EPA
United States
Environmental Protection
Agency

Introduction To R

EPA's Emerging Leaders Network
2021-02-24

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Who am I?

- Landscape ecology, GIS, Lakes, and Data Science
- US EPA Research Ecologist since ~2006
- Worked on: Forests, wetlands, gopher tortoise, estuaries, lakes, cyanobacteria, …
- useR since 2000 (yikes!)
- @jhollist, #rstats

What is R?

- "Free software environment for statistical computing and graphics"
- Ross Ihaka and Robert Gentleman
- Dialect of the S language
- R's first release: 1993
- Version 1.0: 2000
- Current version 4.0.4, Feb 2021.
  - aka "Lost Library Book"
- Excels at statistics and visualization
- Fully functional, general purpose programming language
- Why is it called "R"?

Why use R?

- Free!
- Statistics and Graphics
- GIS/Spatial
- Writing Papers
- Presentations (like this one)
- Programming
- Develop new tools
- Reproducibility
- Open Science

R vs. Python

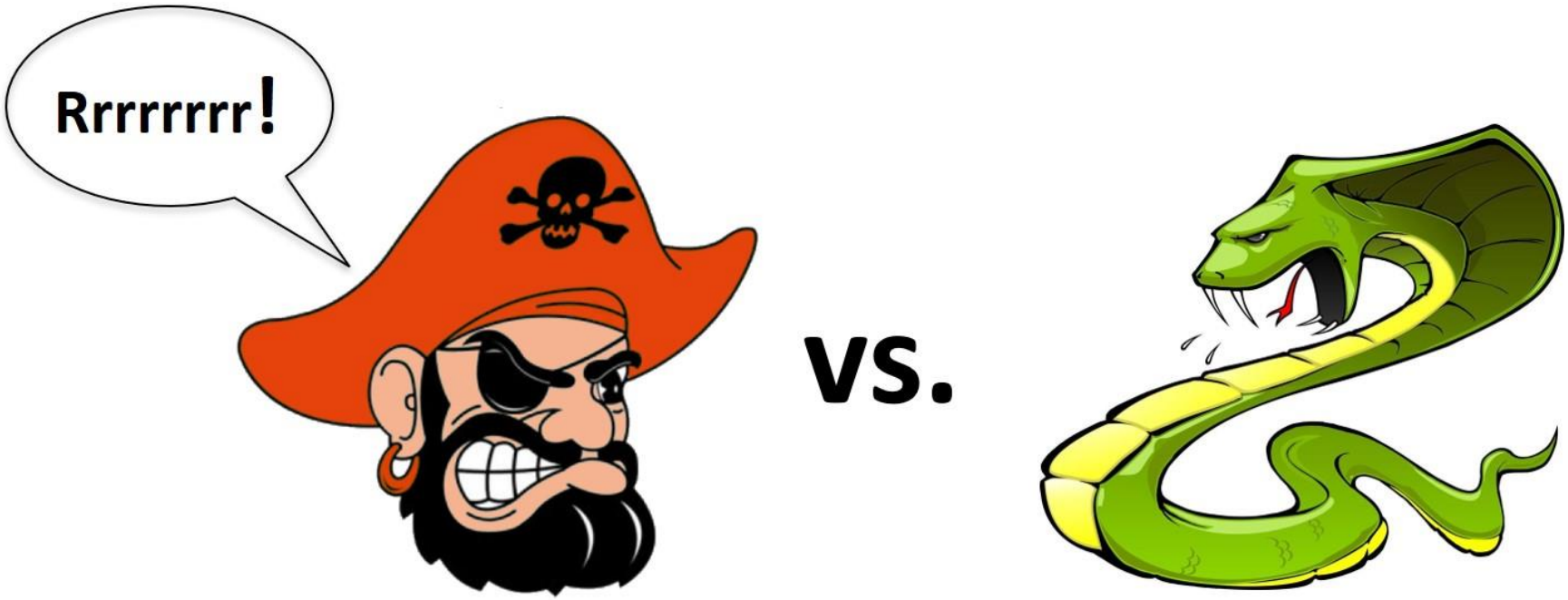


Image credits: https://library.kissclipart.com/ and https://pixy.org/896991/

R ~~vs.~~ & Python

Image credit: https://github.com/rstudio/reticulate/blob/master/images/reticulated_python.png

- RStudio Panel discussion from yesterday: https://www.youtube.com/watch?v=6mp-BWPnqK4

