Consortium des Equipements
de Calcul Intensif
en Fédération Wallonie-Bruxelles

Introduction to code versioning

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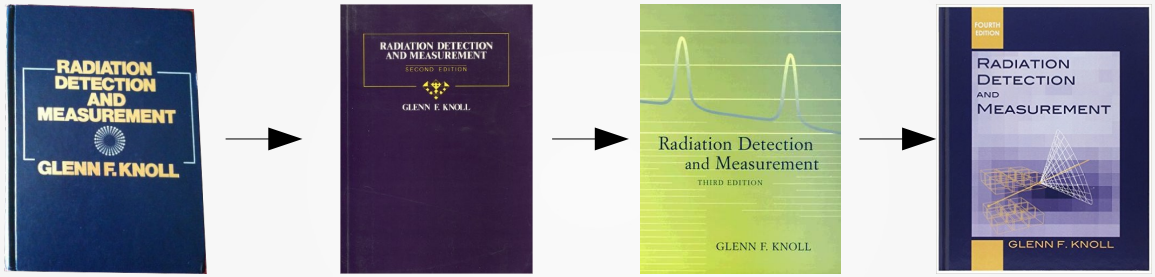
http://www.cism.ucl.ac.be/training

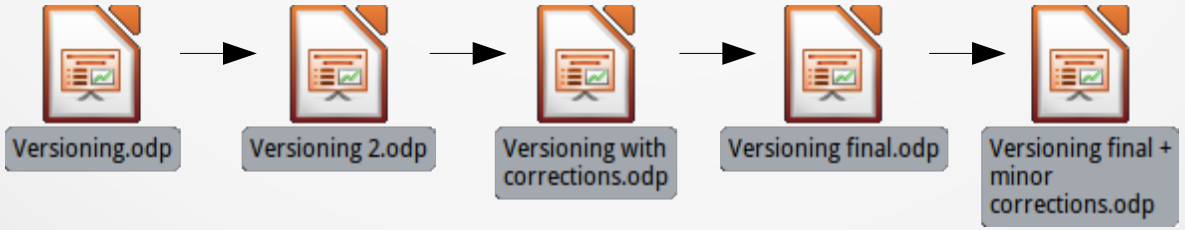
Introduction to code versioning

- Notions of code versioning
  - Local Data Model
  - Client-Server Model
  - Distributed Model
- Working with Git and Mercurial
- Workflows

Notions of code versioning

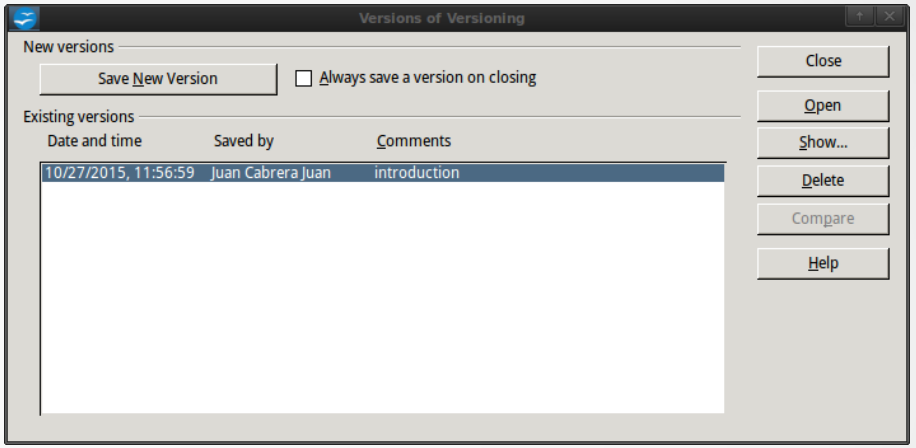
Versions have existed for almost as long as writing has existed





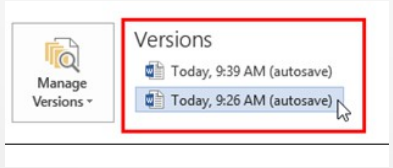
Notions of code versioning

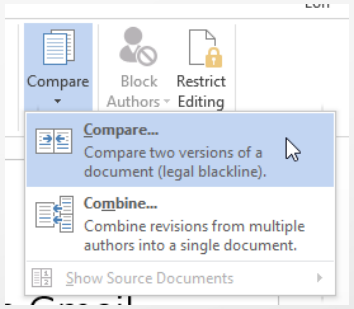
OpenOffice Documents



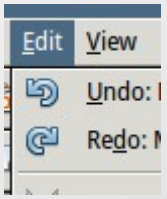
Google Docs

Microsoft Office documents





Undo-Redo



Synonyms

- Version control
- Source control
- Revision control
- Source code management

Notions of code versioning

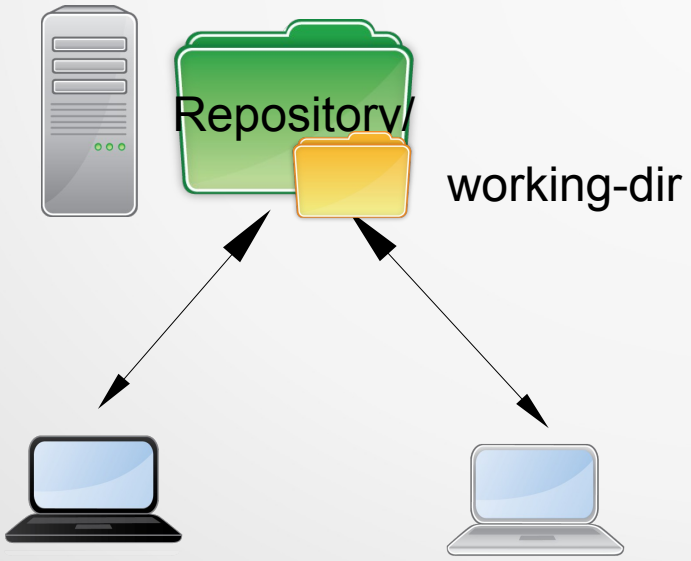
- Track the history and evolution of the project
- Who, what, when, why
- Benefits:
  - team work
  - tracking bugs
  - recovering from mistakes

Evolution of technology

- Local model
- Client-server model
- Distributed model

Local Version Control System

- Source Code Control System (SCCS)
- Revision Control System (RCS)
  - Repository is in a shared folder ; every one works there
  - Operates on individual files, checked out and in
  - Delta files are in a RCS sub-directory (repository or store)



