



# Python for Data Science







Somkiat Puisungnoen

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Intro

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Java and Bigdata



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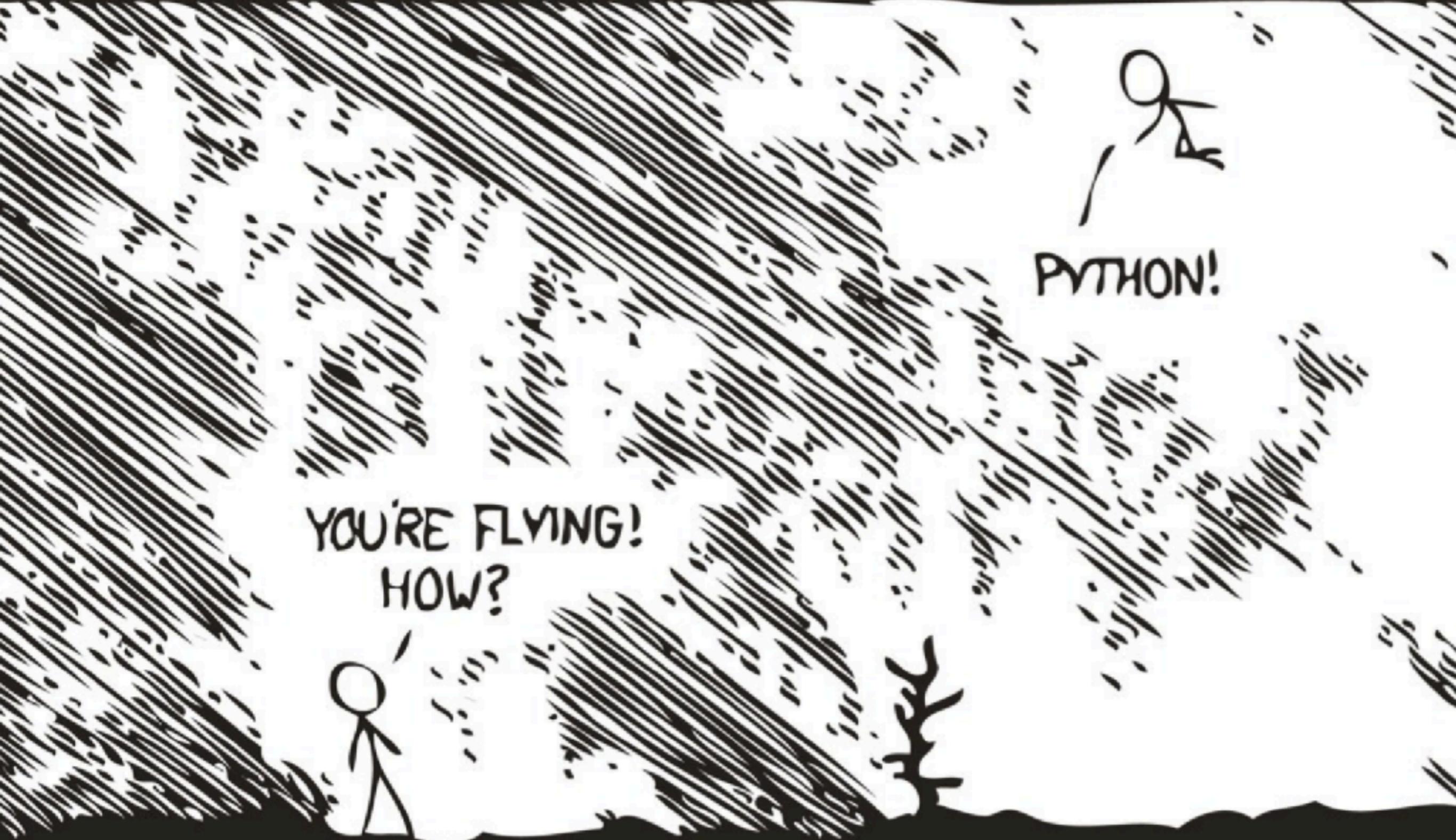
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# **Advance Python for Data Science**





