Advanced use of Git

Matthieu Moy

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`https://matthieu-moy.fr/cours/formation-git/advanced-git-slides.pdf`

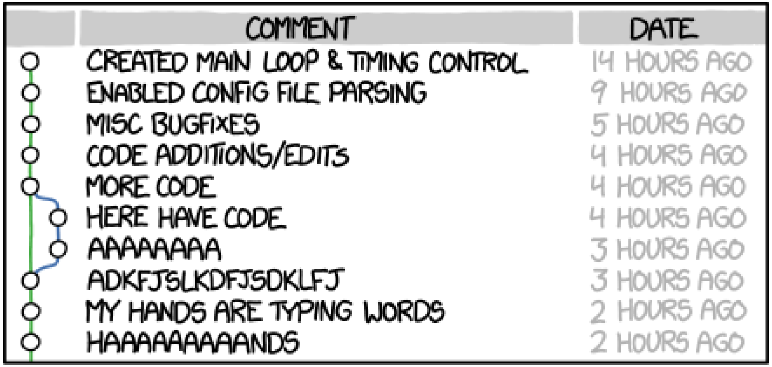
2017

Goals of the presentation

- Understand why Git is important, and what can be done with it
- Understand how Git works
- Motivate to read further documentation

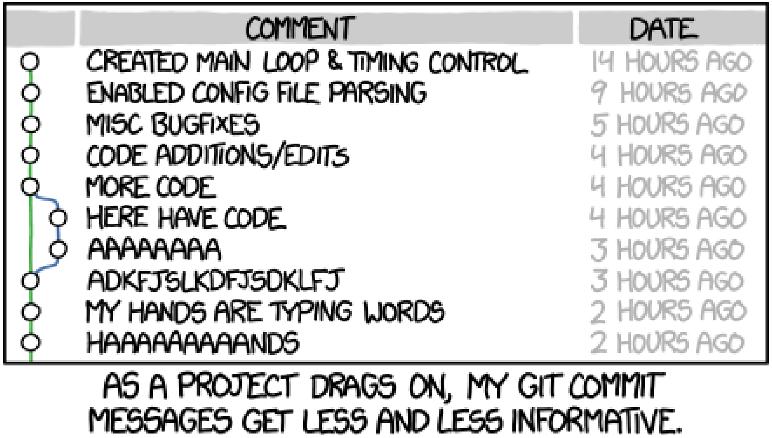
Outline

Lyon 1



	COMMENT	DATE
○	CREATED MAIN LOOP & TIMING CONTROL	14 HOURS AGO
○	ENABLED CONFIG FILE PARSING	9 HOURS AGO
○	MISC BUGFIXES	5 HOURS AGO
○	CODE ADDITIONS/EDITS	4 HOURS AGO
○	MORE CODE	4 HOURS AGO
○	HERE HAVE CODE	4 HOURS AGO
○	AAAAAAAA	3 HOURS AGO
○	ADKFJSLKDFJSDKLFJ	3 HOURS AGO
○	MY HANDS ARE TYPING WORDS	2 HOURS AGO
○	HAAAAAAAANDS	2 HOURS AGO

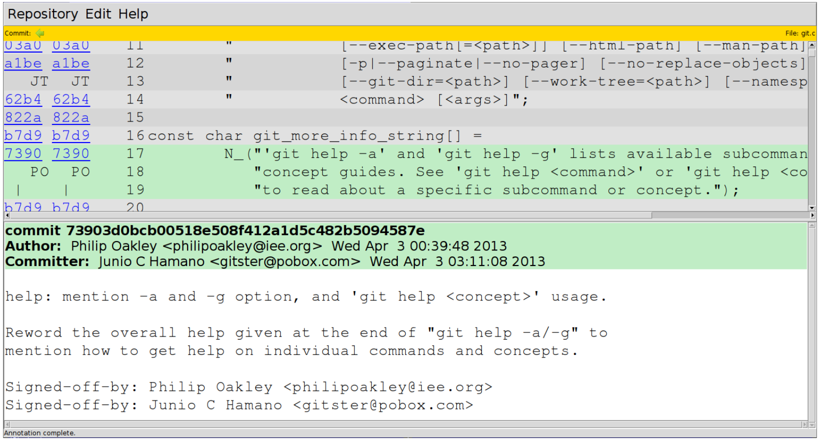
AS A PROJECT DRAGS ON, MY GIT COMMIT MESSAGES GET LESS AND LESS INFORMATIVE.



Merge branch ”asdfasjkfdlas/alkdjf” into sdkjfls-final

Git blame: Who did that?

`git gui blame` *`file`*



```
03a0 03a0   11          "            [--exec-path[=<path>]] [--html-path] [--man-path]
a1be a1be   12          "            [-p|--paginate|--no-pager] [--no-replace-objects]
  JT   JT   13          "            [--git-dir=<path>] [--work-tree=<path>] [--namesp
62b4 62b4   14          "            <command> [<args>]";
822a 822a   15
b7d9 b7d9   16const char git_more_info_string[] =
7390 7390   17        N_("'git help -a' and 'git help -g' lists available subcomman
  PO   PO   18           "concept guides. See 'git help <command>' or 'git help <co
 |     |    19           "to read about a specific subcommand or concept.");
b7d9 b7d9   20
```

commit 73903d0bcb00518e508f412a1d5c482b5094587e
Author: Philip Oakley <philipoakley@iee.org> Wed Apr 3 00:39:48 2013
Committer: Junio C Hamano <gitster@pobox.com> Wed Apr 3 03:11:08 2013

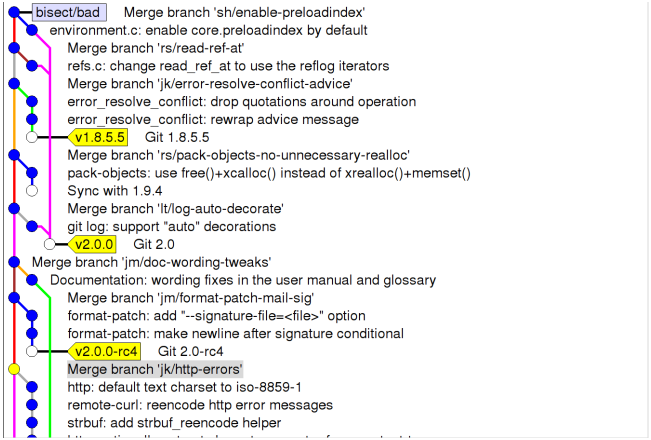
```
help: mention -a and -g option, and 'git help <concept>' usage.

Reword the overall help given at the end of "git help -a/-g" to
mention how to get help on individual commands and concepts.

Signed-off-by: Philip Oakley <philipoakley@iee.org>
Signed-off-by: Junio C Hamano <gitster@pobox.com>
```

Bisect: Find regressions

```
$ git bisect start
$ git bisect bad
$ git bisect good v1.9.0
Bisecting: 607 revisions left to test after this (roughly 9 steps)
[8fe3ee67adcd2ee9372c7044fa311ce55eb285b4] Merge branch 'jx/i18n'
$ git bisect good
Bisecting: 299 revisions left to test after this (roughly 8 steps)
[aa4bffa23599e0c2e611be7012ecb5f596ef88b5] Merge branch 'jc/coding-guidelines'
$ git bisect good
Bisecting: 150 revisions left to test after this (roughly 7 steps)
[96b29bde9194f96cb711a00876700ea8dd9c0727] Merge branch 'sh/enable-preloadindex'
$ git bisect bad
Bisecting: 72 revisions left to test after this (roughly 6 steps)
[09e13ad5b0f0689418a723289dca7b3c72d538c4] Merge branch 'as/pretty-truncate'
...
$ git bisect good
60ed26438c909fd273528e67 is the first bad commit
commit 60ed26438c909fd273528e67b399ee6ca4028e1e
```

