Git - A distributed version control system

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Outline

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What is Git?

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- Manages a given set of files and their histories.

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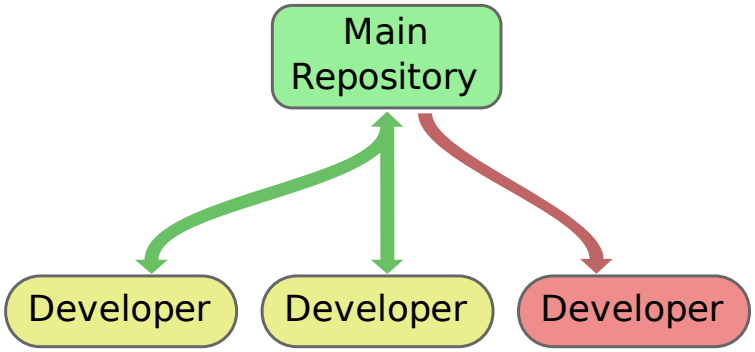
But: Why do you need a Version Control System?

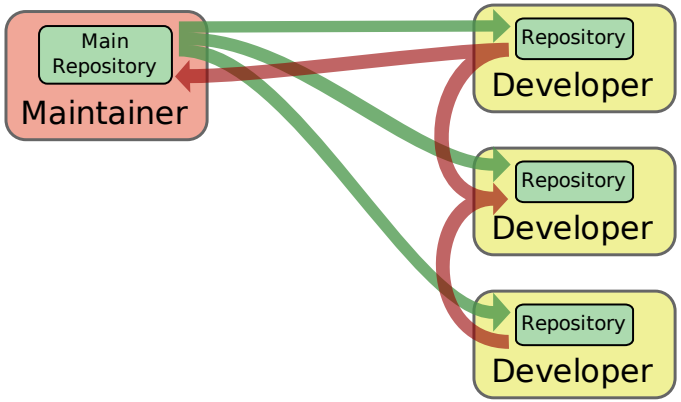
- Backup and restore files
- Share files with other developers
- Keep track of changes and their authors
- Branch and merging

Centralized vs. distributed Version Control Systems

Centralized Model



Distributed Model



vs.

- One central repository with individual access rights
- Changes apply immediately to all developers
- Examples: CVS, Subversion

- Each developer has his/her own local repository
- Changes can be shared between them
- Examples: Git, Mercurial

Pros and cons of the distributed model

Pros

- Don't need a connection to a network to work productively
- Some operations are much faster since no network is needed
- No sensitive single main repository
- Allow easy participation in project without permission
- Usually easier branching and merging

Cons

- More complex concept
- No dedicated version at one time, no easy revision numbers
- No separated backup copy

How to get Git

POSIX

- Official Homepage: `http://git-scm.com/`
- After the setup Git will be available on the command line

Windows

Under `http://nathanj.github.com/gitguide/` you can find a quick introduction about installing and using Git on Windows.

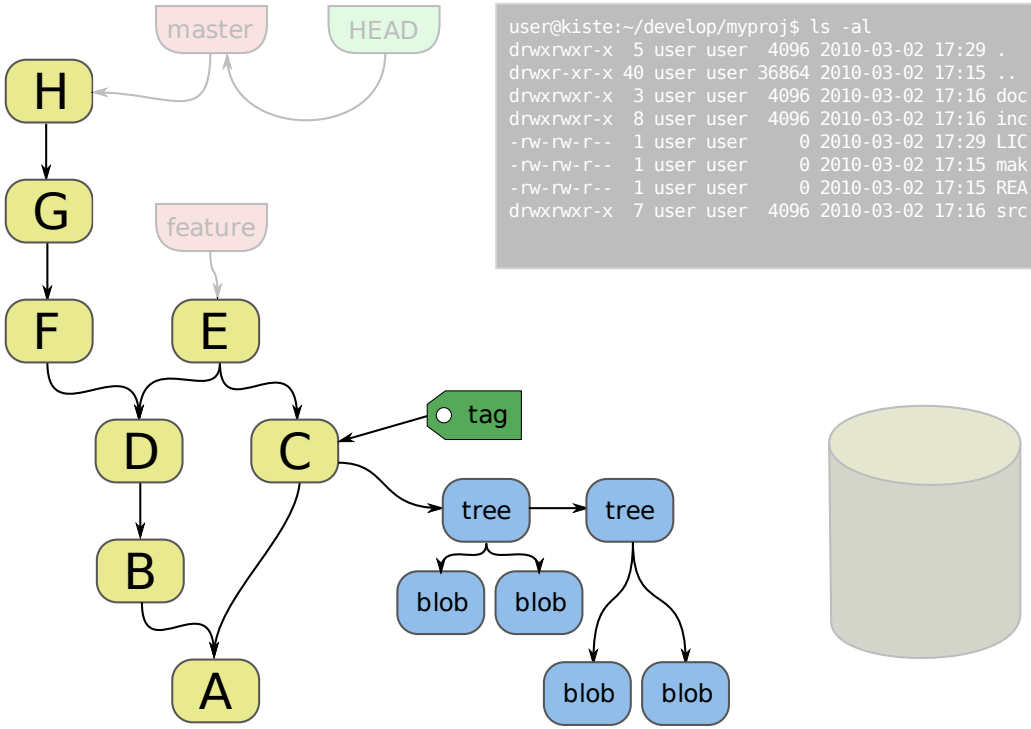
After the setup of `msysgit` (Windows port of Git) you can

- Right click in your explorer and go to "Git Bash Here"
- A command line starts right in the current folder
- And now you can use all the commands given in this talk!

Outline

Structure of a repository

A repository consists of several parts:




```
user@kiste:~/develop/myproj$ ls -al
drwxrwxr-x  5 user user  4096 2010-03-02 17:29 .
drwxr-xr-x 40 user user 36864 2010-03-02 17:15 ..
drwxrwxr-x  3 user user  4096 2010-03-02 17:16 doc
drwxrwxr-x  8 user user  4096 2010-03-02 17:16 inc    lude
-rw-rw-r--  1 user user     0 2010-03-02 17:29 LIC    ENSE
-rw-rw-r--  1 user user     0 2010-03-02 17:15 mak    efile
-rw-rw-r--  1 user user     0 2010-03-02 17:15 REA    DME
drwxrwxr-x  7 user user  4096 2010-03-02 17:16 src
```


1. Objects representing the history of the tracked content

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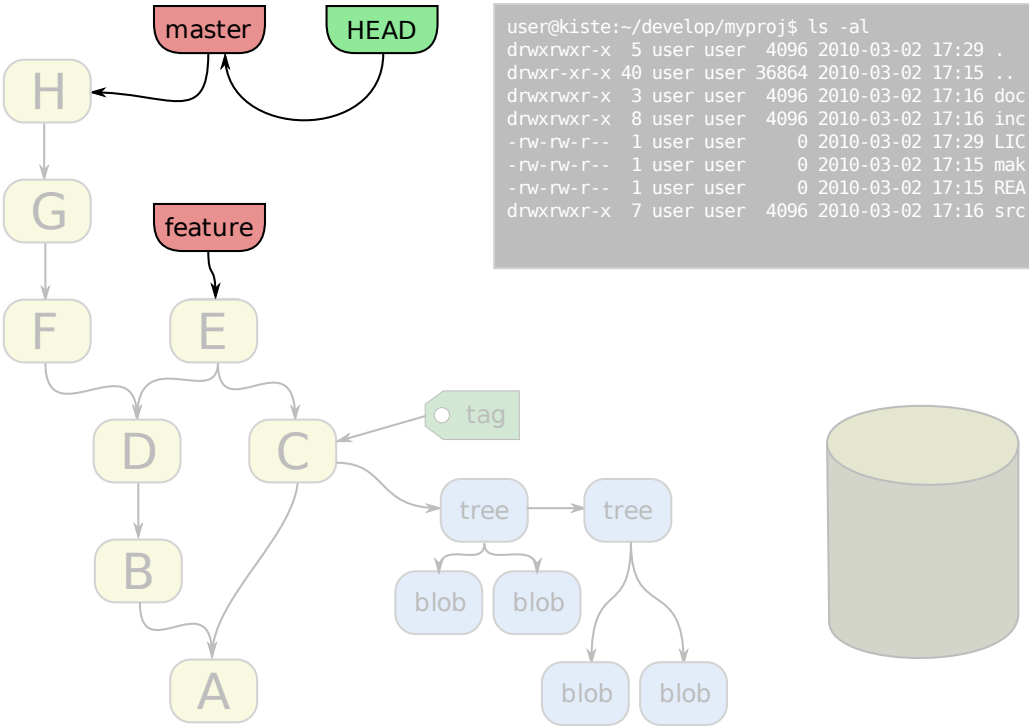


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2. “Refs,” the reference

Structure of a repository

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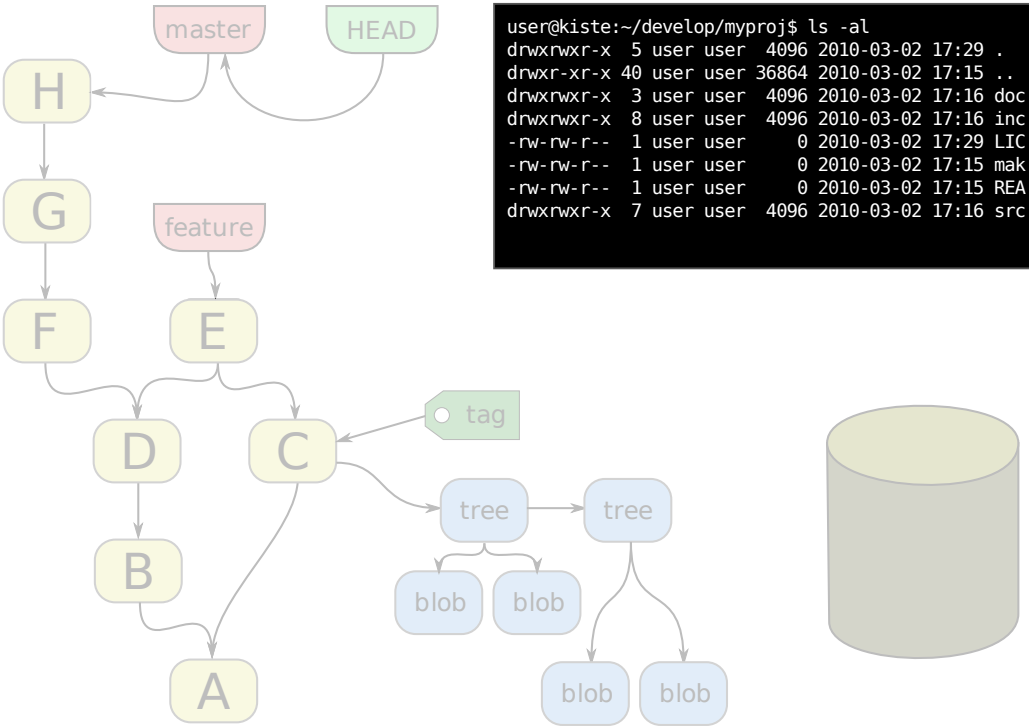


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```


1. Objects representing the history of the tracked content
2. “Refs,” the reference
3. Working tree

Structure of a repository

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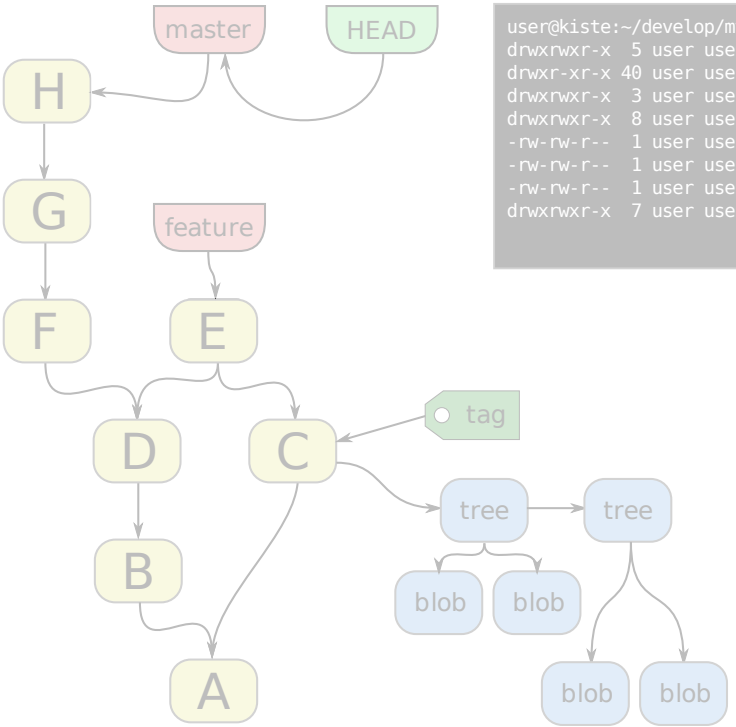


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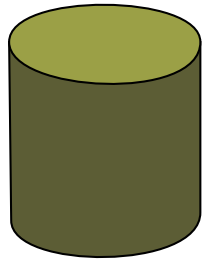
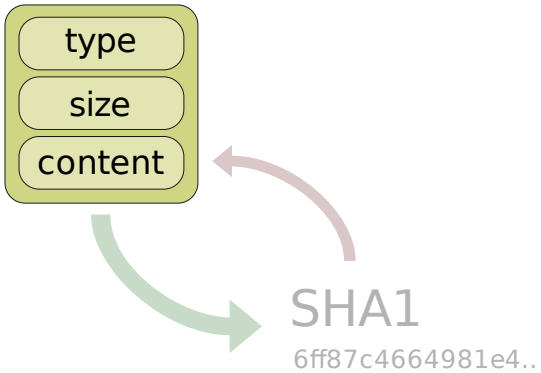


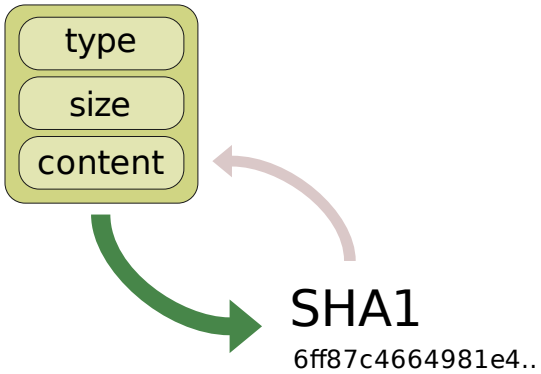
1. Objects representing the history of the tracked content
2. “Refs,” the reference
3. Working tree
4. Index/Stage

How can the objects in the history be adressed?



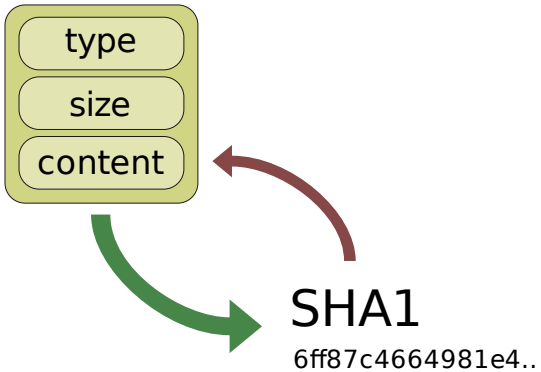
- Every object in the history stores its type, size and content

How can the objects in the history be adressed?



