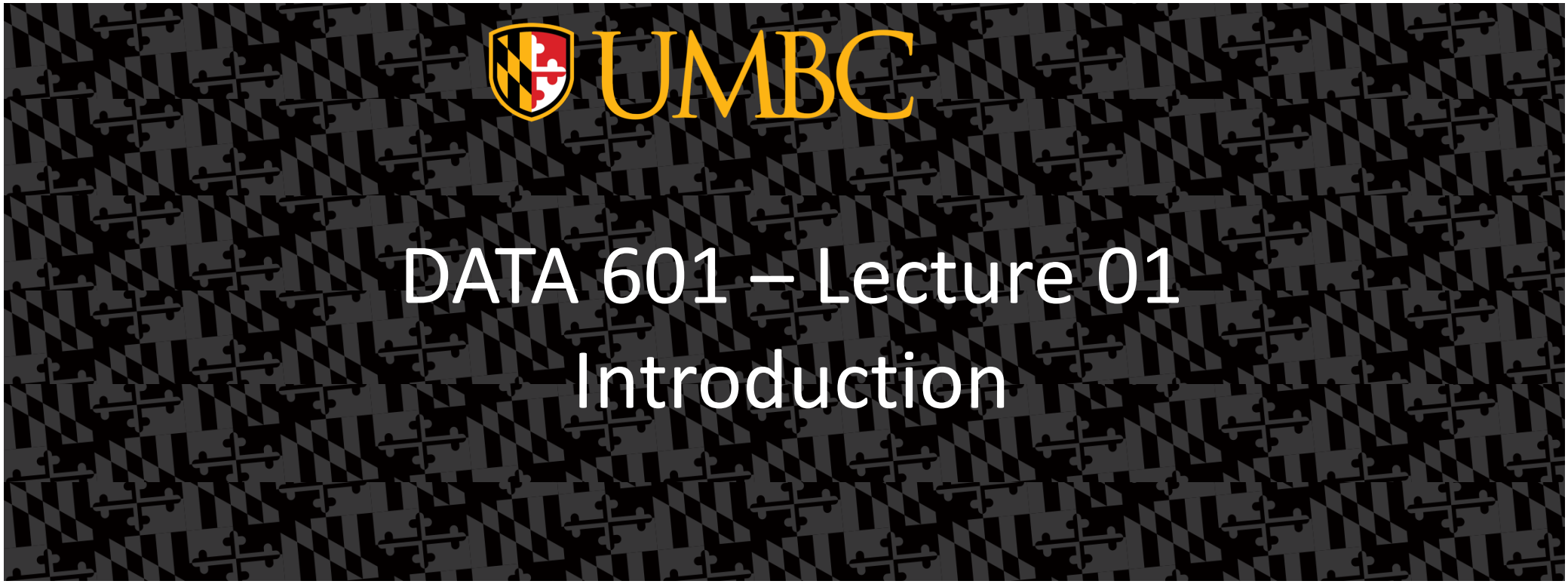


DATA 601 – Lecture 01
Introduction

Dr. Ergun Simsek

About me…

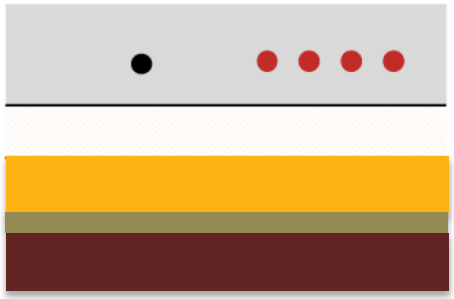
- Real Office: ITE 325 K
- Virtual Office: https://umbc.webex.com/meet/simsek
- Office Hours: Wednesdays 9:30 am – 11:30 am

- Resources: https://dil.umbc.edu/home/resources/graduate-tutors-fall-2021/

About me…

Machine Learning Exercises on One Dimensional Electromagnetic Inversion

Ergun Simsek, *Senior Member, IEEE*



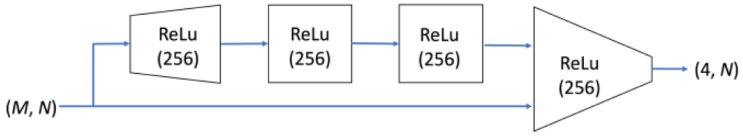
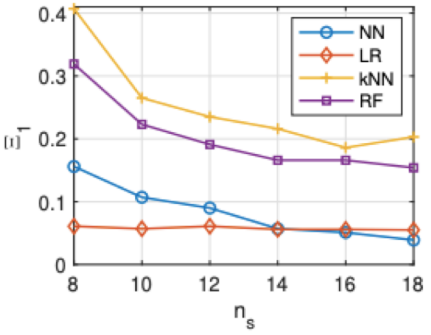
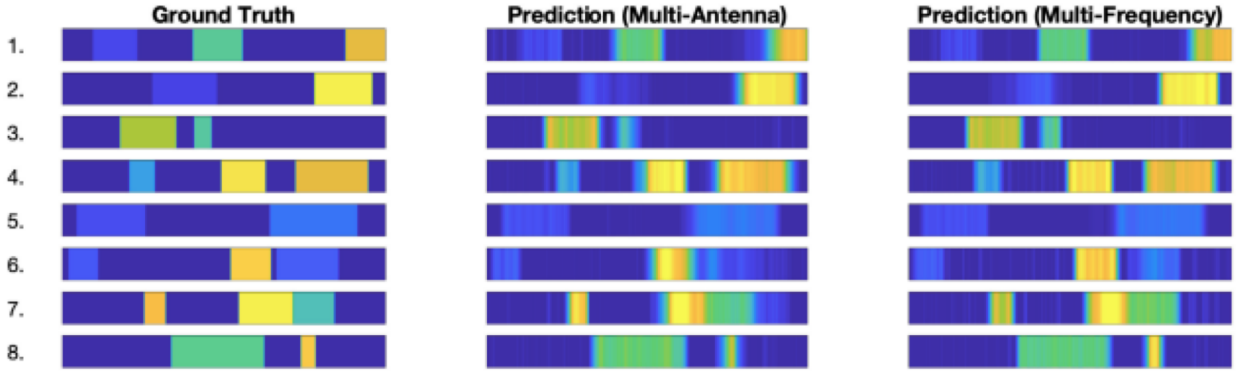


Fig. 3. The neural network implemented in this work has four layers all implemented with 256 neurons and ReLu activation functions. $N = n_s^4$ during training and $N = 1000$ during testing. $M = 10 \times n_r \times n_t$, where n_r and n_t are the number of receiver and transmitter antennas.

