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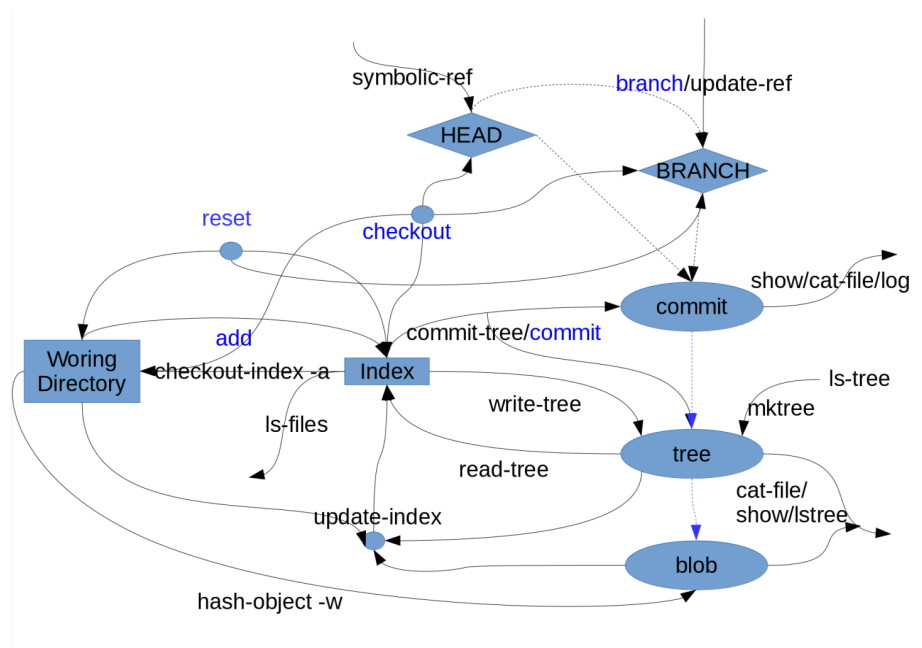
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Git as I understand (4): working tree,index,HEAD,branch,commit and local work flow

In this post, I will describe how git operate on individual entities like working tree, index,HEAD,branch, commit, tree, and how we use these basic level operation to compose a sensible daily work flow. We will constraint ourselves to local work flow in this post. In later post, we will talk about cooperation work flow among remote repositories.



<http://4.bp.blogspot.com/-YoxvROR5XJY/U36PQTaTv-I/AAAAAAAAABmE/Hvg6THnEBqY/s1600/gitk1.png>

git basic commands

1. work tree

A work tree is generally on the same level directory with the ".git" directory, but it can also resides in other place. We need to setup environment variable to tell git command where to find the git repository, and where the working tree is, so git command can work properly. Concept wise, one working tree is linked with a HEAD and an index file, and by design, git will only allow one working tree for one repository at a time, because although we can specify an index file for a work tree, but only one HEAD exists in git repository.

```

[luke@rmbp git]$ git init --bare project1
Initialized empty Git repository in /tmp/git/project1/
[luke@rmbp git]$ mkdir wt
[luke@rmbp git]$ export GIT_DIR=/tmp/git/project1/
[luke@rmbp git]$ export GIT_WORK_TREE=/tmp/git/wt
  
```

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```

[luke@rmbp git]$ git log
fatal: bad default revision 'HEAD'

[luke@rmbp wt]$ echo hello > hello.txt

[luke@rmbp wt]$ git add hello.txt
[luke@rmbp wt]$ git commit -m "first commit"

[master (root-commit) df04880] first commit

1 file changed, 1 insertion(+)
create mode 100644 hello.txt

[luke@rmbp wt]$ git log
commit df04880982563a946784bae5bf6e516d9dc47d42
Author: Luke Luo <luke.jf.luo@gmail.com>
Date: Thu May 22 13:44:48 2014 +0800

    first commit

[luke@rmbp wt]$ git status
On branch master
nothing to commit, working directory clean

```

After we setup a bare repository and environment variables (GIT_DIR and GIT_WORK_TREE), we can use git commands (status,log) in directory other than working tree, since git knows where the repository and work tree is.

The default index file (GIT_INDEX_FILE) for this work tree resides by default in "\$GIT_DIR/index", and the default object store (GIT_OBJECT_DIRECTORY) resides in "\$GIT_DIR/objects".

We already know how to put entries into index via "git update-index/read-tree". If we want to copy all file/dir in index to work tree, we can do "git checkout-index -a":

```

[luke@rmbp wt]$ ls
hello.txt

[luke@rmbp wt]$ git status
On branch master
nothing to commit, working directory clean

[luke@rmbp wt]$ git ls-files -s
100644 3b18e512dba79e4c8300dd08aeb37f8e728b8dad 0 hello.txt

