HEALTH
UNIVERSITY OF UTAH

Principles

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R Bootcamp 2020

R Foundation Principles

R is Open

- R is GNU
- R is open source
  - Source code is almost always available
  - Easy to audit

R is collaborative

Packages

Packages are collections of functions put together by other programmers for your use. (You can also publish packages.)

- CRAN (https://cran.r-project.org/) stands for: Comprehensive * BioConductor (http://www.bioconductor.org/)
- GitHub (https://github.com/search/advanced)

R is a Multi-Paradigm Programming Language

- Imperative & Declarative
- Functional & Object-oriented
- Procedural & Reflective
- Interpreted & Compiled.
- But above all **Data-centric*

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Imperative vs. Declarative

In **imperative** languages you tell the computer *how* you want something done.

In **declarative** languages you tell the compute *what* you want done.

> *"You can tell me what to do or how to do it but not both"*

Imperative Languages

“How to do it”

Examples

- C (https://en.wikipedia.org/wiki/The_C_Programming_Language)
- Fortran (https://en.wikipedia.org/wiki/Fortran)
- Assembly (https://en.wikipedia.org/wiki/Assembly_language)

R

```
x <- 1:100
total = 0
for (i in x)
    total <- total + i
```

Your total is 5050.

Declarative Languages

"What to do"

Examples

- SQL
  - Give me a data set that contains everyone born in or after the year 2000.
- SAS
  - Perform a `PROC FREQ` to give me a count of birth years.

R

```
filter(data, dob >= "2000-01-01")
count(data, year(dob))
```

Functional vs. Object

Functional paradigm centers around functions and connecting them together; output from one is input to another. Output depends only on the input, i.e. idempotent.

- May not **ever** change the inputs to a function.
- Minimize side effects and state changes.

Object oriented programming centers around objects and having objects perform actions.

- Centers around state changes and side effects.
- An argument to a function often is changed by the function.

