



# Version Control with Git & GitHub

UBC

6 August 2014

Kim Gilbert

# What is Git?

- Version control software




























# What is Git?

- Version control software
- What is version control?

# What is Version Control?

 latifolia_ABC_ms_110111.docx	Nov 1, 2011, 1:00 PM	254 KB	Micros...ument
 latifolia_ABC_ms_110211_PDF.docx	Nov 2, 2011, 10:32 AM	298 KB	Micros...ument
 latifolia_ABC_ms_110111KJG.docx	Nov 2, 2011, 7:56 PM	289 KB	Micros...ument
 latifolia_ABC_ms_110211KJG.docx	Nov 4, 2011, 4:23 PM	290 KB	Micros...ument
 latifolia_ABC_ms_11042011_PDF.docx	Nov 6, 2011, 2:23 PM	290 KB	Micros...ument
 latifolia_ABC_ms_11082011_KJG.docx	Nov 8, 2011, 4:15 PM	291 KB	Micros...ument
 latifolia_ABC_ms_11092011_PDF.docx	Nov 10, 2011, 2:29 PM	290 KB	Micros...ument
 latifolia_ABC_ms_11162011_SRK.docx	Nov 16, 2011, 4:50 PM	173 KB	Micros...ument
 latifolia_ABC_ms_11162011_KJG.docx	Nov 19, 2011, 10:55 AM	235 KB	Micros...ument
 latifolia_ABC_ms_11272011_KJG.docx	Nov 27, 2011, 10:48 PM	444 KB	Micros...ument
 latifolia_ABC_ms_113011_SRK.docx	Nov 30, 2011, 11:01 AM	1.5 MB	Micros...ument
 latifolia_ABC_ms_120111_KJG.docx	Nov 30, 2011, 11:55 AM	1.5 MB	Micros...ument
 latifolia_ABC_ms_12052011_KJG.docx	Dec 7, 2011, 8:32 PM	3 MB	Micros...ument
 latifolia_ABC_ms_12072011_KJG.docx	Dec 7, 2011, 8:43 PM	3 MB	Micros...ument
 latifolia_ABC_ms_12082011_KJG.docx	Dec 10, 2011, 8:43 AM	2.3 MB	Micros...ument
 latifolia_ABC_ms_12112011.docx	Dec 12, 2011, 3:16 PM	2.4 MB	Micros...ument
 latifolia_ABC_ms_12122011.docx	Dec 12, 2011, 4:17 PM	2.4 MB	Micros...ument
 latifolia_ABC_ms_12132011.docx	Dec 12, 2011, 11:54 PM	2 MB	Micros...ument
 latifolia_ABC_ms_12132011_PDF.docx	Dec 12, 2011, 11:55 PM	2 MB	Micros...ument
 latifolia_ABC_ms_12122011_SRK.docx	Dec 13, 2011, 8:41 AM	1.4 MB	Micros...ument
 latifolia_ABC_ms_12122011_SRK_edited.docx	Dec 13, 2011, 11:03 AM	1.4 MB	Micros...ument
 latifolia_ABC_ms_12132011_KJG.docx	Dec 13, 2011, 10:03 PM	1.7 MB	Micros...ument
 latifolia_ABC_ms_12142011_KJG.docx	Dec 14, 2011, 10:40 AM	1.6 MB	Micros...ument