[luke@rmbp wt]$ rm hello.txt

[luke@rmbp wt]$ git status
On branch master
Changes not staged for commit:
    (use "git add/rm <file>..." to update what will be committed)
    (use "git checkout -- <file>..." to discard changes in working directory)

    deleted:    hello.txt

no changes added to commit (use "git add" and/or "git commit -a")

```

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nothing to commit, working directory clean

2. index

index is a very critical native structure in git. All tree must first be staged into index, and "write-tree" will create a tree object according to contents in index. There are no other way to create a tree object in git. Many git books describe index as a peculiar optional staging work flow in git comparing to other SCMs. Such description is only partly true, because you can not skip index to do any meaning operation in git.

Index bridges between work tree and object repository. Tree contents flow in bi-direction between work tree and object store via index. "git ls-files" will list content in index, and "git diff/status" will show difference among work tree, index and commit.

index also includes support to construct snapshot tree for merging. Different version of one files during a merge could co-exist within the index, so git knows which file needs to be resolved and it can show you the diff among versions in a typical "3-way" merge. Here is an example:

```
[luke@rmbp index]$ git merge test
Auto-merging hello.txt
CONFLICT (content): Merge conflict in hello.txt
Automatic merge failed; fix conflicts and then commit the result.

[luke@rmbp index]$ git ls-files -s
100644 ce013625030ba8dba906f756967f9e9ca394464a 1 hello.txt
100644 22a5dfdfc80331be8a7f28c59e7646034a40d48a 2 hello.txt
100644 748536090c67dbe2ef825e4fcd8f83901215f601 3 hello.txt

[luke@rmbp index]$ git cat-file -p ce013625030ba8dba906f756967f9e9ca394464a
hello

[luke@rmbp index]$ git cat-file -p 22a5dfdfc80331be8a7f28c59e7646034a40d48a
hello master

[luke@rmbp index]$ git cat-file -p 748536090c67dbe2ef825e4fcd8f83901215f601
hello test

[luke@rmbp index]$ git status
On branch master
You have unmerged paths.
   (fix conflicts and run "git commit")

Unmerged paths:
   (use "git add <file>..." to mark resolution)


   both modified:   hello.txt

no changes added to commit (use "git add" and/or "git commit -a")
[luke@rmbp index]$ cat hello.txt
```


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3. commit

When we deliver a "changeset" into git repository, we say we will commit the change. To construct a commit object, we need to specify:

- a snapshot tree, which is the current status of index
- 0 or 1 or more parent commits, so we can construct a working history/lineage(DAG) among commits;
- Author and Committer information, which are generally derived from git configuration;
- data/time, which can be obtained via system call;
- a commit message, which should be provided via command line or via a temporary file saved via an editor;

In theory, item a through e could be prepared separately. git commit does not care how these items are prepared. For contents in index, we can import contents into index from working directory via "git add", or from tree stored in object store via "git read-tree", or manually select entries/items from object store via "git update-index", or the merged result of two or more commits. For parent commits, we can specify any commits as parent commits. The related tree contents of these specified parent commits might have nothing to do with the contents in index. Git itself does not impose any constraints between parent commits and content in index. This design exactly explains why git is called a "snapshot based" SCM, since it really only records a snapshot of items a to e in a time into a commit object. Git does not care how you reach such a snapshot state. This is what happens when we do a "git commit-tree".

Such a design give end users great leeway to select how they could use git.

Git leave the selection of work flow model to end user. Git only cares about the final results (item a to e) of such work flow. Such freedom is great for veteran users. But for first time user, bearing in mind a work flow beforehand to use Git is a formidable task. Naturally, Git provides pre-setup work flow (or conventions) for normal users. Such convention will cover more than 90% of use cases.

Many of "porcelain" command provide such work flow/convention to construct snapshot tree in index and parent commits for new commit. For example, "git merge" will help you construct a commit based on different versions of files. "git cherry-pick" help you pick content from a commit and merge it into new commit.

4. basic work flow

Git high level commands mandate you to work under a "branch". Branch is represented as a ref file under ".git/refs/heads/xxx". It contains a SHA1 value to a certain commit. Git provides a default branch "master". You can create multiple branch ref files, and Git provide a symbolic reference "HEAD" which generally points to one and only one of the branch. The pointed branch is

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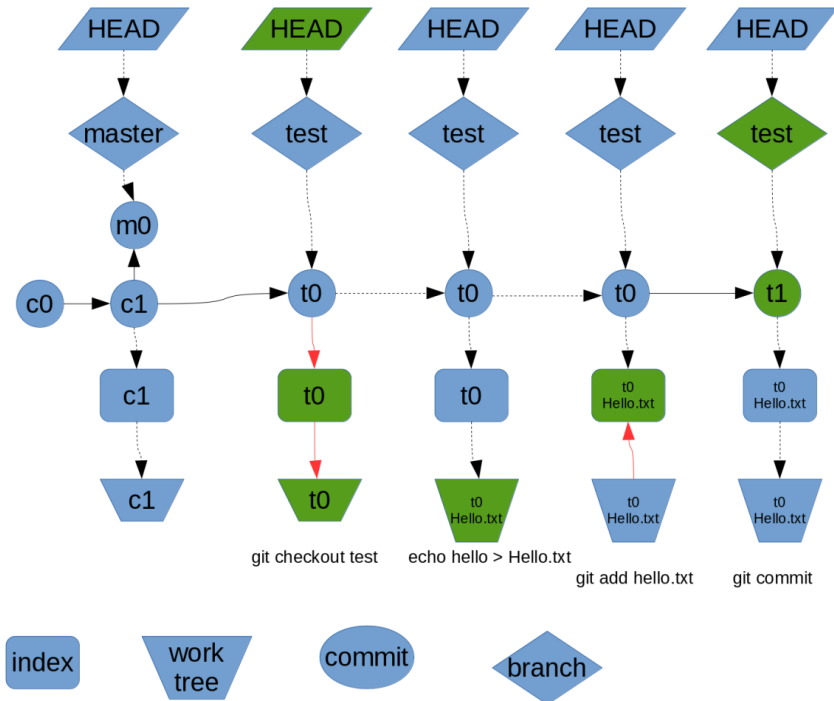
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a. checkout to a new branch, add a new file, then commit



[\[http://2.bp.blogspot.com/-893N0kZlpkc/U36cnKH081I/AAAAAAAAABmM/mVA3whTp38E/s1600/gitk2.png\]](http://2.bp.blogspot.com/-893N0kZlpkc/U36cnKH081I/AAAAAAAAABmM/mVA3whTp38E/s1600/gitk2.png)

