Tutorial on Git

Distributed Version Control and Development Workflow

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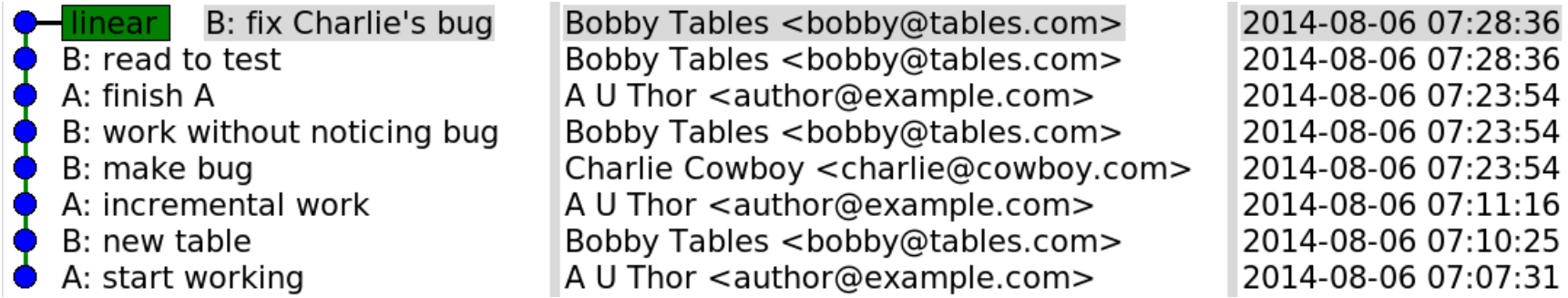
This talk: http://59A2.org/files/20140806-GitTutorial.pdf

Distributed Version Control

- Directed Acyclic Graph (DAG) history
  - Labels and namespaces
  - Branch structure to organize workflow
  - Flexible, asynchronous reviewing and quality control
  - Powerful merging
- Work with clones, each is equivalent and fully-functional
  - Social conventions for which is canonical
  - Each has its own branch namespace
- Provenance and auditability via cryptographic hashes
- Operations are local (and fast)

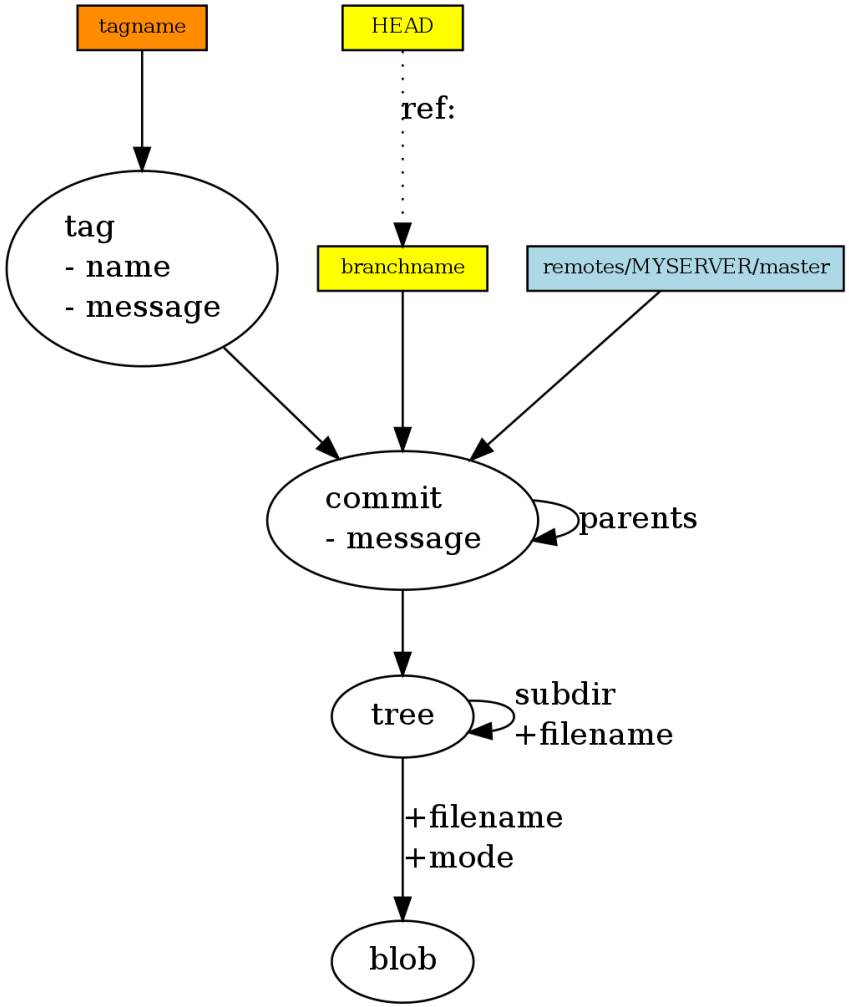
Is linear history good?