Working directory

Repository

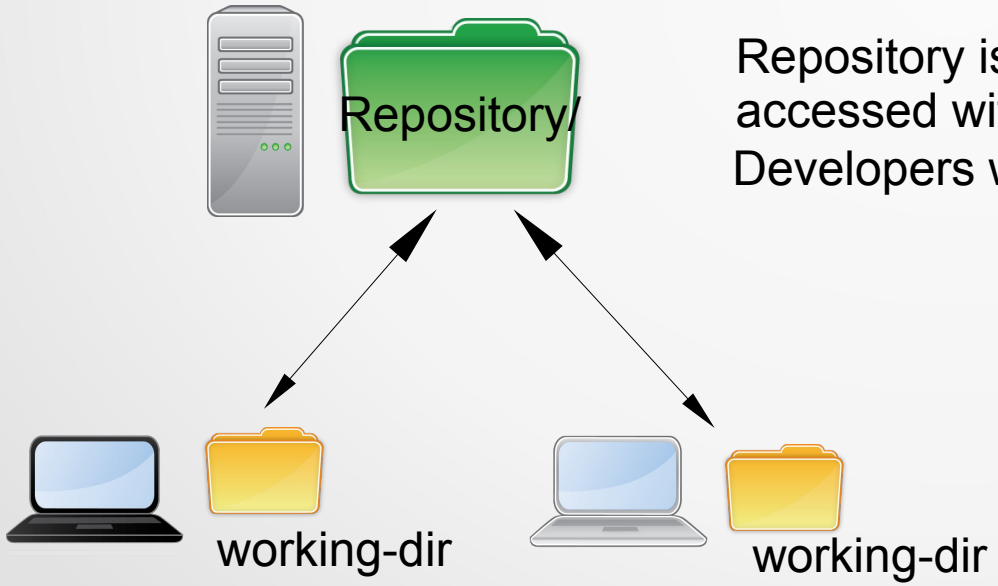
```
testRCS
├── file1.c
├── file2.c
├── file3.c
├── files
├── RCS
│   ├── file1.c,v
│   ├── file2.c,v
│   ├── file3.c,v
│   ├── files,v
│   └── README,v
├── README
└── subdir
    ├── file10.txt
    ├── file11.txt
    ├── file12.txt
    ├── file13.txt
    └── RCS
        ├── file10.txt,v
        ├── file11.txt,v
        ├── file12.txt,v
        └── file13.txt,v

3 directories, 18 files
```

http://basepath.com/aup/talks/SCCS-Slideshow.pdf
http://www.gnu.org/software/rcs/tichy-paper.pdf
http://www.gnu.org/software/rcs/manual/rcs.pdf

Centralized Version Control System

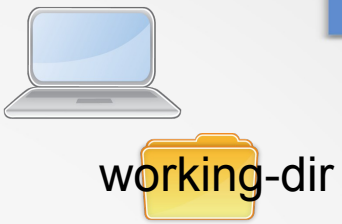
- Concurrent Versions System (CVS)
- Subversion (SVN)



Repository is shared folder in remote machine accessed with ssh, http+web_dav or cvs/svn server
Developers work locally on their computer

http://ftp.gnu.org/non-gnu/cvs/source/feature/1.12.13/cederqvist-1.12.13.pdf
http://svnbook.red-bean.com/en/1.7/svn-book.pdf
http://tortoisesvn.net/support.html http://www.tortoisecvs.org

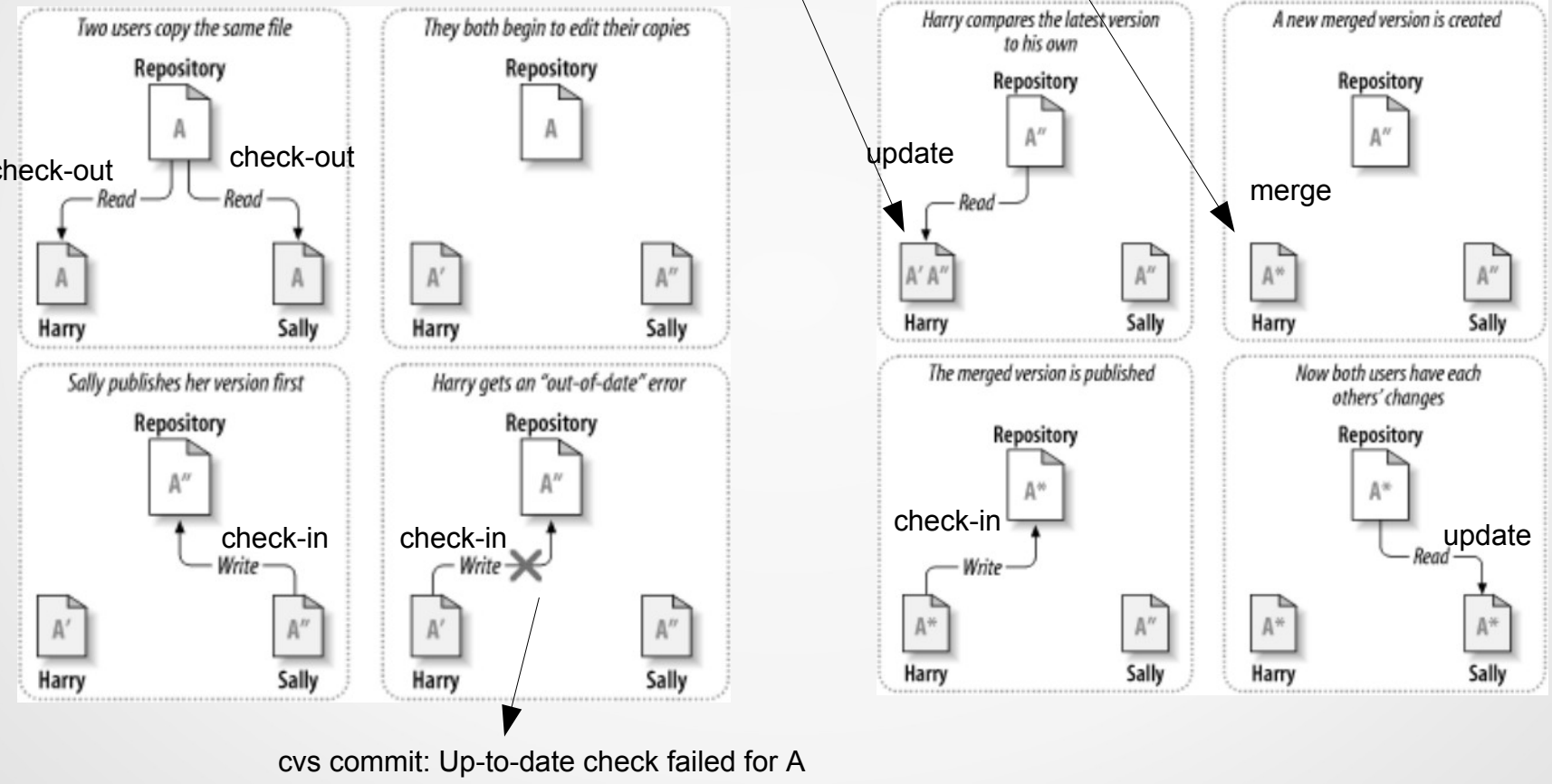
Centralized Version Control System




```
repos
├── conf
│   ├── authz
│   ├── passwd
│   └── svnserve.conf
├── db
│   ├── current
│   ├── ...
│   ├── revprops
│   ├── revs
│   └── ...
├── format
├── hooks
│   ├── post-commit.tmpl
│   ├── ...
│   └── start-commit.tmpl
├── locks
│   ├── db.lock
│   └── db-logs.lock
└── README.txt
```

```
project1/
├── branches
│   └── rel1-0
│       ├── hello_c.c
│       ├── hello_c.h
│       ├── Makefile
│       ├── README
│       └── .svn
├── .svn
│   ├── entries
│   ├── format
│   ├── pristine
│   ├── tmp
│   └── wc.db
├── tags
└── trunk
    ├── hello_c.c
    ├── hello_c.h
    ├── Makefile
    └── README
```