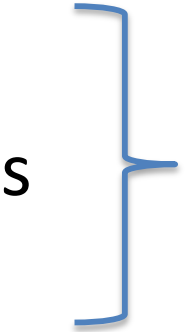




About You

Undergraduate degree in

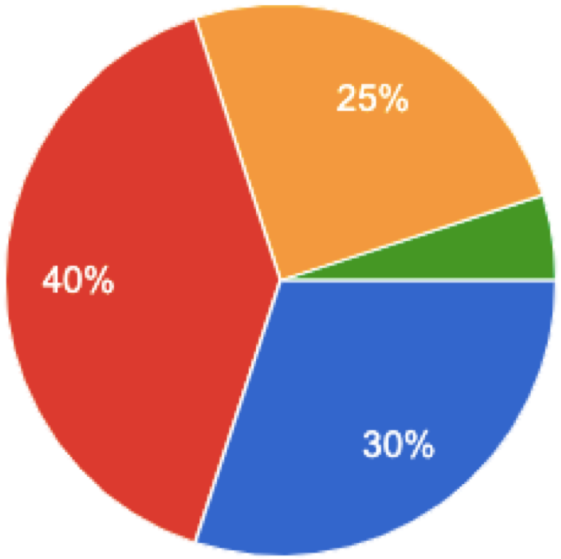
- 9 students: Computer Science (& Engineering)
- 8 students: Engineering and IT
- 1 student: Biology
- 1 student: Financial Economics
- 1 student: Mathematics



About You

What is your familiarity with shells/terminals?

20 responses

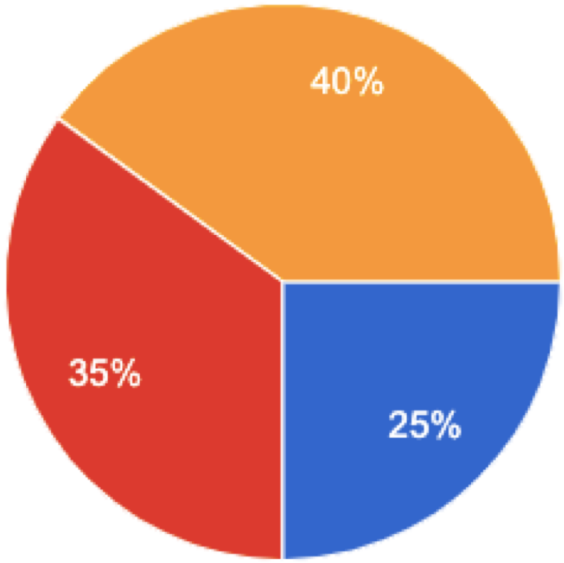


- I've never used them. What are they?
- I have a very little experience, like creating a folder, moving files from one location to another
- I am not an expert but I know enough.
- I have extensive experience.

About You

What is your python programming level?

20 responses



- Almost none
- I can write some short codes/scripts for my classes/work
- I am not an expert but I know all the fundamentals (data types, writing functions, plotting, etc,)
- I am a pro

From You

- *"… I am expecting in-depth knowledge from your course."*
- *"Well, I need some basics in Python"*
- *"… I have a good understanding of SQL programming."*
- *"I wish to be a Data Scientist"*

Ground rules

- Schedule: 7:10 – 7:55, Break, 8:00 – 8:45, Break, 8:50 – 9:40
- Also, it is acceptable to get up at any time and take a bathroom break
- I value being punctual (start of class, breaks, end of class; homework assignments; surveys)

- Raise your hand if you have a question
- Don't apologize for asking a question or for not knowing something

- I find it acceptable for you to occasionally not participate

- Tell me if you cannot hear me or if you cannot understand me
- Slides/notebooks will be provided after lecture (*Via BB?* Sure; *Via GitHub?* I am not sure.)

- I value your feedback:
  - Direct: verbal. Indirect: anonymous question/comment sheets on your desk

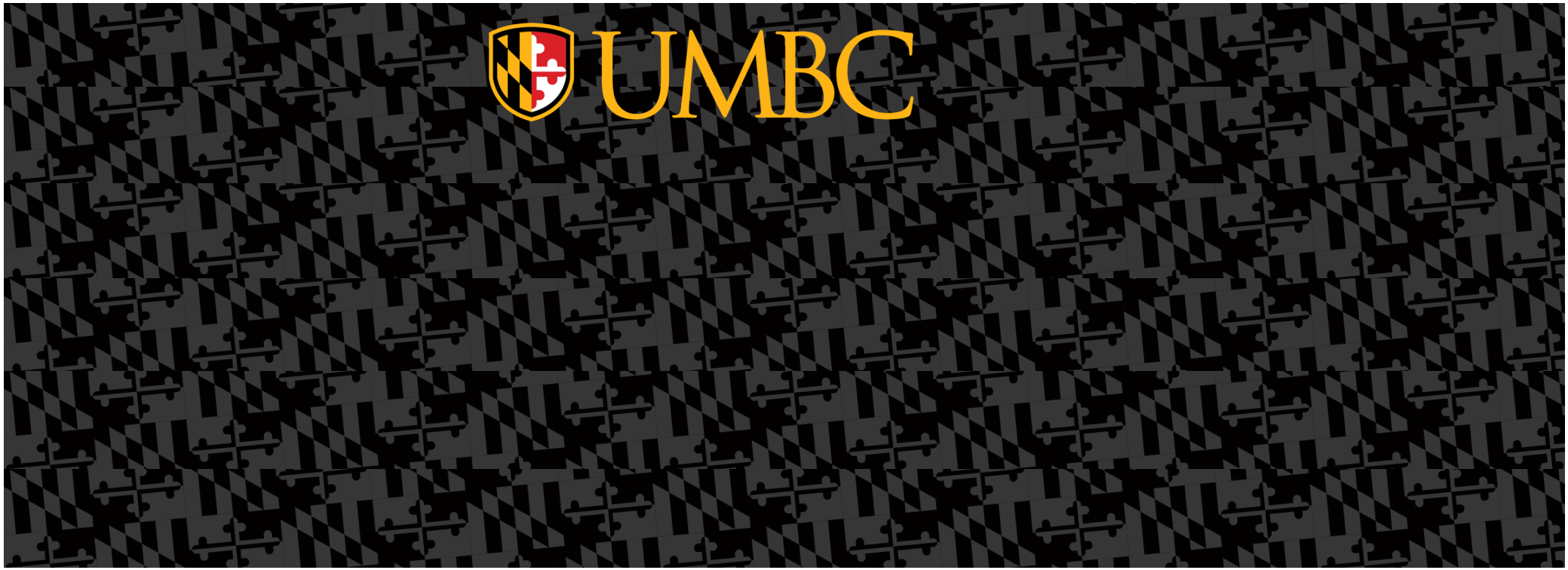
Schedule and Grading

- Note that our syllabus and weekly schedule are totally tentative. We might speed up, slow down, remove a subject, add a subject, etc.

