R vs. Python for Data Science?

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Invited Talk
SDSS 2020

URL for these slides:
`http://heather.cs.ucdavis.edu/RvsPythonForDS.pdf`

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Where I'm coming from

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Thus a definite bias toward R, but am also an enthusiastic *Pythonista*.

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Overview

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Here I will argue in favor of R or Python on each of the below criteria. (If your favorite criterion is missing, please bring it up in Q&A.)

- Elegance.
- Learning curve
- Available libraries for Data Science
- Machine learning
- Statistical sophistication
- Parallel computation
- C/C++ interface and performance enhancement
- Object orientation, metaprogramming
- Language unity
- Linked data structures
- Online help

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Elegance

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Clear win for Python.

Personally, I really appreciate Python's clean lines:

```
if x > y:
    z = 5
    w = 8
```

versus

```
if (x > y)
{
    z = 5
    w = 8
}
```

Python class structure cleaner than the various R structures.

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- In Data Science, many people from backgrounds other than Computer Science or the like.
- Python, especially in usage of libraries, really requires some computer systems sophistication.

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- Of central importance, so I will elaborate here...

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Learning curve cont'd.

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Learning curve cont'd.

Example, trying to install Keras on one of my machines:

```
Found existing installation: pip 8.1.1
Uninstalling pip-8.1.1:
Successfully uninstalled pip-8.1.1
Successfully installed pip-7.1.2
```

It took a *working version* of the package installer **pip** and inexplicably *uninstalled it*, replacing it with an *older* version! Even a systems-savvy person like me might have trouble tracking down the problem.

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Learning curve cont'd.

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As an example, I asked a Python sophisticate to install a library for PHATE, a visualization tool, thinking what a novice would see:

> *I tried it...using PyCharm...as IDE. I started off with a fresh install on a new computer, and I did run into some problems...Numpy.distutils.system_info.NotFoundError: No lapack/blas resources found...[the problem] after doing some google searching... is coming from some missing dependencies. According to stack overflow, one way around this is...*

He did say things went much better with Anaconda, but to me his experience epitomizes the problem:
Python is unnecessarily requiring too much expertise in the user.