Centralized Version Control System



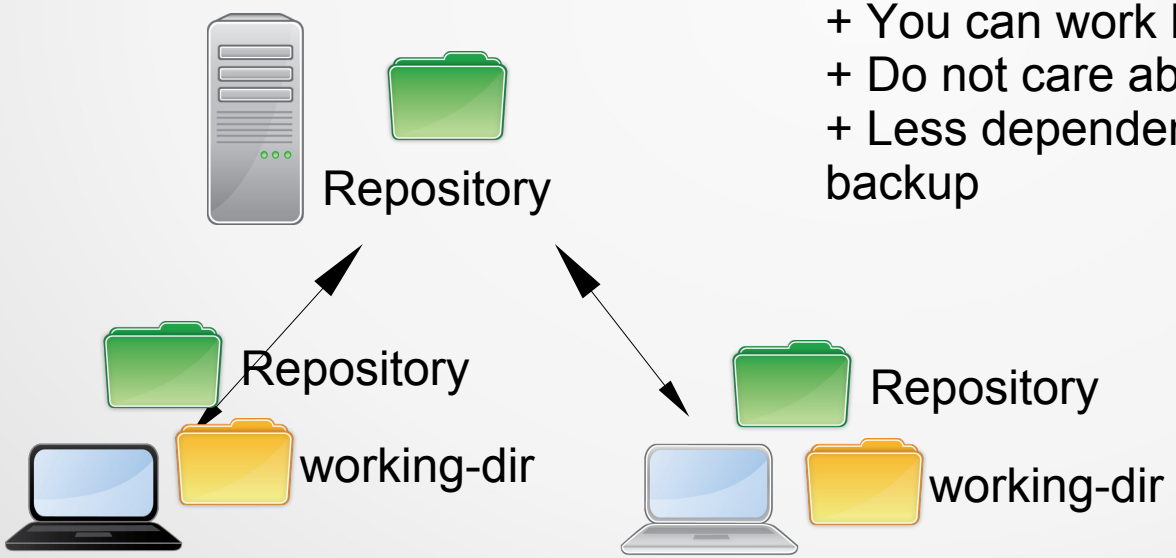
Distributed Version Control System

- Mercurial
- Git

Full copy of the repository

- Repository are cloned on multiple machines:
- Shared folder in remote machine with: ssh, http protocol
- No technical difference between repositories only policy says which one is the reference

+ You can work locally and make draft copies
+ Do not care about network for commits
+ Less dependent on backups every clone is a backup



https://www.mercurial-scm.org/wiki/MercurialBook
https://git-scm.com/book/en/v2

Introduction to code versioning

- Notions of code versioning
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  - Distributed model
- **Working with Git and Mercurial**
- Workflows

Global configuration

Before the use of hg or git set configuration

Edit ~/.hgrc file

```
[ui]
username = John Doe <johndoe@example.com>
```

Set global options for git

```
$ git config --global user.name "John Doe"
$ git config --global user.email johndoe@example.com
```

You can set other parameters as editor, merge tool ...

Ignore files

Use .gitignore or .hgignore files to
select files and folders you do not want to track

```
# Backup files left behind by the Emacs and vim editor.
*~
# Temporary files used by the vim editor.
.*.swp
# compiled objects
*.pyc
*.o
# directory fileter example (case sensitive)
# ignore log dir
Logs/
```

Single project single user


```
$ hg init
$ git init
```

Single project single user

Repository

```
$ vim test.c
$ vim test.h
$ hg status
? test.c
? test.h
```

```
$ vim test.c
$ vim test.h
$ git status
On branch master

Initial commit

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

        test.c
        test.h

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

Single project single user

working-dir

Repository

```
$ hg add *
$ hg st
A test.c
A test.h
```

hg add is used to start tracking files

```
$ git add test.c
$ git status
On branch master

Initial commit

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

        new file:   test.c

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

        test.h
```

git add is used to stage files i.e. mark them for next commit

Single project single user

working-dir

Repository

```
$ hg commit test.c -m'Add test.c'
$ hg st
A test.h
```

```
$ git commit -m'Add test.c'
[master (root-commit) 46ef322] Add test.c
 1 file changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 test.c
$ git status
On branch master
Untracked files:
  (use "git add <file>..." to include in what will be committed)

        test.h

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

Single project single user

working-dir

Repository

```
$ hg commit test.h -m'Add test.h'
$ hg log
changeset:   1:bb105d00ed3a
tag:         tip
user:        Damien Francois  <damien.francois@uclouvain.be>
date:        Tue Oct 25 10:57:35 2016 +0200
summary:     Add test.h

changeset:   0:97d3b6e78985
user:        Damien Francois  <damien.francois@uclouvain.be>
date:        Tue Oct 25 10:55:44 2016 +0200
summary:     Add test.c
```

Single project single user

working-dir

Repository

```
$ git add test.h
$ git commit -m'Add test.h'
[master 56bdae9] Add test.h
 1 file changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 test.h
$ git log
commit 56bdae9399a8d9d74232ee69c2a535d460acf02f
Author: Damien François <damien.francois@uclouvain.be>
Date:   Tue Oct 25 10:58:17 2016 +0200

    Add test.h

commit 46ef3222fadc9d4a50fe6e5ba2f9bfa6345ae719
Author: Damien François <damien.francois@uclouvain.be>
Date:   Tue Oct 25 10:56:20 2016 +0200

    Add test.c
```

Single project single user

working-dir

Repository

Cancel with hg revert
Go back to a specific revision with hg up -r ...

```
$ vim test.c
$ hg diff
diff -r 79fa9e722a59 test.c
--- a/test.c    Wed Nov 09 14:46:51 2016 +0100
+++ b/test.c    Wed Nov 09 14:48:08 2016 +0100
@@ -1,4 +1,4 @@
 int main()
 {
-    int a=5;
+    int a=6;
 }
$
```

Single project single user

working-dir

Repository

Cancel with git revert
Go back to a specific version with git checkout...

```
$ vim test.c
$ git diff
diff --git a/test.c b/test.c
index 0197793..0c7f097 100644
--- a/test.c
+++ b/test.c
@@ -1,4 +1,4 @@
 int main()
 {
-    int a=5;
+    int a=6;
 }
$
```