- Tentative Grading
  - Attendance (Each lecture is 1%)
  - 4 Quizzes (Each quiz is 3%)
  - 7 Homework (Each homework assignment is 5%)
  - 2 Projects (Each project is 20%)

How can we make everyone happy?

- Since we are a diverse group of students, please let me know your suggestions to make everyone happy
- My initial ideas
  - To those students who already know the basics of Python programming, data structures, etc.
    - Adding extra and more challenging questions/projects
    - Asking to complete homework assignments in programming languages other than Python (R, scala, C, C++, Julia, ???)
    - Pairing them up with other students with less exposure

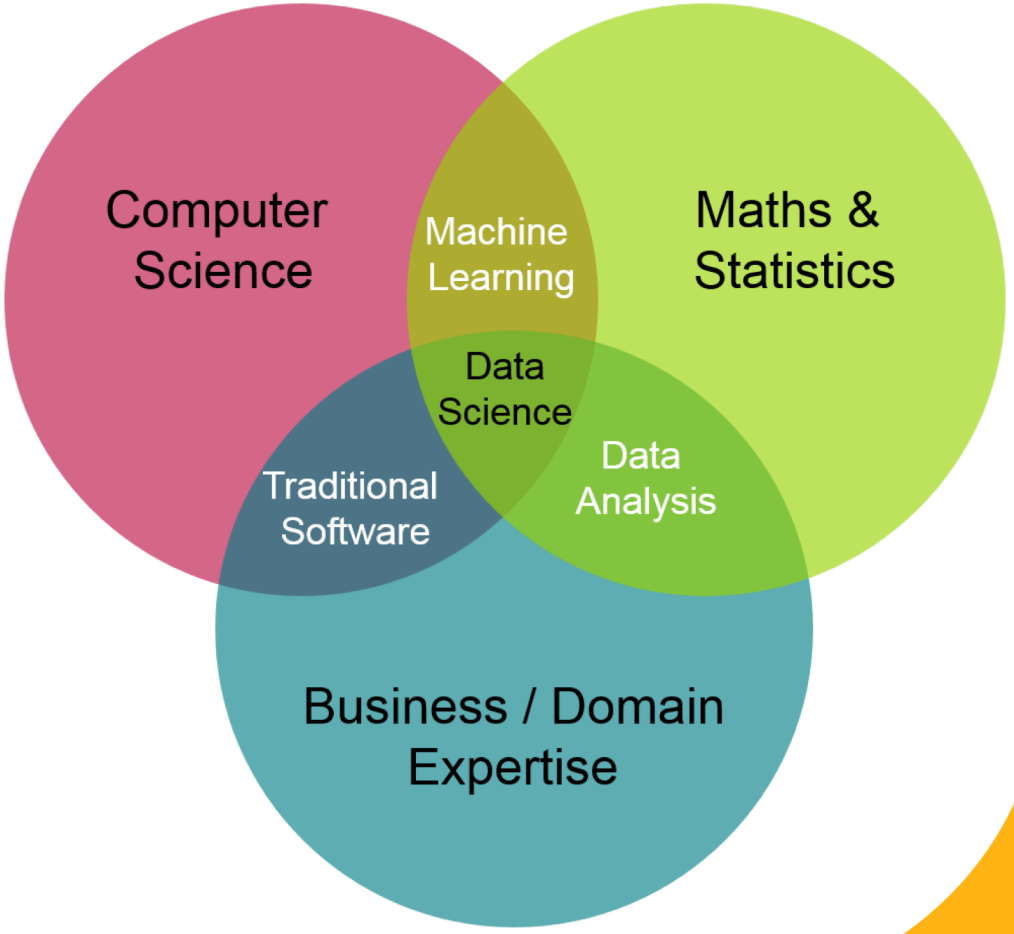


WHAT IS DATA SCIENCE?

What is Data Science?

… knowledge discovery from often large and complex data sets

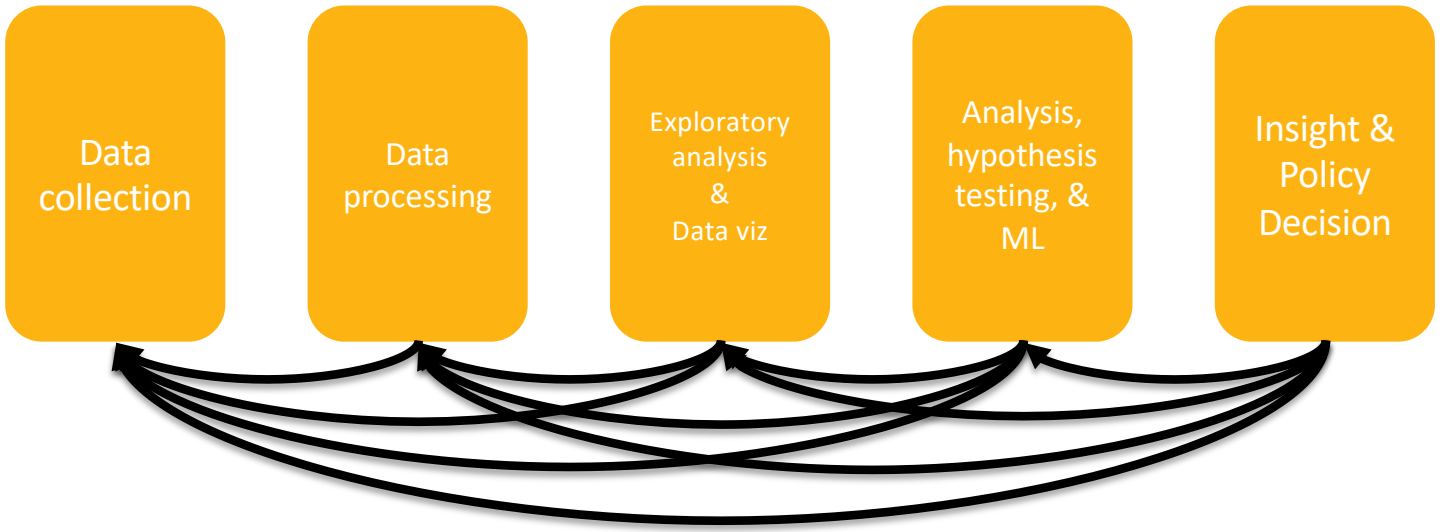
… interdisciplinary by nature, encompassing statistics, computer science, applied mathematics, and domain-specific tools



Data science is the application of computational and statistical techniques to address or gain [managerial or scientific] insight into some problem in the real world.

