Data Science
CS301

Intro to R

Week 2
Fall 2024
Oliver BONHAM-CARTER

Where To Now?

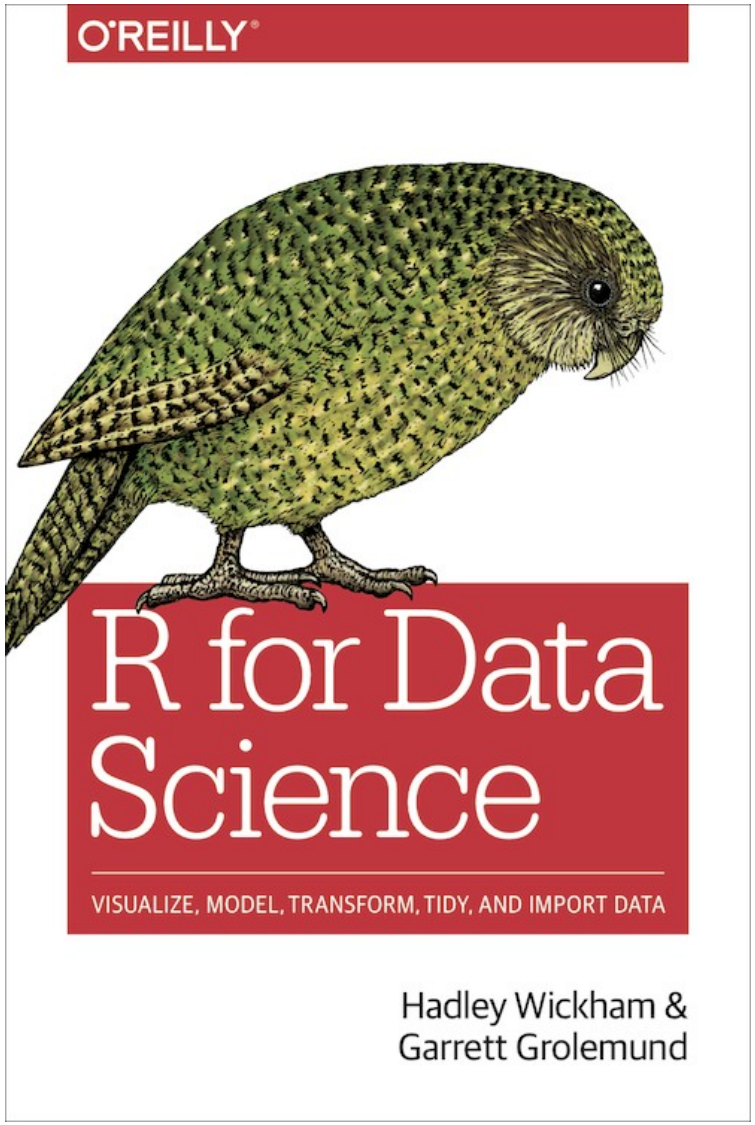
- Softwares exist to do analysis
- Created by developers for a specified purpose (i.e., web site traffic, economy trends, etc.).

For Your Own Analysis?

- **BUT! What if you are working on a project and no tools currently exist?!**

Develop Your Own Tools!!

We will be using the Book



- Note the chapters between the book and the website are not numbered identically!
- Book:
  - Chap 1: Data Visualization with ggplot
  - **Chap 2: Workflow; Basics**
- On the web site:
  - http://r4ds.had.co.nz/
  - Chap 3: Data Visualization
  - **Chap 4: Workflow; Basics**

Who uses R?

R applications are not enough until you don't know how people/companies are using the R programming language.

Facebook – Facebook uses R to update status and its social network graph. It is also used for predicting colleague interactions with R.

Ford Motor Company – Ford relies on Hadoop. It also relies on R for statistical analysis as well as carrying out data-driven support for decision making.

Google – Google uses R to calculate ROI on advertising campaigns and to predict economic activity and also to improve the efficiency of online advertising.

Foursquare – R is an important stack behind Foursquare's famed recommendation engine.