```
. git checkout test
HEAD=master ----> HEAD=test
index=read-tree(t0)
work tree = index
```

As we can see, "git check branch" will point HEAD to new branch head, initialize the index to new branch head commit, and populate working according to new index content.

```
. git add hello.txt
index=t0+hello.txt
.git commit
parent commit=HEAD
commit
test=t1
```

b. adjustment within a branch (git reset)

When you work under a branch, instead of a linear progress with commits on top of another commits, you can reset the branch tip to any commit. You have options to update the index and work tree to the content of new commit. There are three options:

```
git reset --soft
```

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Several usage scenario are:

. You make some local change, and stage them into index. You want to discard all changes and recover state back to current commit, optionally work tree could also revert to current commit:

```
# reset index only, "HEAD" is optional"
```

```
git reset --mixed HEAD
```

```
# reset both index and work tree, HEAD is optional
```

```
git reset --hard HEAD
```

```
# reset only only certain paths/files in index, but not in work tree
```

```
[luke@rmbp index]$ git add test.txt
```

```
[luke@rmbp index]$ git ls-files -s
```

```
100644 748536090c67dbe2ef825e4fcd8f83901215f601 0 hello.txt
```

```
100644 fe0aa778d6dac2263646a421f9fbad5300f70636 0 test.txt
```

```
# reset only certain paths/files
```

```
[luke@rmbp index]$ git reset -- test.txt
```

```
[luke@rmbp index]$ git ls-files -s
```

```
100644 748536090c67dbe2ef825e4fcd8f83901215f601 0 hello.txt
```

```
[luke@rmbp index]$ ls
```

```
hello.txt test.txt
```

```
[luke@rmbp index]$ git status
```

```
On branch master
```

```
Untracked files:
```

```
(use "git add <file>..." to include in what will be committed)
```

```
test.txt
```

```
nothing added to commit but untracked files present (use "git add" to track)
```

.discard several commits on a branch and revert to previous commit

```
[luke@rmbp reset]$ git log --oneline --graph
```

```
* be62aba a3
```

```
* 27fe2d1 a2
```

```
* e5c1948 a1
```

```
[luke@rmbp reset]$ git reset --hard HEAD~2
```

```
HEAD is now at e5c1948 a1
```

```
[luke@rmbp reset]$ git log --oneline --graph
```

```
* e5c1948 a1
```

. reset a branch to another branch

```
[luke@rmbp reset]$ git branch
```

```
master
```

```
* test
```

```
[luke@rmbp reset]$ git log --oneline --graph
```

```
* 4994d4a b2
```

```
* e260b7b b1
```


```
* 1927c09 a1
```

```
[luke@rmbp reset]$ git checkout master
```


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
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```

* master
    test

[luke@rmbp reset]$ git checkout test

Switched to branch 'test'

[luke@rmbp reset]$ git branch

    master
* test

[luke@rmbp reset]$ git reset --hard master

HEAD is now at a6888a2 a3

[luke@rmbp reset]$ git log --oneline --graph

* a6888a2 a3
* c85878d a2
* 1927c09 a1

5. commit --amend

"git commit --amend" generate a new commit, and the parent commit of the
new commit is routed to HEAD~1 instead of HEAD. After commit, the
original HEAD will be an orphaned node, and branch tip is the new commit:

[luke@rmbp a]$ git log --oneline

bc0fd75 a2
b9e77e0 a1

[luke@rmbp a]$ git status -s

M a1.txt
A a3.txt

[luke@rmbp a]$ git commit --amend

[master b3b16db] a2 amend

2 files changed, 2 insertions(+)

create mode 100644 a2.txt
create mode 100644 a3.txt

[luke@rmbp a]$ git log --oneline

b3b16db a2 amend
b9e77e0 a1

```

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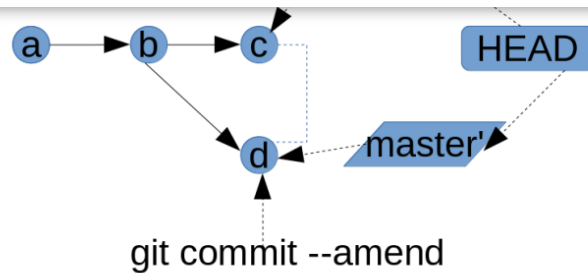
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In the above diagram, a new commit "d" is generated based on node "c", the original branch tip, and d's parent commit is "b", that is "c^"; After commit, branch tip points to "d", and "C" become an orphaned node.