Zico Kolter
Machine Learning Prof, CMU

The Data LifeCycle



"The ability to take data—to be able to understand it, to process it, to extract value from it, to visualize it, to communicate it—that's going to be a hugely important skill in the next decades, not only at the professional level but even at the educational level for elementary school kids, for high school kids, for college kids."

Hal Varian
Chief Economist at Google

In This Course

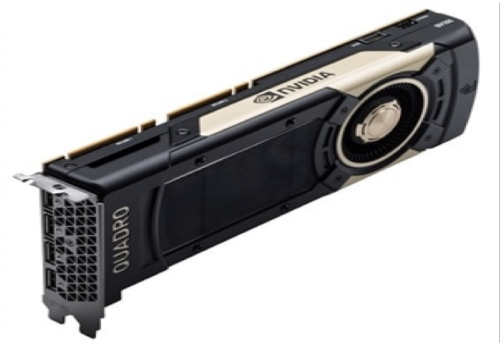
You'll learn

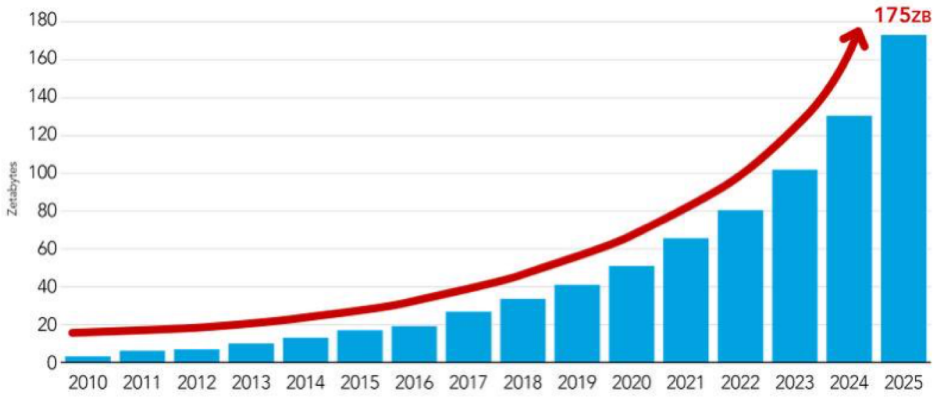
- Process the data
- Visualize it
- Understand it
- Communicate it
- Extract value from it (only using Linear Regression)

What you will not learn

- Anything we cover in DATA 602-605
- Security
- Languages other than Python

Why Now?

