GENERAL ASSEMBLY

INTRODUCTION TO DATA SCIENCE

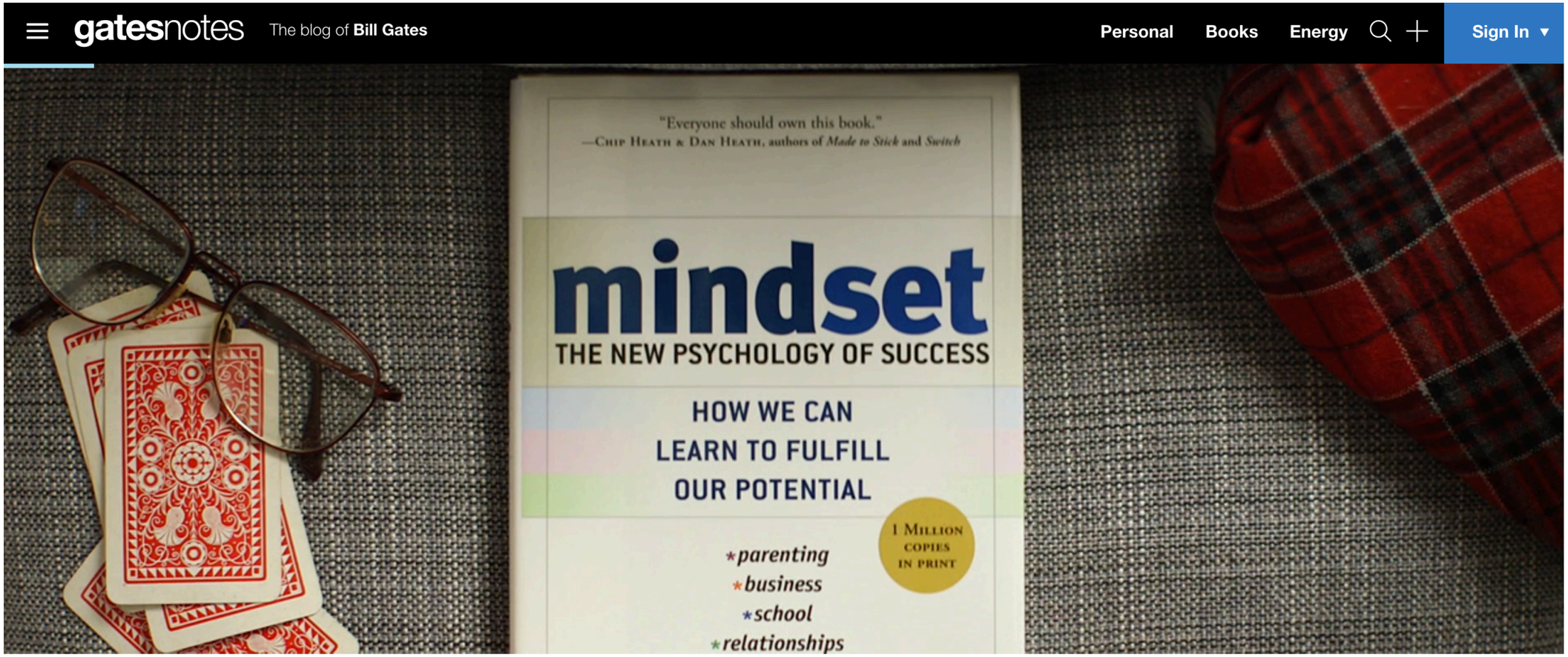
Tan Kwan Chong

Chief Data Scientist, Booz Allen Hamilton

SELF INTRODUCTIONS

- Name
- Background
- What do you want to gain out of this course?
- Experience in programming and data analytics?

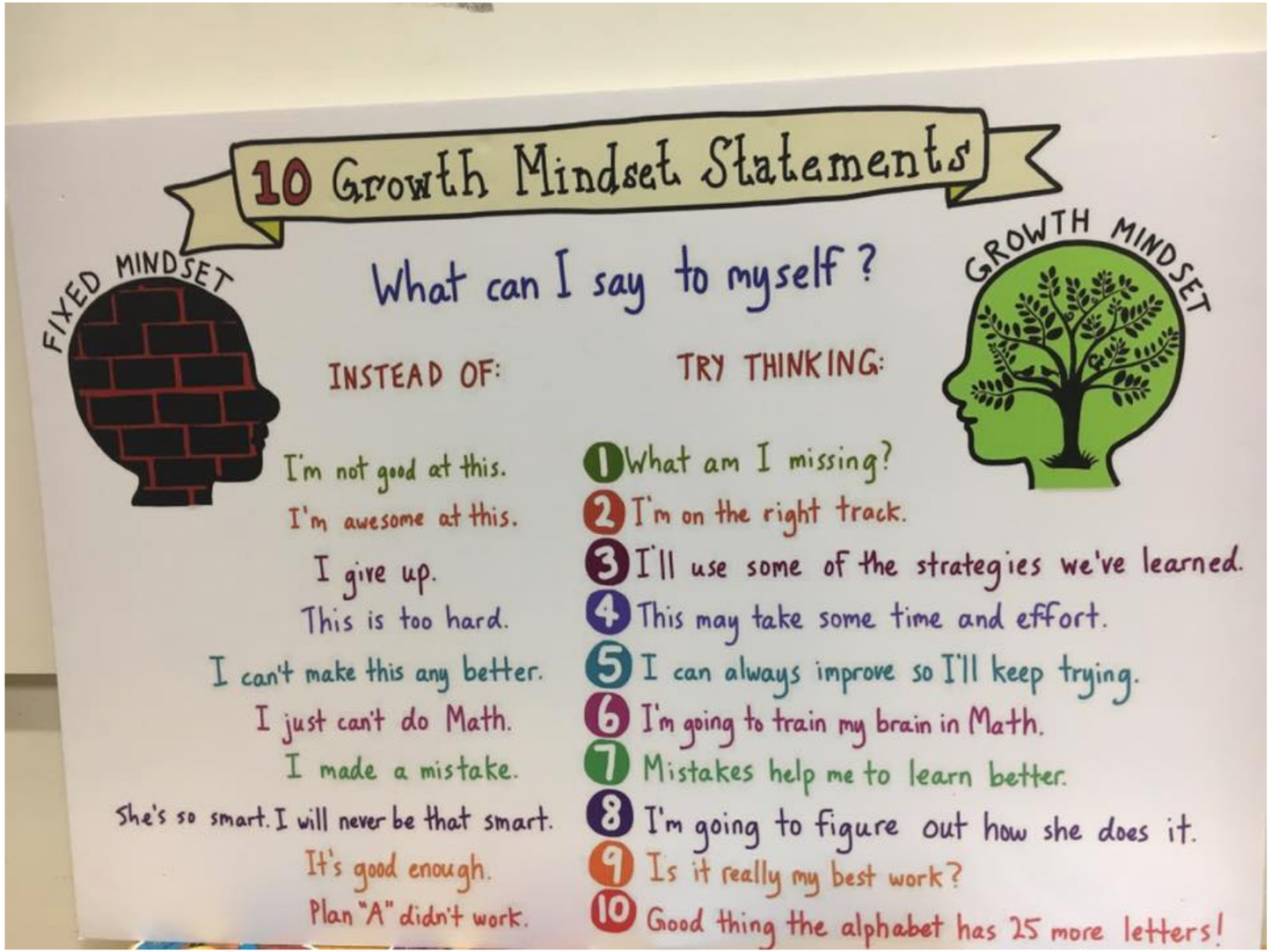
GROWTH VS FIXED MINDSET



Mindset Over Matter

What You Believe Affects What You Achieve

GROWTH VS FIXED MINDSET



Fixed Mindset – Intelligence and talents are fixed at birth, capabilities derive from DNA and destiny

Growth Mindset – Basic qualities including intelligence can be strengthened like muscles with practice and perseverance

COURSE LEARNING OBJECTIVES

- Understand the applications and business use cases for data science
- Acquire, parse, clean and apply various modeling techniques to make predictions from your data using Python
- Communicate findings to both a non-technical and technical audience in both written and verbal formats

COURSE OUTLINE

UNITS

UNIT 1: RESEARCH DESIGN AND EXPLORATORY DATA ANALYSIS	What is Data Science	Lesson 1
	Research Design and Pandas	Lesson 2
	Statistics Fundamentals I	Lesson 3
	Statistics Fundamentals II	Lesson 4
	Flexible Class Session	Lesson 5
UNIT 2: FOUNDATIONS OF DATA MODELING	Introduction to Regression	Lesson 6
	Evaluating Model Fit	Lesson 7
	Introduction to Classification	Lesson 8
	Introduction to Logistic Regression	Lesson 9
	Communicating Logistic Regression Results	Lesson 10
	Flexible Class Session	Lesson 11
UNIT 3: DATA SCIENCE IN THE REAL WORLD	Decision Trees and Random Forests	Lesson 12
	Natural Language Processing	Lesson 13
	Dimensionality Reduction	Lesson 14
	Time Series Data I	Lesson 15
	Time Series Data II	Lesson 16
	Database Technologies	Lesson 17
	Where to Go Next	Lesson 18
	Flexible Class Session	Lesson 19
	Final Project Presentations	Lesson 20

COURSE PROJECTS

Research Design and EDA		Foundation of Data Modeling			Data Science in the Real World				
1	2	3	4	5	6	7	8	9	10
	PROJECT 1	PROJECT 2		PROJECT 3	PROJECT 4				
			FINAL PROJECT DELIVERABLE 1			FINAL PROJECT DELIVERABLE 2	FINAL PROJECT DELIVERABLE 3	FINAL PROJECT DELIVERABLE 4	FINAL PROJECT DELIVERABLE 5

GENERAL ASSEMBLY

WHAT IS DATA SCIENCE

Tan Kwan Chong

Chief Data Scientist, Booz Allen Hamilton

LEARNING OBJECTIVES

- Define data science and the data science workflow
- Setup your development environment and review command line, git, and python basics

WHAT IS DATA SCIENCE?

BACKGROUND AND CONTEXT

1. Data is increasingly cheap and ubiquitous

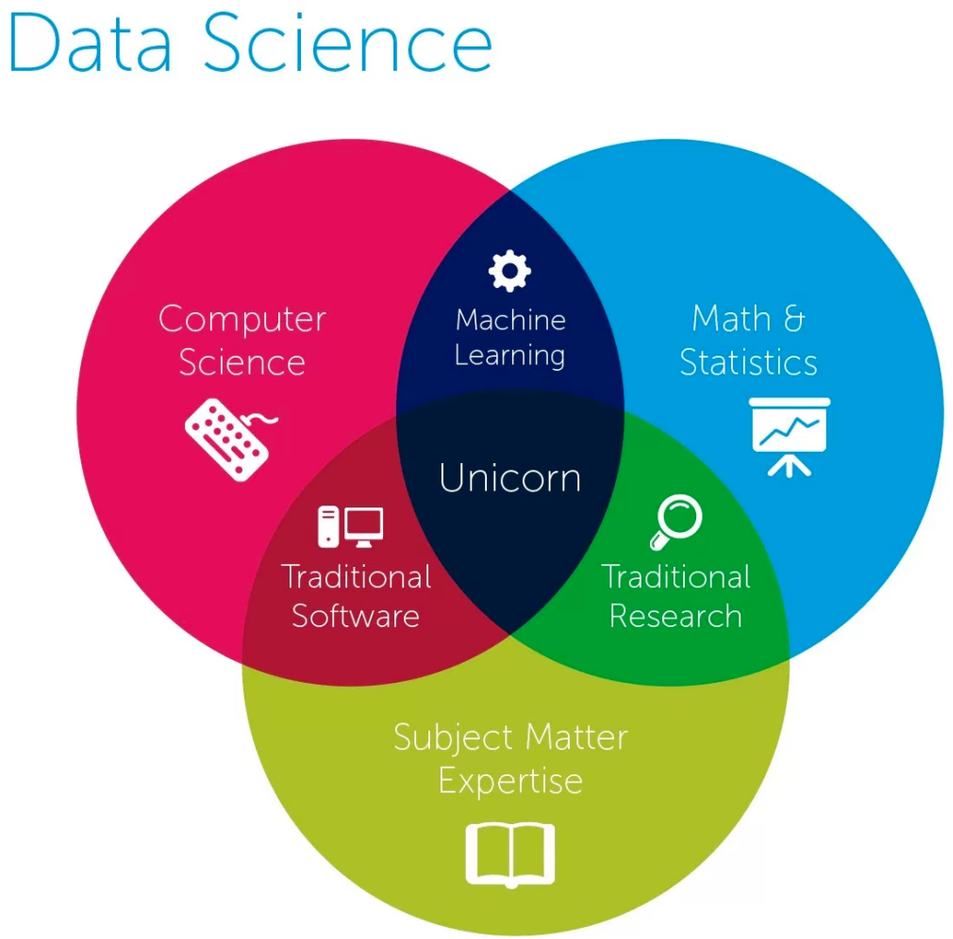
2. New technologies are emerging to organize and make sense of this avalanche of data