Single project single user + backup

working-dir

Repository

```
$ ssh hall "mkdir -p bcktestgit && cd bcktestgit && git init --bare"
Initialized empty Git repository in /home/pan/dfr/bcktestgit/
$ ssh hall "mkdir bcktesthg && hg init"
```

working-dir

Repository

hall

Repository
(empty)

Single project single user + backup

working-dir

Repository

hall

Repository (empty)

```
$ echo -e '[paths]\nhall=ssh://hall/bcktesthg' >> .hg/hgrc
$ hg path
hall = ssh://hall/bcktesthg
$ hg push hall
pushing to ssh://hall/bcktesthg
searching for changes
remote: adding changesets
remote: adding manifests
remote: adding file changes
remote: added 2 changesets with 2 changes to 2 files
```

working-dir

Repository

hall

Repository (full)

Single project single user + backup

working-dir

Repository

hall

Repository (empty)

```
$ git remote add hall ssh://hall/bcktestgit
$ git remote -v
hall  ssh://hall/bcktestgit (fetch)
hall  ssh://hall/bcktestgit (push)
$ git push hall --all
Counting objects: 5, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (3/3), done.
Writing objects: 100% (5/5), 439 bytes | 0 bytes/s, done.
Total 5 (delta 0), reused 0 (delta 0)
To ssh://hall/~/bcktestgit
 * [new branch]      master -> master
```

working-dir

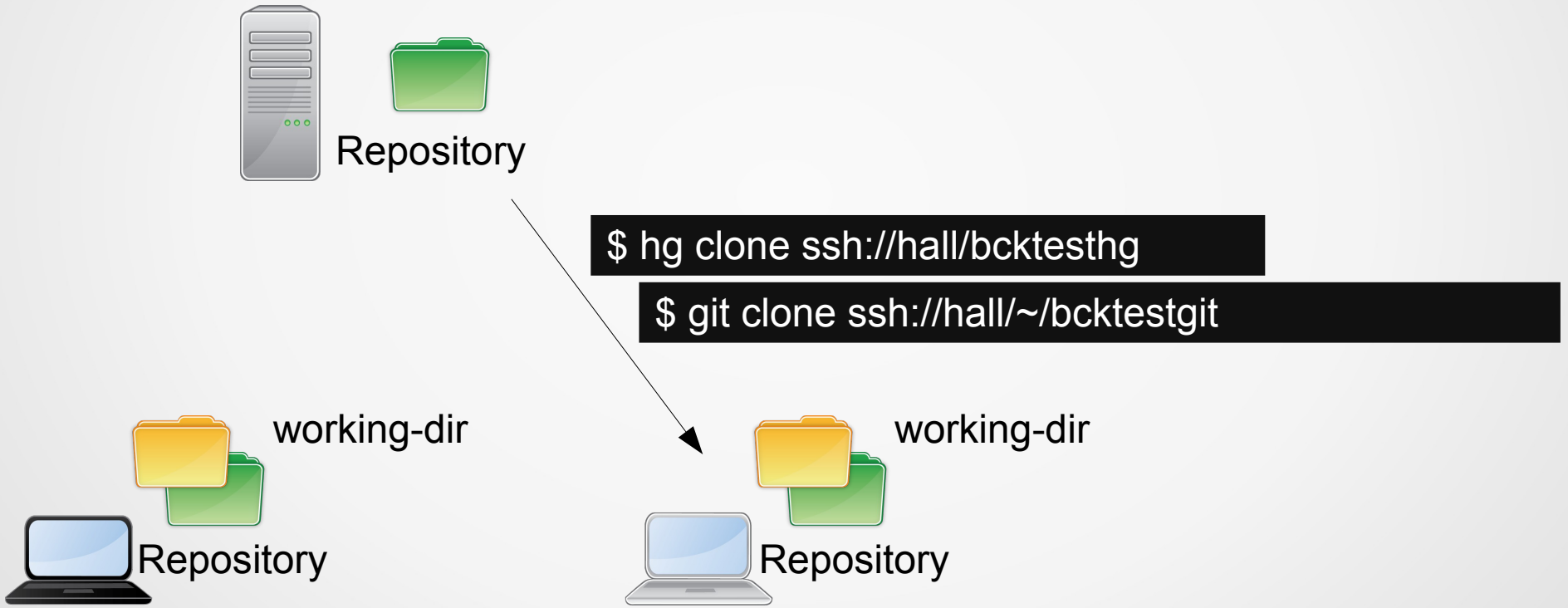
Repository

hall

Repository (full)

