Git Cheatsheet

by Blair Labatt III

1 Work

Terminology & state machine:

State	Index	W-Dir	Next
Untracked	?	?	Add
Unmodified	-	-	Edit
Modified	-	M	Stage
Staged	[A|M]	[M]?	Commit

You can rm from "untracked" or git rm from any other state.

git reset

Reset moves HEAD's branch & HEAD, versus checkout, which only moves HEAD. Below, <ref> ∈ {SHA1, branch, file path}:

```
git reset <ref> # move HEAD bch & idx to ref
git reset --mixed <ref> # equiv to above
git reset --soft <ref> # Move HEAD brch ¬ idx
git reset --hard # revert WD, idx & brch
# Only the --hard option is dangerous to WD.
# Revert specific file in working directory:
git reset <file> # file in WD Δs to last HEAD
git reset <SHA> <file> # revert to specific SHA
git checkout -- <file> # "unsafely" revert file
```

git add

```
git add <filename> # add to index
git add . # stage all changed
git add --all # stage all
git add -i # interactive staging
```

git commit

```
git commit -m 'message' # commit all staged
git commit -am 'message' # commit all tracked
git commit -a --amend # redo last commit
git commit --amend # tweak last commit
```

git tag

```
git tag # show tags
git tag -l # same as above
git tag -l <tag_ref> # show all matches
git tag "<str>" # create "lightweight" tag
git tag -a <str> -m "<str>" # "annotated" tag
git tag -a <tag> <hash> # after-the-fact tag
# using tags:
git show <tag> # display commit @ <tag>
git checkout <tag> # checkout tagged commit
# remote tags:
git push origin <tag> # explicit push required
git push <remote> --tags # push all tags
# deleting tags:
git tag -d <tag> # delete locally
git push <remote> --delete <tag> # remotely
# sign tags (must disseminate pub key):
git tag -s v1.5 # sign
```

git rm

```
git rm <file> # stage <file>'s removal
git rm -f <file> # remove modified / staged
git rm --cached <file> # untrack
Can use globs instead of filenames:
git rm \* # anything ending in ~
```

git mv

```
git mv <old> <new> # rename to <new>
This is shorthand for:
$ git rm _; mv _ _; git add _
on a tracked file.
```

git stash

```
git stash push #
git stash list #
git stash apply #
git stash drop # remove from stack
git stash pop # apply & drop last
```

git cherry-pick

Like a rebase for a single commit. Can cherry-pick multiple commits into one prior to integration, or cherry-pick single commit onto master instead of rebasing.

```
git cherry-pick <SHA1> #
```

2 Observe

git status

```
git status # show w-dir vs index
git status -s # short-hand view
```

git diff

```
git diff # wd vs repo
git diff --staged # idx vs repo
git diff master orgin/master # diff vs remote
git difftool # use a different diff
```

git log

```
git log #
git log -p # shows Δ's ("patches")
git log -3 # last 3
git log --stat # include summary info
git log --graph # graphical
git log --decorate --all # show branching
git log --pretty=oneline # beautiful
git log --pretty=format:"<fmt>" # format
```

- %H commit hash
- %h abbrev. hash
- %T Tree hash
- %t abbrev. tree
- %P parent hashes
- %p abbrev. prnt
- %an author name
- %ae auth. email
- %ad auth. date
- %ar relative date
- %cn commiter name
- %ce commit. email
- %cd commit date
- %cr relative date
- %s subject

Subselect & bracked logs to show:

```
git log --since=<date> # bracket low
git log --since=2.weeks # for example
git log --until=<date> # bracket high
git log --author=<auth> # by author
git log --grep <pattrn> # matching pattern
git log --S <str> # "pickaxe" option
git log brnA..brnB # only brnB, ¬ brnA
git log --not brnA brnB # same as above
```

git describe

Create version # from latest tag:

```
git describe master # yields v1.6-<SHA1>
```

git shortlog

```
git shortlog master --not v1.5 # since 1.5
```

git grep

- -p ... enclosing block
- -e <str> ... exists string
- --and ... complex matches

git blame

```
git blame <file> # show last Δs, authors
git blame -L 51,59 <file> # restrict to line #s
git blame -C <file> # find Δ-origins, other files
```

git reflog

```
git reflog # local history of HEAD, branches
```

git show

```
git show master@{5} # using reflog labels
git show master@{yesterday} # special labels
```

git bisect

Iteratively search for breaking Δs by repeatedly resetting old commits. Is a commit good or bad?

```
git bisect start HEAD v1.0 # from 1.0 to HEAD
```

