Introduction to Data Science

Data Science Essentials

NASHVILLE
SOFTWARE
SCHOOL

Meet your instructors!

Michael Holloway is a mathematician turned data scientist. Michael holds a PhD in Mathematics from the University of Tennessee, Knoxville and a Masters from Tennessee Technological University. Michael loves the challenge and excitement of keeping up with the ever-evolving landscape of data science. Prior to joining Nashville Software School in April 2019, Michael served as an Assistant Professor in the Department of Mathematics at Saint Augustine's University.

Mahesh Rao is a neuroscientist turned data scientist. Mahesh received his PhD in Biological Sciences from Vanderbilt University before starting as a data scientist at Amira Learning, where he worked to develop their data science pipeline and machine learning models. He's a lifelong learner who enjoys taking an interdisciplinary approach to new problems. Mahesh couldn't stay away from NSS and is excited be a part of the growing data community in Nashville.

NASHVILLE
SOFTWARE
SCHOOL

- Your name
- The place you call home
- Something people are usually surprised to discover about you

Classroom rules

- Ask lots of questions
- Help each other; learn from each other
- Coding tasks are a guide
  - You **don’t** have to get them **all** done
  - You **can** form your own ideas and do your own exploration beyond what has been suggested

Class format

- Review of previous coding tasks
- Concepts/Code Lecture
- Coding tasks
- Interactive with instruction team!

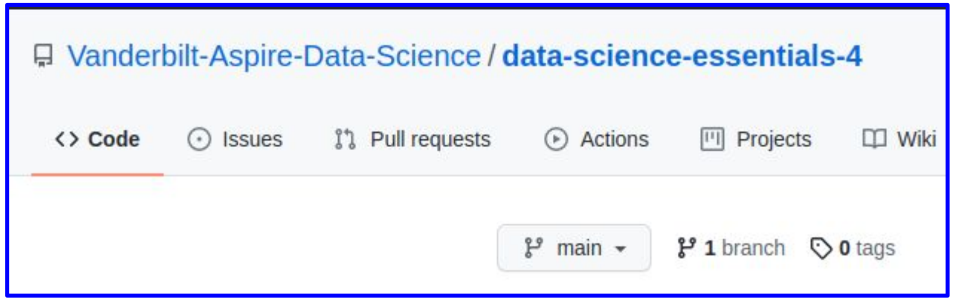
Goals for the class

- Get hands-on experience of what it might be like to work as a data scientist
- Get an idea of whether or not this might be a good fit for a career
- Make discoveries and have fun

Goals for today

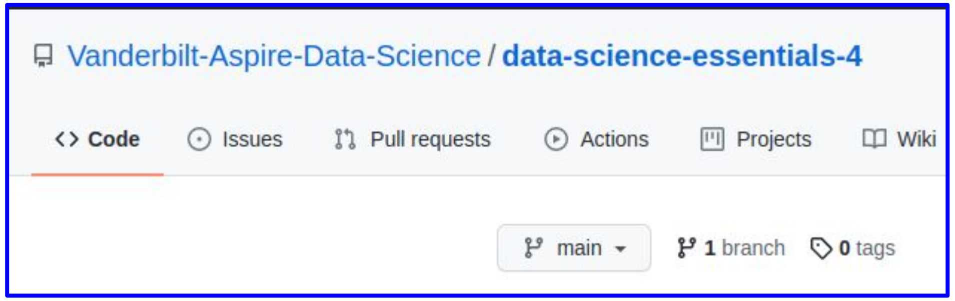
- Pull new materials from the class repo
- DM us your github account name on Slack
- Define Data Science and the Data Science Process
- Understand the project questions
- Learn a little *pandas*
- Work on the coding tasks for this week

Class Repository on GitHub



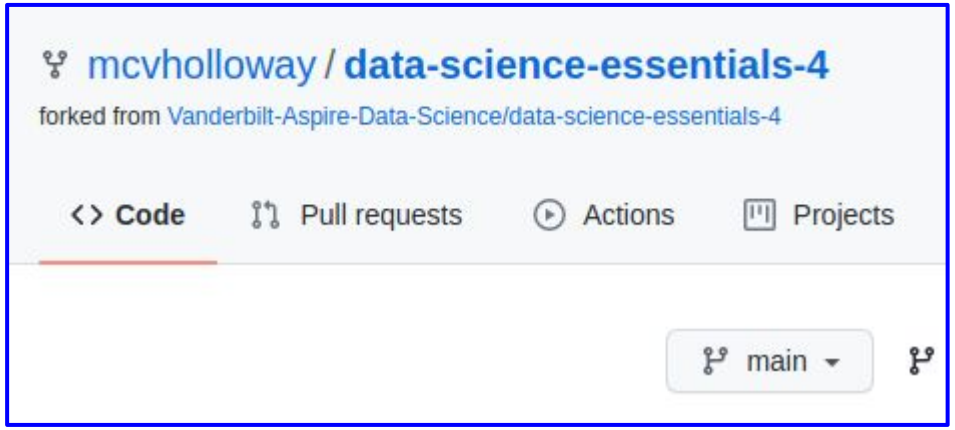
Vanderbilt-Aspire-Data-Science / **data-science-essentials-4**

