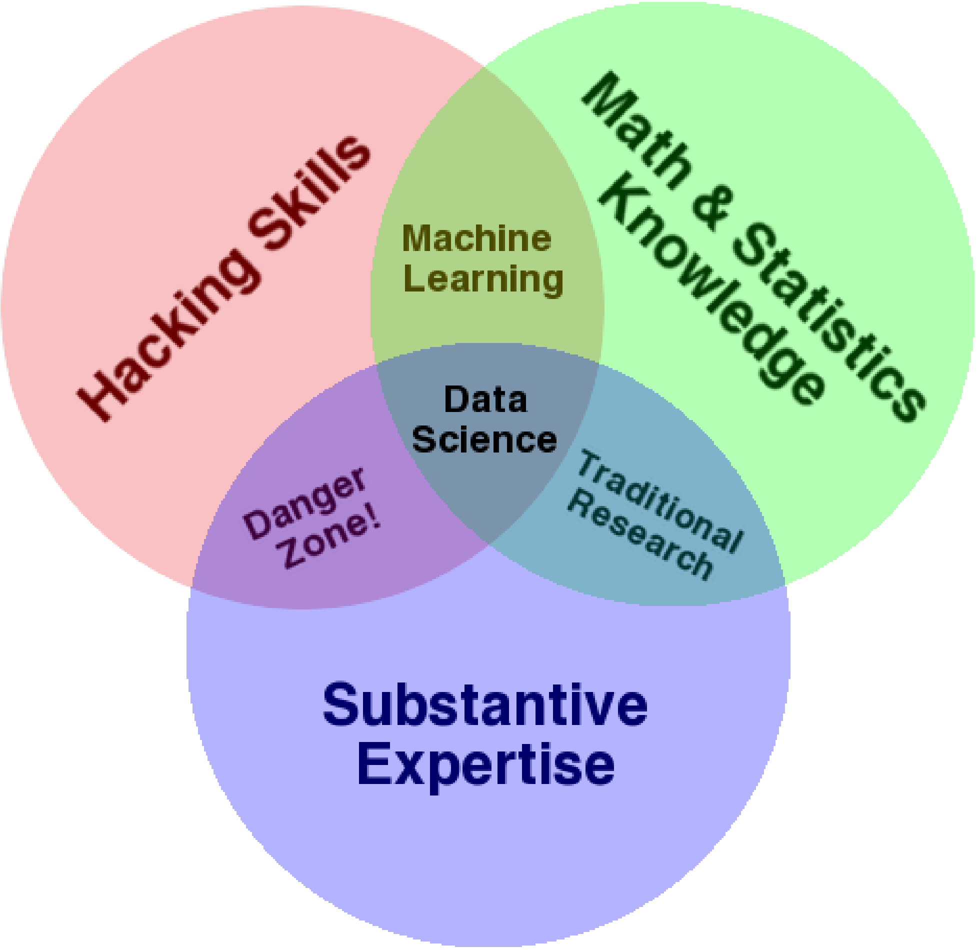
Everything you ever wanted to know about data science (but were too afraid to ask)

Chris Beeley

What is data science?

- “A data scientist knows more about computer science than the average statistician, and more about statistics than the average computer scientist”