3 Branch

Types of commits:

- initial commit ... no parent
- normal commit ... one parent
- merge commit ... multiple parents

Types of branches:

- "Long-running" branches
- "Topic" branches
- "Tracking" branches

Types of history:

- Original, unedited (3-way merges)
- Curated, linearized (rebase, cherry-pick)

git branch

```
git branch -v # show branches
git branch -vv # show tracking branches
git branch --merged # end-of-road branches
git branch --no-merged # show WIP branches
git branch <bname> # new branch @ HEAD
git branch -d <branch> # delete
# Set upstream branch:
git branch -u <remote>/<branch>
```

git checkout

A checkout moves HEAD to a named branch or SHA commit. You cannot checkout a branch that clashes with changes in your working directory.

```
git checkout <branch> # move HEAD
git checkout -b <bname> # create & checkout
git switch -c <bname> # ibid, new in v2.23
# Create remote tracking branch:
git checkout -b <name> <remote>/<branch>
git checkout --track <remote>/<branch>
```

git merge

```
git merge <branch> [<into>] # * assumed
A merge is three-way, generally, but a two-way
"fast-forward" when <branch> is a direct ancestor of <into>.
git merge @{u} # shorthand for upstream
git mergetool # visual conflict-resolution
git merge --squash brnA # single parent
```

git rebase

Rebasing replays changes from one line of work onto another in the order they were introduced. Only rebase if it's the project's convention to do so and if you want to clean up your clutter. **Never rebase anything you've pushed** (although it's technically still okay if no one else will base their work on those commits).

```
# Rebase <topic> onto <base>:
git rebase <base> <topic> # general form
# Now, <base> is fast-forwardable:
git checkout <base>; git merge <topic>
git rebase master # rebase * onto master
# Rebase c onto a, holding off on b:
git rebase --onto <a> <b> <c>
# Split, squash, edit, reorder commits:
git rebase -i ... # interactive
```

git merge-base

Finds common ancestor:

```
git merge-base brn master # find
git diff ${git merge-base brn master} # use
git diff master...brn # shorthand for above
```

4 Share & Synchronize

Major sync work-flows:

- Centralized – any can push to a shared bare
- Managed – only manager can push
- Hierarchical – multiple levels of pushing

git fetch

```
git fetch <remote> # download latest
git fetch <remote> <refspec> # specific rqst
```

git push

Only works if:

- you have write access to <to>
- no on has pushed since your last fetch

If 2nd condition isn't true, it is an attempted push of "non-fast-forward" changes.

```
git push <to> <from> # generally
git push origin master # specifically
git push -u origin my_brn # set remote & push
git push <refspec> # eg, frombrn:tobrn
Push message includes a statement like:
 1edee6b..fbff5bc master -> master
ie, <oldref>..<newref> <frombr> -> <tobr>
Pushes on rebased branches require forcing:
git push -f myfork brnA # force
```

git pull

```
git pull # git fetch + git merge
git pull <url> # one-time: don't set remote
```

git remote

```
git remove -v # show all remotes
git remote add [<nickname>?] <url> # add
git remote show <remote> # inquire
git remote rename <old> <new> # new alias
git remote rm # no longer track remote
git remote set-head #
git remote prune #
git remote set-branches #
```

git request-pull
Absent GitHub forks & pull-requests, use this to facilitate the integration process. (A fork is just a clone to or push to an accessible repo.)
`git request-pull origin/master myfork # text`

GitHub
Generally, pull requests don't close right away. The idea is to open, collaborate, & finally merge. Use markdown to reference IDs & prettify:
- #<id> reference branch, commit, or PR
- username#<refid> more specifically
- username/rep#<id> or externally
- <SHA1> unchanging, concretely
- :<emo>: enter an emoji
- [X] item A [] item B or checklist
- java"'if(true) a=b;"' code snippet
- > whan that aprile block quote

"Trackback" event is then created in referenced conversation.