- Every object in the history stores its type, size and content
- From this data the SHA1 hash (40-digit number) is calculated

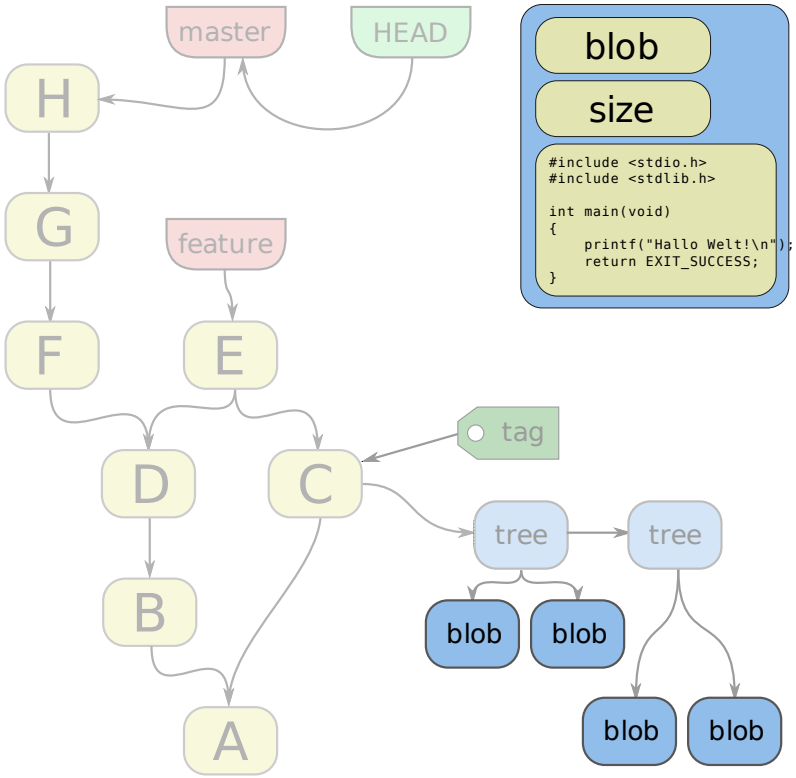
How can the objects in the history be adressed?



- Every object in the history stores its type, size and content
- From this data the SHA1 hash (40-digit number) is calculated
- This value serves as a unique name. Collisions are highly unlikely!

What do the objects in the history look like?

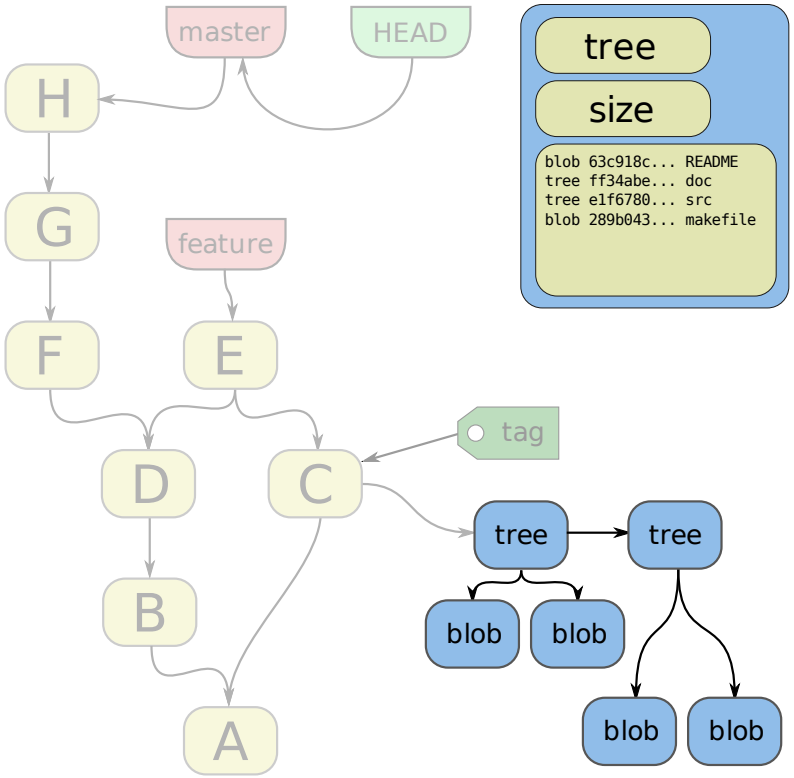
Blob objects



- A blob object represents a file and contain the file's content

What do the objects in the history look like?

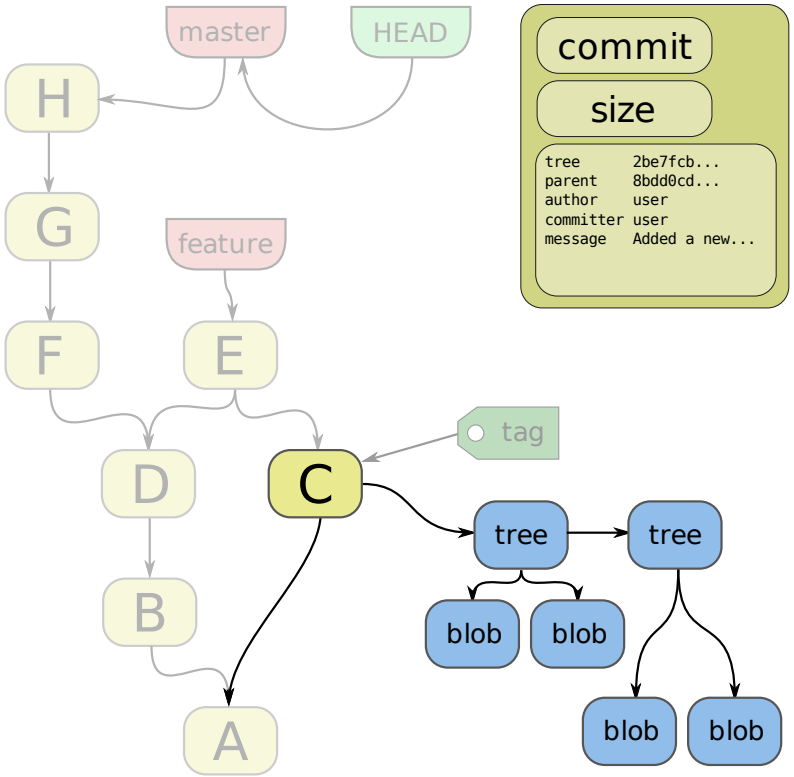
Tree objects



- A tree object represents a directory and its content
- It contains a list of SHA1 values pointing to other tree and blob objects

What do the objects in the history look like?

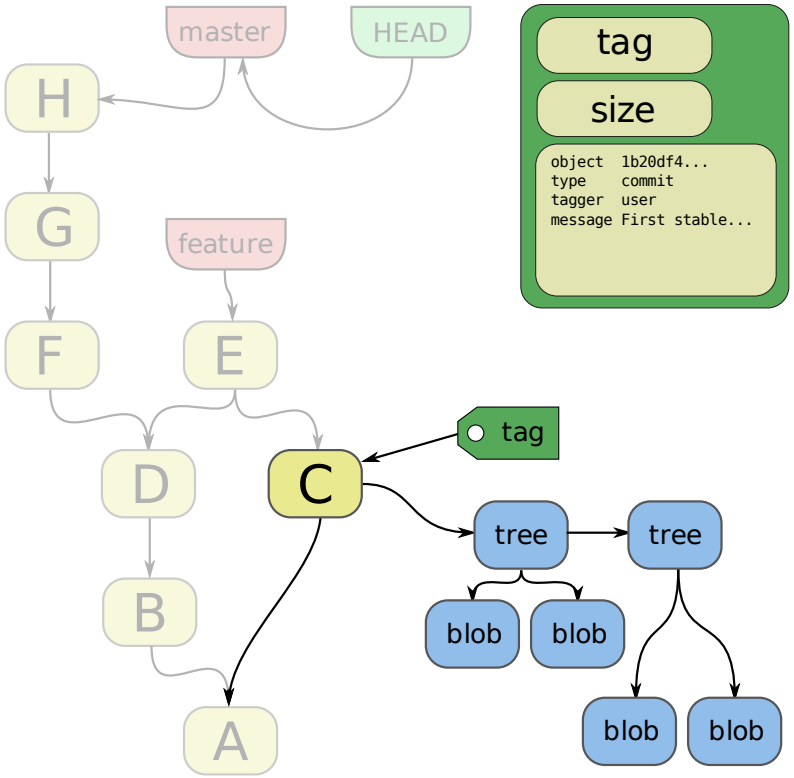
Commit objects



- A commit represents a snapshot of the working directory
- It contains the
  - SHA1 of the corresponding tree object
  - SHA1 of the parent commit
  - Name of the author and the committer
  - Message describing the commit

What do the objects in the history look like?

Tag objects



- A tag points out a certain object in your history
- It contains the
  - SHA1 name of the tagged object and its type
  - Name of the person who created the tag
  - Message describing the tag

Outline

Basics

Every Git command looks like this

```
$ git <options> command <options>
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For example:

```
$ git --help commit
$ git commit -m "Message"
$ git-merge featureX
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Basics

Every Git command looks like this

```
$ git <options> command <options>
```

For example:

```
$ git --help commit
$ git commit -m "Message"
$ git-merge featureX
```

There are

- ca. 140 commands
- ca. 25 every day commands
- 4 GUI commands

Where to get help?

To get the most common Git commands

```
$ git --help
```

Where to get help?

To get the most common Git commands

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```

Need help to a certain Git command

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Two online books with many informations:

- The Git community book: `http://book.git-scm.com/`
- Pro Git book: `http://progit.org/book/`

Tips collections:

- Git ready: `http://gitready.com/`
- And of course: Your favorite online search engine

At the very Beginning

- Set up your name

```
$ git config --global user.name <name>
$ git config --global user.email <email>
```

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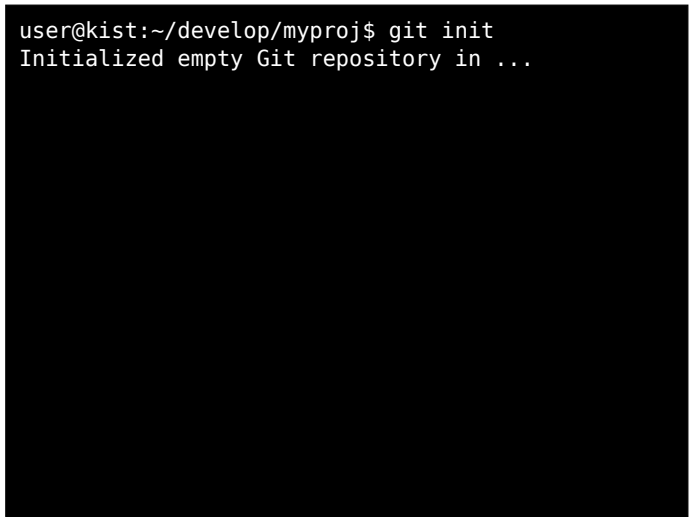
  $ git config --global user.email <email>
  ```

- Create a new repository
  - Go to the directory whose content shall be in a repository and type
  - `$ git init`



At the very Beginning

- Set up your name
  ```
  $ git config --global user.name <name>
  $ git config --global user.email <email>
  ```
- Create a new repository
  - Go to the directory whose content shall be in a repository and type
  - `$ git init`
- Clone an existing repository
  - Go to the directory which shall contain the directory with the repository and type
  - `$ git clone <URL>`

```
user@kiste:~/develop$ git clone git://...
Initialized empty Git repository in ...
remote: Counting objects: 9, done.
remote: Compressing objects: 100% (6/6), done.
remote: Total 9 (delta 2), reused 0 (delta 0)
Receiving objects: 100% (9/9), done.
Resolving deltas: 100% (2/2), done.
user@kiste:~/develop$ cd myproj/
user@kiste:~/develop/myproj$ ls
doc  include  LICENSE  makefile  READMY src
```

Inspecting your Repository I

Show the current state of the repository

- Status of the current working tree

  `$ git status`

```
user@kist:~/develop/myproj$ git status
# On branch master
# Changed but not updated:
#   (use "git add <file>..." to update what ...
#   (use "git checkout -- <file>..." to ...
#
# modified:   main.c
#
no changes added to commit (use "git add" ...
```

Inspecting your Repository I

Show the current state of the repository

- Status of the current working tree

  ```
  $ git status
  ```

- Changes between index and working tree

  ```
  $ git diff
  ```

```
user@kist:~/develop/myproj$ git diff
diff --git a/main.c b/main.c
index 0123c74..b6c2d0e 100644
--- a/main.c
+++ b/main.c
@@ -2,6 +2,5 @@

 int main(void) {
   printf("Hallo Welt!\n");
-  printf("Secret!");
   return EXIT_SUCCESS;
 }
```

Inspecting your Repository I

Show the current state of the repository

- Status of the current working tree
  ```
  $ git status
  ```
- Changes between index and working tree
  ```
  $ git diff
  ```
- Changes between index and last commit
  ```
  $ git diff --staged
  ```

```
user@kist:~/develop/myproj$ git add main.c
user@kist:~/develop/myproj$ git diff --staged
diff --git a/main.c b/main.c
index 0123c74..b6c2d0e 100644
--- a/main.c
+++ b/main.c
@@ -2,6 +2,5 @@

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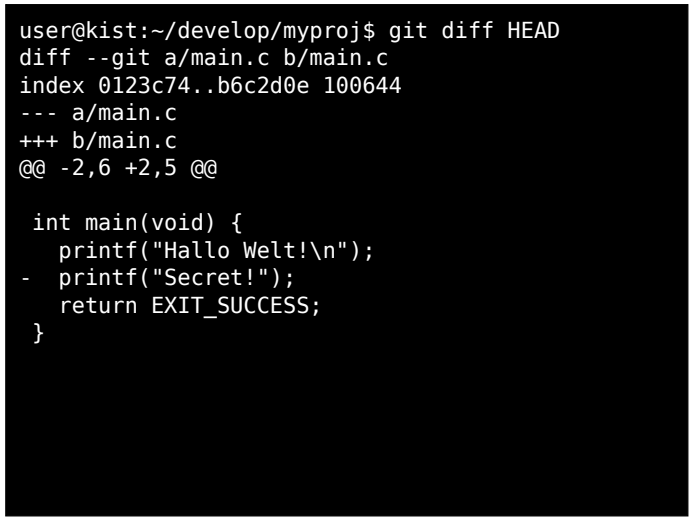
Show the current state of the repository

- Status of the current working tree
  ```
  $ git status
  ```
- Changes between index and working tree
  ```
  $ git diff
  ```
- Changes between index and last commit
  ```
  $ git diff --staged
  ```
- Changes between current working tree and last commit
  ```
  $ git diff HEAD
  ```



Inspecting your Repository II

Review commits

- Review the last commit

  ```
  $ git show
  ```

```
user@kist:~/develop/myproj$ git show
commit a42108605d8f55fb3666c18a6905274dc0eb88be
Author: user <user@cia.org>
Date:   Wed Feb 24 20:41:45 2010 +0100

    Added secret message

diff --git a/main.c b/main.c
index b6c2d0e..0123c74 100644
--- a/main.c
+++ b/main.c
@@ -2,5 +2,6 @@

 int main(void) {
   printf("Hello World!\n");
+  printf("Secret!\n");
   return EXIT_SUCCESS;
 }
```

Inspecting your Repository II

Review commits

- Review the last commit

  ```
  $ git show
  ```

- Review parent commit of the last commit

  ```
  $ git show HEAD~1
  ```

```
user@kist:~/develop/myproj$ git show HEAD~1
commit 13c399d66c3960f562632abc75b8f14a7e6e9bdd
Author: user <user@cia.org>
Date:   Wed Feb 24 20:30:17 2010 +0100

    Initial commit

diff --git a/main.c b/main.c
new file mode 100644
index 0000000..b6c2d0e
--- /dev/null
+++ b/main.c
@@ -0,0 +1,6 @@
+#include <stdio.h>
+#include <stdlib.h>
+
+int main(void) {
...
```

Inspecting your Repository II

Review commits

- Review the last commit

  ```
  $ git show
  ```

- Review parent commit of the last commit

  ```
  $ git show HEAD~1
  ```

- Changes in the last commit

  ```
  $ git show --name-status
  ```

```
user@kist:~/develop/myproj$ git show ...
... --name-status
commit a42108605d8f55fb3666c18a6905274dc0eb88be
Author: user <user@cia.org>
Date:   Wed Feb 24 20:41:45 2010 +0100

    Added new message

M       main.c
```

Inspecting your Repository II

Review commits

- Review the last commit
  ```
  $ git show
  ```
- Review parent commit of the last commit
  ```
  $ git show HEAD~1
  ```
- Changes in the last commit
  ```
  $ git show --name-status
  ```
- Show contents of `<file>` in the last commit
  ```
  $ git show HEAD:<file>
  ```

Remark: `HEAD~n` is the parent commit of `HEAD~(n-1)` (for $n > 1$) and `HEAD~1` = `HEAD^` is the parent commit of the last commit.