3. Organizations need to harness internal and external data effectively to attract and retain their customers

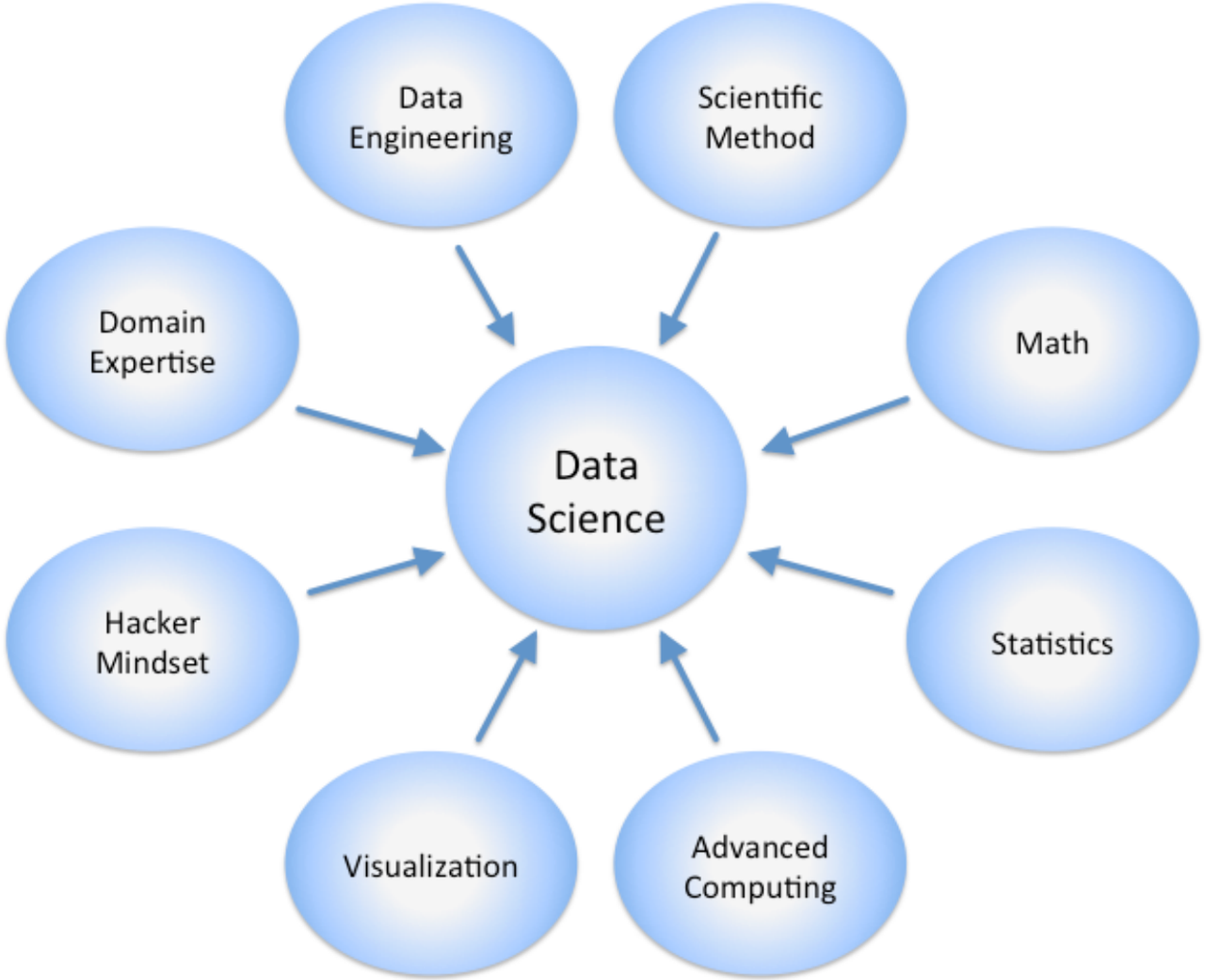
https://datascience.berkeley.edu/about/what-is-data-science/

WHAT IS DATA SCIENCE?

- A set of tools and techniques for data
- Interdisciplinary problem-solving
- Application of scientific techniques to practical problems

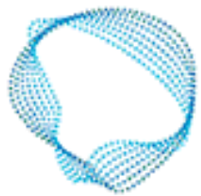


WHAT IS DATA SCIENCE?



The scientific approach to knowledge extraction from data

WHO USES DATA SCIENCE?



SINGAPORE EXAMPLES - IS THIS DATA SCIENCE?

datagovsg Follow

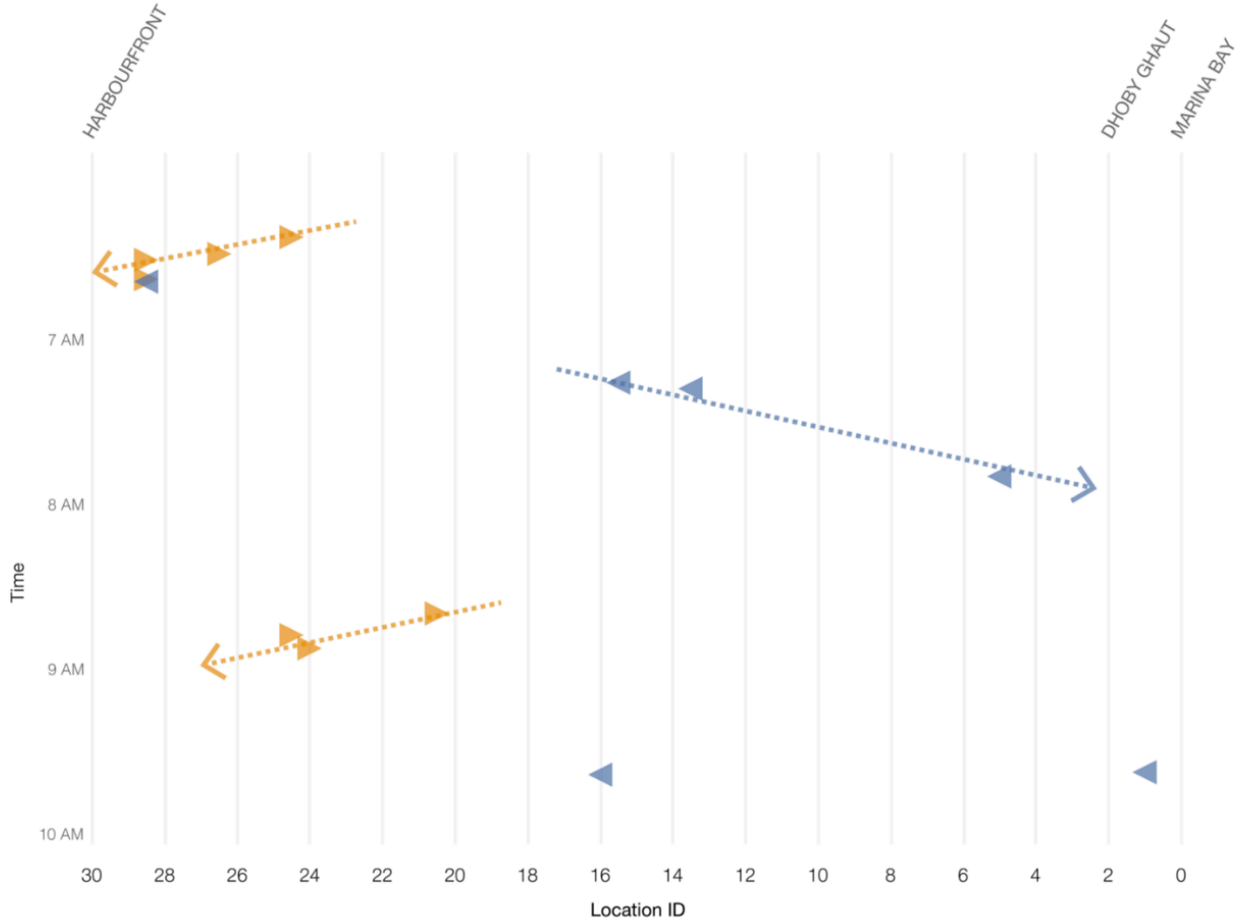
Official Medium account for https://data.gov.sg, Singapore's open data portal.

Dec 1, 2016 · 8 min read

How the Circle Line rogue train was caught with data

Text: Daniel Sim | Analysis: Lee Shangqian, Daniel Sim & Clarence Ng

Singapore's MRT Circle Line was hit by a spate of mysterious disruptions in recent months, causing much confusion and distress to thousands of commuters.



https://blog.data.gov.sg/how-we-caught-the-circle-line-rogue-train-with-data-79405c86ab6a

SINGAPORE EXAMPLES - IS THIS DATA SCIENCE?

Yellow taxis have fewer accidents than blue ones, says study

Researchers from NUS and the Chinese University of Hong Kong say that yellow taxis are more noticeable than blue taxis in both daylight and under street lighting. PHOTO: BLOOMBERG NEWS

PUBLISHED MAR 8, 2017, 5:00 AM SGT | UPDATED MAR 8, 2017, 11:01 AM

Tay Hong Yi

The next time you hail a taxi, take note of its colour, for it might mean a safer ride.

Researchers at the National University of Singapore (NUS) found that taxis painted yellow, a colour that stands out, were involved in significantly fewer traffic accidents than taxis painted blue.

Their results were based on analysing three years' worth of detailed taxi, driver and accident data from a large fleet of over 4,000 yellow taxis and 12,500 blue taxis locally.

Yellow taxis have fewer accidents than blue taxis because yellow is more visible than blue

Teck-Hua Ho[a,b,1], Juin Kuan Chong[c], and Xiaoyu Xia[d]

[a]Office of the Deputy President (Research & Technology), National University of Singapore, Singapore 119077; [b]Haas School of Business, University of California, Berkeley, CA 94720; [c]National University of Singapore Business School, National University of Singapore, Singapore 119245; and [d]Department of Decision Sciences and Managerial Economics, Chinese University of Hong Kong Business School, Chinese University of Hong Kong, Shatin, NT, Hong Kong

Edited by George A. Akerlof, University of California, Berkeley, CA, and approved January 31, 2017 (received for review August 3, 2016)

Is there a link between the color of a taxi and how many accidents it has? An analysis of 36 mo of detailed taxi, driver, and accident data (comprising millions of data points) from the largest taxi company in Singapore suggests that there is an explicit link. Yellow taxis had 6.1 fewer accidents per 1,000 taxis per month than blue taxis, a 9% reduction in accident probability. We rule out driver difference as an explanatory variable and empirically show that because yellow taxis are more noticeable than blue taxis—especially when in front of another vehicle, and in street lighting—other drivers can better avoid hitting them, directly reducing the accident rate. This finding can play a significant role when choosing colors for public transportation and may save lives as well as millions of dollars.

car color | road safety | data science | transportation science | sensory perception

Accidents involving public transport are common and cause significant economic losses as well as loss of human life. Applying statistical analysis to a unique and comprehensive dataset we establish that a change in color can avert a significant number of taxi accidents, leading to a reduction in economic losses. Specifically, analysis of a complete set of accident records from the largest taxi operator in Singapore, which uses yellow and blue taxis, shows that yellow is safer than blue because yellow is more noticeable, with the result that potential accidents are avoided by other drivers' timely responses.

Yellow has been a popular color for taxis since 1907, when the Chicago Yellow Cab Company chose the color based on a survey conducted at the University of Chicago. The survey showed that yellow was the most noticeable color, which would make it easy for potential passengers to spot a yellow taxi in the sea of mass-demographic characteristics. These two datasets include millions of observations on the company's drivers and taxis, and accidents involving these taxis. The data from both datasets have been anonymized and are available in Datasets S1–S6.