Class Repository on GitHub


Vanderbilt-Aspire-Data-Science / data-science-essentials-4

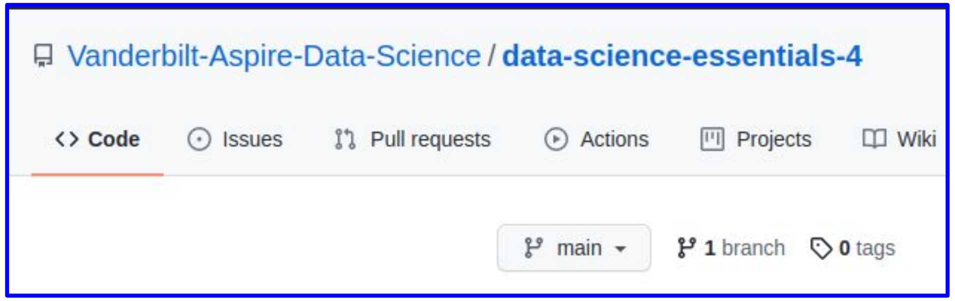
Fork

Personal Repository on GitHub


mcvholloway / data-science-essentials-4

forked from Vanderbilt-Aspire-Data-Science/data-science-essentials-4

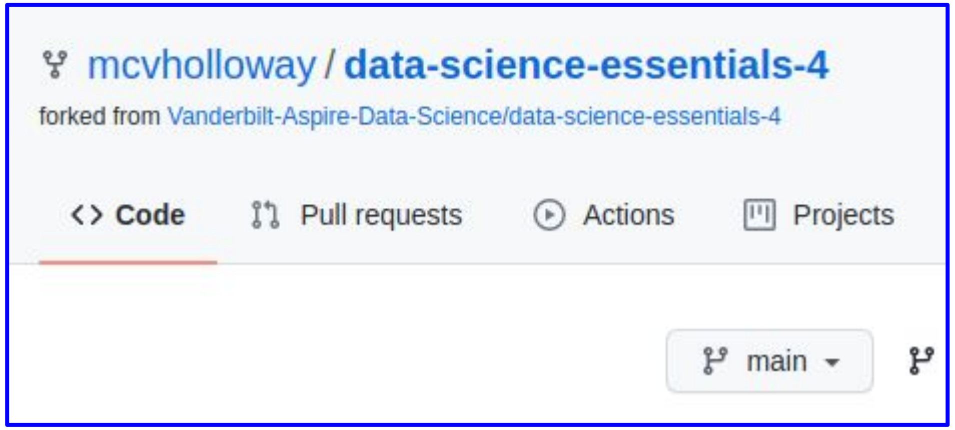
Class Repository on GitHub



Vanderbilt-Aspire-Data-Science / **data-science-essentials-4**

Fork

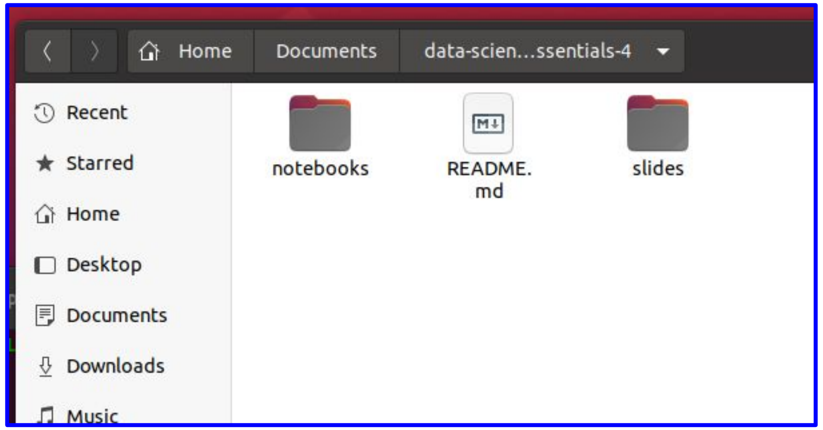