Bisect: Binary search

`git bisect visualize`



```
bisect/bad   Merge branch 'sh/enable-preloadindex'
environment.c: enable core.preloadindex by default
Merge branch 'rs/read-ref-at'
refs.c: change read_ref_at to use the reflog iterators
Merge branch 'jk/error-resolve-conflict-advice'
error_resolve_conflict: drop quotations around operation
error_resolve_conflict: rewrap advice message
v1.8.5.5   Git 1.8.5.5
Merge branch 'rs/pack-objects-no-unnecessary-realloc'
pack-objects: use free()+xcalloc() instead of xrealloc()+memset()
Sync with 1.9.4
Merge branch 'lt/log-auto-decorate'
git log: support "auto" decorations
v2.0.0   Git 2.0
Merge branch 'jm/doc-wording-tweaks'
Documentation: wording fixes in the user manual and glossary
Merge branch 'jm/format-patch-mail-sig'
format-patch: add "--signature-file=<file>" option
format-patch: make newline after signature conditional
v2.0.0-rc4   Git 2.0-rc4
Merge branch 'jk/http-errors'
http: default text charset to iso-8859-1
remote-curl: reencode http error messages
strbuf: add strbuf_reencode helper
```

Bisect: Binary search

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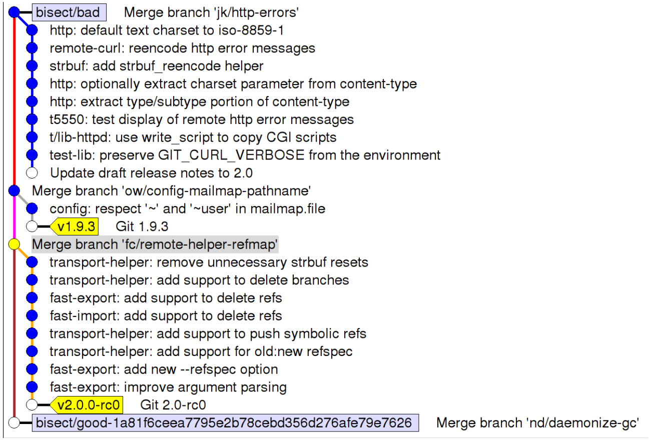

```
bisect/bad   Merge branch 'jk/http-errors'
  http: default text charset to iso-8859-1
  remote-curl: reencode http error messages
  strbuf: add strbuf_reencode helper
  http: optionally extract charset parameter from content-type
  http: extract type/subtype portion of content-type
  t5550: test display of remote http error messages
  t/lib-httpd: use write_script to copy CGI scripts
  test-lib: preserve GIT_CURL_VERBOSE from the environment
  Update draft release notes to 2.0
Merge branch 'ow/config-mailmap-pathname'
  config: respect '~' and '~user' in mailmap.file
  v1.9.3   Git 1.9.3
Merge branch 'fc/remote-helper-refmap'
  transport-helper: remove unnecessary strbuf resets
  transport-helper: add support to delete branches
  fast-export: add support to delete refs
  fast-import: add support to delete refs
  transport-helper: add support to push symbolic refs
  transport-helper: add support for old:new refspec
  fast-export: add new --refspec option
  fast-export: improve argument parsing
  v2.0.0-rc0   Git 2.0-rc0
bisect/good-1a81f6ceea7795e2b78cebd356d276afe79e7626   Merge branch 'nd/daemonize-gc'
```

Bisect: Binary search

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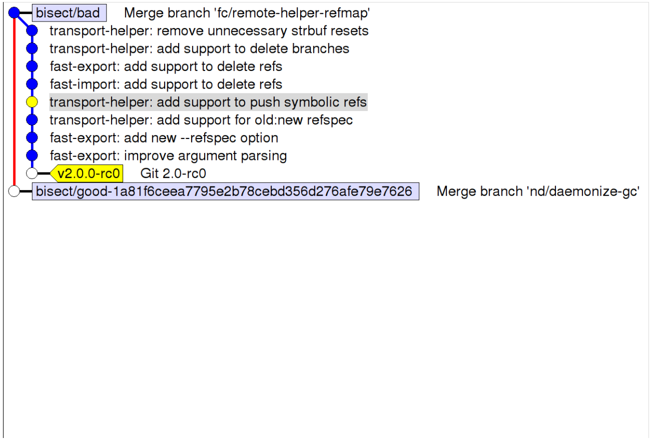

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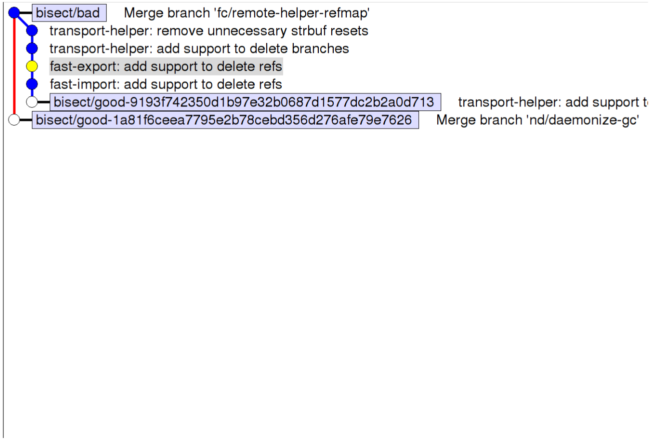

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  transport-helper: remove unnecessary strbuf resets
  transport-helper: add support to delete branches
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  fast-import: add support to delete refs
  bisect/good-9193f742350d1b97e32b0687d1577dc2b2a0d713   transport-helper: add support t
bisect/good-1a81f6ceea7795e2b78cebd356d276afe79e7626   Merge branch 'nd/daemonize-gc'
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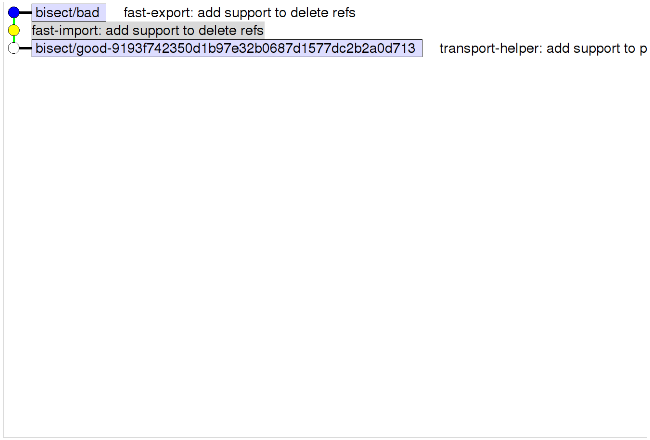
Bisect: Binary search

`git bisect visualize`



```
bisect/bad   fast-export: add support to delete refs
fast-import: add support to delete refs
bisect/good-9193f742350d1b97e32b0687d1577dc2b2a0d713   transport-helper: add support to p
```

Then what?

`git blame` and `git bisect` point you to a commit, then ...

- Dream:
  - The commit is a 50-lines long patch
  - The commit message explains the intent of the programmer
- Nightmare 1:
  - The commit mixes a large reindentation, a bugfix and a real feature
  - The message says “I reindented, fixed a bug and added a feature”
- Nightmare 2:
  - The commit is a trivial fix for the previous commit
  - The message says “Oops, previous commit was stupid”
- Nightmare 3:
  - Bisect is not even applicable because most commits aren’t compilable.

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Which one do you prefer?