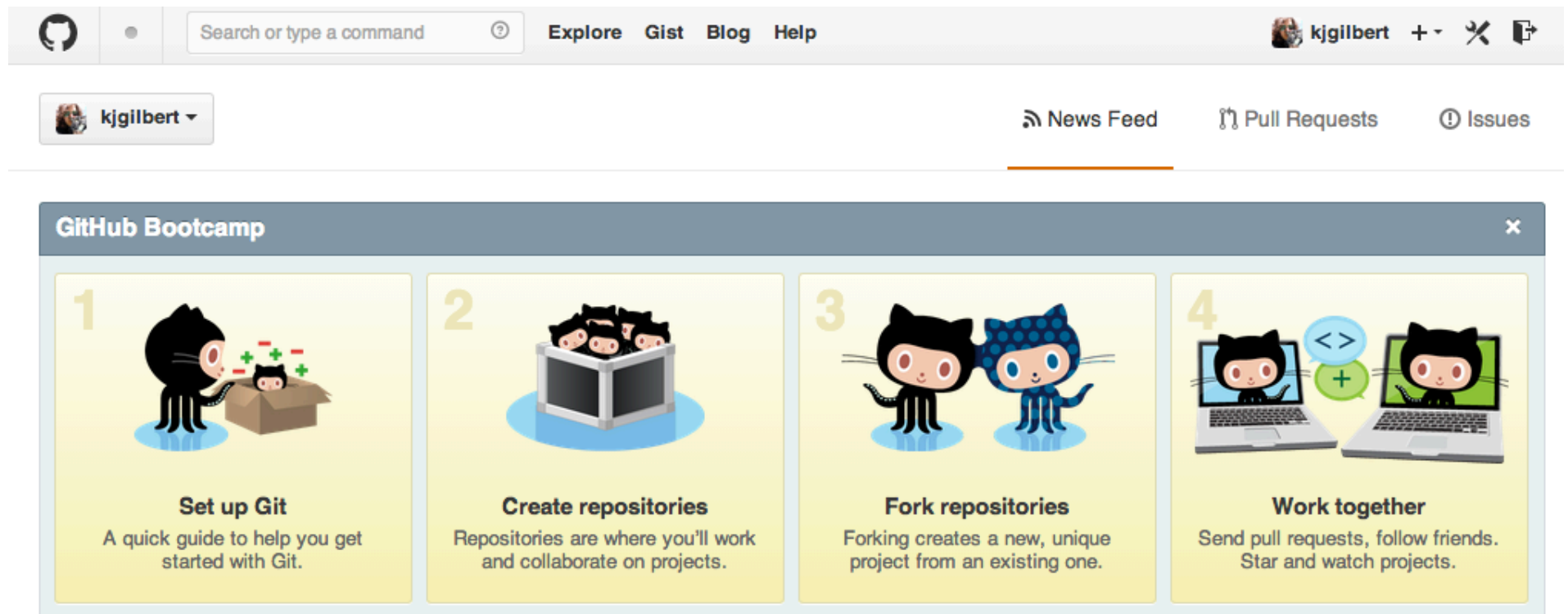


# Better version control

- GitHub is an online repository-based server
  - Collaborate
  - Review/manage code
  - Open source/private projects

# Better version control

- GitHub is an online repository-based server

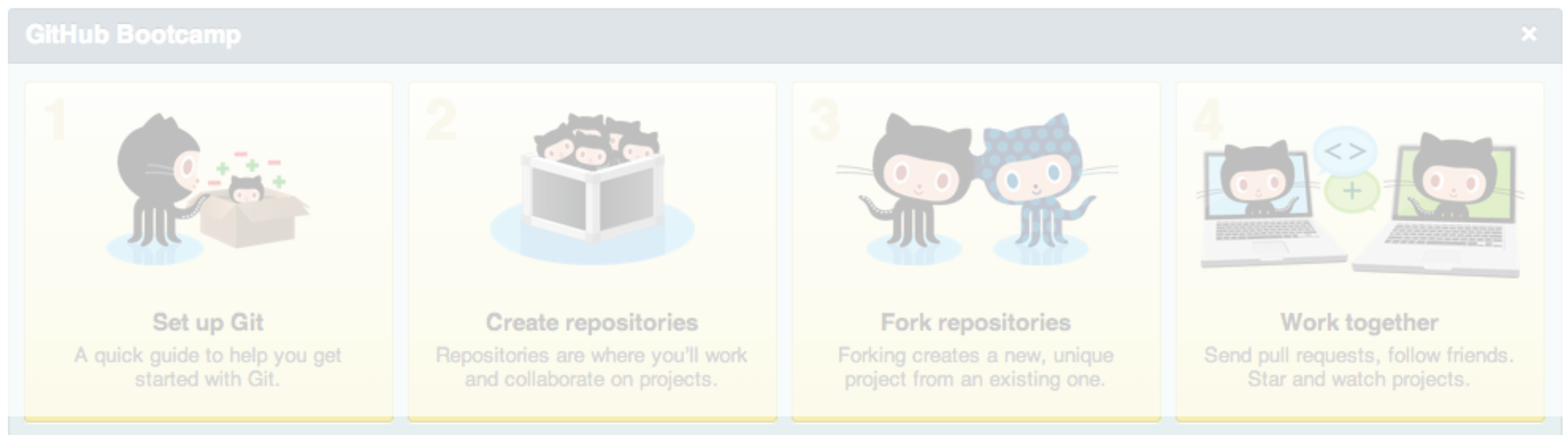


The screenshot shows the GitHub homepage for user 'kjgilbert'. The top navigation bar includes the GitHub logo, a search bar, and links to Explore, Gist, Blog, and Help. The user's profile is shown as 'kjgilbert' with a dropdown menu. Below the navigation bar, there are links to News Feed, Pull Requests, and Issues. The main content area features the 'GitHub Bootcamp' guide, which consists of four numbered steps:

- 1 Set up Git**  
A quick guide to help you get started with Git.
- 2 Create repositories**  
Repositories are where you'll work and collaborate on projects.
- 3 Fork repositories**  
Forking creates a new, unique project from an existing one.
- 4 Work together**  
Send pull requests, follow friends. Star and watch projects.

# Better version control

- GitHub is an online repository-based server





# Git & GitHub

- Git is a command line tool
- But if you prefer a GUI, there is one



# The easiest way to use GitHub on Mac

Download GitHub for Mac

Requires OS X 10.8 or later. [Learn more](#)

The screenshot shows a web browser window with the address bar displaying 'github/mac.github.com'. The page layout includes a sidebar on the left with a 'Filter Repositories' search bar and a list of repositories under 'GITHUB' and 'ENTERPRISE' categories. The main content area is divided into two columns. The left column, titled '223 commits', lists recent commits and pull requests, including 'Merge pull request #36 from github/requir...' and 'THE FUTURE'. The right column, titled 'Merge pull request #36 from github/requires-10-8', shows the details of the selected pull request, including the requirement for OS 10.8 and a diff view of the 'index.html' file. The diff view highlights changes to the download requirements, showing the transition from 'OS X 10.7 or later' to 'OS X 10.8 or later'.

github/mac.github.com

Changes History Branches Settings Sync

Filter Repositories

GITHUB

- Archimedes
- blog-posts
- libgit2
- Mac
- mac.github.com
- Mantle
- objective-git
- octokit.objc
- ReactiveCocoa
- ReactiveCocoaLayout
- ReactiveViewModel
- Rebel
- Squirrel.Mac

ENTERPRISE

- git-error-translations

223 commits

Merge pull request #36 from github/requir...  
1 day ago by dannygreg

THE FUTURE  
7 days ago by joshaber

Merge pull request #32 from github/exclud...  
4 months ago by jspahrsummers

Merge pull request #35 from github/remov...  
4 months ago by tobiasahlin

Add "removed" badge for release notes  
4 months ago by jspahrsummers

Merge pull request #34 from github/branch...  
5 months ago by dannygreg

Change branches popover decription  
5 months ago by lukehefson

Exclude jQuery from index and help  
6 months ago by tobiasahlin

Enable files to exclude shared js  
6 months ago by tobiasahlin

Merge pull request #29 from github/add-k...  
6 months ago by tobiasahlin

Make the description consistent with the sh...

Merge pull request #36 from github/requires-10-8  
Requires 10.8  
dannygreg 1c83349 1 day ago

index.html

```
... @@ -10,7 +10,7 @@ include_js: false
10 10     <h1 class="promo-header">The easiest way to use
      GitHub on Mac.</h1>
11 11
12 12     <a href="https://central.github.com/mac/latest"
      class="download-button huge">Download GitHub for
      Mac</a>
13 13 -     <p class="download-requirements">OS X 10.7 or
      later</p>
      +     <p class="download-requirements">OS X 10.8 or
      later</p>
14 14
15 15     <div class="section-shadow"></div>
16 16     <div></div>
```



# Git & GitHub

- Git is a command line tool
- GitHub is the online server
  - There are other online repositories you could use
  - e.g. Bitbucket
- Git lets you ‘link’ your local files with those stored online

# How?

- Local directory
  - Have all your files here
  - Edit them, add/delete them
- Online repository
  - Mirrors local directory
  - **Stores history of changes you've made to local**
  - Allows sharing/collaborating with others