The company uses yellow or blue for all its regular taxis (approximate colors are shown in Fig. 1).[†] The colors are the remnants of a 2002 merger that took place between two taxi companies, one of which used yellow and the other, blue. The company owns ~16,700 taxis in a ratio of one yellow to three blue (1y:3b), which translates to 4,175 yellow taxis and 12,525 blue ones. These account for 60% of the ~27,800 taxis in Singapore.[‡]

To control for the difference in the number of taxis used by the company (1y:3b), we calculated a normalized accident rate using the average number of accidents that occurred per 1,000 taxis

Significance

This paper examines the phenomenon that yellow taxis have fewer accidents than blue taxis. Statistical analysis of a unique and comprehensive dataset suggests that the higher visibility of the color yellow makes it easier for other drivers to avoid getting into accidents with yellow taxis, leading to a lower accident rate. This suggests that color visibility should play a major role in determining the colors used for public transport vehicles.

Author contributions: T.-H.H. and J.K.C. designed research; T.-H.H. and J.K.C. performed research; T.-H.H., J.K.C., and X.X. contributed new reagents/analytic tools; T.-H.H., J.K.C., and X.X. analyzed data; and T.-H.H., J.K.C., and X.X. wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

SINGAPORE EXAMPLES - IS THIS DATA SCIENCE?

How Lazada ranks products

to improve customer experience and conversion

Strata Hadoop Singapore 2016

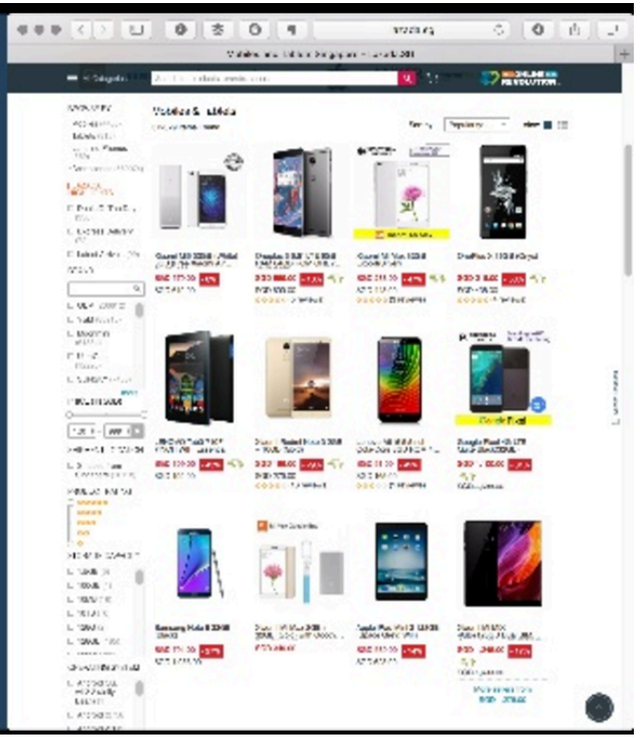
Overall results

Better ranking improved conversion and revenue per session

Introducing new products improved new product engagement

Emphasizing product quality had neutral to positive outcomes

Ranking affects what appears on top



COMMON QUESTIONS ASKED IN DATA SCIENCE

How much? How many?

- What will the stock price of Microsoft be next week?
- What will my fourth quarter sales be?
- How many kilowatts of electricity will be demanded between 7-8pm?
- How many new Twitter followers will I get next week?

Regression

Predict a continuous outcome

- K-Nearest Neighbors
- Linear Regression
- Regression Trees

COMMON QUESTIONS ASKED IN DATA SCIENCE

Is this A, B or C?

- Is this a fraudulent transaction?
- Is this an image of a man, a cat, or a dog?
- Will this customer click on the advertisement?
- Is the sentiment of the review positive or negative?

Classification

Predict a discrete outcome

- K-Nearest Neighbors
- Logistic Regression
- Classification Trees

COMMON QUESTIONS ASKED IN DATA SCIENCE

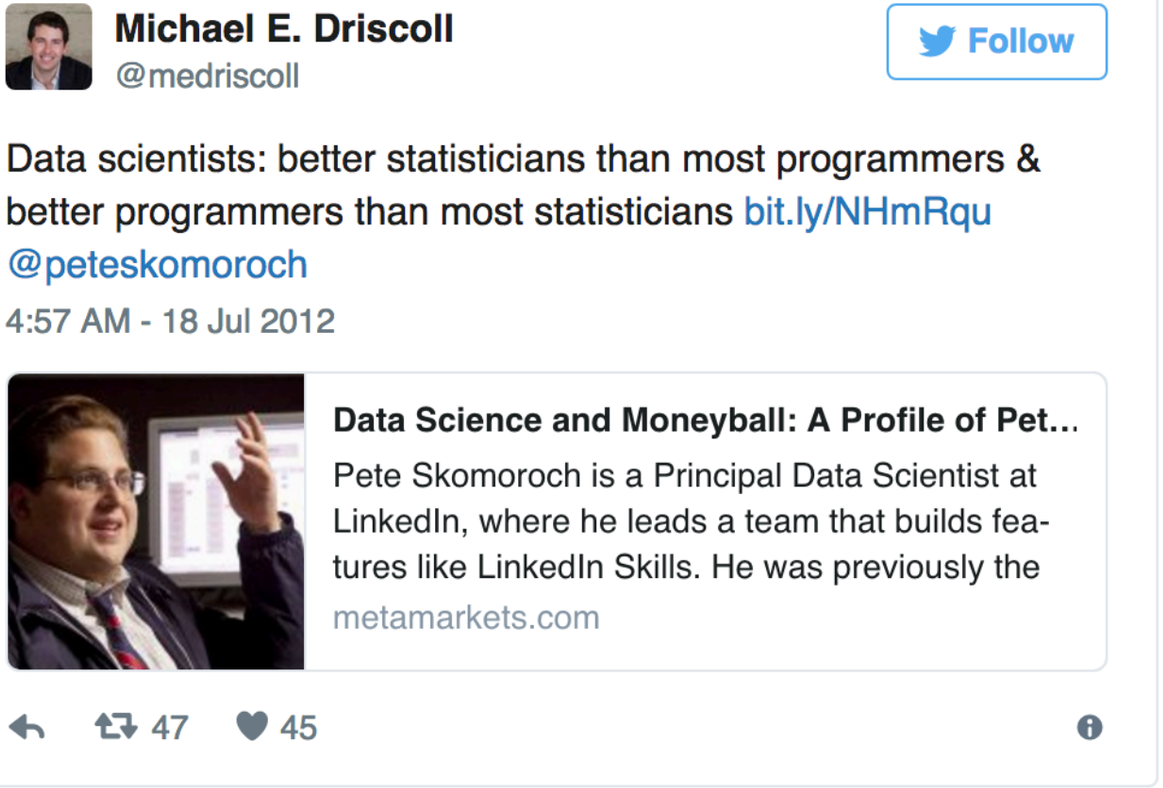
How is this Data Organized?

- What are the different types of coffee drinkers?
- Which viewers like the same kind of movies?
- Are there common clusters of cable channels that customers tend to purchase together?
- What is a natural way to break these documents into five topics?

Clustering

What are the “categories” within the data?

WHAT IS A DATA SCIENTIST?



"A Data Scientist should have a wide breadth of abilities: **academic curiosity**, **storytelling**, **product sense**, **engineering experience** and just a catch-all I call **cleverness**. But he or she should also have deep domain expertise in **Statistical and Machine Learning Knowledge**" – Thomson Nguyen

WHAT ARE THE ROLES IN DATA SCIENCE?

DATA SCIENTIST
'AS RARE AS UNICORNS'

Languages
R, SAS, Python, Matlab, SQL, Hive, Pig, Spark

Skills & Talents
- ✓ *Distributed computing*
- ✓ *Predictive modeling*
- ✓ *Story-telling and visualizing*
- ✓ *Math, Stats, Machine Learning*

Role
Cleans, massages and organizes (big) data

Mindset
Curious data wizard

HIRED BY
Google Microsoft Adobe

DATA ANALYST
'DATA DETECTIVE'

Role
Collects, processes and performs statistical data analyses

Mindset
Intuitive data junkie with high "figure-it-out" quotient

Languages
R, Python, HTML, Javascript, C/C++, SQL

Skills & Talents
- ✓ *Spreadsheet tools (e.g. Excel)*
- ✓ *Database systems (SQL and NO SQL based)*
- ✓ *Communication & visualization*
- ✓ *Math, Stats, Machine Learning*

HIRED BY
IBM hp DHL

DATA ARCHITECT
'THE CONTEMPORARY DATA MODELLER'

Languages
SQL, XML, Hive, Pig, Spark

Skills & Talents
- ✓ *Data warehousing solutions*
- ✓ *In-depth knowledge of database architecture*
- ✓ *Extraction Transformation and Load (ETL), spreadsheet and BI tools*
- ✓ *Data modeling*
- ✓ *Systems development*

Role:
Creates blueprints for data management systems to integrate, centralize, protect and maintain data sources

Mindset:
Inquiring ninja with a love for data architecture design patterns

HIRED BY
VISA Coca-Cola logitech

DATA AND ANALYTICS MANAGER
'DATA SCIENCE TEAM LEADER'

Role
Manages a team of analysts and data scientists

Mindset
Data Wizards' Cheerleader

Languages
SQL, R, SAS, Python, Matlab, Java

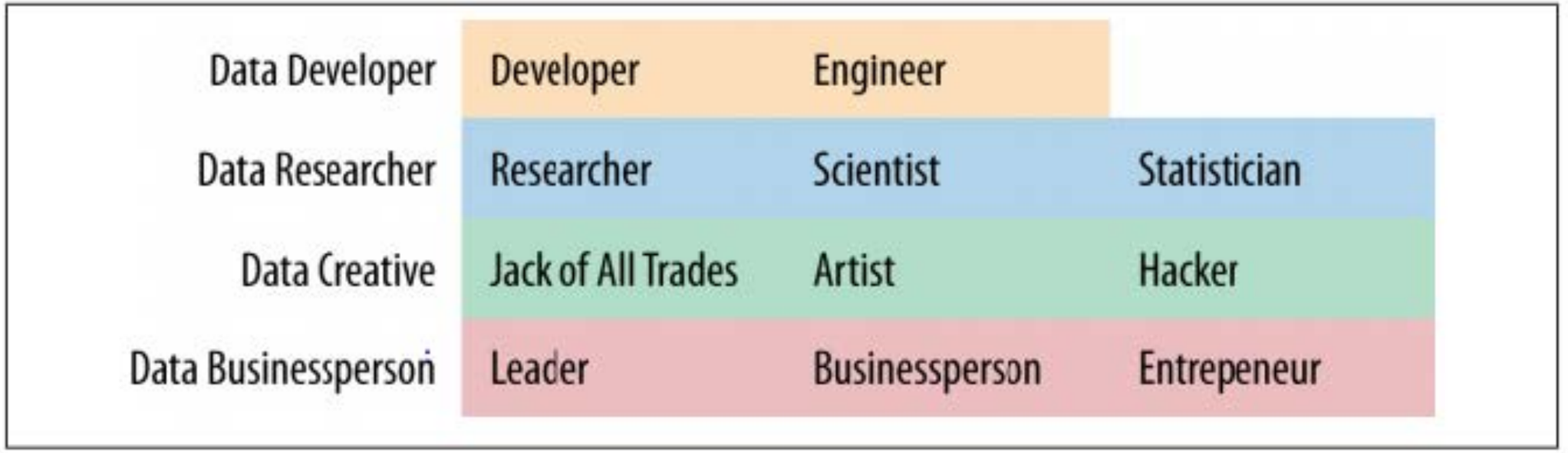
Skills & Talents
- ✓ *Database systems (SQL and NO SQL based)*
- ✓ *Leadership & project management*
- ✓ *Interpersonal communication*
- ✓ *Data mining & predictive modeling*

