SIAM: Getting Started with Git

based on http://git-scm.com/book and slides by Bart Trojanowski

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Overview

Git

Git is a

- Free and Open Source
- Distributed
- Version Control System.

Version Control System

Preserve a clear, timely record of software evolution

- Record changes to files
- History can be recalled/inspected

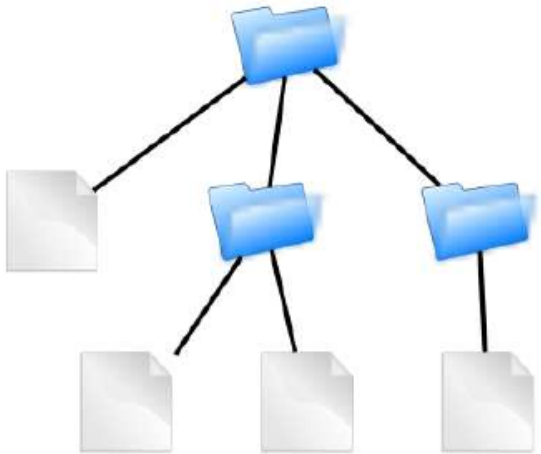
Implications:

- Rollback changes
- Know what collaborators are working on
- Investigate changes when bugs emerge
- Find how and where a particular bug was fixed

Components

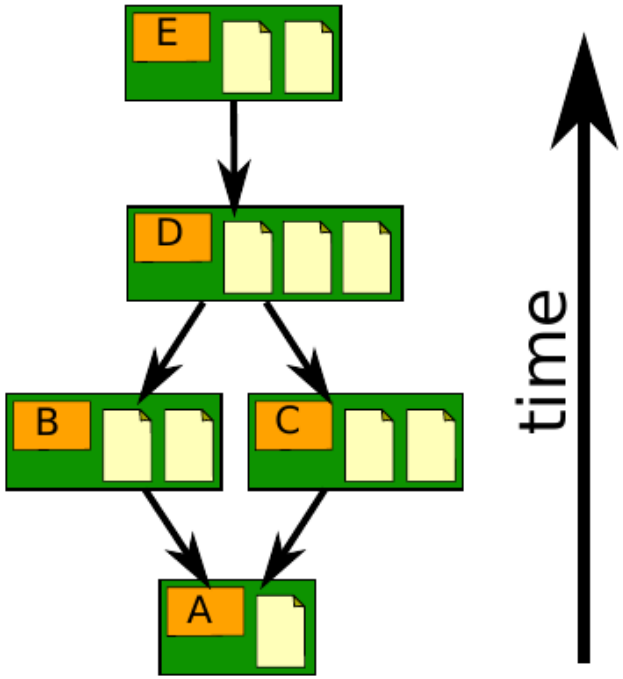
VCS Components (Working Tree)

- Single checkout of one version of the project
- Directories
- Files



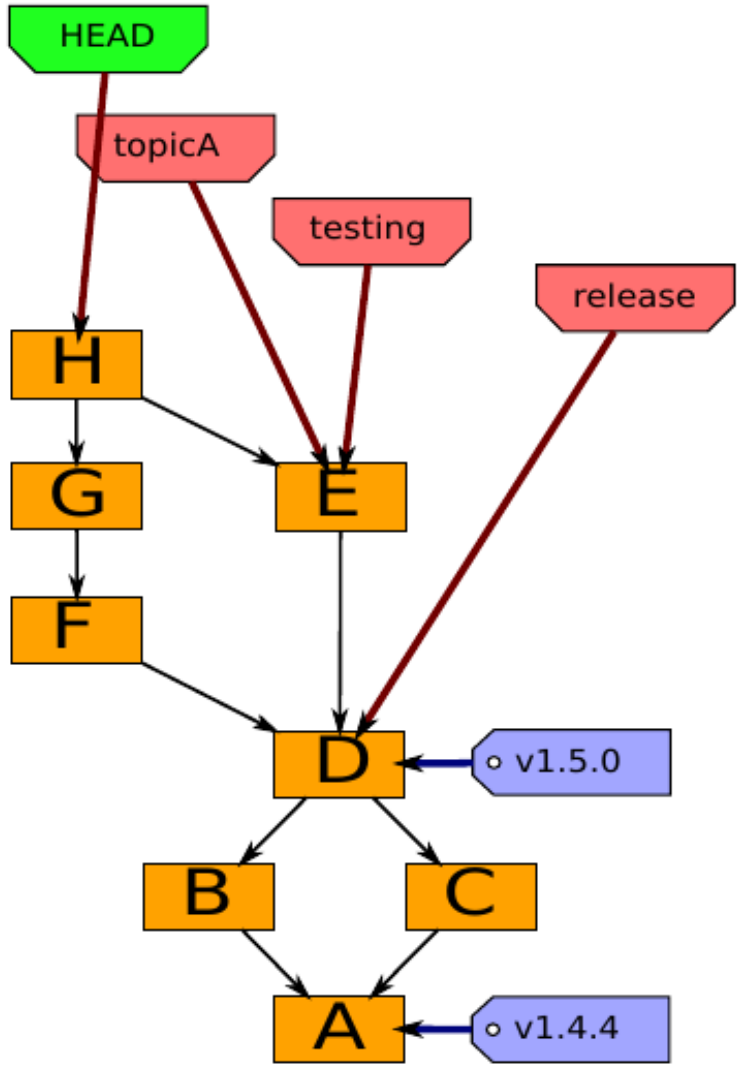
VCS Components (Repository)

