Version 2014-1
as of 1 February 2014

Scientific and Technical Computing

Distributed Source Control Management

Outline

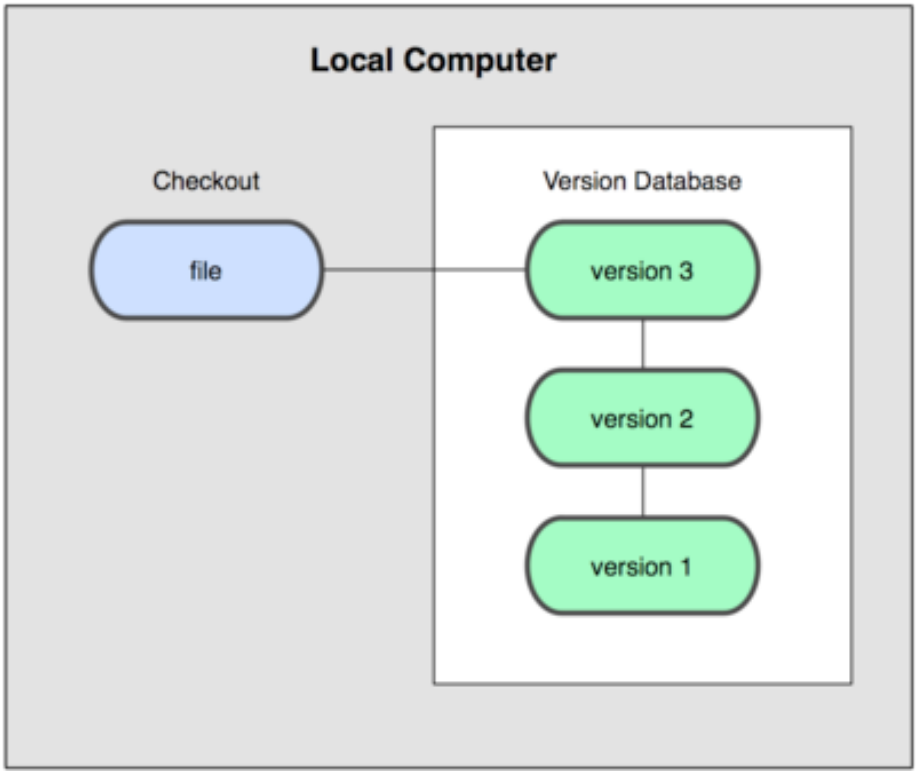
- Source Control Management
- Basic Mercurial/Git Usage
- Branches, Forks, and more

See:
http://git-scm.com
https://bitbucket.com

Why use source control?

- **Reproducibility** - know what code was run when
- **Traceability** - know when things were added
- **Collaboration** - allow contributions without risking code breakage
- **Organization** - enforces a method of organization