HIRED BY
coursera slack MOTOROLA SOLUTIONS

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

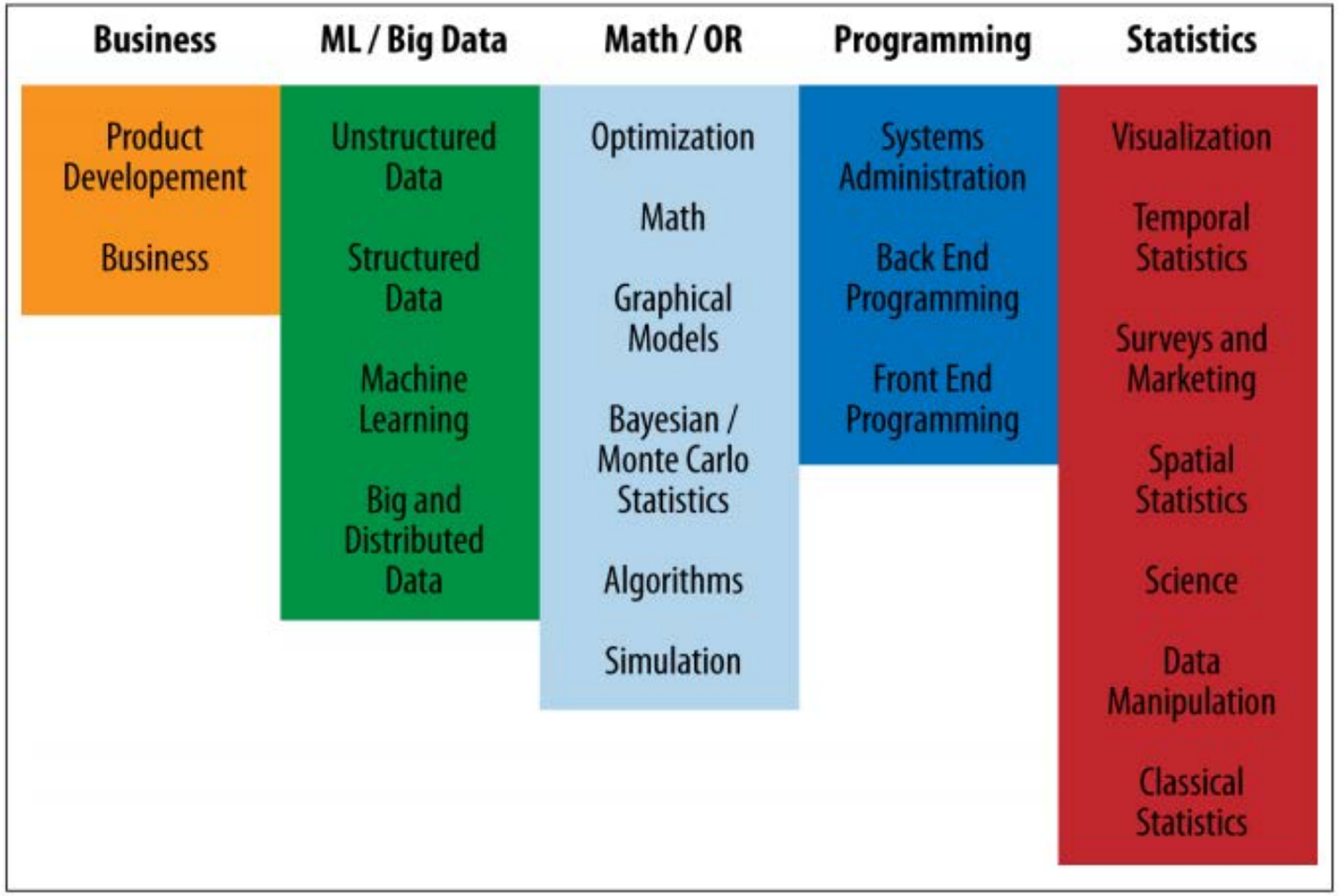
WHAT ARE THE ROLES IN DATA SCIENCE?

- Data Science involves a variety of roles, not just one.



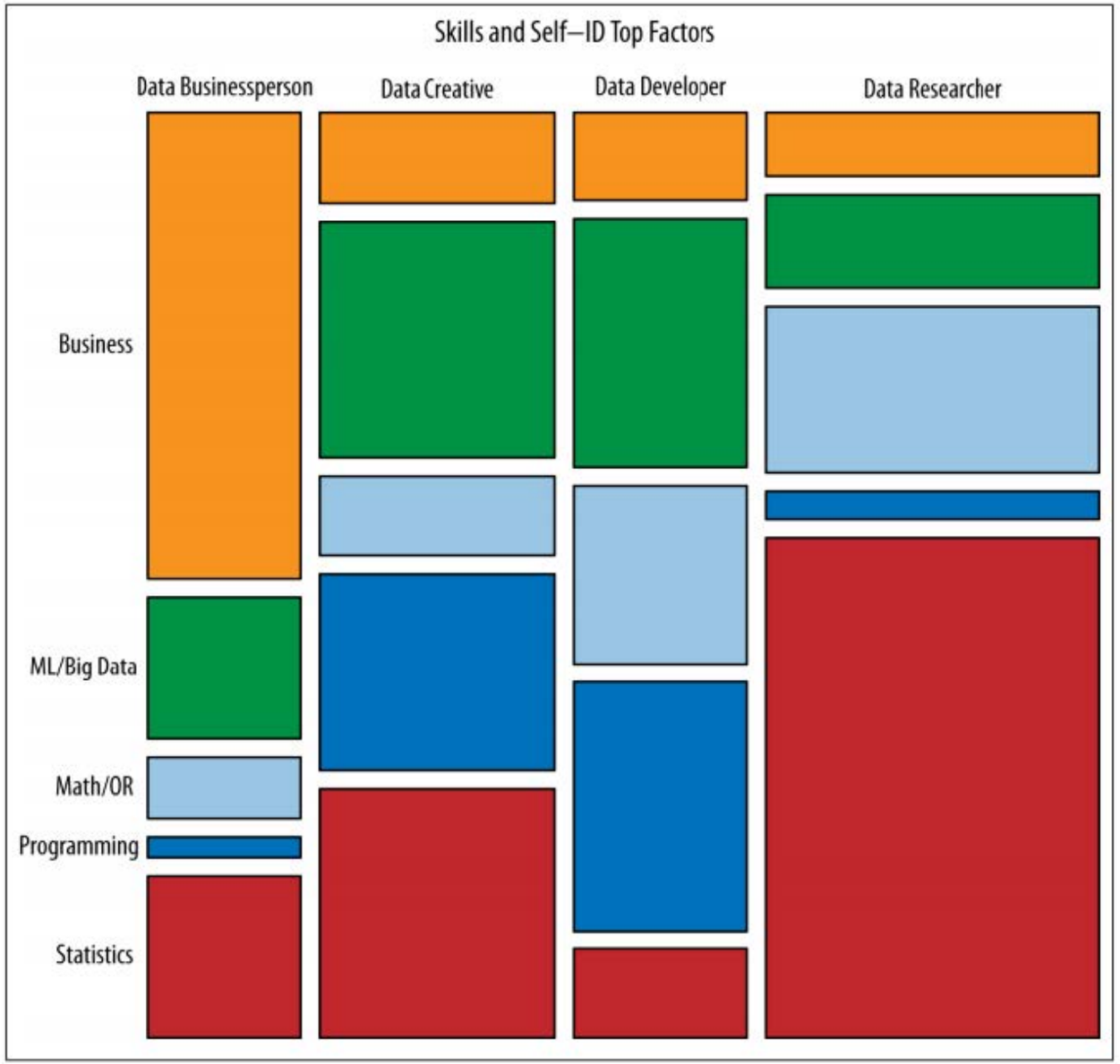
WHAT ARE THE ROLES IN DATA SCIENCE?

- Data Science involves a variety of skill sets, not just one.



WHAT ARE THE ROLES IN DATA SCIENCE?

- These roles prioritize different skill sets.
- However, all roles involve some part of each skillset.
- Where are your strengths and weaknesses?



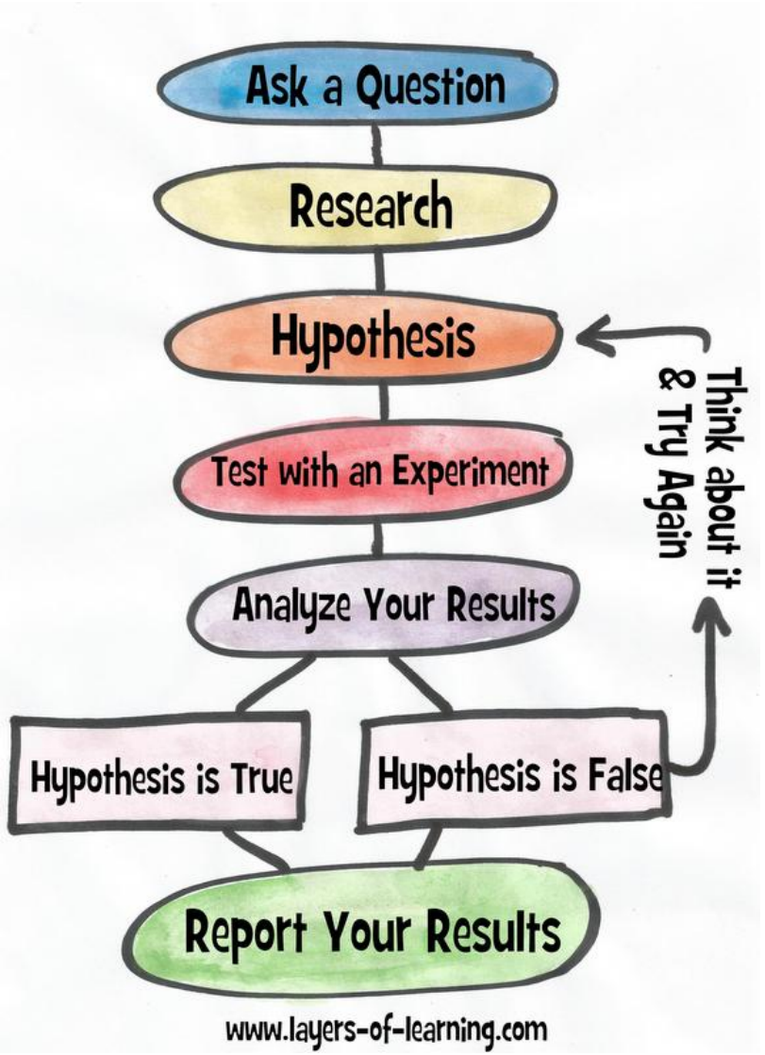
INTRODUCTION

THE DATA SCIENCE WORKFLOW

OVERVIEW OF THE DATA SCIENCE WORKFLOW

- A methodology for doing Data Science
- Similar to the scientific method
- Helps produce *reliable* and *reproducible* results
  - *Reliable*: Accurate findings
  - *Reproducible*: Others can follow your steps and get the same results

OVERVIEW OF THE DATA SCIENCE WORKFLOW



DATA SCIENCE WORKFLOW

Identify

IDENTIFY THE PROBLEM

- ☐ Identify business/product objectives
- ☐ Identify and hypothesize goals and criteria for success
- ☐ Create a set of questions for identifying correct data set

Acquire

ACQUIRE THE DATA

- ☐ Identify the "right" data set(s)
- ☐ Import data and set up local or remote data structure
- ☐ Determine most appropriate tools to work with data

Parse

PARSE THE DATA

- ☐ Read any documentation provided with the data
- ☐ Perform exploratory data analysis
- ☐ Verify the quality of the data

Mine

MINE THE DATA

- ☐ Determine sampling methodology and sample data
- ☐ Format, clean, slice, and combine data in Python
- ☐ Create necessary derived columns from the data (new data)

Refine

REFINE THE DATA

- ☐ Identify trends and outliers
- ☐ Apply descriptive and inferential statistics
- ☐ Document and transform data

