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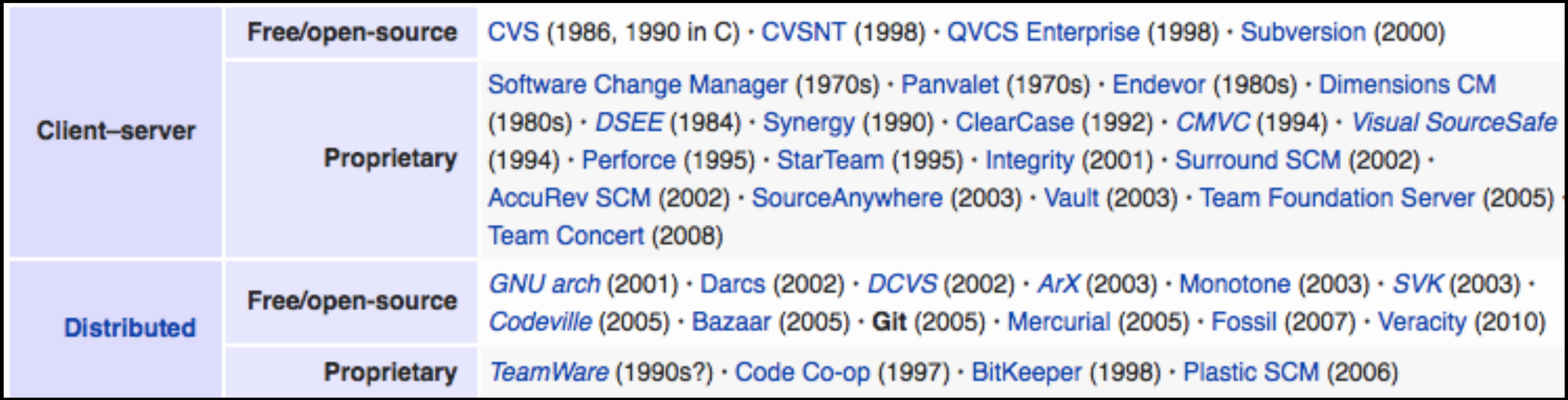
What is Git?

(1) An unpleasant or contemptible person. Often incompetent, annoying, senile, elderly or childish in character.

(2) A modern distributed version control system with an emphasis on speed and data integrity.

Version Control

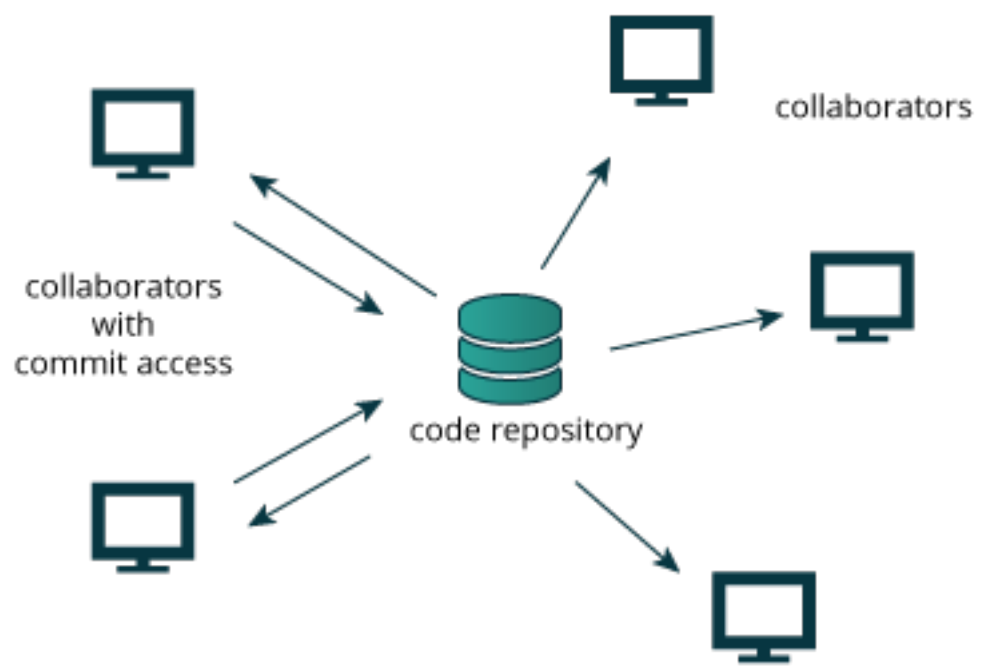
Version control systems (VCS) record changes to a file or set of files over time so that you can recall specific versions later.



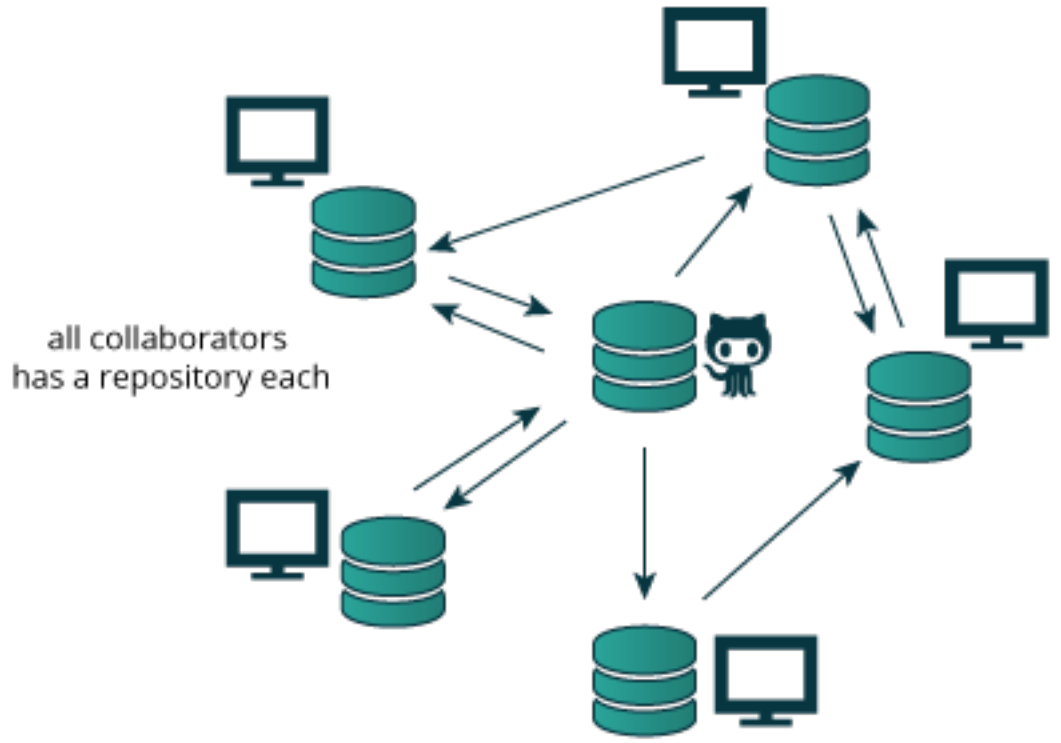
Client–server	Free/open-source	CVS (1986, 1990 in C) · CVSNT (1998) · QVCS Enterprise (1998) · Subversion (2000)
	Proprietary	Software Change Manager (1970s) · Panvalet (1970s) · Endevor (1980s) · Dimensions CM (1980s) · *DSEE* (1984) · Synergy (1990) · ClearCase (1992) · *CMVC* (1994) · *Visual SourceSafe* (1994) · Perforce (1995) · StarTeam (1995) · Integrity (2001) · Surround SCM (2002) · AccuRev SCM (2002) · SourceAnywhere (2003) · Vault (2003) · Team Foundation Server (2005) · Team Concert (2008)
Distributed	Free/open-source	*GNU arch* (2001) · Darcs (2002) · *DCVS* (2002) · *ArX* (2003) · Monotone (2003) · *SVK* (2003) · *Codeville* (2005) · Bazaar (2005) · **Git** (2005) · Mercurial (2005) · Fossil (2007) · Veracity (2010)
	Proprietary	*TeamWare* (1990s?) · Code Co-op (1997) · BitKeeper (1998) · Plastic SCM (2006)

