


Basic Git workflow



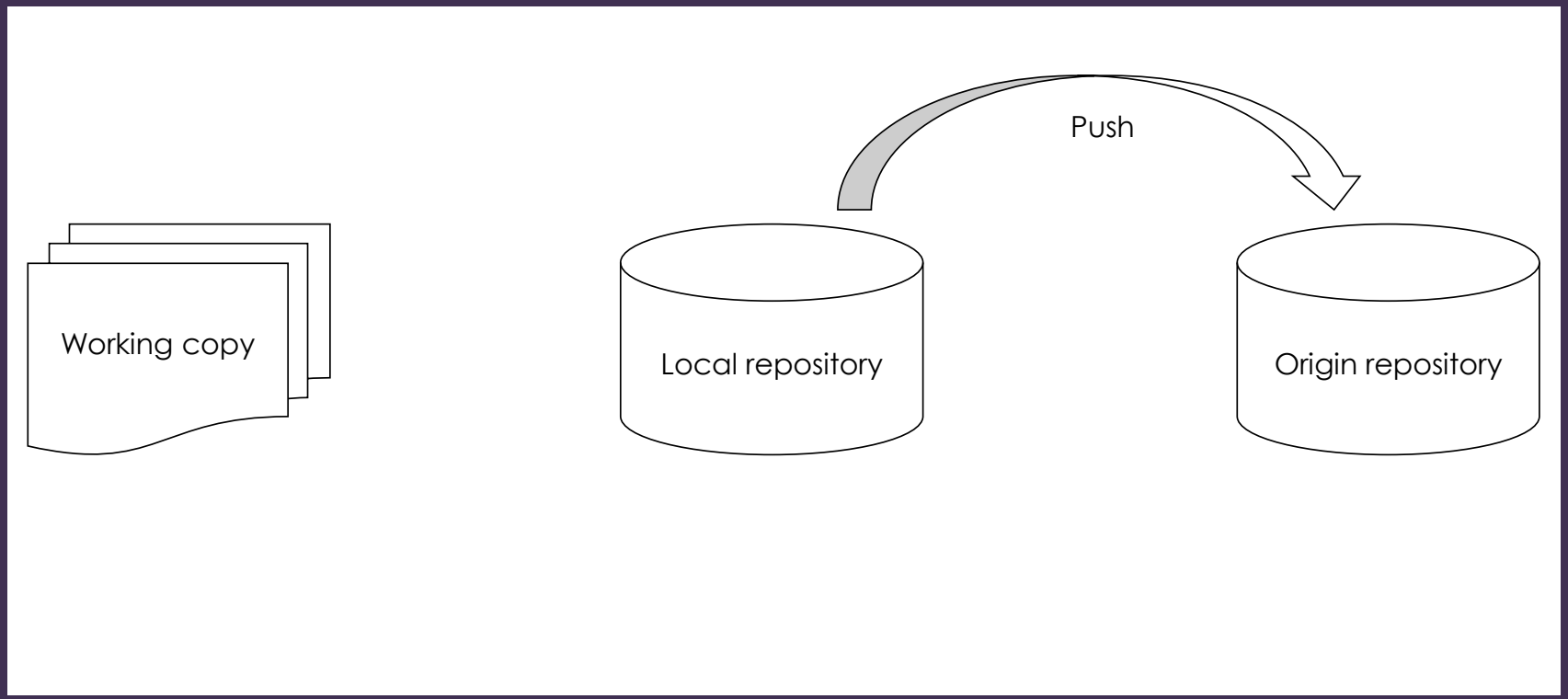
Commit adds your recent changes to your local repository

Basic Git workflow



Pull fetches any changes from the GitHub server

Basic Git workflow



Push sends your committed changes to the GitHub server

Basic Git workflow: recap

- **Commit** when you have changed something
- **Pull** to fetch the latest changes from the server
- **Push** to upload your changes to the server
- Generally want to stick to doing things in this order, in particular:
  - Always **pull** before you **push**
  - Always **commit** before you **pull**
- Some clients (e.g. GitHub for Windows) combine pull and push into a single **sync** command

When to commit

- **Commit early and commit often**
- If you implement something, test it and it works, commit it!
- **Rule of thumb**: if it takes more than one sentence to describe what you have changed, you should have committed earlier!

