Unix/Linux Command Reference

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File Commands

ls – directory listing
ls -al – formatted listing with hidden files
cd *dir* - change directory to *dir*
cd – change to home
pwd – show current directory
mkdir *dir* – create a directory *dir*
rm *file* – delete *file*
rm -r *dir* – delete directory *dir*
rm -f *file* – force remove *file*
rm -rf *dir* – force remove directory *dir* *
cp *file1 file2* – copy *file1* to *file2*
cp -r *dir1 dir2* – copy *dir1* to *dir2*; create *dir2* if it doesn't exist
mv *file1 file2* – rename or move *file1* to *file2*
if *file2* is an existing directory, moves *file1* into directory *file2*
ln -s *file link* – create symbolic link *link* to *file*
touch *file* – create or update *file*
cat > *file* – places standard input into *file*
more *file* – output the contents of *file*
head *file* – output the first 10 lines of *file*
tail *file* – output the last 10 lines of *file*
tail -f *file* – output the contents of *file* as it grows, starting with the last 10 lines

Process Management

ps – display your currently active processes
top – display all running processes
kill *pid* – kill process id *pid*
killall *proc* – kill all processes named *proc* *
bg – lists stopped or background jobs; resume a stopped job in the background
fg – brings the most recent job to foreground
fg *n* – brings job *n* to the foreground

File Permissions

chmod *octal file* – change the permissions of *file* to *octal*, which can be found separately for user, group, and world by adding:

- 4 – read (r)
- 2 – write (w)
- 1 – execute (x)

Examples:
chmod 777 – read, write, execute for all
chmod 755 – rwx for owner, rx for group and world
For more options, see **man chmod**.

SSH

ssh *user@host* – connect to *host* as *user*
ssh -p *port user@host* – connect to *host* on port *port* as *user*
ssh-copy-id *user@host* – add your key to *host* for *user* to enable a keyed or passwordless login

Searching

grep *pattern files* – search for *pattern* in *files*
grep -r *pattern dir* – search recursively for *pattern* in *dir*
command* | grep *pattern – search for *pattern* in the output of *command*
locate *file* – find all instances of *file*

System Info

date – show the current date and time
cal – show this month's calendar
uptime – show current uptime
w – display who is online
whoami – who you are logged in as
finger *user* – display information about *user*
uname -a – show kernel information
cat /proc/cpuinfo – cpu information
cat /proc/meminfo – memory information
man *command* – show the manual for *command*
df – show disk usage
du – show directory space usage
free – show memory and swap usage
whereis *app* – show possible locations of *app*
which *app* – show which *app* will be run by default

Compression

tar cf *file.tar files* – create a tar named *file.tar* containing *files*
tar xf *file.tar* – extract the files from *file.tar*
tar czf *file.tar.gz files* – create a tar with Gzip compression
tar xzf *file.tar.gz* – extract a tar using Gzip
tar cjf *file.tar.bz2* – create a tar with Bzip2 compression
tar xjf *file.tar.bz2* – extract a tar using Bzip2
gzip *file* – compresses *file* and renames it to *file.gz*
gzip -d *file.gz* – decompresses *file.gz* back to *file*

Network

ping *host* – ping *host* and output results
whois *domain* – get whois information for *domain*
dig *domain* – get DNS information for *domain*
dig -x *host* – reverse lookup *host*
wget *file* – download *file*
wget -c *file* – continue a stopped download

Installation

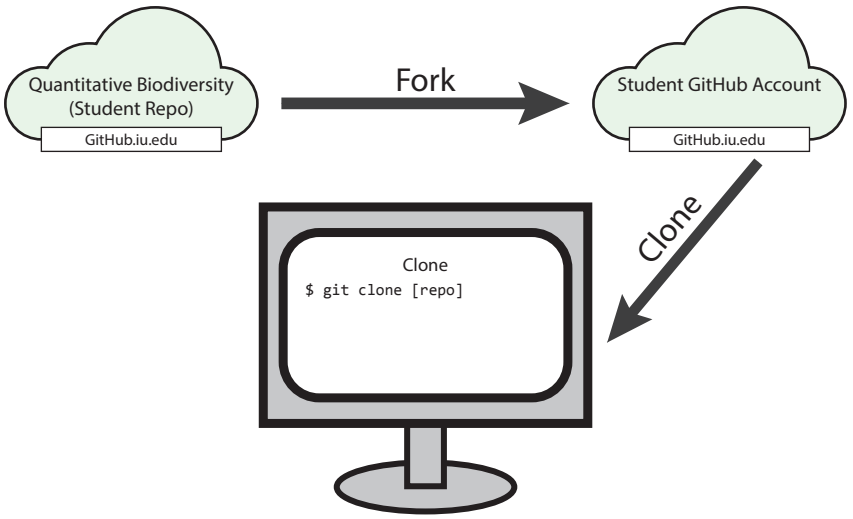
Install from source:
./configure
make
make install
dpkg -i *pkg.deb* – install a package (Debian)
rpm -Uvh *pkg.rpm* – install a package (RPM)

Shortcuts

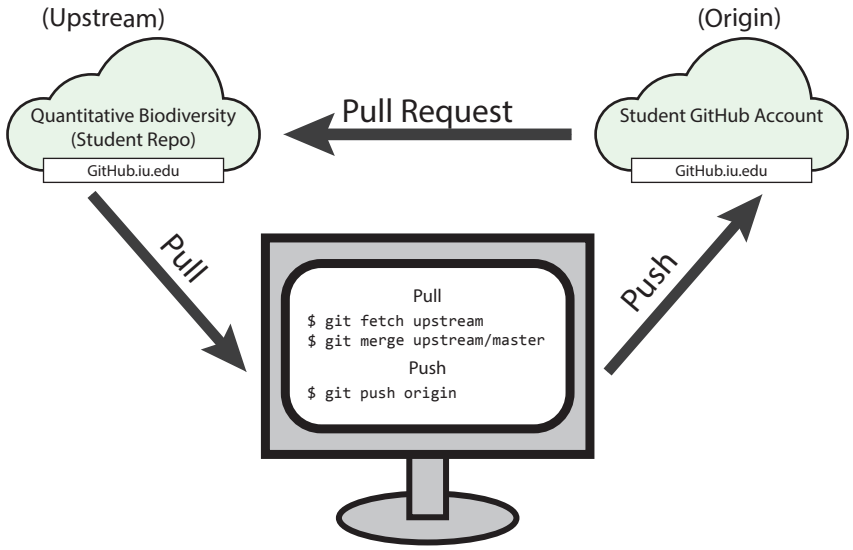
Ctrl+C – halts the current command
Ctrl+Z – stops the current command, resume with **fg** in the foreground or **bg** in the background
Ctrl+D – log out of current session, similar to **exit**
Ctrl+W – erases one word in the current line
Ctrl+U – erases the whole line
Ctrl+R – type to bring up a recent command
!! - repeats the last command
exit – log out of current session

* use with extreme caution.