Build

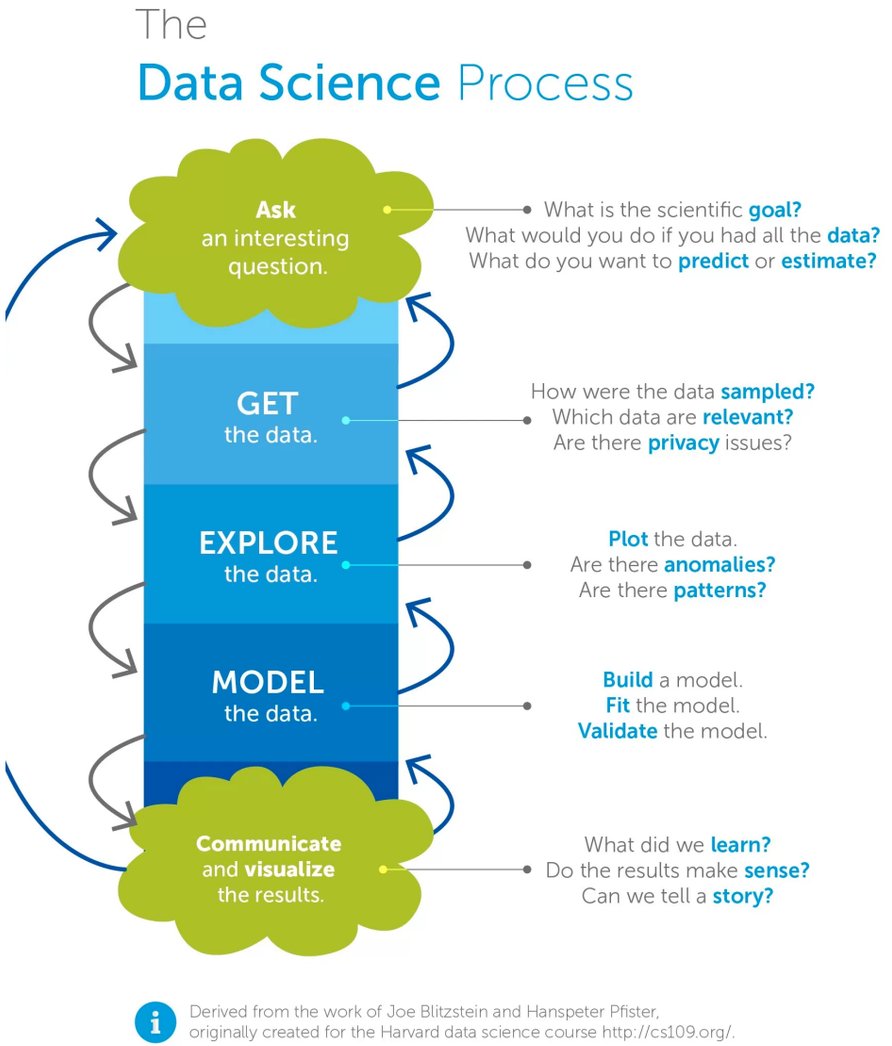
BUILD A DATA MODEL

- ☐ Select appropriate model
- ☐ Build model
- ☐ Evaluate and refine model

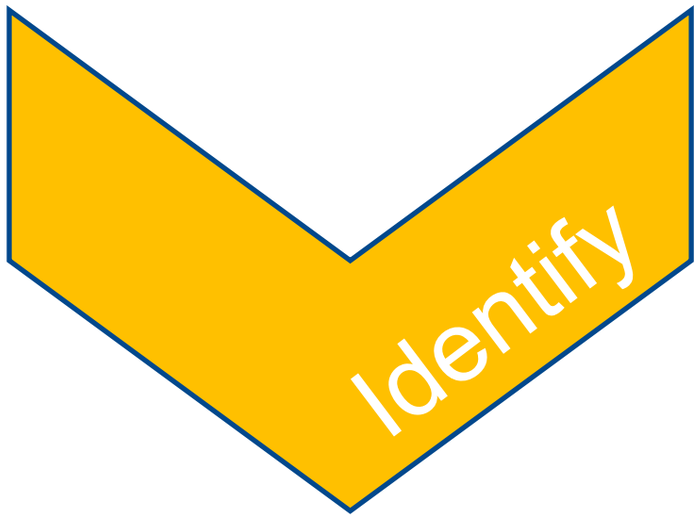
Present

PRESENT THE RESULTS

- ☐ Summarize findings with narrative, storytelling techniques
- ☐ Present limitations and assumptions of your analysis
- ☐ Identify follow up problems and questions for future analysis



IDENTIFY THE PROBLEM



IDENTIFY THE PROBLEM

- Identify business / product objectives
- Identify and hypothesize goals and criteria for success
- Create a set of questions for identifying the correct data set

IDENTIFY THE PROBLEM

- Begin by identifying the objectives and desired outcomes of the analysis
- Typical scenarios:
  - Given dataset(s) and tasked to explore and uncover insights
  - Specific business problem and need to source the relevant data

Example Problem Statement: What will the expected resale value of my HDB flat be in 10 years time?

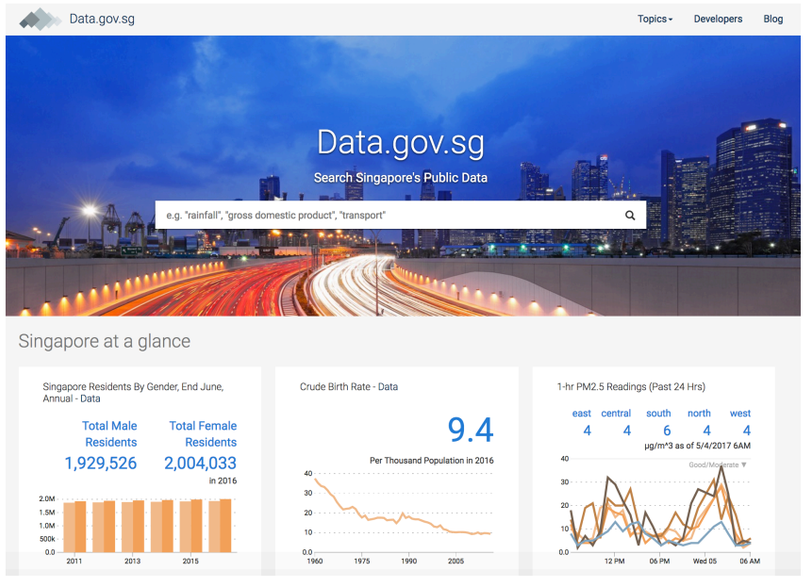
ACQUIRE THE DATA

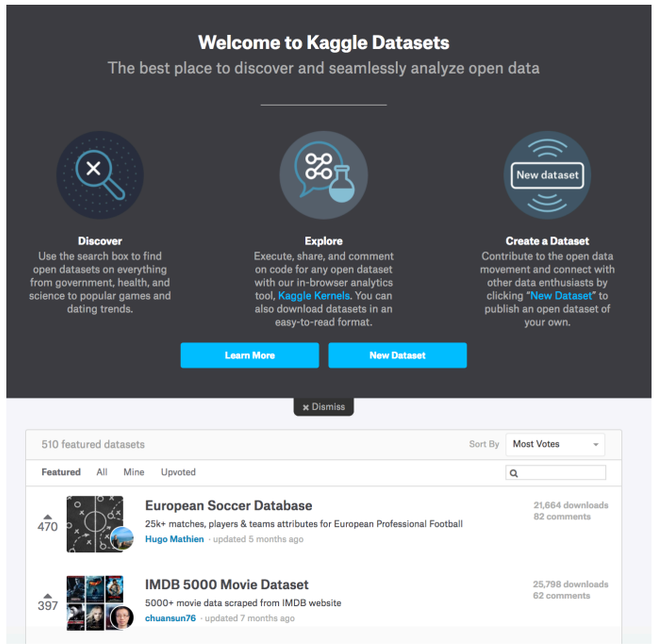
ACQUIRE THE DATA

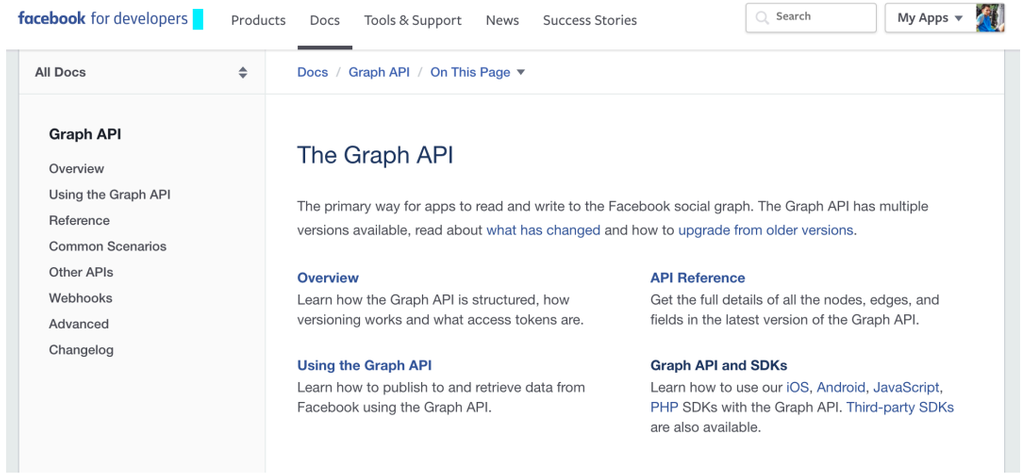
- Identify the “right” data set(s)
- Import data and set up local or remote data structure
- Determine most appropriate tools to work with data

ACQUIRE THE DATA

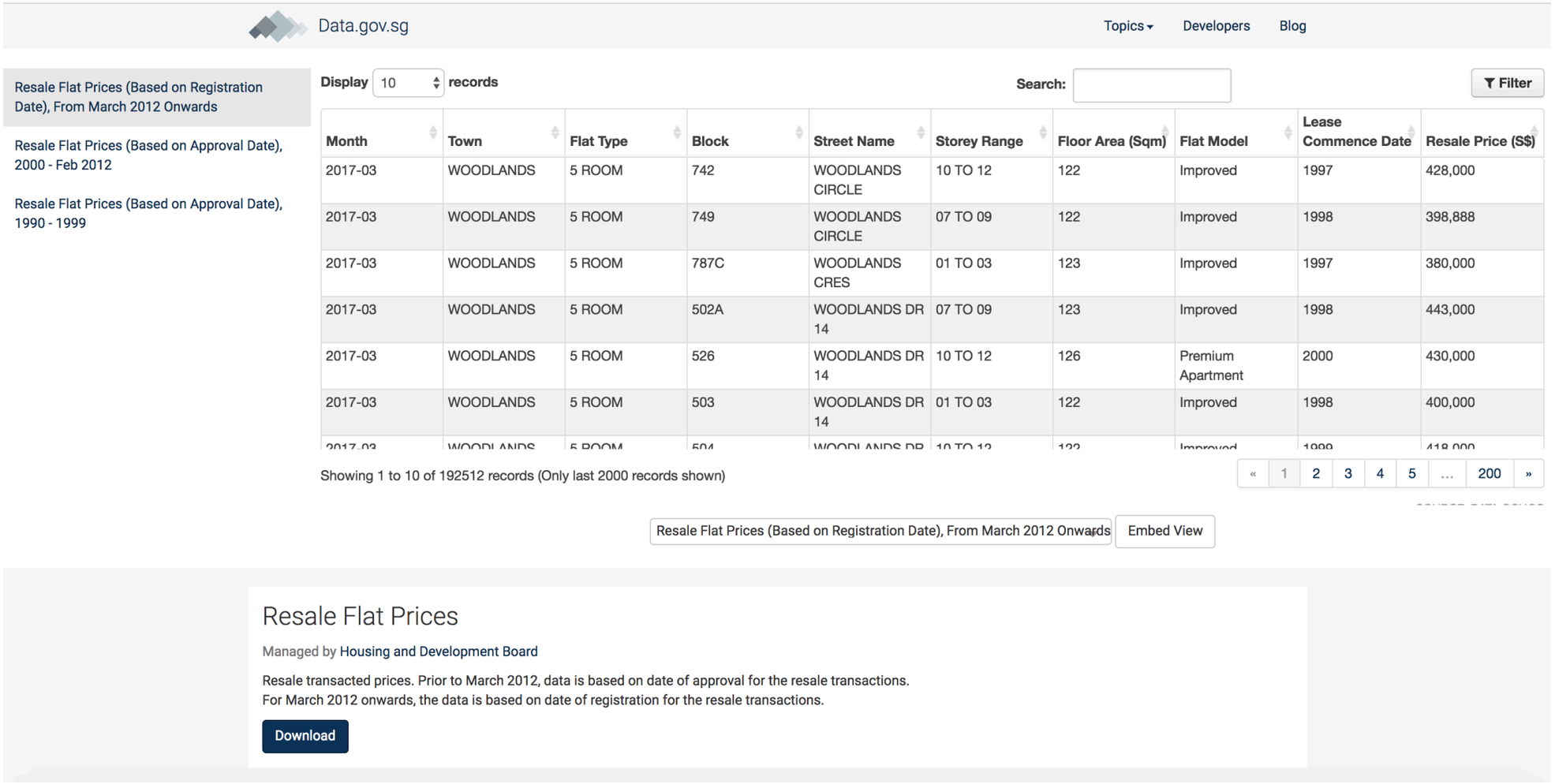
- Internal data – spreadsheets, csv files, databases, system logs
- External data – csv files, API requests, web scraping