Personal Repository on GitHub



mcvholloway / **data-science-essentials-4**

forked from Vanderbilt-Aspire-Data-Science/data-science-essentials-4

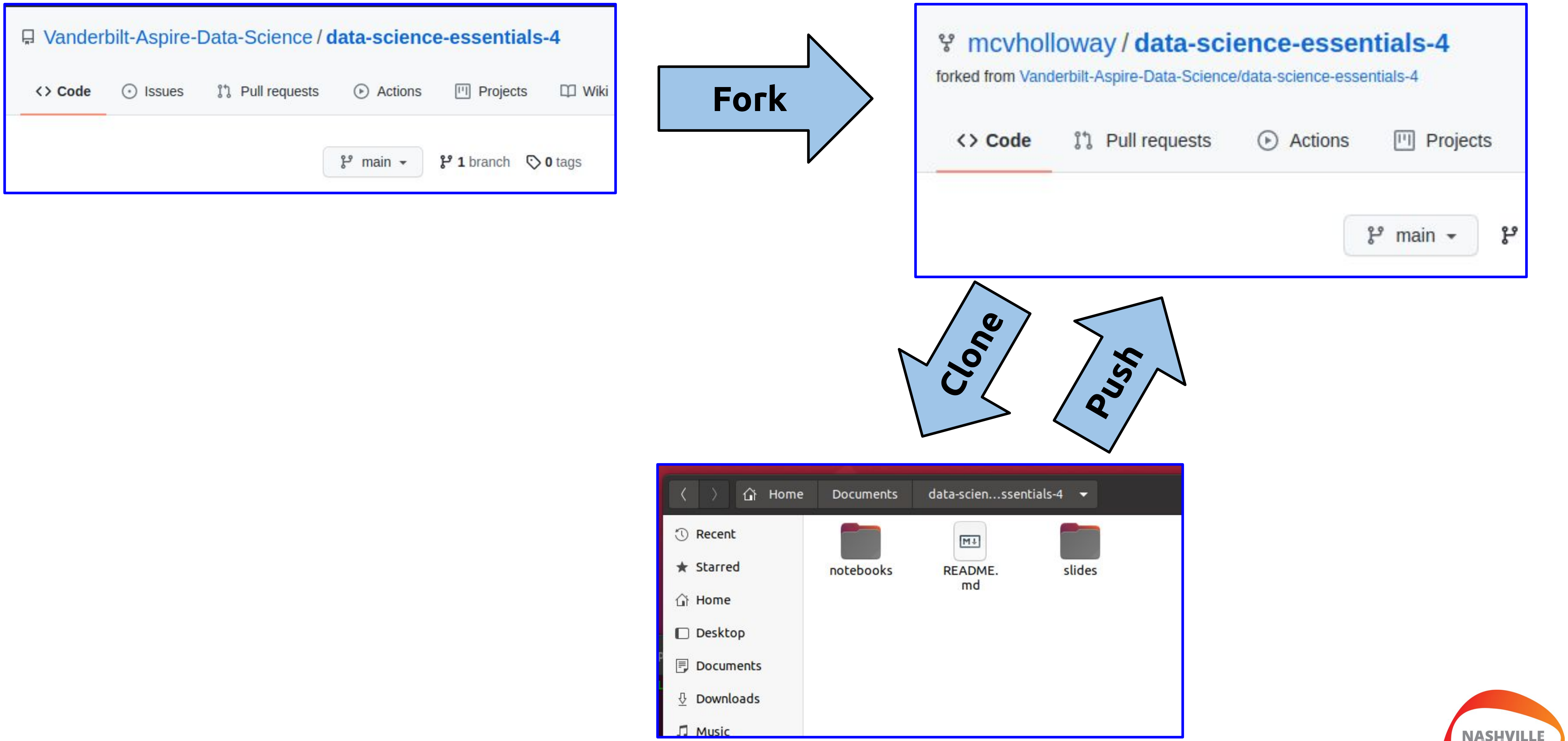
Clone



Local Copy of Personal Repository

Class Repository on GitHub

Personal Repository on GitHub



Vanderbilt-Aspire-Data-Science / **data-science-essentials-4**

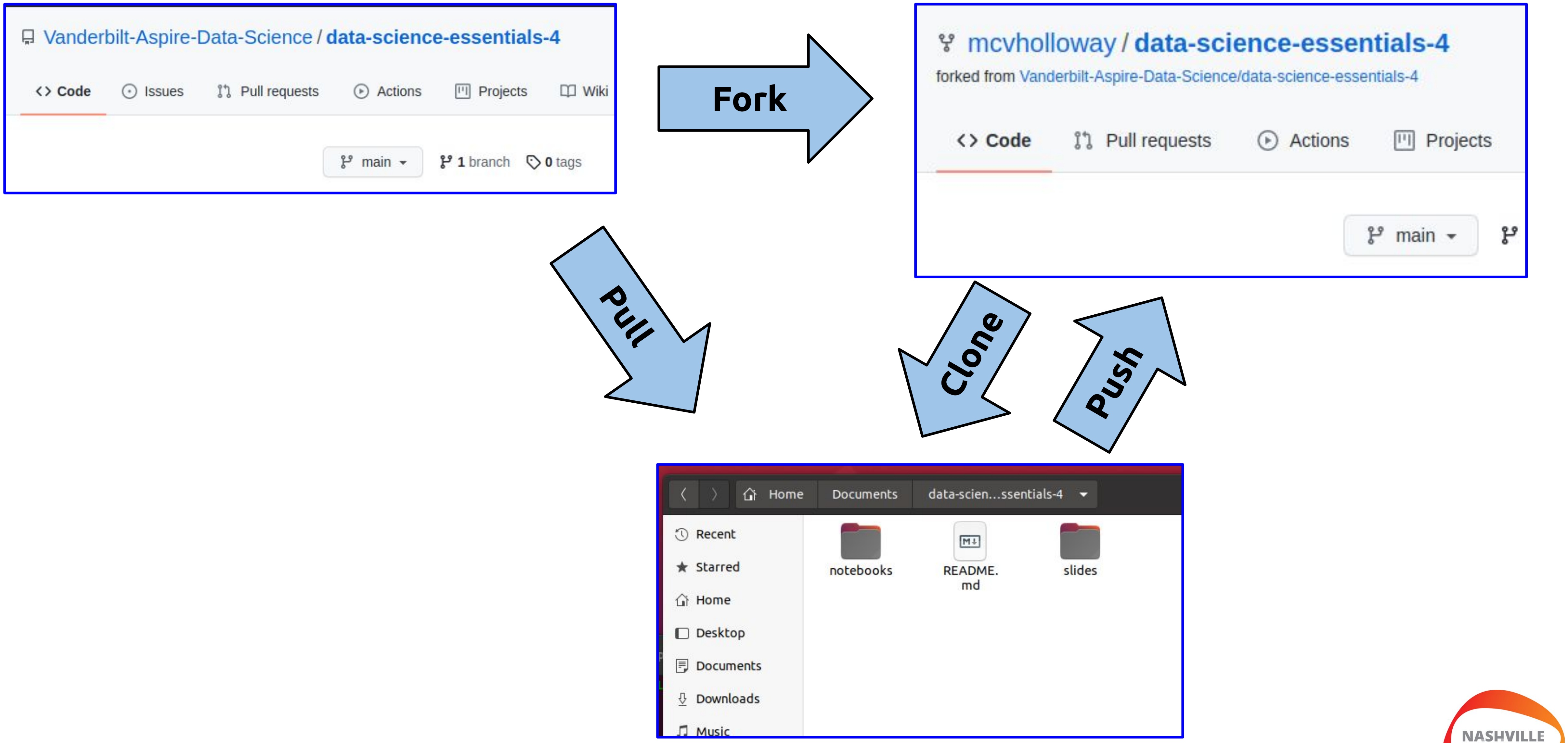
mcvholloway / **data-science-essentials-4**