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Clean history is important
for software maintainability

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Clean history is **as** important **as comments**
for software maintainability

Two Approaches To Deal With History

Approach 1

“Mistakes are part of history.”

Approach 2

“History is a set of lies agreed upon.”[1]

[1] Napoleon Bonaparte

Approach 1: Mistakes are part of history

- $\approx$ the only option with Subversion/CVS/...
- History reflects the chronological order of events
- Pros:
  - Easy: just work and commit from time to time
  - Traceability
- But ...
  - Is the actual order of event what you want to remember?
  - When you write a draft of a document, and then a final version, does the final version reflect the mistakes you did in the draft?

Approach 2: History is a set of lies agreed upon

- Popular approach with modern VCS (Git, Mercurial. . .)
- History tries to show the best logical path from one point to another
- Pros:
  - See above: blame, bisect, ...
  - Code review
  - Claim that you are a better programmer than you really are!

Another View About Version Control

- 2 roles of version control:
  - For beginners: help the code reach upstream.
  - For advanced users: prevent bad code from reaching upstream.
- Several opportunities to reject bad code:
  - Before/during commit
  - Before push
  - Before merge

What is a clean history

- Each commit introduce small group of related changes ($\approx$ 100 lines changed max, no minimum!)
- Each commit is compilable and passes all tests (“bisectable history”)
- “Good” commit messages

Outline

Outline of this section

2 Clean commits
- Writing good commit messages
- Partial commits with `git add -p`, the index

Reminder: good comments

- Bad:

```
int i; // Declare i of type int
for (i = 0; i < 10; i++) { ... }
f(i)
```

- Possibly good:

```
int i; // We need to declare i outside the for
       // loop because we'll use it after.
for (i = 0; i < 10; i++) { ... }
f(i)
```

Common rule: if your code isn't clear enough,
rewrite it to make it clearer
instead of adding comments.

Reminder: good comments

- Bad: What? The code already tells

```
int i; // Declare i of type int
for (i = 0; i < 10; i++) { ... }
f(i)
```

- Possibly good: Why? Usually the relevant question

```
int i; // We need to declare i outside the for
       // loop because we'll use it after.
for (i = 0; i < 10; i++) { ... }
f(i)
```

Common rule: if your code isn't clear enough,
rewrite it to make it clearer
instead of adding comments.

Good commit messages

- Recommended format:

```
One-line description (< 50 characters)

Explain here why your change is good.
```

- Write your commit messages like an email: subject and body
- Imagine your commit message is an email sent to the maintainer, trying to convince him to merge your code[2]
- Don't use `git commit -m`

[2]Not just imagination, see `git send-email`

Good commit messages: examples

From Git's source code

https://github.com/git/git/commit/90dce21eb0fcf28096e661a3dd3b4e93fa0bccb5

```
remote-curl: unquote incoming push-options

The transport-helper protocol c-style quotes the value of any options passed to the helper via the "option <key>
<value>" directive. However, remote-curl doesn't actually unquote the push-option values, meaning that we will send
the quoted version to the other side (whereas git-over-ssh would send the raw value).

The pack-protocol.txt documentation defines the push-options as a series of VCHARs, which excludes most characters
that would need quoting. But:

  1. You can still see the bug with a valid push-option that starts with a double-quote (since that triggers quoting).

  2. We do currently handle any non-NUL characters correctly in git-over-ssh. So even though the spec does not say
     that we need to handle most quoted characters, it's nice if our behavior is consistent between protocols.

There are two new tests: the "direct" one shows that this already works in the non-http case, and the http one covers
this bugfix.

Reported-by: Jon Simons <jon@jonsimons.org>
Signed-off-by: Jeff King <peff@peff.net>
Signed-off-by: Junio C Hamano <gitster@pobox.com>
```

Good commit messages: counter-example

GNU-style changelogs

```
http://git.savannah.gnu.org/cgit/emacs.git/commit/?id=90ca83d4bf17a334902321e93fa89ccb1f4a5a4e
```

```
* lisp/isearch.el (search-exit-option): Add options 'shift-move' and 'move'.

Change type from `boolean' to `choice'.  Extend docstring.
(isearch-pre-move-point): New variable.
(isearch-pre-command-hook, isearch-post-command-hook):
Handle search-exit-option for values `move' and `shift-move'.

* doc/emacs/search.texi (Not Exiting Isearch): Document new
values `shift-move' and `move' of search-exit-option.

https://lists.gnu.org/archive/html/emacs-devel/2018-03/msg00013.html
```

Not much the patch didn't already say ... (do you understand the problem the commit is trying to solve?)

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2 Clean commits
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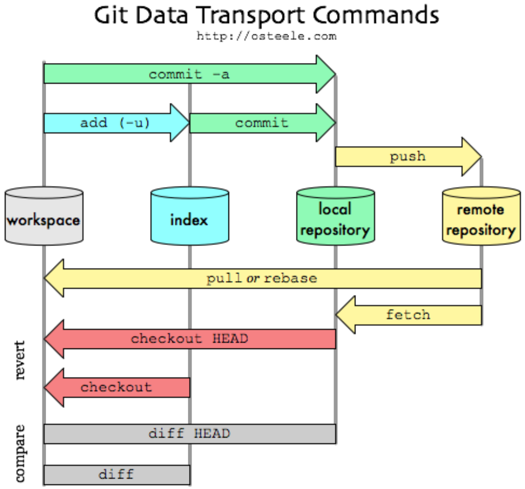
Git Data Transport Commands
http://osteele.com
commit -a
add (-u)
commit
push
workspace
index
local repository
remote repository
pull or rebase
fetch
revert
checkout HEAD
checkout
compare
diff HEAD
diff

The index, or “Staging Area”

- “the index” is where the next commit is prepared
- Contains the list of files and their content
- `git commit` transforms the index into a commit
- `git commit -a` stages all changes in the worktree in the index before committing. You’ll find it sloppy soon.

Dealing with the index

- Commit only 2 files:

```
git add file1.txt
git add file2.txt
git commit
```

- Commit only some patch hunks:

```
git add -p
(answer yes or no for each hunk)
git commit
```

git add -p: example

```
$ git add -p
@@ -1,7 +1,7 @@
 int main()
-        int i;
+        int i = 0;
         printf("Hello, ");
         i++;
Stage this hunk [y,n,q,a,d,/,K,g,e,?]? y
```

git add -p: example

```
$ git add -p
@@ -1,7 +1,7 @@
 int main()
-        int i;
+        int i = 0;
         printf("Hello, ");
         i++;
Stage this hunk [y,n,q,a,d,/,K,g,e,?]? y
@@ -5,6 +5,6 @@

-        printf("i is %s\n", i);
+        printf("i is %d\n", i);

Stage this hunk [y,n,q,a,d,/,K,g,e,?]? n
```

git add -p: example

```
$ git add -p
@@ -1,7 +1,7 @@
 int main()
-        int i;
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         i++;
Stage this hunk [y,n,q,a,d,/,K,g,e,?]? y
@@ -5,6 +5,6 @@

-        printf("i is %s\n", i);
+        printf("i is %d\n", i);

Stage this hunk [y,n,q,a,d,/,K,g,e,?]? n
$ git commit -m "Initialize i properly"
[master c4ba68b] Initialize i properly
 1 file changed, 1 insertion(+), 1 deletion(-)
```
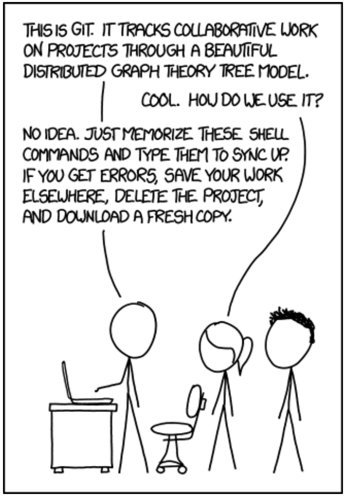
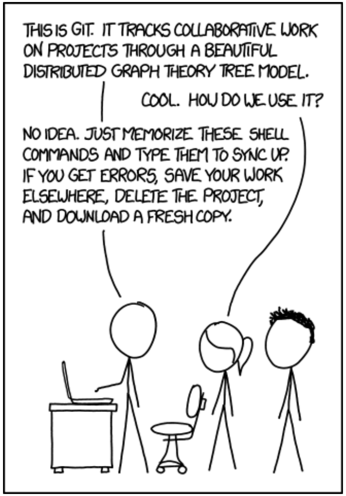

