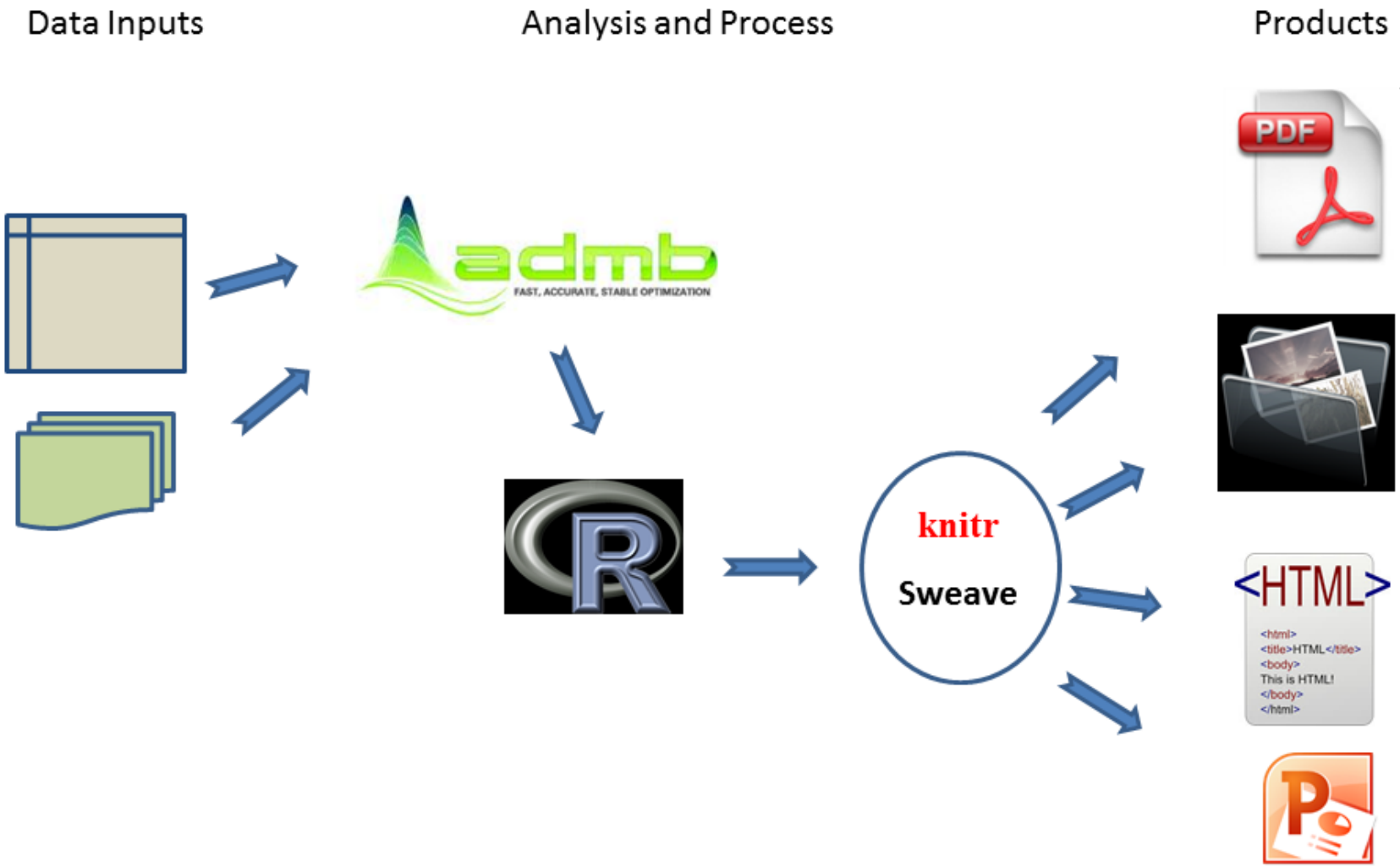