forked from Vanderbilt-Aspire-Data-Science/data-science-essentials-4

Local Copy of Personal Repository

Class Repository on GitHub

Personal Repository on GitHub



Local Copy of Personal Repository

Adding the class repo as a tracked repository

1. Add the class repository

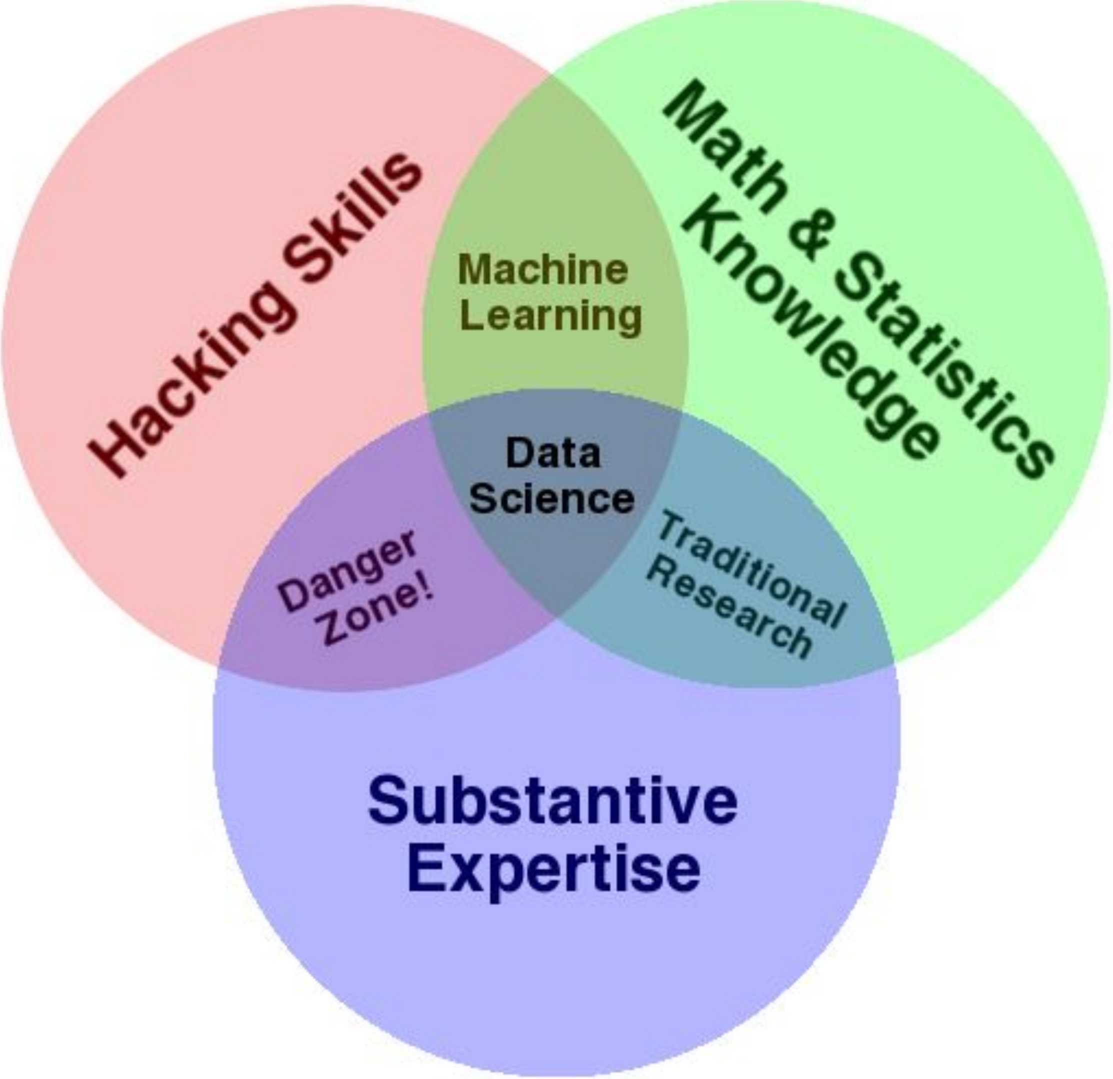
```
    git remote add upstream
https://github.com/Vanderbilt-Aspire-Data-Science/data-science-essentials-4.git
```