Multiple users central server

- Cloning



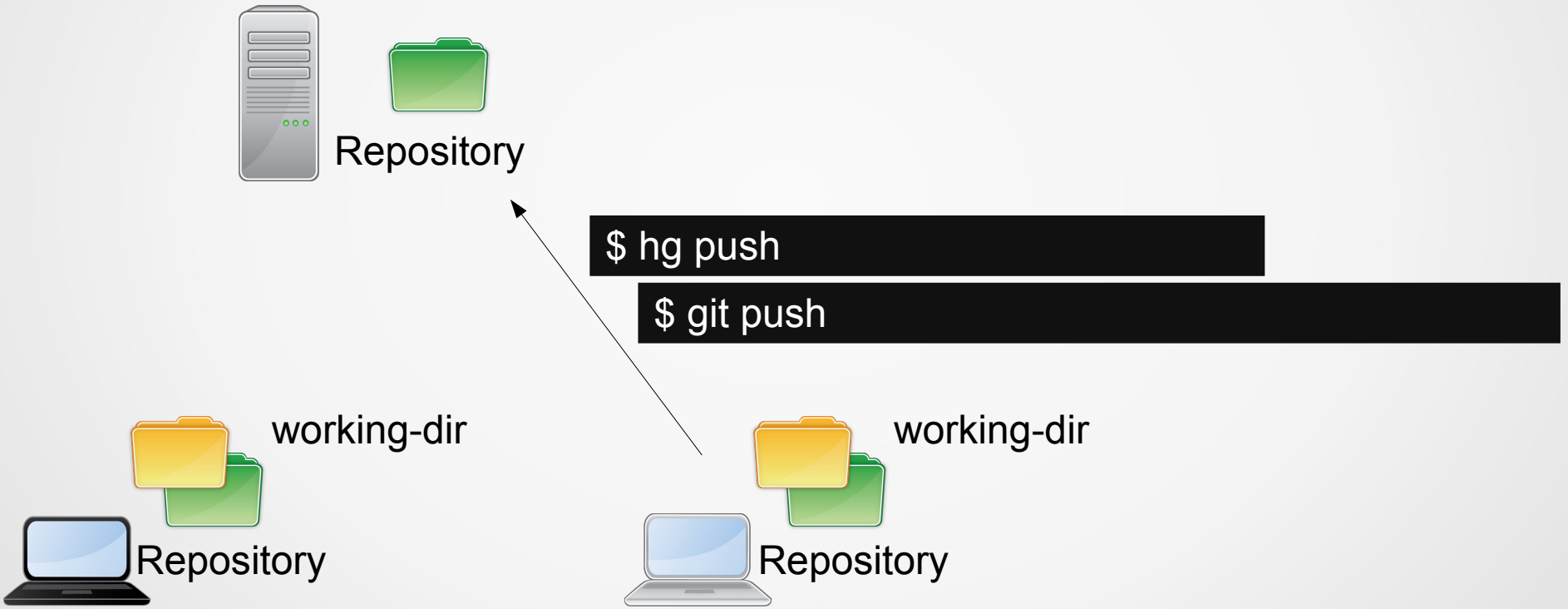
Multiple users central server

- Working + committing


```
$ hg commit ...
$ git commit
```

Multiple users central server

- Pushing



Multiple users central server

- Conflict resolution

```
$ hg push hall
pushing to ssh://hall/bcktesthg
searching for changes
remote has heads on branch 'default' that are not known locally: 7aaa042c0373
abort: push creates new remote head 5a984c5a3005!
(pull and merge or see "hg help push" for details about pushing new heads)
$ hg pull
pulling from ssh://hall/bcktesthg
searching for changes
adding changesets
adding manifests
adding file changes
added 2 changesets with 2 changes to 1 files (+1 heads)
(run 'hg heads' to see heads, 'hg merge' to merge)
$ hg merge
merging test.c
warning: conflicts while merging test.c! (edit, then use 'hg resolve --mark')
0 files updated, 0 files merged, 0 files removed, 1 files unresolved
use 'hg resolve' to retry unresolved file merges or 'hg update -C .' to abandon
```

Multiple users central server

- Conflict resolution

```
$ cat test.c
<<<<<<< local
line you wanted to push
=======
current version of the line on the server
>>>>>>> other
$ vim test.c
$ hg resolve --mark
(no more unresolved files)
$ hg commit -mmerge
$ hg push
pushing to ssh://hall/bcktesthg
searching for changes
remote: adding changesets
remote: adding manifests
remote: adding file changes
remote: added 2 changesets with 2 changes to 1 files
```

Multiple users central server

- Conflict resolution

```
$ git push origin master
To ssh://hall/~/bcktestgit
 ! [rejected]        master -> master (fetch first)
error: failed to push some refs to 'ssh://hall/~/bcktestgit'
hint: Updates were rejected because the remote contains work that you do
hint: not have locally. This is usually caused by another repository pushing
hint: to the same ref. You may want to first integrate the remote changes
hint: (e.g., 'git pull ...') before pushing again.
hint: See the 'Note about fast-forwards' in 'git push --help' for details.
$ git pull
remote: Counting objects: 5, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
From ssh://hall/~/bcktestgit
   a547735..7f32455  master     -> origin/master
Auto-merging test.c
CONFLICT (content): Merge conflict in test.c
Automatic merge failed; fix conflicts and then commit the result.
```

Multiple users central server

- Conflict resolution

```
$ cat test.c
<<<<<<< HEAD
line you wanted to push
=======
current version of the line on the server
>>>>>>> 7f32455dbe6bea745bc94efd6b3d5f473446d581
$ vim test.c
$ git add .
$ git commit -m merge
[master 6b884f0] merge
$ git push origin master
Counting objects: 6, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (5/5), done.
Writing objects: 100% (6/6), 676 bytes | 0 bytes/s, done.
Total 6 (delta 0), reused 0 (delta 0)
To ssh://hall/~/bcktestgit
   7f32455..6b884f0  master -> master
```

Multiple users central server

- To avoid trouble when merging, pull often
- These commands merge automatically if possible

```
$ hg pull --update
$ git pull --rebase
```

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- **Workflows**

One-off patch submission

- You do not have write access to the repository


```
$ hg clone https://...
$ git clone https://...
```

Clone, then edit, commit, and extract a patch to send by email for instance

```
$ hg export tip > patch.diff
$ git format-patch -1 > patch.diff
```

Feature Branch Workflow

- Develop features in separate 'branches'

```
$ hg branch new-feature-name ; git commit -m'Create new branch'
$ git checkout -b new-feature-name master
```

- You can list branches and choose one with:

```
$ hg branches ; git update branch-name
$ git branches ; git checkout branch-name
```

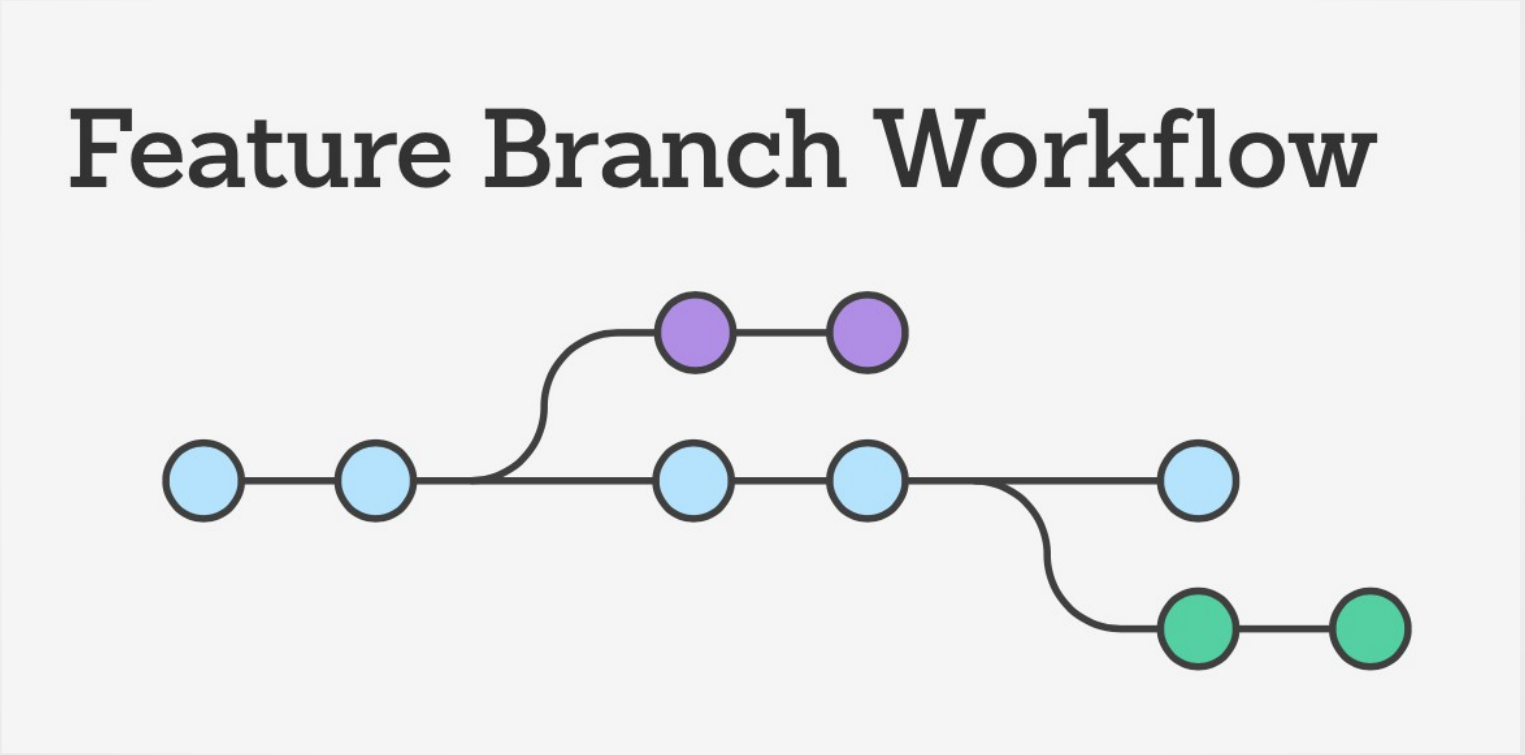
- Merge the main branch into your as often as possible

```
$ hg up new-feature-name ; hg merge default ; hg commit -m'Merge default'
$ git checkout  new-feature-name ; git merge master; git commit
```