There are many VCS available, see: https://en.wikipedia.org/wiki/Revision_control

Client-Server *vs* Distributed VCS

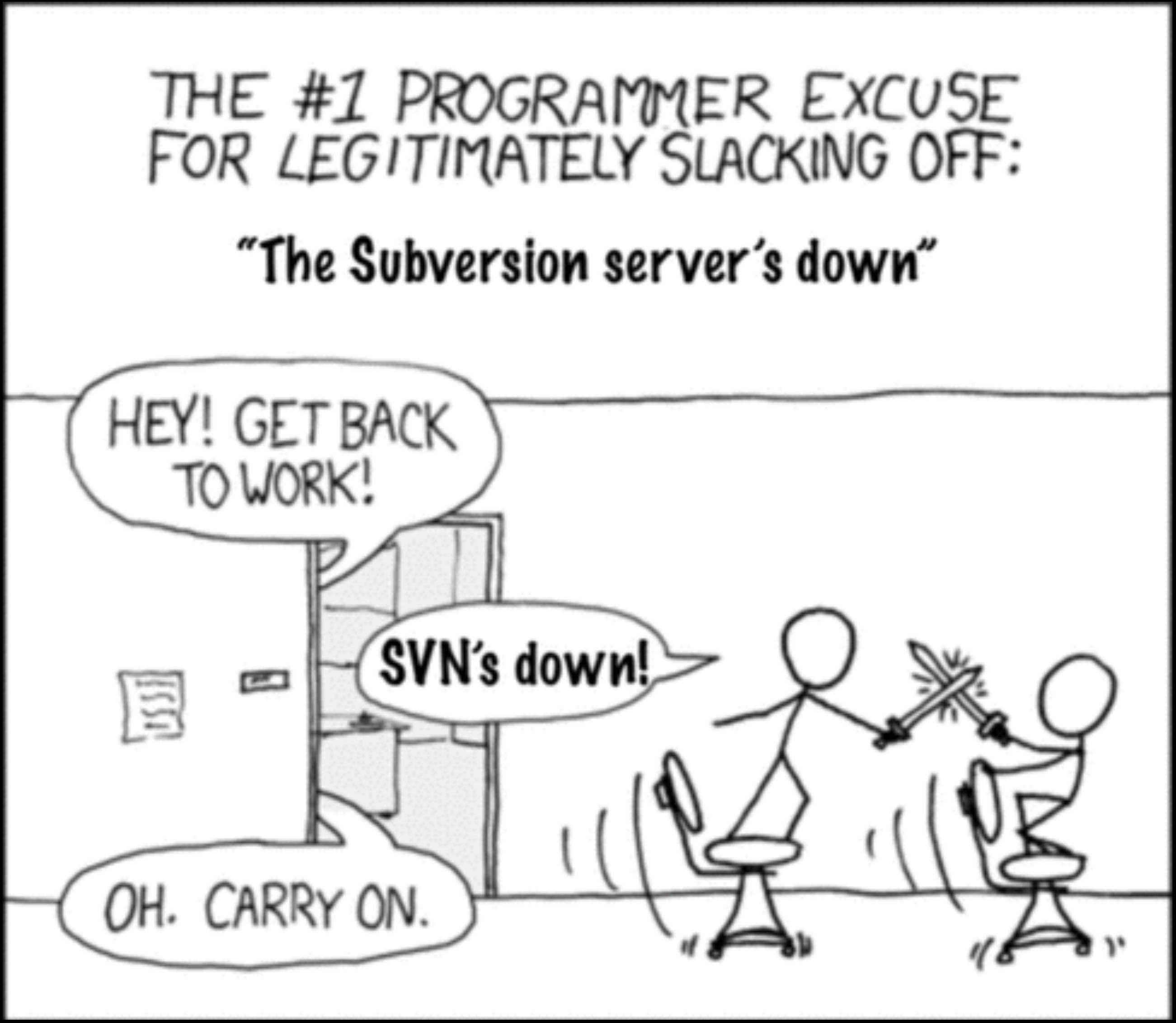


Client-server approach



Distributed approach

Distributed version control systems (DCVS) allows multiple people to work on a given project without requiring them to share a common network.


THE #1 PROGRAMMER EXCUSE FOR LEGITIMATELY SLACKING OFF:
"The Subversion server's down"
HEY! GET BACK TO WORK!
SVN's down!
OH. CARRY ON.

Git offers:

- Speed
- Backups
- Off-line access
- Small footprint
- Simplicity*
- Social coding

http://tinyurl.com/distributed-advantages

Where did Git come from?

Written initially by Linus Torvalds to support Linux kernel and OS development.

Meant to be distributed, fast and more natural.

Capable of handling large projects.

Now the most popular free VCS!

Why use Git?