Inspecting your Repository III

Review the complete commit history

- See commit history

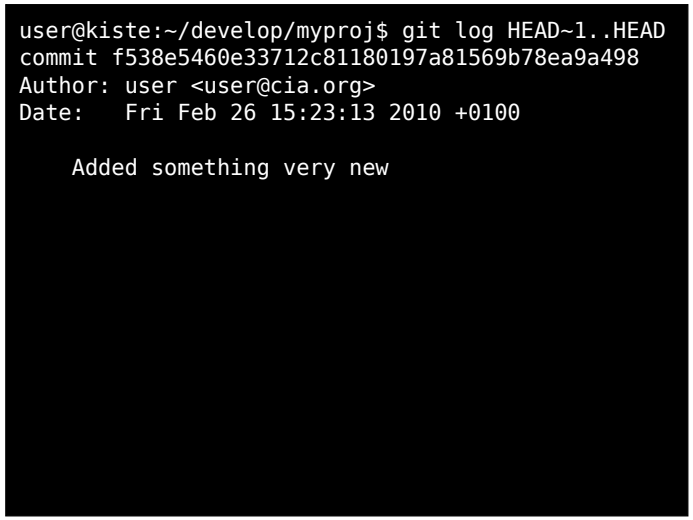
  ```
  $ git log
  ```

```
user@kiste:~/develop/myproj$ git log
commit f538e5460e33712c81180197a81569b78ea9a498
Author: user <user@cia.org>
Date:   Fri Feb 26 15:23:13 2010 +0100

    Added something very new

commit 37a83dd700c48cedcecf6352bea6bef0ec0b7c67
Author: user <user@cia.org>
Date:   Thu Feb 25 21:55:10 2010 +0100

    Something new add

commit 9844251c2243a90d19f5fbd6bd6ecd3ecb3e4f6f
Author: user <user@cia.org>
Date:   Fri Feb 19 15:33:11 2010 +0100

    first commit
```

Inspecting your Repository III

Review the complete commit history

- See commit history
  ```
  $ git log
  ```
- See commit history from the next to last commit to the last one
  ```
  $ git log HEAD~1..HEAD
  ```

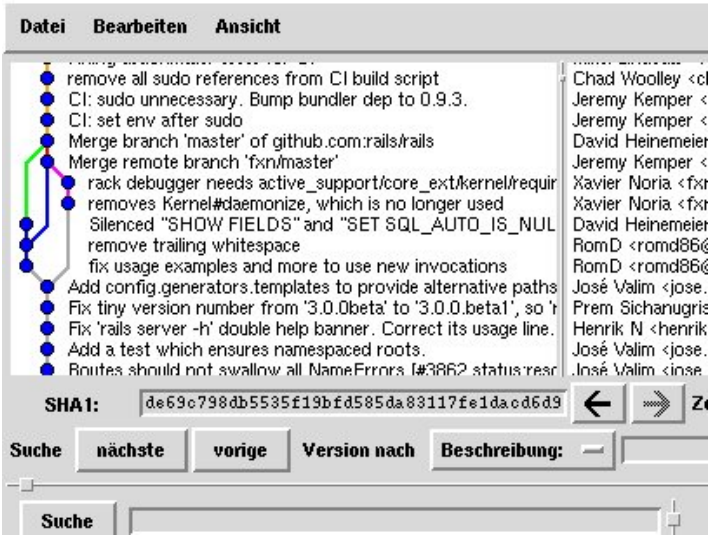


Inspecting your Repository III

Review the complete commit history

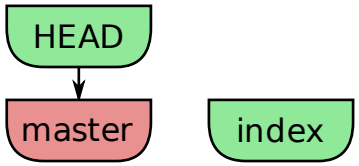
- See commit history
  ```
  $ git log
  ```
- See commit history from the next to last commit to the last one
  ```
  $ git log HEAD~1..HEAD
  ```
- A nice tree of your history
  ```
  $ gitk [--all]
  ```

  `--all` to show all branches



Outline

Commit

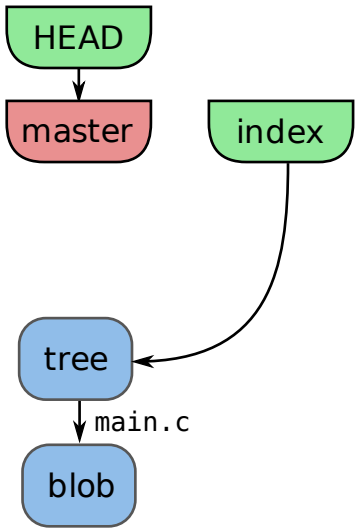


- Initialize Repository

  ```
  $ git init
  ```

```
user@kiste:~/develop/myproj$ ls -a
.  ..
user@kiste:~/develop/myproj$ git init
user@kiste:~/develop/myproj$ ls -a
.  ..  .git
user@kiste:~/develop/myproj$
```

Commit



- Initialize Repository

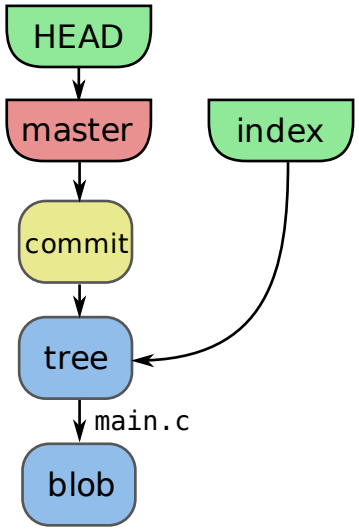
  ```
  $ git init
  ```

- Create/modify files and stage them

  ```
  $ git add <files>
  ```

```
user@kiste:~/develop/myproj$ touch main.c
user@kiste:~/develop/myproj$ git add main.c
user@kiste:~/develop/myproj$
```

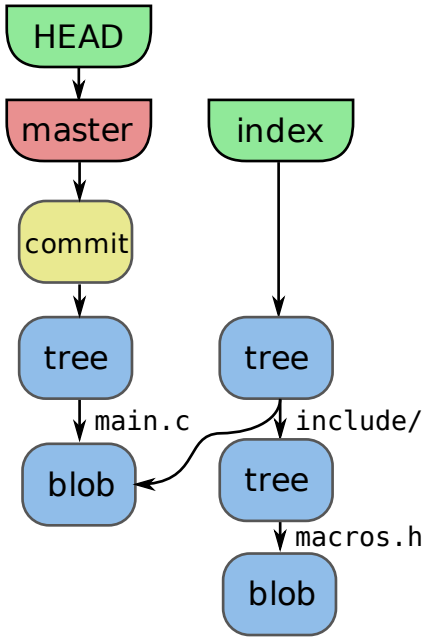
Commit



- Initialize Repository
  `$ git init`
- Create/modify files and stage them
  `$ git add <files>`
- Commit the staged items
  `$ git commit -m <msg>`

```
user@kiste:~/develop/myproj$ git commit -m "Messag    e"
[master (root-commit) 7e08b20] Message
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 main.c
user@kiste:~/develop/myproj$
```

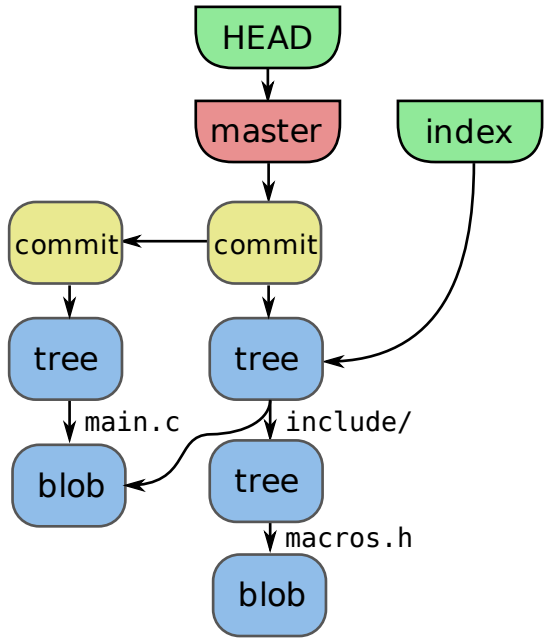
Commit




```
user@kiste:~/develop/myproj$ mkdir include
user@kiste:~/develop/myproj$ touch include/macros.    h
user@kiste:~/develop/myproj$ git add include/macro    s.h
user@kiste:~/develop/myproj$
```

- Initialize Repository
  `$ git init`
- Create/modify files and stage them
  `$ git add <files>`
- Commit the staged items
  `$ git commit -m <msg>`
- Create/modify other files and stage them
  `$ git add <files>`

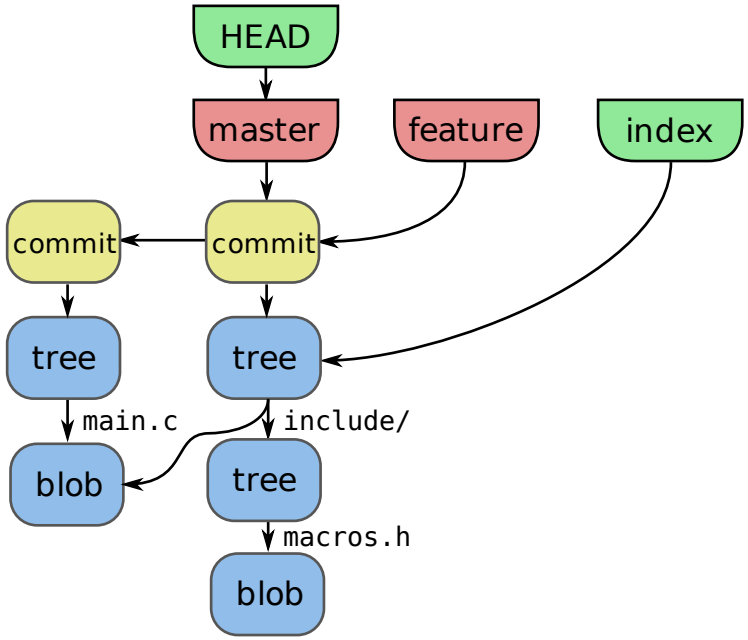
Commit




```
user@kiste:~/develop/myproj$ mkdir include
user@kiste:~/develop/myproj$ touch include/macros.    h
user@kiste:~/develop/myproj$ git add include/macro    s.h
user@kiste:~/develop/myproj$
```

- Initialize Repository
  `$ git init`
- Create/modify files and stage them
  `$ git add <files>`
- Commit the staged items
  `$ git commit -m <msg>`
- Create/modify other files and stage them
  `$ git add <files>`
- Commit these staged items
  `$ git commit -m <msg>`

Branching




```
user@kiste:~/develop/myproj$ git branch feature
user@kiste:~/develop/myproj$ git branch
  feature
* master
user@kiste:~/develop/myproj$
```

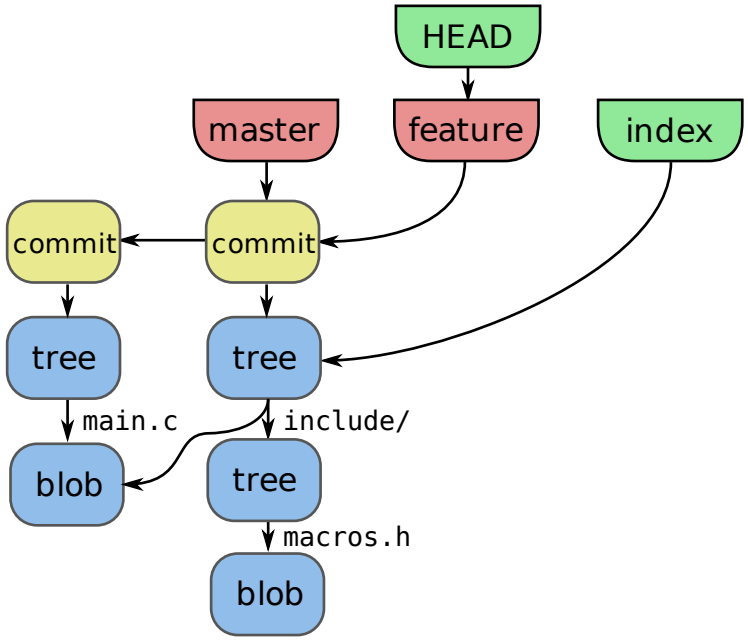
- Create a new branch

  `$ git branch <name>`

  Inspect available branches

  `$ git branch`

Branching




```
user@kiste:~/develop/myproj$ git checkout feature
Switched to branch 'feature'
user@kiste:~/develop/myproj$ git branch
* feature
  master
user@kiste:~/develop/myproj$
```

- Create a new branch

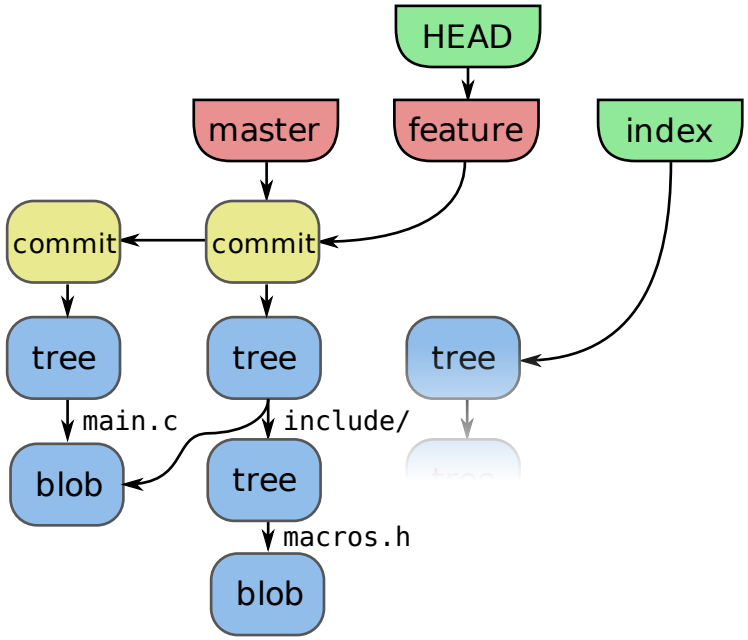
  `$ git branch <name>`

  Inspect available branches

  `$ git branch`
- Switch to a branch

  `$ git checkout <name>`

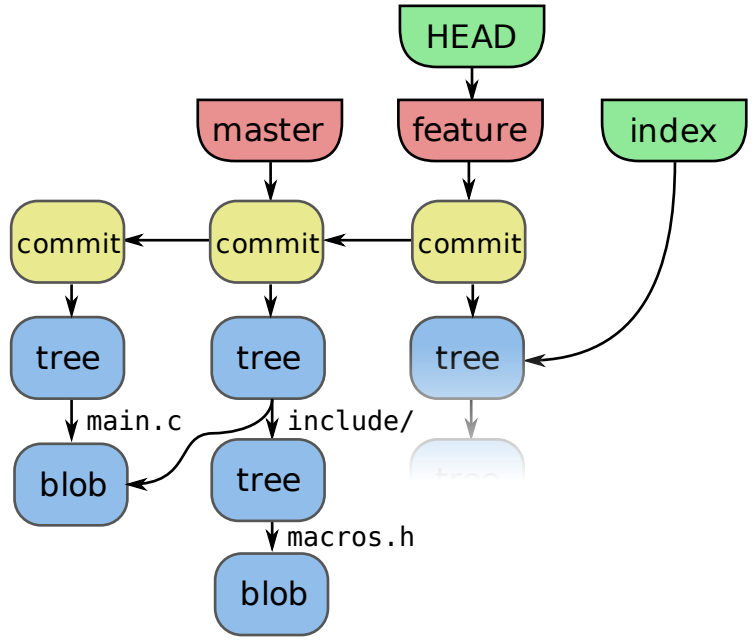
Branching




```
user@kiste:~/develop/myproj$ touch solver.c
user@kiste:~/develop/myproj$ git add solver.c
user@kiste:~/develop/myproj$
```

- Create a new branch
  `$ git branch <name>`
  Inspect available branches
  `$ git branch`
- Switch to a branch
  `$ git checkout <name>`
- Create/modify files and stage them
  `$ git add <files>`