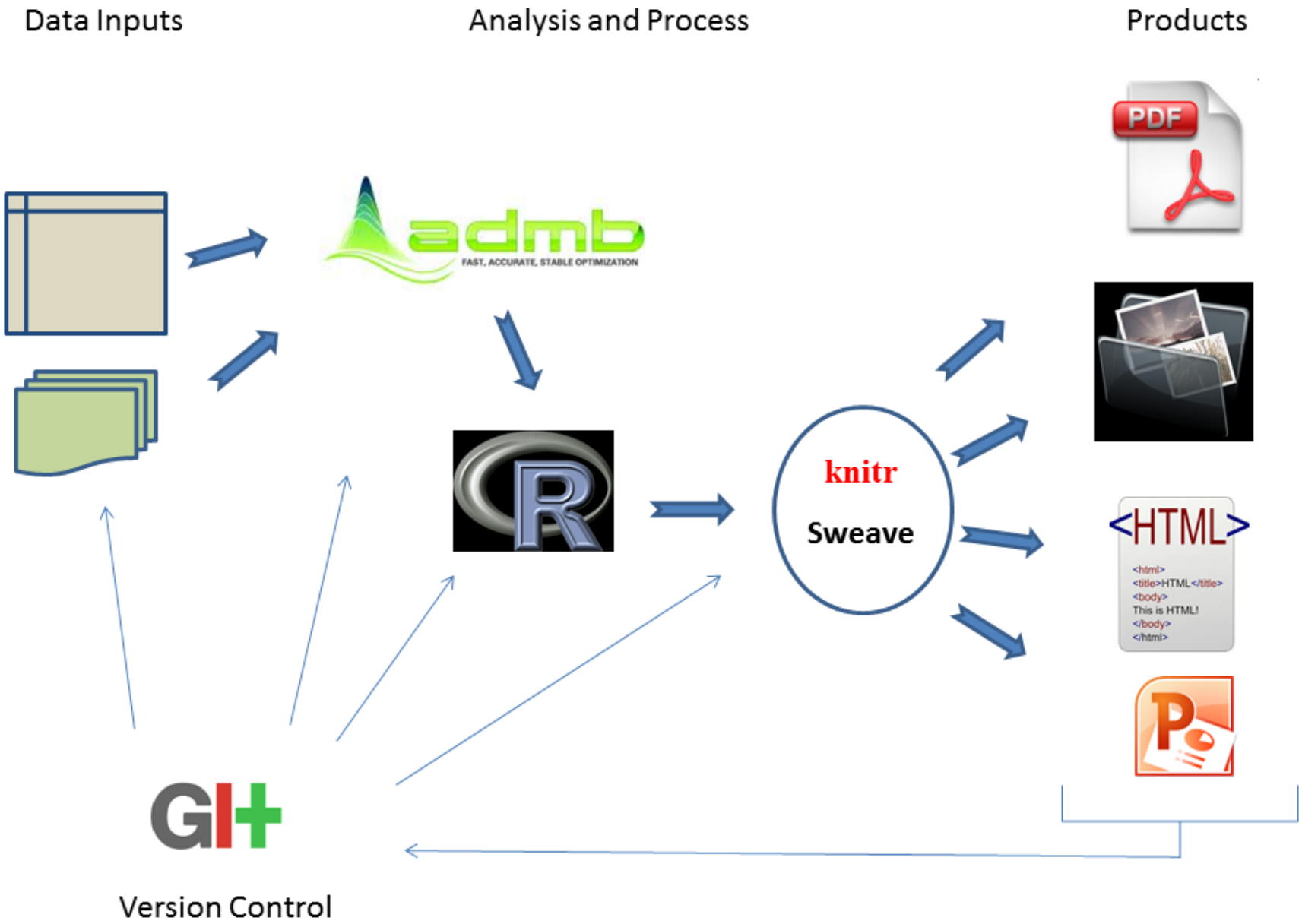
So What is Git??