6. stash

stash is a special kind of "HEAD". A stash is recorded in ref ".git/refs/stash".

```
[luke@rmbp project]$ git reflog stash
```

```
6ced678 stash@{0}: WIP on doc: 79f4756 merged of doc and info
```

```
e962b40 stash@{1}: WIP on doc: 79f4756 merged of doc and info
```

Here is an example of "git stash":

```
[luke@rmbp s]$ git log
```

```
commit e774c05c99a9f3e6e2d8490fceb7277100a44779
```

```
Author: Luke Luo <luke.jf.luo@gmail.com>
```

```
Date: Sun Jun 1 11:43:55 2014 +0800
```

```
a1
```

```
[luke@rmbp s]$ git ls-tree master
```

```
100644 blob da0f8ed91a8f2f0f067b3bdf26265d5ca48cf82c a1.txt
```

```
[luke@rmbp s]$ ls
```

```
a1.txt a2.txt a3.txt a4.o
```

```
[luke@rmbp s]$ git status -s
```

```
A a3.txt
```

```
?? a2.txt
```

```
?? a4.o
```

Here we have "a1.txt" already in master branch. "a2.txt" is un-tracked, "a4.o" is an ignored file, and "a3.txt" has been added into staged area(index). "git stash --all " will stash both index, untracked file, and ignored file:

```
[luke@rmbp s]$ git stash --all
```

```
Saved working directory and index state WIP on master: e774c05 a1
```

```
HEAD is now at e774c05 a1
```

```
[luke@rmbp s]$ git log --graph --all --oneline --decorate
```

```
*- 1e7ac4b (refs/stash) WIP on master: e774c05 a1
```

```
| \ \
```

```
| | * b7f5698 untracked files on master: e774c05 a1
```


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Date: Sun Jun 1 11:49:20 2014 +0800

index on master: e774c05 a1

diff --git a/a3.txt b/a3.txt

new file mode 100644

index 0000000..d616f73

--- /dev/null

+++ b/a3.txt

@@ -0,0 +1 @@

+a3

[luke@rmbsp sj]\$ git show b7f5698 (untracked+ignore file commit)

commit b7f569836036d11595ad0caafd03ea26e327d074

Author: Luke Luo <luke.jf.luo@gmail.com>

Date: Sun Jun 1 11:49:20 2014 +0800

untracked files on master: e774c05 a1

diff --git a/a2.txt b/a2.txt

new file mode 100644

index 0000000..c1827f0

--- /dev/null

+++ b/a2.txt

@@ -0,0 +1 @@

+a2

diff --git a/a4.o b/a4.o

new file mode 100644

index 0000000..88ba23d

--- /dev/null

+++ b/a4.o

@@ -0,0 +1 @@

+a4

[luke@rmbsp sj]\$ git show 1e7ac4b (stash commit)

commit 1e7ac4b2f55713aee9cb79999d14c35379841ec1

Merge: e774c05 e0d115f b7f5698

Author: Luke Luo <luke.jf.luo@gmail.com>

Date: Sun Jun 1 11:49:20 2014 +0800

WIP on master: e774c05 a1

Here we can see the final "stash" commit is the merge of 3 node: master itself, index content, untracked+ignored files. This is a so called "octopus merge".

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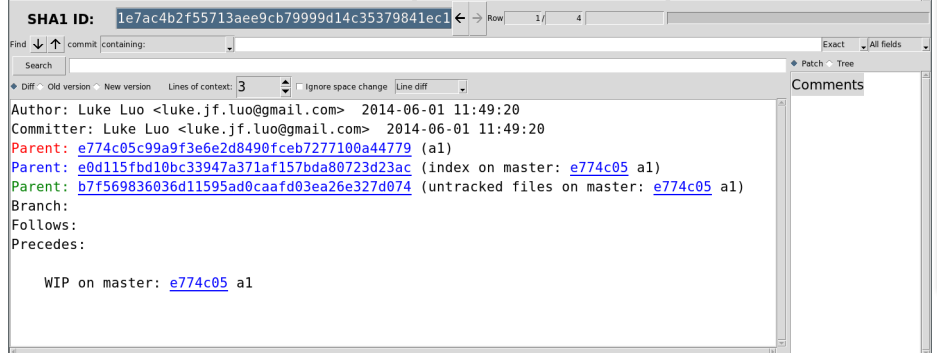
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[[http://4.bp.blogspot.com/-](http://4.bp.blogspot.com/-LhhcJhh_oYo/U4qk6K852dl/AAAAAAAAABnc/mffxYsQAAbk/s1600/gitk8.png)