- When new-feature is finished, merge in the opposite direction

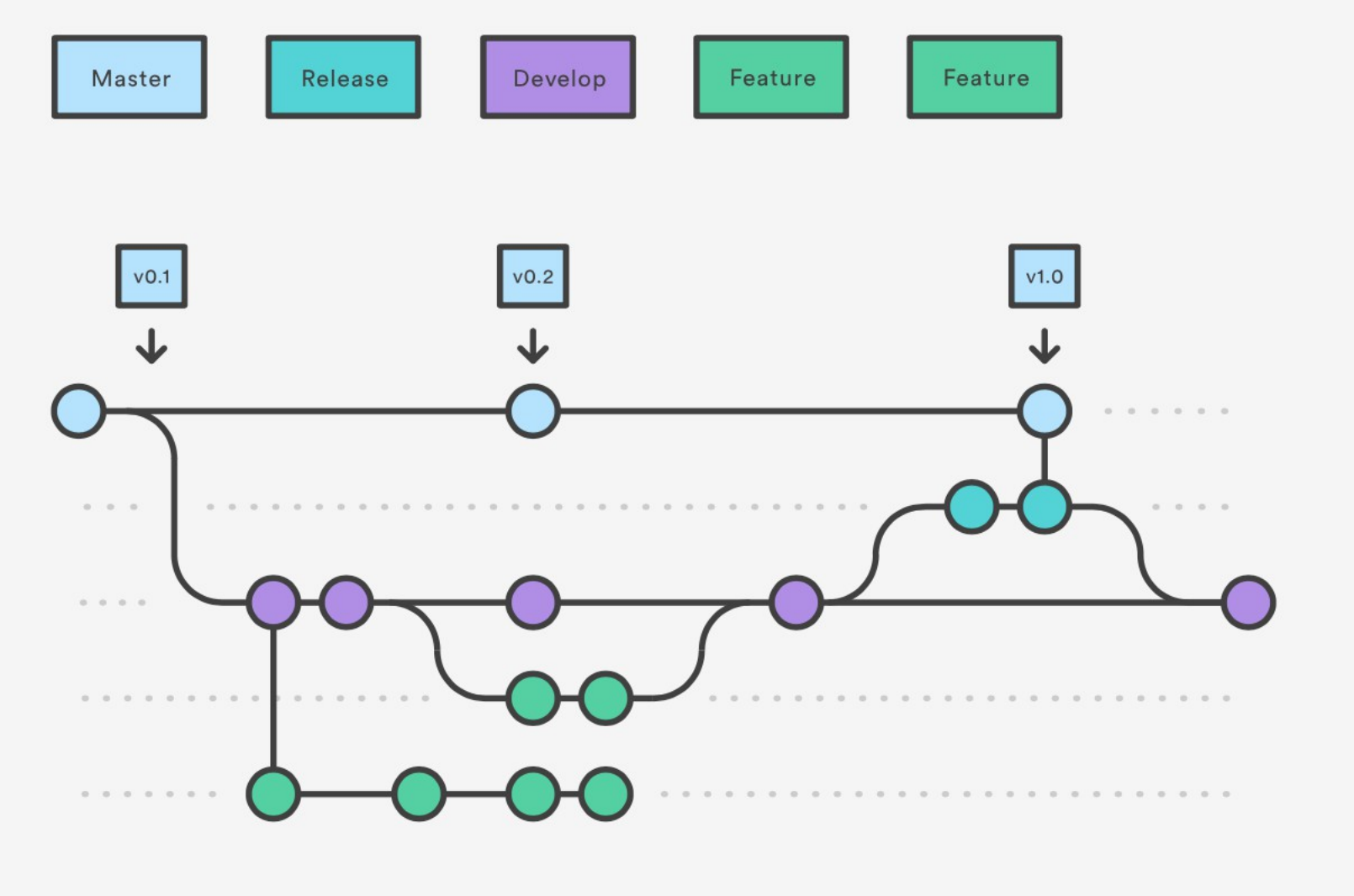
```
$ hg up default ; hg merge new-feature-name ; hg commit -m'Merge new-feature'
$ git checkout  master; git merge new-feature-name
```