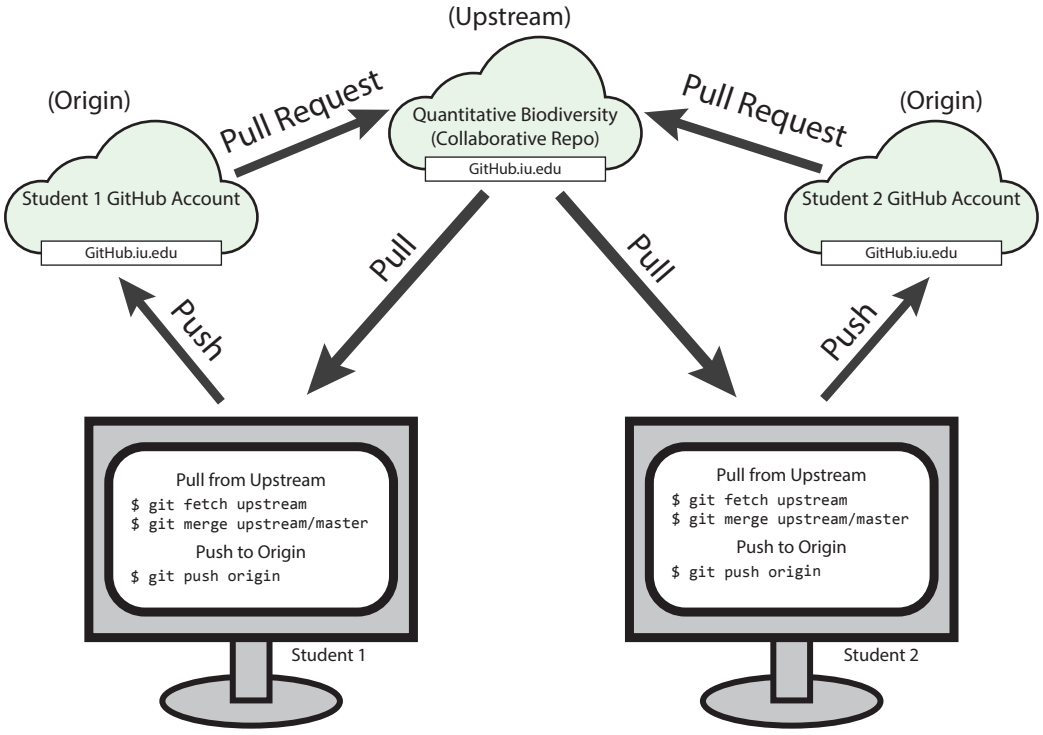
Initial Setup



Work Flow



Collaborative Work Flow



Git Notes

Git Cheat Sheet

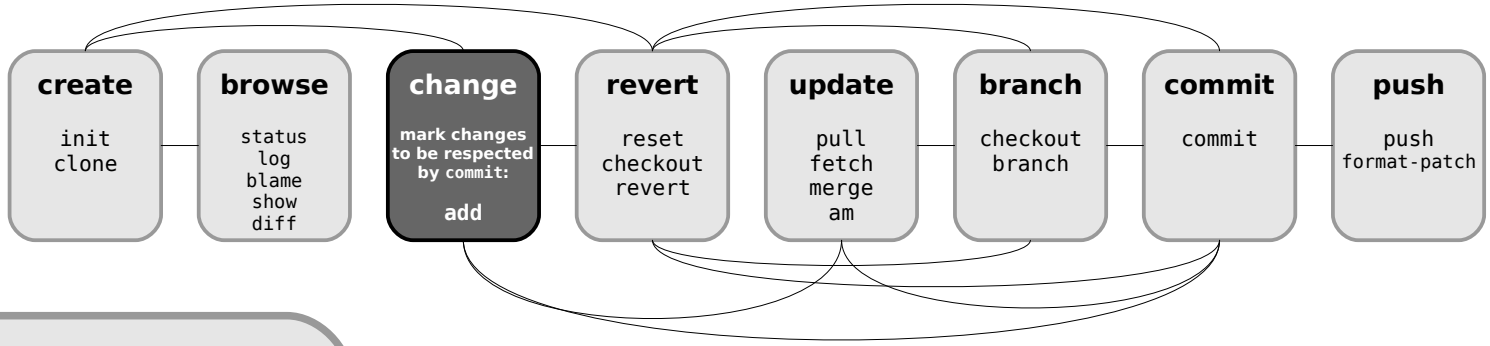
by Jan Krüger <jk@jk.gs>, http://jan-krueger.net/git/
Based on work by Zack Rusin

Basics

Use git help [*command*] if you're stuck.

`master`	default devel branch
`origin`	default upstream branch
`HEAD`	current branch
`HEAD^`	parent of HEAD
`HEAD~4`	great-great grandparent of HEAD
`foo..bar`	from branch *foo* to branch *bar*

(left to right) Command Flow



Create

From existing files

```
git init
git add .
```

From existing repository

```
git clone ~/old ~/new
git clone git://...
git clone ssh://...
```

View

```
git status
git diff [oldid newid]
git log [-p] [file|dir]
git blame file
git show id (meta data + diff)
git show id:file
git branch (shows list, * = current)
git tag -l (shows list)
```

Revert

In Git, revert usually describes a new commit that undoes previous commits.

```
git reset --hard (NO UNDO)
        (reset to last commit)
git revert branch
git commit -a --amend
        (replaces prev. commit)
git checkout id file
```

Publish

In Git, `commit` only respects changes that have been marked explicitly with add.

```
git commit [-a]
        (-a: add changed files automatically)
git format-patch origin
        (create set of diffs)
git push remote
        (push to origin or remote)
git tag foo
        (mark current version)
```

Update

```
git fetch (from def. upstream)
git fetch remote
git pull (= fetch & merge)
git am -3 patch.mbox
git apply patch.diff
```

Branch

```
git checkout branch
        (switch working dir to branch)
git merge branch
        (merge into current)
git branch branch
        (branch current)
git checkout -b new other
        (branch new from other and switch to it)
```

Useful Tools

```
git archive
        Create release tarball
git bisect
        Binary search for defects
git cherry-pick
        Take single commit from elsewhere
git fsck
        Check tree
git gc
        Compress metadata (performance)
git rebase
        Forward-port local changes to remote branch
git remote add URL
        Register a new remote repository for this tree
git stash
        Temporarily set aside changes
git tag
        (there's more to it)
gitk
        Tk GUI for Git
```

Conflicts

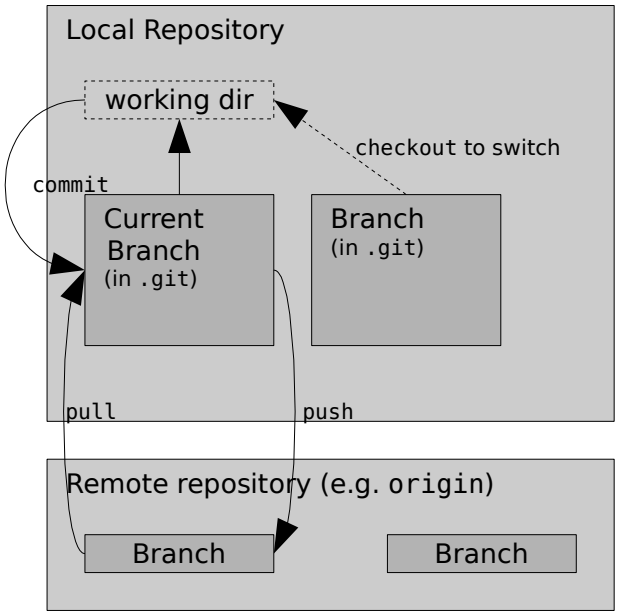
Use add to mark files as resolved.

```
git diff [--base]
git diff --ours
git diff --theirs
git log --merge
gitk --merge
```

Tracking Files

```
git add files
git mv old new
git rm files
git rm --cached files
        (stop tracking but keep files in working dir)
```

Structure Overview



R Reference Card

by Tom Short, EPRI PEAC, tshort@epri-peac.com 2004-11-07

Getting help

Most R functions have online documentation.

`help(topic)` documentation on `topic`
`?topic` id.
`help.search("topic")` search the help system
`apropos("topic")` the names of all objects in the search list matching the regular expression "topic"
`help.start()` start the HTML version of help
`str(a)` display the internal *str*ucture of an R object
`summary(a)` gives a "summary" of `a`, usually a statistical summary but it is *generic* meaning it has different operations for different classes of `a`
`ls()` show objects in the search path; specify `pat="pat"` to search on a pattern
`ls.str()` str() for each variable in the search path
`dir()` show files in the current directory
`methods(a)` shows S3 methods of `a`
`methods(class=class(a))` lists all the methods to handle objects of class a

Input and output

`load()` load the datasets written with `save`
`data(x)` loads specified data sets
`library(x)` load add-on packages
`read.table(file)` reads a file in table format and creates a data frame from it; the default separator `sep=""` is any whitespace; use `header=TRUE` to read the first line as a header of column names; use `as.is=TRUE` to prevent character vectors from being converted to factors; use `comment.char=""` to prevent `"#"` from being interpreted as a comment; use `skip=n` to skip `n` lines before reading data; see the help for options on row naming, NA treatment, and others
`read.csv("filename",header=TRUE)` id. but with defaults set for reading comma-delimited files
`read.delim("filename",header=TRUE)` id. but with defaults set for reading tab-delimited files
`read.fwf(file,widths,header=FALSE,sep="",as.is=FALSE)` read a table of *f*ixed *width f*ormatted data into a 'data.frame'; `widths` is an integer vector, giving the widths of the fixed-width fields
`save(file,...)` saves the specified objects (...) in the XDR platform-independent binary format
`save.image(file)` saves all objects
`cat(..., file="", sep=" ")` prints the arguments after coercing to character; `sep` is the character separator between arguments
`print(a, ...)` prints its arguments; generic, meaning it can have different methods for different objects
`format(x,...)` format an R object for pretty printing
`write.table(x,file="",row.names=TRUE,col.names=TRUE, sep=" ")` prints `x` after converting to a data frame; if `quote` is `TRUE`, character or factor columns are surrounded by quotes ("); `sep` is the field separator; `eol` is the end-of-line separator; `na` is the string for missing values; use `col.names=NA` to add a blank column header to get the column headers aligned correctly for spreadsheet input
`sink(file)` output to `file`, until `sink()`

Most of the I/O functions have a `file` argument. This can often be a character string naming a file or a connection. `file=""` means the standard input or output. Connections can include files, pipes, zipped files, and R variables.