- Files
- Commits
- Ancestry



VCS Components (References)

- Tags
- Branches
- `HEAD`
- Index (Staging area)



Operations

VCS Operations

Bootstrap

- `init`
- `clone`
- `checkout`

Modify

- add, delete (`rm`)
- rename (`mv`)
- `commit`

Information

- `status`
- `diff`
- `log`

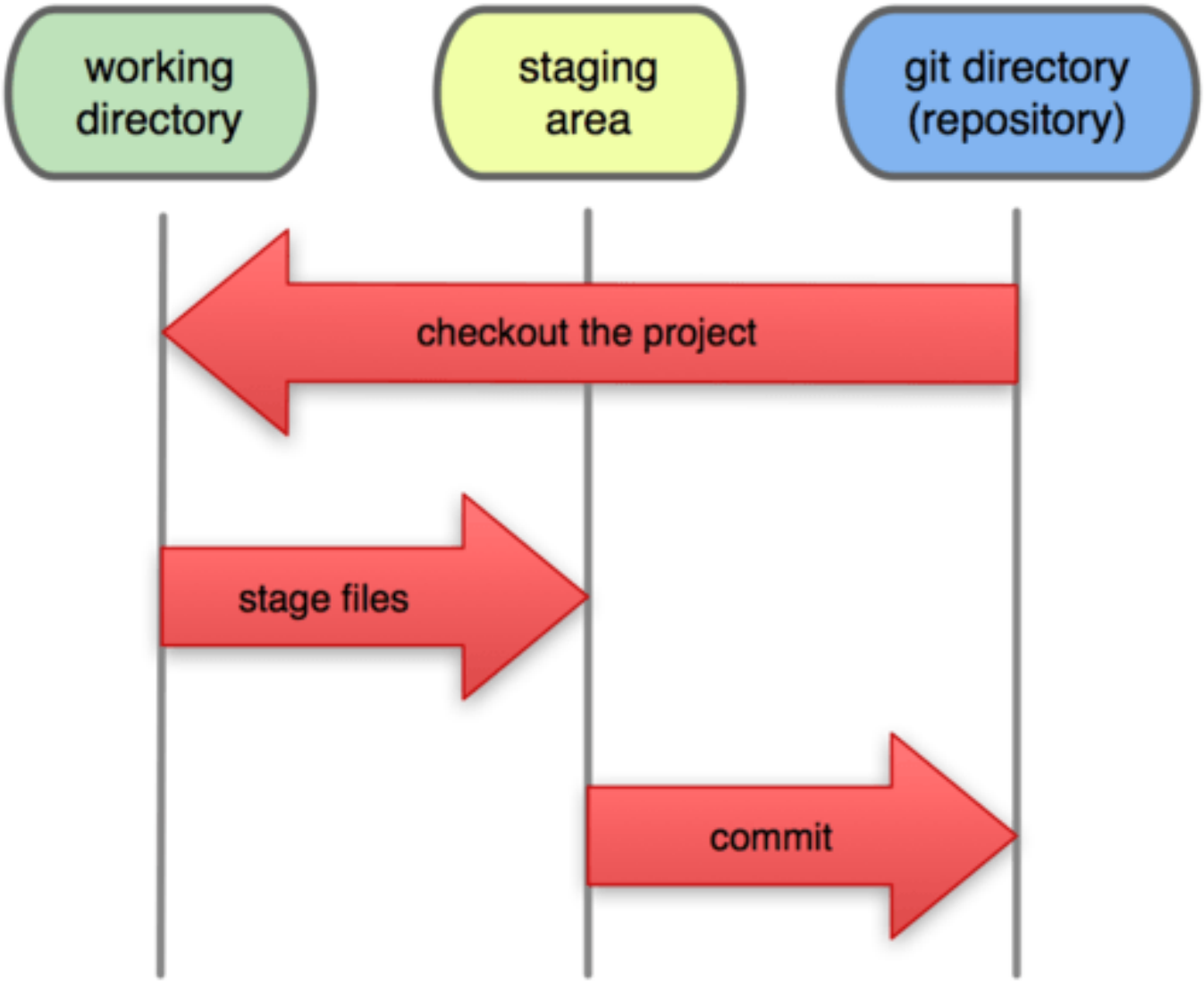
Reference

- `tag`
- `branch`

Sharing work, backing it up

- `pull`, `fetch`
- `push`

Local Operations



Bootstrapping

`$ git init`

- creates .git directory and initializes the repository

`$ git clone <URL>`

- replicates a remote repository
- checks out new working tree
- Git URLs
  - /home/user/my-project.git
  - http://github.com/user/my-project.git
  - git://remote.server/my-project.git
  - user@remote.server:my-project.git
  - ssh://user@remote.server/ user/my-project.git

Staging

`$ git add <path>`

- Adds contents of `<path>` to index
- `$ git add .`

`$ git rm <file>`

- Removes files from working tree and index

`$ git mv <source> <destination>`

- Moves or renames a file or directory

`.gitignore`

- Text file that specifies files to ignore

Example .gitignore file

```
*.aux
*.fdb_latexmk
*.fls
*.nav
*.out
*.snm
*.toc
*.vrb
*~
```

Changing Settings

`$ git config --list`

- Lists the current configuration settings

`$ git config <key>`

- Gets the current value of `key`

`$ git config [level] <key> <value>`

- Changes setting `key` to `value`