December 11-12, 2013.

Our Alternative Work-flow



Our Alternative Work-flow



What is Git

- distributed version control software
- widely used in computer science
- designed to support development of Linux Kernel
  - designed to scalable
  - designed for collaberative coding
- 'save-as' on steroids
- distributed
  - no central server
  - each repository is complete and independent

Version control allows you to

- easily back-up projects to a server and/or the web
- work effectively on multiple computers
- reset your directory to any previous state
- use branches to safely make changes that might break your code
- work collaboratively with other analysts
  - sharing whole project
  - easily integrate their changes or contributions

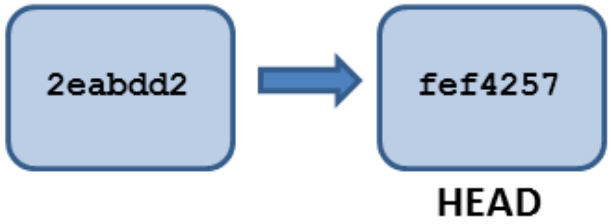
Version Control Basics

- 'repository' version control database
  - `.git` directory in project root
- a 'commit' is a snapshop that captures the state of selected files
- each commit has one or more parents
- git allows us to reset the directory to the state of any existing commit

Initialize Repository

First Commit

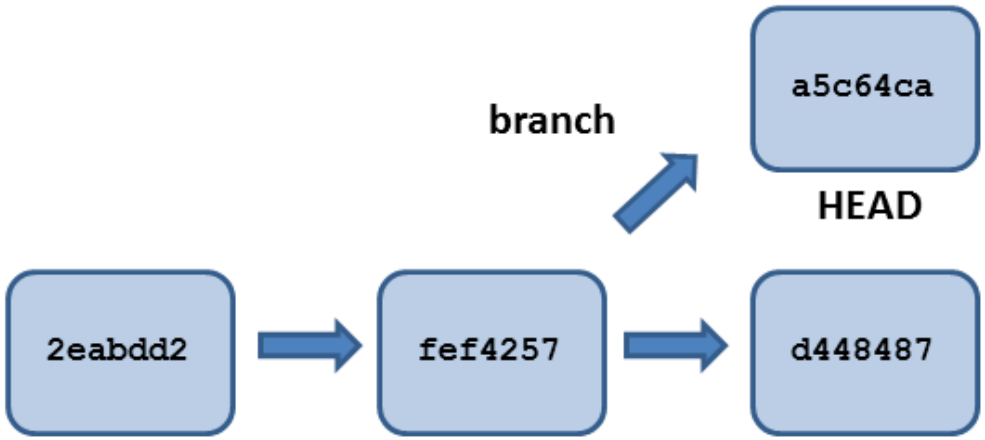
Second Commit



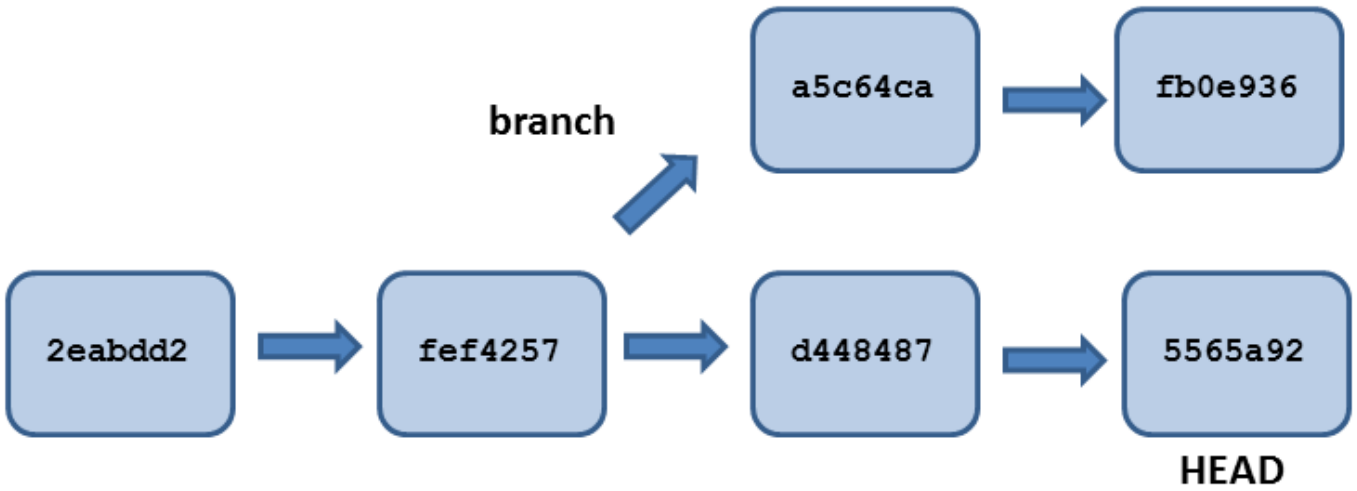
Third Commit

Checkout Commit

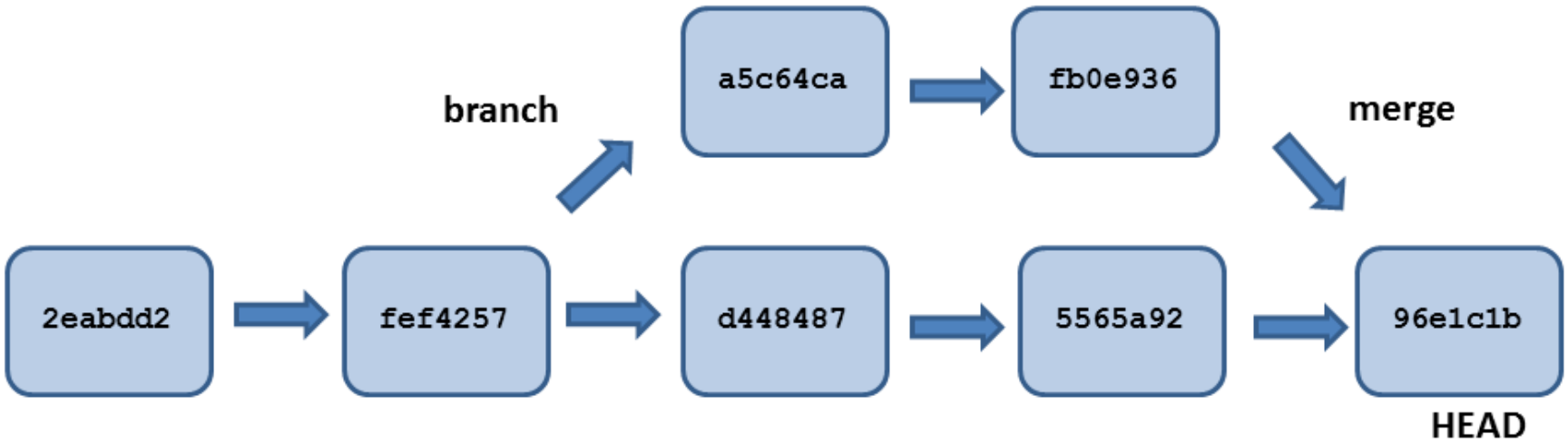
Branch



Checkout Branch



Merge


branch
a5c64ca
fb0e936
merge
2eabdd2
fef4257
d448487
5565a92
96e1c1b
HEAD

Setting up git

from a command prompt:

```
> git config --global user.name "<your name>"
> git config --global user.email "you@there.com"
```

verify:

```
> git config --list
```

Your First Repository

- navigate to one of the example directories (e.g. -`/examples/9_amdb_sweave`)
- alternatively copy one to a convenient location

from a command prompt:

```
> cd <project root directory>
> git init
> dir /a
```