On windows, the file connection can also be used with `description = "clipboard"`. To read a table copied from Excel, use

```
x <- read.delim("clipboard")
```

To write a table to the clipboard for Excel, use

```
write.table(x,"clipboard",sep="\t",col.names=NA)
```

For database interaction, see packages `RODBC`, `DBI`, `RMySQL`, `RPgSQL`, and `ROracle`. See packages `XML`, `hdf5`, `netCDF` for reading other file formats.

Data creation

`c(...)` generic function to combine arguments with the default forming a vector; with `recursive=TRUE` descends through lists combining all elements into one vector
`from:to` generates a sequence; ":" has operator priority; 1:4 + 1 is "2,3,4,5"
`seq(from,to)` generates a sequence `by=` specifies increment; `length=` specifies desired length
`seq(along=x)` generates `1, 2, ..., length(along)`; useful for `for` loops
`rep(x,times)` replicate `x times`; use `each=` to repeat "each" element of `x each` times; `rep(c(1,2,3),2)` is 1 2 3 1 2 3; `rep(c(1,2,3),each=2)` is 1 1 2 2 3 3
`data.frame(...)` create a data frame of the named or unnamed arguments; `data.frame(v=1:4,ch=c("a","B","c","d"),n=10)`; shorter vectors are recycled to the length of the longest
`list(...)` create a list of the named or unnamed arguments; `list(a=c(1,2),b="hi",c=3i)`;
`array(x,dim=)` array with data `x`; specify dimensions like `dim=c(3,4,2)`; elements of `x` recycle if `x` is not long enough
`matrix(x,nrow=,ncol=)` matrix; elements of `x` recycle
`factor(x,levels=)` encodes a vector `x` as a factor
`gl(n,k,length=n*k,labels=1:n)` generate levels (factors) by specifying the pattern of their levels; `k` is the number of levels, and `n` is the number of replications
`expand.grid()` a data frame from all combinations of the supplied vectors or factors
`rbind(...)` combine arguments by rows for matrices, data frames, and others
`cbind(...)` id. by columns

Slicing and extracting data

Indexing vectors

`x[n]`	n^{th} element
`x[-n]`	all *but* the n^{th} element
`x[1:n]`	first `n` elements
`x[-(1:n)]`	elements from `n+1` to the end
`x[c(1,4,2)]`	specific elements
`x["name"]`	element named `"name"`
`x[x > 3]`	all elements greater than 3
`x[x > 3 & x < 5]`	all elements between 3 and 5
`x[x %in% c("a","and","the")]`	elements in the given set

Indexing lists

`x[n]`	list with elements `n`
`x[[n]]`	n^{th} element of the list
`x[["name"]]`	element of the list named `"name"`
`x$name`	id.

Indexing matrices

`x[i,j]`	element at row `i`, column `j`
`x[i,]`	row `i`
`x[,j]`	column `j`
`x[,c(1,3)]`	columns 1 and 3
`x["name",]`	row named `"name"`

Indexing data frames (matrix indexing plus the following)

`x[["name"]]`	column named `"name"`
`x$name`	id.

Variable conversion

`as.array(x), as.data.frame(x), as.numeric(x), as.logical(x), as.complex(x), as.character(x), ...` convert type; for a complete list, use `methods(as)`

Variable information

`is.na(x), is.null(x), is.array(x), is.data.frame(x), is.numeric(x), is.complex(x), is.character(x), ...` test for type; for a complete list, use `methods(is)`
`length(x)` number of elements in `x`
`dim(x)` Retrieve or set the dimension of an object; `dim(x) <- c(3,2)`
`dimnames(x)` Retrieve or set the dimension names of an object
`nrow(x)` number of rows; `NROW(x)` is the same but treats a vector as a one-row matrix
`ncol(x)` and **`NCOL(x)`** id. for columns
`class(x)` get or set the class of `x`; `class(x) <- "myclass"`
`unclass(x)` remove the class attribute of `x`
`attr(x,which)` get or set the attribute `which` of `x`
`attributes(obj)` get or set the list of attributes of `obj`

Data selection and manipulation

`which.max(x)` returns the index of the greatest element of **`x`**
`which.min(x)` returns the index of the smallest element of **`x`**
`rev(x)` reverses the elements of `x`
`sort(x)` sorts the elements of `x` in increasing order; to sort in decreasing order: `rev(sort(x))`
`cut(x,breaks)` divides `x` into intervals (factors); `breaks` is the number of cut intervals or a vector of cut points
`match(x, y)` returns a vector of the same length than `x` with the elements of `x` which are in `y` (`NA` otherwise)
`which(x == a)` returns a vector of the indices of `x` if the comparison operation is true (`TRUE`), in this example the values of `i` for which `x[i] == a` (the argument of this function must be a variable of mode logical)
`choose(n, k)` computes the combinations of k events among n repetitions $= n!/[(n-k)!k!]$
`na.omit(x)` suppresses the observations with missing data (`NA`) (suppresses the corresponding line if `x` is a matrix or a data frame)
`na.fail(x)` returns an error message if `x` contains at least one `NA`

unique(x) if x is a vector or a data frame, returns a similar object but with the duplicate elements suppressed
table(x) returns a table with the numbers of the differents values of x (typically for integers or factors)
subset(x, ...) returns a selection of x with respect to criteria (..., typically comparisons: x$V1 < 10); if x is a data frame, the option select gives the variables to be kept or dropped using a minus sign
sample(x, size) resample randomly and without replacement size elements in the vector x, the option replace = TRUE allows to resample with replacement
prop.table(x,margin=) table entries as fraction of marginal table

Math

sin,cos,tan,asin,acos,atan,atan2,log,log10,exp
max(x) maximum of the elements of x
min(x) minimum of the elements of x
range(x) id. then c(min(x), max(x))
sum(x) sum of the elements of x
diff(x) lagged and iterated differences of vector x
prod(x) product of the elements of x
mean(x) mean of the elements of x
median(x) median of the elements of x
quantile(x,probs=) sample quantiles corresponding to the given probabilities (defaults to 0,.25,.5,.75,1)
weighted.mean(x, w) mean of x with weights w
rank(x) ranks of the elements of x
var(x) or cov(x) variance of the elements of x (calculated on $n-1$); if x is a matrix or a data frame, the variance-covariance matrix is calculated
sd(x) standard deviation of x
cor(x) correlation matrix of x if it is a matrix or a data frame (1 if x is a vector)
var(x, y) or cov(x, y) covariance between x and y, or between the columns of x and those of y if they are matrices or data frames
cor(x, y) linear correlation between x and y, or correlation matrix if they are matrices or data frames
round(x, n) rounds the elements of x to n decimals
log(x, base) computes the logarithm of x with base base
scale(x) if x is a matrix, centers and reduces the data; to center only use the option center=FALSE, to reduce only scale=FALSE (by default center=TRUE, scale=TRUE)
pmin(x,y,...) a vector which *i*th element is the minimum of x[i], y[i], ...
pmax(x,y,...) id. for the maximum
cumsum(x) a vector which *i*th element is the sum from x[1] to x[i]
cumprod(x) id. for the product
cummin(x) id. for the minimum
cummax(x) id. for the maximum
union(x,y), **intersect(x,y)**, **setdiff(x,y)**, **setequal(x,y)**, **is.element(el,set)** "set" functions
Re(x) real part of a complex number
Im(x) imaginary part
Mod(x) modulus; abs(x) is the same
Arg(x) angle in radians of the complex number
Conj(x) complex conjugate
convolve(x,y) compute the several kinds of convolutions of two sequences
fft(x) Fast Fourier Transform of an array
mvfft(x) FFT of each column of a matrix
filter(x,filter) applies linear filtering to a univariate time series or to each series separately of a multivariate time series

Many math functions have a logical parameter na.rm=FALSE to specify missing data (NA) removal.