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Learning curve,xkcd

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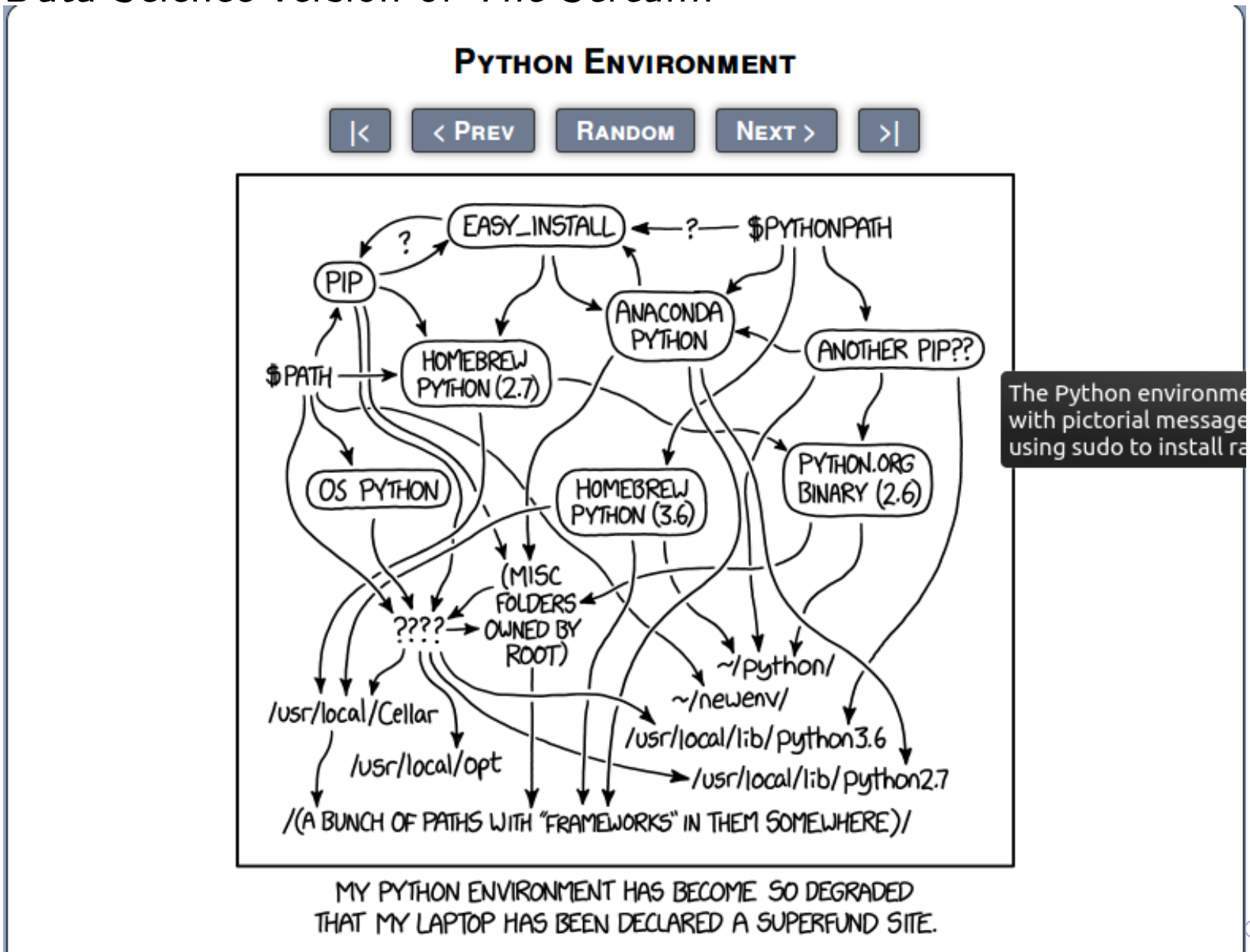
Data Science version of *The Scream*:



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- For many in ML, machine learning = neural networks.
- Since NNs have been developed mainly by CS people, the more sophisticated libraries, esp. for image classification, tend to be in Python.
- But random forests, gradient boosting etc. have been developed mainly by stat people, and R has excellent packages for these.
- Want to do NNs in R? RStudio put in a huge effort to develop the R **keras** package, and it's excellent. H2O too.

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- I find that Python ML people are more interested in the CS side of a method, e.g. fast sorting, than the probabilistic meaning of the model.
- They tend to downplay the stat, and often don't understand it.
- I was appalled recently to see one of the most prominent ML people state in his book that standardizing the data to mean-0, variance-1 means one is assuming the data are Gaussian — absolutely false and misleading.

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- Python currently has better GPU access.
- But still, R **parallel** package is much easier to use.

C/C++ interface and performance enhancement

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- But the versatility of R's Rccp is really much more powerful.
- And R's new ALTREP has tremendous promise.

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- To some degree, that split also falls along the lines of people who do statistics and those who view Data Science as graphics and data wrangling.
- I'm a skeptic re Tidy (*http://github.com/matloff/TidyverseSkeptic*), but no matter what one's view is, this split is not good for R.

Linked data structures

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- E.g. binary trees.
- Easy in Python, hard in R.
- Not common in Data Science.
- There is the R package **datastructures**.

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Online help

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- R's **help()** generally more helpful than Python's.
- Also, **example()**, vignettes.
- Same for R's *generic* functions. When I'm using a new package, I know that I can probably use **print()**, **plot()**, **summary()**, and so on, while I am exploring.

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A small example

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- OMSI online exam tool (*github.com/matloff/omsi*).
- Rather complex client/server app.
- Written by a highly talented team of students under my direction.
- I had them write the exam tool itself in Python, as I thought it would be easier to get top students who knew Python well.
- But I wrote the companion grading code, also rather complex, myself. And I wrote in R, my preference.
- Not a stat/Data Science app at all.
- Yet R was just as usable as Python in this app.
- Unlike some claims to the contrary, Yes, R in fact IS a "real" language!