# The Online Repository



kjgilbert / ThesisProposal **PRIVATE**

Watch 0

Star 0

Fork 0

ProposalDrafts\_PhD — Edit

44 commits

1 branch

0 releases

1 contributor



branch: master

ThesisProposal / +



FINAL proposal being turned in to office



kjgilbert authored on Apr 11, 2013

latest commit 6b66b11dcb



Chapters	writing draft 1	2 years ago
MyProposal.aux	almost done Ne chapter	2 years ago
MyProposal.bbl	almost done Ne chapter	2 years ago
MyProposal.blg	almost done Ne chapter	2 years ago
MyProposal.log	almost done Ne chapter	2 years ago
MyProposal.out	almost done Ne chapter	2 years ago
MyProposal.pdf	FINAL proposal being turned in to office	a year ago
MyProposal.synctex.gz	almost done Ne chapter	2 years ago
MyProposal.tex	FINAL proposal being turned in to office	a year ago
README	add Readme to Repo	2 years ago

<> Code

Issues 0

Pull Requests 0

Wiki

Pulse

Graphs

Settings

HTTPS clone URL

https://github.com/



You can clone with [HTTPS](#), [SSH](#), or [Subversion](#).

Clone in Desktop

Download ZIP

# My Local Directory

The screenshot shows a macOS Finder window titled "My\_Proposal". The window has a standard macOS title bar with red, yellow, and green window control buttons. Below the title bar is a toolbar with icons for "Back", "View" (icon view, compare view, web view, column view), "Arrange" (icon view, compare view, web view, column view), "Share", "Edit Tags", "Quick Look" (eye icon), "Action" (gear icon), and a search bar.

The left sidebar contains the "FAVORITES" section with links to "All My Files", "AirDrop", "Desktop", "Kim", "Applications", "Documents", and "Deleted Users". Below this are the "SHARED" and "TAGS" sections, which are currently empty.

The main pane displays a list of files and folders in a table format. The table has four columns: "Name", "Date Modified", "Size", and "Kind". The files listed are:

Name	Date Modified	Size	Kind
MyProposal.tex	Apr 15, 2013, 9:38 AM	76 KB	TeX sou
MyProposal.aux	Apr 15, 2013, 9:38 AM	15 KB	aux
MyProposal.log	Apr 15, 2013, 9:38 AM	24 KB	Log File
MyProposal.out	Apr 15, 2013, 9:38 AM	655 bytes	gmon.o
MyProposal.pdf	Apr 15, 2013, 9:38 AM	5.4 MB	Adobe..
MyProposal.synctex.gz	Apr 15, 2013, 9:38 AM	220 KB	gzip c...
MyProposal.bbl	Apr 11, 2013, 9:59 AM	21 KB	Docume
MyProposal.blg	Apr 11, 2013, 9:59 AM	1 KB	Docume
Chapters	Oct 23, 2012, 9:17 AM	--	Folder
README	Oct 1, 2012, 11:19 PM	69 bytes	Docume