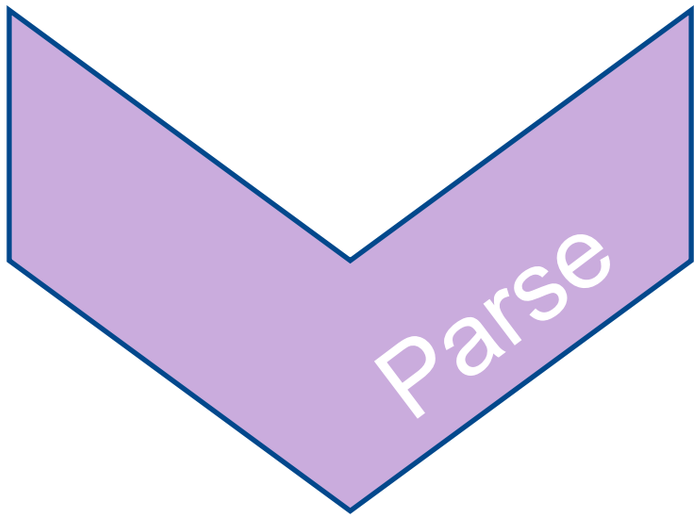


ACQUIRE THE DATA



- Resale flat prices data available for download from Data.gov.sg website

PARSE THE DATA

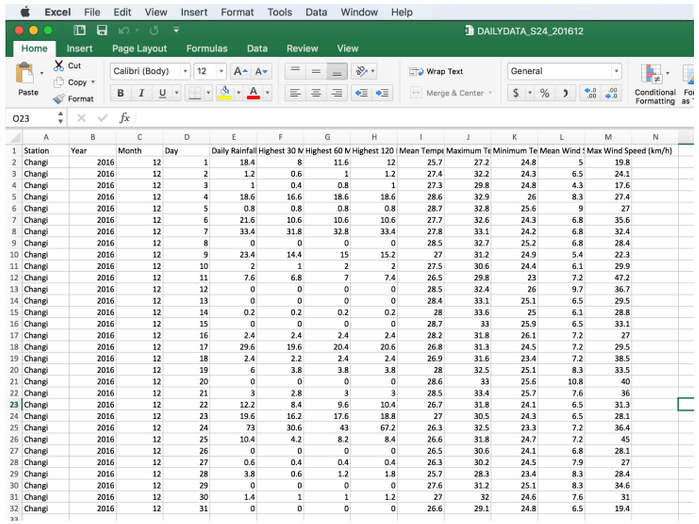


PARSE THE DATA

- Read any documentation provided with the data
- Perform exploratory data analysis
- Verify the quality of the data

PARSE THE DATA

- Structured data – well formatted, data schema defined, generally easy to parse
- Unstructured data – may require additional processing or programming tools to extract relevant metadata e.g. sentiments, word count, entities
- Semi-structured data – may require use of regex or programming logic to extract relevant fields e.g. logs, JSON, XML



Station	Year	Month	Day	Daily Rainfall	Highest 30 M	Highest 60 M	Highest 120	Mean Tempe	Maximum Te	Minimum Te	Mean Wind S	Max Wind Speed (km/h)
Changi	2016	12	1	18.4	8	11.6	12	25.7	27.2	24.8	5	19.8
Changi	2016	12	2	1.2	0.6	1	1.2	27.4	32.2	24.3	6.5	24.1
Changi	2016	12	3	1	0.4	0.8	1	27.3	29.8	24.8	4.3	17.6
Changi	2016	12	4	18.6	16.6	18.6	18.6	28.6	32.9	26	8.3	27.4
Changi	2016	12	5	0.8	0.8	0.8	0.8	28.7	32.8	25.6	9	27
Changi	2016	12	6	21.6	10.6	10.6	10.6	27.7	32.6	24.3	6.8	35.6
Changi	2016	12	7	33.4	31.8	32.8	33.4	27.8	33.1	24.2	6.8	32.4
Changi	2016	12	8	0	0	0	0	28.5	32.7	25.2	6.8	28.4
Changi	2016	12	9	23.4	14.4	15	15.2	27	31.2	24.9	5.4	22.3
Changi	2016	12	10	2	1	2	2	27.5	30.6	24.4	6.1	29.9
Changi	2016	12	11	7.6	6.8	7	7.4	26.5	29.8	23	7.2	47.2
Changi	2016	12	12	0	0	0	0	28.5	32.4	26	9.7	36.7
Changi	2016	12	13	0	0	0	0	28.4	33.1	25.1	6.5	29.5
Changi	2016	12	14	0.2	0.2	0.2	0.2	28	33.6	25	6.1	28.8
Changi	2016	12	15	0	0	0	0	28.7	33	25.9	6.5	33.1
Changi	2016	12	16	2.4	2.4	2.4	2.4	28.2	31.8	26.1	7.2	27
Changi	2016	12	17	29.6	19.6	20.4	20.6	26.8	31.3	24.5	7.2	29.5
Changi	2016	12	18	2.4	2.2	2.4	2.4	26.9	31.6	23.4	7.2	38.5
Changi	2016	12	19	6	3.8	3.8	3.8	28	32.5	25.1	8.3	33.5
Changi	2016	12	20	0	0	0	0	28.6	33	25.6	10.8	40
Changi	2016	12	21	3	2.8	3	3	28.5	33.4	25.7	7.6	36
Changi	2016	12	22	12.2	8.4	9.6	10.4	26.7	31.8	24.1	6.5	31.3
Changi	2016	12	23	19.6	16.2	17.6	18.8	27	30.5	24.3	6.5	28.1
Changi	2016	12	24	73	30.6	43	67.2	26.3	32.5	23.3	7.2	36.4
Changi	2016	12	25	10.4	4.2	8.2	8.4	26.6	31.8	24.7	7.2	45
Changi	2016	12	26	0	0	0	0	26.5	30.6	24.1	6.8	28.1
Changi	2016	12	27	0.6	0.4	0.4	0.4	26.3	30.2	24.5	7.9	27
Changi	2016	12	28	3.8	0.6	1.2	1.8	25.7	28.3	23.4	8.3	28.4
Changi	2016	12	29	0	0	0	0	27.6	31.2	25.1	8.3	34.6
Changi	2016	12	30	1.4	1	1	1.2	27	32	24.6	7.6	31
Changi	2016	12	31	0	0	0	0	26.6	29.1	24.8	6.5	19.4

Structured

ORAL ANSWERS TO QUESTIONS

FEATURES FOR MERGED SKILLSFUTURE AND JOBS BANK PORTALS

1 **Ms Sun Xueling** asked the Minister for Education (Higher Education and Skills) (a) whether the merger of the SkillsFuture and Jobs Bank portals will incorporate a review function for training providers to ensure outcome-based training provisions; (b) whether the merged portal can include internship opportunities for young Singaporeans; (c) whether the merged portal can include personality assessments that gauge the fit of the user to jobs as opposed to just skills; and (d) whether jobs listed in the Jobs Bank are regularly updated to ensure relevance.

The Parliamentary Secretary to the Ministers for Education (Assoc Prof Dr Muhammad Faishal Ibrahim) (for the Minister for Education (Higher Education and Skills)) : Madam, the Individual Learning Portfolio (ILP) is designed to be a one-stop online portal which empowers individuals to make informed learning and career choices. There will be platforms for individuals to review and provide feedback on the training programmes available on the ILP, and information on training outcomes will be published on the portal.

Unstructured

```
893252015.307 14 <client-ip> TCP_HIT/200 227 GET
  http://images.go2net.com/metacrawler/images/transparent.gif - NONE/- image/gif
893252015.312 23 <client-ip> TCP_HIT/200 4170 GET
  http://images.go2net.com/metacrawler/images/head.gif - NONE/- image/gif
893252015.318 38 <client-ip> TCP_HIT/200 406 GET
  http://images.go2net.com/metacrawler/images/bg2.gif - NONE/- image/gif
893252015.636 800 <client-ip> TCP_REFRESH_MISS/200 8872 GET
  http://www.metacrawler.com/ - DIRECT/www.metacrawler.com text/html
893252015.728 355 <client-ip> TCP_HIT/200 5691 GET
  http://images.go2net.com/metacrawler/images/market2.gif - NONE/- image/gif
893252016.138 465 <client-ip> TCP_HIT/200 219 GET
  http://images.go2net.com/metacrawler/templates/tips/../../images/pixel.gif -
  NONE/- image/gif
893252016.430 757 <client-ip> TCP_REFRESH_HIT/200 2106 GET
  http://images.go2net.com/metacrawler/templates/tips/../../images/ultimate.jpg -
  DIRECT/images.go2net.com image/jpeg
```

Pretty Raw Preview JSON Save Response


```
{
  "odata.metadata": "http://datamall2.mytransport.sg/ltaodataservice/$metadata#CarParkAvailability",
  "value": [
    {
      "CarParkID": 1,
      "Area": "Marina",
      "Development": "Suntec City",
      "Latitude": 1.29375,
      "Longitude": 103.85718,
      "Lots": 1460
    },
    {
      "CarParkID": 2,
      "Area": "Marina",
      "Development": "Marina Square",
      "Latitude": 1.29115,
      "Longitude": 103.85728,
      "Lots": 1789
    },
    {
      "CarParkID": 4,
      "Area": "Marina",
      "Development": "The Esplanade",
      "Latitude": 1.29011,
```


Semi-structured

PARSE THE DATA

```
# Metadata for Resale Flat Prices
---
Identifier: '7a339d20-3c57-4b11-a695-9348adfd7614'
Name: 'resale-flat-prices'
Title: 'Resale Flat Prices'
Description:
  - 'Resale transacted prices.'
  - 'Prior to March 2012, data is based on date of approval for the resale transactions.'
  - 'For March 2012 onwards, the data is based on date of registration for the resale
    transactions.'
Topics:
  - 'Infrastructure'
Keywords:
  - 'Cost of Living'
  - 'HDB'
  - 'Housing'
  - 'Property'
  - 'Public Housing'
  - 'Resale Flats'
Publisher:
  Name: 'Housing and Development Board'
  Admin 1:
    Name: 'Michelle Tay'
    Department: 'CDG'
    Email: 'Michelle_MB_TAY@hdb.gov.sg'
Sources:
  - 'Housing and Development Board'
License: 'https://data.gov.sg/open-data-licence'
Frequency: 'Monthly'
Coverage: '1990-01-01 to 2017-04-30'
Last Updated: '2017-05-15T07:03:31.090642'
Resources:
  -
    Identifier: '83b2fc37-ce8c-4df4-968b-370fd818138b'
    Title: 'Resale Flat Prices (Based on Registration Date), From March 2012 Onwards'
    Url: 'https://storage.data.gov.sg/resale-flat-prices/resources/resale-flat-prices-based-on-regis
    Format: 'CSV'
    Coverage: '2012-03-01 to 2017-04-30'
    Last Updated: '2017-05-15T07:03:30.565947'
    Schema:
      -
        Name: 'month'
        Title: 'Month'
        Type: 'datetime'
        Sub Type: 'month'
        Format: 'YYYY-MM'
```

In [156]:
```
resale_prices.head()
```

Out[156]:

	month	town	flat_type	block	street_name	storey_range	floor_area_sqm	flat_model	lease_commence_date	resale_price
0	2012-03	ANG MO KIO	2 ROOM	172	ANG MO KIO AVE 4	06 TO 10	45.0	Improved	1986	250000.0
1	2012-03	ANG MO KIO	2 ROOM	510	ANG MO KIO AVE 8	01 TO 05	44.0	Improved	1980	265000.0
2	2012-03	ANG MO KIO	3 ROOM	610	ANG MO KIO AVE 4	06 TO 10	68.0	New Generation	1980	315000.0
3	2012-03	ANG MO KIO	3 ROOM	474	ANG MO KIO AVE 10	01 TO 05	67.0	New Generation	1984	320000.0
4	2012-03	ANG MO KIO	3 ROOM	604	ANG MO KIO AVE 5	06 TO 10	67.0	New Generation	1980	321000.0

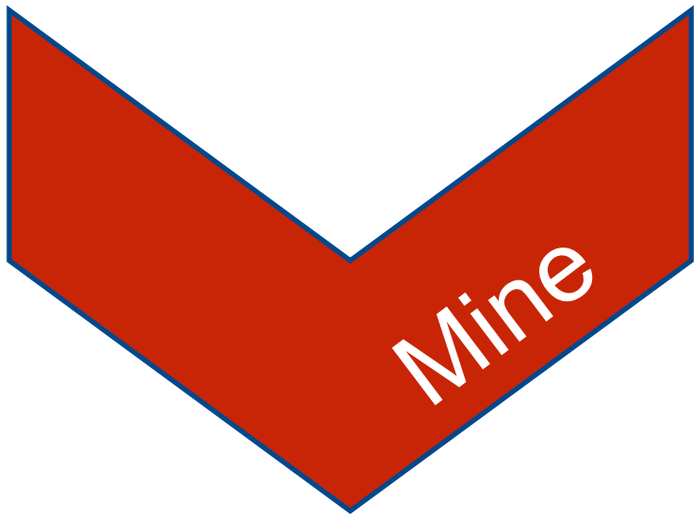
In [169]:
```
resale_prices.isnull().values.any()
```