Matrices

t(x) transpose
diag(x) diagonal
%*% matrix multiplication
solve(a,b) solves a %*% x = b for x
solve(a) matrix inverse of a
rowsum(x) sum of rows for a matrix-like object; **rowSums(x)** is a faster version
colsum(x), **colSums(x)** id. for columns
rowMeans(x) fast version of row means
colMeans(x) id. for columns

Advanced data processing

apply(X,INDEX,FUN=) a vector or array or list of values obtained by applying a function FUN to margins (INDEX) of X
lapply(X,FUN) apply FUN to each element of the list X
tapply(X,INDEX,FUN=) apply FUN to each cell of a ragged array given by X with indexes INDEX
by(data,INDEX,FUN) apply FUN to data frame data subsetted by INDEX
merge(a,b) merge two data frames by common columns or row names
xtabs(a b,data=x) a contingency table from cross-classifying factors
aggregate(x,by,FUN) splits the data frame x into subsets, computes summary statistics for each, and returns the result in a convenient form; by is a list of grouping elements, each as long as the variables in x
stack(x, ...) transform data available as separate columns in a data frame or list into a single column
unstack(x, ...) inverse of stack()
reshape(x, ...) reshapes a data frame between 'wide' format with repeated measurements in separate columns of the same record and 'long' format with the repeated measurements in separate records; use (direction="wide") or (direction="long")

Strings

paste(...) concatenate vectors after converting to character; sep= is the string to separate terms (a single space is the default); collapse= is an optional string to separate "collapsed" results
substr(x,start,stop) substrings in a character vector; can also assign, as substr(x, start, stop) <- value
strsplit(x,split) split x according to the substring split
grep(pattern,x) searches for matches to pattern within x; see ?regex
gsub(pattern,replacement,x) replacement of matches determined by regular expression matching sub() is the same but only replaces the first occurrence.
tolower(x) convert to lowercase
toupper(x) convert to uppercase
match(x,table) a vector of the positions of first matches for the elements of x among table
x %in% table id. but returns a logical vector
pmatch(x,table) partial matches for the elements of x among table
nchar(x) number of characters

Dates and Times

The class Date has dates without times. POSIXct has dates and times, including time zones. Comparisons (e.g. >), seq(), and difftime() are useful. Date also allows + and −. ?DateTimeClasses gives more information. See also package chron.

as.Date(s) and **as.POSIXct(s)** convert to the respective class; format(dt) converts to a string representation. The default string format is "2001-02-21". These accept a second argument to specify a format for conversion. Some common formats are:

%a, %A Abbreviated and full weekday name.
%b, %B Abbreviated and full month name.
%d Day of the month (01–31).
%H Hours (00–23).
%I Hours (01–12).
%j Day of year (001–366).
%m Month (01–12).
%M Minute (00–59).
%p AM/PM indicator.
%S Second as decimal number (00–61).
%U Week (00–53); the first Sunday as day 1 of week 1.
%w Weekday (0–6, Sunday is 0).
%W Week (00–53); the first Monday as day 1 of week 1.
%y Year without century (00–99). Don't use.
%Y Year with century.
%z (output only.) Offset from Greenwich; -0800 is 8 hours west of.
%Z (output only.) Time zone as a character string (empty if not available).

Where leading zeros are shown they will be used on output but are optional on input. See ?strftime.

Plotting

plot(x) plot of the values of x (on the *y*-axis) ordered on the *x*-axis
plot(x, y) bivariate plot of x (on the *x*-axis) and y (on the *y*-axis)
hist(x) histogram of the frequencies of x
barplot(x) histogram of the values of x; use horiz=FALSE for horizontal bars
dotchart(x) if x is a data frame, plots a Cleveland dot plot (stacked plots line-by-line and column-by-column)
pie(x) circular pie-chart
boxplot(x) "box-and-whiskers" plot
sunflowerplot(x, y) id. than plot() but the points with similar coordinates are drawn as flowers which petal number represents the number of points
stripplot(x) plot of the values of x on a line (an alternative to boxplot() for small sample sizes)
coplot(x~y | z) bivariate plot of x and y for each value or interval of values of z
interaction.plot (f1, f2, y) if f1 and f2 are factors, plots the means of y (on the *y*-axis) with respect to the values of f1 (on the *x*-axis) and of f2 (different curves); the option fun allows to choose the summary statistic of y (by default fun=mean)

matplot(x,y) bivariate plot of the first column of x *vs.* the first one of y, the second one of x *vs.* the second one of y, etc.
fourfoldplot(x) visualizes, with quarters of circles, the association between two dichotomous variables for different populations (x must be an array with dim=c(2, 2, k), or a matrix with dim=c(2, 2) if $k = 1$)
assocplot(x) Cohen–Friendly graph showing the deviations from independence of rows and columns in a two dimensional contingency table
mosaicplot(x) 'mosaic' graph of the residuals from a log-linear regression of a contingency table
pairs(x) if x is a matrix or a data frame, draws all possible bivariate plots between the columns of x
plot.ts(x) if x is an object of class "ts", plot of x with respect to time, x may be multivariate but the series must have the same frequency and dates
ts.plot(x) id. but if x is multivariate the series may have different dates and must have the same frequency
qqnorm(x) quantiles of x with respect to the values expected under a normal law
qqplot(x, y) quantiles of y with respect to the quantiles of x
contour(x, y, z) contour plot (data are interpolated to draw the curves), x and y must be vectors and z must be a matrix so that dim(z)=c(length(x), length(y)) (x and y may be omitted)
filled.contour(x, y, z) id. but the areas between the contours are coloured, and a legend of the colours is drawn as well
image(x, y, z) id. but with colours (actual data are plotted)
persp(x, y, z) id. but in perspective (actual data are plotted)
stars(x) if x is a matrix or a data frame, draws a graph with segments or a star where each row of x is represented by a star and the columns are the lengths of the segments
symbols(x, y, ...) draws, at the coordinates given by x and y, symbols (circles, squares, rectangles, stars, thermometres or "boxplots") which sizes, colours ... are specified by supplementary arguments
termplot(mod.obj) plot of the (partial) effects of a regression model (mod.obj)

The following parameters are common to many plotting functions:

add=FALSE if TRUE superposes the plot on the previous one (if it exists)
axes=TRUE if FALSE does not draw the axes and the box
type="p" specifies the type of plot, "p": points, "l": lines, "b": points connected by lines, "o": id. but the lines are over the points, "h": vertical lines, "s": steps, the data are represented by the top of the vertical lines, "S": id. but the data are represented by the bottom of the vertical lines
xlim=, ylim= specifies the lower and upper limits of the axes, for example with xlim=c(1, 10) or xlim=range(x)
xlab=, ylab= annotates the axes, must be variables of mode character
main= main title, must be a variable of mode character
sub= sub-title (written in a smaller font)

Low-level plotting commands

points(x, y) adds points (the option type= can be used)
lines(x, y) id. but with lines
text(x, y, labels, ...) adds text given by labels at coordinates (x,y); a typical use is: plot(x, y, type="n"); text(x, y, names)
mtext(text, side=3, line=0, ...) adds text given by text in the margin specified by side (see axis() below); line specifies the line from the plotting area
segments(x0, y0, x1, y1) draws lines from points (x0,y0) to points (x1,y1)
arrows(x0, y0, x1, y1, angle= 30, code=2) id. with arrows at points (x0,y0) if code=2, at points (x1,y1) if code=1, or both if code=3; angle controls the angle from the shaft of the arrow to the edge of the arrow head
abline(a,b) draws a line of slope b and intercept a
abline(h=y) draws a horizontal line at ordinate y
abline(v=x) draws a vertical line at abcissa x
abline(lm.obj) draws the regression line given by lm.obj
rect(x1, y1, x2, y2) draws a rectangle which left, right, bottom, and top limits are x1, x2, y1, and y2, respectively
polygon(x, y) draws a polygon linking the points with coordinates given by x and y
legend(x, y, legend) adds the legend at the point (x,y) with the symbols given by legend
title() adds a title and optionally a sub-title
axis(side, vect) adds an axis at the bottom (side=1), on the left (2), at the top (3), or on the right (4); vect (optional) gives the abcissa (or ordinates) where tick-marks are drawn
rug(x) draws the data x on the *x*-axis as small vertical lines
locator(n, type="n", ...) returns the coordinates (*x*,*y*) after the user has clicked n times on the plot with the mouse; also draws symbols (type="p") or lines (type="l") with respect to optional graphic parameters (...); by default nothing is drawn (type="n")

Graphical parameters

These can be set globally with **par(...)**; many can be passed as parameters to plotting commands.