emacs and git: magit

- git command line tool
- several GUI's available
- most widely used plug-in for emacs is 'magit'
- from emacs
  - open any file the in project directory
  - type `C-c C-g` to open `*magit*` buffer

What to commit - .gitignore

- only source files need to checked into version control
  - .r, .rnw
  - .dat, .pin, .tpl
- `.gitignore` controls files and directories that git will consider as eligible
  - .gitignore lists files and directories that will **NOT** be committed
- an example for admb projects found in ~/workshop/utils/.gitignore
- Next
  - copy .gitignore from ~/workshop/utils/.gitignore into your project directory and then within `*magit*` buffer type "=g=" to refresh it's contents

Staging

- committing files in git is two step process
- first need to be 'staged'
  - placed in the queue
- then committed
  - during commit, all staged files are added to the repository
- if you change file after it is staged, it needs to be 'unstaged' and staged again for changes to be reflected in commit
- Staging files in `*magit*`:
  - place your cursor beside each file and type "=s="
  - each file will move from `Untracked Files` to `Staged Files`

Your First Commit

- each commit is accompanied by message
  - first line - treated as title
  - subsequent lines/paragraphs form body
  - good messages a succinct and too point, but accurately capture differences between previous commit
  - git has a number of tools to search for commits based on message content
- Commit
  - if you're happy with the staged files type "=c=" to commit
  - emacs will open a `*magit-edit-log*` buffer
  - type your commit message and then type `C-c C-c` to finalize commit

magit buffer

```
Local:     master ~/ScrapBook/gittest/
Head:      5a1ee68 Initial commit of testgit.
```

What is a hash?