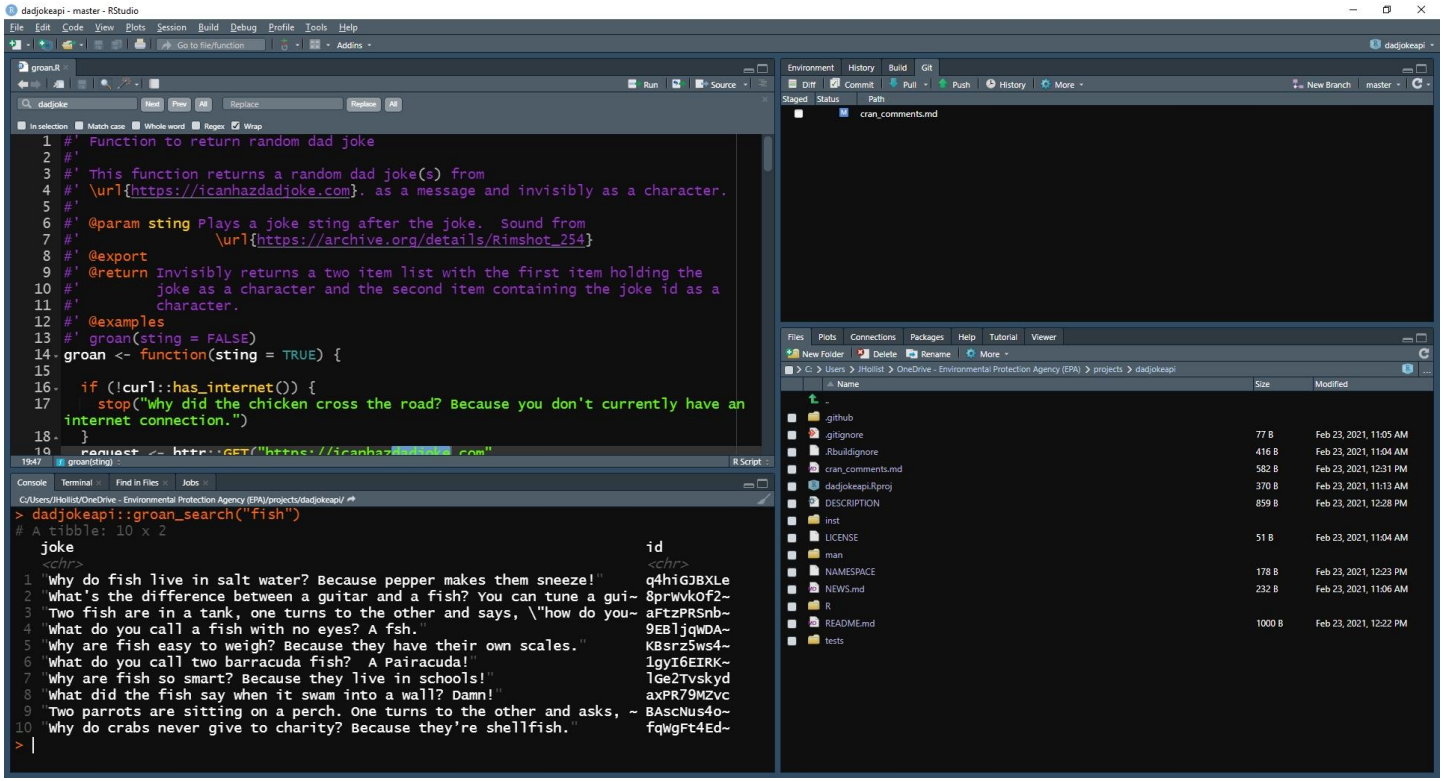
R at EPA

- Large and active community
- July 2020: 1142 installs
  - HQ offices only
- R Users Group
  - Started ~2013/2014
  - Channel in Data Science team
  - Sharepoint (legacy)
  - Monthly meetings
  - Bi-annual face to face
- Installation (for HQ Offices, regions are Ad hoc)
  - R
  - RStudio
  - Rtools (required build tools for Windows)

One Minute Demos

RStudio

- Integrated Development Environment
- Also a company that supports the R community
- RStudio 1-minute Demo



Base R

- Fresh out of the box you get 6618 functions!
- You can do a lot
  - stats, graphics, parallel computing, …
- Base R 1-minute Demo

