Data Science: Interdisciplinary Opportunities for Education and Development

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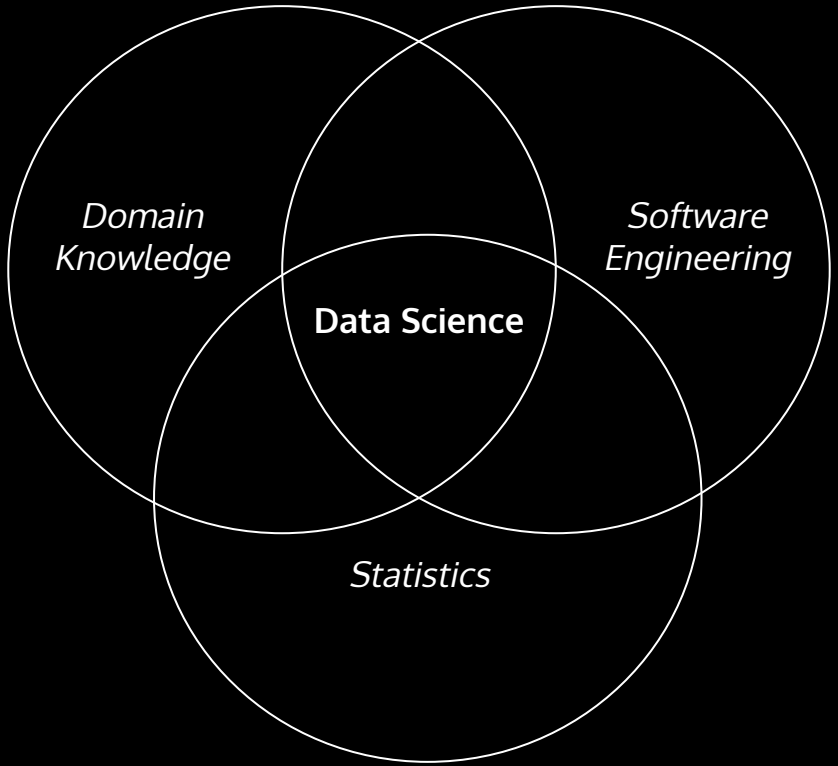
What is Data Science?

All science is data science. However, when we talk about data science as a discipline, we define it as the study of extracting value from data.