Feature Branch Workflow

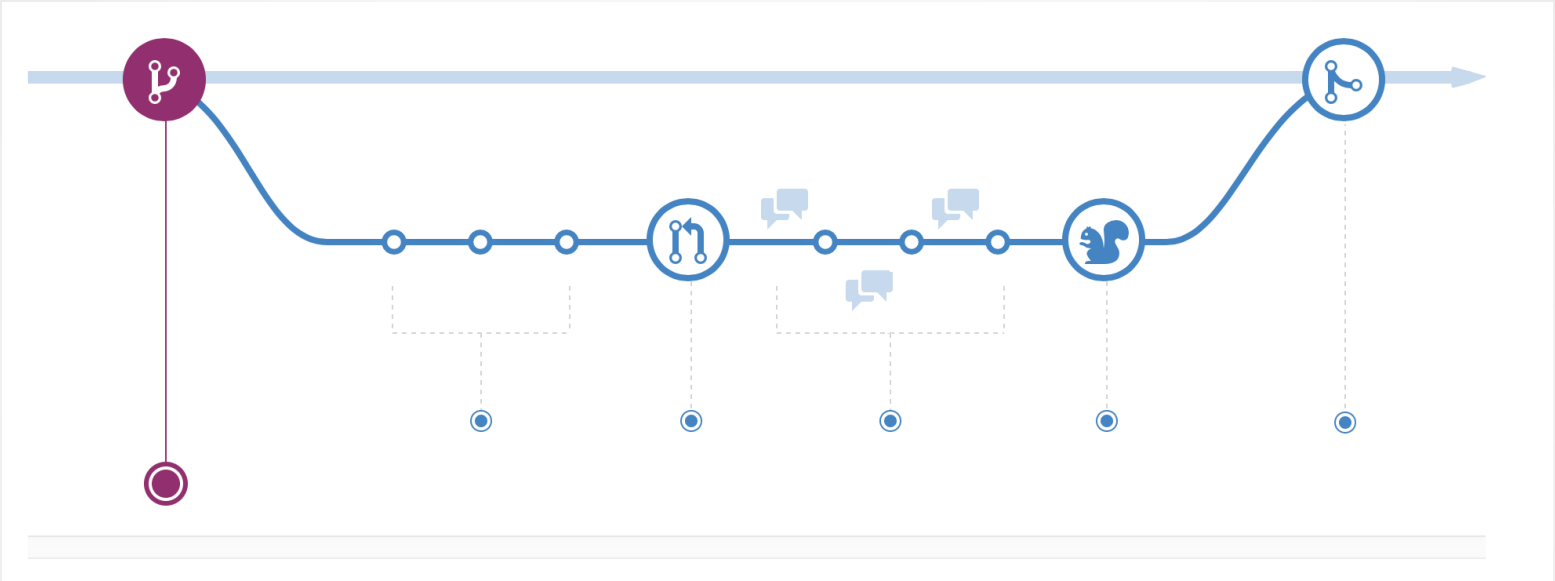


https://www.atlassian.com/git/tutorials/comparing-workflows/

Gitflow Workflow

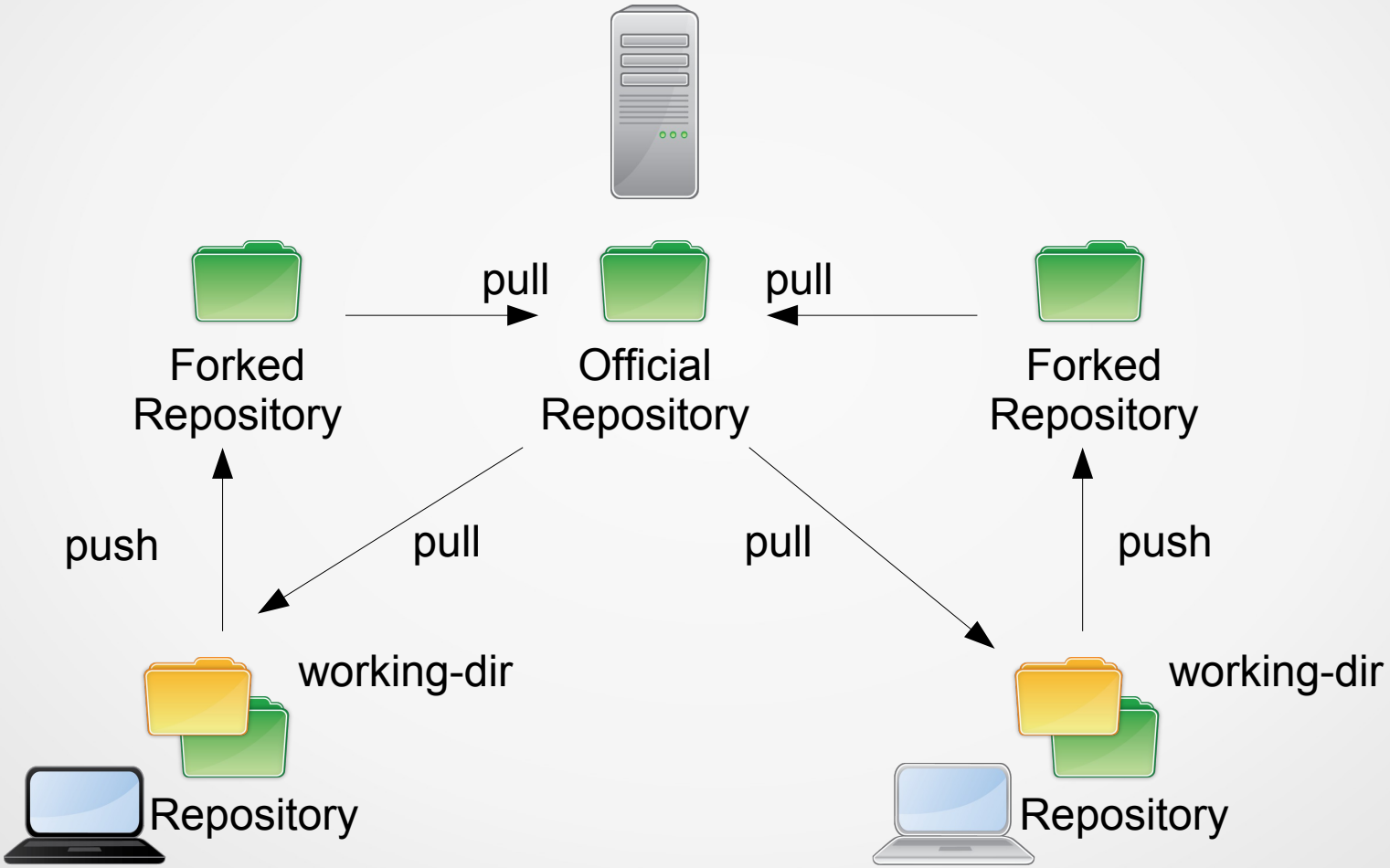


Github flow

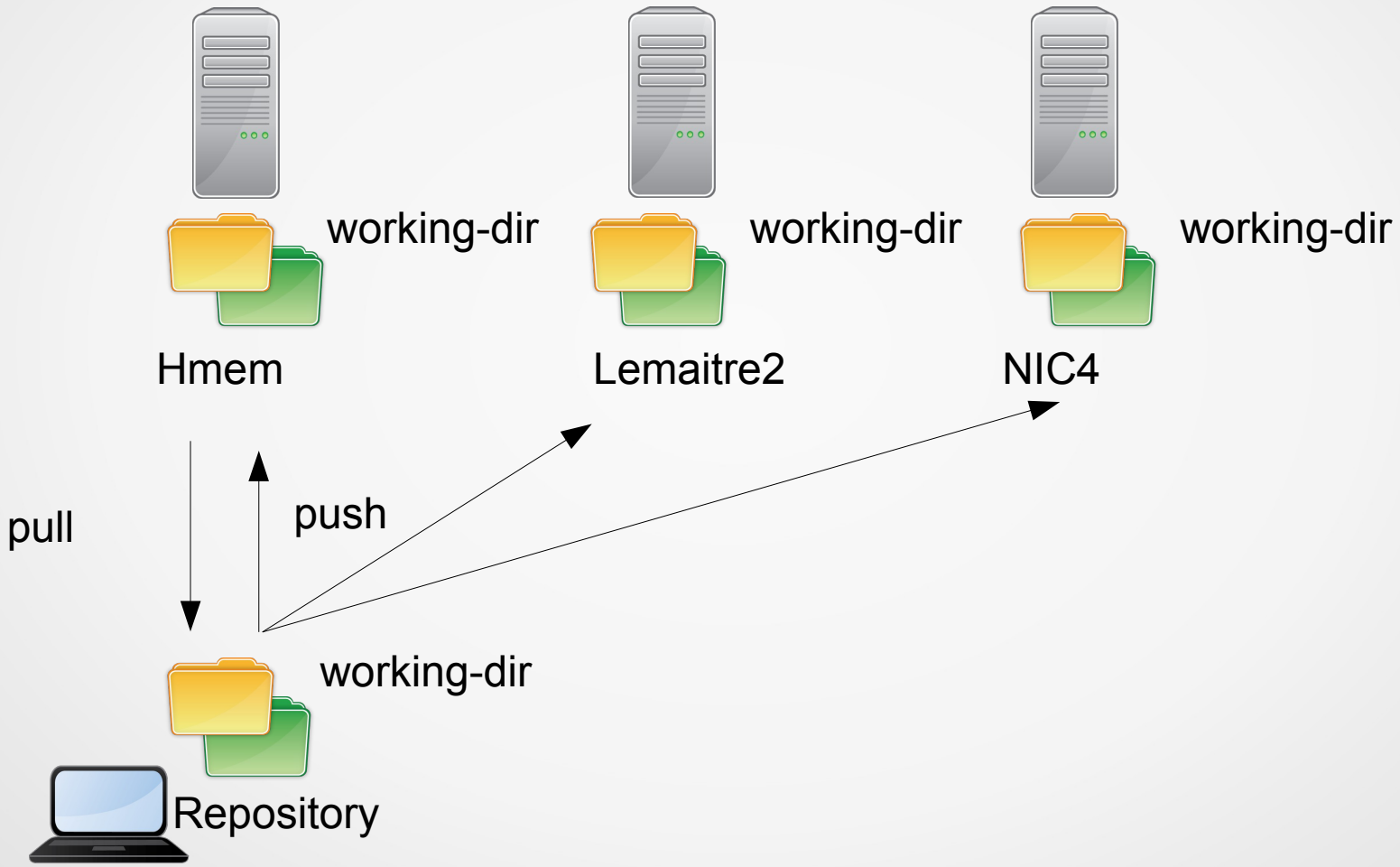


One main branch ('trunk') that is always deployable (protect your new feature with a switch if the feature is not ready for production yet) and issue a pull request very early.

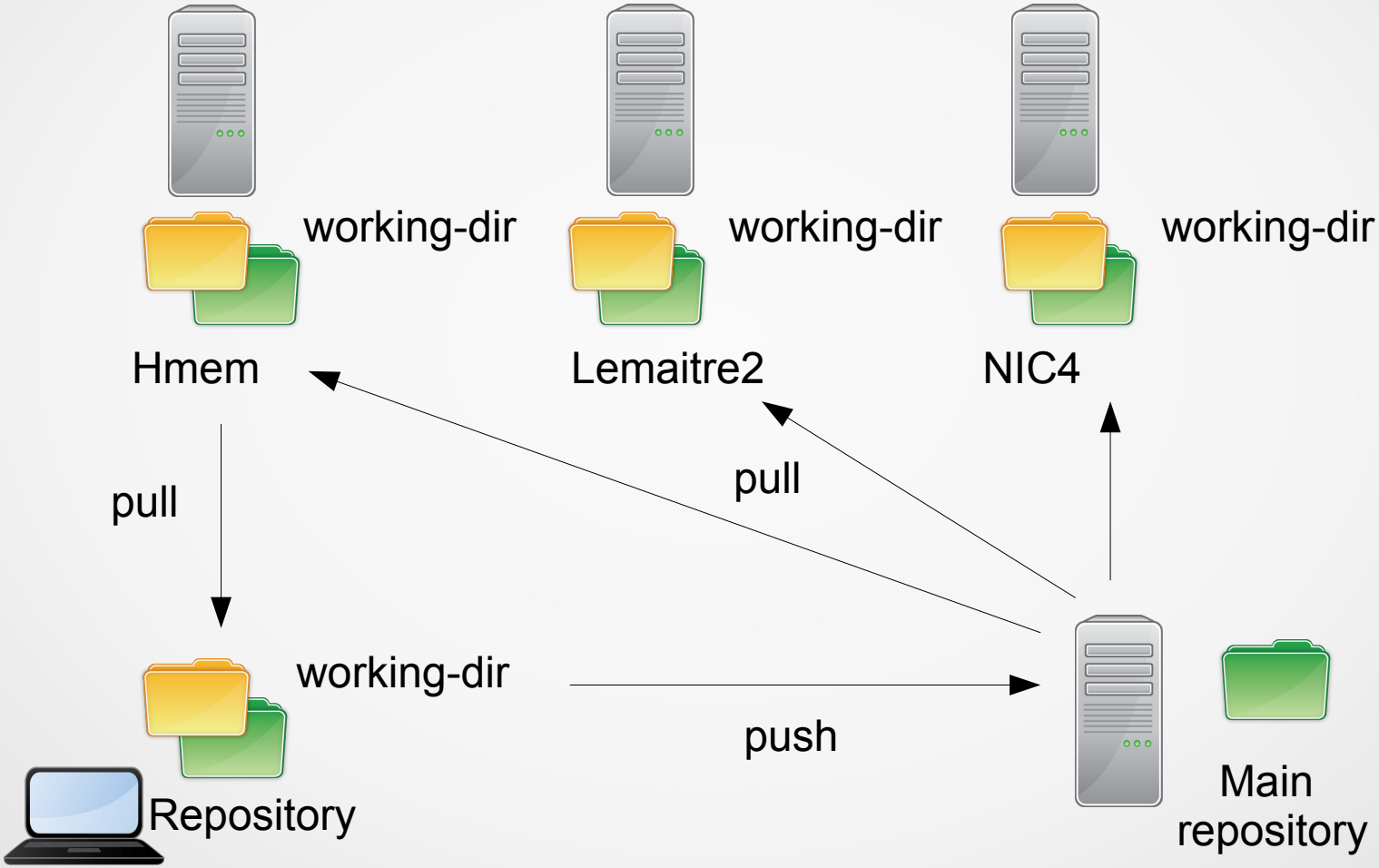
Forking Workflow



Working with several clusters



Working with several clusters



Final messages

- Use Git or Mercurial to manage your code
- Have a remote copy of the repository

- Version everything ! (data.csv, code.c, thesis.tex, .bashrc, submit.sh, todo.txt, etc.)

- Learn enough Mercurial to be able to manage a repository
- Learn enough Git to be able to collaborate with others

Final messages

Mercurial

very easy to handle

cannot do everything

Git

a solution for every situation

more changes to hurt yourself