- Testing and review? Bugs and fixes are spread out.
- When is a feature complete?

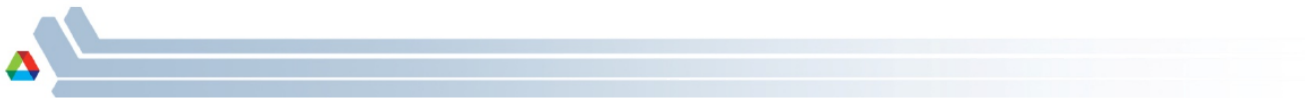
- Merges contain completed features.
- Asynchronous testing and review.

Labeling the DAG



- `HEAD`: cursor naming "current branch" or tag/commit
  - If a branch (usually), committing will advance that branch
  - Implicit reference for many commands (like `git diff`)
- Branches: lightweight labels that move with cursor (HEAD) and push/pull
- Tags: stationary, can be signed
- Hashes: every object is uniquely identifiable by a SHA1 hash

`http://eagain.net/articles/git-for-computer-scientists/`



Basic DAG commands

Git is fundamentally a tool for incrementally updating and analyzing the labeled DAG.

`commit`	create a new node in DAG and advance HEAD
`checkout` *name*	move HEAD to specified branch and update working tree to match
`branch` *name*	create new branch label
`tag` *name*	create (stationary) tag on commit indicated by HEAD
`merge` *commitish*	merge specified branch/tag/commit into current branch, creating new commit and advancing HEAD
`log`	ancestors of HEAD
`log --first-parent`	ancestors of HEAD following only first parent of merges
`log --` *path*	only those that modify path