2. Pull changes to your local repository

```
    git pull upstream main
```

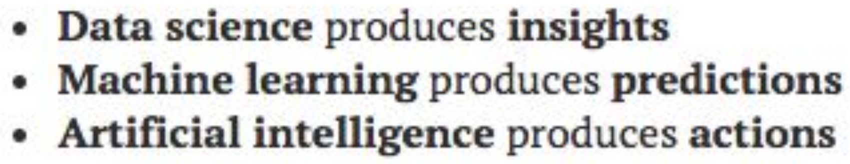
What is Data Science?

March 26, 2013



http://drewconway.com/zia/2013/3/26/the-data-science-venn-diagram

January 9, 2018

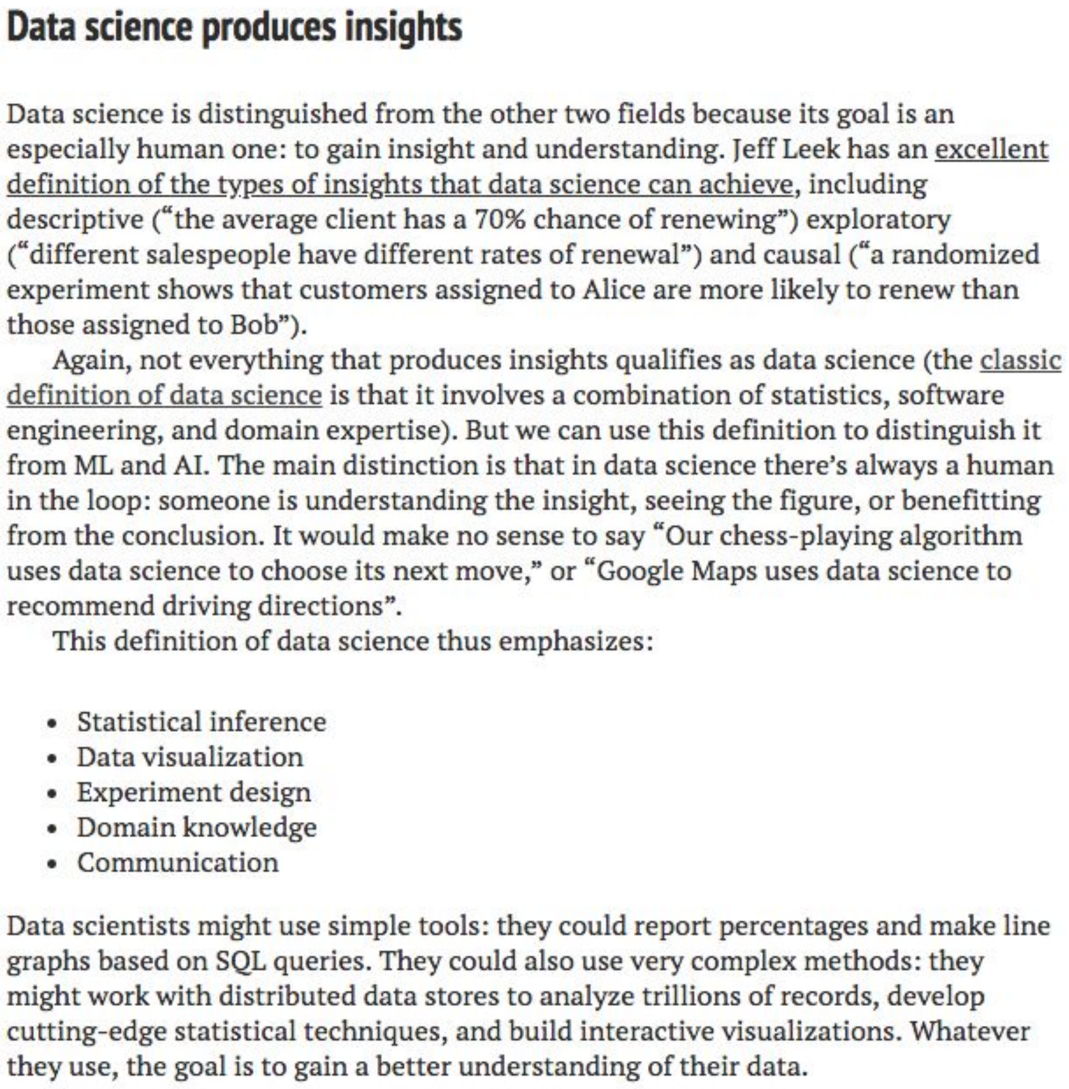


- **Data science** produces **insights**
- **Machine learning** produces **predictions**
- **Artificial intelligence** produces **actions**

VARIANCE EXPLAINED

David Robinson

Chief Data Scientist at DataCamp, works in R and Python.