Q. Would you write your lab book in pencil, then erase and overwrite it every day with new content?

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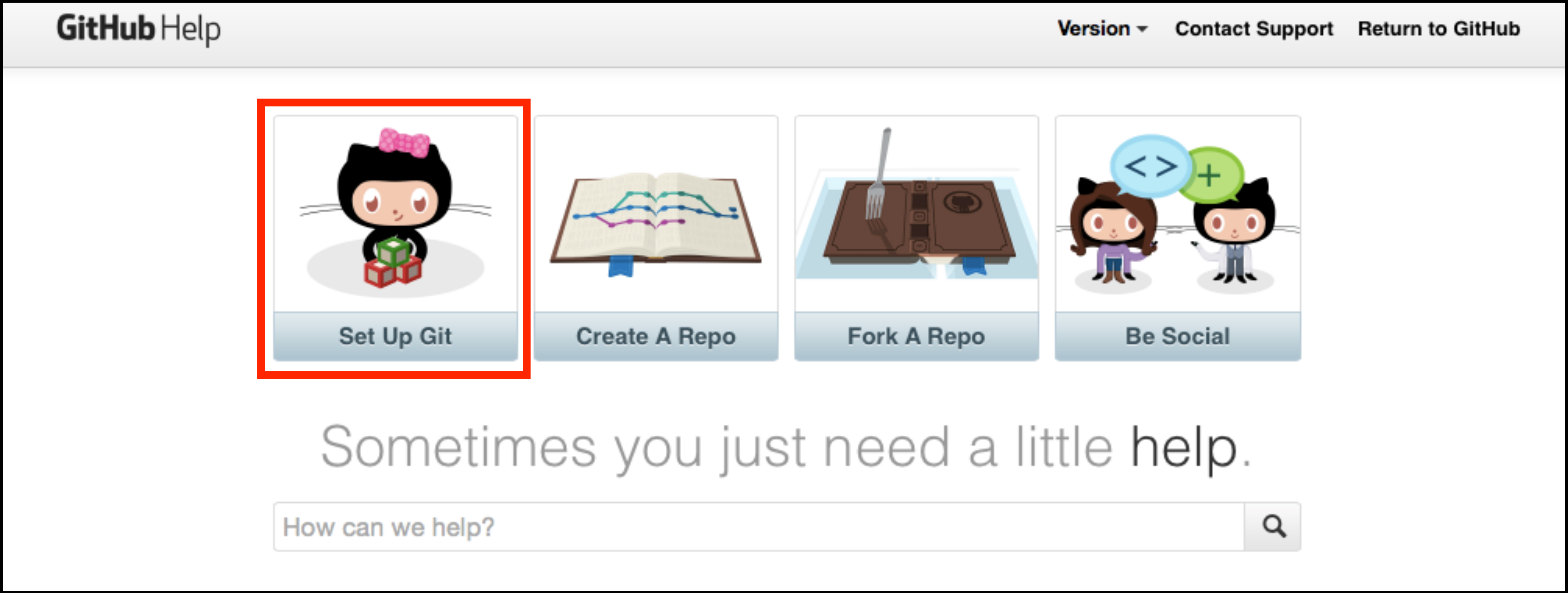
Version control is the lab notebook of the digital world: it's what professionals use to keep track of what they've done and to collaborate with others.

Why use Git?

- Provides ‘**snapshots**’ of your project during development and provides a full record of project **history**.
- Allows you to easily **reproduce** and **rollback** to past versions of analysis and compare differences. (N.B. Helps fix software regression bugs!)
- Keeps **track of changes** to code you use from others such as fixed bugs & new features
- Provides a mechanism for sharing, updating and collaborating (like a social network)
- Helps keep your work and software organized and available

Obtaining Git



https://help.github.com

Configuring Git

Do it Yourself!

Configuring Git

```
# First tell Git who you are
> git config --global user.name  "Barry Grant"
> git config --global user.email  "bjgrant@umich.edu"

# Optionally enable terminal colors
> git config --global color.ui true
```

Using Git

Using Git

1. Initiate a Git repository.
2. Edit content (i.e. change some files).
3. Store a 'snapshot' of the current file state.*

Initiate a Git repository

Do it Yourself!

Initiate a Git repository

```
> cd Desktop
> mkdir git_class  # Make a new directory
> cd git_class      # Change to this directory
> git init          # Our first Git command!
> ls -a             # what happened?
```

Side-Note: **The .git/ directory**

- Git created a ‘hidden’ **.git/** directory inside your current working directory.
- You can use the ‘**ls -a**’ command to list (*i.e.* see) this directory and its contents.
- This is where Git stores all its goodies - **this is Git!**
- You should not need to edit the contents of the **.git** directory for now but do feel free to poke around.

Important Git commands

```
> git status         # report on content changes
```

```
> git add <filename>       # stage/track a file
> git commit  -m “message”    # snapshot
```

Important Git commands

```
> git status          # report on content changes
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```
> git add <filename>        # stage/track a file
> git commit  -m "message"    # snapshot
```

You will use these three commands again and again in your Git workflow!

Git TRACKS your directory content

- To get a report of changes (since last commit) use:

```
> git status
```

- You tell Git which files to track with:

```
> git add <filename>
```

  This adds files to a so called **STAGING AREA** (akin to a "shopping cart" before purchasing).

- You tell Git when to take an historical **SNAPSHOT** of your staged files (*i.e.* record their current state) with:

```
>   git commit -m 'Your message about changes'
```

Example Git workflow

Eva creates a README text file
(this starts as untracked)

Adds file to STAGING AREA*
(tracked and ready to take a snapshot)

Commit changes*
(records snapshot of staged files!)

Hands on example!

Example Git workflow

Eva creates a README text file

Adds file to STAGING AREA*

Commit changes*

Eva modifies README and adds a ToDo text file

Adds both to STAGING AREA*

Commit changes*

Do it Yourself!

1. Eva creates a README file

```
> # cd ~/Desktop/git_class
> # git init

> echo "This is a first line of text." > README
> git status            # Report on changes
# On branch master
#
# Initial commit
#
# Untracked files:
#   (use "git add <file>..." to include in what will be committed)
#
#     README
#
# nothing added to commit but untracked files present (use "git add" to track)
```

2. Adds to 'staging area'

```
> git add README        # Add README file to staging area
> git status            # Report on changes

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

3. Commit changes

```
> git commit -m “Create a README file”      # Take snapshot
# [master (root-commit) 8676840] Create a README file
#  1 file changed, 1 insertion(+)
#  create mode 100644 README


> git status                    # Report on changes
# On branch master
# nothing to commit, working directory clean
```

4. Eva modifies README file and adds a ToDo file

```
> echo "This is a 2nd line of text." >> README
> echo "Learn git basics" >> ToDo

> git status          # Report on changes
# On branch master
#
# Changes not staged for commit:
#   (use "git add <file>..." to update what will be committed)
#   (use "git checkout -- <file>..." to discard changes in working directory)
#
#     modified:   README
#
# Untracked files:
#   (use "git add <file>..." to include in what will be committed)
#
#     ToDo
#
# no changes added to commit (use "git add" and/or "git commit -a")
```

5. Adds both files to ‘staging area’

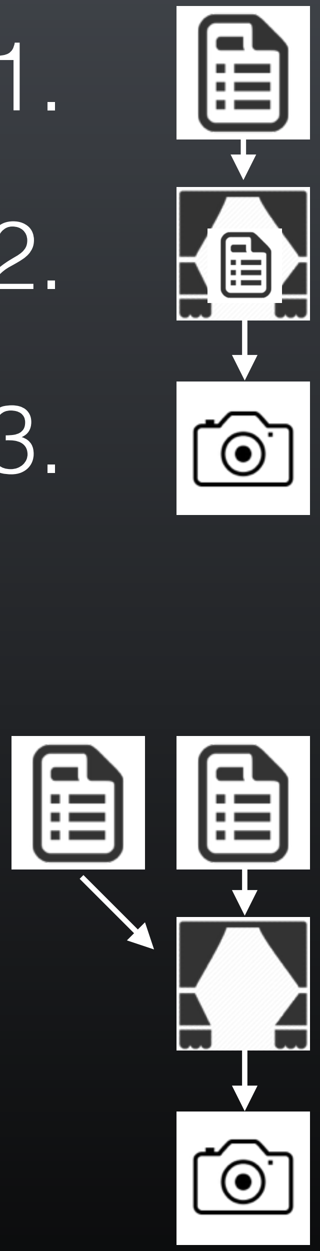
```
> git add README ToDo      # Add both files to ‘staging area’
> git status               # Report on changes
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#    modified:   README
#      new file:   ToDo
#
```

6. Commits changes