5 Setup
git config
Manipulate configuration settings.
```
git config --system <cfg> # in /etc/gitconfig
git config --global <cfg> # in ~/.gitconfig
git config --local<cfg> # in ~.git/config
# where <cfg> is <key> <value>, for example:
git config --global core.editor vim
git config <key> # query value
git config --list # show all cfgs
git config --list --show-origin # cfg origin
# Creating aliases:
git config --global alias.<als> <cmd>
git config alias.l log --oneline # examples
git config --global alias.unstage 'reset HEAD -- '
# Simplify long commands:
git config --local remote.pushDefault origin
```
Run `man git-config` for more config options.

git help
```
git help <cmd> # general inquiry
git help config # eg: help on "config"
git <cmd> -h # abridged help
```

git init
Start new git repository locally.
```
$ mkdir /Projects/moustrap # create
$ cd /Projects/moustrap # relocate
$ vim innovation.rs # innovate
git init # track
```
Create a central hub repo, ie one you can push to that lacks a working dir:
```
$ mkdir /Projects/central # create
$ cd /Projects/central # relocate
git init --bare # no working dir.
```

git clone
Grab & track an existing, remote git repository.
```
git clone <url> # store locally in \
git clone <url> <name> # set local <name>
git clone <url> -o <name> # set remote name
git clone --bare <url> # no working dir
git clone ssh://[user@]server/project.git # SSH
```

.gitignore
Pattern matching rules:
- comment out line with `#`
- standard globs (`*`, `?`) work recursively
- avoid recursion by prefacing with `\`
- match directory recursion by `**`
- specify directory by suffixing with `\`
- negate a pattern with `!`
- case matching with `[abc]` or `[a-c]`

For example:
```
(file) *.a # ignore all *.a
(file) !lib.a # do track lib.a
(file) /TODO # ignore top-level /TODO
(file) build/ # ignore anything under build/
(file) doc/*.txt # ignore doc txt's
(file) doc/**/*.pdf # ignore all pdf's
```

Key Management
```
ssh-keygen -o # create pub/prv key pair
cat ~/.ssh/id_rsa.pub # view pub key
```

Server Administration
There are several ways to serve git (and cons):
1. The local filesystem (no redundancy)
2. An SSH server (cumbersome user admin)
3. GIT protocol (no user admin possible)
4. "Smart" HTTP (complex web server)
5. Self-hosting, eg GitLab (time to set up)
6. Commercial hosting, eg Github (money)

```
# Set up remote access SSH server:
mkdir .ssh && chmod 700 .ssh && /
touch .ssh/authorized_keys && /
chmod 600 /ssh/authorized_keys
# Allow jack access to ssh user:
cat /tmp/id_rsa.jack.pub » /
~/.ssh/authorized_keys
# Set up Git-protocol server:
git daemon --reuseaddr <path>
cd prj_path/ && touch git-daemon-export-ok
```

6 Patching
Partial changes
Use --patch with: git [add|reset|checkout|stash]:
```
git add --patch # interactive patch staging
```

git format-patch
Generate emailable patches, one per commit past indicated branch (here origin/master):
```
git format-patch -M origin/master
```

git [send]
```
cat *.patch | git imap-send
git send-email *.patch
```

git [apply|am]
Use former if user submitted diff format "patch"; latter if user submitted format-patch patches. Latter is better: already contains commit metadata.
```
git apply /tmp/pname.patch
git am pname.patch
git am -3 pname.patch # attempt 3-way merge
```