adj controls text justification (0 left-justified, 0.5 centred, 1 right-justified)
bg specifies the colour of the background (ex. : bg="red", bg="blue", ... the list of the 657 available colours is displayed with colors())
bty controls the type of box drawn around the plot, allowed values are: "o", "l", "7", "c", "u" ou "]" (the box looks like the corresponding character); if bty="n" the box is not drawn
cex a value controlling the size of texts and symbols with respect to the default; the following parameters have the same control for numbers on the axes, cex.axis, the axis labels, cex.lab, the title, cex.main, and the sub-title, cex.sub
col controls the color of symbols and lines; use color names: "red", "blue" see colors() or as "#RRGGBB"; see rgb(), hsv(), gray(), and rainbow(); as for cex there are: col.axis, col.lab, col.main, col.sub
font an integer which controls the style of text (1: normal, 2: italics, 3: bold, 4: bold italics); as for cex there are: font.axis, font.lab, font.main, font.sub
las an integer which controls the orientation of the axis labels (0: parallel to the axes, 1: horizontal, 2: perpendicular to the axes, 3: vertical)
lty controls the type of lines, can be an integer or string (1: "solid", 2: "dashed", 3: "dotted", 4: "dotdash", 5: "longdash", 6: "twodash", or a string of up to eight characters (between "0" and "9") which specifies alternatively the length, in points or pixels, of the drawn elements and the blanks, for example lty="44" will have the same effect than lty=2
lwd a numeric which controls the width of lines, default 1
mar a vector of 4 numeric values which control the space between the axes and the border of the graph of the form c(bottom, left, top, right), the default values are c(5.1, 4.1, 4.1, 2.1)
mfcol a vector of the form c(nr,nc) which partitions the graphic window as a matrix of nr lines and nc columns, the plots are then drawn in columns
mfrow id. but the plots are drawn by row
pch controls the type of symbol, either an integer between 1 and 25, or any single character within ""

1 ○ 2 △ 3 + 4 × 5 ◇ 6 ▽ 7 ⊠ 8 ✳ 9 ◈ 10 ⊕ 11 ⊠ 12 ⊞ 13 ⊠ 14 ◪ 15 ■
16 ● 17 ▲ 18 ◆ 19 ● 20 • 21 ○ 22 □ 23 ◇ 24 △ 25 ▽ * ⋆ . · X X a a ? ?

ps an integer which controls the size in points of texts and symbols
pty a character which specifies the type of the plotting region, "s": square, "m": maximal
tck a value which specifies the length of tick-marks on the axes as a fraction of the smallest of the width or height of the plot; if tck=1 a grid is drawn
tcl a value which specifies the length of tick-marks on the axes as a fraction of the height of a line of text (by default tcl=-0.5)
xaxt if xaxt="n" the *x*-axis is set but not drawn (useful in conjonction with axis(side=1, ...))
yaxt if yaxt="n" the *y*-axis is set but not drawn (useful in conjonction with axis(side=2, ...))

Lattice (Trellis) graphics

xyplot(y~x) bivariate plots (with many functionalities)
barchart(y~x) histogram of the values of y with respect to those of x
dotplot(y~x) Cleveland dot plot (stacked plots line-by-line and column-by-column)
densityplot(~x) density functions plot
histogram(~x) histogram of the frequencies of x
bwplot(y~x) "box-and-whiskers" plot
qqmath(~x) quantiles of x with respect to the values expected under a theoretical distribution
stripplot(y~x) single dimension plot, x must be numeric, y may be a factor
qq(y~x) quantiles to compare two distributions, x must be numeric, y may be numeric, character, or factor but must have two 'levels'
splom(~x) matrix of bivariate plots
parallel(~x) parallel coordinates plot
levelplot(z~x*y|g1*g2) coloured plot of the values of z at the coordinates given by x and y (x, y and z are all of the same length)
wireframe(z~x*y|g1*g2) 3d surface plot
cloud(z~x*y|g1*g2) 3d scatter plot

In the normal Lattice formula, `y x|g1*g2` has combinations of optional conditioning variables `g1` and `g2` plotted on separate panels. Lattice functions take many of the same arguments as base graphics plus also `data=` the data frame for the formula variables and `subset=` for subsetting. Use `panel=` to define a custom panel function (see `apropos("panel")` and `?llines`). Lattice functions return an object of class trellis and have to be `print`-ed to produce the graph. Use `print(xyplot(...))` inside functions where automatic printing doesn't work. Use `lattice.theme` and `lset` to change Lattice defaults.

Optimization and model fitting

`optim(par, fn, method = c("Nelder-Mead", "BFGS", "CG", "L-BFGS-B", "SANN")` general-purpose optimization; `par` is initial values, `fn` is function to optimize (normally minimize)

`nlm(f,p)` minimize function `f` using a Newton-type algorithm with starting values `p`

`lm(formula)` fit linear models; `formula` is typically of the form `response termA + termB + ...`; use `I(x*y) + I(x^2)` for terms made of nonlinear components

`glm(formula,family=)` fit generalized linear models, specified by giving a symbolic description of the linear predictor and a description of the error distribution; `family` is a description of the error distribution and link function to be used in the model; see `?family`

`nls(formula)` nonlinear least-squares estimates of the nonlinear model parameters

`approx(x,y=)` linearly interpolate given data points; `x` can be an xy plotting structure

`spline(x,y=)` cubic spline interpolation

`loess(formula)` fit a polynomial surface using local fitting

Many of the formula-based modeling functions have several common arguments: `data=` the data frame for the formula variables, `subset=` a subset of variables used in the fit, `na.action=` action for missing values: `"na.fail"`, `"na.omit"`, or a function. The following generics often apply to model fitting functions:

`predict(fit,...)` predictions from `fit` based on input data

`df.residual(fit)` returns the number of residual degrees of freedom

`coef(fit)` returns the estimated coefficients (sometimes with their standard-errors)

`residuals(fit)` returns the residuals

`deviance(fit)` returns the deviance

`fitted(fit)` returns the fitted values

`logLik(fit)` computes the logarithm of the likelihood and the number of parameters

`AIC(fit)` computes the Akaike information criterion or AIC

Statistics

`aov(formula)` analysis of variance model

`anova(fit,...)` analysis of variance (or deviance) tables for one or more fitted model objects

`density(x)` kernel density estimates of `x`

`binom.test()`, **`pairwise.t.test()`**, **`power.t.test()`**, **`prop.test()`**, **`t.test()`**, ... use `help.search("test")`

Distributions

`rnorm(n, mean=0, sd=1)` Gaussian (normal)

`rexp(n, rate=1)` exponential

`rgamma(n, shape, scale=1)` gamma

`rpois(n, lambda)` Poisson

`rweibull(n, shape, scale=1)` Weibull

`rcauchy(n, location=0, scale=1)` Cauchy

`rbeta(n, shape1, shape2)` beta

`rt(n, df)` 'Student' (*t*)

`rf(n, df1, df2)` Fisher–Snedecor (*F*) (χ^2)

`rchisq(n, df)` Pearson

`rbinom(n, size, prob)` binomial

`rgeom(n, prob)` geometric

`rhyper(nn, m, n, k)` hypergeometric

`rlogis(n, location=0, scale=1)` logistic

`rlnorm(n, meanlog=0, sdlog=1)` lognormal

`rnbinom(n, size, prob)` negative binomial

`runif(n, min=0, max=1)` uniform

`rwilcox(nn, m, n)`, `rsignrank(nn, n)` Wilcoxon's statistics

All these functions can be used by replacing the letter `r` with `d`, `p` or `q` to get, respectively, the probability density (`d`***`func`***`(x, ...)`), the cumulative probability density (`p`***`func`***`(x, ...)`), and the value of quantile (`q`***`func`***`(p, ...)`, with $0 < p < 1$).