# My History of Changes

Commits on Feb 02, 2013



**ch 2 first draft and lab meeting comments not yet incorporated**

kjgilbert authored on Feb 2, 2013



fa3400b



Commits on Jan 31, 2013



**working on ch 2**

kjgilbert authored on Jan 31, 2013



4c88dd



Commits on Jan 29, 2013



**working on Ch 2**

kjgilbert authored on Jan 29, 2013



c2ad7b3



Commits on Jan 27, 2013



**Ne chapter finished for this draft**

kjgilbert authored on Jan 27, 2013



5fcd177



**almost done Ne chapter**

kjgilbert authored on Jan 27, 2013



9eb32dd



Commits on Jan 25, 2013



**Ne intro redone, on to methods**

kjgilbert authored on Jan 25, 2013



3606f19



**working on chapter 3 more**

kjgilbert authored on Jan 25, 2013



5689fde



**working on ch 3**

kjgilbert authored on Jan 25, 2013



48fbf41



Commits on Jan 24, 2013



**climate figure added, a few ch 1 tweaks**

kjgilbert authored on Jan 24, 2013



81b1685



Commits on Jan 23, 2013



**after Mike's chapter 1 edits**

kjgilbert authored on Jan 23, 2013



a24b450



Commits on Jan 22, 2013



**chapter 1 edited**

kjgilbert authored on Jan 22, 2013



9b09b76










# Tracked Changes

102	100	
103		-Though it is well-known that lodgepole pine exhibits local adaptation \citep{Illingworth:1981tp,Ying:1985vk}, the genetic basis of this ability is not well understood. How can such a long-lived organism (life spans average a century but can range up to 300 years, \citealt{Knowles:1983vl}) with high gene flow (wind-dispersed pollen) be capable of such fine scale adaptation? This question is of scientific interest, but also in application, as the lodgepole pine is a major timber resource of the Pacific northwest. Choosing trees that will be best adapted to future conditions under climate change models confers a benefit in fitness and thus a benefit in growth and timber production.
	101	+Though it is well-known that lodgepole pine exhibits local adaptation \citep{Illingworth:1981tp,Ying:1985vk}, the genetic basis of this ability is not well understood. How can such a long-lived organism (life spans average a century but can range up to 300 years, \citealt{Knowles:1983vl}) with high gene flow (wind-dispersed pollen) be capable of such fine scale adaptation? This question is of scientific interest, but also for application, as the lodgepole pine is a major timber resource of the Pacific northwest. Choosing trees that will be best adapted to future conditions under climate change models confers a benefit in fitness and thus a benefit in growth and timber production.
104	102	
105		-A current project in the department of forestry at UBC, \textsc{AdapTree}, aims to uncover SNP markers conferring adaptation to different climatic conditions in terms of temperature and precipitation for just this purpose: choosing genetically well-adapted trees for reforestation. By sequencing and phenotyping seedlings collected from across the range of the species and grown in different climate conditions, genome-wise association studies (GWAS) are being conducted to identify outlier SNPs as candidates for predicting local adaptation. My aim is to ground-truth these findings and establish if such putatively adaptive SNPs truly associate with higher fitness. If confirmed as adaptive, my results would support further application of these identification methods in other scenarios. However, there are several reasons that merit this confirmation.
	103	+A current project in the department of forestry at UBC, \textsc{AdapTree}, aims to uncover SNP markers conferring adaptation to different climatic conditions in terms of temperature and precipitation for this purpose: choosing genetically well-adapted trees for reforestation. My aim is to ground-truth these findings and establish if such putatively adaptive SNPs truly associate with higher fitness. If confirmed as adaptive, my results would support further application of these identification methods in other scenarios. By sequencing and phenotyping seedlings collected from across the range of the species and grown in different climate conditions, \textsc{AdapTree} is conducting genome-wise association studies (GWAS) to identify outlier SNPs as candidates for predicting local adaptation. These loci are classified as outliers when \emph{F}\$_{ST}\$ is calculated at loci across the genome, and some loci show values significantly greater than other locations. This uncovers SNP loci that have differentiated among populations geographically, therefore indicating genes that have either been selected for, or drifted to fixation. There are thus several reasons that these procedures merit confirmation.
106	104	
107		-First, is that measuring fitness in long-lived organisms is difficult. Lodgepole pine has a long lifespan over which many phenotypic changes may occur, of which only some may be predicted from younger age. The GWAS study \textsc{AdapTree} is conducting compares first and second year phenotypes to genome scans to identify SNPs of interest. Seedling phenotypes may not correlate to adult phenotypes for the traits of interest in climate adaptation, resulting in incorrect associations being made between genotype and phenotype.
	105	+First, is that measuring fitness in long-lived organisms is difficult. Lodgepole pine has a long lifespan over which many phenotypic changes may occur, of which only some may be predicted from younger age. The GWAS study \textsc{AdapTree} is conducting compares first and second year phenotypes to genome scans to identify SNPs of interest. There is the potential that seedling phenotypes may not correlate to adult phenotypes for the traits of interest in climate adaptation, resulting in incorrect associations being made between genotype and phenotype.
108	106	
109	107	Second, outlier SNPs can exist for different biological reasons, and their selection can be done in several ways. This may result in incorrect identification of SNPs believed to convey adaptation, termed false positives. Neutral demographic processes, such as allele surfing (Klopfstein et al. 2006) % Klopstein S, Currat M, Excoffier L (2006). The fate of mutations surfing on the wave of a range expansion. Mol Biol Evol 23: 4820490.
	108	+%%CITATION
110	109	can result in clines of allele frequency change that are equally characteristic of selection when they occur across



## add optional change of dam relatedness

[Browse code](#) master kcgilbert authored on Jun 11 parent [d7fa533](#) commit [e57258a3377e36f7a6239224e5b375f0f18fe5dc](#) Showing 1 changed file with 11 additions and 9 deletions.[Show diff stats](#)20   R/QstFstComp.R[View](#)