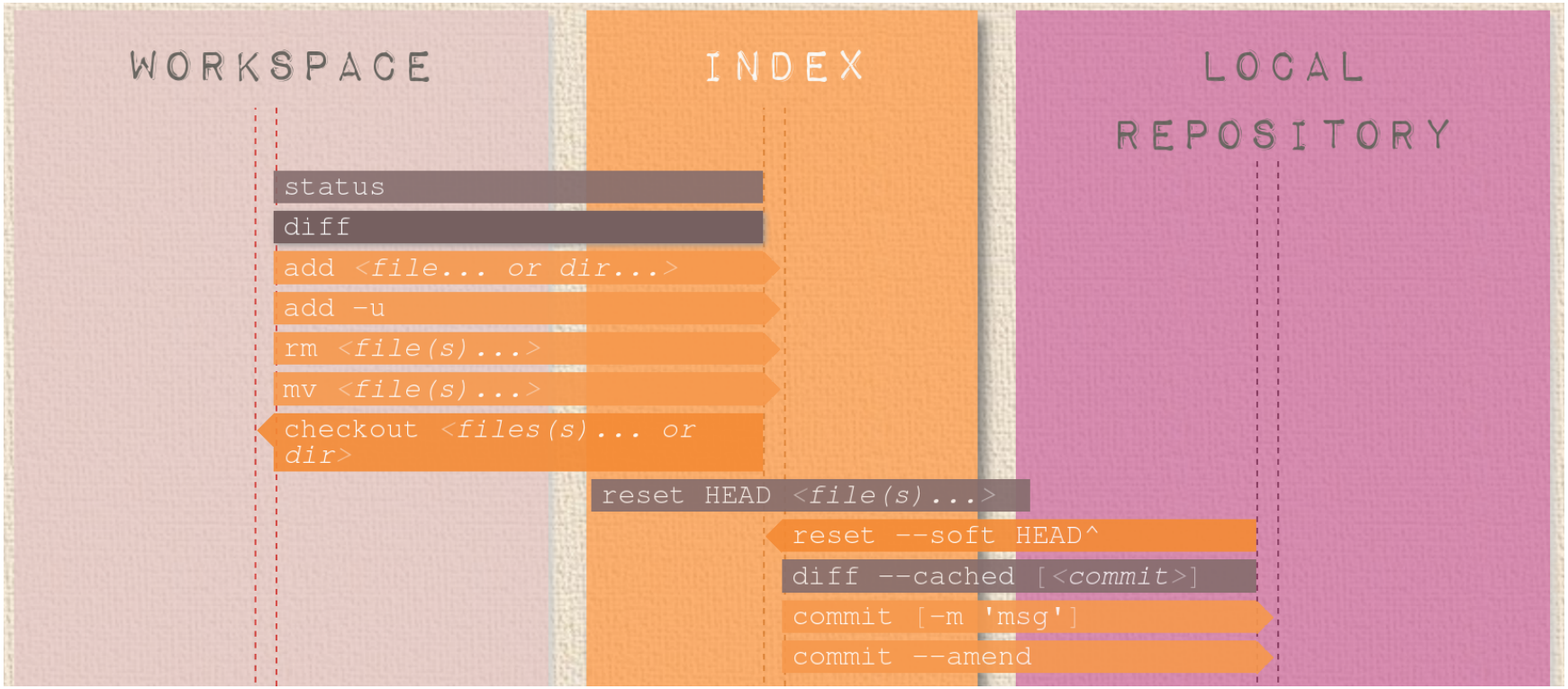
Hands-on: configuration

- `git config --global user.name 'Your Name'`
- `git config --global user.email your@email.com`
- `git config --global color.ui auto`
- Optional: `https://raw.githubusercontent.com/git/git/master/contrib/completion/git-prompt.sh`
- Optional: `https://raw.github.com/git/git/master/contrib/completion/git-completion.bash`
- `git config --global merge.log true`

Hands-on: clone a repository

- `git clone https://bitbucket.org/jedbrown/git-tutorial`
- `cd git-tutorial`
- Compare the history
  - `git log --graph`
  - `git checkout linear && git log --graph`
  - `git checkout integration`
  - `git log origin/a/dev..`

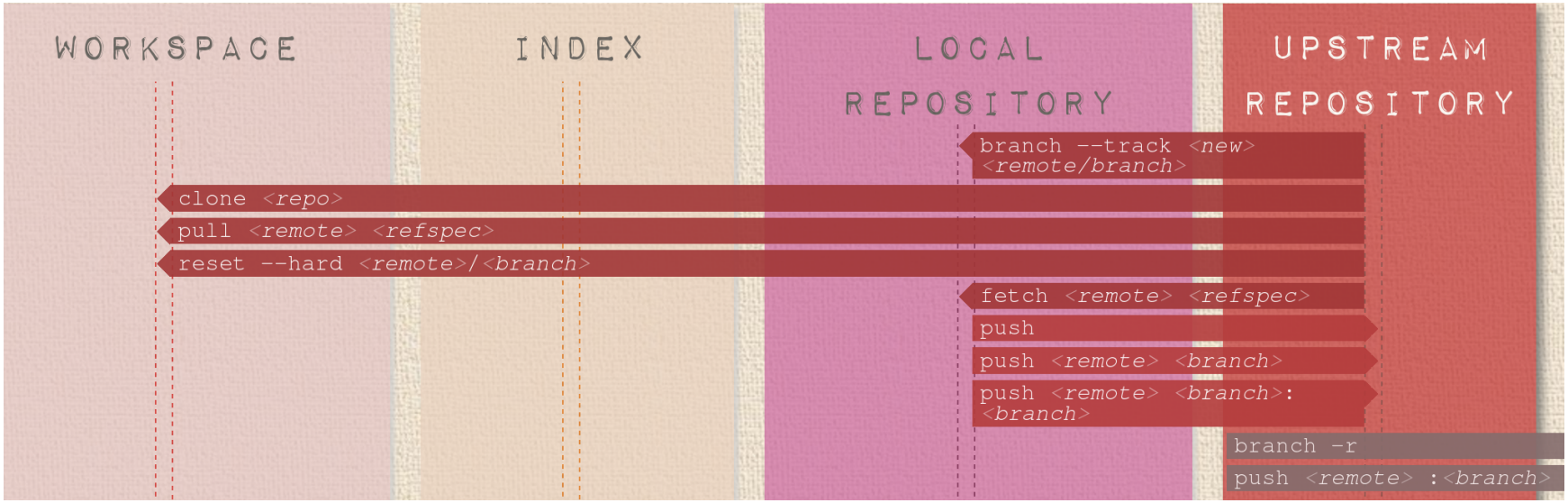
The staging area (or “index”)