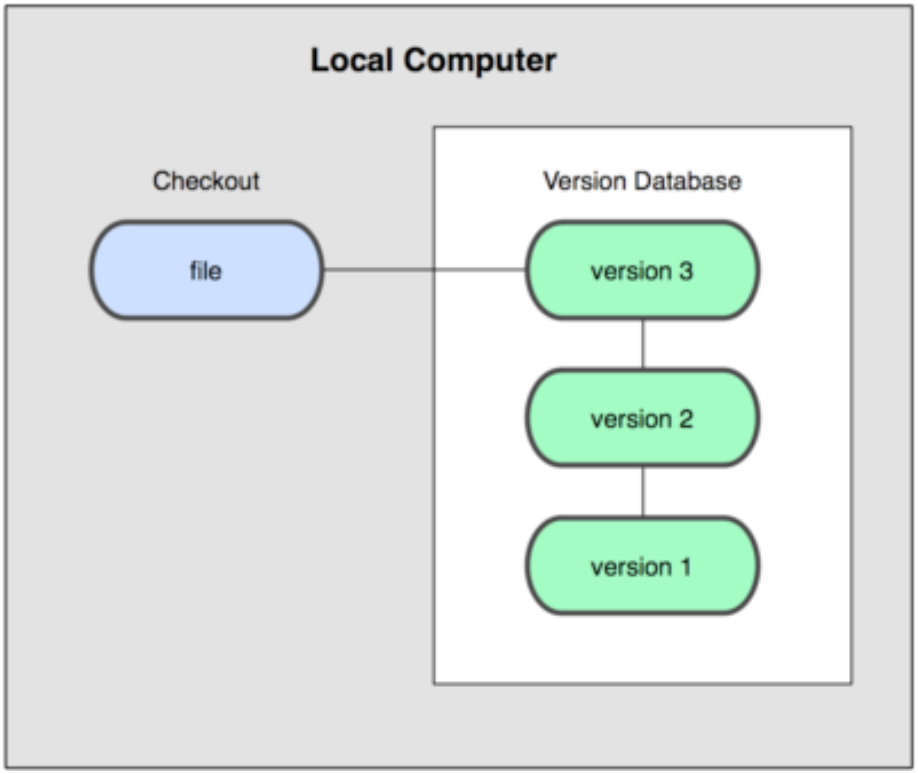
Local Source Control Management



[Image credit: http://git-scm.com]*

- 'Database" keeps versions of the file that can be "checked out"
- Edit and revise local files
- Use smart tools to see differences in the files

Local Source Control Management



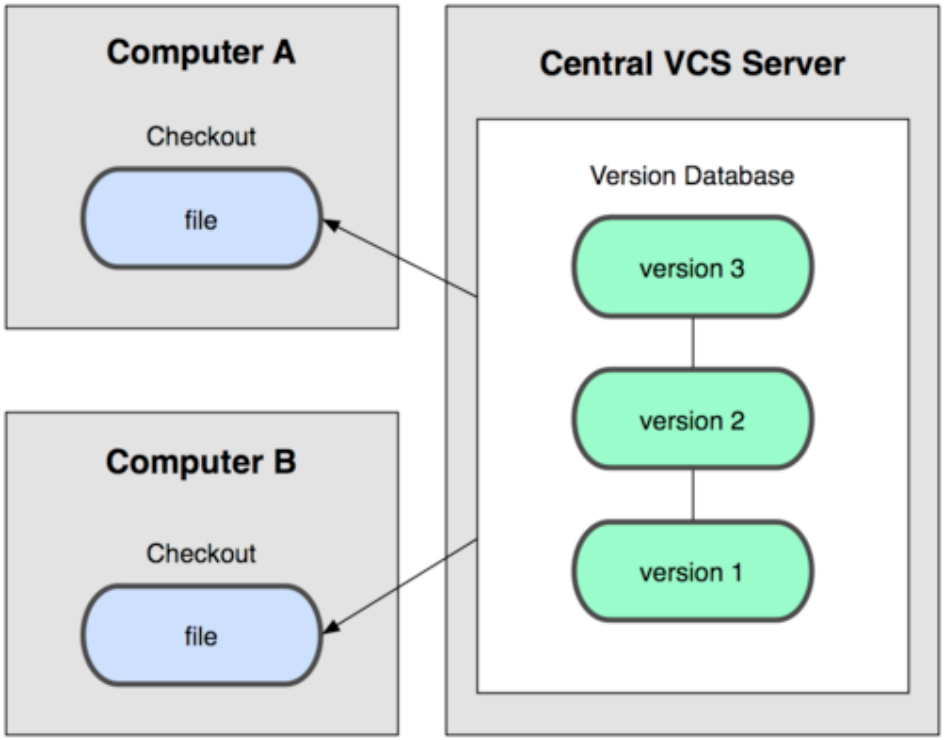
[Image credit: http://git-scm.com]*

Examples

- SCCS (1972)
- RCS (1982)

- Locking mechanism gives exclusive rights to a user.