```
> git commit -m "Add ToDo and modify README"
# [master 7b679fa] Add ToDo and modify README
#  2 files changed, 2 insertions(+)
#  create mode 100644 ToDo

> git status
# On branch master
# nothing to commit, working directory clean
```

Example Git workflow



1. Eva creates a README text file
2. Adds file to STAGING AREA*
3. Commit changes*

4. Eva modifies README and adds a ToDo text file
5. Adds both to STAGING AREA*
6. Commit changes*

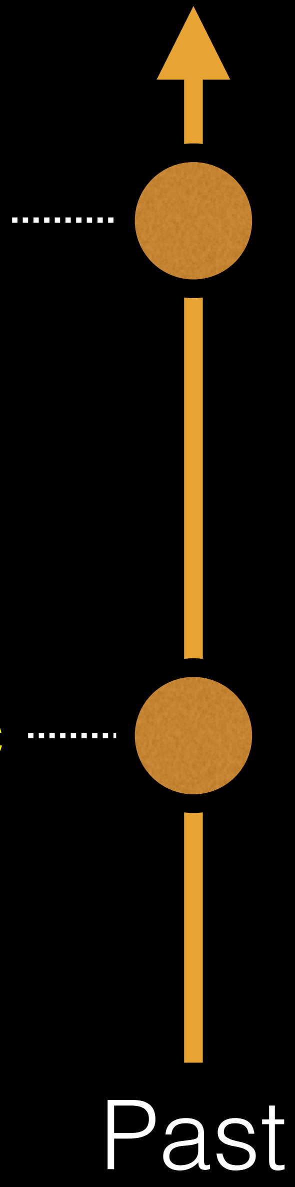
…But, how do we see the history of our project changes?

git log: Timeline history of snapshots (*i.e.* commits)

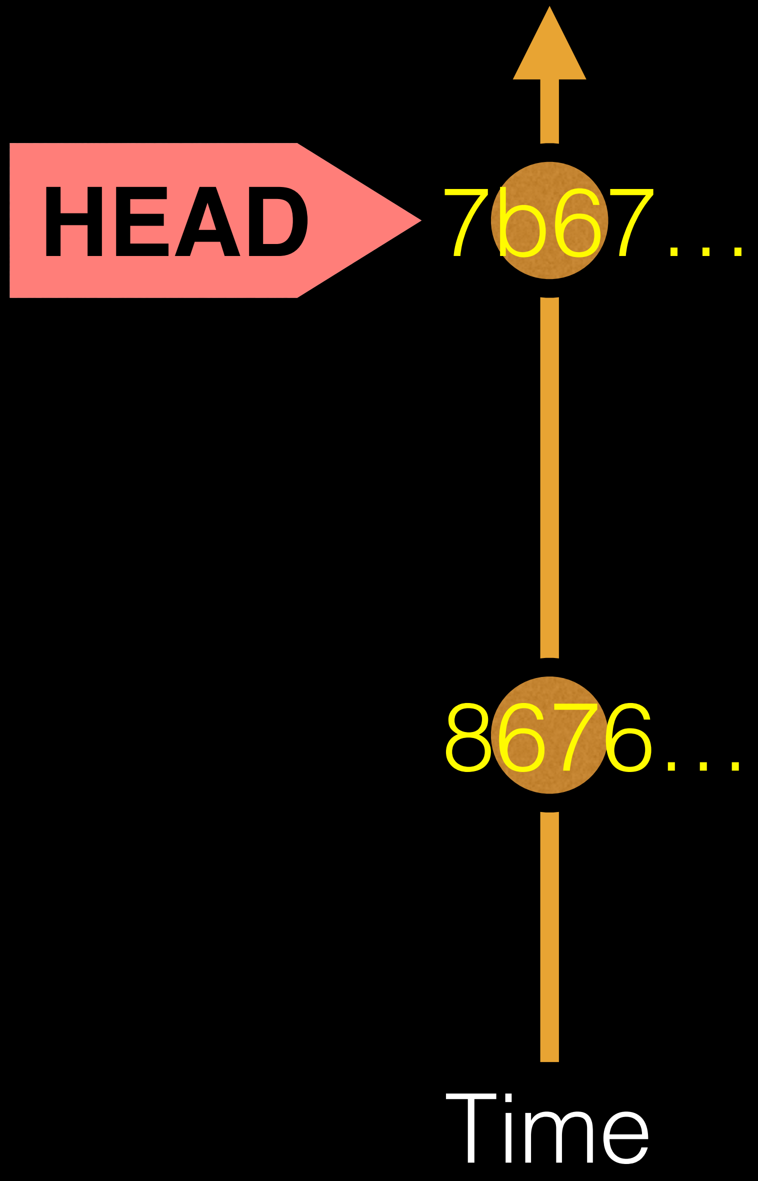
```
> git log
# commit 7b679fa747e8640918fcaad7e4c3f9c70c87b170
# Author: Barry Grant <bjgrant@umich.edu>
# Date:   Thu Jul 30 11:43:40 2015 -0400
#
#    Add ToDo and finished README
#
# commit 86768401610770ae32e2fd4faee07d1d5c68619c
# Author: Barry Grant <bjgrant@umich.edu>
# Date:   Thu Jul 30 11:26:40 2015 -0400
#
#    Create a README file
#
```

git log: Timeline history of snapshots (*i.e.* commits)