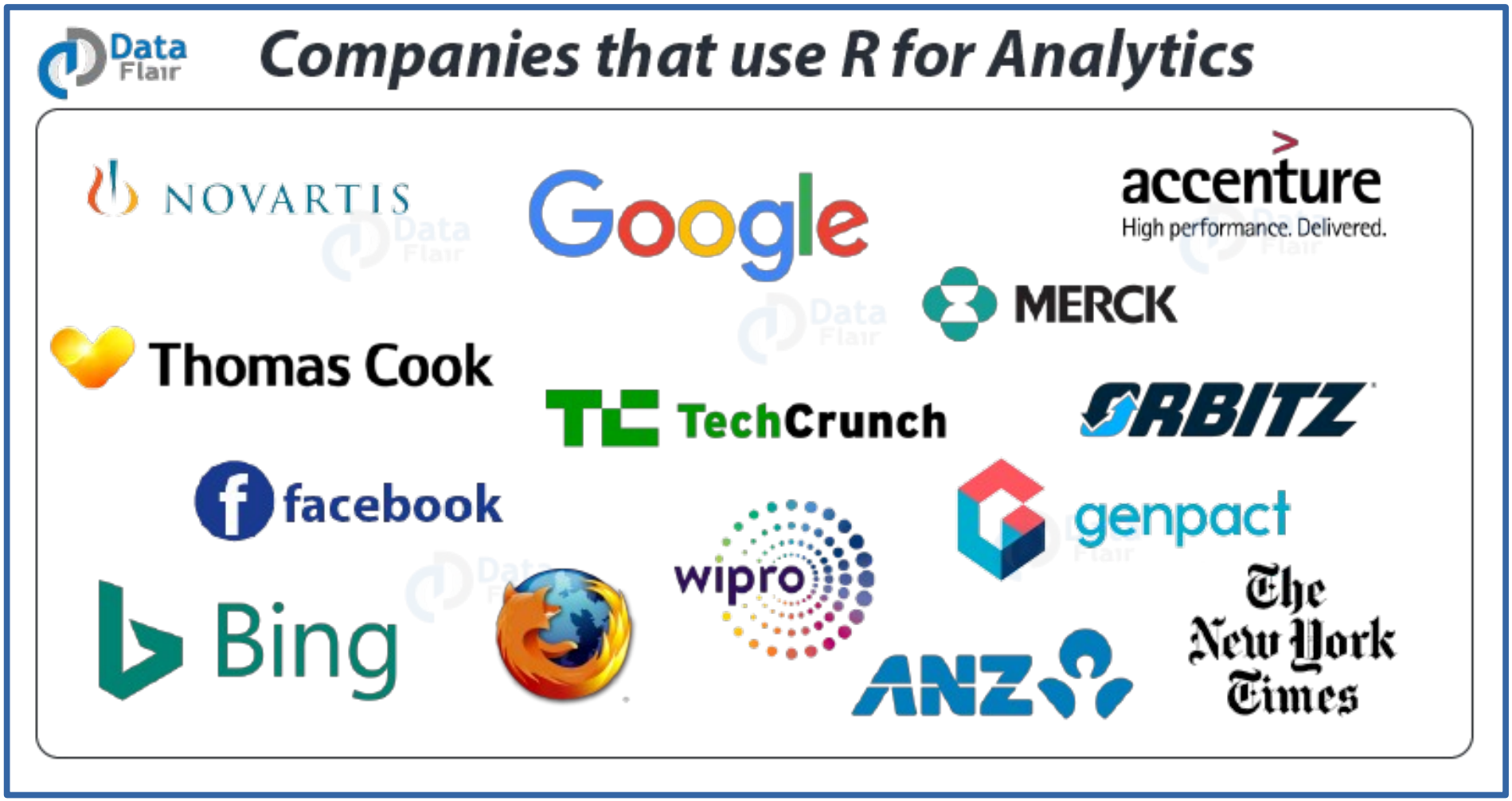
John Deere – Statisticians at John Deere use R for time series modeling and also geospatial analysis in a reliable and reproducible way. The results are then integrated with Excel and SAP.

Microsoft – Microsoft uses R for the Xbox matchmaking service and also as a statistical engine within the Azure ML framework.

Mozilla – It is the foundation behind the Firefox web browser and uses R to visualize web activity.

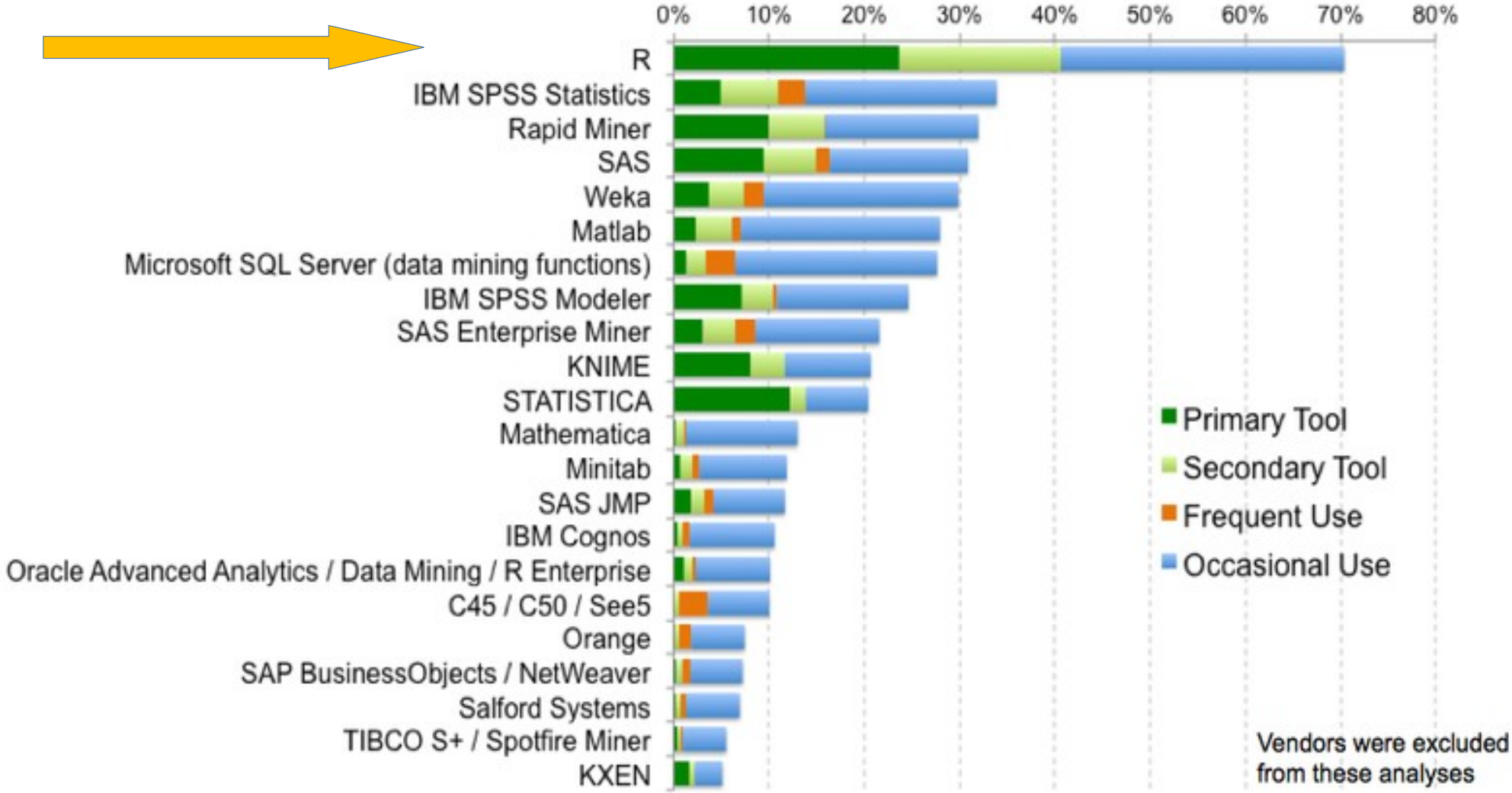
Ref: https://data-flair.training/blogs/r-applications/

Who uses R?