xkcd



# Agenda

TDD for Python

Setup your computer => Python 3 and Jupyter

Summary of Python

List comprehensive

Workshop



# Agenda

Data Science

Data Science with Python

Numpy, Pandas and Matplotlib/Seaborn

Scikit-learn

Kaggle :: Home for Data Science

RSpark for Big Data

Workshop and Homework



**<https://github.com/up1/course-python-for-data-science>**

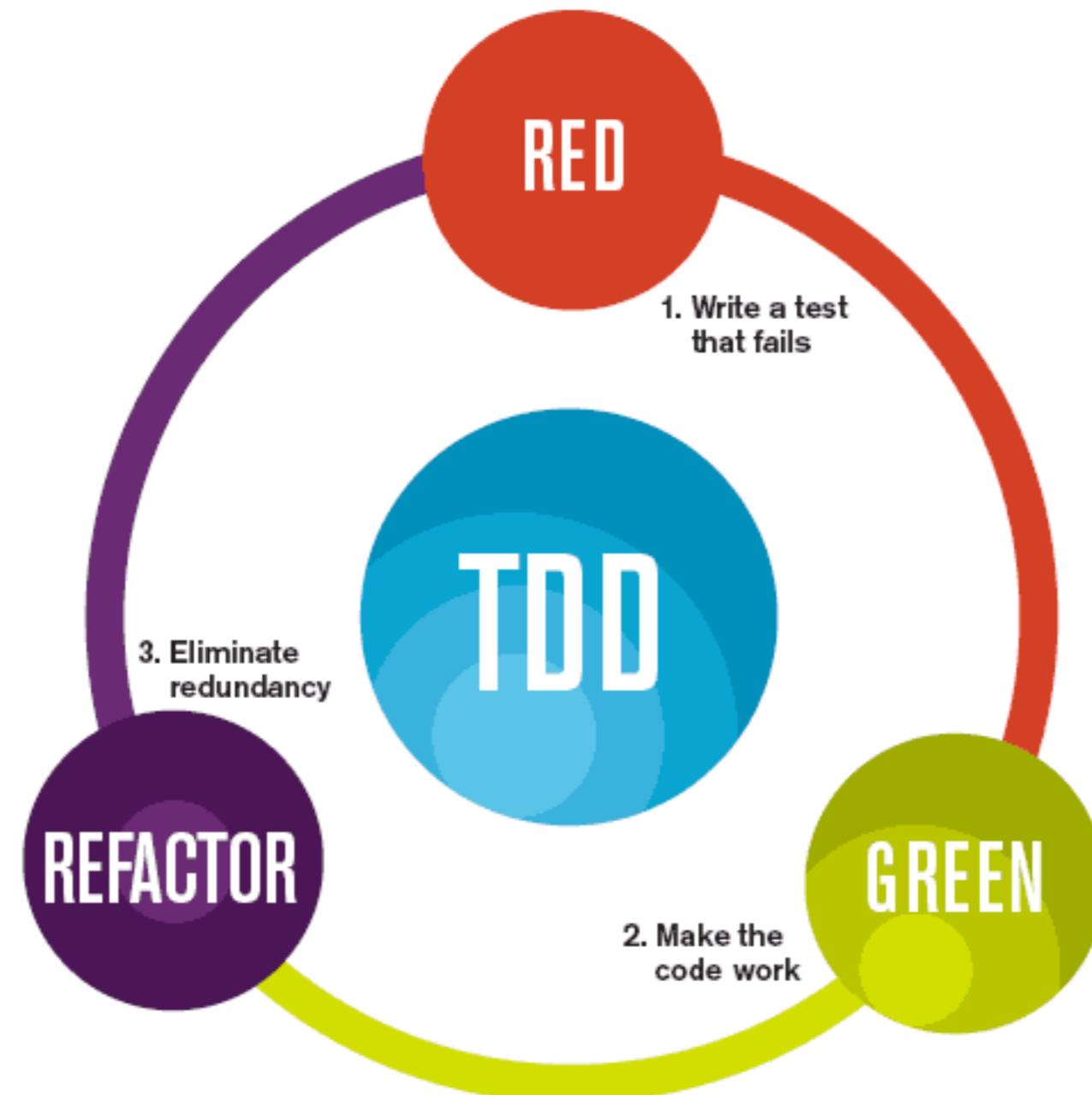




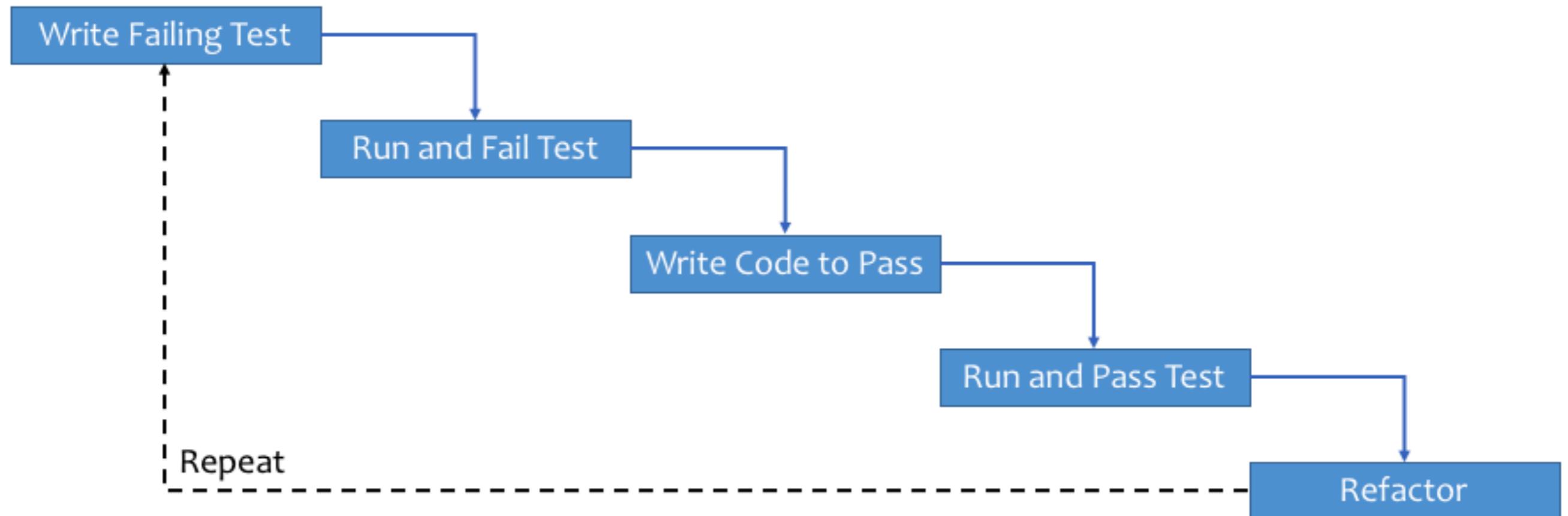
# TDD for Data Science (Python)



# TDD for Data Science (Python)



# Workflow



# Write first test case

```
import unittest
from hello import *

class MyFirstTests(unittest.TestCase):

    def test_hello(self):
        self.assertEqual(hello_world(), 'hello world')

if __name__ == '__main__':
    unittest.main()
```



# Run your test

```
$python hellotests.py
```



# Write your code



# Basic Data Types

**int** - Integer value

**float** - Decimal value

**bool** - True/False

**complex** - imaginary

**NoneType** - null value



# Iterable data types

Type	Meaning
str	String immutable value
list	Collection of elements
tuple	Immutable list
dict	Unordered key-value pairs
set	Unordered collection of unique elements



# Iterable data types

Type	How to use ?	Example
str	Defined with quotes	'ab'
list	Defined with brackets	['a', 'b']
tuple	Defined with parentheses	('a', 'b')
dict	Defined with braces	{'a': 1, 'b': 2}
set	Defined with braces	{'a', 'b'}