Data Science ≠ Machine Learning

Machine Learning ⊂ Data Science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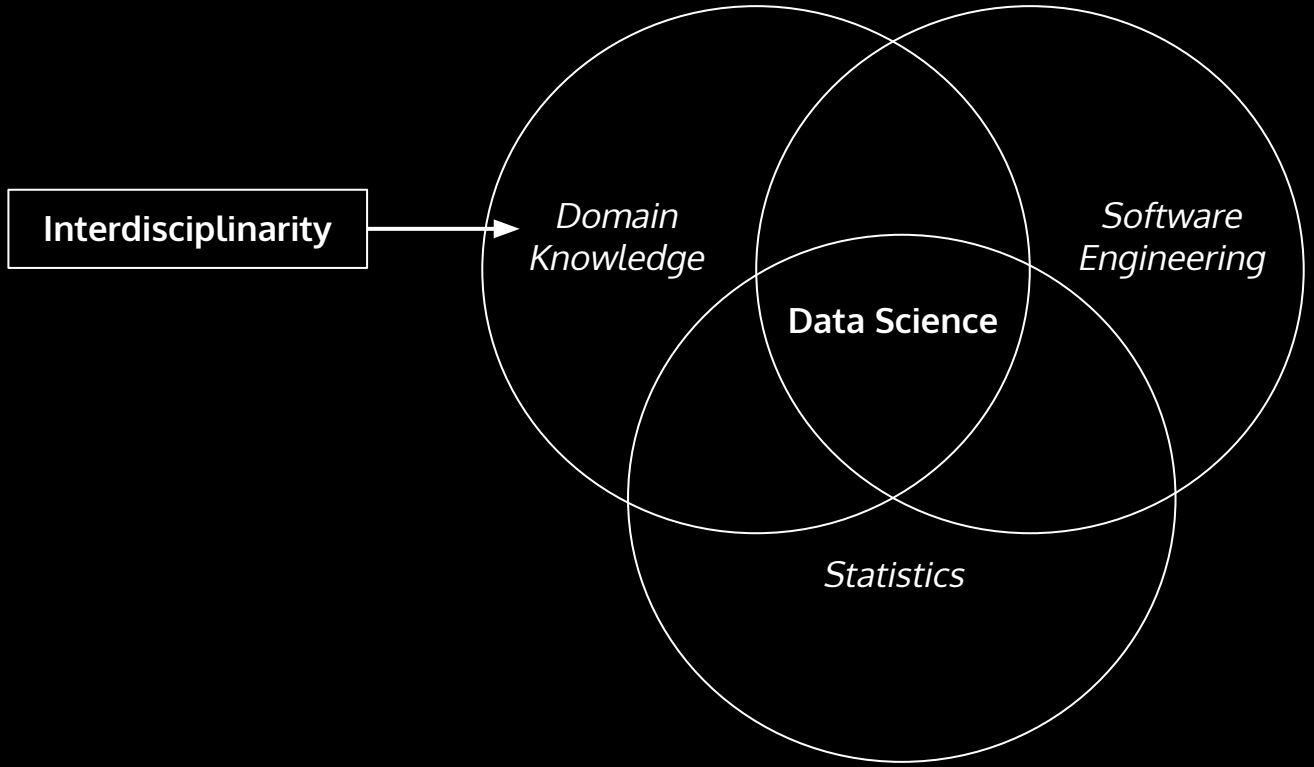
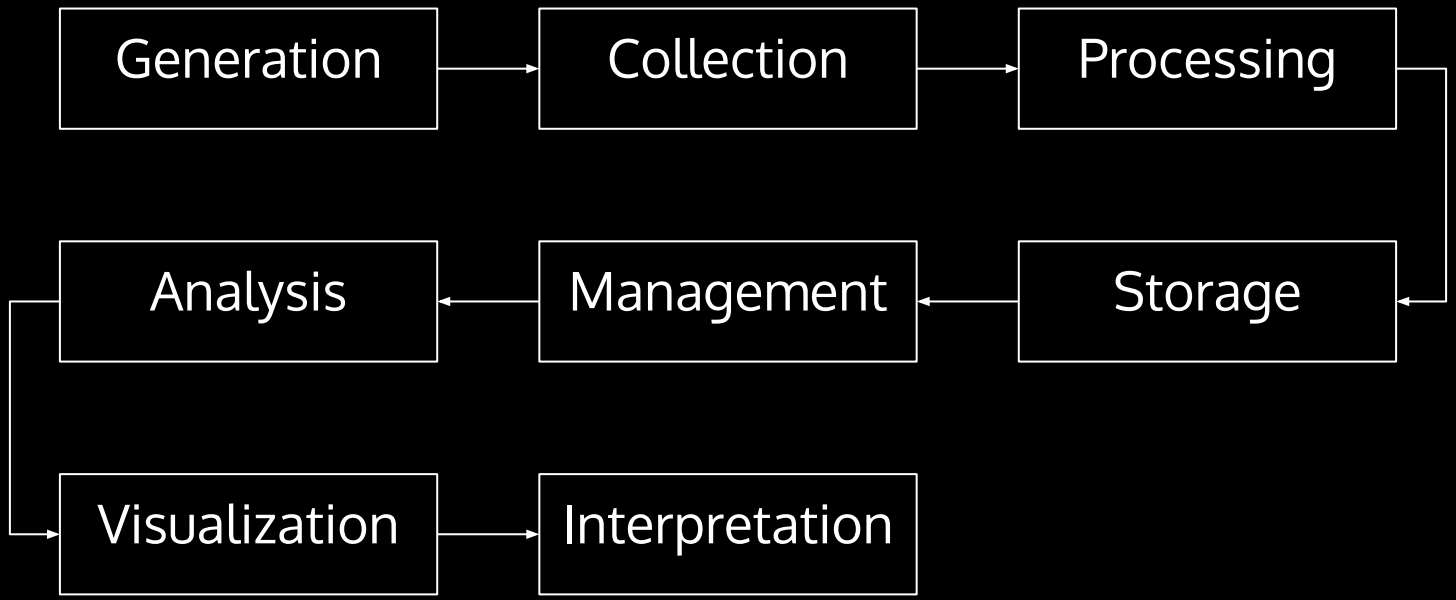
Engineering
Data Science
Statistics


Interdisciplinarity
Domain Knowledge
Software Engineering
Data Science
Statistics