Ref: https://data-flair.training/blogs/r-applications/

R: The Most Popular Data Mining Tool



http://blog.revolutionanalytics.com/2013/10/r-usage-skyrocketing-rexer-poll.html

NEWS | COMPUTING

Top Programming Languages 2022 >

Python's still No. 1, but employers love to see SQL skills

BY STEPHEN CASS | 23 AUG 2022 | 4 MIN READ

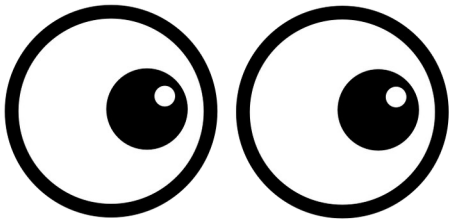
R is in the top Ten!

https://spectrum.ieee.org/top-programming-languages-2022

Let's look at R!

ALLEGHENY COLLEGE

Click this image to go to resources !!



Home / Resources / Data Science Resources

Data Science Resources

Welcome to a resources page for Data Science research. Here you will find a list of links for data, tools, tutorials and related resources that may be very helpful to your work.

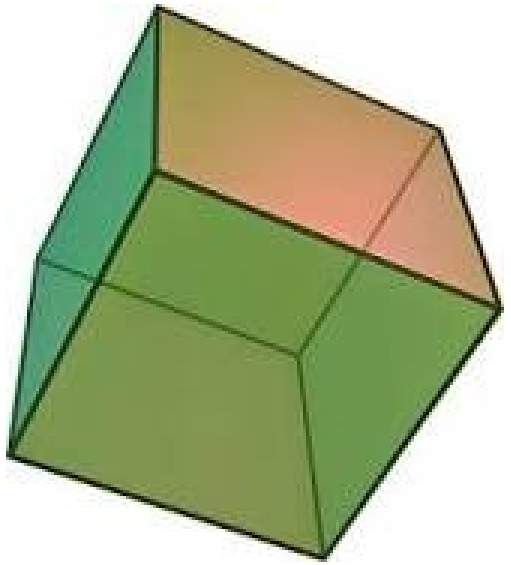
```
# You can run any R code...
print("Hello, world!")

# Use plots...
plot(cars)

# Even packages like ggplot!
library(ggplot2)
qplot(wt, mpg, data = mtcars, colour = factor(cyl))
```

Run (Cmd-Enter)

https://www.oliverbonhamcarter.com/resources/dataanalytics_resources/

Variable Names

- Variable Names:
  - Begin with a letter, and can only include letters, numbers, periods and hyphens.
  - Hyphens: “-”
  - Periods: “.”
- SnakeCase (recommended by book)
  - val_of_height,
  - val_of_length,
  - val_of_width



Basic Math

- Mathematics
  - Addition: 1 + 1
  - Subtraction: 1 - 1
  - Multiplication: 3 * 7
  - Division: 1 / 4
- More complicated math, var assignments:
  - 4*(7+3)/10+1 Note: watch the order of operations!
  - Parameter of circle ($C = 2 * pi * r$)
    - *R* <- 4, Note the "<-" means *equal* in R.
    - *C* <- 2 * pi * R = 2 * 3.1415 * 4
    - *C* is 25.13274

Variable Names

- CamalCase:
  - valOfHeight,
  - valOfLength,
  - valOfWidth
- Period.Case
  - Val.of.height,
  - Val.of.length,
  - Val.of.width
- What-EVER.Case
  - Val.ofHEIGHT,
  - Val.Of_Length,
  - Val.oF.Width

Working On a Case (I)


```
firstName <- "Sherlock"
print(firstName)
[1] "Holmes"
```

Camal Case

Working On a Case (I)

```
Last.name <- "Holmes"
print(Last.name)
[1] "Holmes"
```

Period Case

```
firstClue <- "stain"
second.clue <- "scarf"
```

Whatever Case (a mix)

Working with Variables

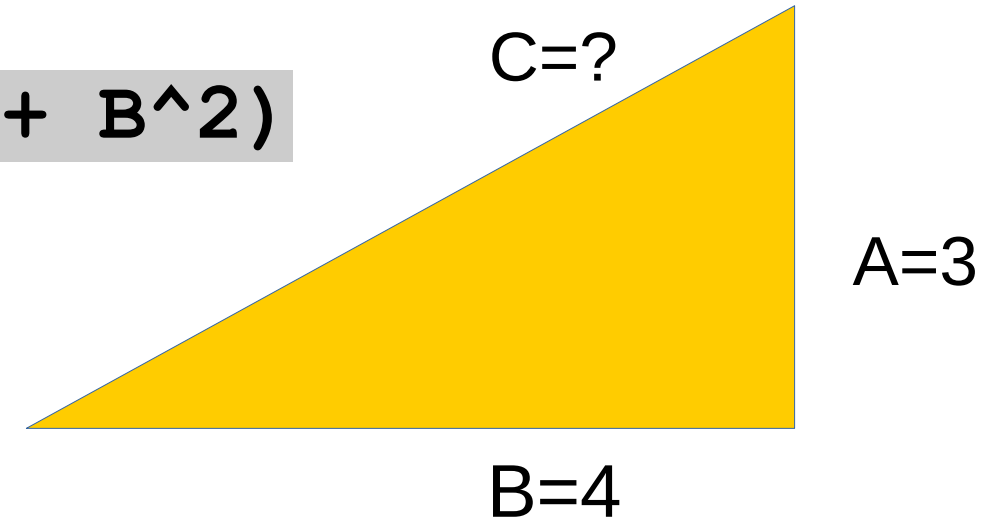
```
x = 1
y = 3
# or
x <- 1
y <- 3
# Run:
x + y
#output
[1] 4
```

```
> x <- 1
> y <- 3
> x + y
[1] 4
```

```
> myNum <- -2
> myOtherNum <- -4
> myNum + myOtherNum
[1] -6
```