```
> git log
# commit 7b679fa747e8640918fcaad7e4c3f9c70c87b170
# Author: Barry Grant <bjgrant@umich.edu>
# Date:   Thu Jul 30 11:43:40 2015 -0400
#
#    Add ToDo and finished README
#
# commit 8676840161077 0ae32e2fd4faee07d1d5c68619c
# Author: Barry Grant <bjgrant@umich.edu>
# Date:   Thu Jul 30 11:26:40 2015 -0400
#
#    Create a README file
#
```



Side-Note: Git history is akin to a graph

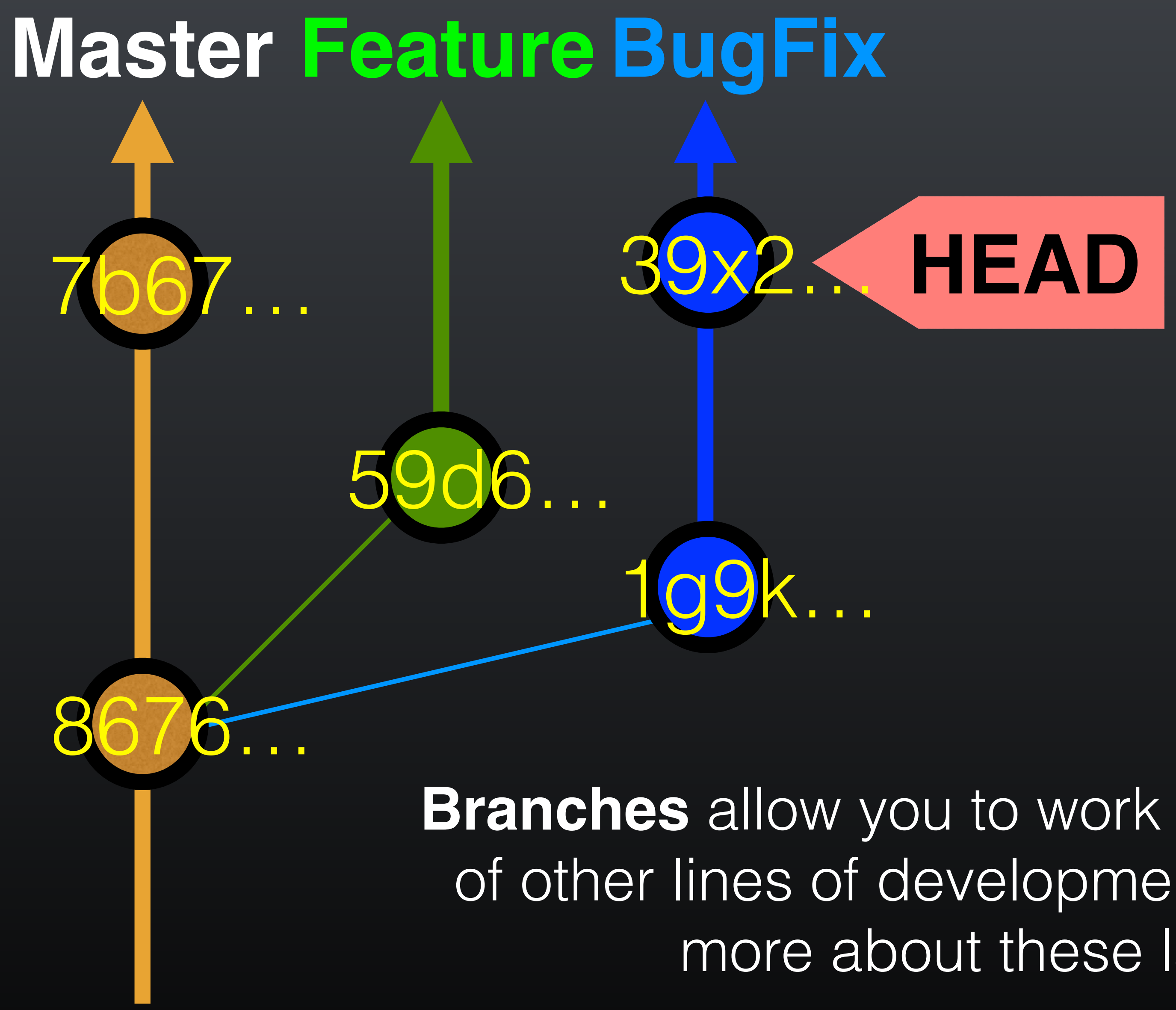


Nodes are **commits** labeled by their unique ‘**commit ID**’.

(This is a CHECKSUM of the commits author, time, commit msg, commit content and previous commit ID).

HEAD is a reference (or ‘**pointer**’) to the currently checked out commit (typically the most recent commit).

Projects can have complicated graphs due to **branching**



Branches allow you to work independently of other lines of development we will talk more about these later!

Key Points:

You explicitly and iteratively tell git what files to track (“**git add**”) and snapshot (“**git commit**”).

Git keeps an historical log “(**git log**”) of the content changes (and your comments on these changes) at each past commit.

It is good practice to regularly check the status of your working directory, staging arena repo (“**git status**“)

Break

Summary of key Git commands:

```
> git status                          # Get a status report of changes since last commit

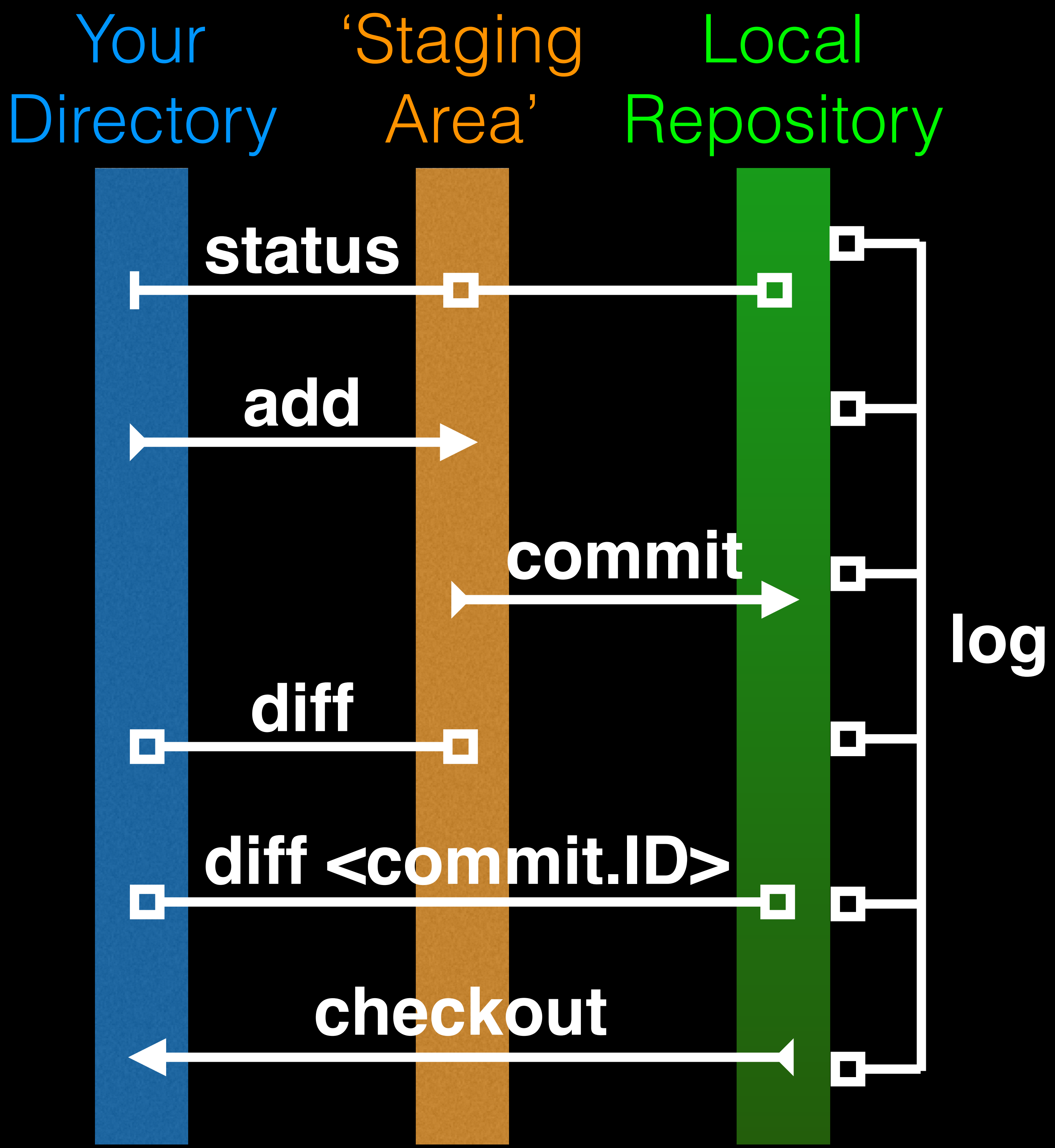
> git add <filename>                  # Tell Git which files to track/stage

> git commit -m 'Your message'        # Take a content snapshot!