Extending Base R: Packages

- Community developed extensions
- Many quality checks
- Two main sources
  - CRAN (https://cran.r-project.org/): 17147 packages
  - Bioconductor (https://www.bioconductor.org/): 20463 packages
    - Genomics/bioinformatics

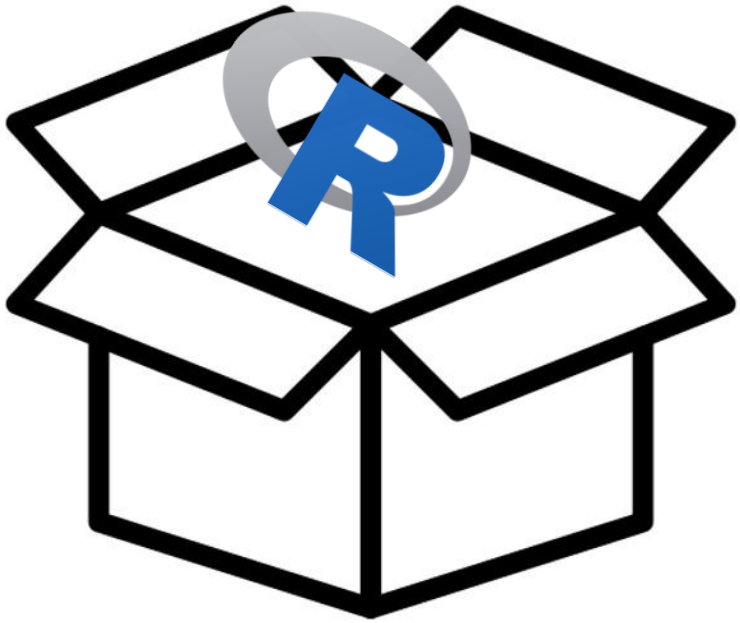


Image credit: https://www.flaticon.com/authors/dinosoftlabs

What can you do with R?

- Well-known:
  - Statistics
  - Graphics
- Less well-known:
  - Geospatial/GIS
  - Documents
    - word, pdf, ppt
  - Web applications
- Offbeat things

Image credit: https://www.flickr.com/people/100030176@N02

Offbeat 1 minute demo

- beepr: Easily Play Notification Sounds on any Platform
- BRRR: Rap adlibs in R
- dadjokeapi: Return a Dad Joke
- demotivr: Show Demotivational Messages on Errors
- kittyR: Kitty pictures and meows from R console
- praise: Praise Users
- memer: A tidyverse compatible package for creating memes in R using magick
- rainbowwrite: Rainbow Coloured Output
- wesanderson: A Wes Anderson Palette Generator

```
# Noises!
beepr::beep(2)
kittyR::meowR(4)
BRRR::skrrrahh(16)

# Messages
dadjokeapi::groan()
praise::praise()

# Images and colors
library(magrittr)
meme_get("DosEquisMan") %>%
 meme_text_top("I don't always
useR!", size = 28) %>%
 meme_text_bottom("But when I do, I
procrastinate\nby making memes.",
size = 28)
joke <- dadjokeapi::groan(FALSE)$joke
rainbowrite::lolcat(joke)
```

Statistics 1 minute demo

```
# Read data from a URL
nla_url <- "https://www.epa.gov/sites/production/files/2014-
10/nla2007_chemical_conditionestimates_20091123.csv"
nla_wq <- read.csv(nla_url)

# Remove missing data
nla_wq <- nla_wq[complete.cases(nla_wq[,c("CHLA", "PTL",
"NTL")]),]

# Some stats
mean(nla_wq$CHLA)
t.test(nla_wq$CHLA ~ nla_wq$LAKE_ORIGIN)
nla_lm <- lm(log10(CHLA) ~ log10(PTL) + log10(NTL),
             data = nla_wq)
summary(nla_lm)
```

Visualization 1 minute demo

```
# Use ggplot2 to create viz
library(ggplot2)

# Iteratively add parts to my plot
nla_wq %>%
  ggplot(aes(x=NTL,y=PTL)) +
  geom_point(aes(size=CHLA, color=CHLA)) +
  scale_x_log10() +
  scale_y_log10() +
  scale_color_continuous(low = "springgreen", high =
"darkgreen") +
  geom_smooth(method = "lm", color = "grey50") +
  theme_classic() +
  labs(title = "Total Nitrogen, Total Phosphorus, and
Chlorophyll Associations",
       x = "Log 10 (Total Nitrogen)",
       y = "Log 10 (Total Phosphorus)")
```