Functional Languages

- Never changes the inputs
- you want something changed, explicitly say so

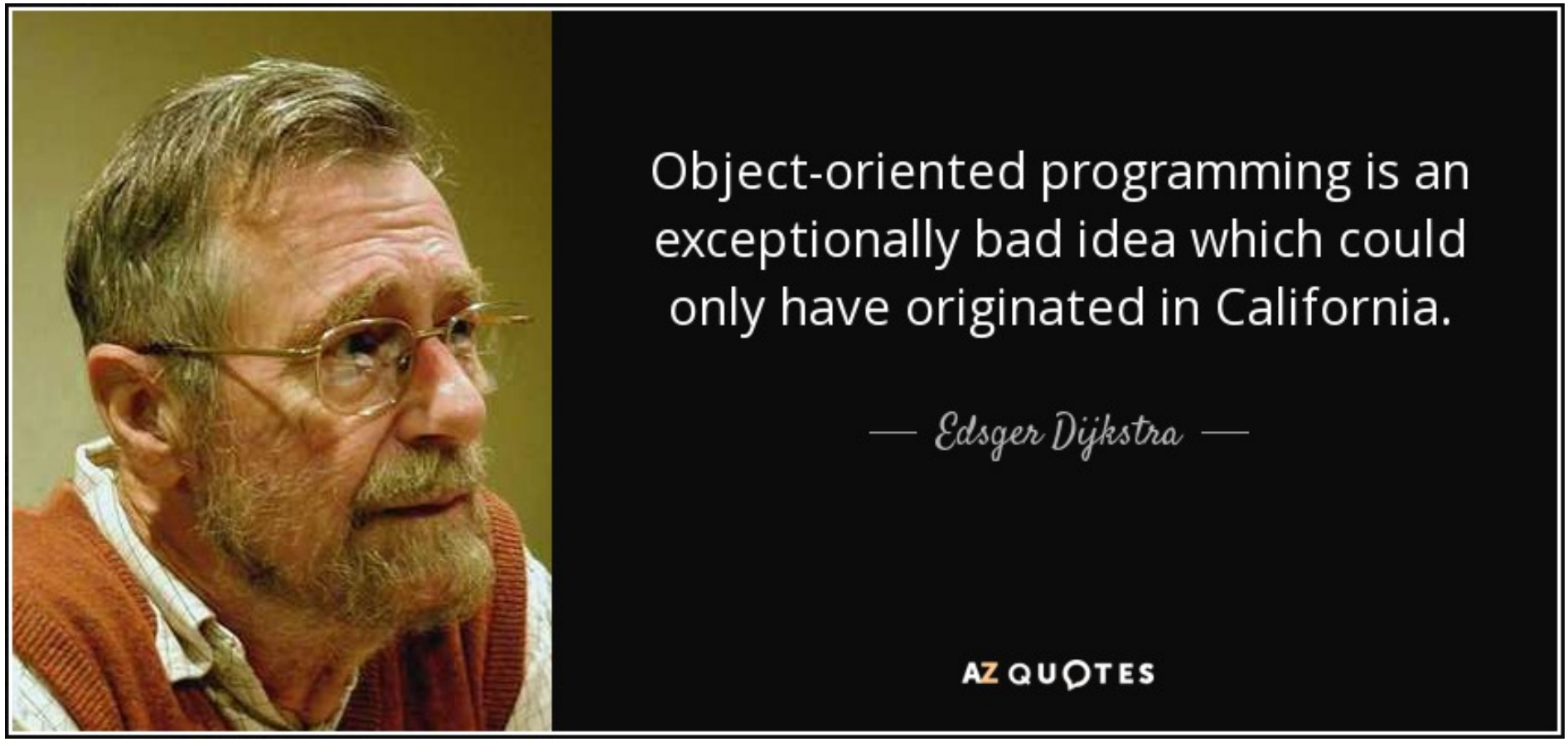
Examples

- Lisp (https://en.wikipedia.org/wiki/Common_Lisp)
- JavaScript (https://en.wikipedia.org/wiki/JavaScript)

R

```
filter(iris, Species == "setosa")          #< Does nothing
iris <- filter(iris, Species == "setosa") #< Actually filters
```

Object Oriented Programming



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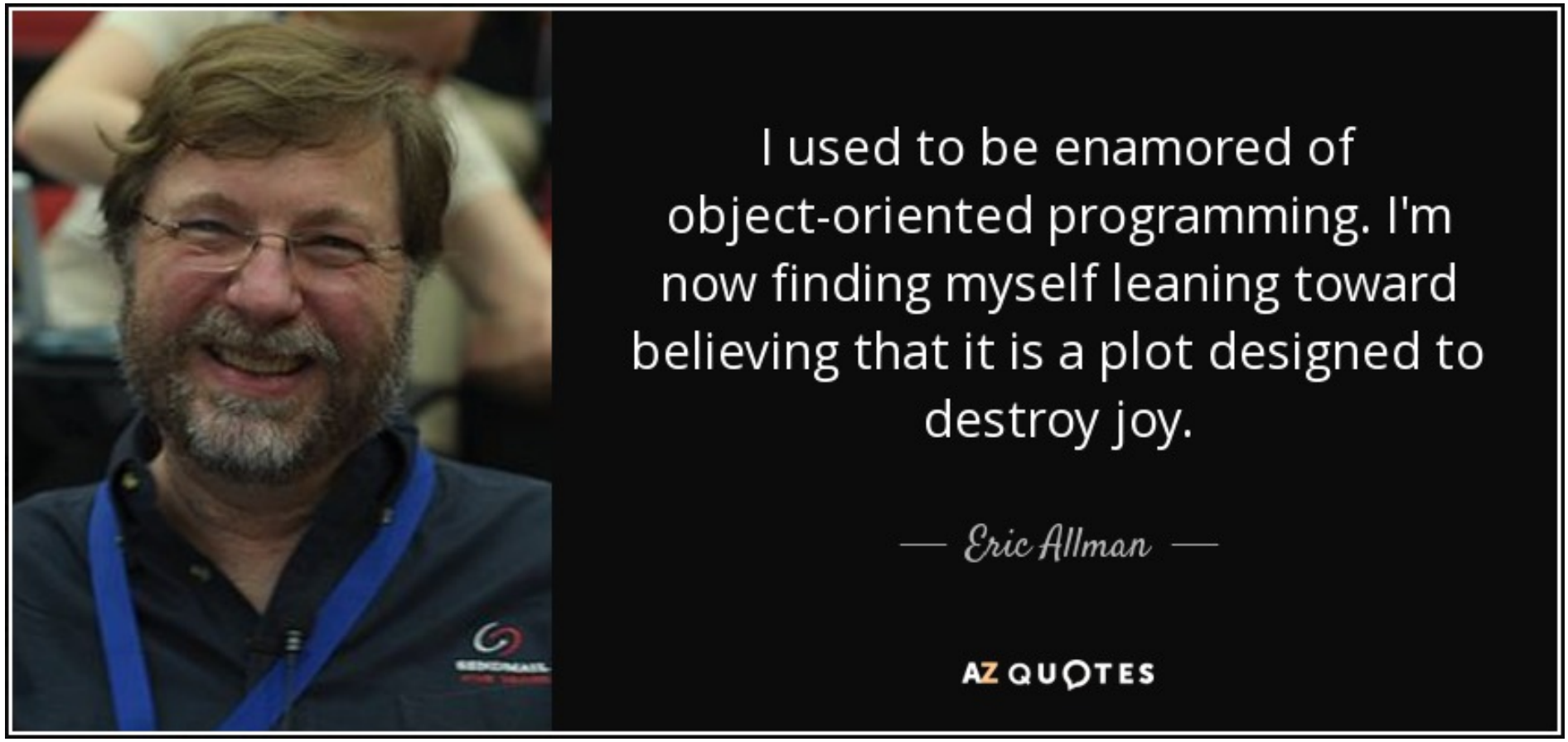
Object Oriented Programming