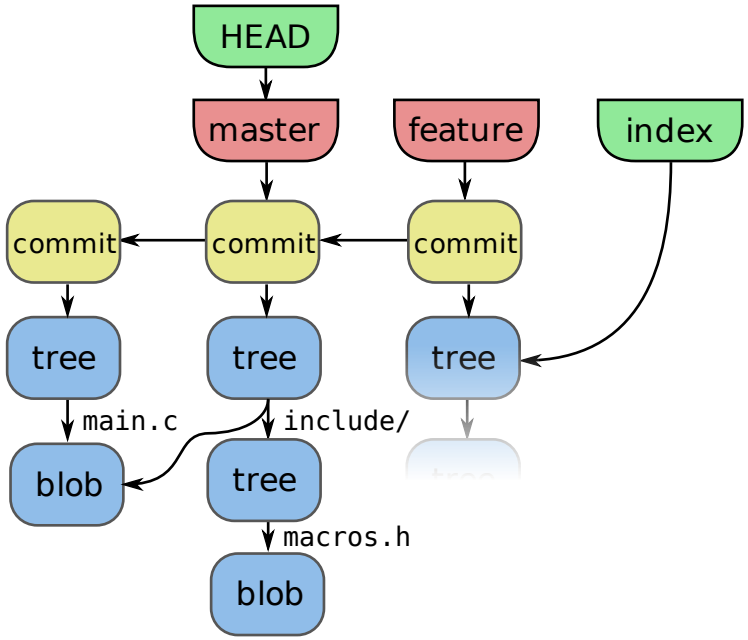
Branching




```
user@kiste:~/develop/myproj$ git commit -m "Blo"
[feature a1ea7a2] Blo
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 solver.c
user@kiste:~/develop/myproj$
```

- Create a new branch
  `$ git branch <name>`
  Inspect available branches
  `$ git branch`
- Switch to a branch
  `$ git checkout <name>`
- Create/modify files and stage them
  `$ git add <files>`
- Commit them to the currently active branch
  `$ git commit -m <msg>`

Merging - the simple case

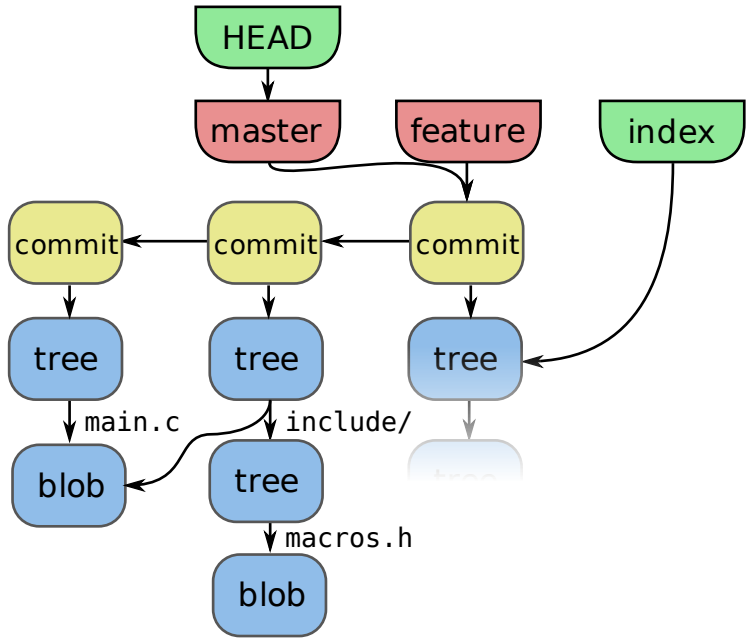



```
user@kiste:~/develop/myproj$ git checkout master
Switched to branch 'feature'
user@kiste:~/develop/myproj$ ls
include  main.c
user@kiste:~/develop/myproj$
```

- Switch to a branch

  `$ git checkout <name>`

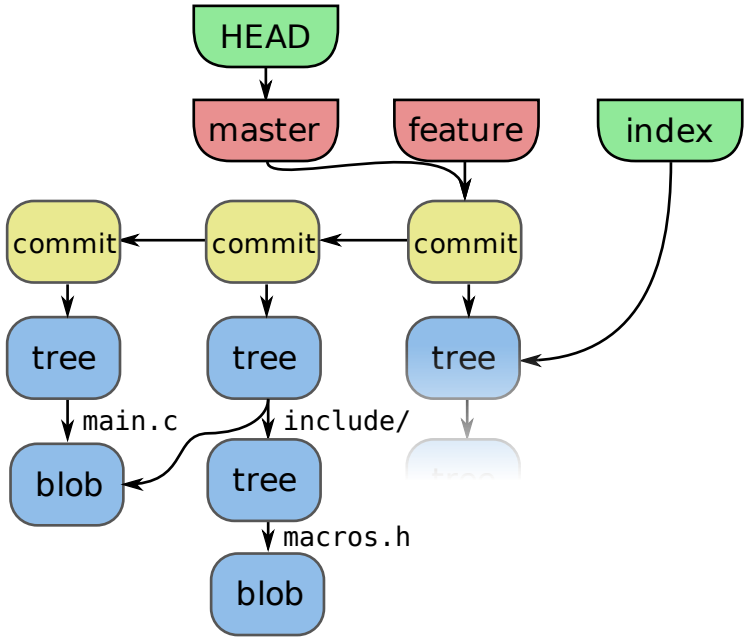
Merging - the simple case




```
user@kiste:~/develop/myproj$ git merge feature
Updating 3527764..a1ea7a2
Fast forward
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 solver.c
user@kiste:~/develop/myproj$
```

- Switch to a branch
  `$ git checkout <name>`
- Merge `<branch>` into current branch
  `$ git merge <branch>`

Merging - the simple case

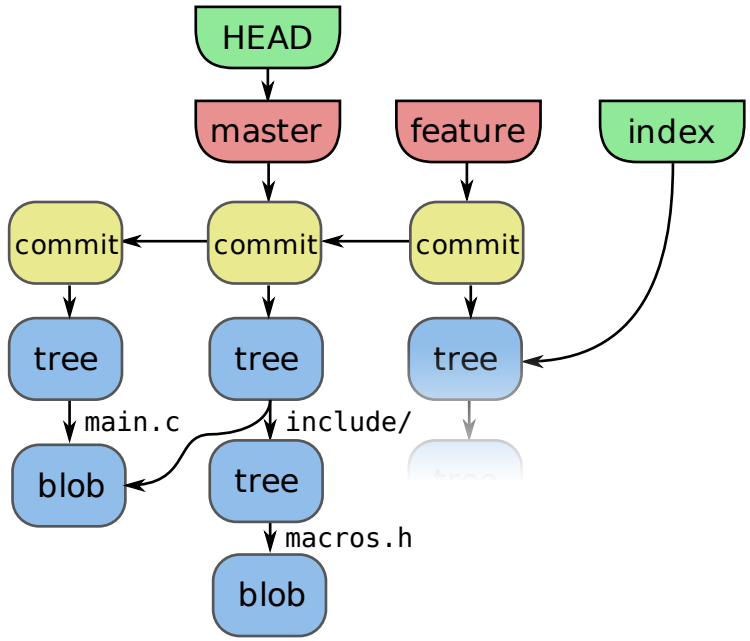



```
user@kiste:~/develop/myproj$ git merge feature
Updating 3527764..a1ea7a2
Fast forward
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 solver.c
user@kiste:~/develop/myproj$
```

- Switch to a branch
  `$ git checkout <name>`
- Merge `<branch>` into current branch
  `$ git merge <branch>`

Fast forward merge!

Merging - the standard case

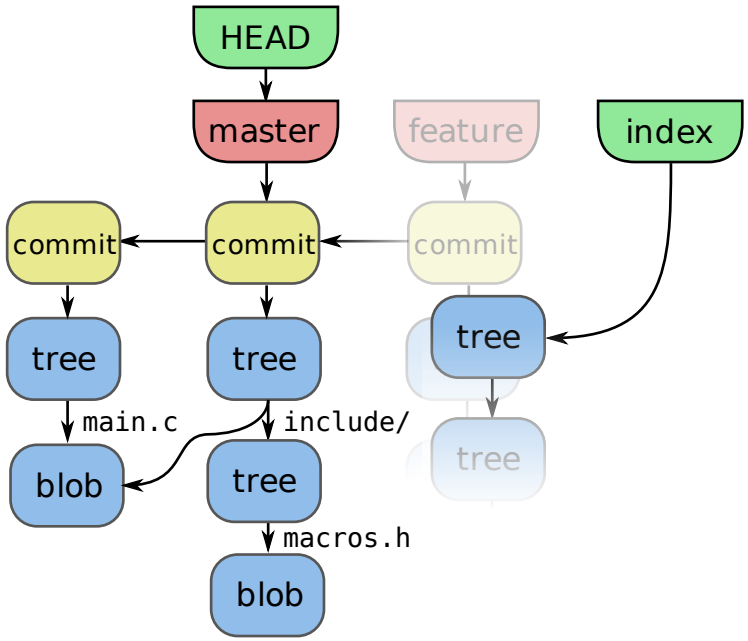



```
user@kiste:~/develop/myproj$ git checkout master
Switched to branch 'feature'
user@kiste:~/develop/myproj$ ls
include  main.c
user@kiste:~/develop/myproj$
```

- Switch to a branch

  `$ git checkout <name>`

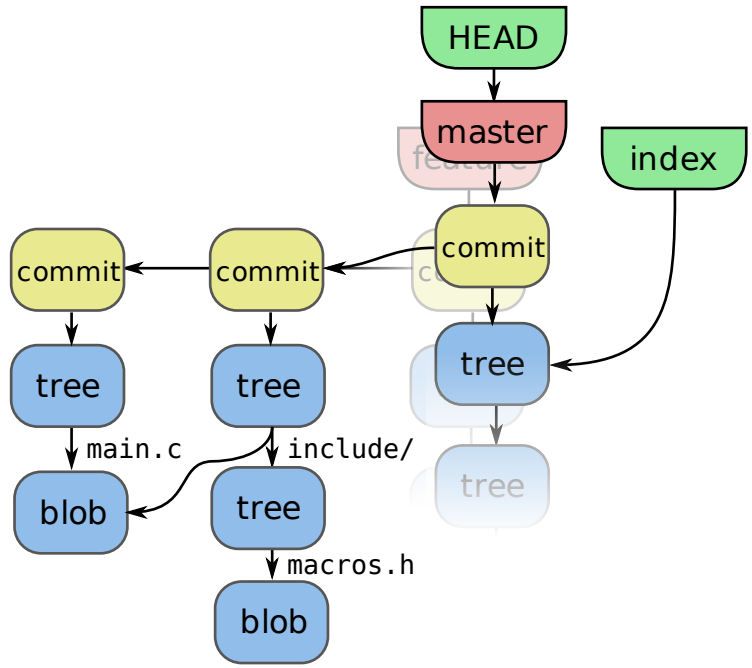
Merging - the standard case




```
user@kiste:~/develop/myproj$ touch transform.c
user@kiste:~/develop/myproj$ git add transform.c
user@kiste:~/develop/myproj$
```

- Switch to a branch
  `$ git checkout <name>`
- Create/modify files and stage them
  `$ git add <files>`

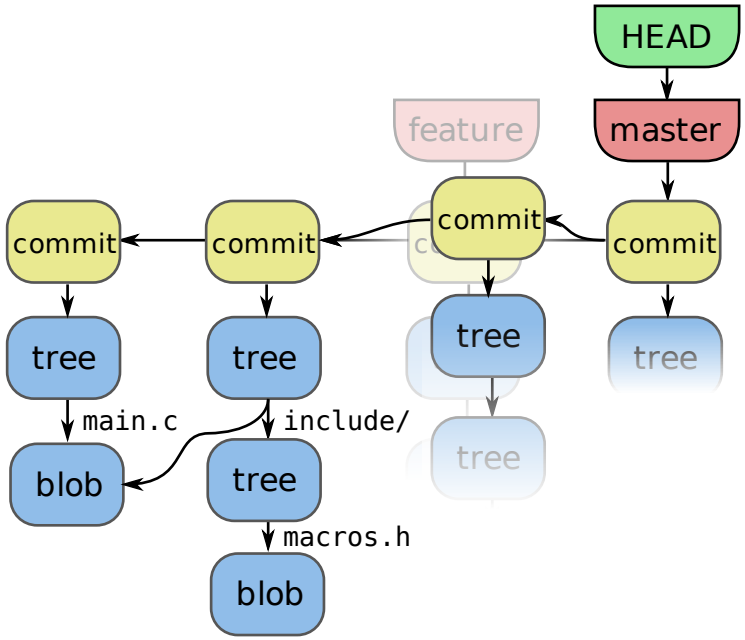
Merging - the standard case




```
user@kiste:~/develop/myproj$ git commit -m "Blof"
[master d9c35b5] Blof
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 transform.c
user@kiste:~/develop/myproj$
```

- Switch to a branch
  `$ git checkout <name>`
- Create/modify files and stage them
  `$ git add <files>`
- Commit staged items
  `$ git commit -m <msg>`

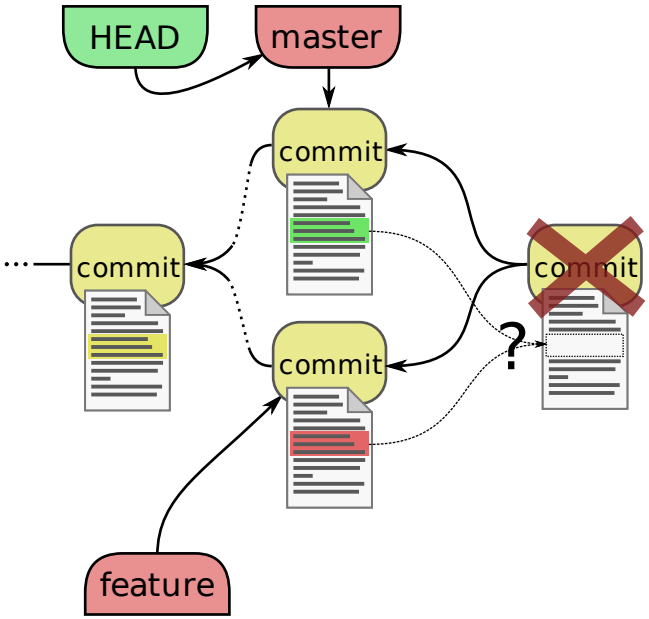
Merging - the standard case




```
user@kiste:~/develop/myproj$ git merge feature
Merge made by recursive.
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 solver.c
user@kiste:~/develop/myproj$
```

- Switch to a branch
  `$ git checkout <name>`
- Create/modify files and stage them
  `$ git add <files>`
- Commit staged items
  `$ git commit -m <msg>`
- Merge `<branch>` into current branch
  `$ git merge <branch>`

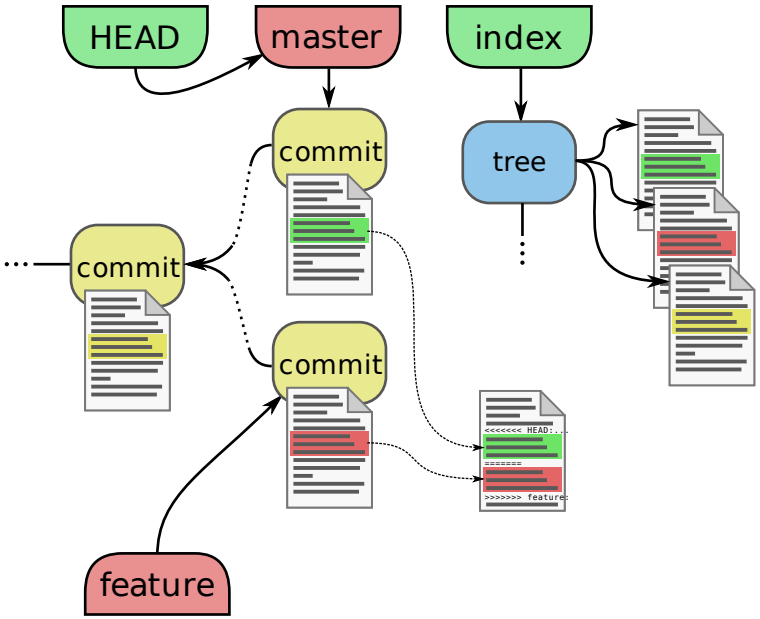
Merging conflicts




```
user@kiste:~/develop/myproj$ git merge feature
Auto-merging main.c
CONFLICT (content): Merge conflict in main.c
Automatic merge failed; fix conflicts and then ...
... commit the result.
user@kiste:~/develop/myproj$
```

Merging conflicts occur if for example the same file differs at the same line in the two branches.