`git add -p`: dangers

- Commits created with `git add -p` do not correspond to what you have on disk
- You probably never tested these commits ...
- Solutions:
  - `git stash -k`: stash what's not in the index
  - `git rebase --exec`: see later
  - (and code review)

Outline


THIS IS GIT. IT TRACKS COLLABORATIVE WORK ON PROJECTS THROUGH A BEAUTIFUL DISTRIBUTED GRAPH THEORY TREE MODEL.
COOL. HOW DO WE USE IT?
NO IDEA. JUST MEMORIZE THESE SHELL COMMANDS AND TYPE THEM TO SYNC UP. IF YOU GET ERRORS, SAVE YOUR WORK ELSEWHERE, DELETE THE PROJECT, AND DOWNLOAD A FRESH COPY.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If that doesn't fix it, git.txt contains the phone number of a friend of mine who understands git. Just wait through a few minutes of "It's really pretty simple, just think of branches as..." and eventually you'll learn the commands that will fix everything.

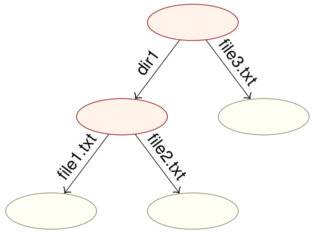
Why do I need to learn about Git's internal?

- Beauty of Git: very simple data model
  (The tool is clever, the repository format is simple&stupid)
- Understand the model, and the 150+ commands will become simple!

Outline of this section

Content of a Git repository: Git objects

blob	Any sequence of bytes, represents file content
tree	Associates object to pathnames, represents a directory



Content of a Git repository: Git objects

blob	Any sequence of bytes, represents file content
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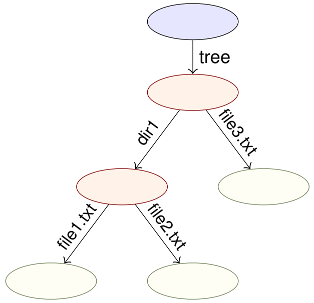
commit	Metadata + pointer to tree + pointer to parents



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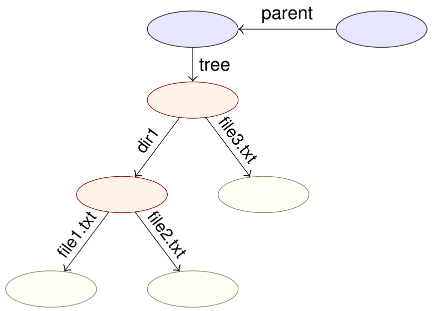

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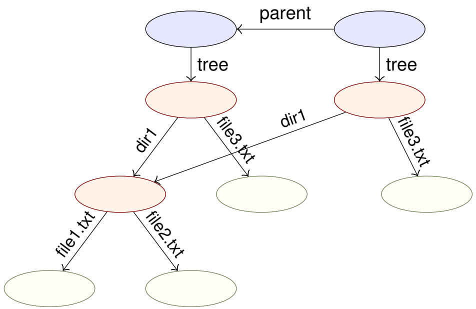

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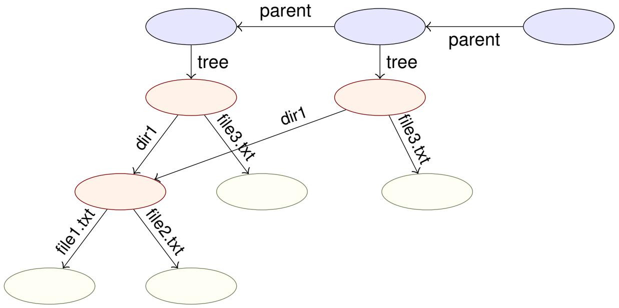

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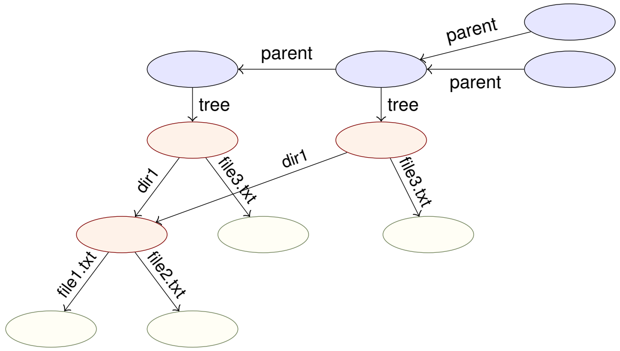

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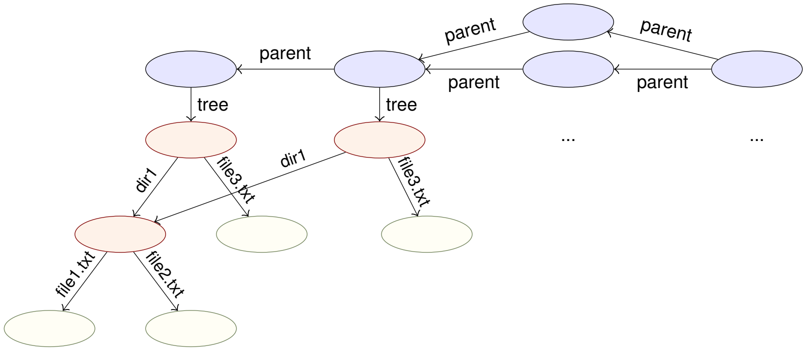


Git objects: On-disk format

```
$ git log
commit 7a7fb77be431c284f1b6d036ab9aebf646060271
Author: Matthieu Moy <Matthieu.Moy@univ-lyon1.fr>
Date:   Wed Jul 2 20:13:49 2014 +0200

    Initial commit
$ find .git/objects/
.git/objects/
.git/objects/fc
.git/objects/fc/264b697de62952c9ff763b54b5b11930c9cfec
.git/objects/a4
.git/objects/a4/7665ad8a70065b68fbcfb504d85e06551c3f4d
.git/objects/7a
.git/objects/7a/7fb77be431c284f1b6d036ab9aebf646060271
.git/objects/50
.git/objects/50/a345788a8df75e0f869103a8b49cecdf95a416
.git/objects/26
.git/objects/26/27a0555f9b58632be848fee8a4602a1d61a05f
```

Git objects: On-disk format

```
$ echo foo > README.txt; git add README.txt
$ git commit -m "add README.txt"
[master 5454e3b] add README.txt
 1 file changed, 1 insertion(+)
 create mode 100644 README.txt
$ find .git/objects/
.git/objects/
.git/objects/fc
.git/objects/fc/264b697de62952c9ff763b54b5b11930c9cfec
.git/objects/a4
.git/objects/a4/7665ad8a70065b68fbcfb504d85e06551c3f4d
.git/objects/59
.git/objects/59/802e9b115bc606b88df4e2a83958423661d8c4
.git/objects/7a
.git/objects/7a/7fb77be431c284f1b6d036ab9aebf646060271
.git/objects/25
.git/objects/25/7cc5642cb1a054f08cc83f2d943e56fd3ebe99
.git/objects/54
.git/objects/54/54e3b51e81d8d9b7e807f1fc21e618880c1ac9
...
```