Geospatial 1 minute demo

```
# Load up several spatial packages
library(USAboundaries)
library(sf)
library(dplyr)
library(elevatr)
library(mapview)
library(raster)

# Get map of lower 48 states
usa_l48 <- us_boundaries() %>%
  filter(state_abbr != "HI" &
           state_abbr != "AK" &
           state_abbr != "PR")

# Get DEM. Zoom level 4 returns DEM of ~ 3.8km resolution
usa_l48_dem <- get_elev_raster(usa_l48, src="aws", z = 4,
                               clip = "location")

# Create quick leaflet map
mapview(usa_l48_dem) + usa_l48
```

Documents 1 minute demo

- R mixed with Markdown:
  - https://daringfireball.net/projects/markdown
- PDF
- Word Documents
- Presentations

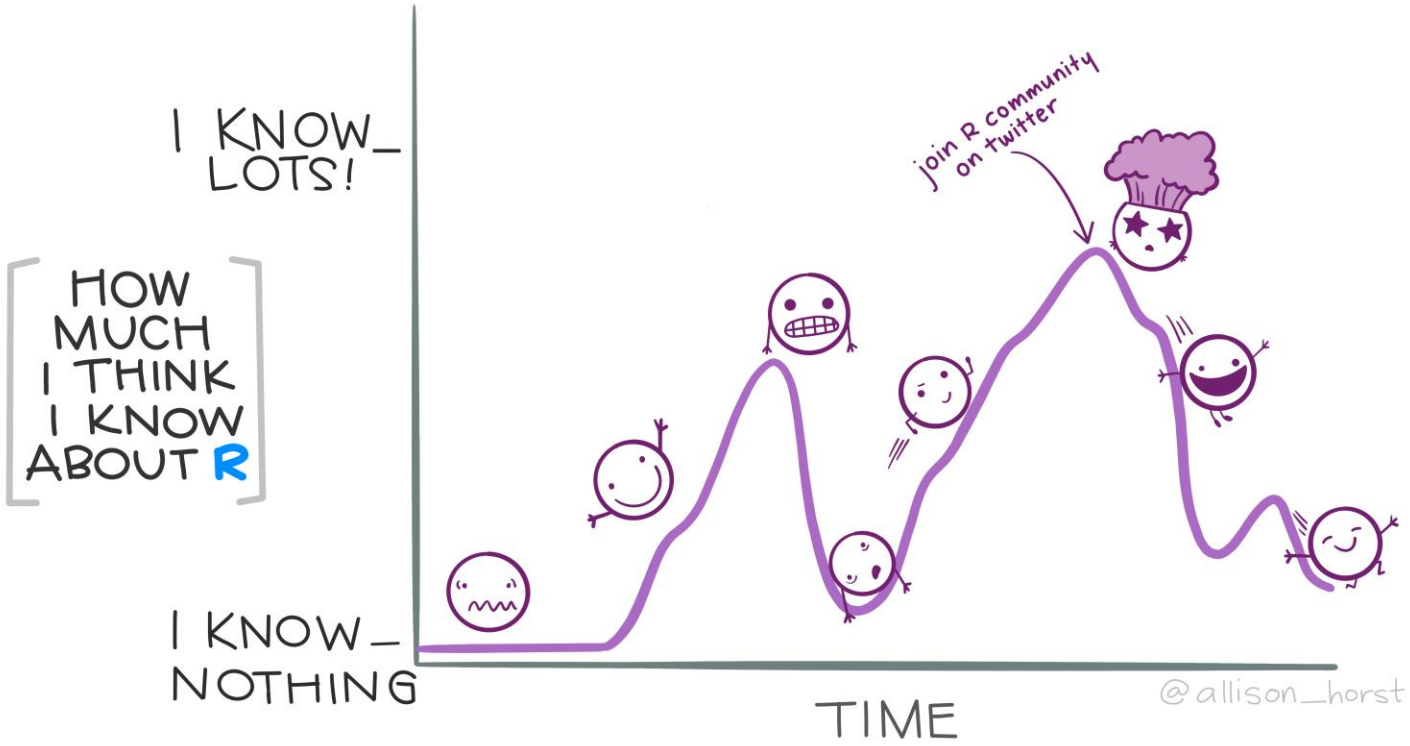
Illustration credit: Allison Horst, https://github.com/allisonhorst/stats-illustrations