http://ndpsoftware.com/git-cheatsheet.html

- Sometimes we don’t want to commit everything
- It’s nice to incrementally resolve conflicts, then not be shown again
- `git add`, `git rm`, and others need to be logged somehow
- Fast and useful primitive for building tools (in Git and externally)

Remotes



- Remotes are named and cached remote repositories
  - more commands can complete locally
- Cache is updated by `git fetch` and similar
- Private namespace for branches (prevents conflicts)
- “origin” is created by default by `git clone`
- `git remote add gh git@github.com:jedbrown/git-tutorial`

Hands-on: make a commit to show you were here

- `git checkout attendees`
- `echo MCS > Jed_Brown`
- `git add Jed_Brown`
- `git commit -m"I'm at the Git tutorial"`
- Submit changes
  - `git format-patch origin/attendees`
    and email patch to `jed-tutorial@jedbrown.org`
  - Fork repository on Bitbucket:
    `https://bitbucket.org/jedbrown/git-tutorial`
    - `git remote add yourname`
      `https://yourname@bitbucket.org/yourname/git-tutorial`
    - `git push yourname attendees`
    - Make a pull request to my repository
  - Fork repository on GitHub:
    `https://github.com/jedbrown/git-tutorial`

Hands-on: working with branches

In your browser:

`https://pcottle.github.io/learnGitBranching/`

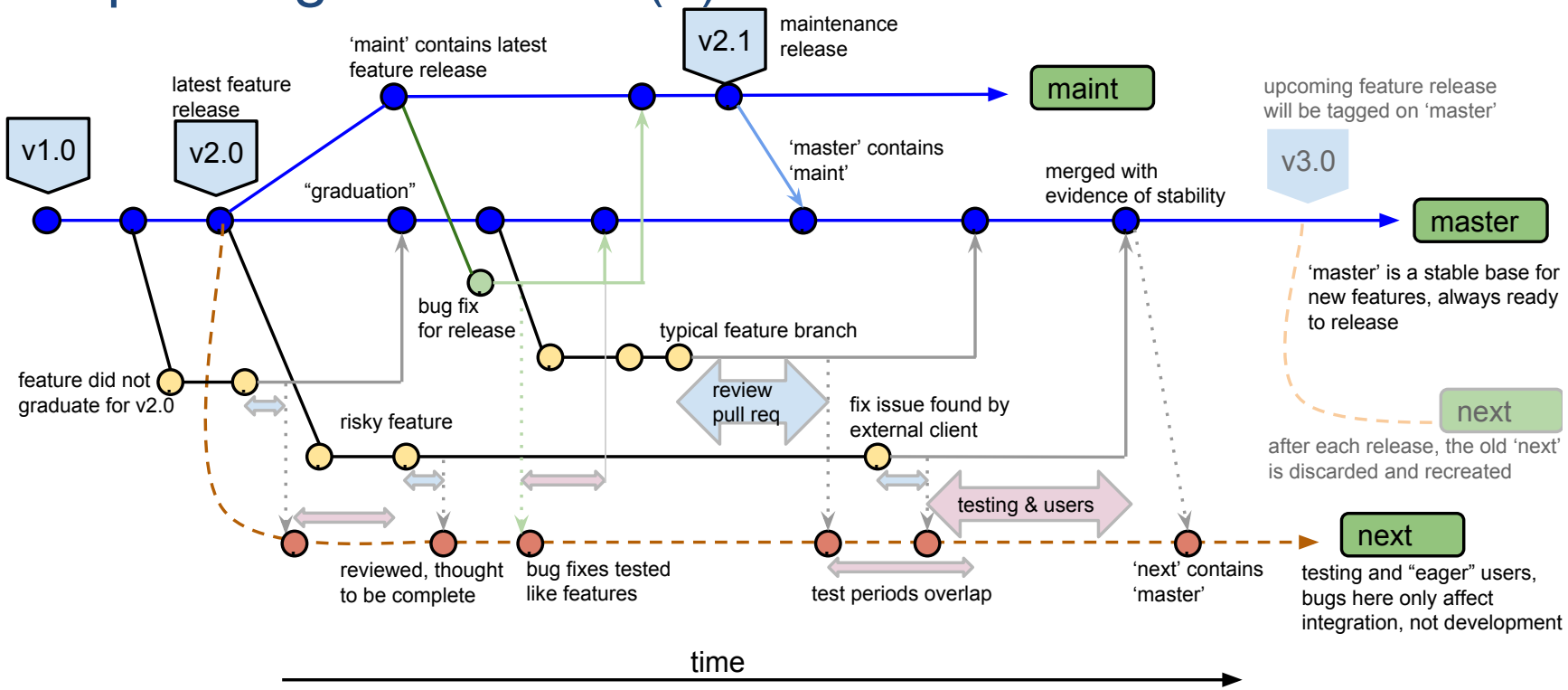
- Spend a few minutes with the branching and merging examples
- Advanced commands