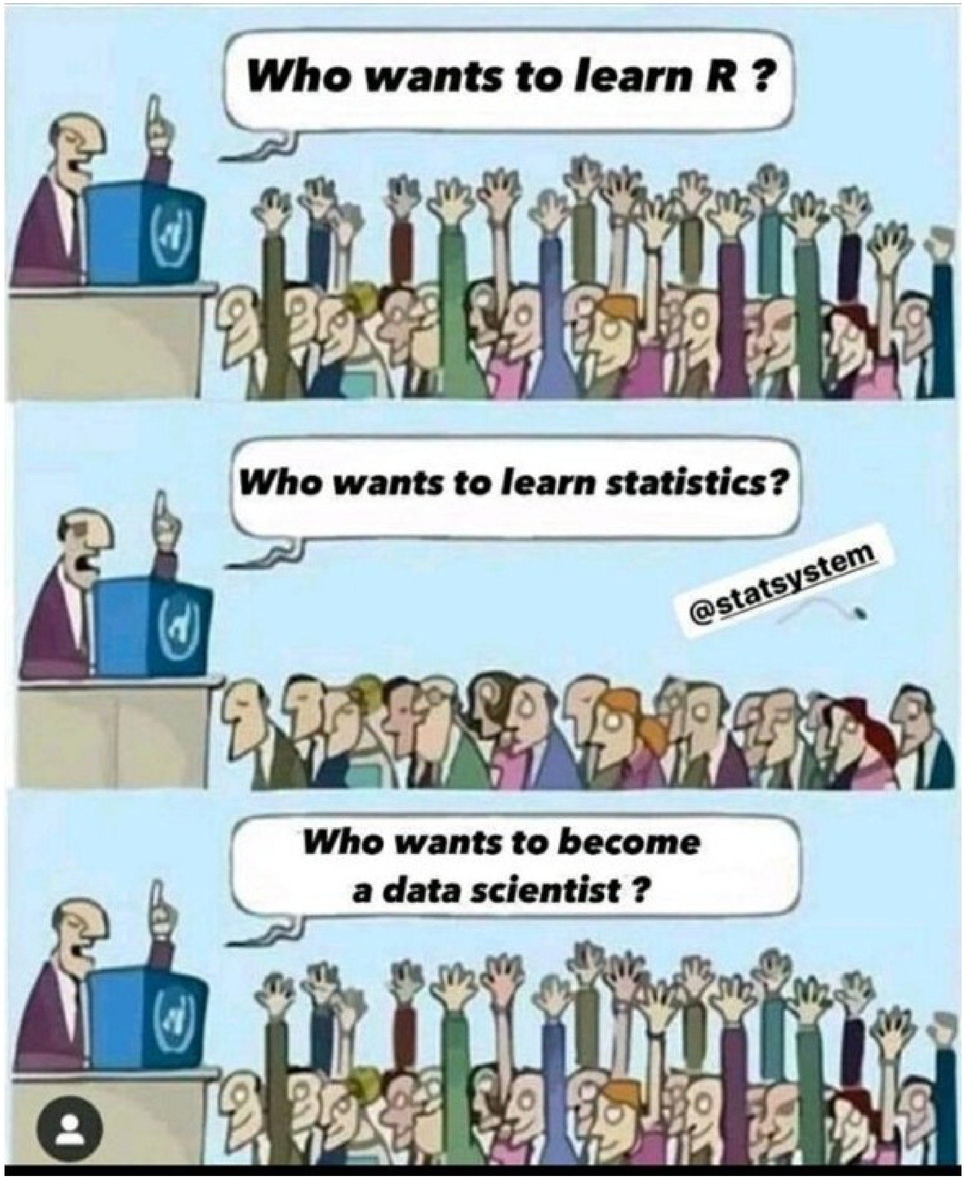
Drew Conway’s famous Venn diagram



Source

Around the web…

- The difference between a statitician and a data scientist? About $30,000
- … an actual definition of data science. Taking a database and making it do something else. (warning: this quote is me! 😉)
- Statistics done on a Mac


Who wants to learn R ?
Who wants to learn statistics?
@statsystem
Who wants to become a data scientist ?