Commits are changes

56 assignment_briefs/comp140_1/comp140_1.tex

```
@@ -55,18 +55,29 @@ \subsection*{A. \emph{Design} a novel game controller device}
55 55  \textbf{Formative submission:} Arrange a meeting with your tutor to discuss your task board.
56 56
57 57  \textbf{Summative submission:} Take screenshots of your Trello task board,
58    -    and include them in your summative submission on LearningSpace.
   58 +    and add them to your GitHub repository (see below) for inclusion in your summative submission on LearningSpace.
59 59
60 60  \subsection*{B. \emph{Build} a prototype of your game controller}
61 61
```

- A commit is a set of **changes** to files
- A commit **is not** a snapshot of the code (although it can be used to make one)

Collaborative development

- Alice changes something in `game.cpp`, commits it and pushes it
- **Meanwhile**, Bob changes something in `game.cpp` and commits it
- Bob pulls Alice's changes. What happens?

Merging changes

- If Alice **hasn't** edited any of the **same lines of code** as Bob, Git will **merge** the changes automatically
  - NB: Git is clever about figuring out **where** a change should be applied — e.g. it **doesn't** just use line numbers, so inserting code earlier in the file shouldn't mess it up
  - Bob will see **both** his and Alice's changes, and so will Alice next time she pulls
- If they **have** edited the same lines, Git won't be able to merge them automatically — this is a **conflict!**

Resolving conflicts

- If there is a conflict, the offending file will look like this:

```
int main(int argc, char* argv[])
{
    std::cout << "Hello world!" << std::endl;
<<<<<<< HEAD
    std::cout << "My name is Bob!" << std::endl;
=======
    std::cout << "My name is Alice!" << std::endl;
>>>>>>> origin/master
    return 0;
}
```

- You are given **both versions** of the code — you need to **manually edit** the code to make sense again

Resolving conflicts

```
int main(int argc, char* argv[])
{
    std::cout << "Hello world!" << std::endl;
    std::cout << "Our names are Alice and Bob!" << std ↩
        ::endl;
    return 0;
}
```

- After editing **and testing**, commit and push as normal

Prevention is better than the cure

- In a properly managed project, conflicts should be a **rarity**
- **Coordinate** your efforts so that developers are not working on the same lines of code at the same time
- Use a sensible **branching** strategy (see later) to manage and plan the times when code is to be merged

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Branching

Forking vs branching

- Both represent a set of changes based on, but separate from, the repository's "main" set of commits
- A **fork** is a completely separate repository
- A **branch** exists within the same repository
- Which to use?
  - We recommend you use branches — they are easier to work with, and keep everything within the same repository
  - In industry, many (larger) teams use forks, many do not