- Optional `level` determines scope of setting
  - Omitting `level`: repository
  - `--global`: user
  - `--system`: system

Common Configuration Settings

A few settings you will want to update when first using Git:

```
$ git config --global user.name "John Doe"
$ git config --global user.email johndoe@example.com
$ git config --global core.editor emacs
$ git config --global core.excludesfile ~/.gitignore
$ git config --global merge.tool meld
```

Committing

```
$ git commit -m <msg>
```

- Creates a commit of staged items
- `$ git commit -m "fixes issue #108"`

Inspection

`$ git status`

- Displays the working tree status
- staged, unstaged, untracked

`$ git diff`

- Displays changes between index and working tree

`$ git diff --staged`

- Displays changes between HEAD and index

`$ git diff HEAD`

- Displays changes between HEAD and working tree

`$ git diff <commit> <commit>`

- Displays changes between two commits

Demonstration of Staging

```
$ echo "foo" >> myfile
$ git diff myfile
diff --git a/myfile b/myfile
index e69de29..257cc56 100644
--- a/myfile
+++ b/myfile
@@ -0,0 +1 @@
+foo
```

Referencing Objects

- `a88dbbe57b9e9fc01f701c45c405647c588e6a6a`
- `a88d`
- `v1.0.3`
- `master`
- `origin/master`
- `HEAD`
- `HEAD^ == HEAD~1`
- `feature_brach@{May.30}`

Show and Log

`$ git show <object>`

- Show various types of objects
- `$ git show HEAD@{yesterday}`
- `$ git show HEAD:file`