[LhhcJhh_oYo/U4qk6K852dl/AAAAAAAAABnc/mffxYsQAAbk/s1600/gitk8.png](http://4.bp.blogspot.com/-LhhcJhh_oYo/U4qk6K852dl/AAAAAAAAABnc/mffxYsQAAbk/s1600/gitk8.png)]

Now let us apply this stash somewhere else.

```
[luke@rmbp s]$ git log --oneline
6b81a16 a5
e774c05 a1
[luke@rmbp s]$ ls
a1.txt a5.txt
[luke@rmbp s]$ git status -s
[luke@rmbp s]$ git stash apply
On branch master
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    new file:   a3.txt
Untracked files:
  (use "git add <file>..." to include in what will be committed)

    a2.txt
    a4.o

[luke@rmbp s]$ ls
a1.txt a2.txt a3.txt a4.o a5.txt
[luke@rmbp s]$ git status -s
A  a3.txt
?? a2.txt
?? a4.o
```

"git stash apply" play some tricks, so untracked files are still kept as untracked, and staged file as staged.

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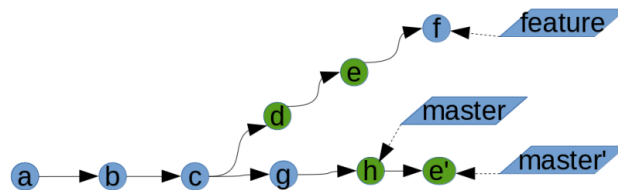
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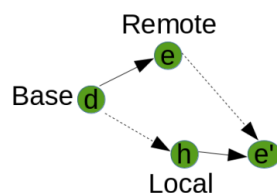
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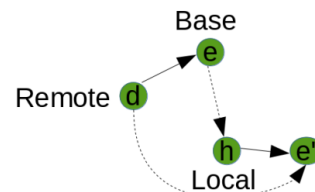
parent node instead of two.



"git cherry-pick e"



"git revert e"

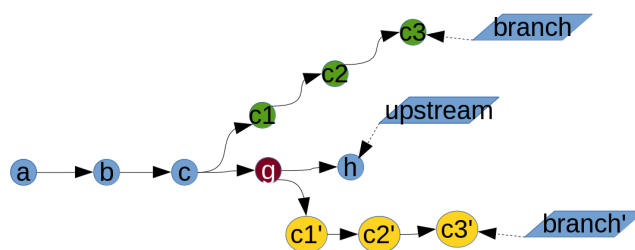


[\[http://3.bp.blogspot.com/-tbWhuywsqhA/U4pFS-1cE6l/AAAAAAAAABm8/jA3dWrDx7Rw/s1600/gitk6.png\]](http://3.bp.blogspot.com/-tbWhuywsqhA/U4pFS-1cE6l/AAAAAAAAABm8/jA3dWrDx7Rw/s1600/gitk6.png)

8. rebase

rebase is a series of cherry-pick.

git rebase upstream branch -onto g



[\[http://3.bp.blogspot.com/-ksFvhj6tWts/U4pQSefmEAI/AAAAAAAAABnM/-Kw174WNTTEY/s1600/gitk7.png\]](http://3.bp.blogspot.com/-ksFvhj6tWts/U4pQSefmEAI/AAAAAAAAABnM/-Kw174WNTTEY/s1600/gitk7.png)

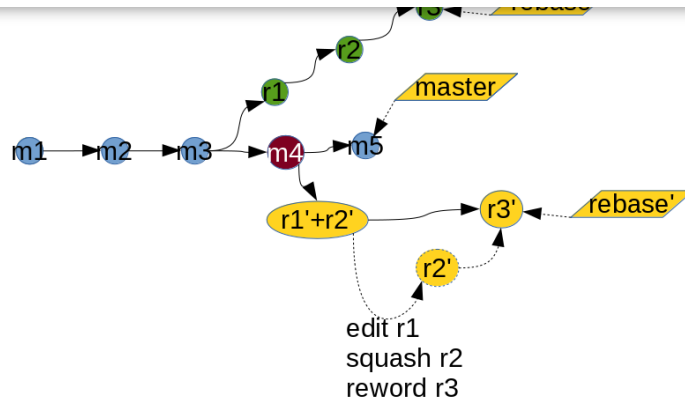
- C = [c1 c2 c3] = upstream..branch = ^upstream branch
- git checkout branch
- git reset --hard g
- for ci in C; do
 git cherry-pick ci;
done;

8. rebase --interactive

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[\[http://3.bp.blogspot.com/-](http://3.bp.blogspot.com/-NFGRYqdlsmA/U4rkUW4X3fI/AAAAAAAAABn8/f_TE61loQJE/s1600/gitk10.png)

[NFGRYqdlsmA/U4rkUW4X3fI/AAAAAAAAABn8/f_TE61loQJE/s1600/gitk10.png\]](http://3.bp.blogspot.com/-NFGRYqdlsmA/U4rkUW4X3fI/AAAAAAAAABn8/f_TE61loQJE/s1600/gitk10.png)

We will analyze the internal process of git rebase via an interactive rebase.

```
[luke@rmbp r]$ git branch
master
* rebase

[luke@rmbp r]$ git log --graph --decorate --oneline --all
* 652eb43 (master) m5
* 8b96b83 m4
| * eec6f27 (HEAD, rebase) r3
| * cb95f9d r2
| * ec49169 r1
|/
* 86e1152 m3
* 69bd729 m2
* 19e4a55 m1
```