Out[169]:
```
False
```

In [160]:
```
resale_prices.count()
```

Out[160]:
```
month                 96631
town                  96631
flat_type             96631
block                 96631
street_name           96631
storey_range          96631
floor_area_sqm        96631
flat_model            96631
lease_commence_date   96631
resale_price          96631
dtype: int64
```

MINE THE DATA



MINE THE DATA

- Determine sampling methodology and sample data
- Format, clean, slice, and combine data in Python
- Create necessary derived columns from the data (new data)

MINE THE DATA

```
In [171]: resale_prices = resale_prices.rename(columns={'month': 'year-month'})

In [181]: resale_prices['year'] = resale_prices['year-month'].apply(lambda x: int(x.split("-")[0]))

In [182]: resale_prices['month'] = resale_prices['year-month'].apply(lambda x: int(x.split("-")[1]))

In [174]: resale_prices['lower_storey_range'] = resale_prices['storey_range'].apply(lambda x: int(x.split()[0]))

In [175]: resale_prices['upper_storey_range'] = resale_prices['storey_range'].apply(lambda x: int(x.split()[2]))

In [184]: resale_prices['flat_age'] = resale_prices['year'] - resale_prices['lease_commence_date']

In [185]: resale_prices.head()
```

Out[185]:

ne	storey_range	floor_area_sqm	flat_model	lease_commence_date	resale_price	year	month	lower_storey_range	upper_storey_range	flat_age
	06 TO 10	45.0	Improved	1986	250000.0	2012	3	6	10	26
	01 TO 05	44.0	Improved	1980	265000.0	2012	3	1	5	32
	06 TO 10	68.0	New Generation	1980	315000.0	2012	3	6	10	32
	01 TO 05	67.0	New Generation	1984	320000.0	2012	3	1	5	28

REFINE THE DATA

REFINE THE DATA

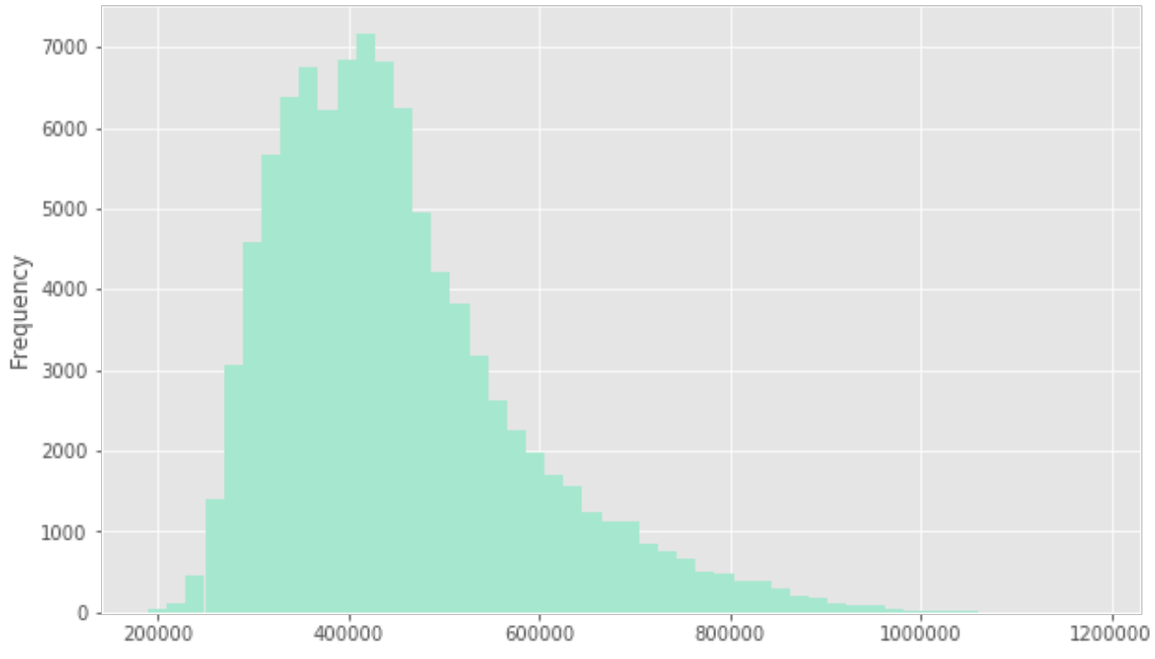
- Identify trends and outliers
- Apply descriptive and inferential statistics
- Document and transform data

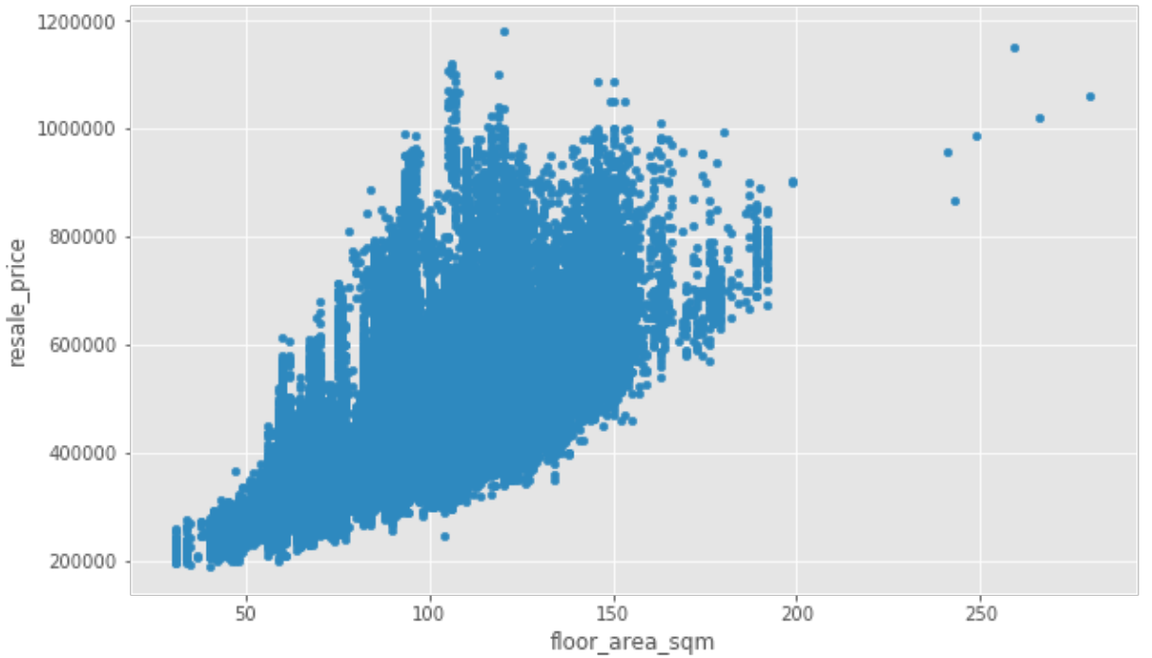
REFINE THE DATA

```
In [186]: resale_prices.describe()
```

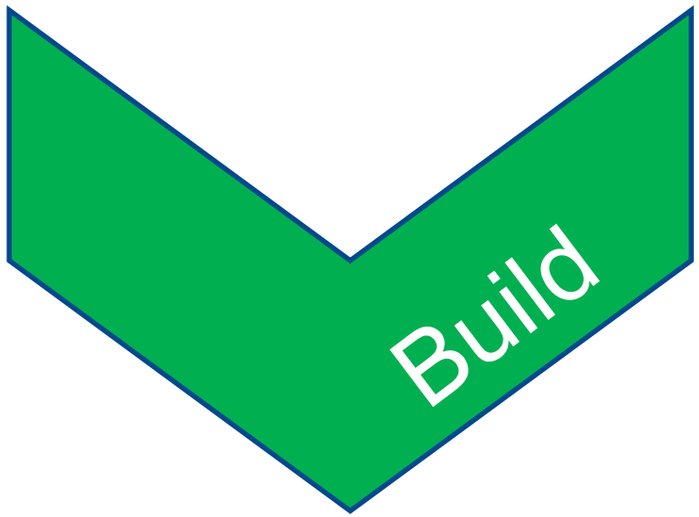
Out[186]:

	floor_area_sqm	lease_commence_date	resale_price	year	month	lower_storey_range	upper_storey_range	flat_age
count	96631.000000	96631.000000	9.663100e+04	96631.000000	96631.000000	96631.000000	96631.000000	96631.00000
mean	96.570929	1990.219039	4.502107e+05	2014.204003	6.382331	6.843156	8.984684	23.984963
std	24.615748	10.549772	1.298110e+05	1.585023	3.324086	5.149889	5.143670	10.554514
min	31.000000	1966.000000	1.900000e+05	2012.000000	1.000000	1.000000	3.000000	1.000000
25%	74.000000	1983.000000	3.550000e+05	2013.000000	4.000000	4.000000	6.000000	15.000000
50%	95.000000	1988.000000	4.250000e+05	2014.000000	6.000000	7.000000	9.000000	26.000000
75%	111.000000	1999.000000	5.150000e+05	2016.000000	9.000000	10.000000	12.000000	32.000000
max	280.000000	2013.000000	1.180000e+06	2017.000000	12.000000	49.000000	51.000000	51.000000





BUILD A DATA MODEL



BUILD A DATA MODEL

- Select appropriate model
- Build model
- Evaluate and refine model

BUILD A DATA MODEL

- Predicting a continuous variable -> regression model
- Target variable -> resale_price
- Iteratively add / remove / modify input variables, validate errors

```
from sklearn import linear_model
```

```
reg = linear_model.LinearRegression()
```

```
reg.fit(resale_prices[["floor_area_sqm", "upper_storey_range", "flat_age"]], resale_prices["resale_price"])
```

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=1, normalize=False)
```

```
reg.predict([[50,10,10], [67,5,28]])
```

```
array([ 305218.45070752,  315782.87716889])
```

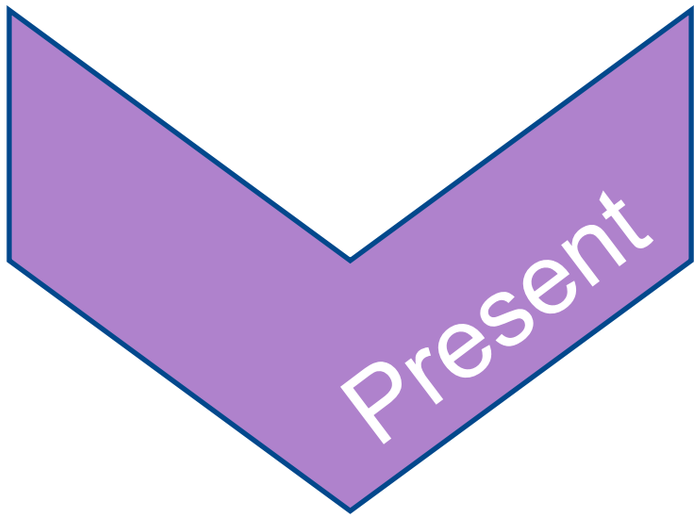
```
from sklearn.metrics import mean_squared_error
```

```
rmse = mean_squared_error(resale_prices["resale_price"],
                          reg.predict(resale_prices[["floor_area_sqm", "upper_storey_range", "flat_age"]]))**0.5
```