`$ git log [<since>..<until>] [-- <path>]`

- Show commit logs
- `$ git log HEAD~3..HEAD^`
- `$ git log -- file-with-bug.c`

Branching

`$ git branch -l`

- List local branches

`$ git branch <branchname>`

- Create new branch on HEAD

`$ git branch <branchname> <start-commit>`

- Create new branch on specified commit

`$ git checkout <branch>`

- Checkout branch by name

`$ git checkout -b <branchname> [<start-commit>]`

- Create and switch to a new branch

Merging

`$ git merge <branch>`

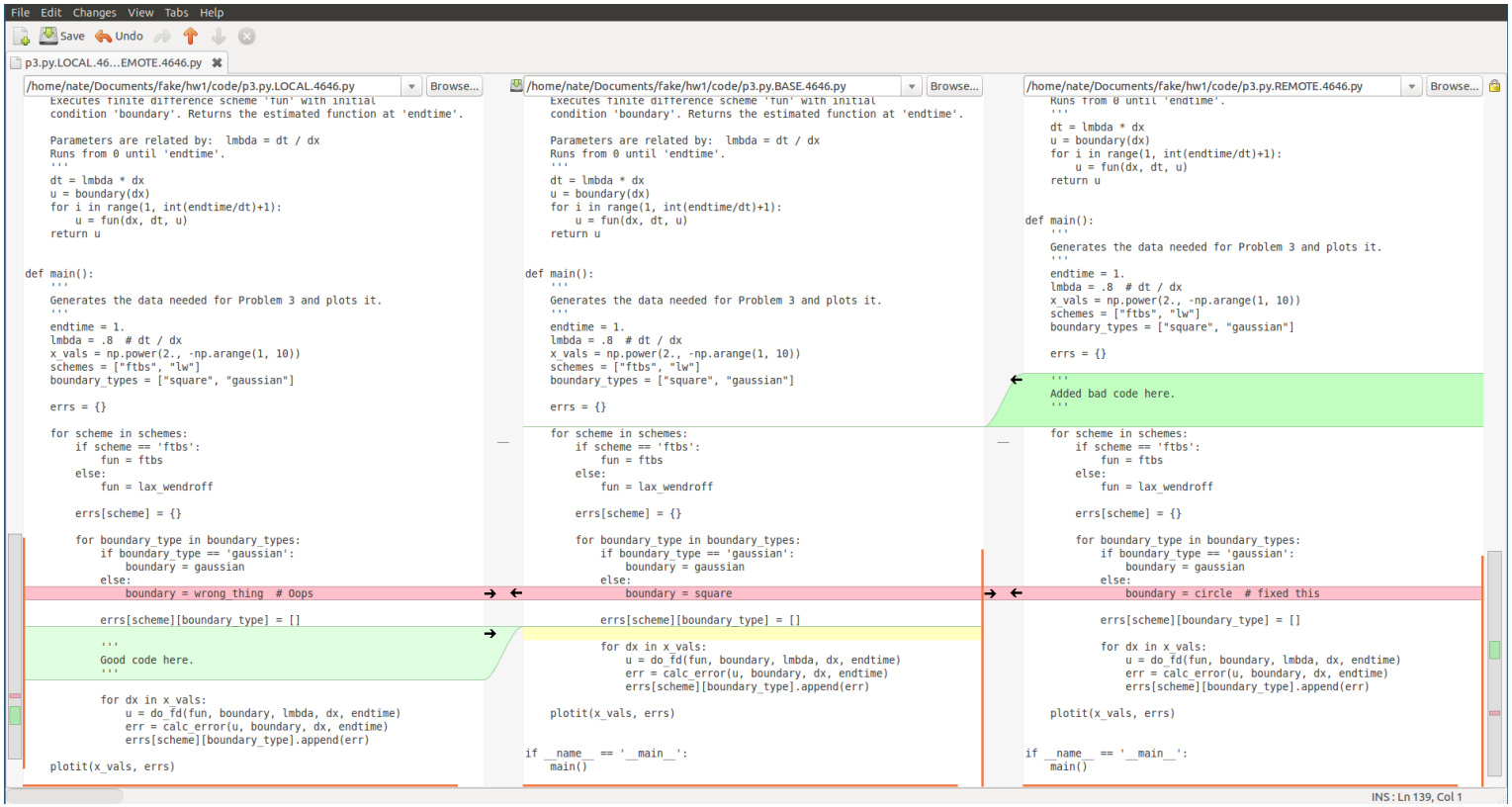
- Incorporates changes from the specified branch into the current branch.
- Conflicts may result
- Any conflicts must be resolved before merge is completed

```
var = 3
<<<<<<< HEAD
x = 0.5 * var
=======
x = 1/2. * var
>>>>>>> origin/master
```

Mergetool

`$ git merge <branch>`

- Presents a visual interface to merging
- Example:
- `$ git mergetool --tool=meld`