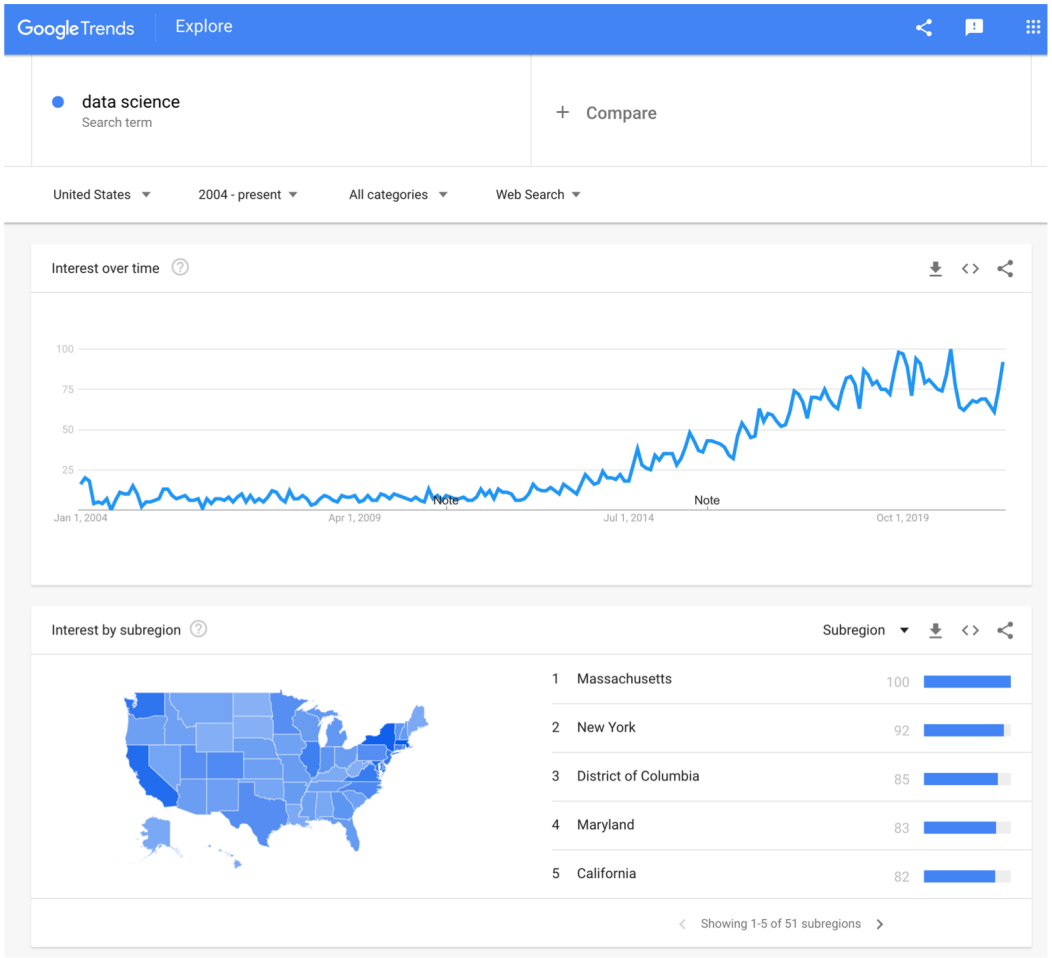




5MB – $50,000

1 TB - $60

Interest on Data Science



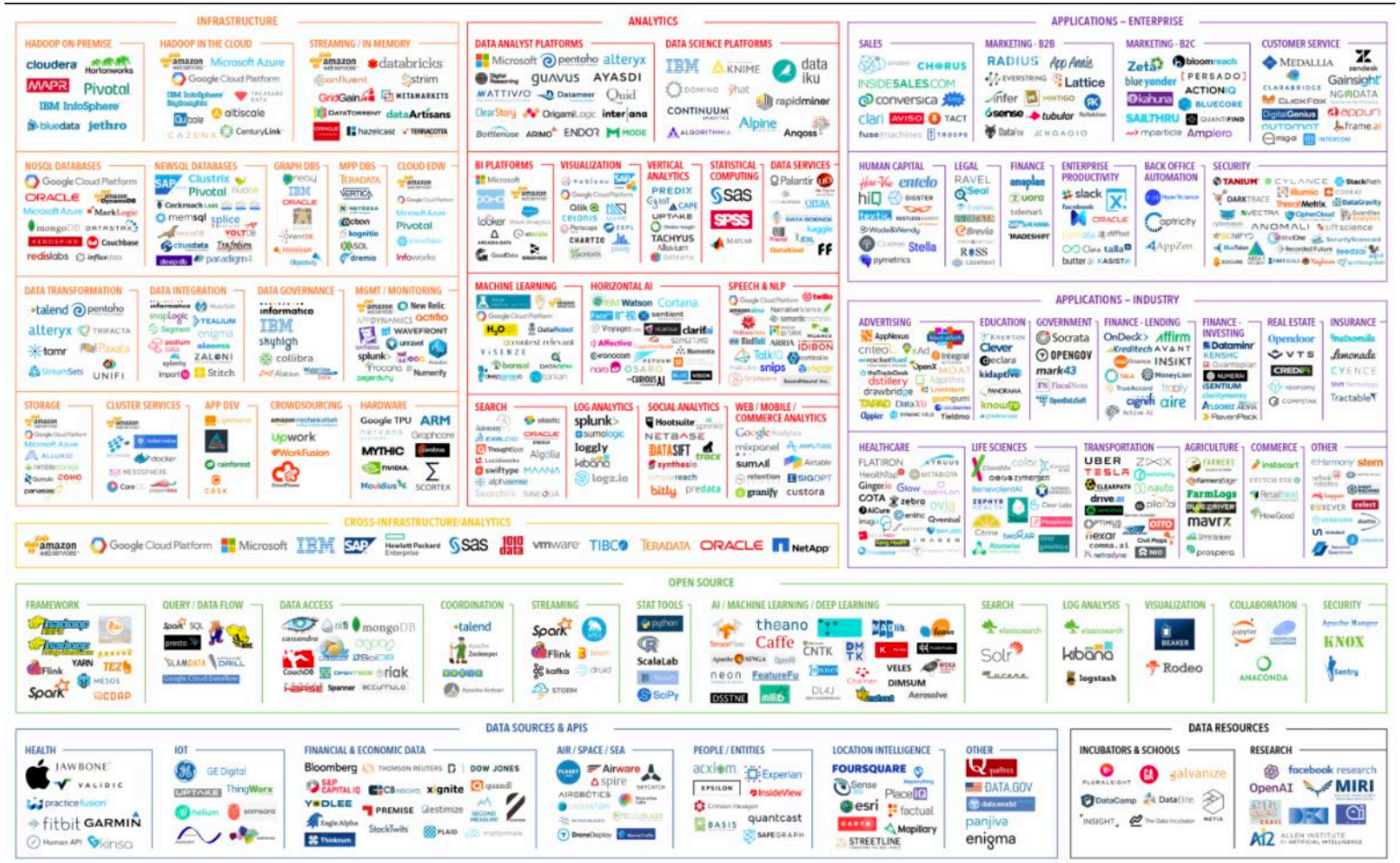
DS is an active field with lots of jargon

There will always be something you haven't heard of before.

- Know enough to be conversant with peers
- Be curious about new topics
- Research concepts and labels before using them

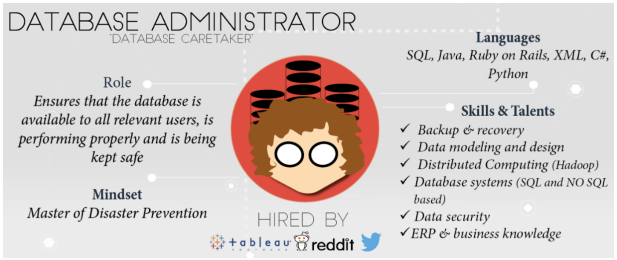
Reference: http://www.datascienceglossary.org/

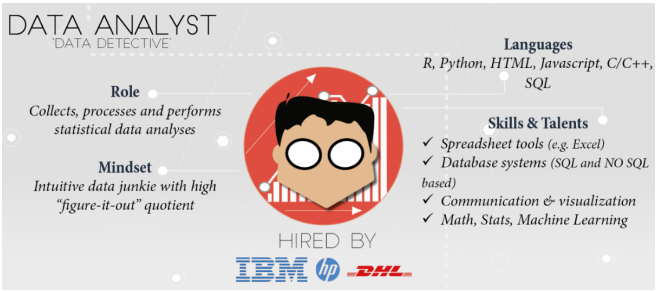
The World of DS is Huge. Don't get lost!

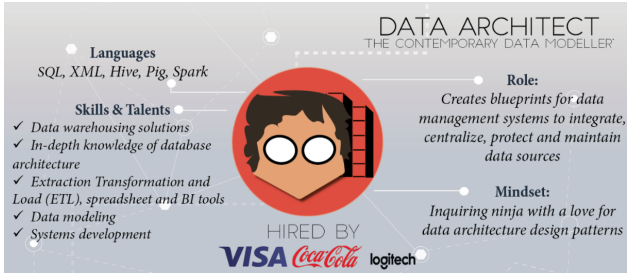


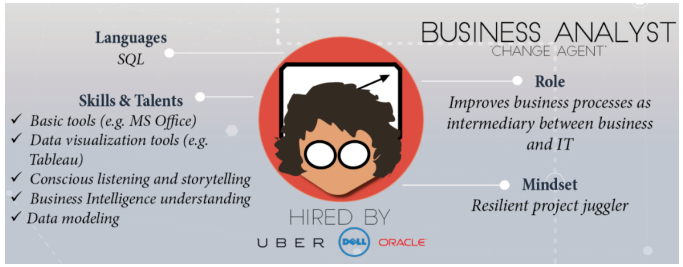
Skills and experience matter

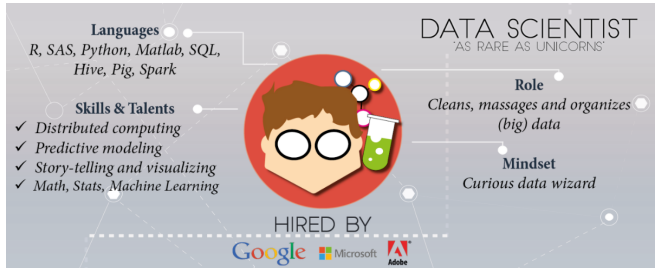
more than title and labels

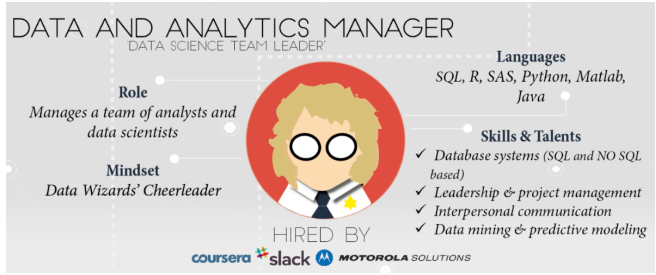












https://www.datacamp.com/community/tutorials/data-science-industry-infographic

Historical progression: data grooming, data mining, data scientist

Why learn data science?