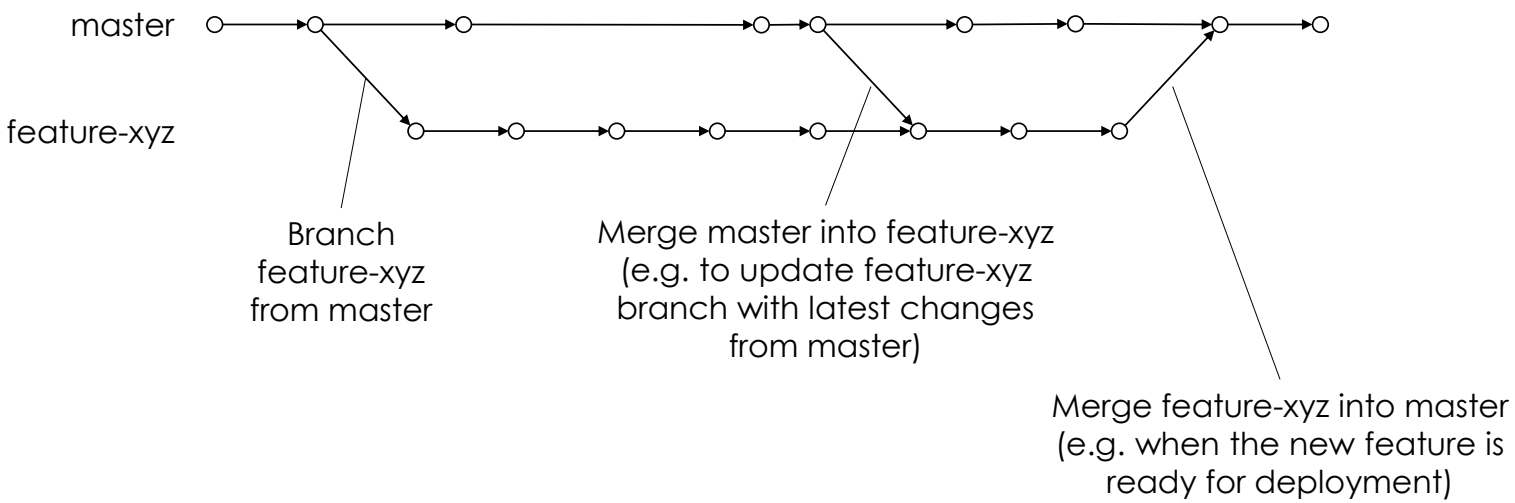
Branching

- Every repository has one branch called `master`
- New branches can be created at any time
- Branches can be **merged**
  - "Merge A into B": take the commits (remember: changes) from branch A, and apply them to branch B

The golden rule

- The `master` branch should always be **deployable**
  - No half-finished features
  - No obvious bugs
  - **Definitely** no compile errors
  - If a VIP walked into the room and asked for a demo, `master` is what you'd show them

Branching

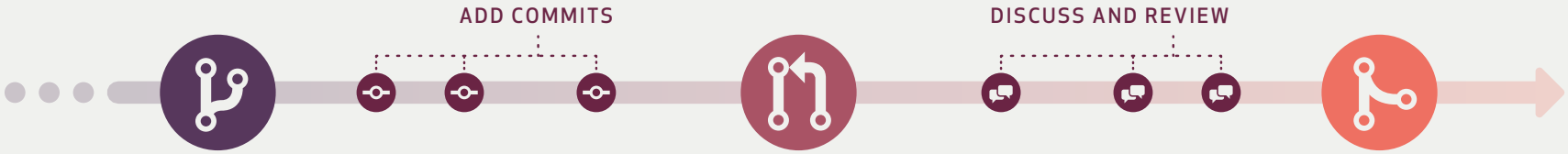

master
feature-xyz
Branch feature-xyz from master
Merge master into feature-xyz (e.g. to update feature-xyz branch with latest changes from master)
Merge feature-xyz into master (e.g. when the new feature is ready for deployment)

GitHub flow

https://guides.github.com/introduction/flow/

WORK FAST
WORK SMART
THE GITHUB FLOW

The GitHub Flow is a lightweight, branch-based workflow that's great for teams and projects with regular deployments. Find this and other guides at **http://guides.github.com/**.



CREATE A BRANCH

Create a branch in your project where you can safely experiment and make changes.

OPEN A PULL REQUEST

Use a pull request to get feedback on your changes from people down the hall or ten time zones away.