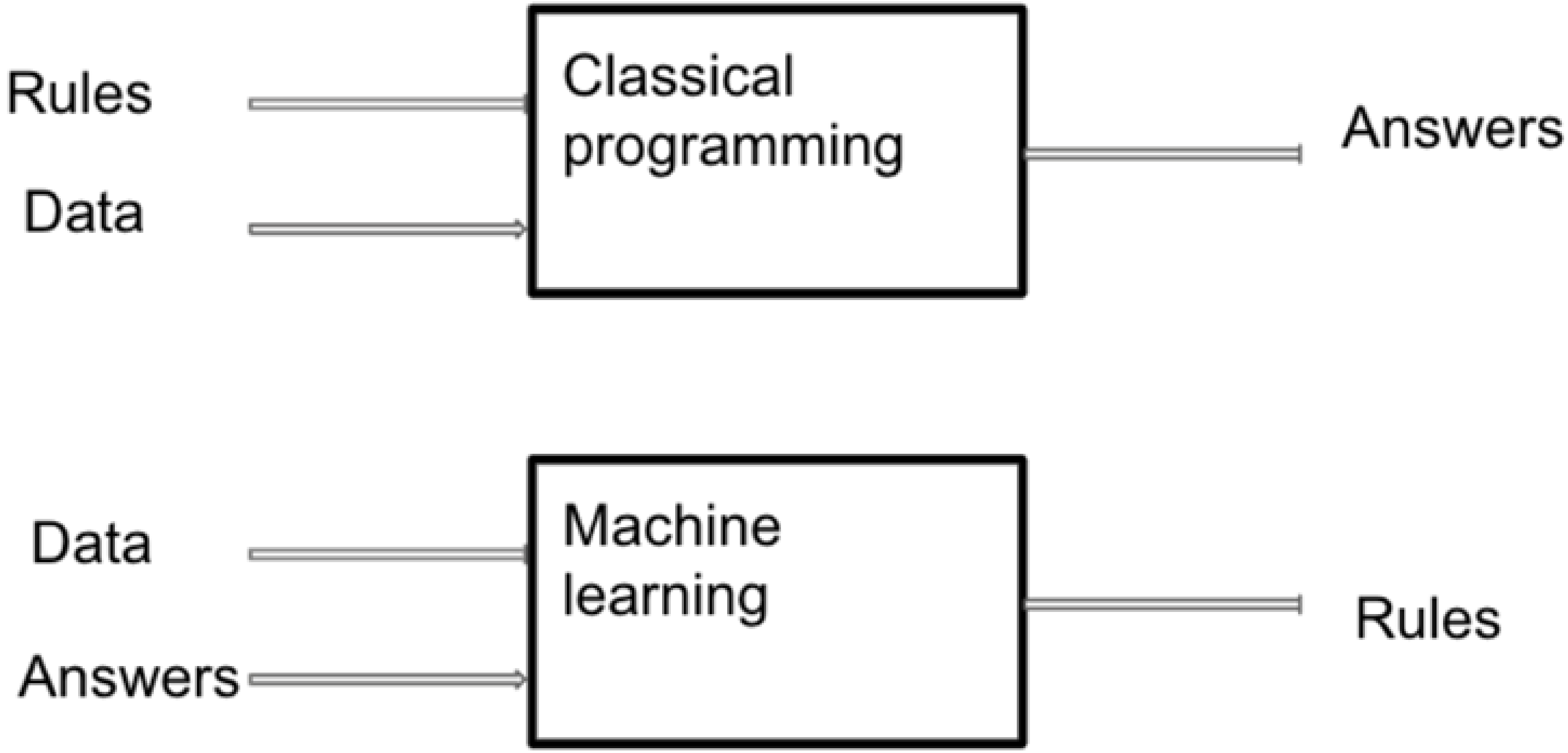
What are the skills of data science?

- Analysis
  - ML
  - Stats
  - Data viz
- Software engineering
  - Programming
  - SQL/ data
  - DevOps
  - RAP

What are the skills of data science?

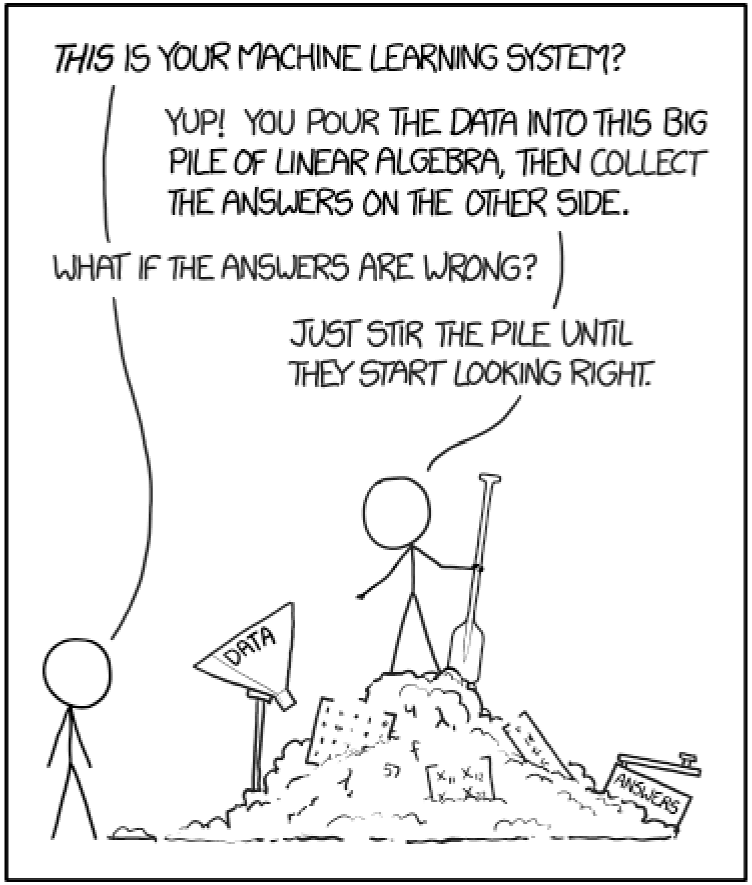
- Domain knowledge
  - Communication
  - Problem formulation
  - Dashboards and reports