Variables and Assignments

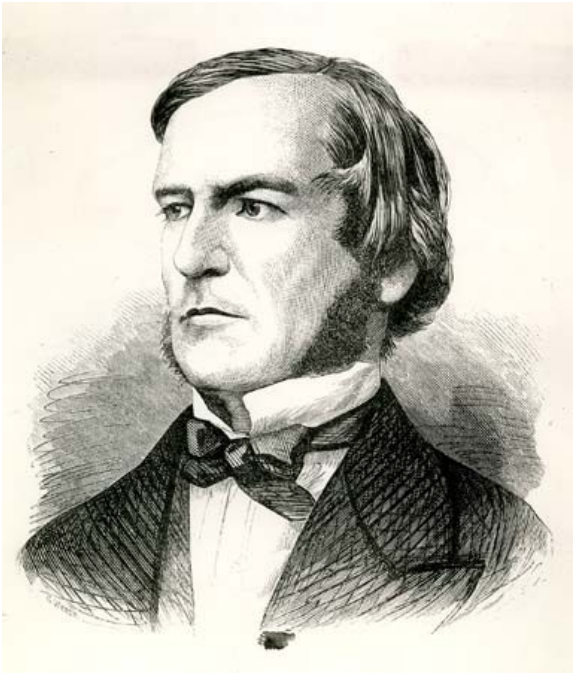
- *A* <- 3
- You could also use "*A*=3" (but this is not traditional programming in R)
- Hypotenuse (*C*) defined by *sqrt(A^2 + B^2)*
- `A <- 3`
- `B <- 4`
- `C <- sqrt(A^2 + B^2)`
- `C is ??`

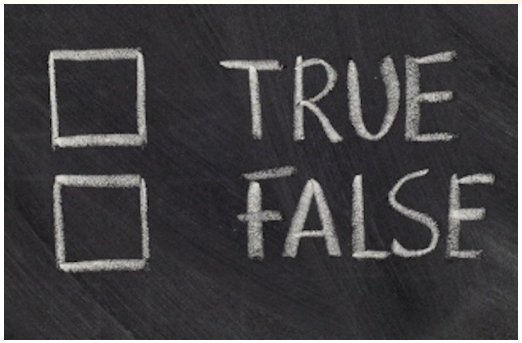


Logical Operations

- Booleans: Returning True or False:

```
3 > 4, 3 < 4,
2 + 4 == 6,
2 + 3 == 4 + 1
T == TRUE
F == FALSE
3 + 4 != 5
3 + 4 == 7
5 * 2 != 11
```





Try some of These in R!

- Logical **AND**
- (&&)

```
F && F is F
F && T is F
T && F is F
T && T is T
```

- Logical **OR**
- (||)

```
F || F is F
F || T is T
T || F is T
T || T is T
```

- Logical **NOT**
- (!)

```
!F is T
!T is F
```

Truth Tables:
https://en.wikipedia.org/wiki/Truth_table
De Morgan's Laws:
https://en.wikipedia.org/wiki/De_Morgan%27s_laws

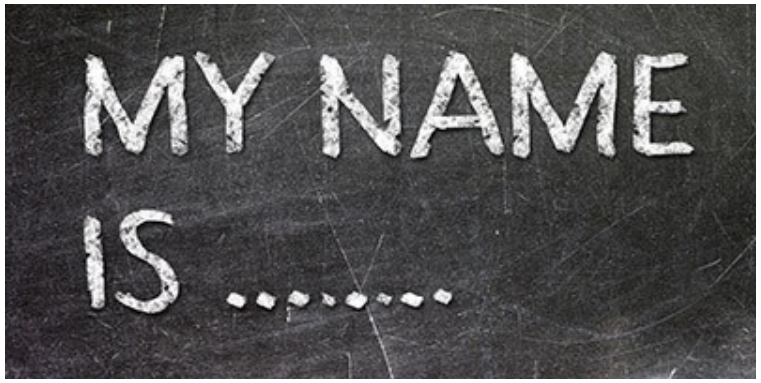
Concatenating Strings

- Strings have quotation marks
  - “Hello World”

```
H <-   "Hello"
W <-   "world"
paste(H,W, sep = " ")
```

What is the result here??

You try:
Print your full name!




```
first <- "Sherlock"
last <-  "Holmes"
paste(first,last, sep =" ")
```

Built-in Functions

- R has a large collection of built-in functions:
  - function_name(arg1 = val1, arg2 = val2, …)
  - `seq(from, to), ex: seq(0,10)`
  - Gives a sequence, *S* ={0,…,10}
  - What happens when you press TAB after typing, “seq”?
- Use the `sum( )` function to add two numbers
  - sum(1,10)
  - Adds 1 and 10
- Add all elements in a vector, *v*
  - v <- 0:10
  - sum(v)
  - Adds: 0 + 1 + … + 9 + 10 = 55