- git uses 'hashes' to track commits
- a hash is generated by an algorithm run on the content of the commit
- hashes are unique to the commit (1.2×10^{24})
- small changes in content result in wildly different hashes - probability of collisions extremely small.
- why hashes?
  - distributed nature means that git can't use sequential commit numbers

What is a hash? (cont'd)

- R can generate hashes using the digest library.

For example try:

```
> library(digest)

> digest('QFC_workshop', algo='sha1')

> digest('QFC workshop', algo='sha1')
```

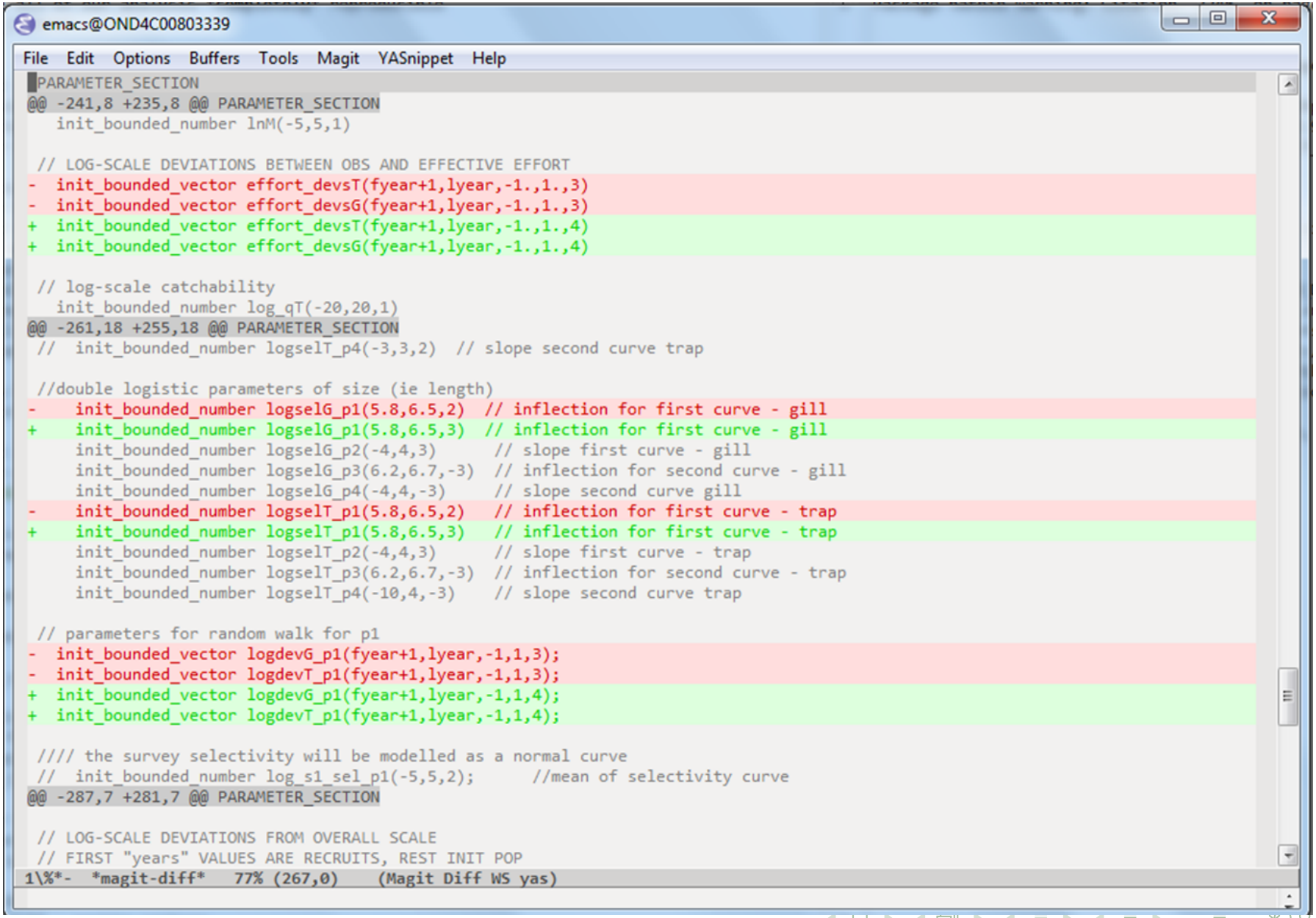
Your Second Commit

- make and some changes to any of files included in the first commit.
- in the `*magit*` buffer type '=g=' to refresh it contents
- the files you changed should appear under Changes in the `*magit*` buffer
- to actually see the changes you just made, type "=d=" in the `*magit*` buffer followed by `<return>`

Git Diff

- disply line-by-line difference between commits
- by default shows difference between latest commit and current directory contents
- commit numbers and/or file names can be used as arguments
- parts of each changed file are shown for context
- new lines are green and prefixed with '+'
- removed line red and prefixed with '-'

Git Diff


emacs@OND4C00803339
File Edit Options Buffers Tools Magit YASnippet Help
PARAMETER_SECTION
@@ -241,8 +235,8 @@ PARAMETER_SECTION
init_bounded_number lnM(-5,5,1)
// LOG-SCALE DEVIATIONS BETWEEN OBS AND EFFECTIVE EFFORT
- init_bounded_vector effort_devsT(fyear+1,lyear,-1.,1.,3)
- init_bounded_vector effort_devsG(fyear+1,lyear,-1.,1.,3)
+ init_bounded_vector effort_devsT(fyear+1,lyear,-1.,1.,4)
+ init_bounded_vector effort_devsG(fyear+1,lyear,-1.,1.,4)
// log-scale catchability
init_bounded_number log_qT(-20,20,1)