Git objects: On-disk format

- By default, 1 object = 1 file
- Name of the file = object unique identifier content
- Content-addressed database:
  - Identifier computed as a hash of its content
  - Content accessible from the identifier
- Consequences:
  - Objects are immutable
  - Objects with the same content have the same identity (deduplication for free)
  - No known collision in SHA1 until recently, still very hard to find $\Rightarrow$ SHA1 uniquely identifies objects
  - Acyclic (DAG = Directed Acyclic Graph)

On-disk format: Pack files

```
$ du -sh .git/objects/
68K     .git/objects/
$ git gc
...
$ du -sh .git/objects/
24K     .git/objects/
$ find .git/objects/
.git/objects/
.git/objects/pack
.git/objects/pack/pack-f9cbdc53005a4b500934625d...a3.idx
.git/objects/pack/pack-f9cbdc53005a4b500934625d...a3.pack
.git/objects/info
.git/objects/info/packs
$
```

⇝ More efficient format, no conceptual change (objects are still there)

Exploring the object database

- **`git cat-file -p`** : pretty-print the content of an object

```
$ git log --oneline
5454e3b add README.txt
7a7fb77 Initial commit
$ git cat-file -p 5454e3b
tree 59802e9b115bc606b88df4e2a83958423661d8c4
parent 7a7fb77be431c284f1b6d036ab9aebf646060271
author Matthieu Moy <Matthieu.Moy@univ-lyon1.fr> 1404388746 +0200
committer Matthieu Moy <Matthieu.Moy@univ-lyon1.fr> 1404388746 +0200

add README.txt
$ git cat-file -p 59802e9b115bc606b88df4e2a83958423661d8c4
100644 blob 257cc5642cb1a054f08cc83f2d943e56fd3ebe99  README.txt
040000 tree 2627a0555f9b58632be848fee8a4602a1d61a05f  sandbox
$ git cat-file -p 257cc5642cb1a054f08cc83f2d943e56fd3ebe99
foo
$ printf 'blob 4\0foo\n' | sha1sum
257cc5642cb1a054f08cc83f2d943e56fd3ebe99  -
```

Merge commits in the object database

```
$ git checkout -b branch HEAD^
Switched to a new branch 'branch'
$ echo foo > file.txt; git add file.txt
$ git commit -m "add file.txt"
[branch f44e9ab] add file.txt
 1 file changed, 1 insertion(+)
 create mode 100644 file.txt
$ git merge master
Merge made by the 'recursive' strategy.
 README.txt | 1 +
 1 file changed, 1 insertion(+)
 create mode 100644 README.txt
```

Merge commits in the object database

```
$ git checkout -b branch HEAD^
$ echo foo > file.txt; git add file.txt
$ git commit -m "add file.txt"
$ git merge master
$ git log --oneline --graph
*   1a7f9ae (HEAD, branch) Merge branch 'master' into branch
|\
| * 5454e3b (master) add README.txt
* | f44e9ab add file.txt
|/
* 7a7fb77 Initial commit
$ git cat-file -p 1a7f9ae
tree 896dbd61ffc617b89eb2380cdcaffcd7c7b3e183
parent f44e9abff8918f08e91c2a8fefe328dd9006e242
parent 5454e3b51e81d8d9b7e807f1fc21e618880c1ac9
author Matthieu Moy <Matthieu.Moy@univ-lyon1.fr> 1404390461 +0200
committer Matthieu Moy <Matthieu.Moy@univ-lyon1.fr> 1404390461 +0200

Merge branch 'master' into branch
```

Snapshot-oriented storage

- A commit represents exactly the state of the project
- A tree represents only the state of the project (where we are, not how we got there)
- Renames are not tracked, but re-detected on demand
- Diffs are computed on demand (e.g. `git diff HEAD HEAD^`)
- Physical storage still efficient

Outline of this section

Branches, tags: references

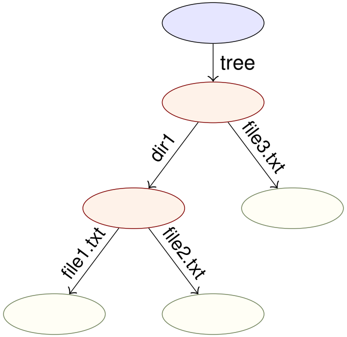
- In Java:

```
String s; // Reference named s
s = new String("foo"); // Object pointed to by s
String s2 = s; // Two refs for the same object
```

- In Git: likewise!

```
$ git log -oneline
5454e3b add README.txt
7a7fb77 Initial commit
$ cat .git/HEAD
ref: refs/heads/master
$ cat .git/refs/heads/master
5454e3b51e81d8d9b7e807f1fc21e618880c1ac9
$ git symbolic-ref HEAD
refs/heads/master
$ git rev-parse refs/heads/master
5454e3b51e81d8d9b7e807f1fc21e618880c1ac9
```

References (refs) and objects



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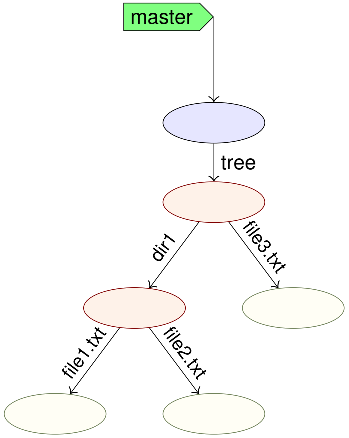

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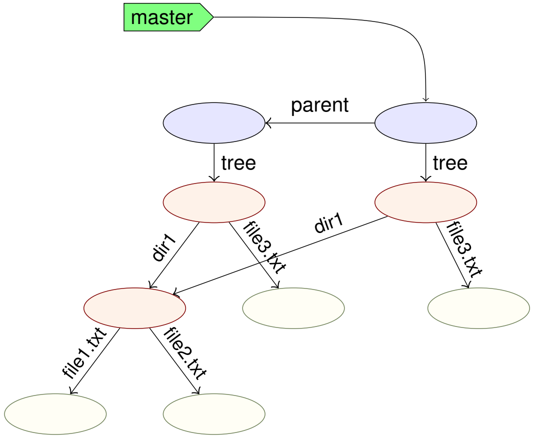

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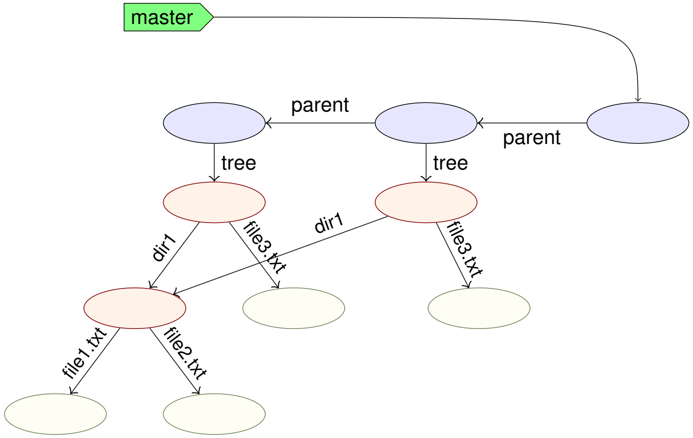