> git log                             # Review your commit history

> git diff <commit.ID>  <commit.ID>   # Inspect content differences

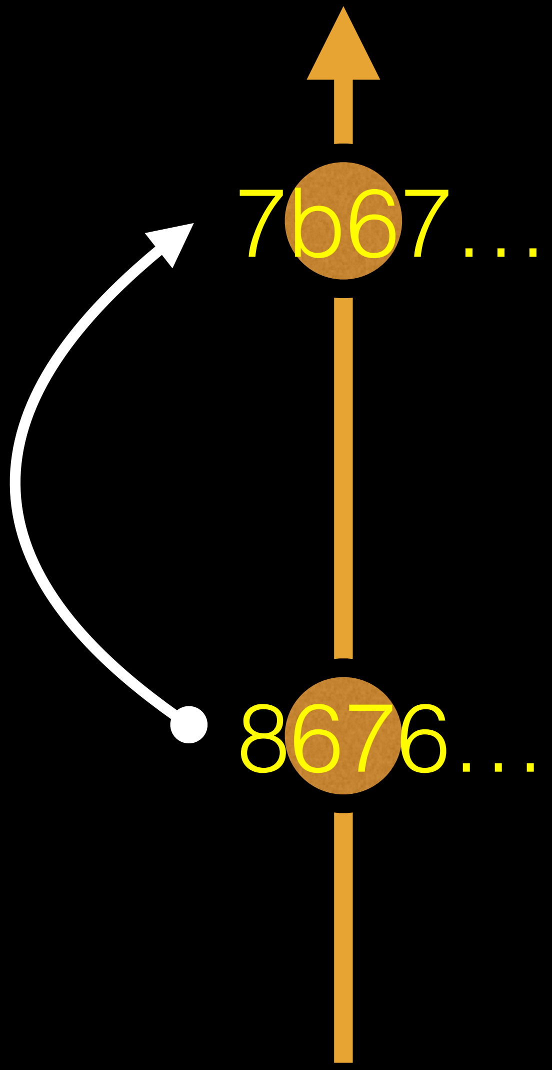
> git checkout  <commit.ID>           # Navigate through the commit history
```


Your Directory
'Staging Area'
Local Repository
status
add
commit
diff
diff <commit.ID>
checkout
log

git diff: Show changes between commits

```
> git diff 8676 7b67
# diff --git a/README b/README
# index 73bc85a..67bd82c 100644
# --- a/README
# +++ b/README
# @@ -1 +1,2 @@
#  This is a first line of text.
# +This is a 2nd line of text.

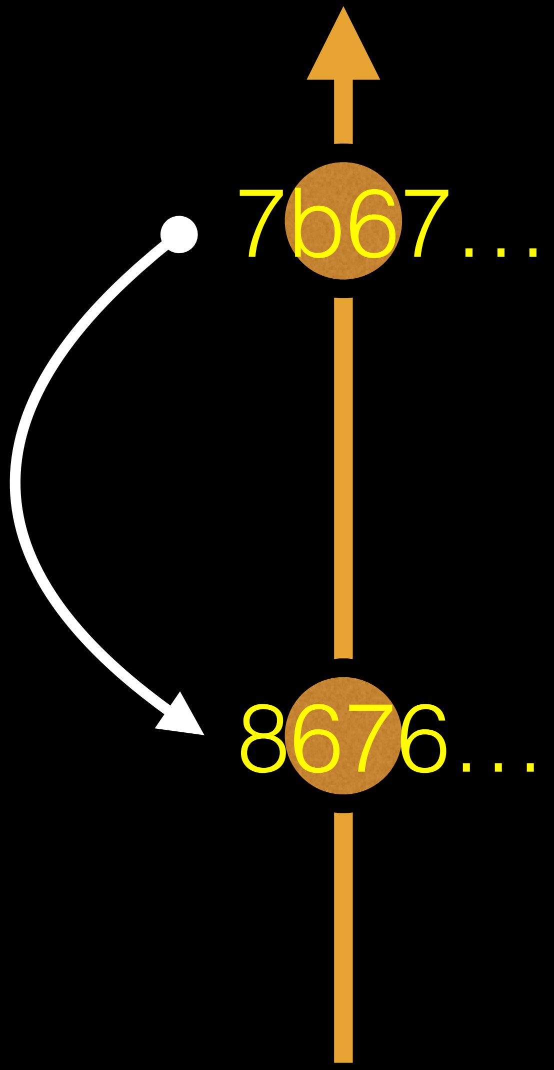
# diff --git a/ToDo b/ToDo
# new file mode 100644
# index 0000000..14fbd56
# --- /dev/null
# +++ b/ToDo
# @@ -0,0 +1 @@
# +Learn git basics
```



git diff: Show changes between commits

```
> git diff 7b67 8676
# diff --git a/README b/README
# index 67bd82c..73bc85a 100644
# --- a/README
# +++ b/README
# @@ -1,2 +1 @@
#  This is a first line of text.
# -This is a 2nd line of text.