Here we have two branch, "master" and "rebase". We will rebase branch "rebase" into node "8b96b83 m4" interactively.

```
[luke@rmbp r]$ git rebase --interactive --onto 8b96b83 master rebase
```

```

1 edit ec49169 r1
2 squash  cb95f9d r2
3 reword eec6f27 r3
4
5 # Rebase 652eb43..eec6f27 onto 8b96b83
6 #
7 # Commands:
8 # p, pick = use commit
9 # r, reword = use commit, but edit the commit message
10 # e, edit = use commit, but stop for amending
11 # s, squash = use commit, but meld into previous commit
12 # f, fixup = like "squash", but discard this commit's log message
```

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You can amend the commit now, with

```
git commit --amend
```

Once you are satisfied with your changes, run

```
git rebase --continue
```

First , we "edit" node "r1".

```
[luke@rmbp r]$ git log --oneline
e8ae488 r1
8b96b83 m4
86e1152 m3
69bd729 m2
19e4a55 m1

[luke@rmbp r]$ git show e8ae488
commit e8ae4882a26394e9c9966f0faf3183730c422e31
Author: Luke Luo <luke.jf.luo@gmail.com>
Date: Sun Jun 1 12:34:14 2014 +0800
```

```
r1
```

```
diff --git a/r1.txt b/r1.txt
new file mode 100644
index 0000000..f7d55cf
--- /dev/null
+++ b/r1.txt
@@ -0,0 +1 @@
+r1
```

```
[luke@rmbp r]$ ls
```

```
m1.txt m2.txt m3.txt m4.txt r1.txt
```

Right now, we can see "r1" has been cherry-pick onto node "m4". There are many files under ".git/rebase_merge" which records the current status of interactive rebase:

```
[luke@rmbp r]$ ls .git/rebase-merge/
amend author-script done end git-rebase-todo git-rebase-todo.backup head-
name interactive message msgnum onto orig-head patch quiet stopped-sha
```

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r1

diff --git a/r1.txt b/r1.txt

new file mode 100644

index 0000000..f7d55cf

--- /dev/null

+++ b/r1.txt

@@ -0,0 +1 @@

+r1

The "amend" file contains the SHA1 of "r1". It means when we do "rebase --continue", it actually will do a "git commit --amend". We will add an "edit.txt" then do "rebase --continue" to see what would actually happen:

[luke@rmbp r]\$git rebase --continue

[luke@rmbp r]\$ git log --oneline

f17875f r1 amend

8b96b83 m4

86e1152 m3

69bd729 m2

19e4a55 m1

[luke@rmbp r]\$ git show f17875f603576b472e453b915b6047db8a25eb1e

commit f17875f603576b472e453b915b6047db8a25eb1e

Author: Luke Luo <luke.jf.luo@gmail.com>

Date: Sun Jun 1 12:34:14 2014 +0800

r1 amend

diff --git a/edit.txt b/edit.txt

new file mode 100644

index 0000000..366226f

--- /dev/null

+++ b/edit.txt

@@ -0,0 +1 @@

+edit

diff --git a/r1.txt b/r1.txt

new file mode 100644

index 0000000..f7d55cf

--- /dev/null

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```
100644 blob 08bb2331e777f431177c40df6841c0034f89fb58 m2.txt
100644 blob e5c9ce9248c688a566f3d03be31d0097edb96443 m3.txt
100644 blob 995fb876a427d4042101ad139e24ac80e53b456b m4.txt
100644 blob f7d55cf9a84e9ea95e8db2b6264e5a5db85d22ad r1.txt
```

We can see the "r1" commit has been "amended" and edit.txt is in its directory tree;

The next action is "squash r2". Git will bring up a editor screen and ask us to key in the commit message for this "squash commit".

```
1 # This is a combination of 2 commits.
2 # The first commit's message is:
3
4 r1 amend
5
6 # This is the 2nd commit message:
7
8 r2 squash
9
10 # Please enter the commit message for your changes. Lines starting
11 # with '#' will be ignored, and an empty message aborts the commit.
12 # rebase in progress; onto 8b96b83
13 # You are currently editing a commit while rebasing branch 'rebase' on
14 # '8b96b83'.
15 #
16 # Changes to be committed:
17 #       new file:   edit.txt
18 #       new file:   r1.txt
19 #       new file:   r2.txt
```

Let us verify current repository status:

```
[luke@rmbp r]$ git log --oneline
```

```
f17875f r1 amend
```

```
8b96b83 m4
```

```
86e1152 m3
```

```
69bd729 m2
```

```
19e4a55 m1
```

We can see "edit r1" has been committed. We are working based on node "r1 amend".