Remotes

`$ git remote add <name> <url>`

- Adds a remote named `<name>` for the repository at `<url>`

`$ git fetch <remote>`

- Fetches updates from specified remote
- `$ git fetch --all`

`$ git branch -r`

- List remote branches
- Use `$ git merge` to merge these branches

`$ git pull [<remote>] [<branch>]`

- Short for a fetch followed by a merge

Challenge Problem

Shape module at
`https://github.com/dattashantih/git-example.git`

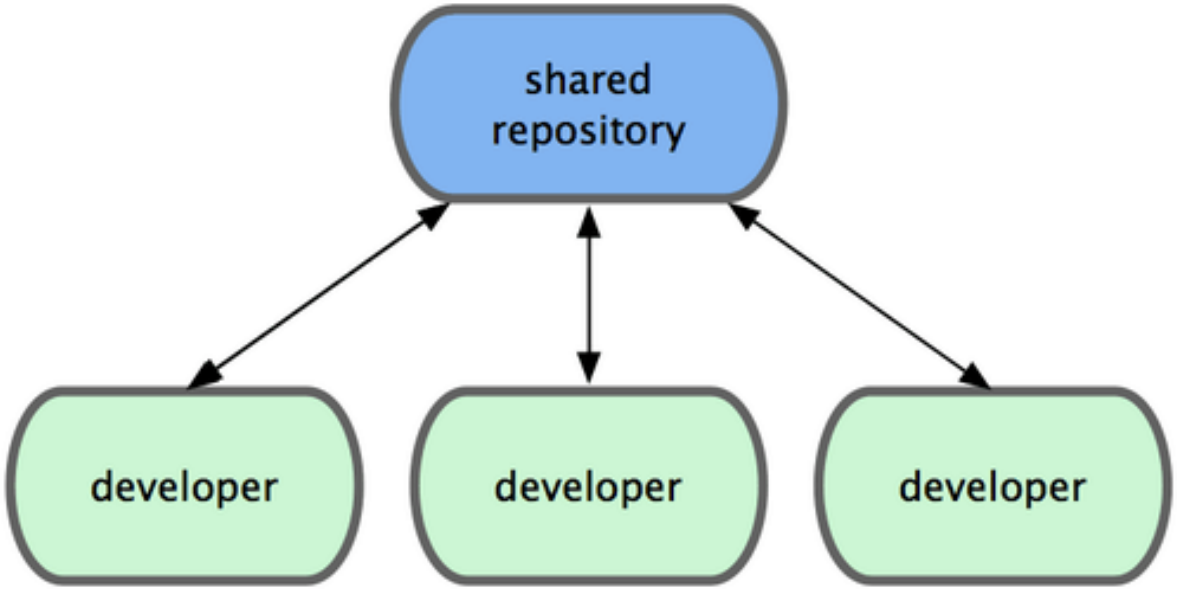
- Fork and clone repository
- Locate and fix bug
- Push to your public repository
- Submit pull request (note: pull requests will be processed in order and must be up to date)

Distributed Workflows

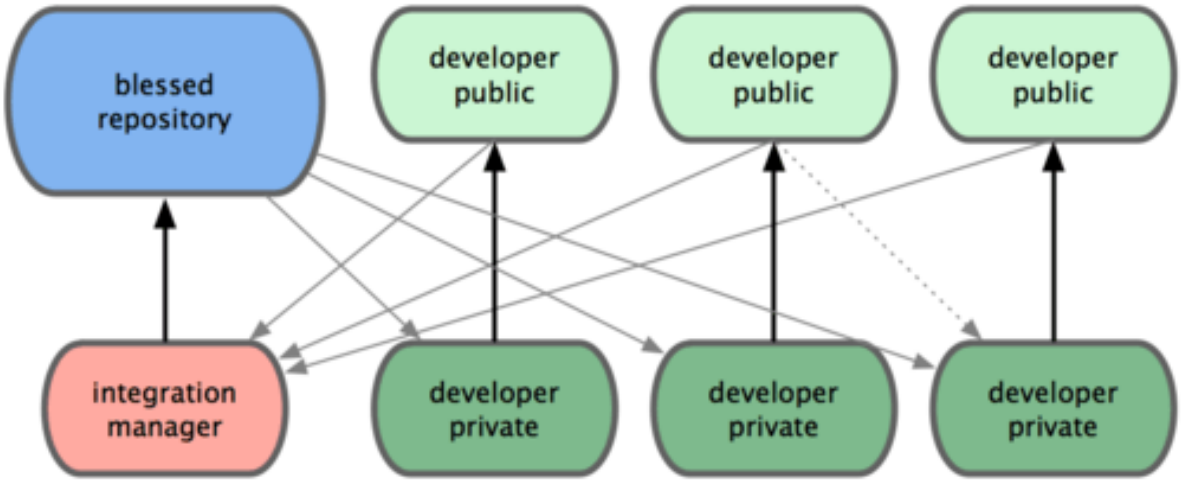
Distributed

- No central location that keeps track of your data (no single place is more important than another)
- Encourages small commits and frequent merging
- Branches don't affect the main repository and can commit changes without disturbing others
- Work offline
- Rely on a network of trust