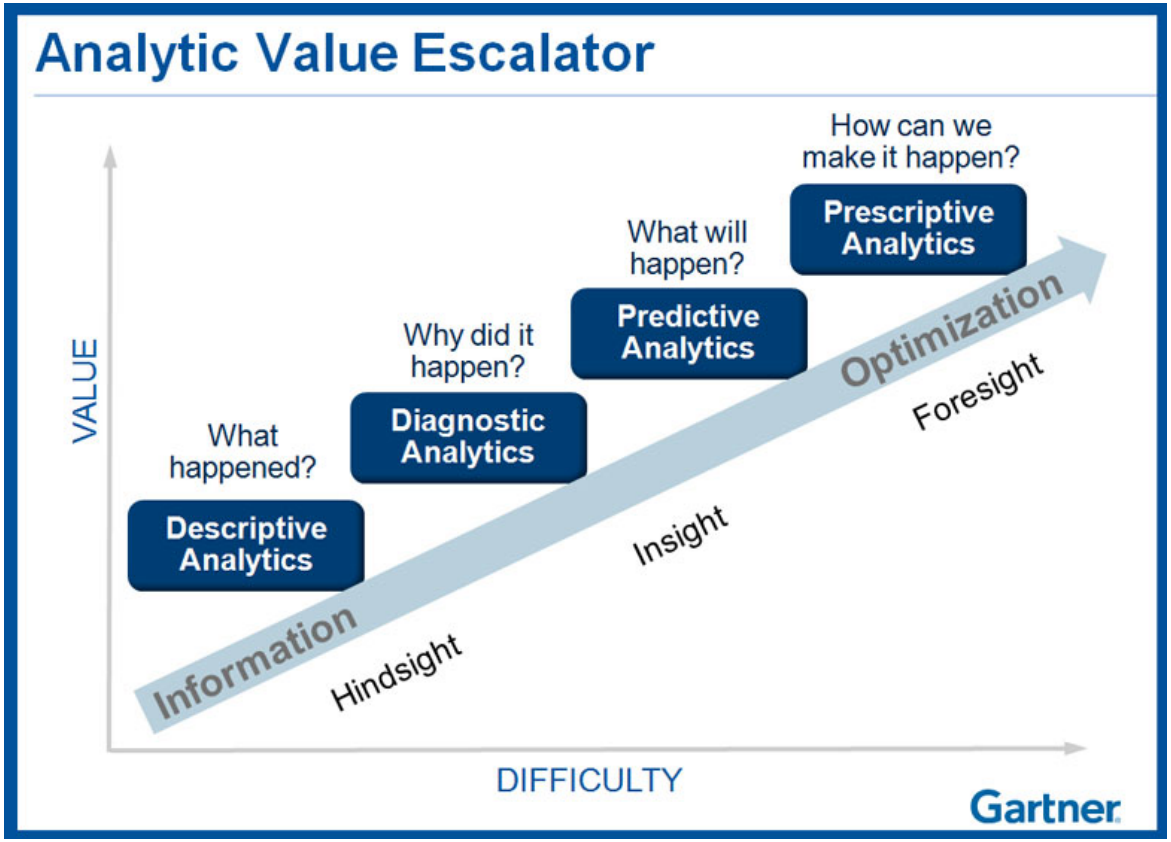
Explore: **identify patterns**

Predict: **make informed guesses**

Infer: **quantify what you know**

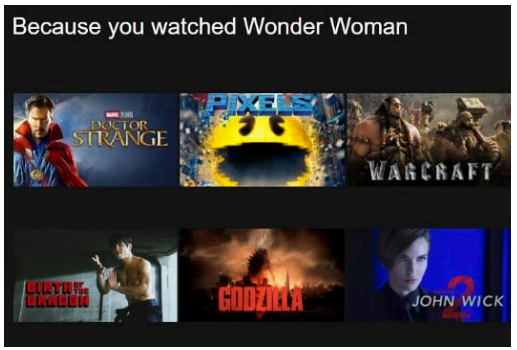
Motives:

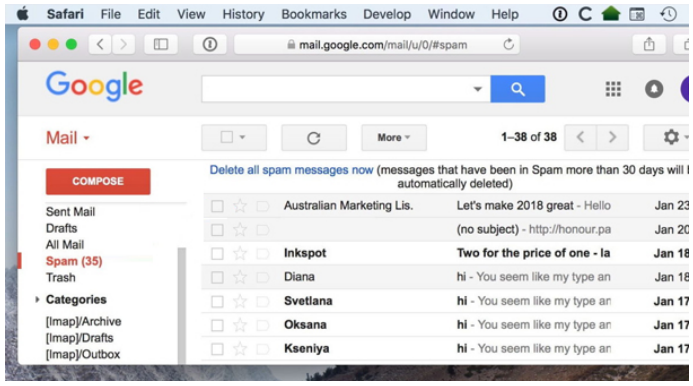
- Make money
  - Employment
  - Promotion
- Help people
- Gain new knowledge

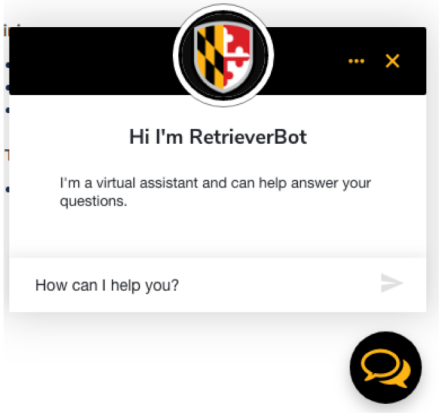


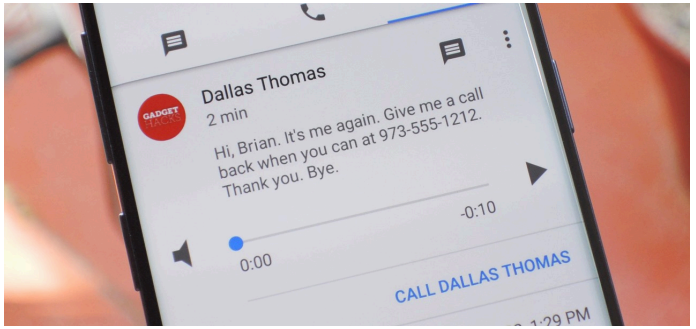
Large scale use cases with lots of data

- Google's search engine
- Bank and Credit Card fraud detection
- Logistics (DHL, UPS) of fleet management
- Healthcare records from patients









Each depends on availability of compute and data

Assumption in this class

- In class we will assume you are a lone data scientist on an island with an internet connection.