(https://www.azquotes.com/quote/932334)

So what?

Why this maters if you are coming from SAS

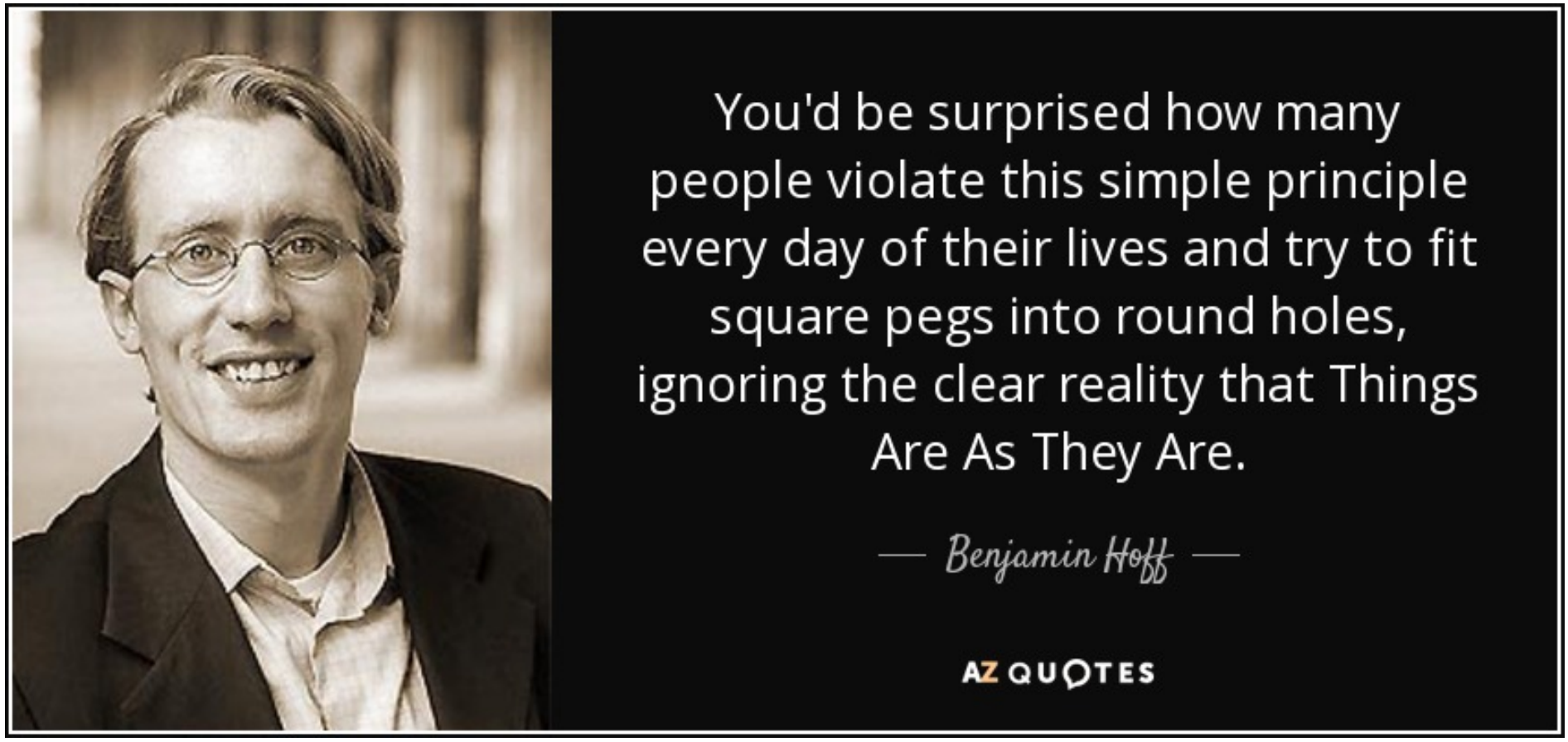
- R is **VERY** different than SAS.
- You will have to step back from the Data step/Proc paradigm
- More procedures and structures less declarations.