Merging conflicts



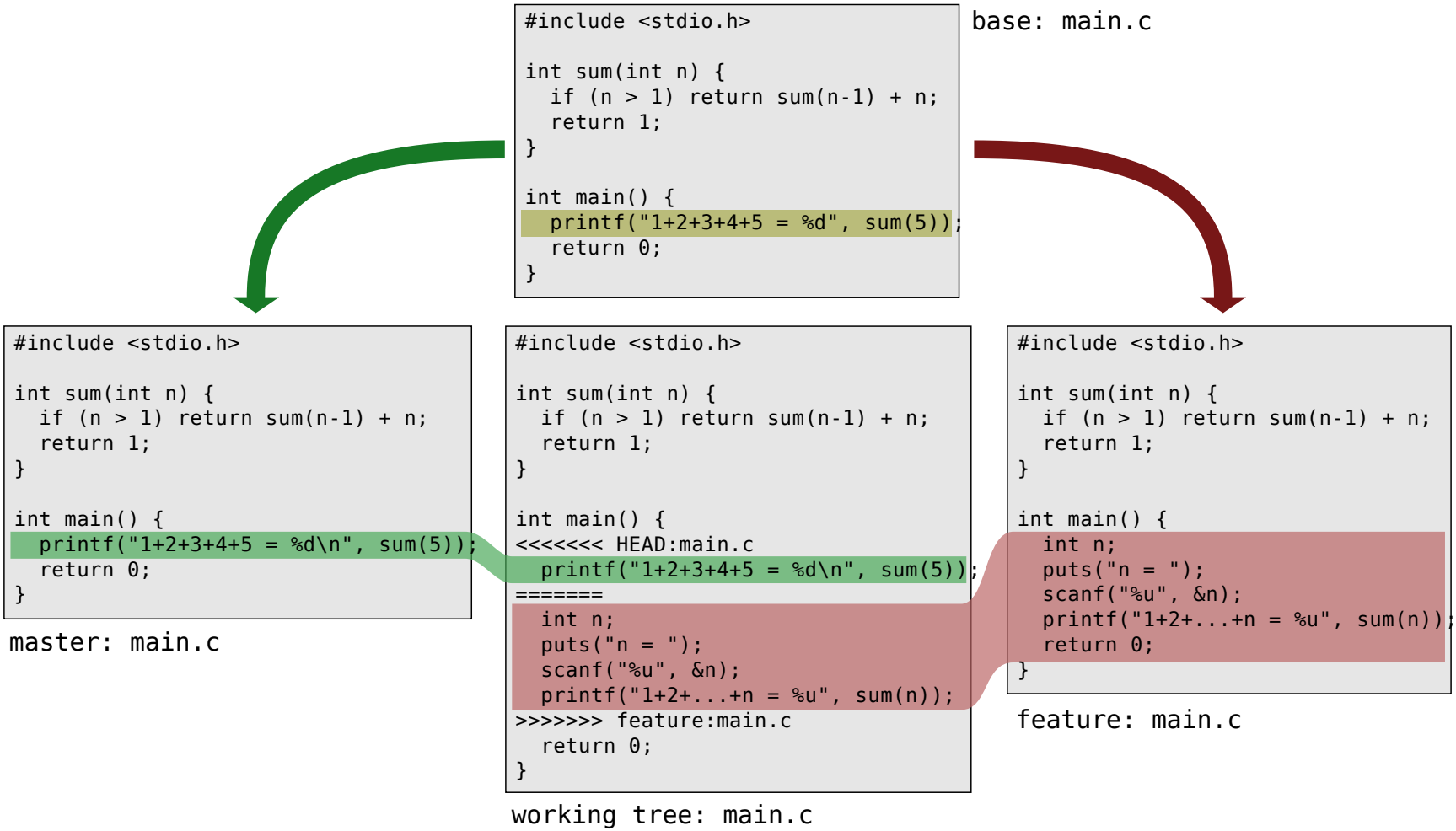

```
user@kiste:~/develop/myproj$ git status
main.c: needs merge
...
user@kiste:~/develop/myproj$
```

Merging conflicts occur if for example the same file differs at the same line in the two branches.

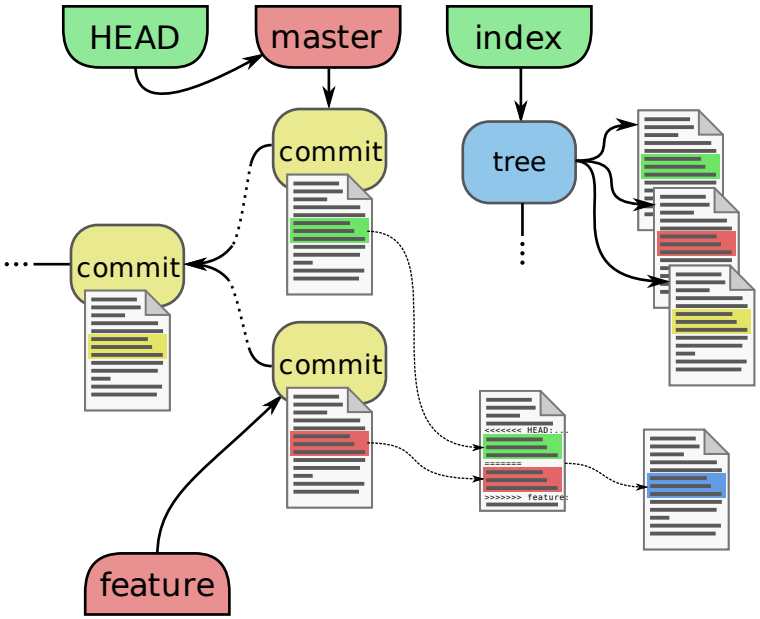
After a failed merge the repository remains in a special state:

- All well merged files are written to the index and the working directory
- The index contains all three versions of the unmerged file
- The working tree contains a special version of the unmerged file

Merging conflicts - file versions



Merging conflicts - resolve conflict

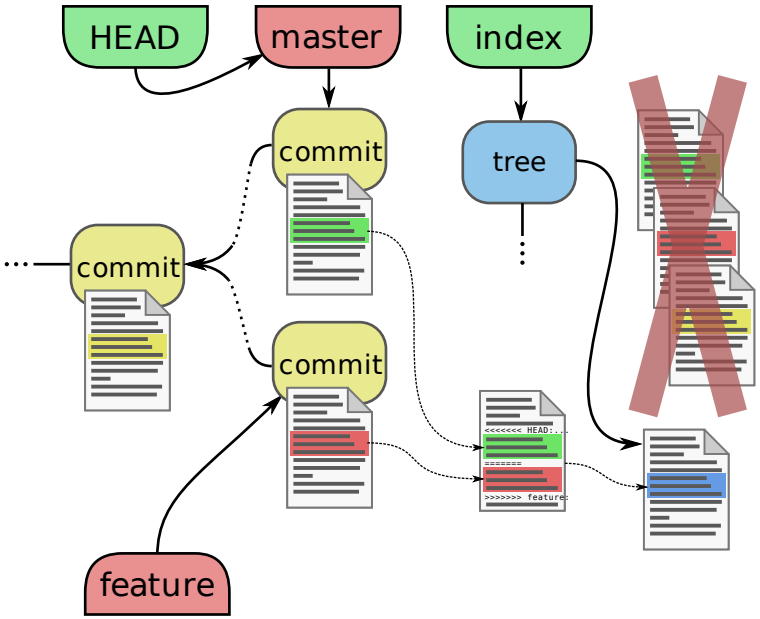


To resolve a merging conflict you have to

- Edit the unmerged files

```
user@kiste:~/develop/myproj$
```

Merging conflicts - resolve conflict



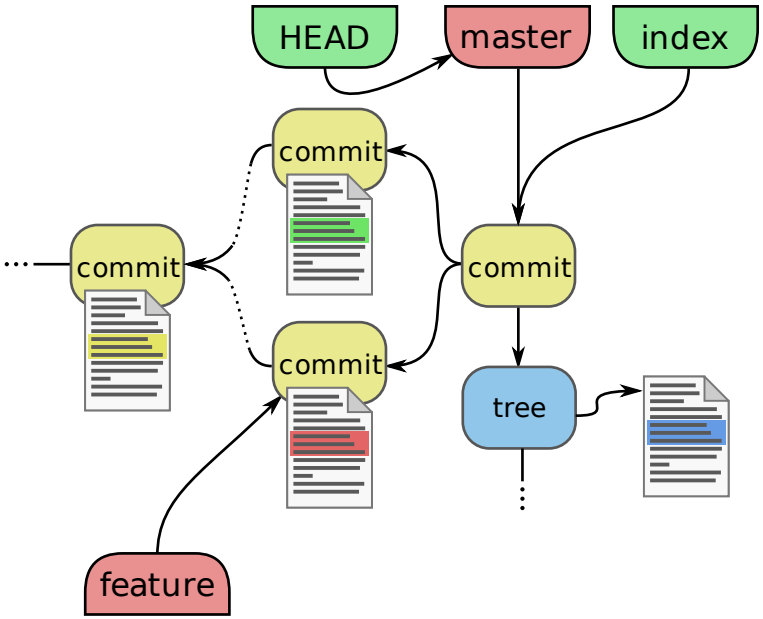

```
user@kiste:~/develop/myproj$ git add main.c
user@kiste:~/develop/myproj$
```

To resolve a merging conflict you have to

- Edit the unmerged files
- Add the corrected files to the index

```
$ git add <files>
```

Merging conflicts - resolve conflict




```
user@kiste:~/develop/myproj$ git commit -m "D"
Created commit 3974070: D
user@kiste:~/develop/myproj$
```

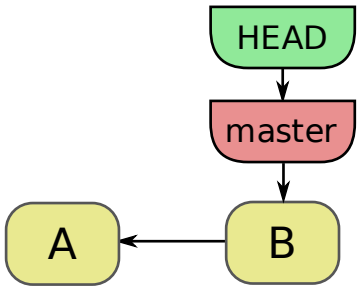
To resolve a merging conflict you have to

- Edit the unmerged files
- Add the corrected files to the index

  `$ git add <files>`
- Complete the merge by commiting the index

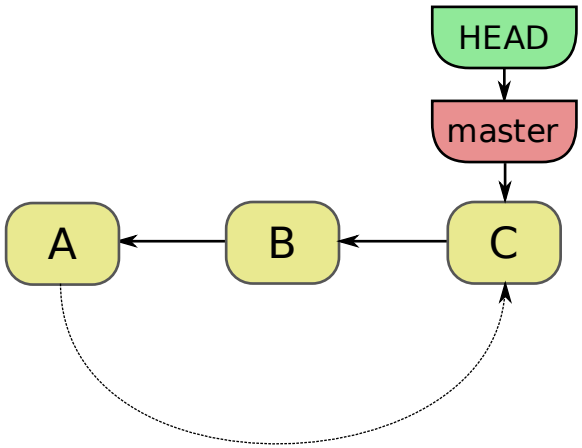
  `$ git commit -m <msg>`

Undo things




```
user@kiste:~/develop/myproj$ git init
Initialized empty Git repository in .git/
user@kiste:~/develop/myproj$ touch main.c
user@kiste:~/develop/myproj$ git add main.c
user@kiste:~/develop/myproj$ git commit -m "A"
...
user@kiste:~/develop/myproj$ touch transform.c
user@kiste:~/develop/myproj$ git add transform.c
user@kiste:~/develop/myproj$ git commit -m "B"
...
user@kiste:~/develop/myproj$
```

Undo things

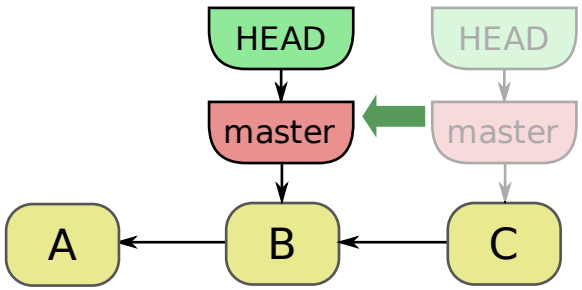


- Revert <commit> by creating a new commit

```
$ git revert <commit>
```

```
user@kiste:~/develop/myproj$ git revert HEAD
user@kiste:~/develop/myproj$ ls
main.c
user@kiste:~/develop/myproj$
```

Undo things



- Revert <commit> by creating a new commit

```
$ git revert <commit>
```

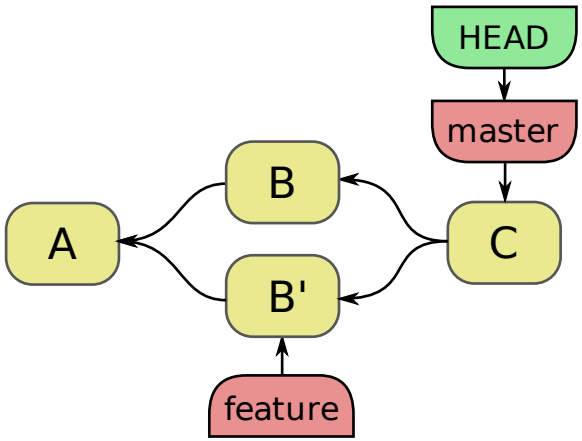
- Reset the HEAD to <commit>

```
$ git reset
    [--hard|--soft]
    <commit>
```

--hard to set all files to the new state

```
user@kiste:~/develop/myproj$ git reset HEAD^
HEAD is now at 9150776 B
user@kiste:~/develop/myproj$ ls
main.c  transform.c
user@kiste:~/develop/myproj$
```

Undo things




```
user@kiste:~/develop/myproj$
```

- Revert `<commit>` by creating a new commit

```
$ git revert <commit>
```

- Reset the `HEAD` to `<commit>`

```
$ git reset
    [--hard|--soft]
    <commit>
```

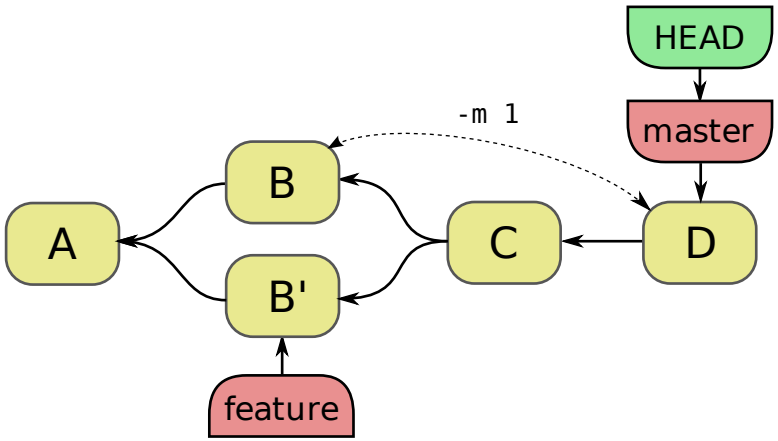
`--hard` to set all files to the new state

- Revert a merge `<commit>`

```
$ git revert
  -m <parent> <commit>
```

`-m` n denotes the n-th parent of the commit

Undo things




```
user@kiste:~/develop/myproj$ git revert -m 1 HEAD
Removed transform.c
Finished one revert.
No protocol specified
Created commit cb4600f: D
 0 files changed, 0 insertions(+), 0 deletions(-)
 delete mode 100644 transform.c
user@kiste:~/develop/myproj$
```

- Revert `<commit>` by creating a new commit

  ```
  $ git revert <commit>
  ```

- Reset the `HEAD` to `<commit>`

  ```
  $ git reset
      [--hard|--soft]
      <commit>
  ```