		@@ -51,6 +51,8 @@
51	51	#' which works for either balanced or unbalanced sampling designs
52	52	#' }
53	53	#'
	54	+#' @param dam.offspring.relatedness
	55	+#'
54	56	#' @param output whether to output full or concise results, see details below
55	57	#'
56	58	#' @return
		@@ -102,7 +104,7 @@
102	104	
103	105	
104	106	
105		-QstFstComp <- function(fst.dat, qst.dat, numpops, nsim=1000, AFLP=FALSE, breeding.design, output="concise")
	107	+QstFstComp <- function(fst.dat, qst.dat, numpops, nsim=1000, AFLP=FALSE, breeding.design, dam.offspring.relatedness=0.
106	108	{
107	109	if(missing(fst.dat)) stop("Genotypic data must be provided.")
108	110	if(missing(qst.dat)) stop("Phenotypic data must be provided.")
		@@ -123,7 +125,7 @@ QstFstComp <- function(fst.dat, qst.dat, numpops, nsim=1000, AFLP=FALSE, breedin
123	125	qst.MS <- MeanSq.unbalanced.dam(qst.dat)
124	126	qst.obs <- QSTfromDamModel(qst.MS\$MSpops,qst.MS\$MSdams,qst.MS\$MSwithin,qst.MS\$n0prime,qst.MS\$n0,qst.MS\$
125	127	mean.trait.value <- mean(qst.dat[,3], na.rm=TRUE) # this takes the mean of all trait values across all
126		- Va <- 4*(qst.MS\$MSdams-qst.MS\$MSwithin)/qst.MS\$n0
	128	+ Va <- 1/dam.offspring.relatedness*(qst.MS\$MSdams-qst.MS\$MSwithin)/qst.MS\$n0
127	129	if(Va < 0){Va <- 0} # if Va includes negative values, the distribution is truncated to zero
128	130	CVa <- sqrt(Va)/mean.trait.value * 100
129	131	}



[Explore](#) [Gist](#) [Blog](#) [Help](#)

kjgilbert

+ -

**Rich FitzJohn**

richfitz



Sydney, NSW



Joined on Mar 20, 2012

**30**

Followers

**28**

Starred

**17**

Following

[Contributions](#)[Repositories](#)[Public activity](#)

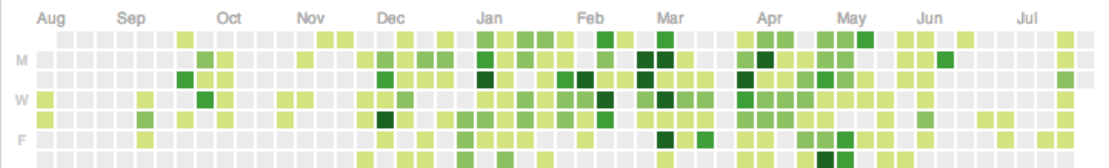
Unfollow

**Popular repositories**

	<b>diversitree</b>	diversitree: comparative phylogenetic a...	15 ★
	<b>forest</b>	New Phylogenetics Data Structures in R	6 ★
	<b>wood</b>	How much of the world is woody?	6 ★
	<b>rodeint</b>	Interface to boost's odeint-v2	5 ★
	<b>sowsear</b>	Frictionless literate programming: gener...	3 ★

**Repositories contributed to**

	<b>dfalster/Revolve</b>	Adaptive Dynamics toolkit for R	0 ★
	<b>nicercode/2014-02-13-UNSW</b>	Software Carpentry bootcamp at UNSW...	0 ★
	<b>mwpennell/arbutus</b>	Assessing the adequacy of phylogeneti...	0 ★
	<b>nicercode/2014-09-25-MQ</b>		0 ★
	<b>nicercode/2014-02-18-UTS</b>		1 ★

**Public contributions**Summary of Pull Requests, issues opened, and commits. [Learn more.](#)

Less More

Year of contributions

**1,242 total**

Aug 05 2013 - Aug 05 2014

Longest streak

**19 days**

April 06 - April 24

Current streak

**0 days**

Rock - Hard Place

**Contribution activity**Period: **1 week** **7 commits****Pushed 7 commits to richfitz/rcppr6** Jul 30 - Aug 01 **1 Issue reported****Open**#19 **Inconsistent newlines when section value is in a list** 6 days ago