Programming

`function( arglist ) expr` function definition

`return(value)`

`if(cond) expr`

`if(cond) cons.expr else alt.expr`

`for(var in seq) expr`

`while(cond) expr`

`repeat expr`

`break`

`next`

Use braces {} around statements

`ifelse(test, yes, no)` a value with the same shape as `test` filled with elements from either `yes` or `no`

`do.call(funname, args)` executes a function call from the name of the function and a list of arguments to be passed to it

R Markdown Cheat Sheet

learn more at rmarkdown.rstudio.com

rmarkdown 0.2.50 Updated: 8/14

RStudio®

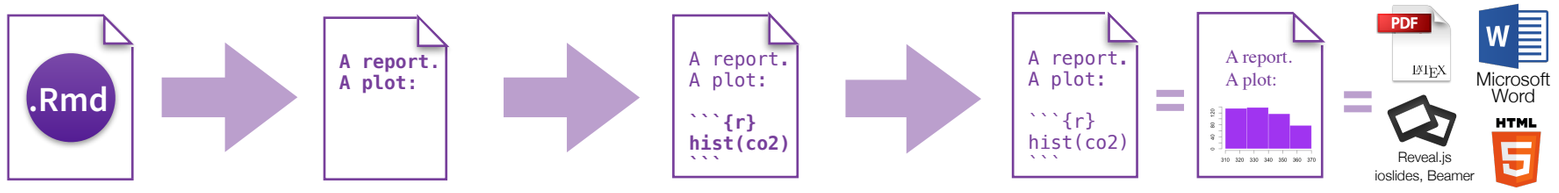
1. Workflow R Markdown is a format for writing reproducible, dynamic reports with R. Use it to embed R code and results into slideshows, pdfs, html documents, Word files and more. To make a report:

i. Open - Open a file that uses the .Rmd extension.

ii. Write - Write content with the easy to use R Markdown syntax

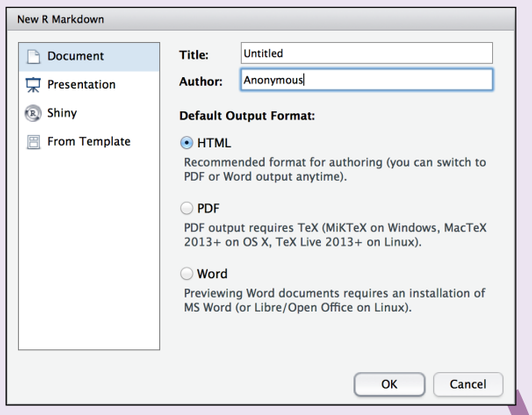
iii. Embed - Embed R code that creates output to include in the report

iv. Render - Replace R code with its output and transform the report into a slideshow, pdf, html or ms Word file.



2. Open File Start by saving a text file with the extension .Rmd, or open an RStudio Rmd template

- In the menu bar, click **File ▶ New File ▶ R Markdown…**
- A window will open. Select the class of output you would like to make with your .Rmd file
- Select the specific type of output to make with the radio buttons (you can change this later)
- Click OK



4. Choose Output Write a YAML header that explains what type of document to build from your R Markdown file.

YAML

A YAML header is a set of key: value pairs at the start of your file. Begin and end the header with a line of three dashes (- - -)

```
---
title: "Untitled"
author: "Anonymous"
output: html_document
---

This is the start of my
report. The above is metadata
saved in a YAML header.
```

The RStudio template writes the YAML header for you

The output value determines which type of file R will build from your .Rmd file (in Step 6)

- **output: html_document** ..... html file (web page)
- **output: pdf_document** ..... pdf document
- **output: word_document** ..... Microsoft Word .docx
- **output: beamer_presentation** ..... beamer slideshow (pdf)
- **output: ioslides_presentation** ..... ioslides slideshow (html)

3. Markdown Next, write your report in plain text. Use markdown syntax to describe how to format text in the final report.

syntax

```
Plain text
End a line with two spaces to start a new paragraph.
*italics* and _italics_
**bold** and __bold__
superscript^2^
~~strikethrough~~
[link](www.rstudio.com)

# Header 1

## Header 2

### Header 3

#### Header 4

##### Header 5

###### Header 6

endash: --
emdash: ---
ellipsis: ...
inline equation: $A = \pi*r^{2}$
image: ![](path/to/smallorb.png)

horizontal rule (or slide break):

***

> block quote

* unordered list
* item 2
    + sub-item 1
    + sub-item 2

1. ordered list
2. item 2
    + sub-item 1
    + sub-item 2

Table Header  | Second Header
------------- | -------------
Table Cell    | Cell 2
Cell 3        | Cell 4
```

becomes

Plain text
End a line with two spaces to start a new paragraph.
italics and *italics*
bold and **bold**
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    - sub-item 1
    - sub-item 2

Table Header	Second Header
Table Cell	Cell 2
Cell 3	Cell 4

5. Embed Code Use knitr syntax to embed R code into your report. R will run the code and include the results when you render your report.

inline code

Surround code with back ticks and r.
R replaces inline code with its results.

```
Two plus two
equals `r 2 + 2`.
```

▶ Two plus two equals 4.

code chunks

Start a chunk with ```{r}.
End a chunk with ```

```
Here's some code
```{r}
dim(iris)
```
```

▶ Here's some code

```
dim(iris)
```

```
## [1] 150   5
```

display options

Use knitr options to style the output of a chunk.
Place options in brackets above the chunk.

```
Here's some code
```{r eval=FALSE}
dim(iris)
```
```

▶ Here's some code

```
dim(iris)
```

```
Here's some code
```{r echo=FALSE}
dim(iris)
```
```

▶ Here's some code

```
## [1] 150   5
```

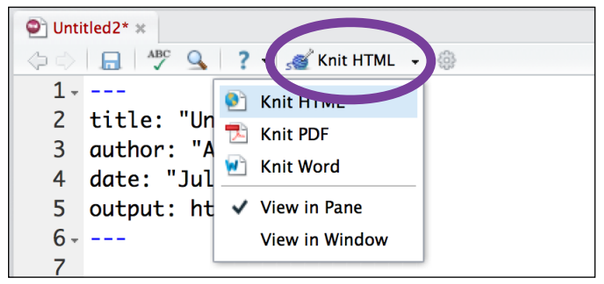
option	default	effect
eval	TRUE	Whether to evaluate the code and include its results
echo	TRUE	Whether to display code along with its results
warning	TRUE	Whether to display warnings
error	FALSE	Whether to display errors
message	TRUE	Whether to display messages
tidy	FALSE	Whether to reformat code in a tidy way when displaying it
results	"markup"	"markup", "asis", "hold", or "hide"
cache	FALSE	Whether to cache results for future renders
comment	"##"	Comment character to preface results with
fig.width	7	Width in inches for plots created in chunk
fig.height	7	Height in inches for plots created in chunk

For more details visit yihui.name/knitr/

6. Render Use your .Rmd file as a blueprint to build a finished report.

Render your report in one of two ways

1. Run **rmarkdown::render("<file path>")**
2. Click the **knit HTML** button at the top of the RStudio scripts pane



When you render, R will

- execute each embedded code chunk and insert the results into your report
- build a new version of your report in the output file type
- open a preview of the output file in the viewer pane
- save the output file in your working directory

7. Interactive Docs Turn your report into an interactive Shiny document in 3 steps

1 Add **runtime: shiny** to the YAML header

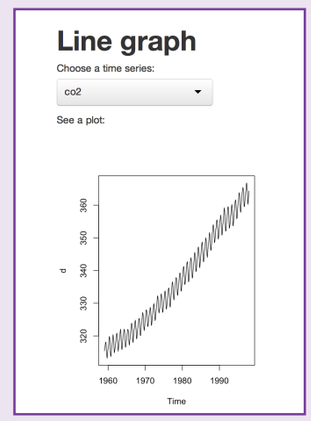
```
---
title: "Line graph"
output: html_document
runtime: shiny
---
```

2 In the code chunks, add Shiny **input** functions to embed widgets. Add Shiny **render** functions to embed reactive output

```
---
title: "Line graph"
output: html_document
runtime: shiny
---

Choose a time series:
```{r echo = FALSE}
selectInput("data", "",
  c("co2", "lh"))
```
See a plot:
```{r echo = FALSE}
renderPlot({
  d <- get(input$data)
  plot(d)
})
```
```

3 Render with **rmarkdown::run** or click **Run Document** in RStudio



** Note: your report will be a Shiny app, which means you must choose an html output format, like **html_document** (for an interactive report) or **ioslides_presentation** (for an interactive slideshow).*

8. Publish Share your report where users can visit it online

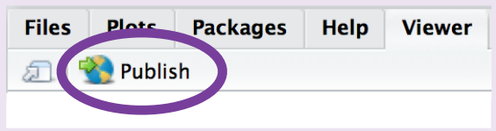
Rpubs.com

Share non-interactive documents on RStudio's free R Markdown publishing site
www.rpubs.com

ShinyApps.io

Host an interactive document on RStudio's server. Free and paid options
www.shinyapps.io

Click the "Publish" button in the RStudio preview window to publish to rpubs.com with one click.