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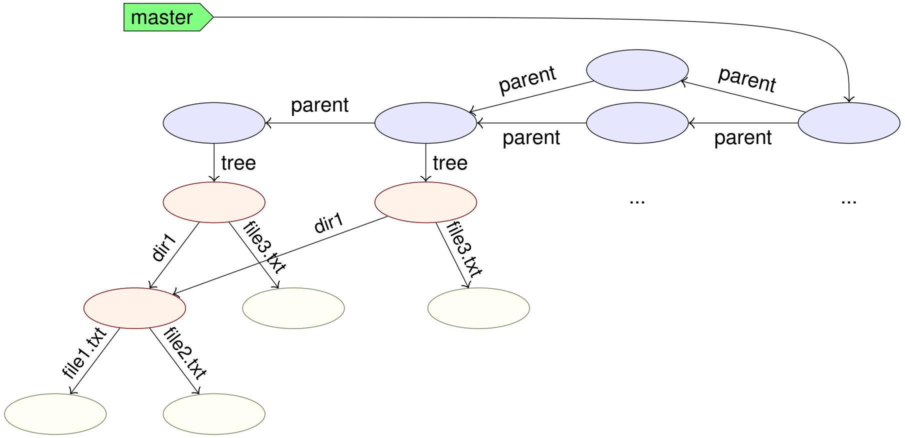

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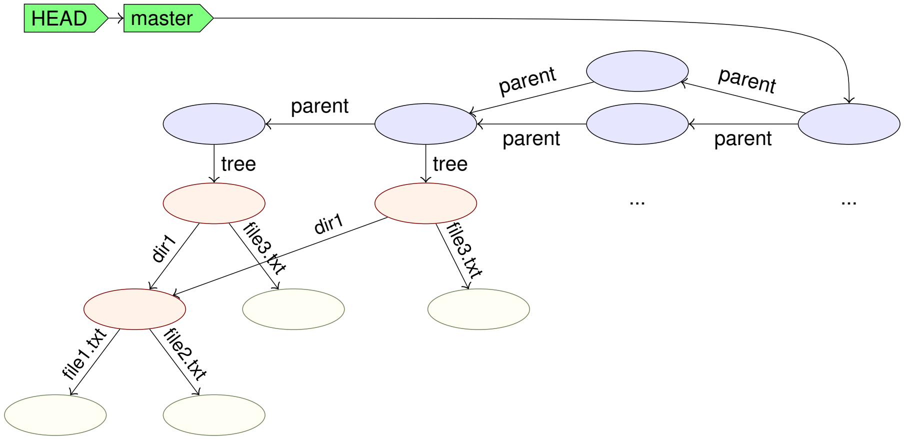
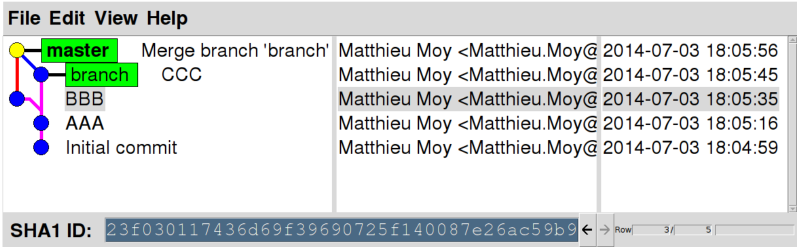


Sounds Familiar?

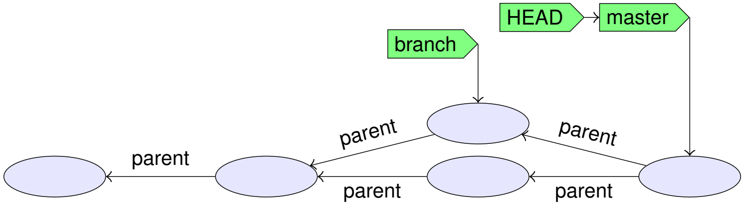


File Edit View Help

```
master  Merge branch 'branch'   Matthieu Moy <Matthieu.Moy@  2014-07-03 18:05:56
branch  CCC                     Matthieu Moy <Matthieu.Moy@  2014-07-03 18:05:45
BBB                             Matthieu Moy <Matthieu.Moy@  2014-07-03 18:05:35
AAA                             Matthieu Moy <Matthieu.Moy@  2014-07-03 18:05:16
Initial commit                  Matthieu Moy <Matthieu.Moy@  2014-07-03 18:04:59
```

SHA1 ID: 23f030117436d69f39690725f140087e26ac59b9 Row 3 / 5

$\approx$



Branches, HEAD, tags

- A branch is a ref to a commit
- A lightweight tag is a ref (usually to a commit) (like a branch, but doesn't move)
- Annotated tags are objects containing a ref + a (signed) message
- HEAD is "where we currently are"
  - If HEAD points to a branch, the next commit will move the branch
  - If HEAD points directly to a commit (detached HEAD), the next commit creates a commit not in any branch (warning!)

Outline

Branches and Tags in Practice

- Create a local branch and check it out:
  `git checkout -b` *`branch-name`*
- Switch to a branch:
  `git checkout` *`branch-name`*
- List local branches:
  `git branch`
- List all branches (including remote-tracking):
  `git branch -a`
- Create a tag:
  `git tag` *`tag-name`*

Outline

Example

Implement `git clone -c var=value` : 9 preparation patches, 1 real (trivial) patch at the end!

`https://github.com/git/git/commits/84054f79de35015fc92f73ec4780102dd820e452`

Did the author actually write this in this order?

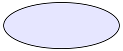
Outline of this section

5 Clean local history
- Avoiding merge commits: `rebase` Vs `merge`
- Rewriting history with `rebase -i`

Merging With Upstream

Question: upstream (where my code should eventually end up) has new code, how do I get it in my repo?

- Approach 1: merge (default with `git pull`)



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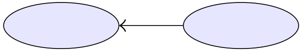

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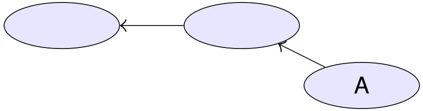

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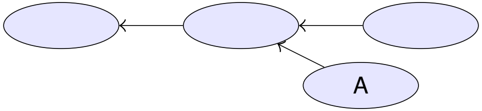

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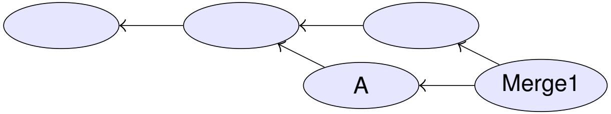

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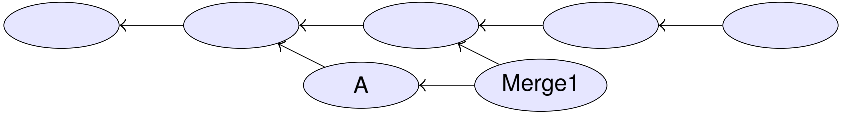

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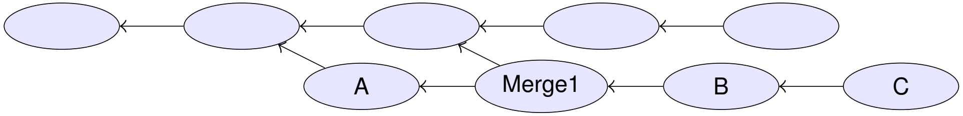

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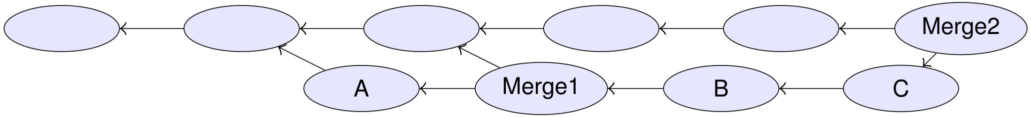

- Drawbacks:
  - Merge1 is not relevant, distracts reviewers (unlike Merge2).