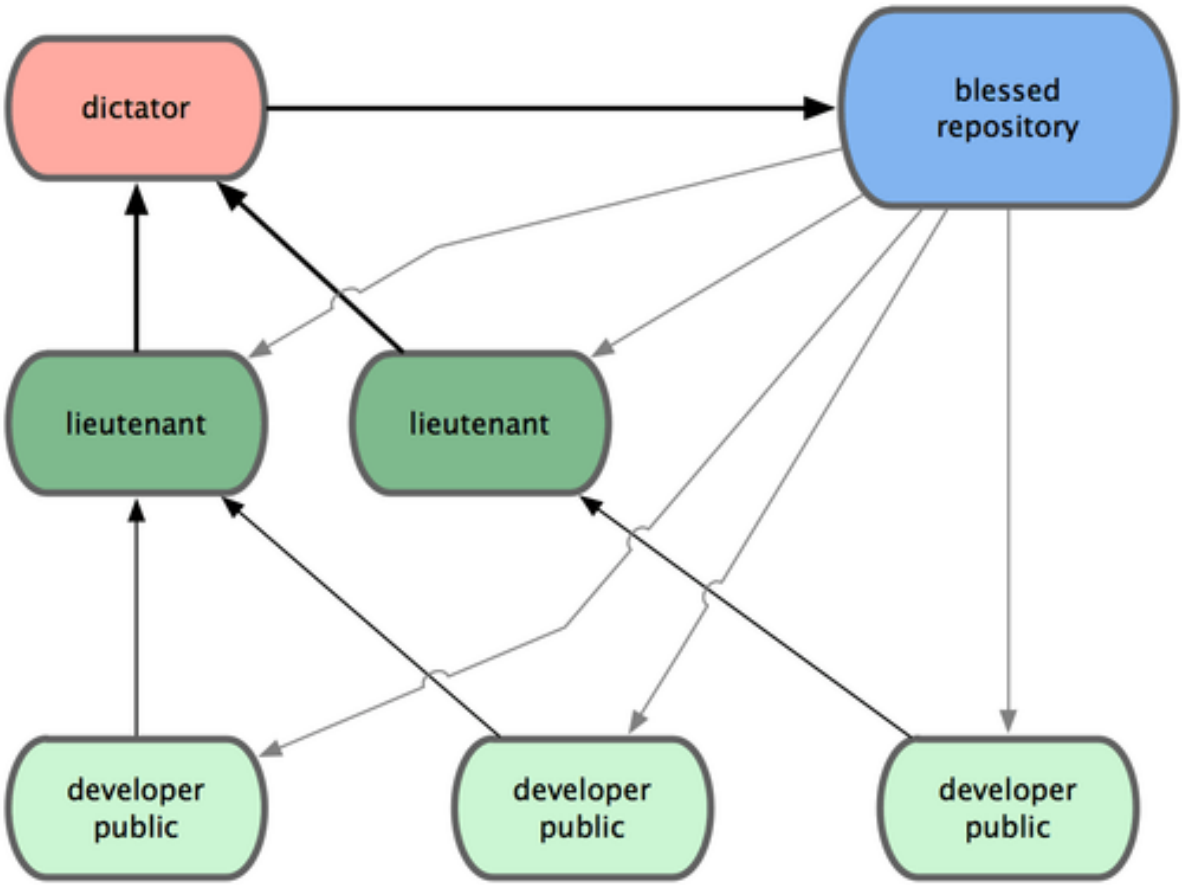
Distributed Workflows: Centralized



Distributed Workflows: Integration-Manager



Distributed Workflows: Dictator and Lieutenants



Git on the Web

Free and Open Source

- Downloads at `http://git-scm.com`
- Libgit2: free and open source library for writing custom Git applications

GitHub

- Powerful web interface for publishing Git repositories
- Simple to view changes and track progress on repositories
- Wiki and bug tracking built into each repository

Bitbucket

- Similar to GitHub
- Allows private repositories for students

Resources

1. Git From the Bottom Up
   `http://ftp.newartisans.com/pub/git.from.bottom.up.pdf`
2. User Manual
   `http://git-scm.com/docs/user-manual.html`
3. Git Magic
   `http://www-cs-students.stanford.edu/~blynn/gitmagic/`
4. Git Book
   `http://git-scm.com/book`
5. Tech Talk: Linus Torvalds on git
   `http://youtu.be/4XpnKHJAok8`
6. Code School - Try Git
   `http://try.github.io`