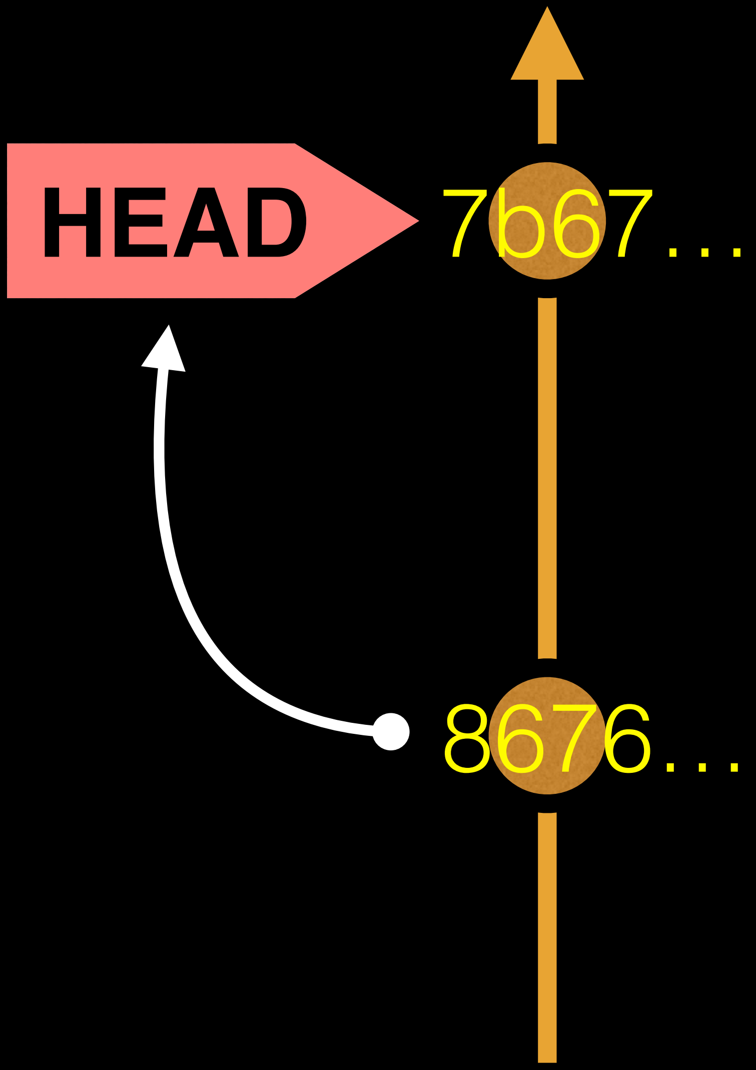
# diff --git a/ToDo b/ToDo
# deleted file mode 100644
# index 14fbd56..0000000
# --- a/ToDo
# +++ /dev/null
# @@ 1 +0,0 @@
# -Learn git basics
```



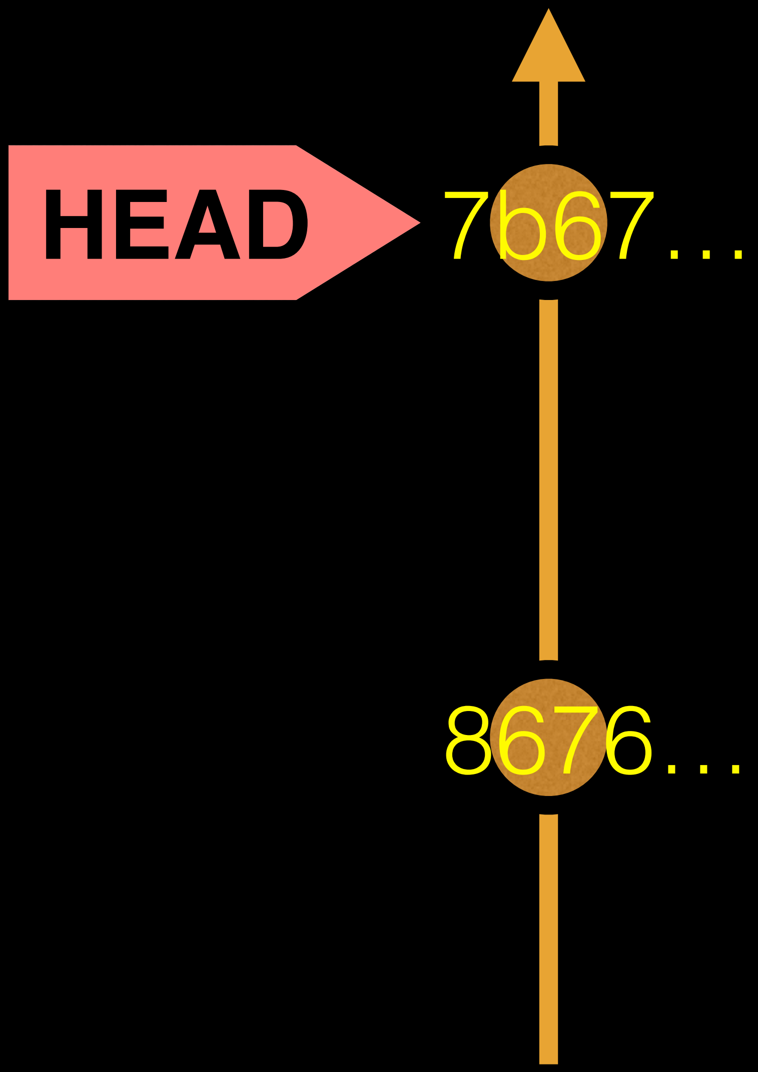
git diff: Show changes between commits

```
> git diff 8676                ## Difference to current HEAD position!
# diff --git a/README b/README
# index 73bc85a..67bd82c 100644
# --- a/README
# +++ b/README
# @@ -1 +1,2 @@
#  This is a first line of text.
# +This is a 2nd line of text.

# diff --git a/ToDo b/ToDo
# new file mode 100644
# index 0000000..14fbd56
# --- /dev/null
# +++ b/ToDo
# @@ -0,0 +1 @@
# +Learn git basics
```



HEAD advances automatically with each new commit



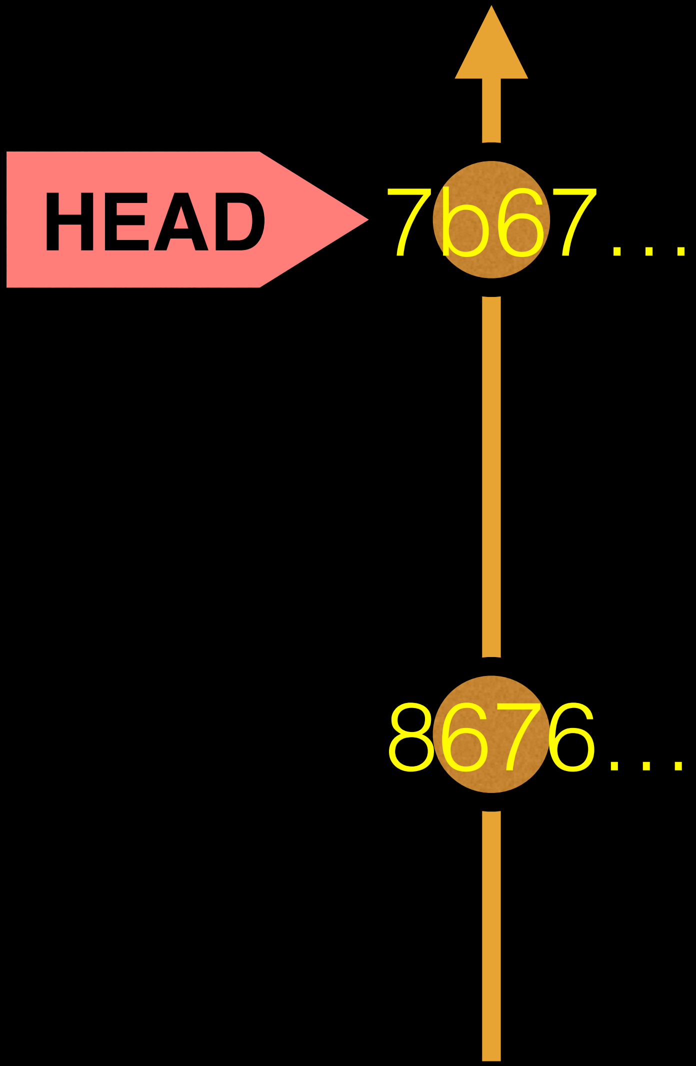
To move **HEAD** (back or forward) on the Git graph (and retrieve the associated snapshot content) we can use the command:

```
> git checkout <commit.ID>
```

git checkout: Moves HEAD

```
> more README
This is a first line of text.
This is a 2nd line of text.