Web 1 minute demo

- Shiny
- Shiny examples:
  - https://shiny.rstudio.com/gallery/
- Shiny at EPA
  - https://shiny.epa.gov/fcedts/
  - Internal at NCC
  - Working on other options
- Web and HTML tools galore
  - Visualization
  - Web Scraping
  - APIs

Learn More

- Twitter
  - #rstats, #TidyTuesday, #rspatial
- EPA R User Group
  - Monthly meetings, face to face meetings, webinars
- learnr:
  - https://rstudio.github.io/learnr/
- The Carpentries:
  - https://carpentries.org/



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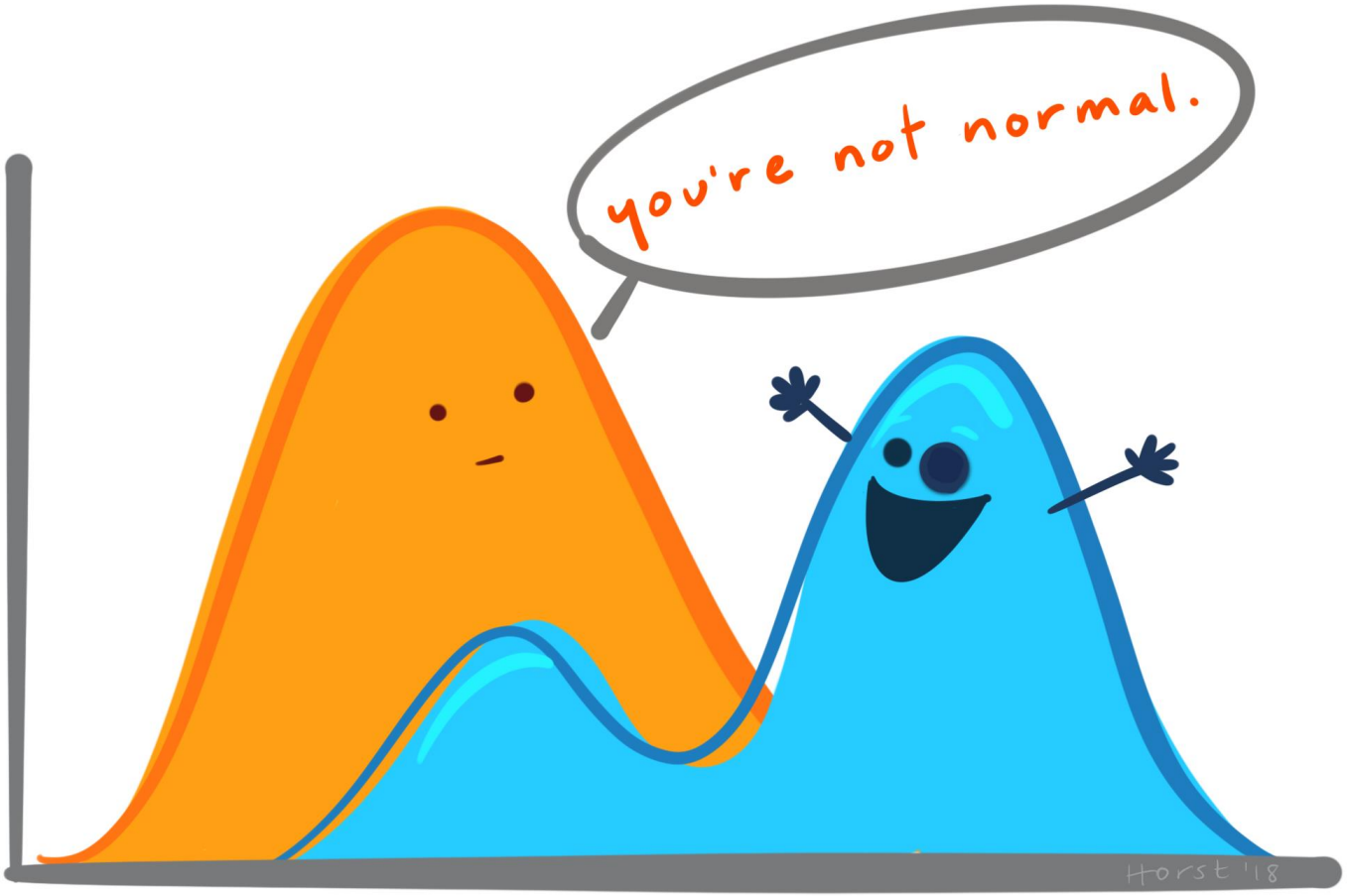
Questions



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