@@ -261,18 +255,18 @@ PARAMETER_SECTION
// init_bounded_number logselT_p4(-3,3,2) // slope second curve trap
//double logistic parameters of size (ie length)
- init_bounded_number logselG_p1(5.8,6.5,2) // inflection for first curve - gill
+ init_bounded_number logselG_p1(5.8,6.5,3) // inflection for first curve - gill
init_bounded_number logselG_p2(-4,4,3) // slope first curve - gill
init_bounded_number logselG_p3(6.2,6.7,-3) // inflection for second curve - gill
init_bounded_number logselG_p4(-4,4,-3) // slope second curve gill
- init_bounded_number logselT_p1(5.8,6.5,2) // inflection for first curve - trap
+ init_bounded_number logselT_p1(5.8,6.5,3) // inflection for first curve - trap
init_bounded_number logselT_p2(-4,4,3) // slope first curve - trap
init_bounded_number logselT_p3(6.2,6.7,-3) // inflection for second curve - trap
init_bounded_number logselT_p4(-10,4,-3) // slope second curve trap
// parameters for random walk for p1
- init_bounded_vector logdevG_p1(fyear+1,lyear,-1,1,3);
- init_bounded_vector logdevT_p1(fyear+1,lyear,-1,1,3);
+ init_bounded_vector logdevG_p1(fyear+1,lyear,-1,1,4);
+ init_bounded_vector logdevT_p1(fyear+1,lyear,-1,1,4);
//// the survey selectivity will be modelled as a normal curve
// init_bounded_number log_s1_sel_p1(-5,5,2); //mean of selectivity curve
@@ -287,7 +281,7 @@ PARAMETER_SECTION
// LOG-SCALE DEVIATIONS FROM OVERALL SCALE
// FIRST "years" VALUES ARE RECRUITS, REST INIT POP
1\%*- *magit-diff* 77% (267,0) (Magit Diff WS yas)

Your Second Commit (cont'd)

- if your are happy with status of files
- stage each of the files as before
- type "=c=" to open the commit buffer
- provide a brief commit message and finialize the commit by typing "~C-c C-c~"
- the `*magit*` buffer will be reset with a new commit hash