> git log --oneline
# 7b679fa  Add ToDo and finished README
# 8676840  Create a README file
```



git checkout: Moves HEAD (e.g. back in time)

Do it Yourself!

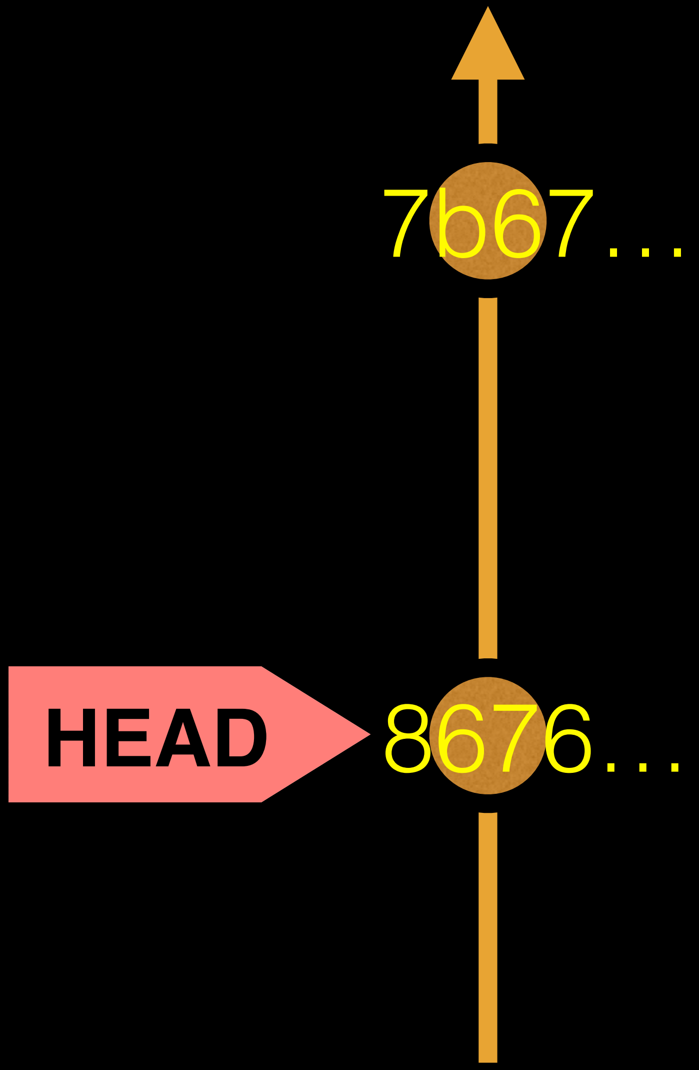
```
> more README
This is a first line of text.
This is a 2nd line of text.

> git log --oneline
# 7b679fa  Add ToDo and finished README
# 8676840  Create a README file

> git checkout 86768
# You are in 'detached HEAD' state…<cut>…
# HEAD is now at 8676840... Create a README file

> more README
This is a first line of text.

> git log --oneline
# 8676840  Create a README file
```

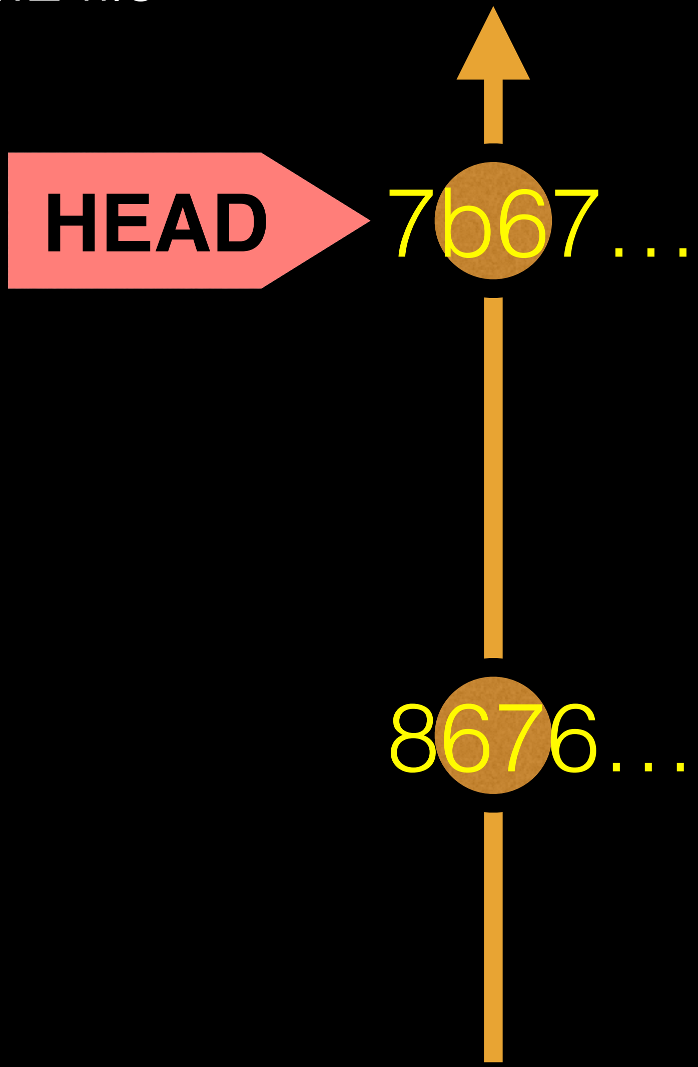


git checkout: Moves HEAD (e.g. back to the future!)

```
> git checkout master
# Previous HEAD position was 8676840... Create a README file
# Switched to branch 'master'

> git log --oneline
# 7b679fa Add ToDo and finished README
# 8676840 Create a README file

> more README
This is a first line of text.
This is a 2nd line of text.
```



Side-Note: There are two* main ways to use **git checkout**

- Checking out a **commit** makes the entire working directory match that commit. This can be used to view an old state of your project.

```
> git checkout <commit.ID>
```

- Checking out a **specific file** lets you see an old version of that particular file, leaving the rest of your working directory untouched.

```
> git checkout <commit.ID> <filename>
```

You can discard revisions with **git revert**

- The **git revert** command undoes a committed snapshot.
- But, instead of removing the commit from the project history, it figures out how to **undo the changes** introduced by the commit and **appends a new commit** with the resulting content.

```
> git revert <commit.ID>
```

- This prevents Git from losing history!

Removing untracked files with **git clean**

- The **git clean** command removes untracked files from your working directory.
- Like an ordinary **rm** command, **git clean** is not undoable, so make sure you really want to delete the untracked files before you run it.

```
> git clean -n # dry run display of files to be ‘cleaned’

> git clean -f   # remove untracked files
```

Demo Tower

GUIs

Tower (Mac only)
GitHub_Desktop (Mac, Windows)
SourceTree (Mac, Windows)
SmartGit (Linux)

https://git-scm.com/downloads/guis

Summary

- Git is a popular ‘distributed’ version control system that is lightweight and free
- Introduced basic git usage and encouraged you to adopt these ‘best practices’ for your future projects
- Next lecture we will cover GitHub and BitBucket two popular hosting services for git repositories that have changed the way people contribute to open source projects

Learning Resources

- **Try Git**. Overrated hands-on git tutorial in your browser.
  < https://try.github.io/levels/1/challenges/1 >
- **Set up Git**. If you will be using Git mostly or entirely via GitHub, look at these how-tos.
  < https://help.github.com/categories/bootcamp/ >
- **Getting Git Right**. Excellent Bitbucket git tutorials
  < https://www.atlassian.com/git/ >
- **Pro Git**. A complete, book-length guide and reference to Git, by Scott Chacon and Ben Straub.
  < http://git-scm.com/book/en/v2 >

Side-Note: Changing your default git text editor

- You can configure the default text editor that will be used when Git needs you to type in a message.

```
> git config --global core.editor nano
```

- If not configured, Git uses your system’s default editor, which is generally Vim.