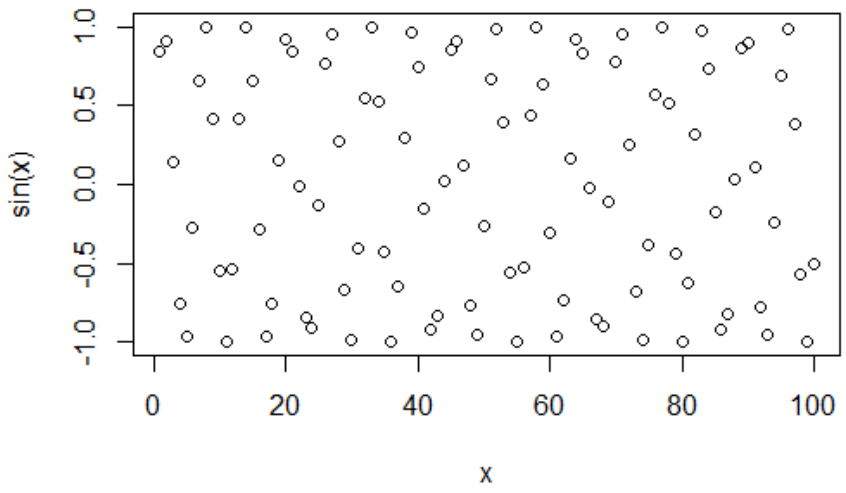
Simple Plots

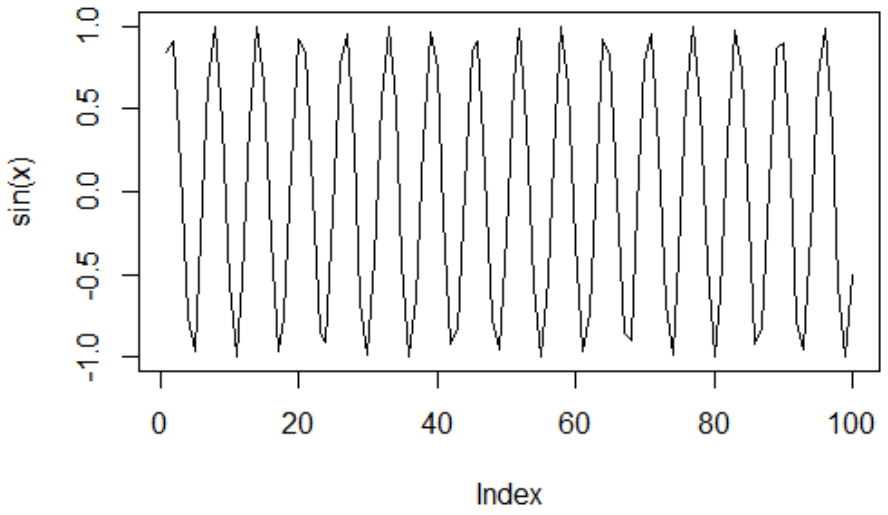
x<- seq(1,100) # assign *x* to the sequence 1 to 100

plot(x) # plot this sequence

plot(sin(x)) or plot(x,sin(x)) # see left plot below

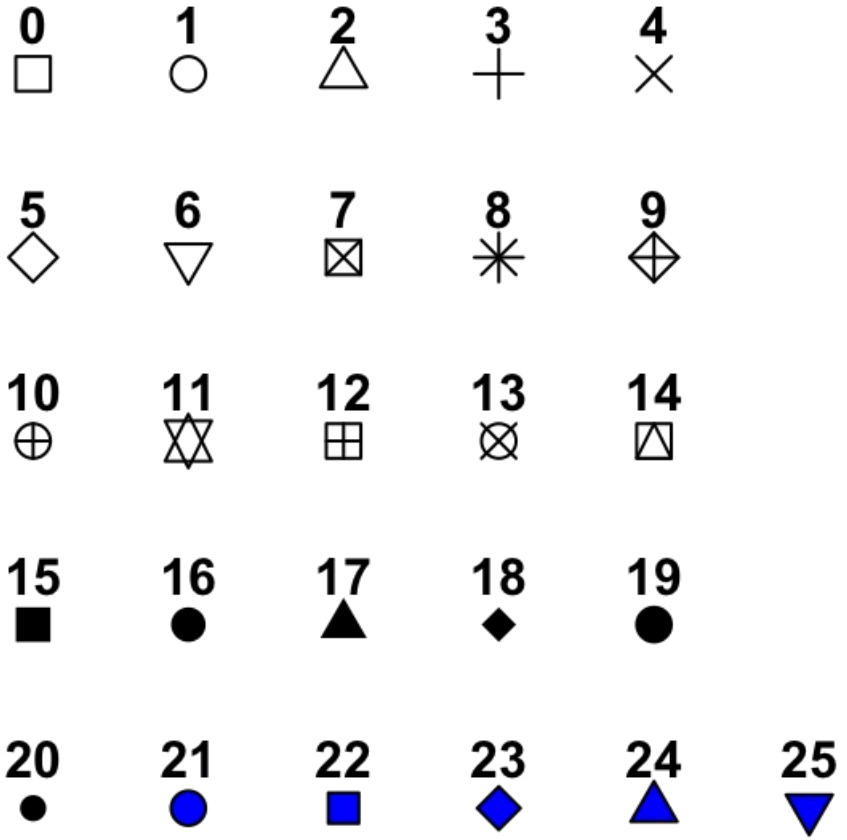
plot(sin(x)) or plot(x,sin(x), type = “l”) # see right plot below





Simple Plots
Plotting symbols

```
x<- seq(1,100)
#  Try these!
plot(sin(x), pch = 1)
plot(sin(x), pch = 2)
...
plot(sin(x), pch = 25)
```



See more at reference:
http://www.sthda.com/english/wiki/r-plot-pch-symbols-the-different-point-shapes-available-in-r

Now, You Try

- Use R to write a command that...
  - Finds the **sum** of all numbers, 0 through 100
  - Finds the **sum** of all numbers, 0 through 10000

    (now, set a variable equal to the sequence first)
- Using the plot function, **plot(x,y,type = "l")** to plot a line of the function, f(*x*) = sin(*x*) for *x* in {0, …, 30}
  - x <- 0:10
  - plot(x, sin(x), type = "l")

Now try `cos()` and `tan()`!