Data science produces insights

Data science is distinguished from the other two fields because its goal is an especially human one: to gain insight and understanding. Jeff Leek has an excellent definition of the types of insights that data science can achieve, including descriptive ("the average client has a 70% chance of renewing") exploratory ("different salespeople have different rates of renewal") and causal ("a randomized experiment shows that customers assigned to Alice are more likely to renew than those assigned to Bob").

Again, not everything that produces insights qualifies as data science (the classic definition of data science is that it involves a combination of statistics, software engineering, and domain expertise). But we can use this definition to distinguish it from ML and AI. The main distinction is that in data science there's always a human in the loop: someone is understanding the insight, seeing the figure, or benefitting from the conclusion. It would make no sense to say "Our chess-playing algorithm uses data science to choose its next move," or "Google Maps uses data science to recommend driving directions".

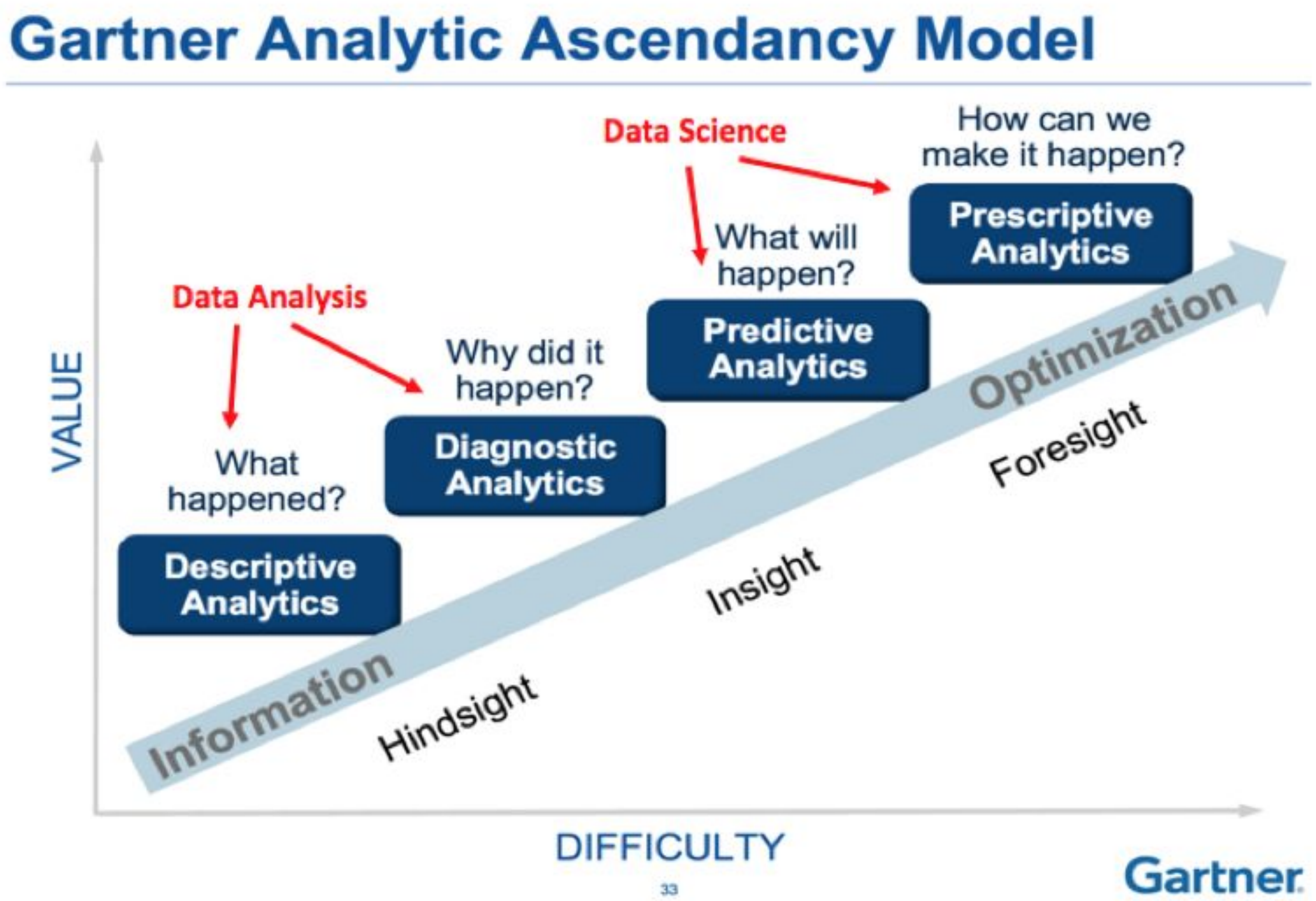
This definition of data science thus emphasizes:

- Statistical inference
- Data visualization
- Experiment design
- Domain knowledge
- Communication

Data scientists might use simple tools: they could report percentages and make line graphs based on SQL queries. They could also use very complex methods: they might work with distributed data stores to analyze trillions of records, develop cutting-edge statistical techniques, and build interactive visualizations. Whatever they use, the goal is to gain a better understanding of their data.

http://varianceexplained.org/r/ds-ml-ai/

NASHVILLE SOFTWARE SCHOOL



Gartner Analytic Ascendancy Model

VALUE

DIFFICULTY

Descriptive Analytics

What happened?