- This is not the typical case -- you'll have coworkers, customers, bosses, competitors, collaborators, peers.

Example of how class ≠ real world

- This class will not use competitive grading. (Imagine if it were.)
- As an employee at a company, you may be competing for a bonus or promotion

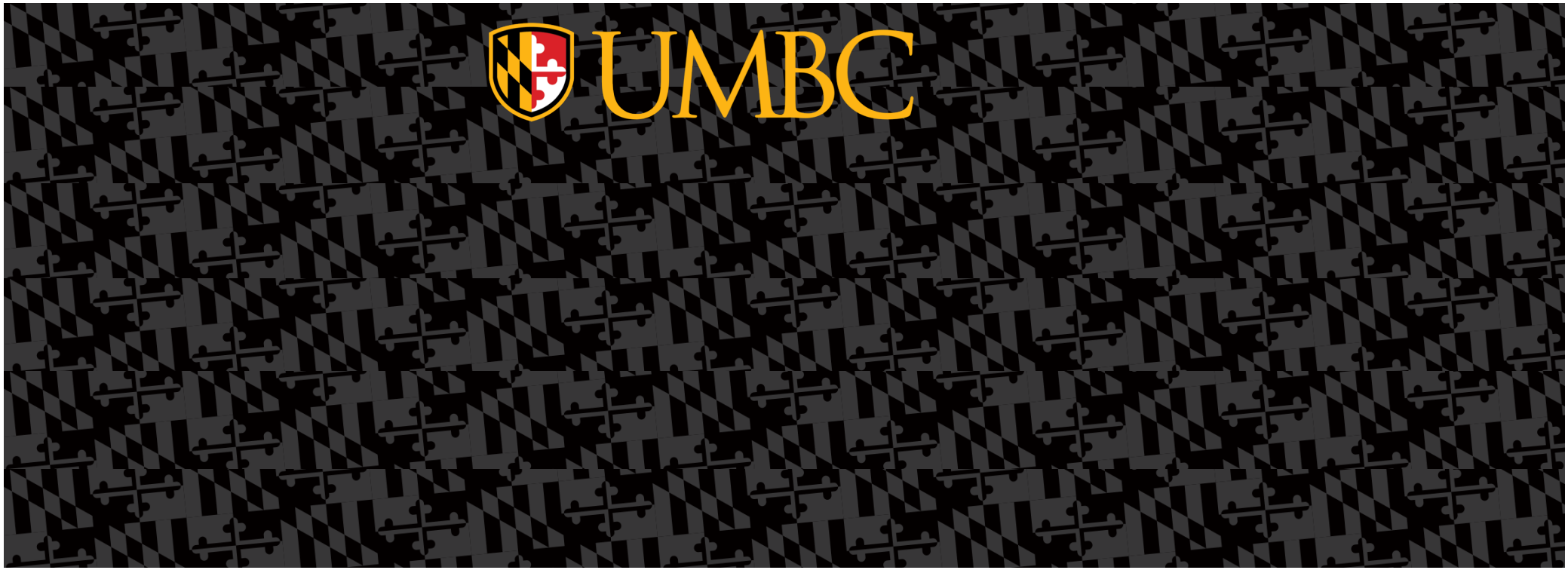
--> consequence: personal and organizational politics factor into the work environment

Small scale use cases with not much data

As a business employee or bureaucrat or politician

- How do I improve decision making process?
- How do I evaluate the outcome of decisions?
- How do I decrease the risk when faced with an opportunity?
- How do I convince other stakeholders of the best course of action?

While not taking too much time, spending too much money, using the resources I already have access to, and in a way that is convincing?



LOGISTICS

Logistics

Python with

- Anaconda
  - Jupyter
- Google Colab

- Google Drive
- GitHub or Blackboard

Why Jupyter + Python for Data 601?

Jupyter is useful for

- Exploration of data (*jargon*: EDA = exploratory data analysis)
- Documenting your activities (to enable reproducibility)
- Figuring out which software is relevant, which algorithms to use, which software libraries are useful
- Visualizing results

And both Jupyter and Python are free!
And both are widely used!

Python and Jupyter do not cover every use case

- For sufficiently large data sets, Jupyter and Python are not the right tool
- For sufficiently complex analytics, Jupyter and Python are not the right tool

Speed and security are typically not your priority during exploration

Knowing when to invest in switching tools is a skill

Evaluate trade-offs of flexibility and security and speed for a given scale

Relevance of infrastructure to data science

Usual explanation when replicating analysis:

1. Get this data
2. (*Documentation*) Apply this transformation to get result

No explanation of

- software used
- software versions
- configurations
- Implementation details

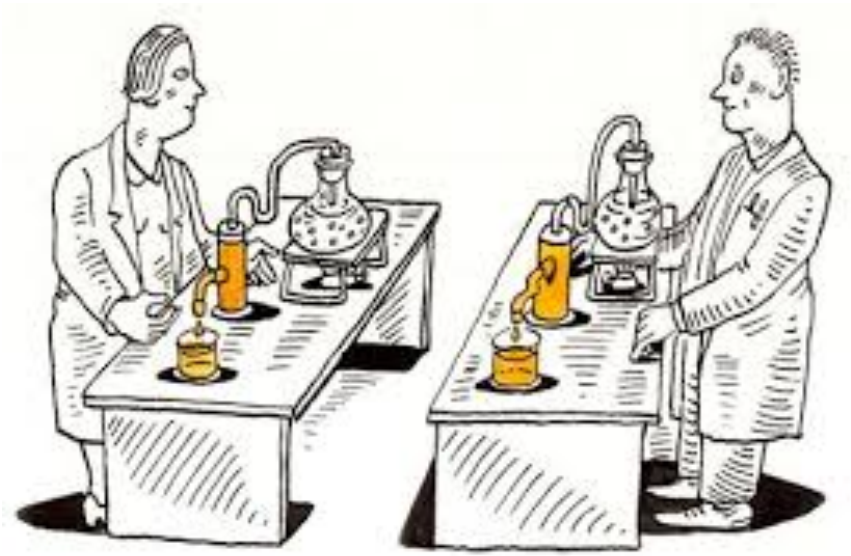
Digital archeology:
Suppose you are to diagnose why someone else's approach doesn't yield same results
Suppose they did their work 20 years ago