Reviewing Previous Commits - Git Log

- git log provides a history of changes that lead to current state
- multiple options to control output and format

from a command prompt in your working directory try:

```
> git log
> git log --oneline
```

or equivalently in emacs with magit

- `C-c C-g l L`
- `C-c C-g l l`

When to commit

- commit early and often
- especially if tests pass or model converges
- immediately before reporting

Reverting to Initial Commit

Creating Branches

- easy to create branches
- branches allow for independent parallel development without disrupting existing code
- making changes that might break something? Create a branch

- Switching between branches
  - ‘checkout <branch name>’

Merging

- merging opposite of branching
- merge commits have more than one parent
- changes in each branch are integrated by git
- merge conflict only occur if same lines changed in both commits

- Merging
  - check out branch you want to keep `checkoutmaster`
    - ★ `b b` in `magit`
  - merge target branch with keeper by `merge<branchname>`
    - ★ `m m` in `magit`

Remote Repositories

- creating and configuring
- what they are
- remote repositories often original source of code
- also serve as backup and mobile repositories

create a remote repository:

```
> dir F:
> mkdir gitrepos
> cd gitrepos
> git init --bare
> cd <your original repo>
> git add remote usb F:/gitrepos
> git remote -v
```

Pushing and Pulling to Remote Repositories

- workflow
- use `git push usb --all` to synchronize the remote (usb) with local repository
- use `git fetch usb` followed by `git merge master` to synchronize local repository with remote on usb
- `git pull usb` is wrapper that calls `git fetch usb` and `git merge master` for you

Clone Existing Repository

- cloning a repository give you an exact copy of an existing repository
- clone from websites such as bitbucket or github
- or from other sources such as usb, ftp site or cloud service
- cloned repository will automatically have remote
  - named 'origin' by convention

Example:

```
> git clone https://github.com/AdamCottrill/QFC_Worksh
```

Hooks

- files that run on when specific actions occur
- git has numerous hooks available
- post-commit, post-checkout, and post-merge hooks used to integrate git and reproducible research
- need to be manually activated in each repository
- each commit, merge or check out will result in file being written to working directory
- contents of the file (commit hash) can then be integrated into reporting products

Make your research reproducible

- use hooks to write a file that contains commit number:
  - on commit
  - on merge
  - on checkout
- package gitinfo to integrate commit number into all pdf reports

changes to `*.rnw`

```
\usepackage{gitinfo}                    % in preabmble
...
Commit Number: \gitAbbrevHash           % some where in docu
```

Hooks

post-checkout hook

```
prefixes=". Sweave SweaveSEP"
echo $GIT_DIR
for pref in $prefixes
        do
        git log -1 --date=short \
        --pretty=format:"\usepackage[%
                shash={%h},
                lhash={%H},
                authname={%an},
                authemail={%ae},
                authsdate={%ad},
                authidate={%ai},
...
                commudate={%at},
                refnames={%d}
        ]{gitsetinfo}" HEAD > $pref/gitHeadInfo.gin
        done
```

Hooks

results in gitHeadInfo.gin:

```
\usepackage[%
                shash={dabb2eb},
                lhash={dabb2eb433a5d14bc45a8dae8aadc7f43208d990},
                authname={Adam Cottrill},
                authemail={adam.cottrill@ontario.ca},
                authsdate={2013-10-07},
                authidate={2013-10-07 10:52:12 -0400},
                authudate={1381157532},
                commname={Adam Cottrill},
                commemail={adam.cottrill@ontario.ca},
                commsdate={2013-10-07},
                commidate={2013-10-07 10:52:12 -0400},
                commudate={1381157532},
                refnames={ (HEAD, master)}
        ]{gitsetinfo}
```

Gotchas

- reports must be generated **after** commiting working directory
- be careful with dropbox
  - don't use dropbox as working directory with git
  - dropbox folders are great as remote repositories

Recap

- git distributed version control system
- designed for collaborative use
- magit emacs plugin for git
- hooks extend functionality

Further Reading and References

- Pro Git:
  - http://git-scm.com/book
- excellent introductory book:
  - Version Control with Git
- A highly recommended introductory talk:
  - http://www.youtube.com/watch?v=ZDR433b0HJY
- A highly recommended intermediate talk:
  - http://www.youtube.com/watch?v=ig5E8CcdM9g
- A recent blog post about using magit:
  - ~/introduction-magit-emacs-mode-git/