```
rmse
```

```
84658.318517472144
```

OVERVIEW OF THE DATA SCIENCE WORKFLOW



PRESENT THE RESULTS

- Summarize findings with narrative, storytelling techniques
- Present limitations and assumptions of your analysis
- Identify follow up problems and questions for future analysis

PRESENT THE RESULTS

- Key factors of a good presentation include:
  - Summarize findings with narrative and storytelling techniques
  - Refine your visualizations for broader comprehension
  - Present both limitations and assumptions
  - Determine the integrity of your analyses
  - Consider the degree of disclosure for various stakeholders
  - Test and evaluate the effectiveness of your presentation beforehand

GUIDED PRACTICE

DATA SCIENCE WORK FLOW

ACTIVITY: DATA SCIENCE WORKFLOW

EXERCISE

DIRECTIONS (25 minutes)

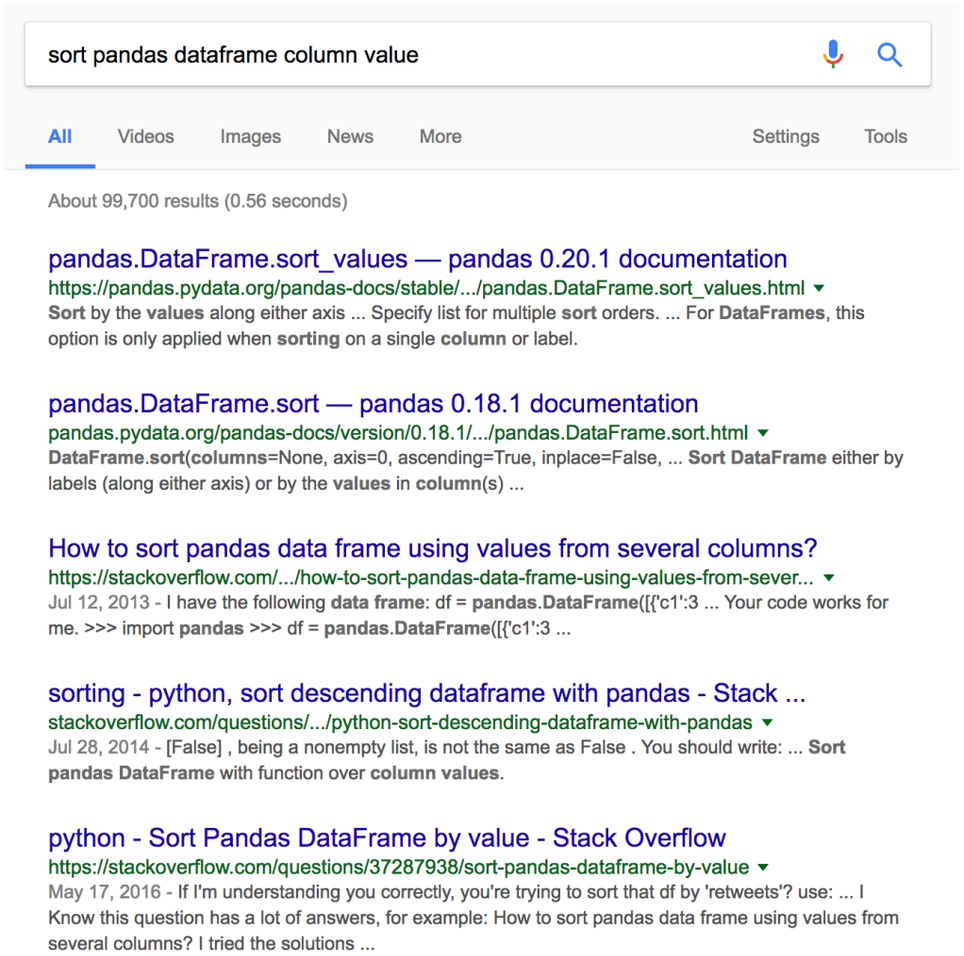
1. Divide into groups of 2-3 people
2. **IDENTIFY**: Each group should develop a data science problem statements on topics of personal or work interest. Create a hypothesis to your question. (5 minutes)
3. **ACQUIRE**: Discuss and list down the required data sources and their formats and fields required to address the problem statement. Do a search to see if the data is publicly available (10 minutes)
4. **PRESENT**: Present on your problem statements and approach to acquiring the data to the class (10 minutes)

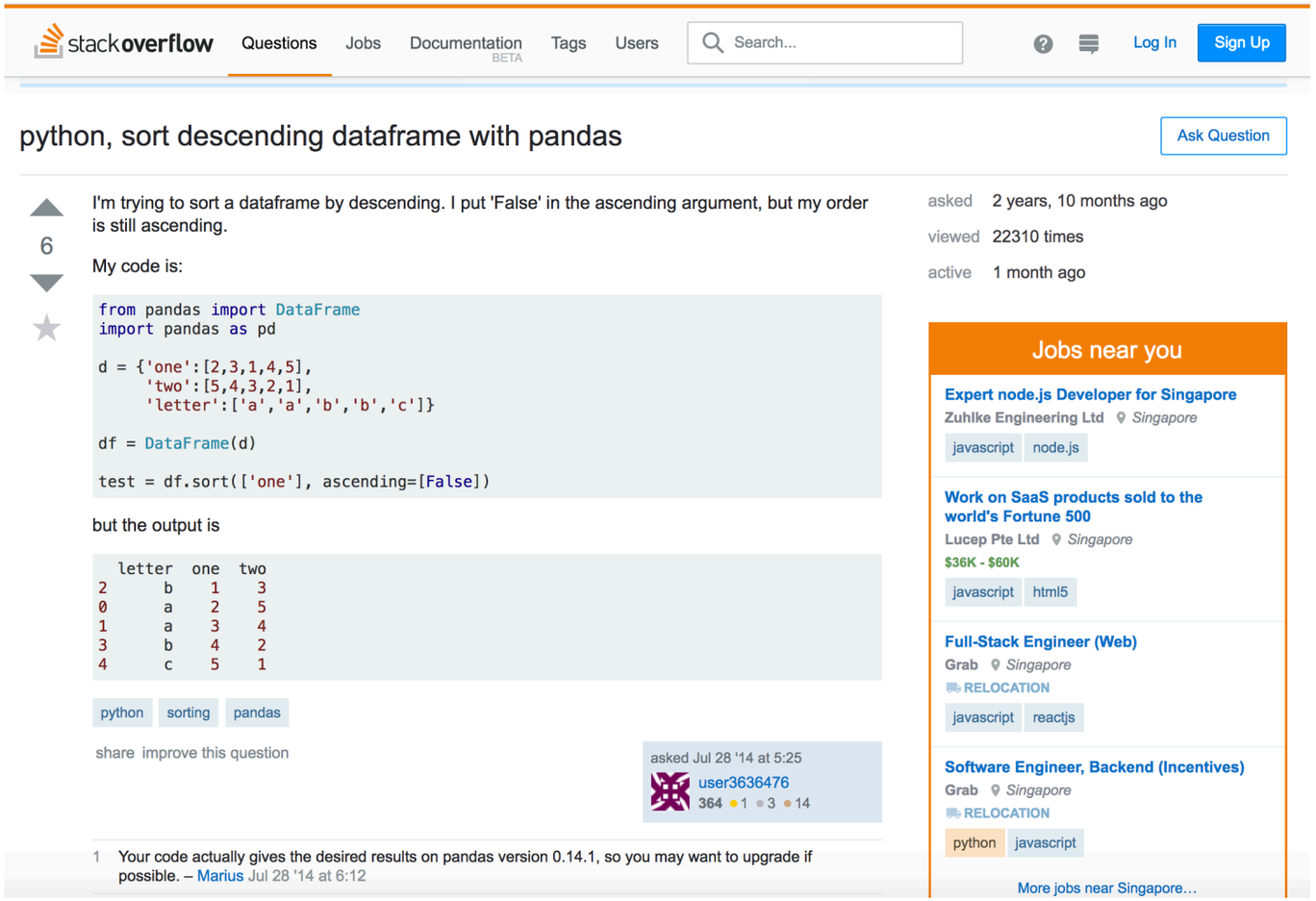
DEMO

ENVIRONMENT SETUP

GETTING HELP

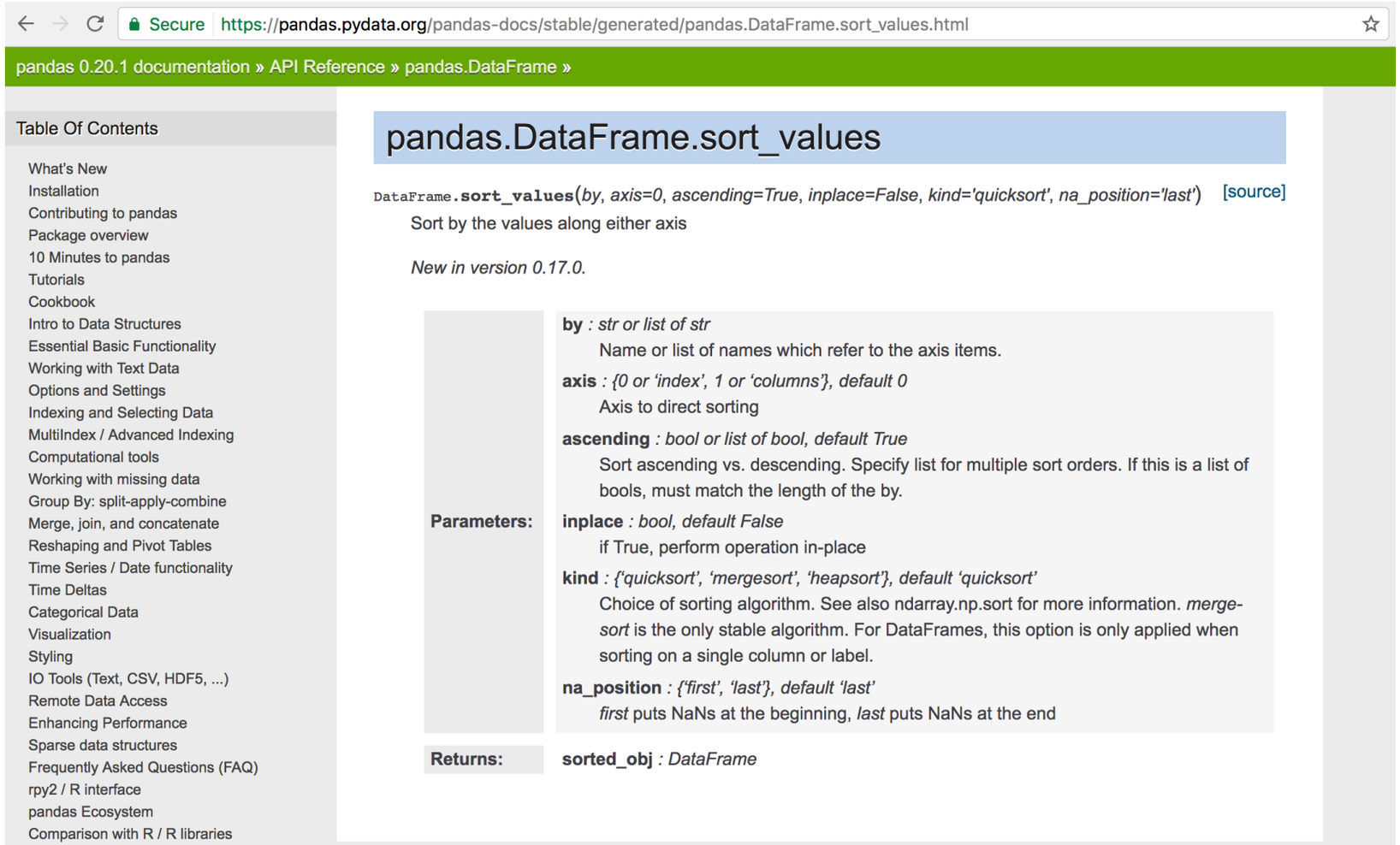
1. Google & Stack Overflow are your friend





GETTING HELP

2. Check the documentation



GETTING HELP

3. Review the error logs

1. Acquire the data

- Identify the "right" data set(s)
- Import data and set up local or remote data structure
- Determine most appropriate tools to work with data

Data downloaded from https://data.gov.sg/dataset/resale-flat-prices

```
resale_prices = pd.read_cs('data/resale-flat-prices-based-on-registration-date-from-march-2012-onwards.csv')
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-19-de8346ce4883> in <module>()
----> 1 resale_prices = pd.read_cs('data/resale-flat-prices-based-on-registration-date-from-march-2012-onwards.csv')

AttributeError: 'module' object has no attribute 'read_cs'
```

```
resale_price.head()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-21-e451aa5364ef> in <module>()
----> 1 resale_price.head()

NameError: name 'resale_price' is not defined
```

GETTING HELP

4. If you can’t resolve the problem yourself within half an hour, reach out for assistance via our class Slack channel or on Stack Overflow

Provide details about the steps you have taken, code you are running and errors to facilitate troubleshooting

DEV ENVIRONMENT SETUP

- Brief intro of tools
- Environment setup
  - Create a Github account
  - Install Python 2.7 and Anaconda
  - Practice Python syntax, Terminal and Git commands
- Jupyter Notebook test and Python review

CONCLUSION

REVIEW

CONCLUSION

- You should now be able to answer the following questions:
  - What is Data Science?
  - What is the Data Science workflow?

WELCOME TO DATA SCIENCE

Q & A

EXIT TICKET

DON’T FORGET TO FILL OUT YOUR EXIT TICKET