Merging With Upstream

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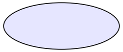
- Approach 2: no merge



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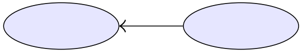

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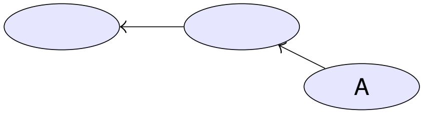

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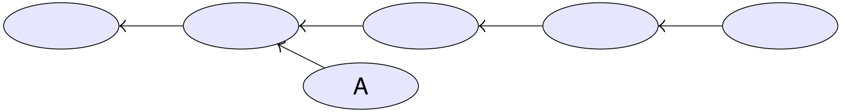

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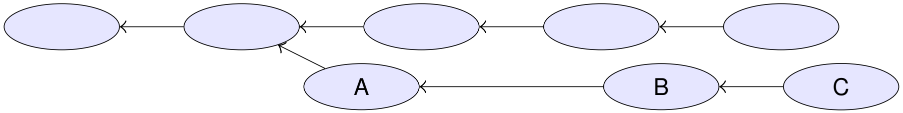

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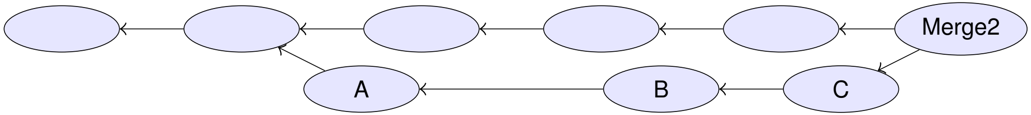
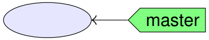


- Drawbacks:
  - In case of conflict, they have to be resolved by the developer merging into upstream (possibly after code review)
  - Not always applicable (e.g. “I need this new upstream feature to continue working”)

Merging With Upstream

Question: upstream (where my code should eventually end up) has new code, how do I get it in my repo?

- Approach 3: rebase (`git rebase` or `git pull --rebase`)



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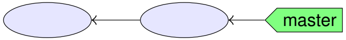

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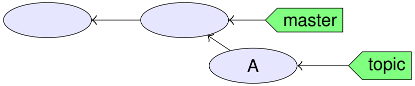

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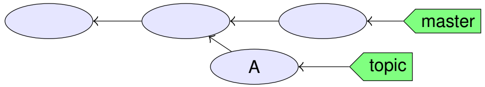

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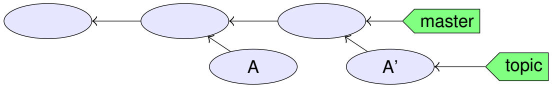

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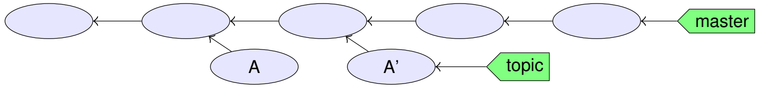

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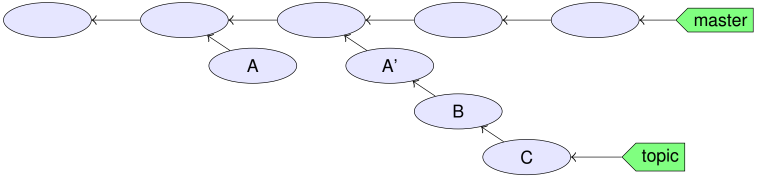

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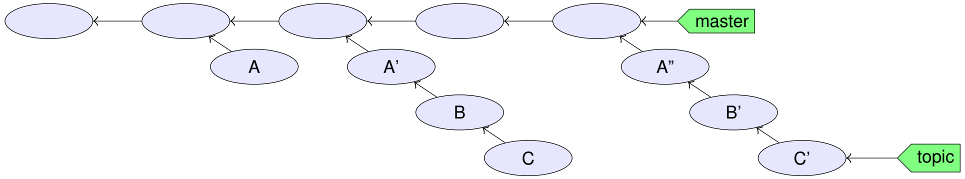

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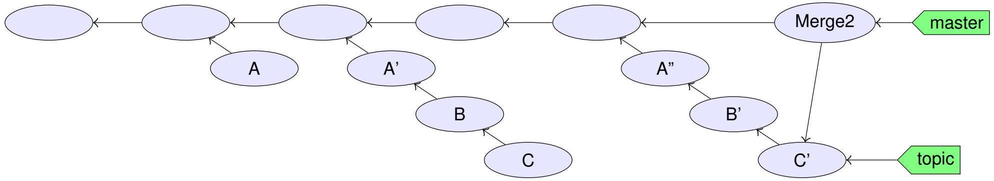

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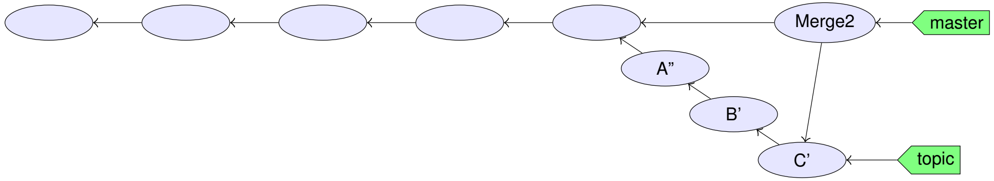

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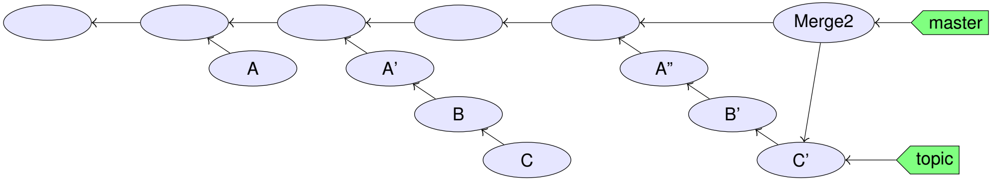


- Drawbacks: rewriting history implies:
  - A', A", B', C' probably haven't been tested (never existed on disk)
  - What if someone branched from A, A', B or C?
  - Basic rule: don't rewrite published history

Outline of this section

5 Clean local history

- Avoiding merge commits: `rebase` Vs `merge`
- Rewriting history with `rebase -i`

Rewriting history with `rebase -i`

- `git rebase`: take all your commits, and re-apply them onto upstream
- `git rebase -i`: show all your commits, and asks you what to do when applying them onto upstream:

```
pick ca6ed7a Start feature A
pick e345d54 Bugfix found when implementing A
pick c03fffc Continue feature A
pick 5bdb132 Oops, previous commit was totally buggy

# Rebase 9f58864..5bdb132 onto 9f58864
#
# Commands:
#  p, pick = use commit
#  r, reword = use commit, but edit the commit message
#  e, edit = use commit, but stop for amending
#  s, squash = use commit, but meld into previous commit
#  f, fixup = like "squash", but discard this commit’s log message
#  x, exec = run command (the rest of the line) using shell
#
# These lines can be re-ordered; they are executed from top to bottom.
#
# If you remove a line here THAT COMMIT WILL BE LOST.
#
# However, if you remove everything, the rebase will be aborted.
```

`git rebase -i` commands (1/2)

p, pick	use commit (by default)
r, reword	use commit, but edit the commit message Fix a typo in a commit message
e, edit	use commit, but stop for amending • Once stopped, use `git add -p`, `git commit -amend`, ...
s, squash	use commit, but meld into previous commit
f, fixup	like "squash", but discard this commit's log message • Very useful when polishing a set of commits (before or after review): make a bunch of short fixup patches, and squash them into the real commits. No one will know you did this mistake ;-).