```
[luke@rmbp r]$ ls
```

```
edit.txt m1.txt m2.txt m3.txt m4.txt r1.txt r2.txt
```

```
[luke@rmbp r]$ git ls-files -s
```

```
100644 366226fb970ac0caa9d3f55967ab01334a548f60 0 edit.txt
```

```
100644 63a911f26fe84ea7fd8a863a636cfac908895ec9 0 m1.txt
```

```
100644 08bb2331e777f431177c40df6841c0034f89fb58 0 m2.txt
```

```
100644 e5c9ce9248c688a566f3d03be31d0097edb96443 0 m3.txt
```

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tree, based on node "r1 amend". When we commit this operation, a new commit node will combine both "r1 amend" and "r2" into one commit node, since we are "squashing" r2 node.

```
[luke@rmbp r]$ git log --oneline
```

```
d35a2f8 r3
```

```
5ed7280 r1 amend
```

```
8b96b83 m4
```

```
86e1152 m3
```

```
69bd729 m2
```

```
19e4a55 m1
```

```
[luke@rmbp r]$ git show 5ed7280
```

```
commit 5ed7280a58f07911824e6366604427b4adb80a95
```

```
Author: Luke Luo <luke.jf.luo@gmail.com>
```

```
Date: Sun Jun 1 12:34:14 2014 +0800
```

```
r1 amend
```

```
r2 squash
```

```
diff --git a/edit.txt b/edit.txt
```

```
new file mode 100644
```

```
index 0000000..366226f
```

```
--- /dev/null
```

```
+++ b/edit.txt
```

```
@@ -0,0 +1 @@
```

```
+edit
```

```
diff --git a/r1.txt b/r1.txt
```

```
new file mode 100644
```

```
index 0000000..f7d55cf
```

```
--- /dev/null
```

```
+++ b/r1.txt
```

```
@@ -0,0 +1 @@
```

```
+r1
```

```
diff --git a/r2.txt b/r2.txt
```

```
new file mode 100644
```

```
index 0000000..9a6c8d1
```

```
--- /dev/null
```

```
+++ b/r2.txt
```

```
@@ -0,0 +1 @@
```

```
+r2
```

```
[luke@rmbp r]$ git ls-tree 5ed7280
```

```
100644 blob 366226fb970ac0caa9d3f55967ab01334a548f60 edit.txt
```

```
100644 blob 63a911f26fe84ea7fd8a863a636cfac908895ec9 m1.txt
```

```
100644 blob 08bb2331e777f431177c40df6841c0034f89fb58 m2.txt
```

```
100644 blob e5c9ce9248c688a566f3d03be31d0097edb96443 m3.txt
```

```
100644 blob 995fb876a427d4042101ad139e24ac80e53b456b m4.txt
```

```
100644 blob f7d55cf9a84e9ea95e8db2b6264e5a5db85d22ad r1.txt
```

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```

1 r3
2
3 # Please enter the commit message for your changes. Lines starting
4 # with '#' will be ignored, and an empty message aborts the commit.
5 # rebase in progress; onto 8b96b83
6 # You are currently editing a commit while rebasing branch 'rebase' on
'8b96b83'.
7 #
8 # Changes to be committed:
9 #       new file:   r3.txt
10 #
The current status is :

[luke@rmbp r]$ ls
edit.txt m1.txt m2.txt m3.txt m4.txt r1.txt r2.txt r3.txt

[luke@rmbp r]$ git status
rebase in progress; onto 8b96b83

You are currently editing a commit while rebasing branch 'rebase' on '8b96b83'.

(use "git commit --amend" to amend the current commit)
(use "git rebase --continue" once you are satisfied with your changes)

```

```

nothing to commit, working directory clean

[luke@rmbp r]$ git ls-files -s
100644 366226fb970ac0caa9d3f55967ab01334a548f60 0 edit.txt
100644 63a911f26fe84ea7fd8a863a636cfac908895ec9 0 m1.txt
100644 08bb2331e777f431177c40df6841c0034f89fb58 0 m2.txt
100644 e5c9ce9248c688a566f3d03be31d0097edb96443 0 m3.txt
100644 995fb876a427d4042101ad139e24ac80e53b456b 0 m4.txt
100644 f7d55cf9a84e9ea95e8db2b6264e5a5db85d22ad 0 r1.txt
100644 9a6c8d12dea8859b821b2ba705f7efd6cc914aa5 0 r2.txt
100644 b6693b64f528de38cde5533acd781fde743bc3df 0 r3.txt

[luke@rmbp r]$ ls .git/rebase-merge/
done end git-rebase-todo git-rebase-todo.backup head-name interactive
msgnum onto orig-head patch quiet rewritten-list stopped-sha

[luke@rmbp r]$ cat .git/rebase-merge/rewritten-list
ec49169a68eff2e74340dc490d7ccfe98b826a9e
5ed7280a58f07911824e6366604427b4adb80a95
cb95f9dcdef1e58943dc6c5b968e5460b2fbfc76
5ed7280a58f07911824e6366604427b4adb80a95

```

Now we save our commit message for "r3". Here is the final results of "git rebase":

```

[luke@rmbp r]$ git rebase --continue

[detached HEAD f17875f] r1 amend
2 files changed, 2 insertions(+)
create mode 100644 edit.txt
create mode 100644 r1.txt

[detached HEAD 5ed7280] r1 amend

```

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```
create mode 100644 r3.txt
Successfully rebased and updated refs/heads/rebase.
```

We can see during interactive rebase, git employ "detach head" mode to store our intermediate state.