Infrastructure in data science to enable

Reproducibility and Portability

In addition to data and analysis, implementation and environment matters

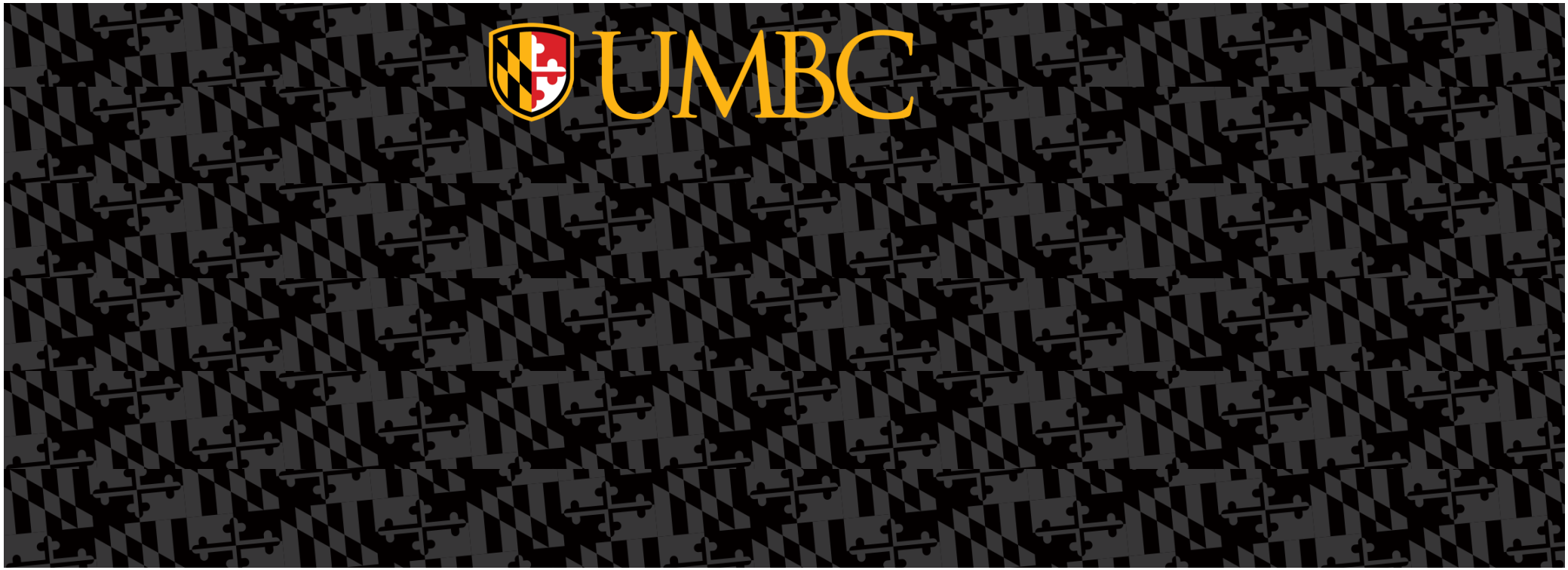
1. Use this Operating System
2. Install this software
3. Configure software this way
4. Add these packages
5. Get this data in this format
6. Run analysis against data
7. Create plots
8. Generate report



Best practices: Version control

- Reproducibility applies to your own attempts (not just other people)
- Regardless of how you develop analytics, you'll be creating or editing software and documents.
- [*lesson*] Regardless of how you implement best practices, avoid inventing solutions for which someone else already provided a path.

Suggested resource: https://try.github.io/



SOFT SKILLS

DS is more than Math and Software

Human interaction in data science

- Discovering stakeholders
- Negotiating with data owners
- Customer engagement

https://hbr.org/2017/01/the-best-data-scientists-get-out-and-talk-to-people

Iterating with customers

- As a data scientist, you'll often be working for someone other than yourself.
- Expect under-specified requirements from customers. Iterate.
- Provide incomplete solutions rather than waiting until the product is perfect.

https://en.wikipedia.org/wiki/Minimum_viable_product

When to persist,
When to change course,
When to seek help

Try attacking the challenge for 30 minutes

Then seek help or do something else for a while

https://en.wikipedia.org/wiki/Pomodoro_Technique

Pro-tip when seeking help

How to ask well-formed questions:

https://stackoverflow.com/help/how-to-ask

[Intentional sidetrack to StackOverflow.]

Ask technical questions:

- *Poor*: "I don't understand Python dictionaries" (--> online tutorials)
- *Better*: "When is it appropriate to use a key-value pair?"

- *Poor*: If I submitted this assignment as is, what score would I get?
- *Better*: I am planning to submit the attached assignment, but currently there's an error in the third cell. I've searched online but don't find any references to the error message. Can you provide guidance?

Emotions in Data Science

- As a data scientist, most of your time will be spent in a desert of uncertainty, frustration, and doubt.

- There will be rare short-lived interspersed spikes of excitement and happiness due to events like getting a new dataset, creating a new analytic, getting a new result, or being thanked by a stakeholder.

This experience is normal and does not go away.

See also the psychology of slot machines

Reading Suggestions

1. 50 years of data science
2. A Very Short History Of Data Science

Action: Read, write, tell

News and blogs

https://www.kdnuggets.com/
https://news.ycombinator.com/
https://hackernoon.com/
https://www.reddit.com/r/datascience/
https://dataelixir.com/newsletters/
https://insidebigdata.com/
https://ai.googleblog.com/

Some Online Resources

- Meetups
  - https://www.meetup.com/topics/data-science/
  - https://www.meetup.com/DataWorks/
  - https://www.meetup.com/Statistical-Seminars-DC/
- Others
  - Salaries: https://www.burtchworks.com/category/salary/
  - A weekly social data project in R: https://github.com/rfordatascience/tidytuesday

- Datasets to work with
  - https://datasetsearch.research.google.com/
  - https://datacatalog.worldbank.org/
  - https://opendata.maryland.gov/