**First version of PGLS via pruning complete.** ...

richfitz authored on Dec 20, 2013



07e17d0



Commits on Dec 16, 2013



**Documentation and NOTE fixes from R CMD check**

richfitz authored on Dec 16, 2013



56e4a19



**OU models now have "with.optimum" option.** ...

richfitz authored on Dec 16, 2013



aa5c186



**Simplify OU rescaling code.**

richfitz authored on Dec 16, 2013



7d5ebaf



**OU via contrasts and rescaling**

richfitz authored on Dec 16, 2013



11b555e



**Bugfix in EB pruning calculations (with R backend only)**

richfitz authored on Dec 16, 2013



850b119



**Tree rescaling code**

richfitz authored on Dec 16, 2013



2d3606d



**Fix bug in time calculation that did not work on non-cladewise tree.** ...

richfitz authored on Dec 16, 2013



2a3da4d



**Handed alpha=0 case gracefully for VCV OU calculation.**

richfitz authored on Dec 16, 2013



874b6da



**Bug fix for contrasts calculation with intermediates**

richfitz authored on Dec 16, 2013



430c927



**Generating function for simulating character histories**

richfitz authored on Dec 16, 2013



8bc66bf



Commits on Dec 14, 2013



**Drop srcref attribute when rewriting default, and test rewriting works**

richfitz authored on Dec 14, 2013



7f10259



**Contrasts-based calculations of BM likelihoods.**

richfitz authored on Dec 14, 2013



f40ff58



Commits on Dec 09, 2013



**Added support for time-varying GeoSSE (contributed by Jonathan Rolland)**

richfitz authored on Nov 6, 2013



09261f5



**Fix typos in help file.** ...

richfitz authored on Dec 9, 2013



9447670





richfitz / diversitree

★ Star 15

🔗 Fork 3

## Fix bug in time calculation that did not work on non-cladewise tree.

[Browse code](#)

This may affect calculations under split models.

🔗 master



richfitz authored on Dec 16, 2013

1 parent 874b6da commit 2a3da4dc5e9ce18f44eeec9354fcfabe633b2485

📄 Showing 1 changed file with 2 additions and 1 deletion.

[Show diff stats](#)

3 diversitree/R/util-tree.R

[View](#)

```
@@ -87,13 +87,14 @@ mrca.tipset <- function(phy, tips) {
87 87   branching.heights <- function(phy) {
88 88     if (!inherits(phy, "phylo"))
89 89       stop('object "phy" is not of class "phylo"')
90 + phy <- reorder(phy, "cladewise")
90 91
91 92   edge <- phy$edge
92 93   n.node <- phy$Nnode
93 94   n.tip <- length(phy$tip.label)
94 95
95 96   ht <- numeric(n.node + n.tip) # zero'd
96 - for (i in seq_len(nrow(edge)))
97 + for (i in seq_len(nrow(edge)))
97 98     ht[edge[i, 2]] <- ht[edge[i, 1]] + phy$edge.length[i]
98 99
99 100   ## Ugly, but fairly compatible with branching.times()
```



# Hands-on



# Recap

- Making a repository
- Pulling/pushing
- Forking
- .gitignore file

# Recap - Making a repository

- On GitHub: create a new Repo
- Locally:
  - Create your directory and *cd* into it
  - *git init*
  - *touch README*
  - *git add README*
  - *git commit -m "first commit"*
  - *git status* (just to check, can be done at any time)
  - *git remote add origin https://github.com/username/repository\_name.git* (done only the first time)
  - *git push -u origin master* (or just *git push*)



# Recap - Pushing & Pulling

- After making some edits locally in your directory:
  - *git add filename* (or *git add . -A* to add everything)
  - *git commit -m “message to yourself about file”*
  - You can do *git status* to see the status of your files ready for pushing
  - *git push*
  - If you’re collaborating:
    - *git pull* will bring any changes made by others in the repo into your local directory
    - This is where some errors occur if there are merge difficulties

# Recap - Forking

- Someone else has a repo you want to use or contribute to
- You can fork it into your own account to make a copy
  - Do this online in github by going to the repo you want and clicking **Fork** in top right corner
  - Clone it locally onto your computer
    - See <https://help.github.com/articles/fork-a-repo> for all of the details
  - Update your copy to match original with '*git fetch upstream*





## Recap - .gitignore file

- Dot in the name means it is an invisible file, i.e. you cannot see it in your Finder window
- The files listed within the .gitignore file are ignored and never pushed online to the GitHub repository
  - Create with *touch .gitignore*
  - Open with *open -e .gitignore*
  - Then add in the files you want ignored