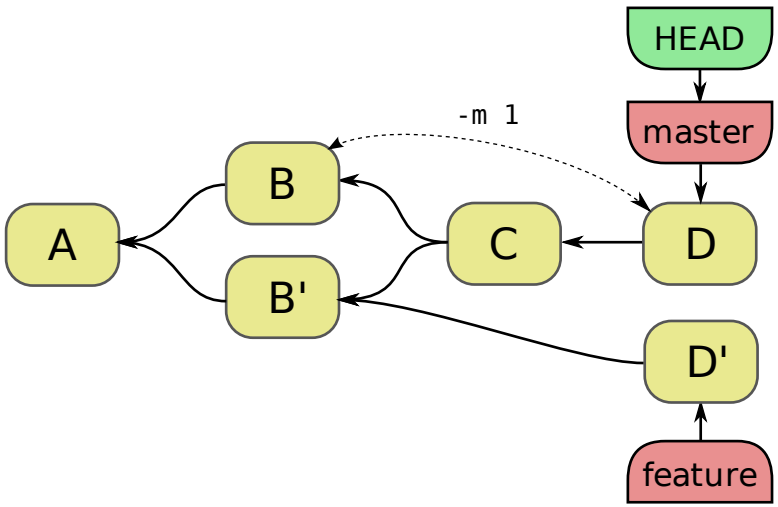
  `--hard` to set all files to the new state

- Revert a merge `<commit>`

  ```
  $ git revert
    -m <parent> <commit>
  ```

  `-m` n denotes the n-th parent of the commit

Undo things




```
user@kiste:~/develop/myproj$ git checkout feature
Switched to branch "feature"
user@kiste:~/develop/myproj$ touch rotate.c
user@kiste:~/develop/myproj$ git add rotate.c
user@kiste:~/develop/myproj$ git commit -m "D'"
Created commit 9ebde48: D'
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 rotate.c
user@kiste:~/develop/myproj$
```

- Revert `<commit>` by creating a new commit

  ```
  $ git revert <commit>
  ```

- Reset the `HEAD` to `<commit>`

  ```
  $ git reset
      [--hard|--soft]
      <commit>
  ```

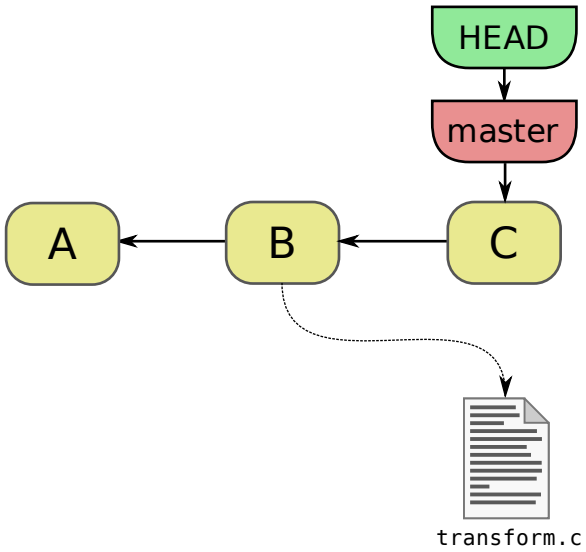
  `--hard` to set all files to the new state

- Revert a merge `<commit>`

  ```
  $ git revert
    -m <parent> <commit>
  ```

  `-m` n denotes the n-th parent of the commit

Undo things




```
user@kiste:~/develop/myproj$ git checkout HEAD^ tr    ansfo
rm.c
user@kiste:~/develop/myproj$ ls
main.c  transform.c
user@kiste:~/develop/myproj$
```

- Revert `<commit>` by creating a new commit

  ```
  $ git revert <commit>
  ```

- Reset the `HEAD` to `<commit>`

  ```
  $ git reset
      [--hard|--soft]
      <commit>
  ```

  `--hard` to set all files to the new state

- Revert a merge `<commit>`

  ```
  $ git revert
    -m <parent> <commit>
  ```

  `-m` n denotes the n-th parent of the commit

- Restore an individual file

  ```
  $ git checkout
      <ref> <file>
  ```

Outline

Remote repositories

A remote repository is a repository which at least partly shares the same history with yours.

- List all remotes

  ```
  $ git remote [-v]
  ```

- Show details about a given remote

  ```
  $ git remote show <name>
  ```

- Add a new remote repository located at `<URL>`

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

- Remove a given remote

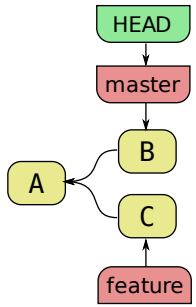
  ```
  $ git remote rm <name>
  ```

Clone an existing repository

user@kiste (local)

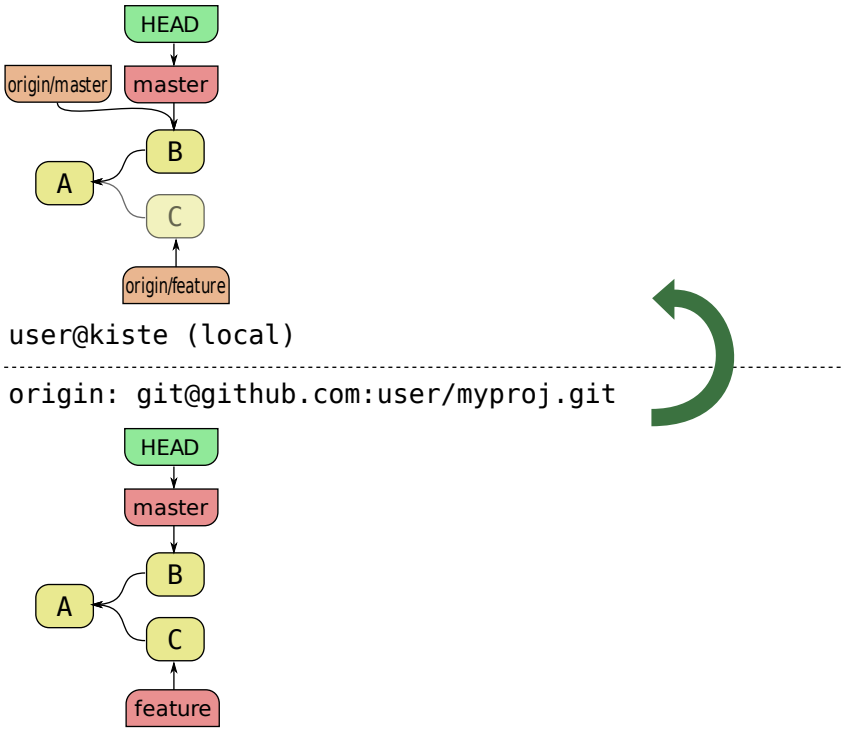
---

git@github.com:user/myproj.git




```
user@kiste:~/develop$ ls -a
./  ../
user@kiste:~/develop$
```

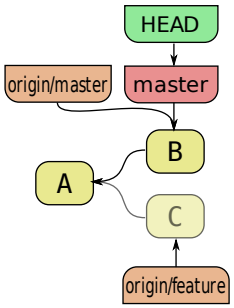
Clone an existing repository




```
user@kiste:~/develop$ git clone git@github.com:user/...
Initialized empty Git repository in /home/user/deve...
user@kiste:~/develop$ cd myproj/
user@kiste:~/develop/myproj$ ls -a
./  ../  .git/  main.c  solver.c
user@kiste:~/develop/myproj$
```

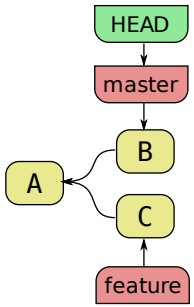
- Clone a repository
  `$ git clone <URL>`
  - All objects from the repository are downloaded
  - But only currently active branch of the remote will be checked out as a branch
  - Remote branches to all other branches

Pulling from a remote - The safe procedure



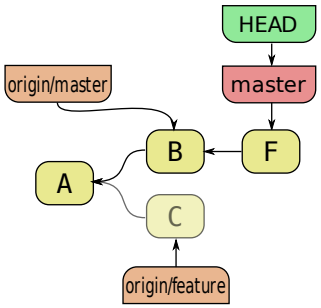
user@kiste (local)

origin: git@github.com:user/myproj.git




```
user@kiste:~/develop$ git clone git@github.com:user/...
Initialized empty Git repository in /home/user/deve...
user@kiste:~/develop$ cd myproj/
user@kiste:~/develop/myproj$ ls -a
./  ../  .git/  main.c  solver.c
user@kiste:~/develop/myproj$
```

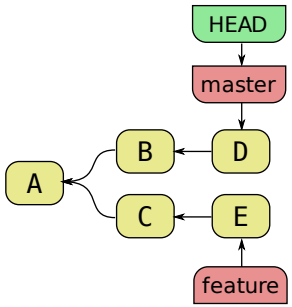
Pulling from a remote - The safe procedure



user@kiste (local)

---

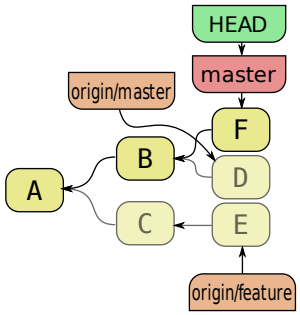
origin: git@github.com:user/myproj.git




```
user@kiste:~/develop/myproj$
```

- Commits to the remote and your repository (worst case scenario)

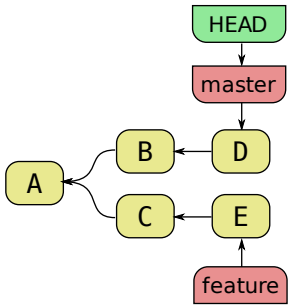
Pulling from a remote - The safe procedure



user@kiste (local)

---

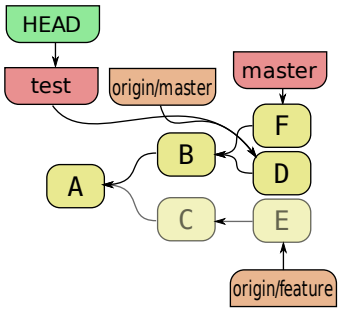
origin: git@github.com:user/myproj.git




```
user@kiste:~/develop/myproj$ git fetch origin
remote: Counting objects: 6, done.
remote: Compressing objects: 100% (4/4), done.
remote: Total 4 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (4/4), done.
From git@github.com:user/myproj.git
   ee65314..dfd2afb  feature    -> origin/feature
   9266699..a96a13a  master     -> origin/master
```

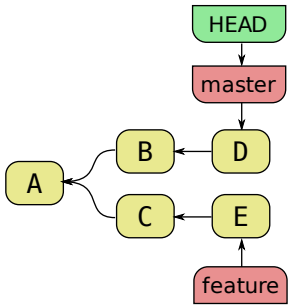
- Commits to the remote and your repository (worst case scenario)
- Fetch newest changes
  `$ git fetch <remote>`
  - Objects will be loaded down but not merged
  - Remote branches are updated

Pulling from a remote - The safe procedure



user@kiste (local)

origin: git@github.com:user/myproj.git



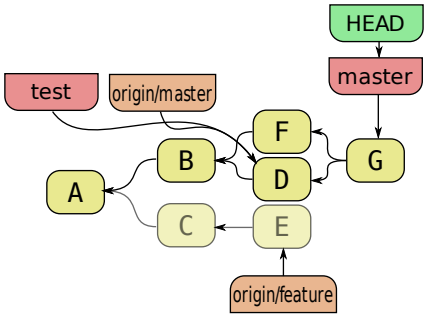

```
user@kiste:~/develop/myproj$ git checkout -b test ...
... origin/master
Branch test set up to track remote branch ...
... refs/remotes/origin/master.
Switched to a new branch "test"
user@kiste:~/develop/myproj$
```

- Commits to the remote and your repository (worst case scenario)
- Fetch newest changes

  `$ git fetch <remote>`
  - Objects will be loaded down but not merged
  - Remote branches are updated
- Create a new branch tracking a remote branch and check it out

  `$ git checkout -b <name> <rem-branch>`
- Test the changes thoroughly!

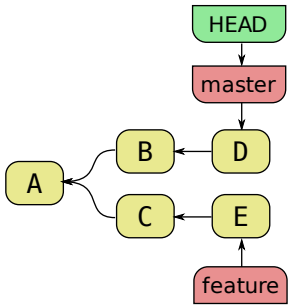
Pulling from a remote - The safe procedure



user@kiste (local)

---

origin: git@github.com:user/myproj.git



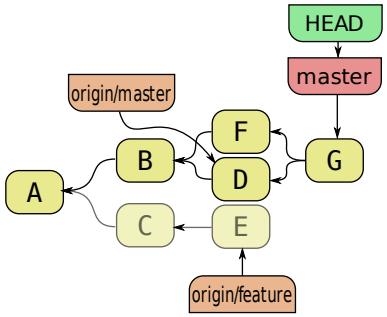

```
user@kiste:~/develop/myproj$ git checkout master
Switched to branch "master"
user@kiste:~/develop/myproj$ git merge test
Merge made by recursive.
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 translate.c
user@kiste:~/develop/myproj$
```

If you agree to the changes:

- Merge the changes to the `master` branch

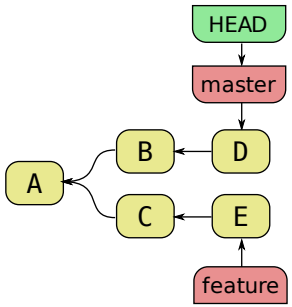
```
$ git checkout master
$ git merge <branch>
```

Pulling from a remote - The safe procedure



user@kiste (local)

origin: git@github.com:user/myproj.git




```
user@kiste:~/develop/myproj$ git branch -d test
user@kiste:~/develop/myproj$
```

If you agree to the changes:

- Merge the changes to the `master` branch

  ```
  $ git checkout master
  $ git merge <branch>
  ```

- Delete the temporary `test` branch

  ```
  $ git branch (-d|-D)
    <branch>
  ```

`-d` checks whether the branch is already merged

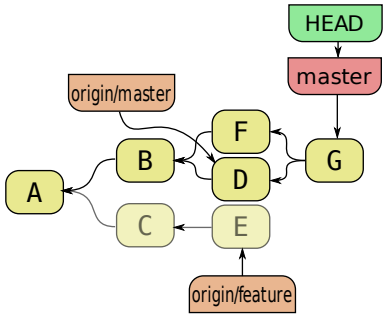
Pulling from a remote

If you always agree to the changes in the remote, use

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

to fetch the changes from `<remote>` and merge them right into your repository.

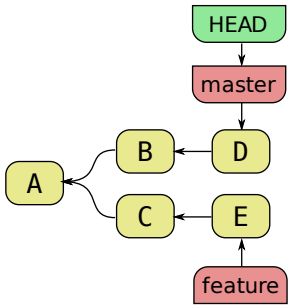
Pushing to a remote



user@kiste (local)

---

origin: git@github.com:user/myproj.git

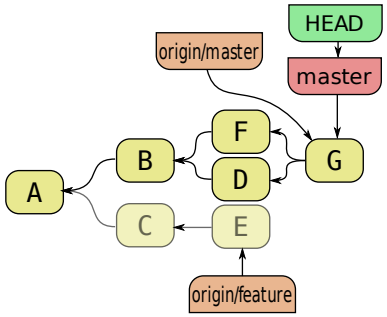



```
user@kiste:~/develop/myproj$
```

You want to

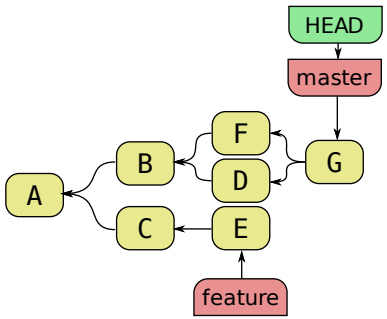
- Update a remote repository,
- That did not change until your last local modifications

Pushing to a remote



user@kiste (local)

origin: git@github.com:user/myproj.git




```
user@kiste:~/develop/myproj$ git push origin master
Counting objects: 6, done.
Compressing objects: 100% (4/4), done.
Writing objects: 100% (4/4), 437 bytes, done.
Total 4 (delta 2), reused 0 (delta 0)
Unpacking objects: 100% (4/4), done.
To git@github.com:user/myproj.git
   a96a13a..cdf06f4  master -> master
```

You want to

- Update a remote repository,
- That did not change until your last local modifications

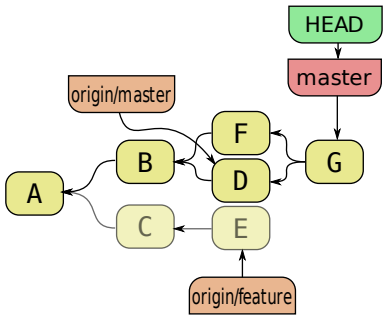
then you can

- Push the changes to the remote

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

No `<branch>` given: Updates all matching branches

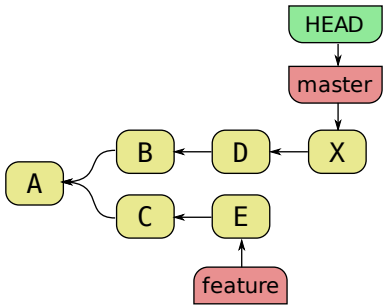
Pushing to a remote



user@kiste (local)

---

origin: git@github.com:user/myproj.git



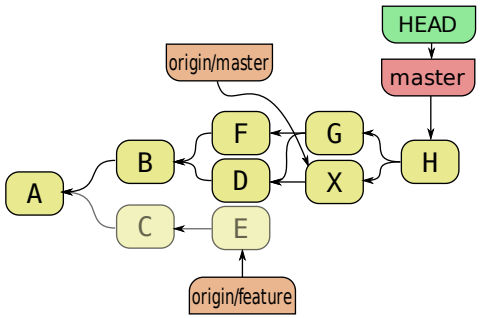

```
user@kiste:~/develop/myproj$ git push origin master
To git@github.com:user/myproj.git
 ! [rejected]        master -> master (non-fast forward)
error: failed to push some refs to '...'
user@kiste:~/develop/myproj$
```

You want to

- Update a remote repository,
- That did change until your last local modifications

then you can't simply push!