Why this maters if you are coming from STATA

- Data is an object in R
- There is no ‘active’ data set.

Why this maters to everybody

- Knowing how a language is designed makes you more effective with it.



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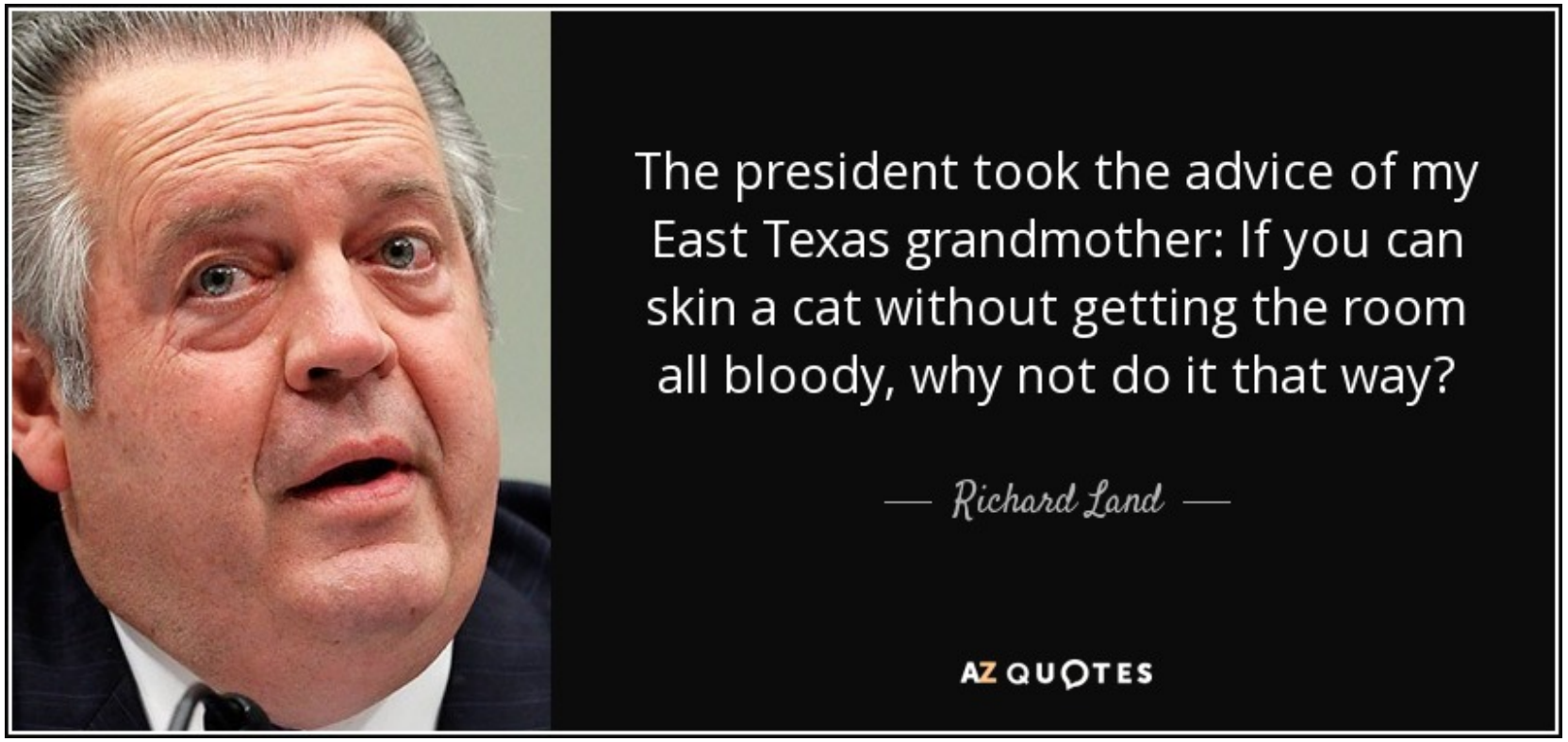

(https://www.azquotes.com/quote/906668)

How I teach R

How I teach R

- The way I use R
  - Programmer time is most important.
  - Simplest is very often the fastest computationaly as well
  - Reuse of code.
- Data focused
  - results not details
- Base R
  - Because you need to know this to be effective.
- Tidyverse
  - Because this is better.

In this class R is

- Functional,
- Imperative, and
- Declarative.