MERGE AND DEPLOY

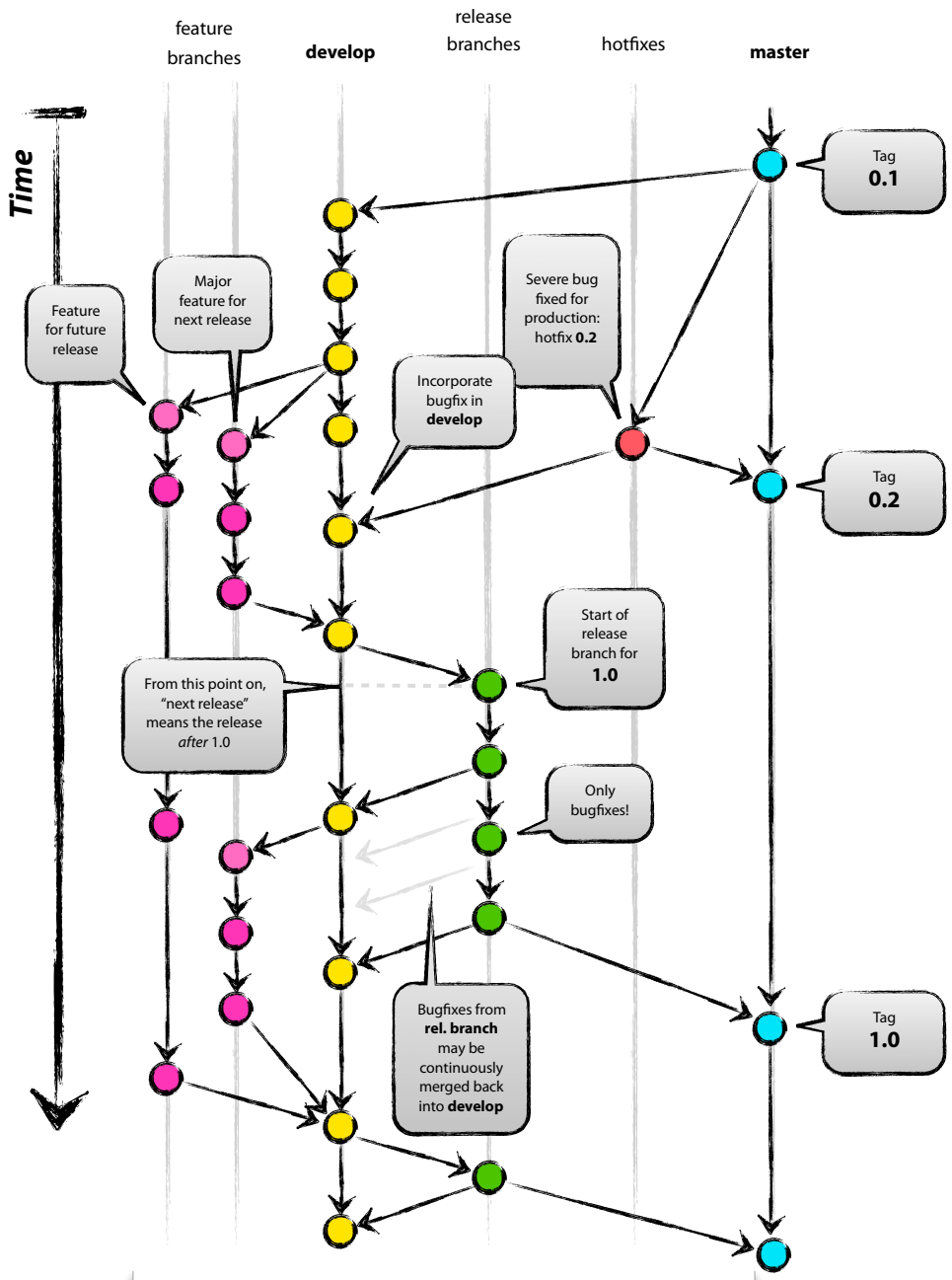
Merge your changes into your master branch and deploy your code.

GitHub is the best way to build software together.

GitHub provides tools for easier collaboration and code sharing from any device. Start collaborating with millions of developers today!

Git flow

http://nvie.com/posts/
a-successful-git-branching-model/



Author: Vincent Driessen
Original blog post: http://nvie.com/posts/a-succesful-git-branching-model
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Discussion

What are the pros and cons of **Git flow** vs **GitHub flow**?

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Activity: branching and merging