Diagnostic Analytics

Why did it happen?

Predictive Analytics

What will happen?

Prescriptive Analytics

How can we make it happen?

Data Analysis

Data Science

Information

Optimization

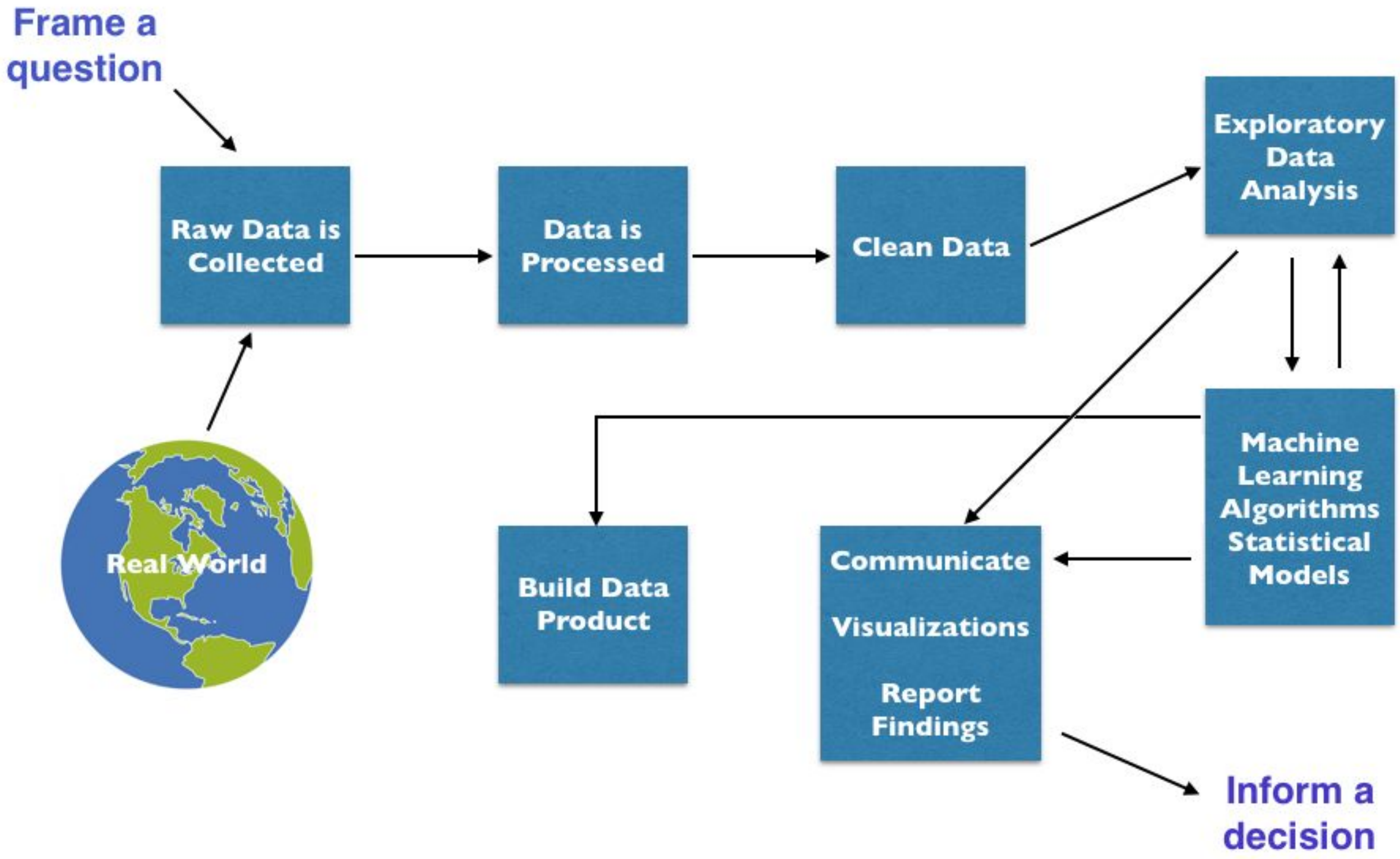
Hindsight

Insight

Foresight

Gartner

Data Science Process



NASHVILLE SOFTWARE SCHOOL

Project Goals

NASHVILLE
SOFTWARE
SCHOOL

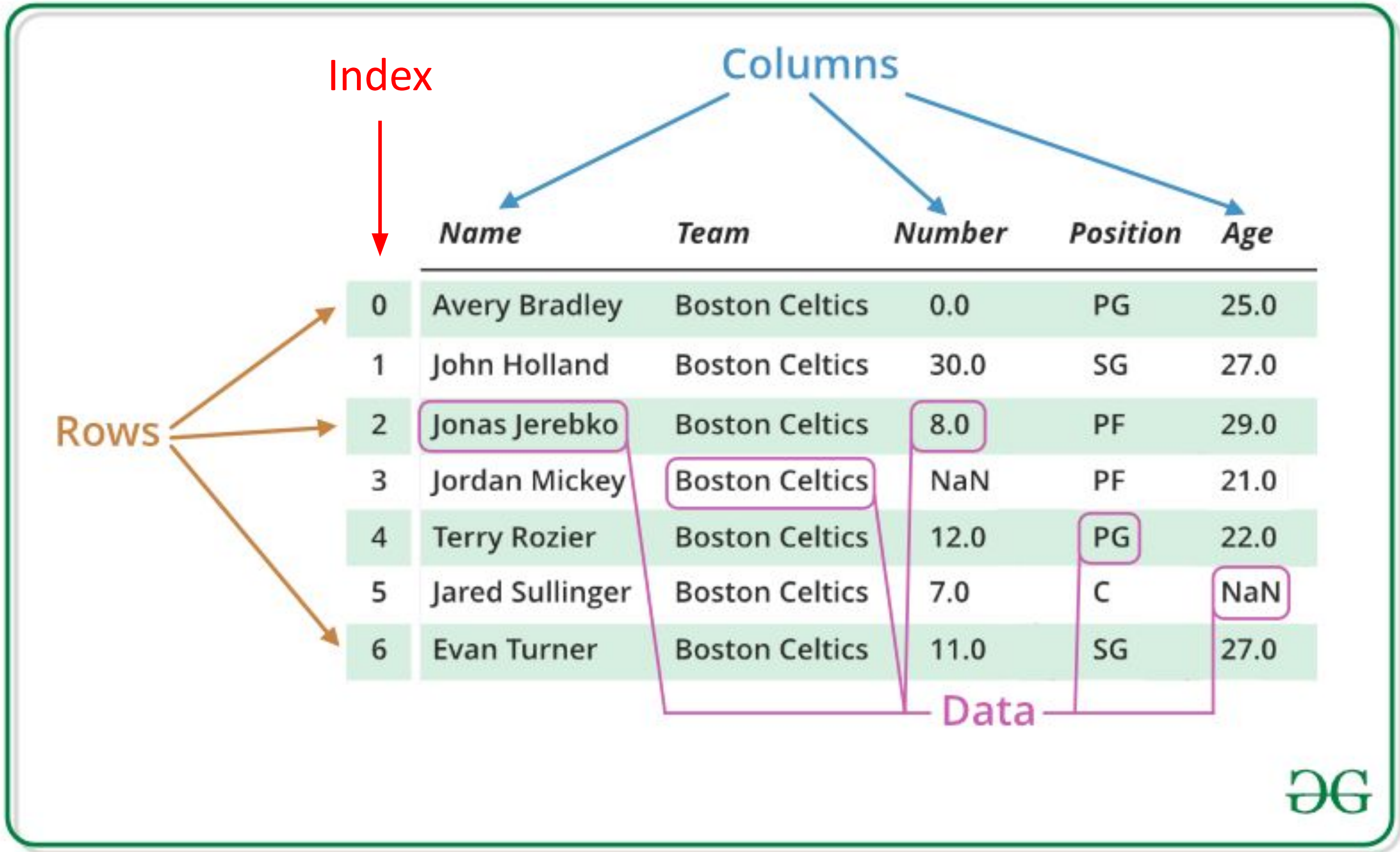
Introduction to *pandas*

NASHVILLE
SOFTWARE
SCHOOL

We will work a lot with Python’s *pandas* library, which provides methods for working with ***DataFrames*** and ***Series***.

A **DataFrame** is a two-dimensional (tabular) data structure.

A **Series** is a one-dimensional data structure – could be a row or a column of data, but usually when we work with a series it is a column of data.



	Name	*Team*	*Number*	*Position*	*Age*
0	Avery Bradley	Boston Celtics	0.0	PG	25.0
1	John Holland	Boston Celtics	30.0	SG	27.0
2	Jonas Jerebko	Boston Celtics	8.0	PF	29.0
3	Jordan Mickey	Boston Celtics	NaN	PF	21.0
4	Terry Rozier	Boston Celtics	12.0	PG	22.0
5	Jared Sullinger	Boston Celtics	7.0	C	NaN
6	Evan Turner	Boston Celtics	11.0	SG	27.0

https://www.geeksforgeeks.org/python-pandas-dataframe/

pandas – https://pandas.pydata.org/pandas-docs/stable/api.html

Importing Data

- **pd.read_csv()** – read a comma delimited file; good practice is to look at the raw file in a text editor (like Visual Studio Code, not Excel); additional arguments may be needed to handle extra rows at the top and extra data (footnotes) at the bottom.

Inspecting

- **df.info()** – method to get information about the DataFrame
- **df.dtypes** – datatypes attribute for the Data Frame
- **df.head()** – looks at the top of the DataFrame; 5 rows by default
- **df.tail()** - looks at the bottom of the DataFrame; 5 rows by default
- **df.shape** – returns a tuple with the number of rows and number of columns

pandas – https://pandas.pydata.org/pandas-docs/stable/api.html

Modifying

- **df.columns** – column labels attribute
- **df.rename()** – rename values (can pass in a dictionary with existing columns as the key and new ones as the values)
- **df.drop()** – drop the specified labels (either rows or columns) from the DataFrame

Summarizing

- **.unique()** – returns the unique values in a column
- **.nunique()** - returns the *number* of unique elements in a column
- **.value_counts()** - returns the unique elements in a column and the number of appearances of each

Slicing/Filtering

- **df.loc[]** – pass in row name and column name to access data at that location
- **df[[ ]]** - creates a slice (subset) of the DataFrame including just the columns passed in