`reset` *path*	set staging area to match *path* in HEAD
`rebase` *commit*	replay commits in `${commit}..` on top of `${commit}`, advancing current branch (old commits will be gc'd if not referenced)
`rebase --abort`	go back to state before starting rebase
`rebase -i HEAD~3`	interactively amend last three commits
`cherry-pick` *commit*	make commit on current branch, effecting the same change as `${commit}`
`reflog`	everywhere that HEAD has been in last 90 days (good to recover after a mistake)
`gitk`	graphical history visualization
`git citool`	graphical incremental commit tool

Workflow ideals

- 'master' is always stable and ready to release
- features are complete and tested before appearing in 'master'
- commits are minimal logically coherent, reviewable, and testable units
- related commits go together so as to be reviewable and debuggable by specialist
- new development is not disrupted by others' features and bugs
- rapid collaboration between developers possible
- `git log --first-parent maint..master` reads like a changelog
- bugs can be fixed once and anyone that needs the fix can obtain it without side-effects

Simplified gitworkflows(7)



first-parent history of branch

merge history (not first-parent)

merges to be discarded when 'next' is rewound at next release

merge in first-parent history of 'master' or 'maint' (approximate "changelog")

merge to branch 'next' (discarded after next major release)

commit in feature branch (feature branches usually start from 'master')

commit in bug-fix branch (bug-fix branches usually start from 'maint' or earlier)

Best practices

- Every branch has a purpose
- Distinguish integration branches from topic branches
- Do all development in topic branches
  - `git checkout -b my/feature-branch master`
- Namespace your branches if working on a shared repository
- Merge integration branches “forward”
  - `maint-1` → `maint` → `master` → `next`
  - `git checkout -b my/bugfix-branch maint-1`
- Write clear commit messages for reviewers and people trying to debug your code
- Avoid excessive merging from upstream
  - Always write a clear commit message explaining what is being merged and why
- Always merge topic branches as non-fast-forward (`merge --no-ff`)
- Gracefully retry if you lose a race to shared integration branch
  - This maximizes utility of `--first-parent` history

Outlook

- `git init` is only 3 more characters than `mkdir`
- Unlimited free private repositories at `https://bitbucket.org`
- Set up ssh keys so you don't have to type passwords
- Always start work in a new topic branch
  - Easy to checkpoint and context switch away
  - Can rebase or merge to existing branch if it makes sense
- You can clean up from almost anything, `reflog` can help
- Do not rebase commits that have been published
- Commit often, then organize with `git rebase -i`
  - See also `rebase.autosquash` and `git commit -fixup`
- Learn to summarize and search history
- Check out merge strategies `git merge --help`
- Git can remember conflict resolutions `rerere.enabled=true`