7 Advanced \ Miscellaneous
git submodule
```
# Add (remove here) a submodule to project:
git submodule add <url> # add submodule
# Getting a project with submodules:
git clone --recurse-submodule <url> # init all
# ... or, if you forget to --recurse-submodule,
# you can initialize each SM manually:
git submodule init # initialize single SM
git submodule update # fetch & checkout
# where "update" is the usual wrapper:
cd <SM>; git fetch; git merge # ≡ update
git diff --submodule # show SM Δs
# Pull (or push) a repo with Δed submodules:
git pull --recurse-submodules # or use update
# Merge or rebase (--rebase) local & remote Δs:
git submodule update --remote --merge
# Do same Δs across all SMs:
git submodule foreach '<cmd>' # cmd is bash
```
Handy configurations:
- diff.submodule
- submodule.<SM>.branch
- status.submodulesummary
- submodule.recurse***
- push.recurseSubmodules

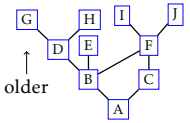
git rerere
Automatically resolve conflicts similar to ones you've fixed in previous merges. Rerere essentially caches pre- and post-merge diffs.
```
git config --global rerere.enabled true
git rerere # direct invocation
```

Porcelain
archive	create tarball, etc of .git filesystem
bundle	package & share w/o network
fsck	
gc	manually invoke git garb. collector
replace	Δ hashes for similar commits

Plumbing
"Object" ∈ {blob (file), tree, commit, tag}
"Reference" ∈ {head (branch), tag, remote}

cat-file	inspect git object (try: -p -t)
commit-tree	requires 1 tree (content) & n objects
filter-branch	Δ all history!!
hash-object	create [& write] objects into git db
ls-files	
ls-remote	
ls-tree	
read-tree	load tree into index
rev-list	
rev-parse	
show-branch	
show-graph	
symbolic-ref	set HEAD
update-index	Δ & add to index from file or gitdb
update-ref	set branch, HEAD, tag pointers
verify-pack	show how git packs Δs into "packfiles"
write-tree	create tree from index

Refspec
Syntax is: [+]<src>:<dest> Often, can use <refspec> instead of a <ref> like a branch, tag, etc.

8 Ancestry


~# is #th ancestor;
^# is either:
1 - merge into or
2 - merge from

Complex exclusions:
```
git log ^<ref> # synonym for --not
git log brA brB ^brC # from A or B not C
```

Paths
A		A^0	
B	A^	A^1	A~1
C	A^2	A^2	
D	A^^	A^1^1	A~2
E	B^2	A^^2	
F	B^3	A^^3	
G	A^^^	A^1^1^1	A~3
H	D^2	B^^2	A^^^2
I	F^	B^3^	A^^3^
J	F^2	^3^2	A^^3^2

Ranges
Args	Expanded	Selected
D		G H D
D F		G H I J D F
^G D		H D
^D B		E I J F B
^D B C		E I J F B C
C		I J F C
B..C	= ^B C	C
B...C	= B ^F C	G H D E B C
B^-	= B^..B	
	= ^B^1 B	E I J F B
C^@	= C^1	
	= F I J F	
B^@	= B^1 B^2 B^3	
	= D E F	D G H E F I J
C^!	= C ^C^@	
	= C ^C^1	
	= C ^F	C
B^!	= B ^B^@	
	= B ^D ^E ^F	B
F^! D	= F ^I ^J D	G H D F

9 Scripting
Hooks
Client Side: Pre and post- events like commit, push, etc, git can run script in .git/hooks/ directory. These are excluded from version control. **Server Side**: Similar to client side, but are included in pushes, and used to implement controlled team processes. **GitHub**: Upon <event> (often a push), GitHub emits an HTTP post to indicated url. The server listening there can parse, interpret & act according to arbitrary logic.

Github API
GET a public HTTP end point like this:
```
git curl <EP> # basic api GET request
```
Or authenticate (token or OAuth) then POST:
```
curl -H "ContentType: application/json "\
     -H "Authorization: token TOK "\
     --data '<json>' <EP>
```
Top level end-points:
- activity
- data
- gists
- actions
- interactions
- issues
- organizations
- projects
- PRs
- reactions
- teams
- users