ML


Rules
Data
Classical programming
Answers
Data
Answers
Machine learning
Rules

Source

Inevitable XKCD


THIS IS YOUR MACHINE LEARNING SYSTEM?
YUP! YOU POUR THE DATA INTO THIS BIG PILE OF LINEAR ALGEBRA, THEN COLLECT THE ANSWERS ON THE OTHER SIDE.
WHAT IF THE ANSWERS ARE WRONG?
JUST STIR THE PILE UNTIL THEY START LOOKING RIGHT.
DATA
ANSWERS

Source

- Google flu trends

Stats and data viz

- ML leans a bit more towards atheoretical prediction
- Stats leans a bit more towards inference (but they both do both)
- Data scientists may use different visualisations
  - Interactive web based tools
  - Dashboard based visualisers e.g. {stminsights}

Software engineering

- Programming
  - No/ low code data science?
- SQL/ data
  - Tend to use reproducible automated processes
- DevOps
  - Plan, code, build, test, release, deploy, operate, monitor
- RAP
  - I will come back to this

Domain knowledge

- Do stuff that matters
  - The best minds of my generation are thinking about how to make people click ads. That sucks. Jeffrey Hammerbacher
- Convince other people that it matters
- This is the hardest part of data science
- Communicate, communicate, communicate!
- Many of you are expert at this

Reproducibility

- Reproducibility in science
- The $6B spreadsheet error
- George Osbourne’s austerity was based on a spreadsheet error
- For us, reproducibility also means we can do the same analysis 50 times in one minute
  - Which is why I started down the road of data science

What is RAP

- a process in which code is used to minimise manual, undocumented steps, and a clear, properly documented process is produced in code which can reliably give the same result from the same dataset
- RAP should be:

> the core working practice that must be supported by all platforms and teams; make this a core focus of NHS analyst training

Goldacre review

Levels of RAP- Baseline

- Data produced by code in an open-source language (e.g., Python, R, SQL).
- Code is version controlled (see Git basics and using Git collaboratively guides).
- Repository includes a README.md file (or equivalent) that clearly details steps a user must follow to reproduce the code
- Code has been peer reviewed.
- Code is published in the open and linked to & from accompanying publication (if relevant).

Levels of RAP- Silver

- Code is well-documented…
- Code is well-organised following standard directory format
- Reusable functions and/or classes are used where appropriate
- Pipeline includes a testing framework
- Repository includes dependency information (e.g. requirements.txt, PipFile, environment.yml
- Data is handled and output in a Tidy data format

Source: NHS Digital RAP community of practice

Levels of RAP- Gold

- Code is fully packaged
- Repository automatically runs tests etc. via CI/CD or a different integration/deployment tool e.g. GitHub Actions
- Process runs based on event-based triggers (e.g., new data in database) or on a schedule
- Changes to the RAP are clearly signposted. E.g. a changelog in the package, releases etc. (See gov.uk info on Semantic Versioning)

Source: NHS Digital RAP community of practice

The data science “Unicorn”

- The maybe-mythical data science “Unicorn” has mastered:
    - Domain knowledge
    - Stats and ML
    - Software engineering

Data science is a team sport

- In my extended DS team I have:
- Stats and DevOps (and rabble rousing) [this one is me 😉]
- SQL, data, and training
- DevOps and programming
- Text mining, Python, and APIs
- Bilingual R/ Python, Shiny dashboards

Data science is an MMO

- Data scientists need help with:
  - Stakeholder communication and engagement
  - Qualitative analysis
  - Translating models and prediction into the real world
  - Evidence review and problem definition

Data science is an MMO

- Data scientists are an excellent help when you:
    - Need a lot of pretty graphs
    - Need the same analysis done 50+ times with different data
    - Have too much text and not enough time to analyse it
    - Want to carefully document your analysis and make it reproducible
    - Have a hideously messy, large dataset that you can’t hack together yourself

The team

Note