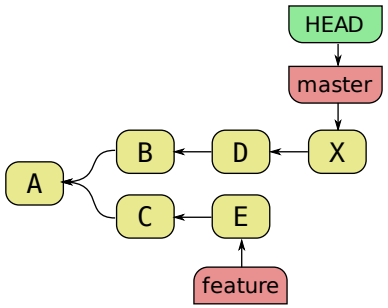
Pushing to a remote



user@kiste (local)

---

origin: git@github.com:user/myproj.git




```
user@kiste:~/develop/myproj$ git pull origin
From /usr/people/waehnert/latex/gittalk/myproj/
 + cdf06f4...ea047c2 master     -> origin/master  (...
Merge made by recursive.
 0 files changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 test.c
user@kiste:~/develop/myproj$
```

You want to

- Update a remote repository,
- That did change until your last local modifications

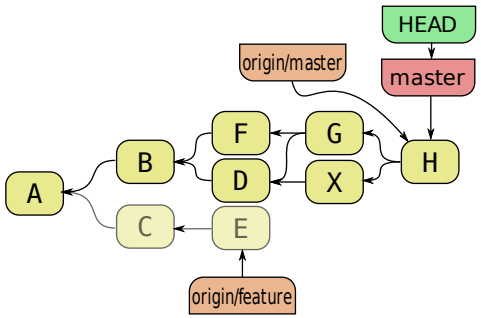
then you can't simply push!

- Pull the changes into your repository

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

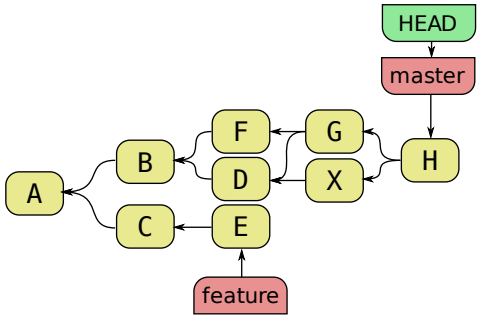
No `<branch>` given: Updates all matching branches

Pushing to a remote



user@kiste (local)

origin: git@github.com:user/myproj.git




```
user@kiste:~/develop/myproj$ git push origin
Counting objects: 9, done.
Compressing objects: 100% (6/6), done.
Writing objects: 100% (6/6), 699 bytes, done.
Total 6 (delta 3), reused 0 (delta 0)
Unpacking objects: 100% (6/6), done.
To git@github.com:user/myproj.git
   ea047c2..275939c  master -> master
```

You want to

- Update a remote repository,
- That did change until your last local modifications

then you can't simply push!

- Pull the changes into your repository

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

No `<branch>` given: Updates all matching branches

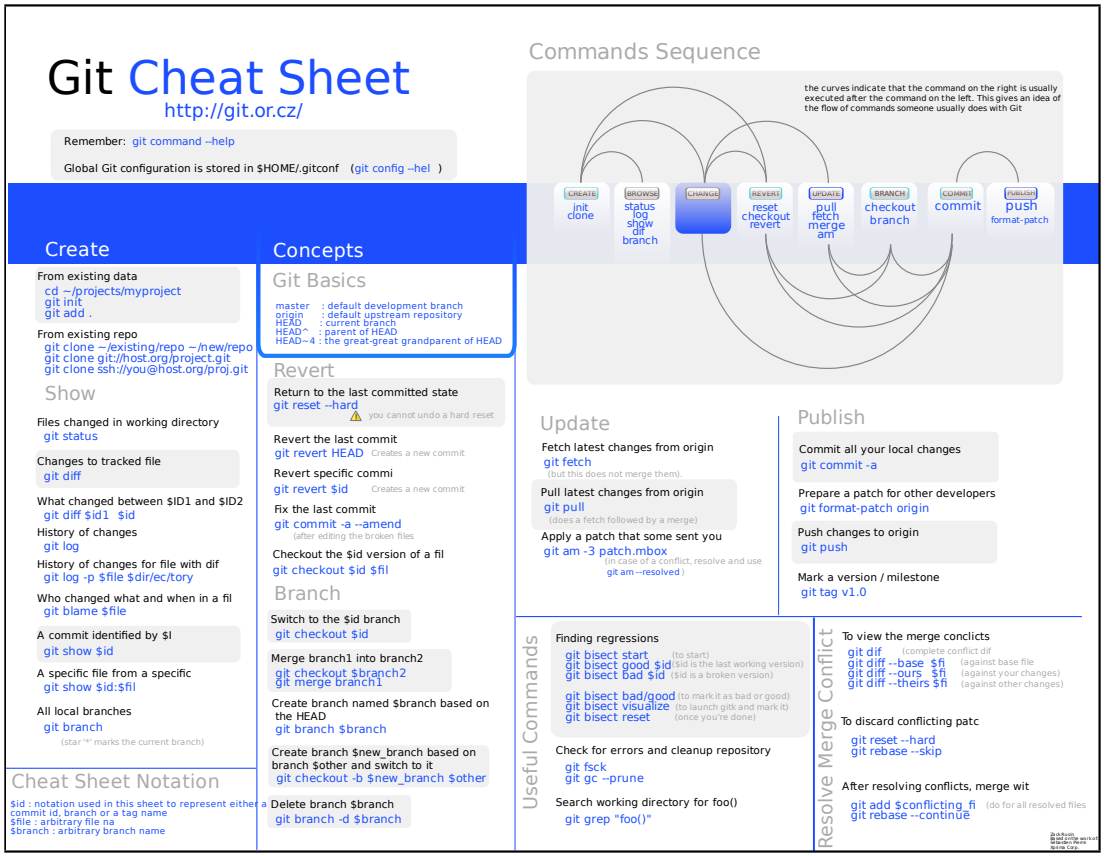
- Push your updated repository to the remote

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

Outline

Git cheat sheet

Gives you an overview of all important Git commands



Download and print it and nail it down onto the wall at your desk!

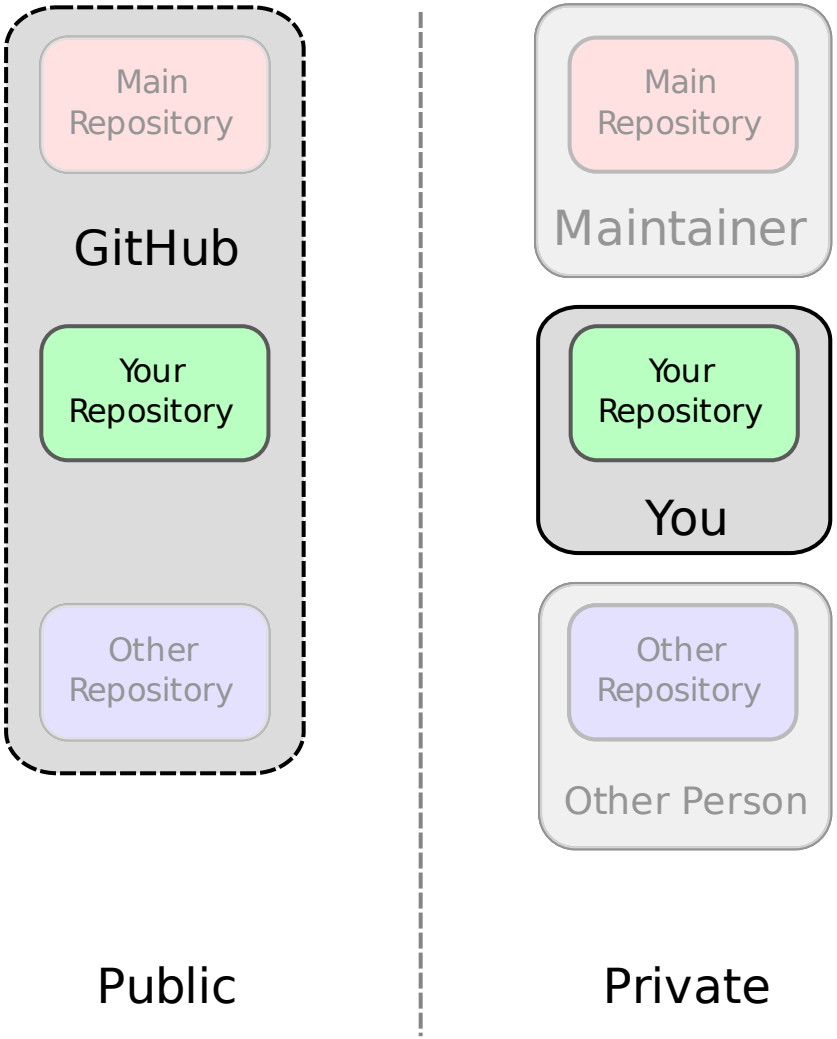
Thank you for your attention!

You can get this talk by using Git: Just type

```
git clone git://github.com/waehnert/gittalk.git
```

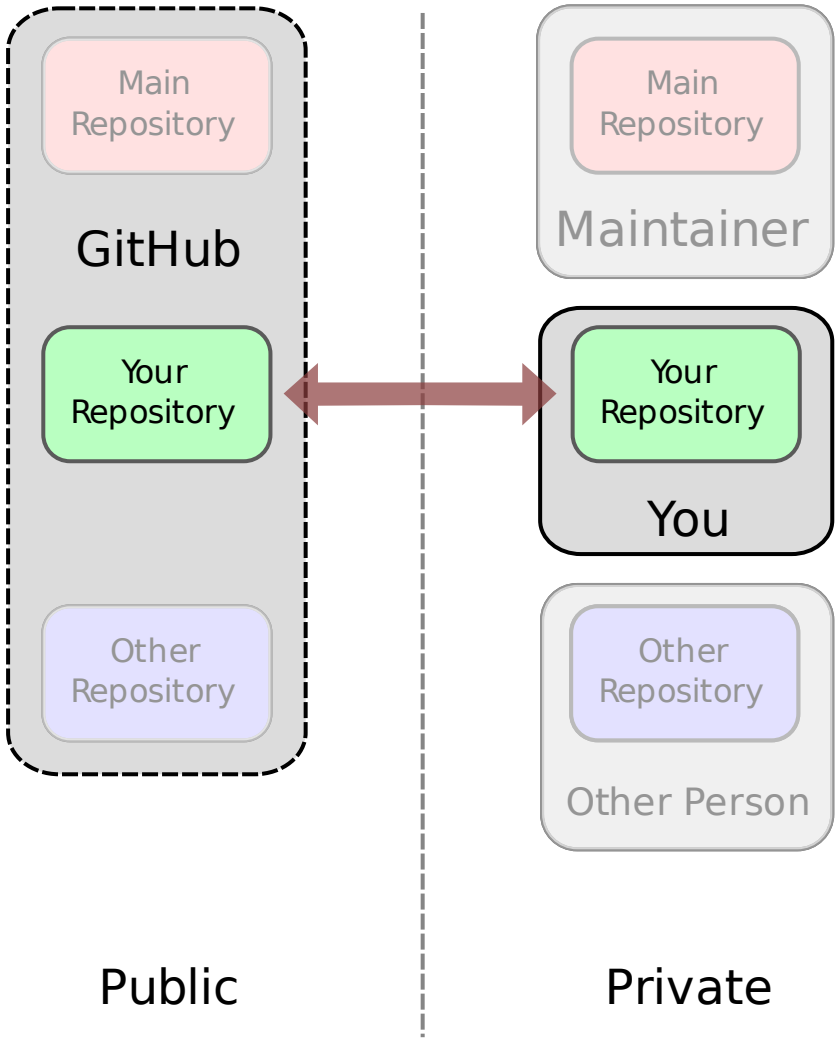
to get a copy of the talk.

Public repositories



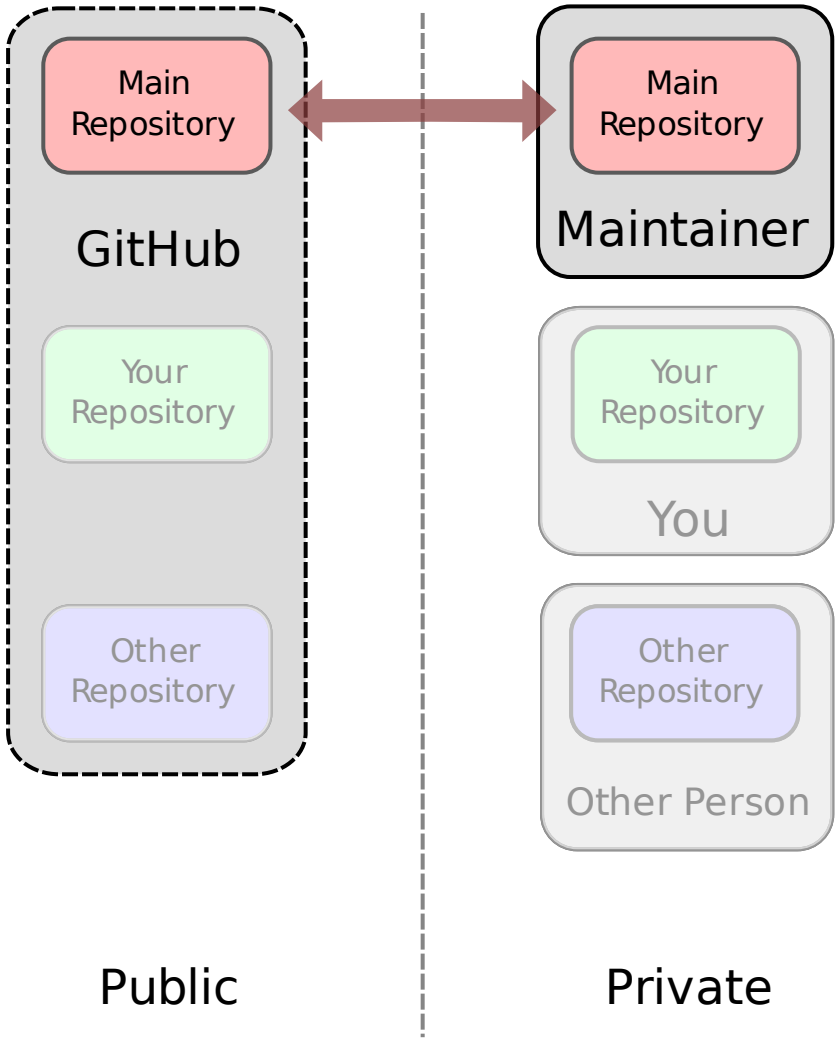
- Each developer has its own private and public repository