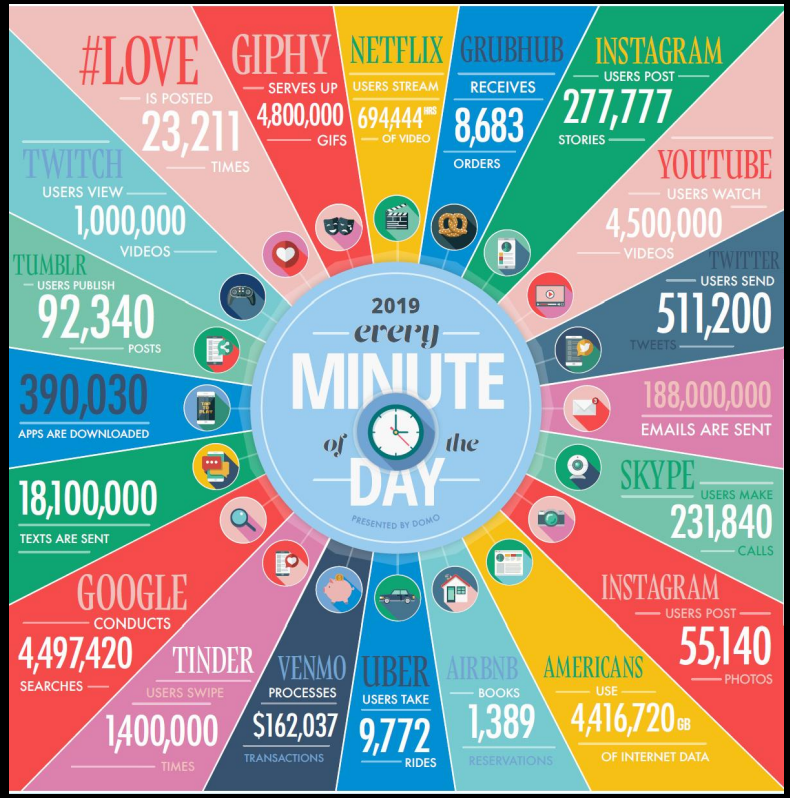
The Data Life Cycle



The Data Life Cycle: Generation

- Digital interaction
- Sensors and automated systems
- Scientific instruments and experiments

By 2025, we'll be generating about 463 EB (10^{18} bytes) of data every day.



Graphic: The Visual Capitalist

The Data Life Cycle: Collection

There are two types of data collection: structured and unstructured.

With structured collection, we utilize purpose-built systems such as Application Programming Interfaces (APIs).

However, if the data that you need isn't being conveniently served by an API, you might have to go through ad-hoc routes such as web scraping: this is what we call unstructured collection.

The Data Life Cycle: Processing

An often under-emphasized yet major part of the process: data scientists spend a significant portion of their time at this stage!

Terms you may have heard of that are relevant to this phase: “data cleaning”, “data wrangling”, and “data munging”.

The Data Life Cycle: Storage and Management

We often separate this phase into a separate discipline and call it “Data Engineering”.

Data engineering primarily consists of working with database systems as well as creating metadata, such as indexes.

The Data Life Cycle: Analysis

This is where some of the more popular aspects of data science come in: basic statistics, network analysis, statistical inference, machine learning, artificial intelligence, and more.

Doing data analysis requires having at least *some* knowledge of statistics and algorithms.

The Data Life Cycle: Visualization and Interpretation

Essentially, any data science project is about storytelling. Communicating findings, results, and predictions through easy-to-understand materials is crucial.

Data visualizations aren't just plain old charts and plots any more, either. *Interactive* visualizations and dashboards can themselves become complex projects.

Privacy and Ethics

Privacy and ethical concerns can come up all through the data life cycle. Preserving privacy and avoiding biased decision-making are hard challenges.

There is significant research and innovation starting to happen in these areas.

Tools of the Trade: Programming Languages

Tools of the Trade: Development Platform

Learning and getting comfortable with the Unix command line is essential.

Tools of the Trade: Useful Python Libraries

base python	pandas	matplotlib	scikit-learn
	sqlalchemy	seaborn	keras
		plotly	tensorflow
			pytorch

Getting Started with Data Science Research

- Gain basic familiarity with tools
- Build example projects
- Find or collect interesting datasets
- Establish hypotheses/research questions
- Run experiments
- Document project

Recommended Resources

- Python basics on codecademy: https://www.codecademy.com/learn/learn-python
- Bash guide for beginners: https://www.tldp.org/LDP/Bash-Beginners-Guide/html/
- The Python Data Science Handbook: https://jakevdp.github.io/PythonDataScienceHandbook/
- Data Science from Scratch, 2nd Edition, by Joel Grus
- Head First Statistics, by Dawn Griffiths
- Datasets, examples, and competitions: Kaggle https://www.kaggle.com/
- A programmer's best friend: StackOverflow https://stackoverflow.com/

Thank You

Slide deck available at
https://munifmujib.github.io/emk-data-science.pdf