Centralized Source Control Management

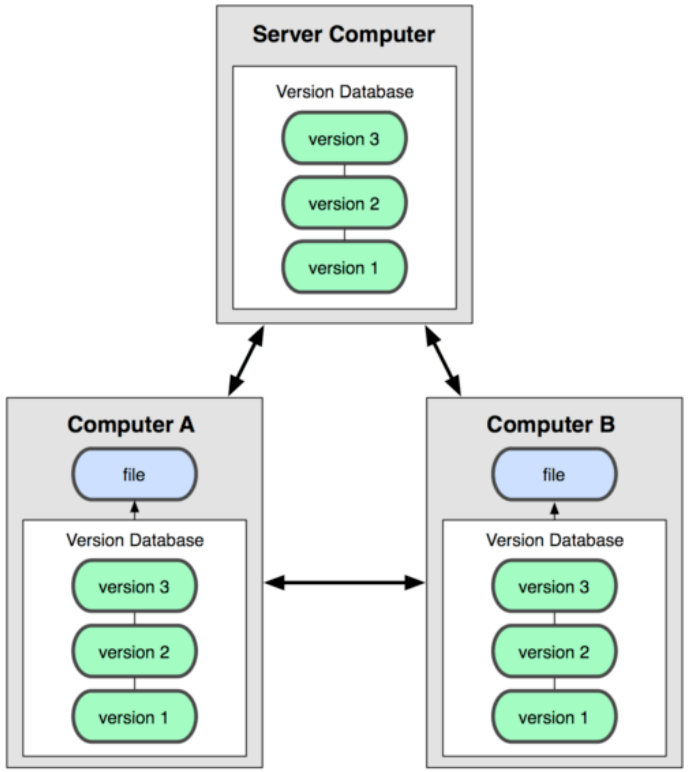


[Image credit: http://git-scm.com]*

Examples

- CVS (1989)
- SVN (2000)
- ClearCase
- Perforce

Distributed Source Control Management



[Image credit: http://git-scm.com]*

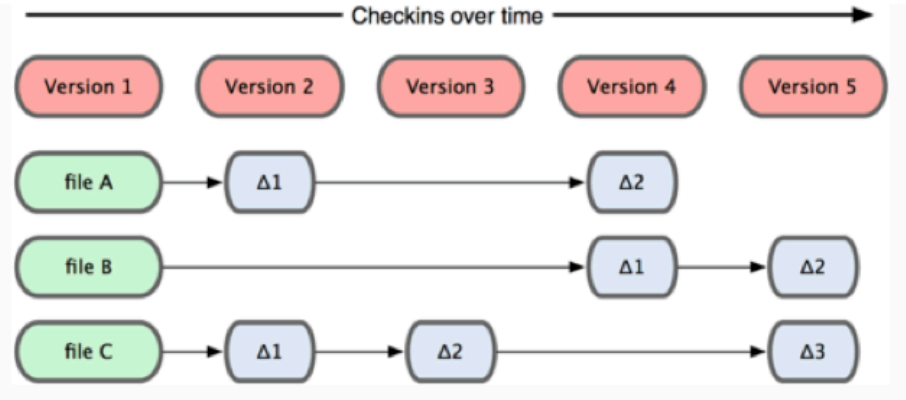
Examples

- Bitkeeper (2000)
- Darcs (2003)
- Git (2005)
- Bazaar (2005)
- Mercurial (2005)

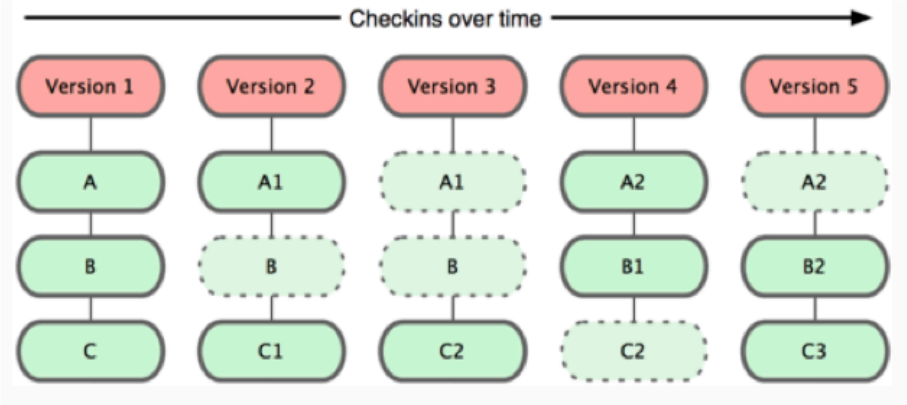
- Often called a DVCS: Distributed Version Control System