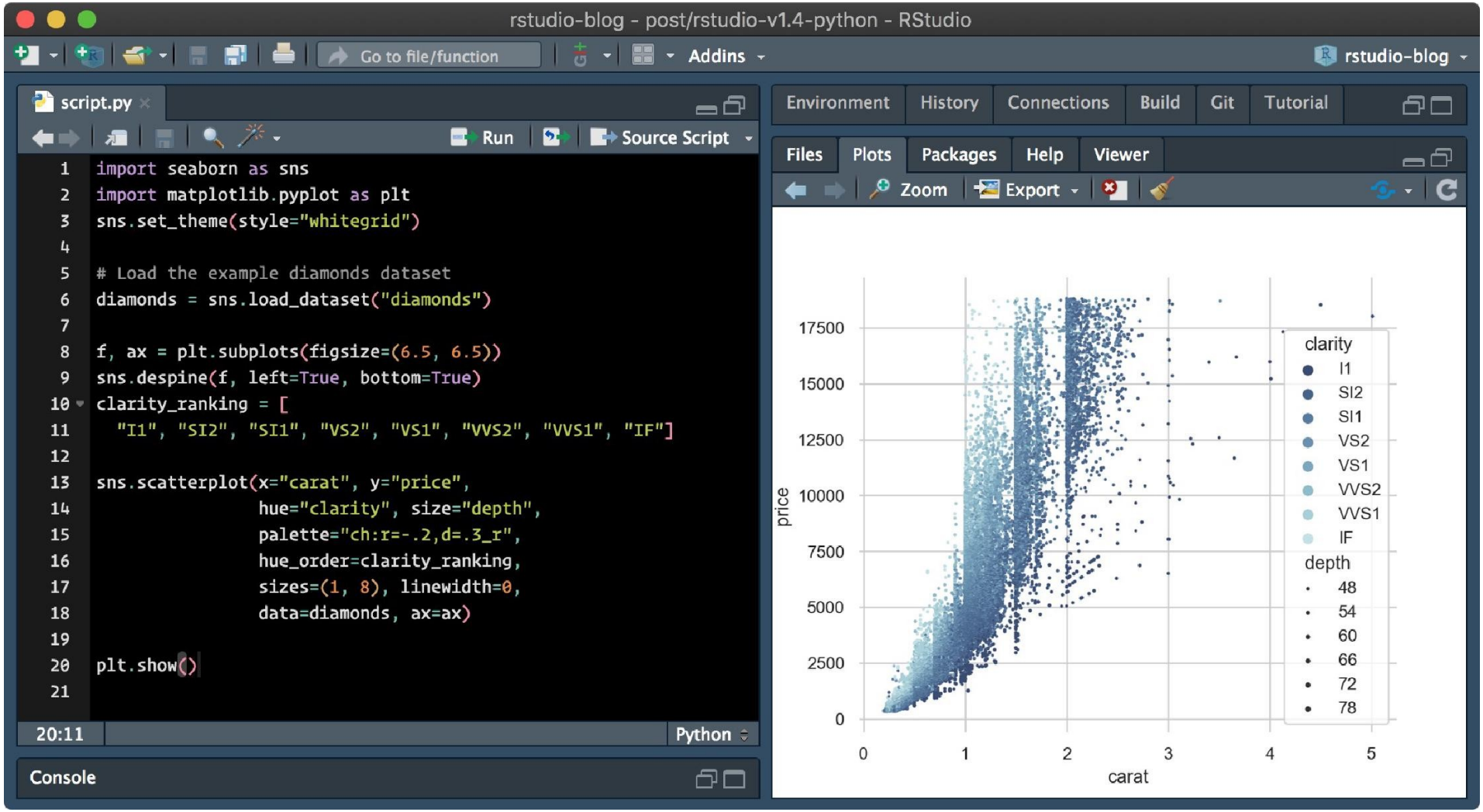
Exiting R:
q()

The R Programming Language

- https://www.r-project.org/
- What is the R language?
  - An open source, well-developed programming platform for work in statistics, mathematics and data analytics
  - Cross platform; runs on major OSs
  - Popular programming skill among Big Data analysts, and data scientists
- Community Blogs:
  - https://www.r-bloggers.com/
  - https://twitter.com/rstudiotips/
  - https://towardsdatascience.com/

RStudio

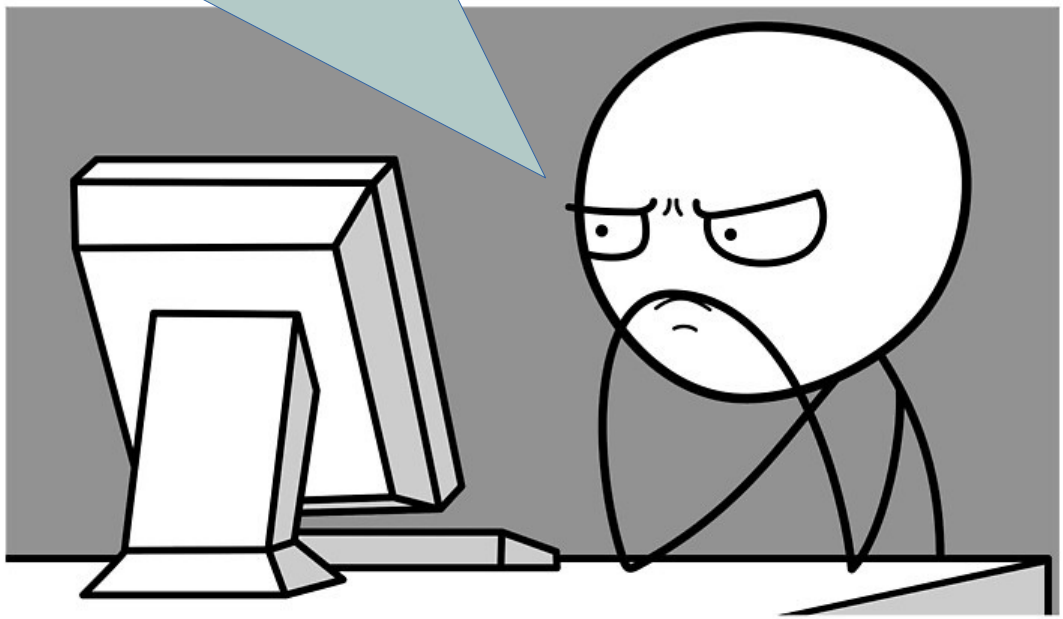
ALLEGHENY COLLEGE



Let's take a moment to install these software packages!