Public repositories



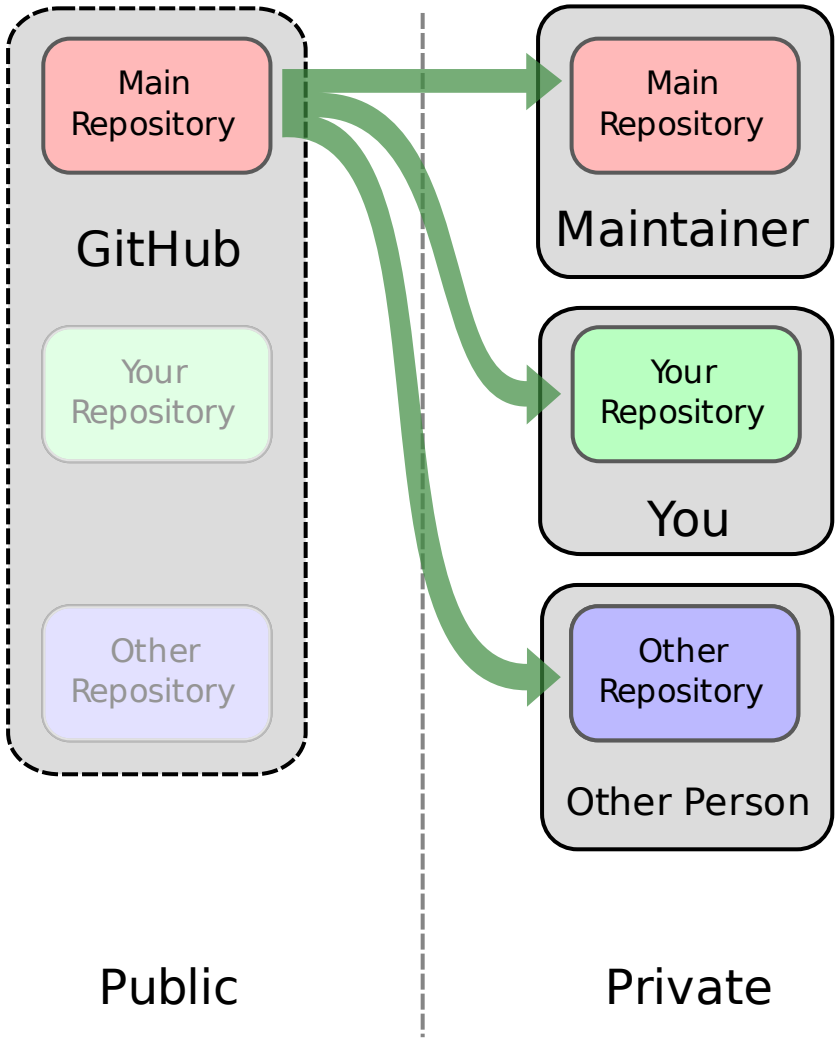
- Each developer has its own private and public repository
- You can pull from and push to your public repository

Public repositories



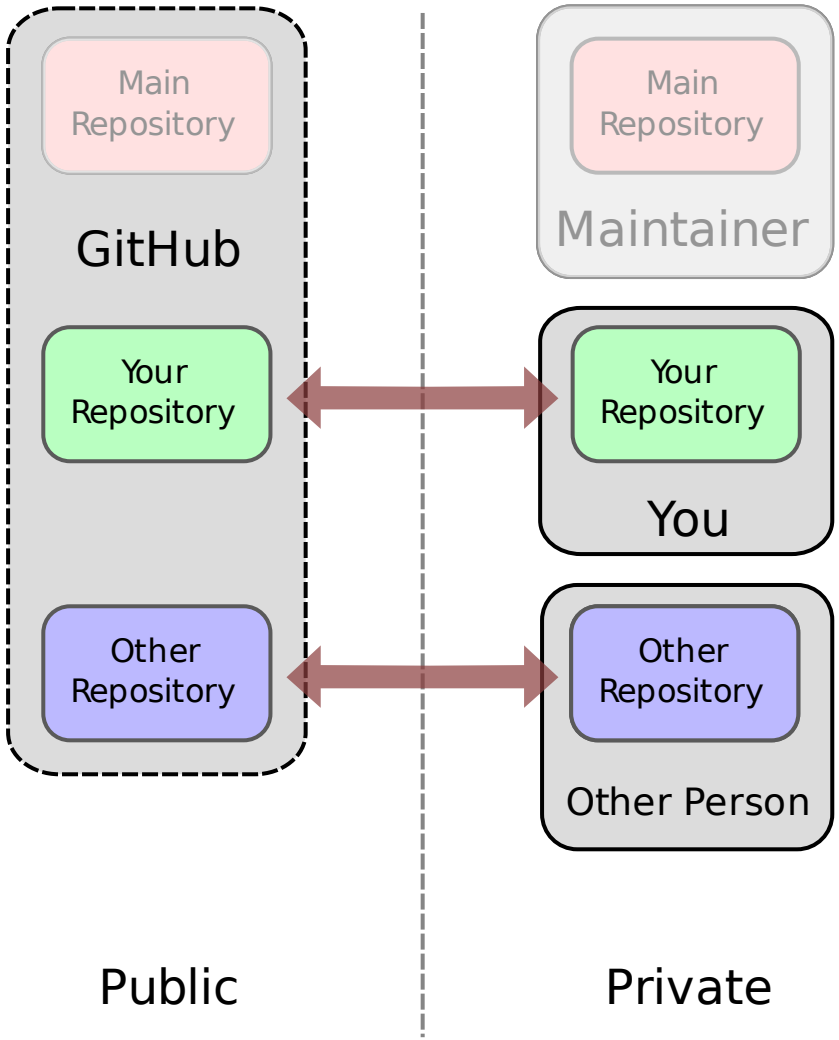
- Each developer has its own private and public repository
- You can pull from and push to your public repository
- Among these repositories there is the main repository

Public repositories



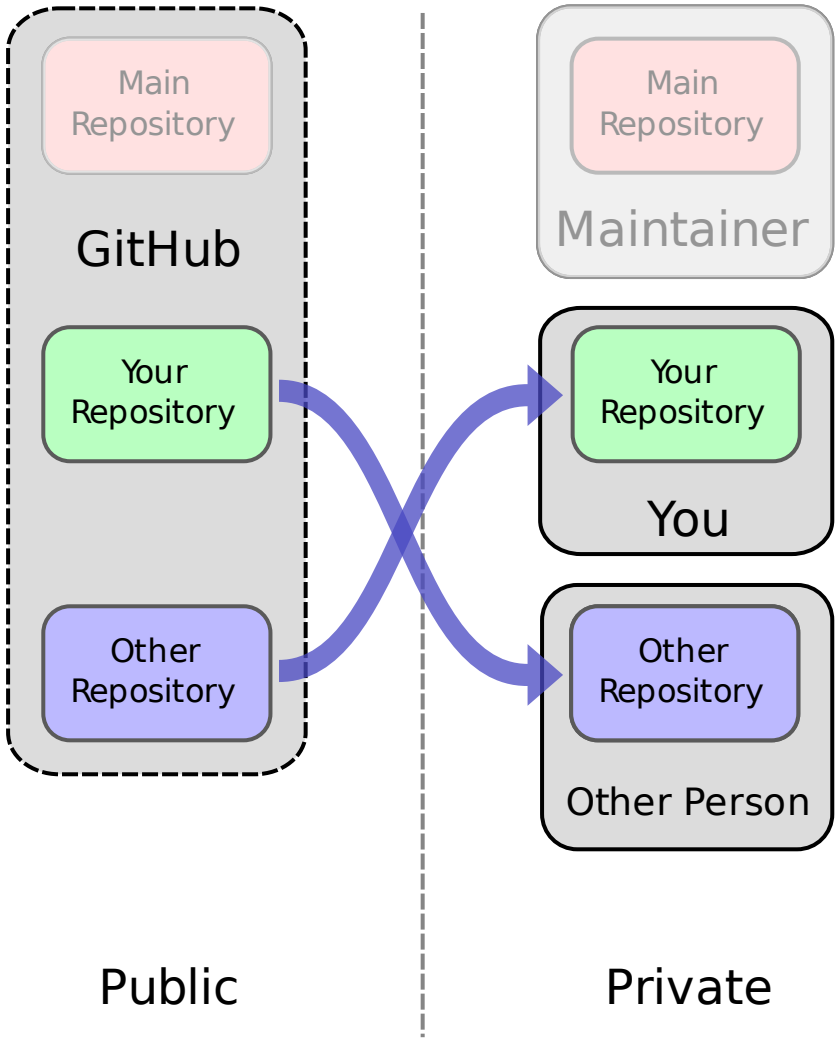
- Each developer has its own private and public repository
- You can pull from and push to your public repository
- Among these repositories there is the main repository
- Every developer can pull the newest official changes from this main repository

Public repositories



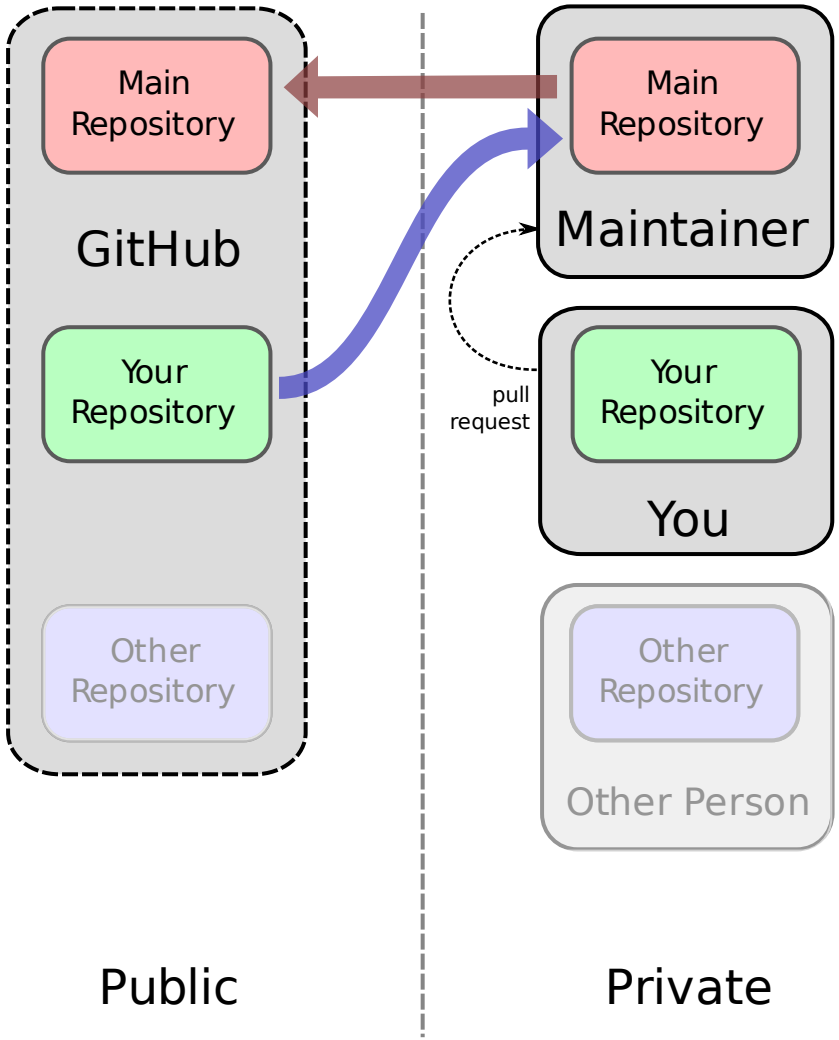
- Each developer has its own private and public repository
- You can pull from and push to your public repository
- Among these repositories there is the main repository
- Every developer can pull the newest official changes from this main repository
- Now each developer works on the project and makes the changes publicly available

Public repositories



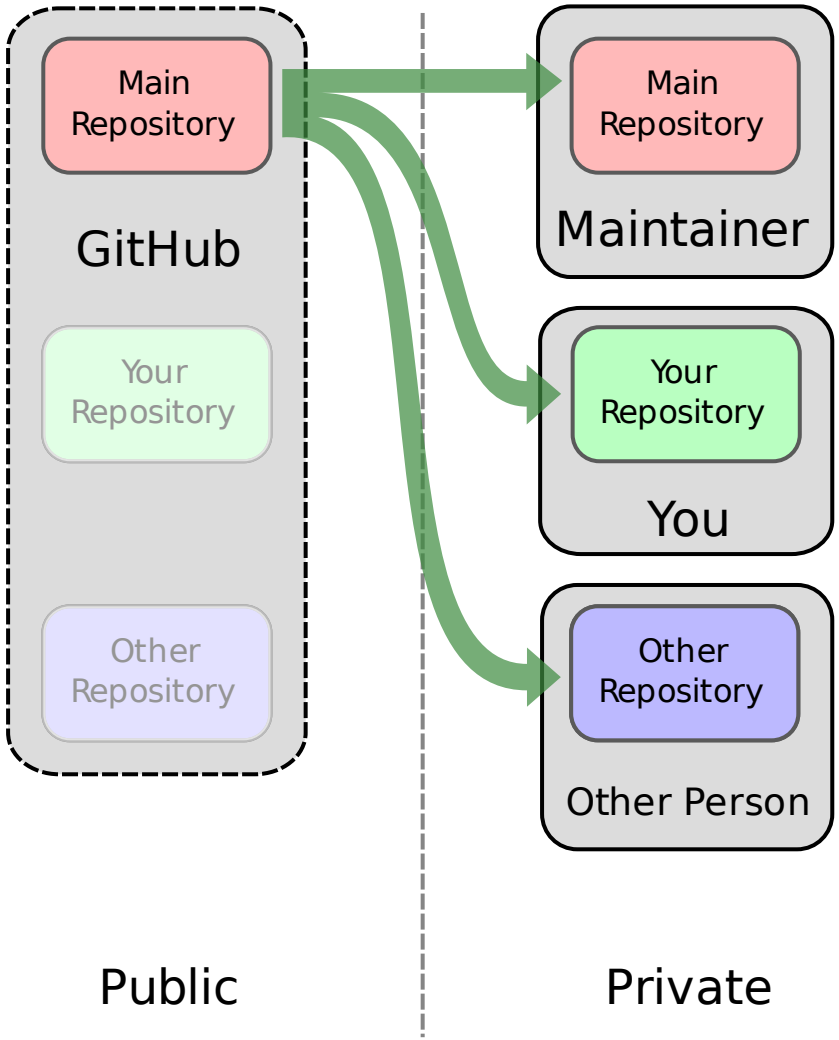
- The developers can share changes among each other

Public repositories



- The developers can share changes among each other
- If you want to bring your changes into the main repository you have to make a pull request to its maintainer

Public repositories



- The developers can share changes among each other
- If you want to bring your changes into the main repository you have to make a pull request to its maintainer
- If these changes are accepted they can be pulled by others from the main repository

Short History

1991-2002	Changes to the Linux kernel were passed around as patches and archived files
2002-2005	The kernel project used the proprietary BitKeeper VCS
2005	The relation between the kernel community and BitMover Inc. broke down
Apr 3, 2005	Begin of the development of Git as a replacement for BitKeeper
Feb 13, 2010	Release of the version 1.7.0

Design Goals

Linus Torvalds had several design criteria

1. Something opposite to CVS (Linus: "[...] and I hate it with passion.")
2. Distributed version control system
3. Strong safeguards against corruption, either accidental or malicious
4. High performance

Every VCS which existed in 2005 didn't meet at least one of these criteria. So Linus sat down and started writing Git.

Why "Git"? Linus: "I'm an egotistical bastard, and I name all my projects after myself. First Linux, now git."

a git, brit. en., stupid or unpleasant person

Basic Tagging

Tags are pointers to specific objects in your history.

- To create an annotated tag containing a description and information about its author
  ```
  $ git tag -a <tag-name> -m <msg> [<objects>]
  ```
- To get the informations stored along with a tag
  ```
  $ git show <tag-name>
  ```
- To get a list of the available tags
  ```
  $ git tag [-l <search-pattern>]
  ```
- To delete a given tag (Public available tags shouldn't be deleted!)
  ```
  $ git tag -d <name>
  ```
- To push a tag to a remote (Tags aren't transfered automaticaly!)
  ```
  $ git push <remote> <tag>
  ```