Mercurial/Git is Different

- A commit creates a version for your file changes (common to most SCMs)
- A commit of your project or file is a snapshot at that moment which has a reference to it. (There is a separate copy, not just a "delta".)



Change(or Delta)-based System



Git, Snapshot-based System

[Image credit: http://git-scm.com]*

Outline

- Source Control Management
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- Branches, Forks, and more

Local Commands

hg help gives list of commands. You can use **man pages**, too

hg help <command> gives details of a command

```
$ ssh stampede.tacc.utexas.edu  or lonestar.tacc.utexas.edu
$ module load hg              #if on stampede or lonestar
$ hg help
usage: hg ...
$ hg help init
hg-INIT(1)                                        hg Manual
...
```

Local Commands

`hg init`: Create an empty hg repository or reinitialize and existing one

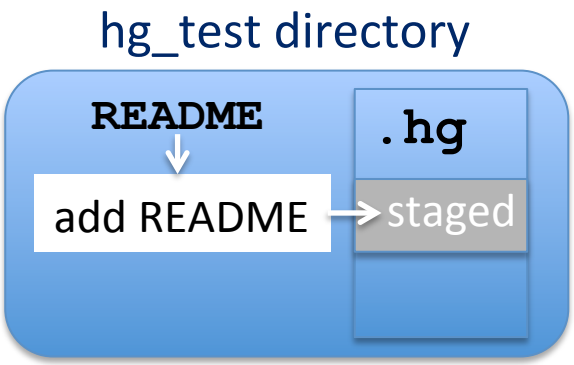
```
$ mkdir hg_test
$ cd hg_test
$ hg init
Initialized empty hg repository in
/home1/01392/aterrel/hg_test/.hg/
```

`.hg` is your local repository.

Local Commands

`hg add`: Add file contents to the index (of files) and stages present copy for commitment.

```
$ echo "Hello hg World" >> README
$ hg add README
```



Local Commands

`hg status`: Show the working tree status

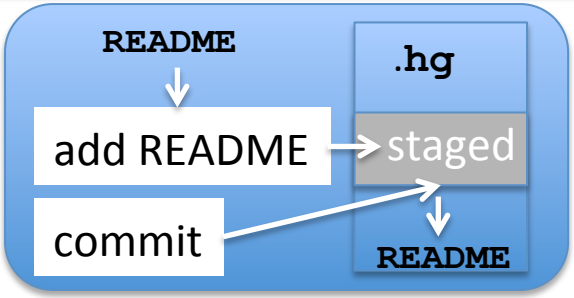
```
$ hg status
# On branch master
#
# Initial commit
# (1)
# Changes to be committed:
# (use "hg rm --cached <file>..." to unstage)
# (2)
# new file: README
```

Shows no commitments (1) and a staged file (2) .