```
[luke@rmbp r]$ git log --oneline
68d7922 r3 reword
5ed7280 r1 amend
8b96b83 m4
86e1152 m3
69bd729 m2
19e4a55 m1
```

```
[luke@rmbp r]$ git branch
master
* rebase
```

And git will finally align "rebase" branch to the rebased commit.

9. orphaned branch

In general, all branches in a repository form a DAG tree. There is only one "root" node of this tree, which is the "initial" commit. In fact, git allow you to have more than one DAG in one repository. With separate DAGS, you have another content partition layer besides branches. The work histories (commits) between different DAGs are separate from each other. Starting from the branch of one DAG, you can not traverse into commits in other DAG. But DAG still can share objects, like tree/blob/tag.

To have an orphaned branch/new DAG, we do:

```
git checkout --orphan orphaned-branch [start-commit]
```

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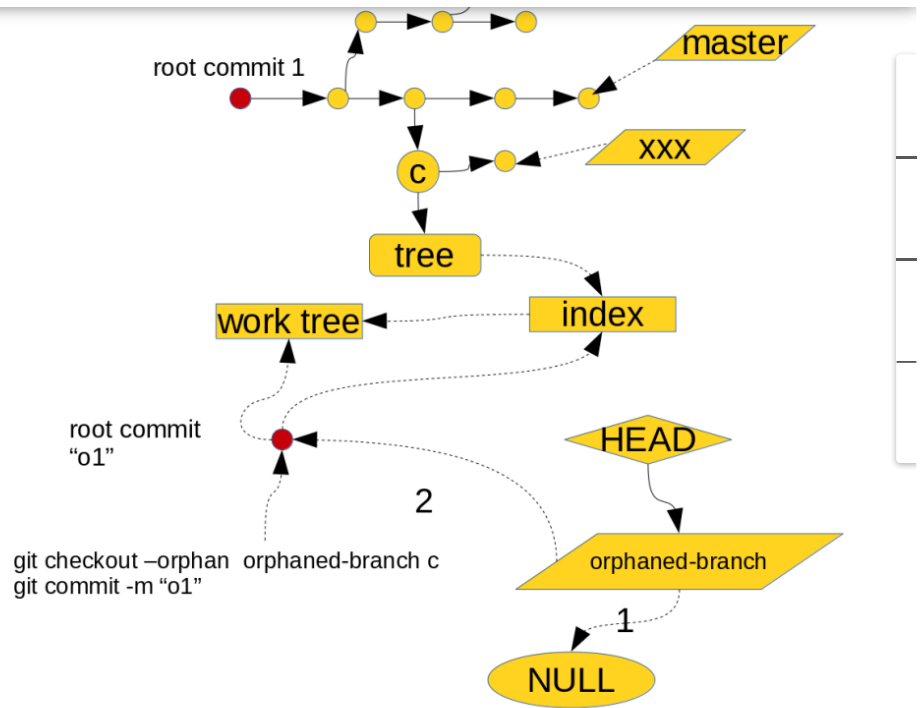
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When an orphaned branch is created, the branch is pointing to NULL. When you issue your first commit in this branch, a root/initial commit is created with null parent. The content of commit "C" is copied into index and work tree as starting point. If you want a clean state for your new orphan branch, you can do "git checkout --orphan ob" without providing a start commit.

An orphaned branch might seem to be a bizarre idea, but actually it is just an exceptional case of a branch. Here is how simple it is:

```
[luke@rmbp a]$ git branch
* master
[luke@rmbp a]$ cat .git/HEAD
ref: refs/heads/master
[luke@rmbp a]$ cat .git/refs/heads/master
72da3496ef4b3a2700d57172aca1bfb331d401b3
[luke@rmbp a]$ git checkout --orphan test
Switched to a new branch 'test'
[luke@rmbp a]$ git branch
master
[luke@rmbp a]$ cat .git/HEAD
ref: refs/heads/test
[luke@rmbp a]$ ls .git/refs/heads/test
```

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without providing a concrete ".git/refs/heads/test" file which should have the content of a concrete commit.

10. filter-branch

I have mentioned how to create a fully legitimate commit using low level commands like "update-index" and "commit-tree" in post "Git as I understand(2)". Actually, git provide a high level command which would help you create new commit based on existing commit. "filter-branch" will loop over a list of commits you provide (a rev-list) and used the "filter" you provide in command lines to replace existing components of a commit, then make a new commit. "git help filter-branch" to get more information on this command.

Here is an example to filter-branch a commit series, where all commit messages are changed.

```
[luke@rmmbp project]$ git log
* 4222cd6 (HEAD, master) a3
* b3aecda a2
* c43bd8f a1

[luke@rmmbp project]$ git filter-branch --msg-filter "echo new commit message" master

Rewrite 4222cd6167cda8845a0cf55461929ef65ce40e3c (3/3)
Ref 'refs/heads/master' was rewritten

[luke@rmmbp project]$ git l
bc44655 new commit message
9f37b93 new commit message
ffc3d49 new commit message
```

Posted 1st June 2014 by [Luke Luo](#)

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