9. Learn More

Documentation and examples - rmarkdown.rstudio.com
Further Articles - shiny.rstudio.com/articles
- blog.rstudio.com
- @rstudio

RStudio

R Markdown Reference Guide

Learn more about R Markdown at rmarkdown.rstudio.com

Learn more about Interactive Docs at shiny.rstudio.com/articles

Contents:

Syntax

```
Plain text

End a line with two spaces
to start a new paragraph.

*italics* and _italics_

**bold** and __bold__

superscript^2^

~~strikethrough~~

[link](www.rstudio.com)

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endash: --

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inline equation: $A = \pi*r^{2}$

image: ![](path/to/smallorb.png)

horizontal rule (or slide break):

***

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* item 2
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1. ordered list
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Table Header  | Second Header
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Table Cell    | Cell 2
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```

Becomes

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italics and *italics*

bold and **bold**

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Table Cell	Cell 2
Cell 3	Cell 4

R Markdown Reference Guide

Learn more about R Markdown at rmarkdown.rstudio.com
Learn more about Interactive Docs at shiny.rstudio.com/articles

Contents:

Syntax	Becomes

Make a code chunk with three back ticks followed by an r in braces. End the chunk with three back ticks:

````
```{r}
paste("Hello", "World!")
```
````

Make a code chunk with three back ticks followed by an r in braces. End the chunk with three back ticks:

```
paste("Hello", "World!")
```

```
## [1] "Hello World!"
```

Place code inline with a single back ticks. The first back tick must be followed by an R, like this `r paste("Hello", "World!")`.

Place code inline with a single back ticks. The first back tick must be followed by an R, like this Hello World!.

Add chunk options within braces. For example, `echo=FALSE` will prevent source code from being displayed:

````
```{r eval=TRUE, echo=FALSE}
paste("Hello", "World!")
```
````

Add chunk options within braces. For example, `echo=FALSE` will prevent source code from being displayed:

```
## [1] "Hello World!"
```

Learn more about chunk options at http://yihui.name/knitr/options

Chunk options

option	default value	description
Code evaluation		
child	NULL	A character vector of filenames. Knitr will knit the files and place them into the main document.
code	NULL	Set to R code. Knitr will replace the code in the chunk with the code in the code option.
engine	'R'	Knitr will evaluate the chunk in the named language, e.g. **engine = 'python'.** Run **names(knitr::knit_engines$get())** to see supported languages.
eval	TRUE	If **FALSE**, knitr will not run the code in the code chunk.
include	TRUE	If **FALSE**, knitr will run the chunk but not include the chunk in the final document.
purl	TRUE	If **FALSE**, knitr will not include the chunk when running **purl()** to extract the source code.
Results		
collapse	FALSE	If **TRUE**, knitr will collapse all the source and output blocks created by the chunk into a single block.
echo	TRUE	If **FALSE**, knitr will not display the code in the code chunk above it's results in the final document.
results	'markup'	If **'hide'**, knitr will not display the code's results in the final document. If **'hold'**, knitr will delay displaying all output pieces until the end of the chunk. If **'asis'**, knitr will pass through results without reformatting them (useful if results return raw HTML, etc.)
error	TRUE	If **FALSE**, knitr will not display any error messages generated by the code.
message	TRUE	If **FALSE**, knitr will not display any messages generated by the code.
warning	TRUE	If **FALSE**, knitr will not display any warning messages generated by the code.
Code Decoration		
comment	'##'	A character string. Knitr will append the string to the start of each line of results in the final document.
highlight	TRUE	If **TRUE**, knitr will highlight the source code in the final output.
prompt	FALSE	If **TRUE**, knitr will add > to the start of each line of code displayed in the final document.
strip.white	TRUE	If **TRUE**, knitr will remove white spaces that appear at the beginning or end of a code chunk.
tidy	FALSE	If **TRUE**, knitr will tidy code chunks for display with the **tidy_source()** function in the **formatR** package.

R Markdown Reference Guide

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Learn more about Interactive Docs at shiny.rstudio.com/articles

Contents:

Chunk options (Continued)

option	default value	description
Chunks		
opts.label	NULL	The label of options set in **knitr:: opts_template()** to use with the chunk.
R.options	NULL	Local R options to use with the chunk. Options are set with **options()** at start of chunk. Defaults are restored at end.
ref.label	NULL	A character vector of labels of the chunks from which the code of the current chunk is inherited.
Cache		
autodep	FALSE	If **TRUE**, knitr will attempt to figure out dependencies between chunks automatically by analyzing object names.
cache	FALSE	If **TRUE**, knitr will cache the results to reuse in future knits. Knitr will reuse the results until the code chunk is altered.
cache.comments	NULL	If **FALSE**, knitr will not rerun the chunk if only a code comment has changed.
cache.lazy	TRUE	If **TRUE**, knitr will use **lazyload()** to load objects in chunk. If **FALSE**, knitr will use **load()** to load objects in chunk.
cache.path	'cache/'	A file path to the directory to store cached results in. Path should begin in the directory that the .Rmd file is saved in.
cache.vars	NULL	A character vector of object names to cache if you do not wish to cache each object in the chunk.
dependson	NULL	A character vector of chunk labels to specify which other chunks a chunk depends on. Knitr will update a cached chunk if its dependencies change.
Animation		
anipots	'controls,loop'	Extra options for animations (see the **animate** package).
interval	1	The number of seconds to pause between animation frames.
Plots		
dev	'png'	The R function name that will be used as a graphical device to record plots, e.g. **dev='CairoPDF'**.
dev.args	NULL	Arguments to be passed to the device, e.g. **dev.args=list(bg='yellow', pointsize=10)**.
dpi	72	A number for knitr to use as the dots per inch (dpi) in graphics (when applicable).
external	TRUE	If **TRUE**, knitr will externalize tikz graphics to save LaTex compilation time (only for the **tikzDevice::tikz()** device).
fig.align	'default'	How to align graphics in the final document. One of 'left', 'right', or 'center'.
fig.cap	NULL	A character string to be used as a figure caption in LaTex.
fig.env	'figure'	The Latex environment for figures.
fig.ext	NULL	The file extension for figure output, e.g. **fig.ext='png'**.
fig.height, fig.width	7	The width and height to use in R for plots created by the chunk (in inches).
fig.keep	'high'	If **'high'**, knitr will merge low-level changes into high level plots. If **'all'**, knitr will keep all plots (low-level changes may produce new plots). If **'first'**, knitr will keep the first plot only. If **'last'**, knitr will keep the last plot only. If **'none'**, knitr will discard all plots.
fig.lp	'fig:'	A prefix to be used for figure labels in latex.
fig.path	'figure/'	A file path to the directory where knitr should store the graphics files created by the chunk.
fig.pos	''	A character string to be used as the figure position arrangement in LaTex.
fig.process	NULL	A function to post-process a figure file. Should take a filename and return a filename of a new figure source.
fig.retina	1	Dpi multiplier for displaying HTML output on retina screens.
fig.scap	NULL	A character string to be used as a short figure caption.
fig.subcap	NULL	A character string to be used as captions in sub-figures in LaTex.
fig.show	'asis'	If **'hide'**, knitr will generate the plots created in the chunk, but not include them in the final document. If **'hold'**, knitr will delay displaying the plots created by the chunk until the end of the chunk. If **'animate'**, knitr will combine all of the plots created by the chunk into an animation.
fig.showtext	NULL	If **TRUE**, knitr will call **showtext::showtext.begin()** before drawing plots.
out.extra	NULL	A character string of extra options for figures to be passed to LaTex or HTML.
out.height, out.width	NULL	The width and height to scale plots to in the final output. Can be in units recognized by output, e.g. **8\\linewidth, 50px**
resize.height, resize.width	NULL	The width and height to resize tike graphics in LaTex, passed to **\resizebox{}{}.**
sanitize	FALSE	If **TRUE**, knitr will sanitize tike graphics for LaTex.

R Markdown Reference Guide

Learn more about R Markdown at rmarkdown.rstudio.com
Learn more about Interactive Docs at shiny.rstudio.com/articles

Contents:

Templates

html_document
pdf_document
word_document
md_document
ioslides_presentation
slidy_presentation
beamer_presentation

Basic YAML

```
---
title: "A Web Doc"
author: "John Doe"
date: "May 1, 2015"
output: md_document
---
```

Template options

```
---
title: "Chapters"
output:
  html_document:
    toc: true
    toc_depth: 2
---
```

Latex options

```
---
title: "My PDF"
output: pdf_document
fontsize: 11pt
geometry: margin=1in
---
```

Interactive Docs

```
---
title: "Slides"
output:
  slidy_presentation:
    incremental: true
runtime: shiny
---
```

Syntax for slide formats (ioslides, slidy, beamer)

```
# Dividing slides 1

Pandoc will start a new slide at each first level header

## Header 2

… as well as each second level header

***

You can start a new slide with a horizontal rule`***` if you do not want
a header.