Local Commands

`hg commit`: Record changes to the repository

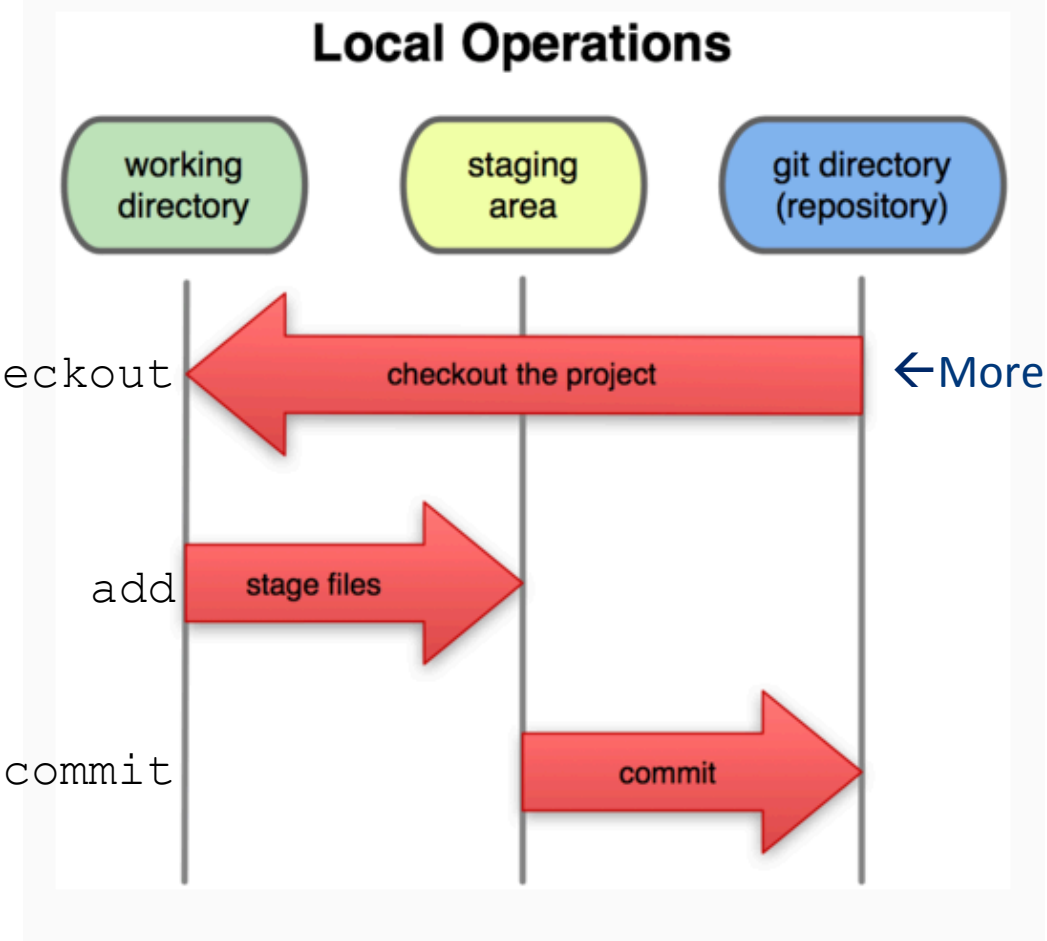
```
$ hg commit -m "Adding README"
[master (root-commit) 774c810] Adding README
1 file changed, 1 insertion(+)
create mode 100644 README
```



May get message to set your
user name and email– so that it knows details of the author.

```
$ hg config --global user.name "Your Name"
```

Add and Commit



←More about this later on.

[Image credit: http://git-scm.com]*

Local Commands

`hg log`: Show the commit logs

```
$ hg log
commit 774c81087d052e43a630db7f676cfd9a6b006772
Author: Andy R. Terrel <andy.terrel@gmail.com>
Date: Tue Jul 24 17:53:04 2012 -0500

    1 Adding README
```

Note comment from **`commit -m`** option (1 Adding README).
Make your comments (history) meaningful.

Local Commands

```
$ echo "Line 2" >> README
$ hg add README
$ hg commit -m "Adding Line 2"
$ echo "Line 3" >> README
$ hg add README
$ hg commit -m "Adding Line 3"
$ echo "Clear file" > README

$ hg commit -am "Clear file"
```