R Language

R Studio®



https://www.oliverbonhamcarter.com/resources/dataanalytics_resources/

Install links

RStudio download

https://posit.co/downloads/

R Programming Language

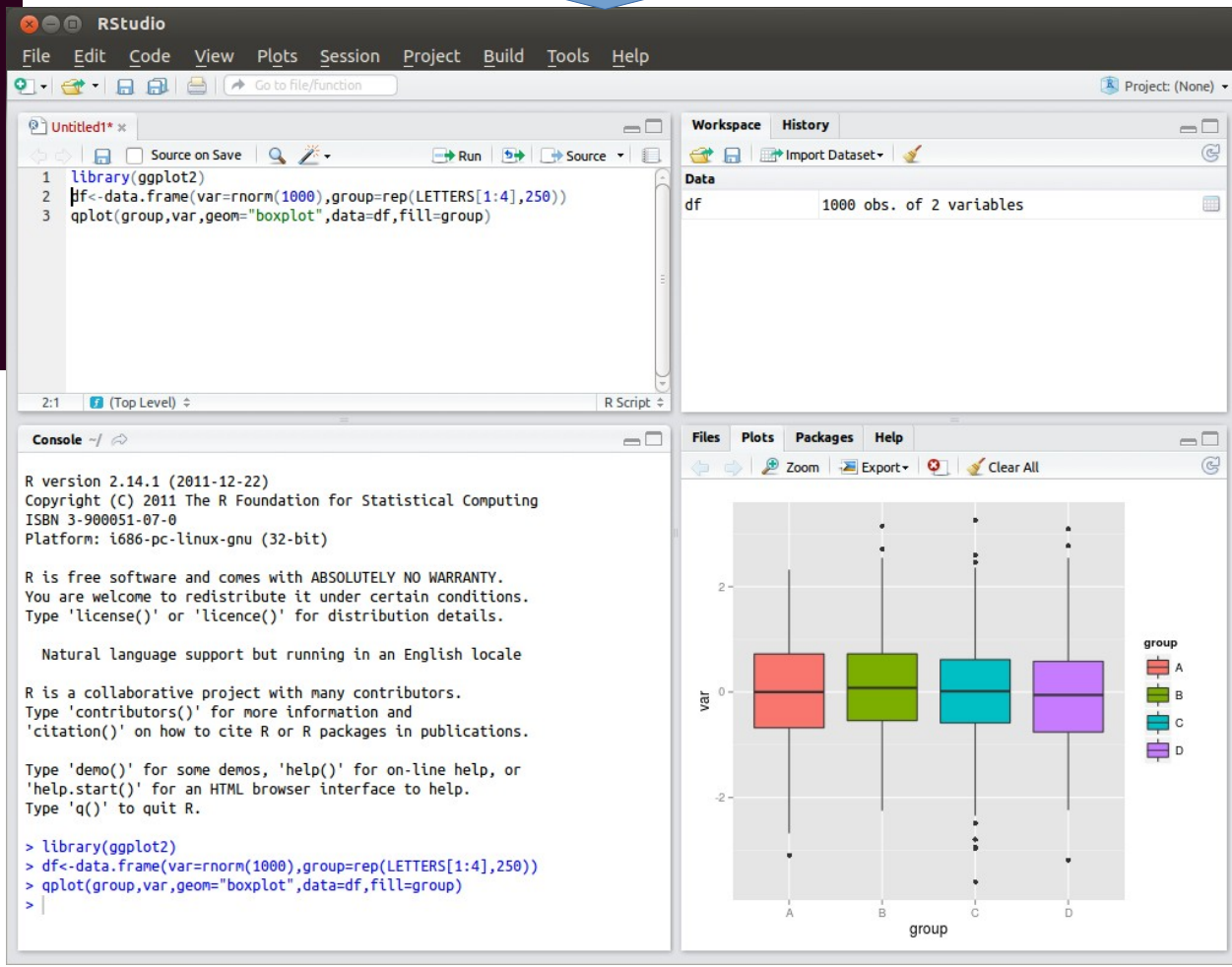
https://cran.rstudio.com/

Verify Your Installation!

- Wait! R or RStudio? Same language!