## Bullets

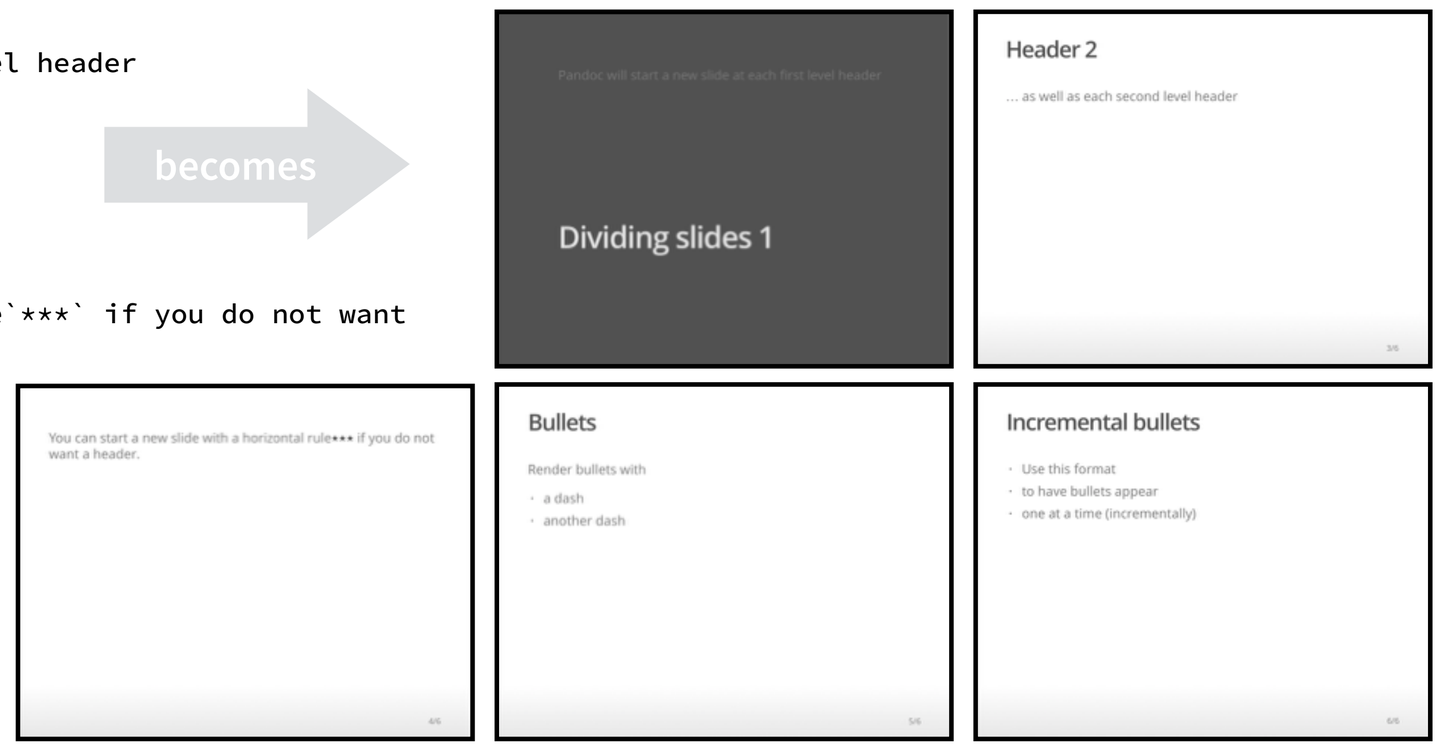
Render bullets with

- a dash
- another dash

## Incremental bullets

>- Use this format
>- to have bullets appear
>- one at a time (incrementally)
```

becomes



Slide display modes

*Press a key below during presentation to enter display mode. Press **esc** to exit display mode.*

ioslides

f - enable fullscreen mode
w - toggle widescreen mode
o - enable overview mode
h - enable code highlight mode
p - show presenter notes

slidy

C - show table of contents
F - toggle display of the footer
A - toggle display of current vs all slides
S - make fonts smaller
B - make fonts bigger

Top level options to customize LaTex (pdf) output

option	description
lang	Document language code
fontsize	Font size (e.g. 10pt, 11pt, 12 pt)
documentclass	Latex document class (e.g. article)
classoption	Option for document class (e.g. oneside); may be repeated
geometry	Options for geometry class (e.g. margin=1in); may be repeated
mainfont, sansfont, monofont, mathfont	Document fonts (works only with xelatex and lualatex, see the latex_engine option)
linkcolor, urlcolor, citecolor	Color for internal, external, and citation links (red, green, magenta, cyan, blue, black)

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Contents:

option	html	pdf	word	md	ioslides	slidy	beamer	description
colortheme							X	Beamer color theme to use (e.g., `colortheme: "dolphin"`).
css	X				X	X		Filepath to CSS style to use to style document (e.g., `css: styles.css`).
duration						X		Add a countdown timer (in minutes) to footer of slides (e.g., `duration: 45`).
fig_caption	X	X	X		X	X	X	Should figures be rendered with captions?
fig_crop		X					X	Should pdfcrop utility be automatically applied to figures (when available)?
fig_height	X	X	X	X	X	X	X	Default figure height (in inches) for document.
fig_retina	X			X	X	X		Scaling to perform for retina displays (e.g., `fig_retina: 2`).
fig_width	X	X	X	X	X	X	X	Default figure width (in inches) for document.
font_adjustmen						X		Increase or decrease font size for entire presentation (e.g., `font_adjustment: -1`).
fonttheme							X	Beamer font theme to use (e.g., `fonttheme: "structurebold"`).
footer						X		Text to add to footer of each slide (e.g., `footer: "Copyright (c) 2014 RStudio"`).
highlight	X	X				X	X	Syntax highlighting style (e.g. `"tango"`, `"pygments"`, `"kate"`, `"zenburn"`, and
includes	X	X		X	X	X	X	See below
-in_header	X	X			X	X	X	File of content to place in document header (e.g., `in_header: header.html`).
-before_body	X	X			X	X	X	File of content to place before document body (e.g., `before_body:`
-after_body	X	X			X	X	X	File of content to place after document body (e.g., `after_body: doc_suffix.html`).
incremental					X	X	X	Should bullets appear one at a time (on presenter mouse clicks)?
keep_md	X				X	X		Save a copy of .md file that contains knitr output (in addition to the .Rmd and HTML files)?
keep_tex		X					X	Save a copy of .tex file that contains knitr output (in addition to the .Rmd and PDF files)?
latex_engine		X						Engine to render latex. Should be one of `"pdflatex"`, `"xelatex"`, and `"lualatex"`.
lib_dir	X				X	X		Directory of dependency files to use (Bootstrap, MathJax, etc.) (e.g., `lib_dir: libs`).
logo					X			File path to a logo (at least 128 x 128) to add to presentation (e.g., `logo: logo.png`).
mathjax	X				X	X		Set to `local` or a URL to use a local/URL version of MathJax to render equations
number_section	X	X						Add section numbering to headers (e.g., `number_sections: true`).
pandoc_args	X	X	X	X	X	X	X	Arguments to pass to Pandoc (e.g., `pandoc_args: ["--title-prefix", "Foo"]`).
preserve_yaml				X				Preserve YAML front matter in final document?
reference_docx			X					A .docx file whose styles should be copied to use (e.g., `reference_docx:`
self_contained	X				X	X		Embed dependencies into the doc? Set to `false` to keep dependencies in external files.
slide_level							X	The lowest heading level that defines individual slides (e.g., `slide_level: 2`).
smaller					X			Use the smaller font size in the presentation?
smart	X				X	X		Convert straight quotes to curly, dashes to em-dashes, ... to ellipses, and so on?
template	X	X				X	X	Pandoc template to use when rendering file (e.g., `template:`
theme	X						X	Bootswatch or Beamer theme to use for page. Valid bootswatch themes include `"cerulean"`, `"journal"`, `"flatly"`, `"readable"`, `"spacelab"`, `"united"`, and `"cosmo"`.
toc	X	X		X			X	Add a table of contents at start of document? (e.g., `toc: true`).
toc_depth	X	X		X				The lowest level of headings to add to table of contents (e.g., `toc_depth: 2`).
transition					X			Speed of slide transitions should be `"slower"`, `"faster"` or a number in seconds.
variant				X				The flavor of markdown to use; one of `"markdown"`, `"markdown_strict"`, `"markdown_github"`, `"markdown_mmd"`, and `"markdown_phpextra"`
widescreen					X			Display presentation in widescreen format?