> deletes previous contents of README

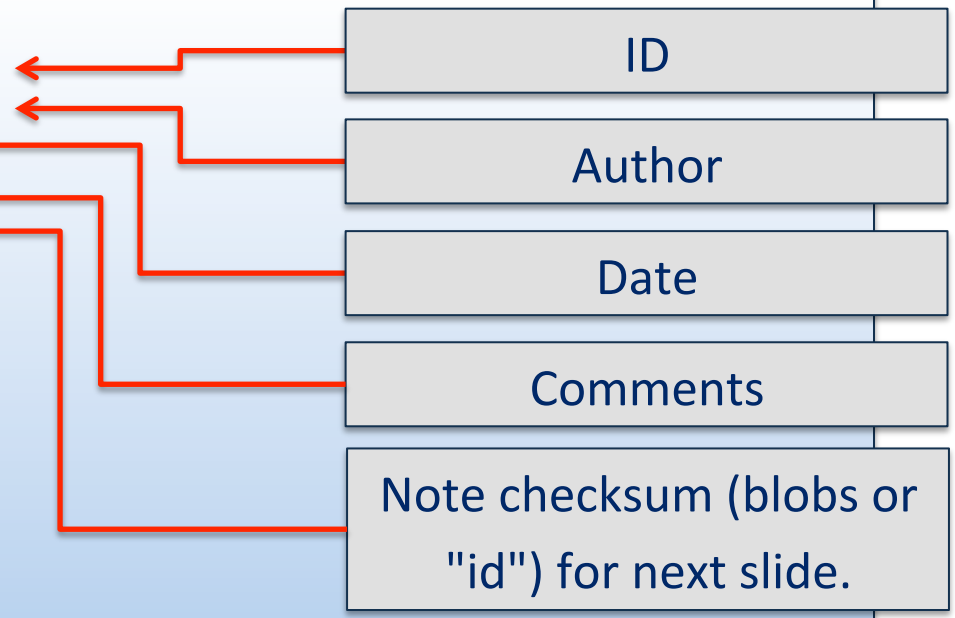
add & commit combined, all modified and indexed files

```
$ hg commit    -m "Clear file" README      #add/commit a file
$ hg commit -p -m "Clear file"             # query add/commit files
```

alternate forms

Local Commands

```
$ hg log

commit c0513dbf6b609715f1510c438b9d00f065f7f3f4
Author: Andy R. Terrel <andy.terrel@gmail.com>
Date: Tue Jul 24 17:58:53 2012 -0500

     Clear file

commit 88d4a87be3e7444d06463108e98ca78802f4859e
Author: Andy R. Terrel <andy.terrel@gmail.com>
Date: Tue Jul 24 17:58:25 2012 -0500

    Adding Line 3

commit 43a446bedd92946d0ccf6fa2218f623284695f8b
Author: Andy R. Terrel <andy.terrel@gmail.com>
Date: Tue Jul 24 17:58:01 2012 -0500

    Adding Line 2

commit 774c81087d052e43a630db7f676cfd9a6b006772
Author: Andy R. Terrel <andy.terrel@gmail.com>
Date: Tue Jul 24 17:53:04 2012 -0500

    Adding README
```




```
$ hg log README          #can view log for individual files.
```

Local Commands

`hg diff`: Show changes between commits, commit and working tree, etc.

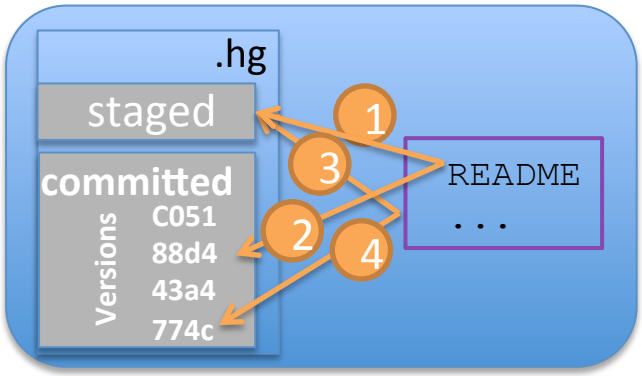
```
$ hg diff README                    #--- staged  +++ modified
diff --hg a/README b/README
index d5c15a2..fcb6062 100644
--- a/README
+++ b/README
@@ -1,3 +1 @@
-Hello hg World
-Line 2
-Line 3
+Clear file
```

Local Commands

Types of differences:		Comparison
`$ hg diff README`	1	staged file with modified README
`$ hg diff 88d4 README`	2	ver 88d4… file with modified README
`$ hg diff`	3	staged files with modified files
`$ hg diff 774c`	4	ver 88d4… files with modified files

If there are no staged files,

diff occurs on latest version.