To run:
Find its icon or type *rstudio at terminal*

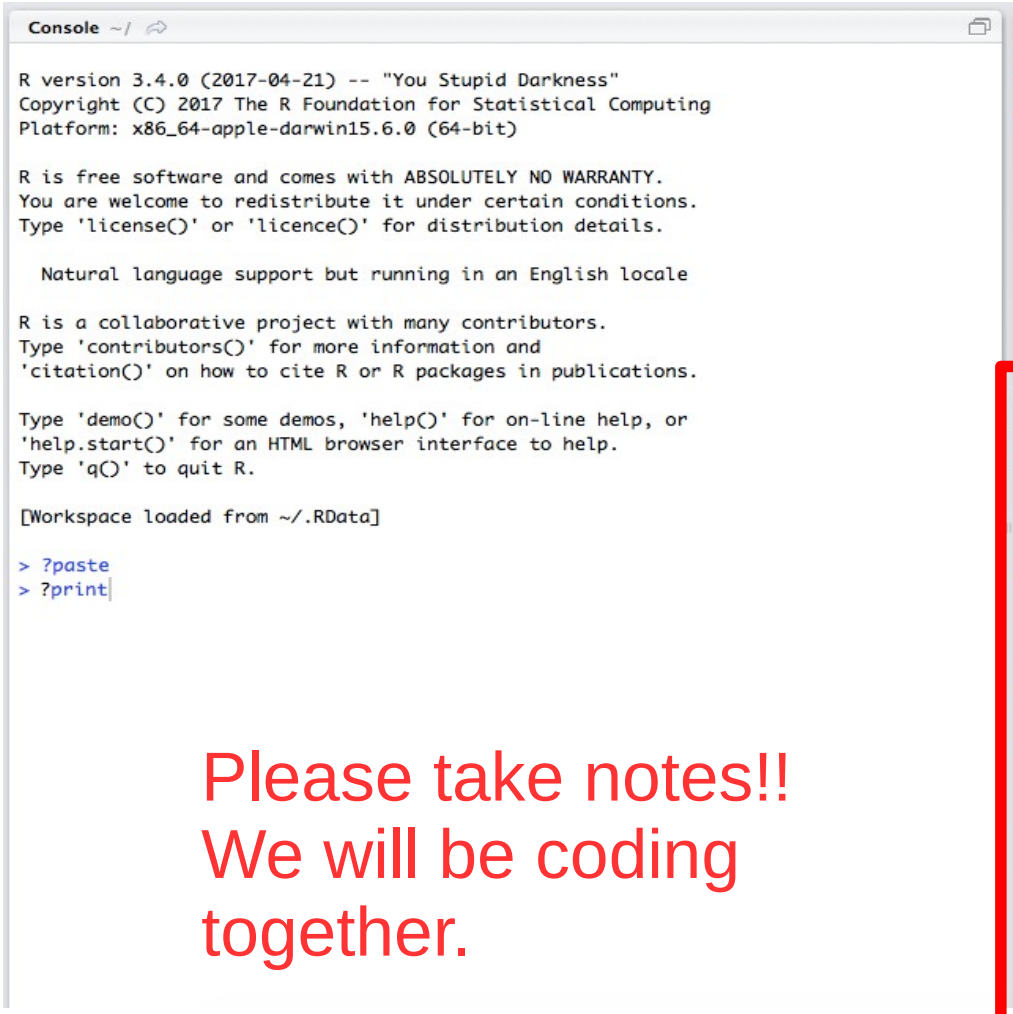
```
R version 3.2.2 (2015-08-14) -- "Fire Safety"
Copyright (C) 2015 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

>
```

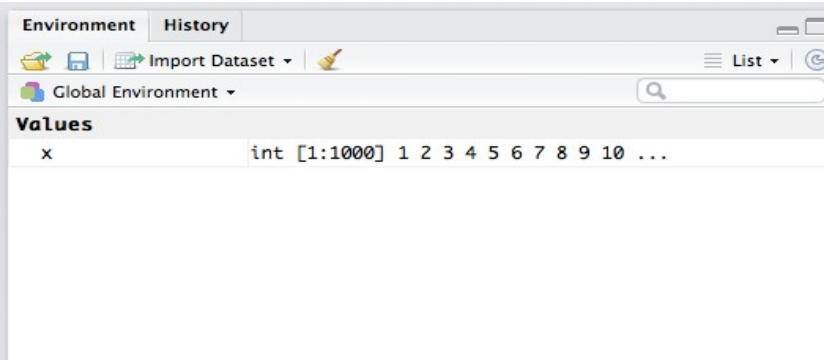


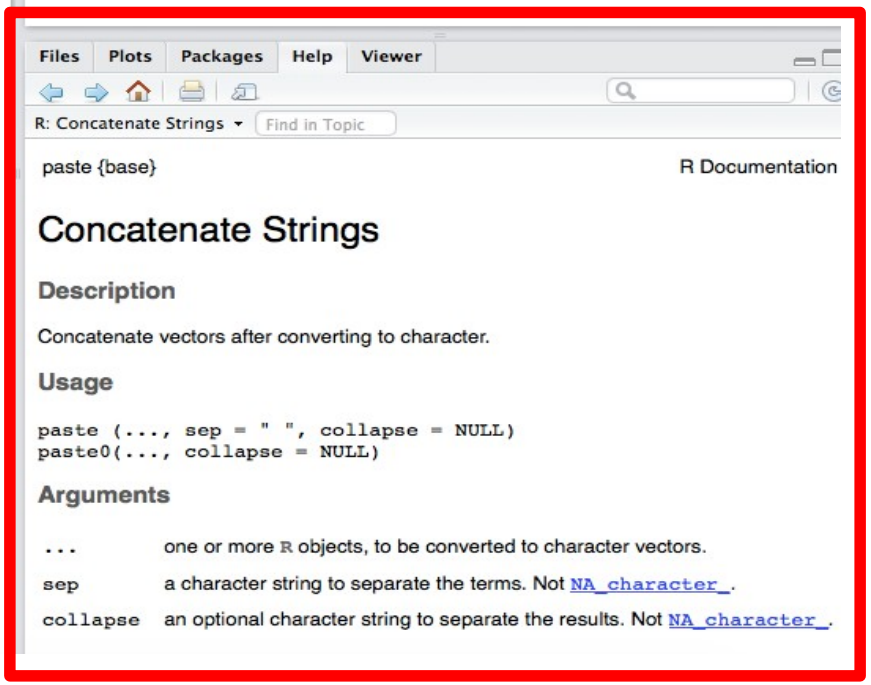
To run:
Type "*R*" at terminal

Getting Help in R

- Online help: place a “?” in front of a keyword
  - Ex: ?print







Please take notes!!
We will be coding together.