`git rebase -i` commands (2/2)

x, exec run command (the rest of the line) using shell

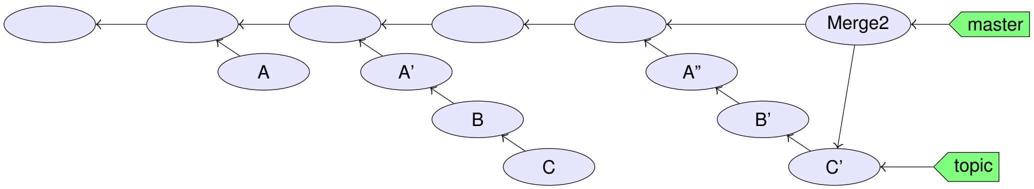
- Example: `exec make check`. Run tests for this commit, stop if test fail.
- Use `git rebase -i --exec 'make check'`[3] to run `make check` for each rebased commit.

[3] Implemented by Ensimag students!

Outline

Git's reference journal: the reflog

- Remember the history of local refs.
- $\neq$ ancestry relation.



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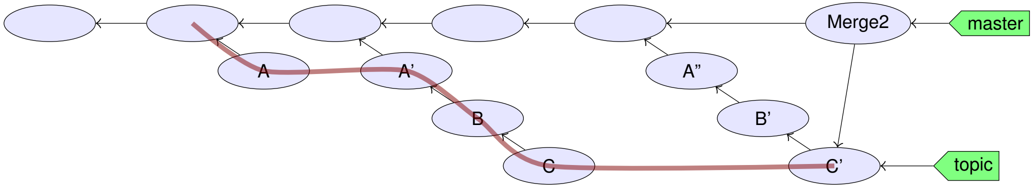

Git’s reference journal: the reflog

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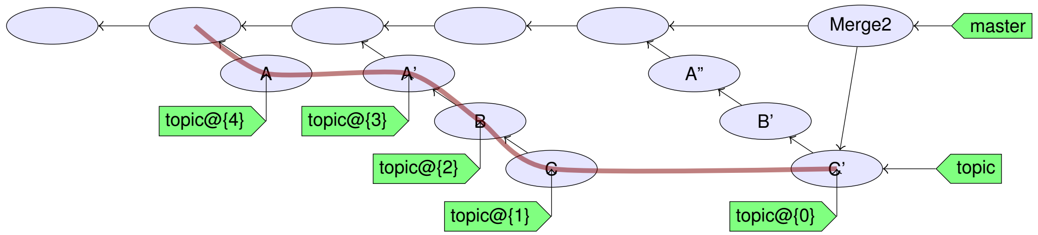

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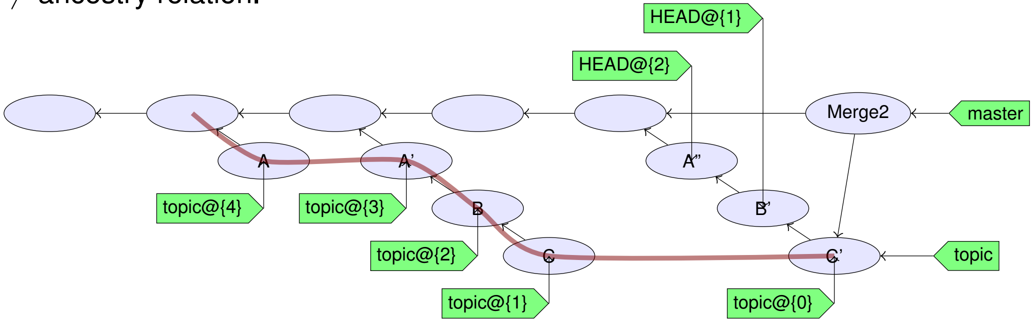


- `ref@{n}`: where *ref* was before the *n* last ref update.
- `ref~n`: the *n*-th generation ancestor of *ref*
- `ref^`: first parent of *ref*
- `git help revisions` for more

Outline

Outline of this section

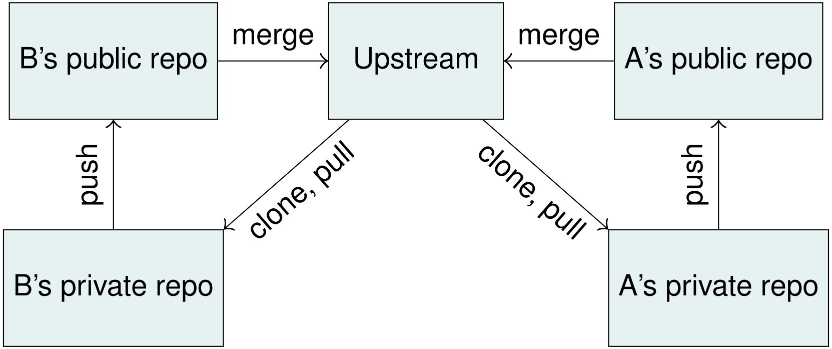
Centralized workflow

```
do {
   while (nothing_interesting())
      work();
   while (uncommited_changes()) {
      while (!happy) { // git diff --staged ?
         while (!enough) git add -p;
         while (too_much) git reset -p;
      }
      git commit; // no -a
      if (nothing_interesting())
         git stash;
   }
   while (!happy)
      git rebase -i;
} while (!done);
git push; // send code to central repository
```

Outline of this section

Triangular Workflow with pull-requests

- Developers pull from upstream, and push to a “to be merged” location
- Someone else reviews the code and merges it upstream



Pull-requests in Practice

Contributor	create a branch, commit, push
Contributor	click “Create pull request” (GitHub, GitLab, BitBucket, ...), or `git request-pull`
Maintainer	receives an email
Maintainer	review, comment, ask changes
Maintainer	merge the pull-request

Outline of this section

Code Review

- What we'd like:
  1. A writes code, commits, pushes
  2. B does a review
  3. B merges to upstream
- What usually happens:
  1. A writes code, commits, pushes
  2. B does a review
  3. B requests some changes
  4. ... then ?

Iterating Code Reviews

- At least 2 ways to deal with changes between reviews:
  1. Add more commits to the pull request and push them on top
  2. Rewrite commits (`rebase -i`, ...) and overwrite the old pull request
     - ⋆ The resulting history is clean
     - ⋆ Much easier for reviewers joining the review effort at iteration 2
     - ⋆ e.g. On Git's mailing-list, 10 iterations is not uncommon.

Triangular Workflow: Advantages

- Beginners integration:
  - start committing on day 0
  - get reviewed later
- In general:
  - Do first
  - Ask permission after
- For Open-Source:
  - Anyone can contribute in good condition
  - “Who’s the boss?” is a social convention

Outline of this section

Continuous Integration: example with GitLab-CI

https://github.com/moy/travis-demo

- Configuration (`.gitlab-ci.yml`):

```
before_script:
  - pip install flake8
  - pip install rstcheck

python_3_5:
  image: python:3.5
  script:
  - flake8 .
  - rstcheck *.rst
  - ./test.py

python_2_7:
  image: python:3.5
```

Continuous Integration: example with GitHub and Travis-CI

https://github.com/moy/travis-demo

- Configuration (`.travis.yml`):

```
language: python
python:
  - "2.7"
  - "3.4"
install:
  - pip install pep8
script:
  - pep8 main.py
  - ./test.py
```

- Use: work as usual ;-). Tests launched at each `git push`.

Outline

More Documentation

- `http://ensiwiki.ensimag.fr/index.php/Maintenir_un_historique_propre_avec_Git`
- `http://ensiwiki.ensimag.fr/index.php/Ecrire_de_bons_messages_de_commit_avec_Git`

Outline

Exercises

- Visit `https://github.com/moy/dumb-project.git`
- Fork it from the web interface (or just `git clone`)
- Clone it on your machine
- Repair the dirty history!