Local Commands

`hg checkout`: Checkout a branch or paths to the working tree

```
$ hg checkout 88d4a87be3e7
Note: checking out '88d4a87be3e7'.

You are in 'detached HEAD' state. You can look around, make experimental changes and
commit them, and you can discard any commits you make in this state without impacting
any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may do so (now or
later) by using -b with the checkout command again. Example:

    hg checkout -b new_branch_name

HEAD is now at 88d4a87... Adding Line 3

$ hg checkout master
Previous HEAD position was 88d4a87... Adding Line 3
Switched to branch 'master'
```

Reverts (files) to snapshot 88..

More on branches (**`-b`**) later.

Revert back to master snapshot (path)

These are the comments!

Remote Commands

`hg clone`: Clone a repository into a new directory

`hg pull`: Fetch from and merge with another repository or a local branch

`hg push`: Update remote refs along with associated objects

Remote Commands

Bitbucket Repository:

- Supports hg and other protocols
- After creating empty repository:
  - Import at bitbucket or push files from local system
- For convenience name local directory of repository and remote repository the same name

```
$ #@bitbucket create repository STC
$ mkdir STC; cd STC  #create local repo
$ date > README
$ hg commit -am "new README"
```

Push to a Server Repository

```
$ hg remote add origin \
  ssh://hg@bitbucket.org/milfeld/STC.hg
```

<protocol://<site>/<user>/<repo_name>.<repo_type>

```
$ hg push -u origin –all
```

First time: push ALL up to site, declare local as upstream

```
$ echo '// No line return' >>p.c
$ hg commit -am '2nd commit'
$ hg push origin master
```

Subsequent pushes: from local master to origin.

Summary of Useful Commands

`hg status` – Show the working tree status

`hg log` – Show commit logs

`hg tag` – Create, list, delete, or verify a tag object signed with GPG

`.hgignore` – Include **`*.o *.a .hgignore`** (1 line each)

`hg diff` – Shows changes between commits, commit, and working tree, etc.

`hg branch -a` – Lists all branches

`hg remote add <rem_nam> <sit>` adds a remote branch

Outline

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Branch Commands

`hg branch` Lists, creates, or deletes branches.

`hg merge` Joins branches together.

`hg rebase` Another form of merge that serializes changes into an easy to follow history.

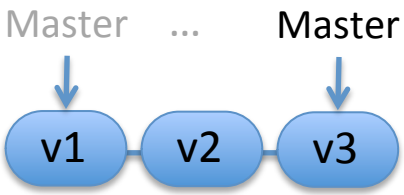
Why Branches?

Branches act as "silos" for a package:

- master — production quality
- proposed — ready for master (early users)
- development — on-going work
- topic — early development

Context switching: Container for historical information

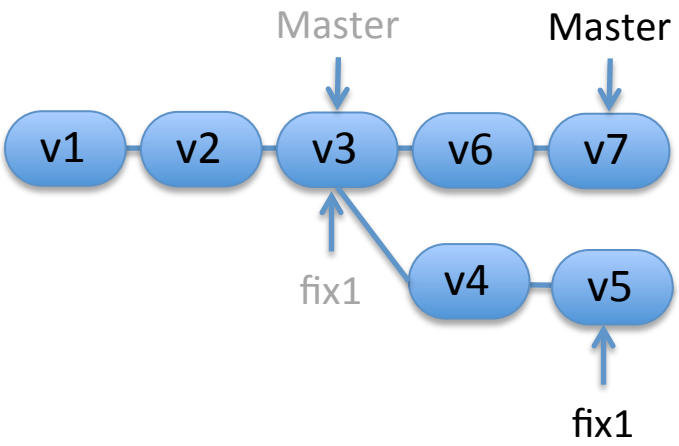
hg Branch




```
$...
$ hg commit -am "2nd change"
$ …
$ commit -am "3rd change"
```

Master follows subsequent commits.

```
$ hg branch fix1
$ hg checkout fix1
$ <changes with 2 commits>
```



New `fix1` branch points also to Master.

Checkout makes copy & `fix1` follows commits.

Use hg checkout master or `fix1` to switch back and forth (same directory) between branches.

```
$ hg checkout master
$ <changes with 2 commits>
```

Example 1 Workflow

```
$ hg checkout -b "opt1"          # -b = branch; optimizing code….
$ hg commit  -am "opt1 branch"
                                  # create new branch for immediate fix
$ hg checkout master             # get back to master
$ hg checkout -b "fix2"          # then edit, compile, test & commit
$ hg commit -am "quick fix 2″    # and next merge it back to master.
$ hg checkout master  # You have the Master as the reference
$ hg merge fix2       # Merging fix2 INTO Master.
                       # If single revision, then no conflicts.
$ hg branch -d fix2   # Remove the fix2 branch (it has been merged).
$ hg checkout opt1    # Go back to working on opt1
$ <work, commit, finish> #optimization (opt1)  done
$ hg checkout master
$ hg merge opt1
    The directory will contains files show conflicts.
    Fix noted differences in files between chevrons:
        <<<<<<< HEAD
        something changed in Master....
       =======
        things changed in opt1
       >>>>>>> opt1
$ hg commit
$ hg branch -d opt1
```

Setting up rsa keys

- Key generation:

```
$ ssh-keygen  -f  $HOME/.ssh/rsa_id_bb
```

(this makes rsa_id_bb and rsa_id_bb.pub files– private & public keys in $HOME/.ssh)

- Cat the contents of rsa_id_bb.pub and put it into bitbucket.

```
$ cat $HOME/.ssh/rsa_id_bb.pub
```

in browser: bitbucket.org→avatar→Manage Accounts→SSH keys→Add

- Make the file **$HOME/.ssh/config** with the following:

```
Host bitbucket.org
 User hg
 Hostname bitbucket.org
 IdentityFile ~/.ssh/rsa_id_bb
```

Hostname, can use aliases on this line

You login as user hg!!!

Actual hostname

Where to find the rsa key for host.

- Make sure it works:

```
$ ssh -T hg@bitbucket.org
logged in as milfeld.
You can use hg …. Shell access is disabled.
```

Access, what can go wrong?

- Access is denied if you get this result:

```
$ ssh -T hg@bitbucket.org
Permission denied (publickey).
```

- Make sure you cut and paste key as a single line. (There is a space after ssh-rsa.)

ssh-rsa AAAAB3NzaC1yc2EAAAABIwAAAIEA4xVc9fj1lLzynrXYeZcAyMG0d5NJSx9ZkAnwUavtLDXOl6XtkMHym6v/
G32A20k9OHMfSuzmp1kMBmyGjErdYJNxTj3M8WC/
EHYS51dkGwzfUH5Irvb49nvY6NH8UVrYIn7bgyELzP0VZPnYgKSbUpkKLT0pH5yryKy2/GTaM8s=
milfeld@login1.ls4.tacc.utexas.edu

- Use the verbose form of ssh to see more details, make sure ssh is using the right key for bitbucket. **$ ssh -Tv hg@bitbucket.org**

```
$ ssh -vT hg@bitbucket.org
OpenSSH_4.3p2, OpenSSL 0.9.8e-fips-rhel5 01 Jul 2008
debug1: Reading configuration data /home1/00770/milfeld/.ssh/config
...
debug1: identity file /home1/00770/milfeld/.ssh/rsa_id type -1
...
debug1: Trying private key: /home1/00770/milfeld/.ssh/rsa_id
debug1: No more authentication methods to try.
Permission denied (publickey).
```

Tips and Tricks

- You must add a new file, and then commit it. **`hg commit -a`** will not work for a new file.

We gratefully acknowledge the sponsorship of Chevron Corporation, whose generous support of TACC has made possible this Scientific Computing Curriculum and other student-focused initiatives.

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