# Control Flows

**If-else** statements

**While** loops

**For** loops





# List comprehensive

Use for creating new list from another iterables

Introduced in Python 2.0

Python 3.0 comes with Dict and Set



# List comprehensive

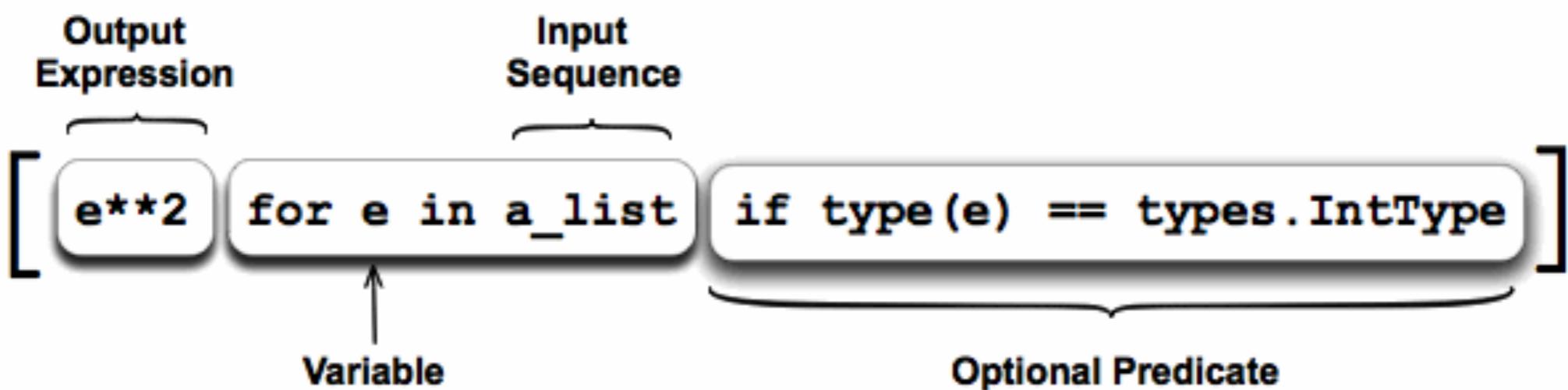
Try to replace for loops and map(), filter(),  
reduce()

In Data Science working with List too much !!



# List comprehensive

1. Input sequence
2. Variable of input sequence
3. Optional predicate expression
4. Output expression



# Example 1

## Square of number

```
def calculate():
    numbers = [1, 2, 3, 4, 5]
    results = []
    for number in numbers:
        results.append(number**2)
    print(results)

if __name__ == "__main__":
    calculate()
```



# Rewrite with List comprehensive

## Square of number

```
def calculate():
    numbers = [1, 2, 3, 4, 5]
    result = [number**2 for number in numbers]
    print(result)

if __name__ == "__main__":
    calculate()
```



# Example 2

Find the same number in 2 lists

```
def process():
    list1 = [1, 2, 3, 4, 5]
    list2 = [3, 4, 5, 6, 7]
    results = []
    for x in list1:
        for y in list2:
            if x == y:
                results.append(x)

    print(results)

if __name__ == "__main__":
    process()
```



# Rewrite with List comprehensive

Find the same number in 2 lists of number

```
def process():
    list1 = [1, 2, 3, 4, 5]
    list2 = [3, 4, 5, 6, 7]
    results = [x for x in list1 for y in list2 if x==y]
    print(results)

if __name__ == "__main__":
    process()
```



# Example 3

## Replace number with string (Even and Odd)

```
def process():
    numbers = [1, 2, 3, 4, 5]
    results = []
    for number in numbers:
        if number%2 == 0:
            results.append("Even")
        else:
            results.append("Odd")
    print(results)

if __name__ == "__main__":
    process()
```



# Rewrite with List comprehensive

Replace number with string (Even and Odd)

```
def process():
    numbers = [1, 2, 3, 4, 5]
    results = ["Even" if number%2 == 0 else "Odd" for number in numbers]
    print(results)

if __name__ == "__main__":
    process()
```



# Example 4

## Remove vowels from sentence

```
def process(sentence):
    vowels = 'aeiou'
    results = []
    for c in sentence:
        if c not in vowels:
            results.append(c)
    return ''.join(results)

if __name__ == "__main__":
    print(process('Hello World'))
```



# Rewrite with List comprehensive

Remove vowels from sentence

```
def process(sentence):
    vowels = 'aeiou'
    return ''.join([c for c in sentence if c not in vowels])

if __name__ == "__main__":
    print(process('Hello World'))
```

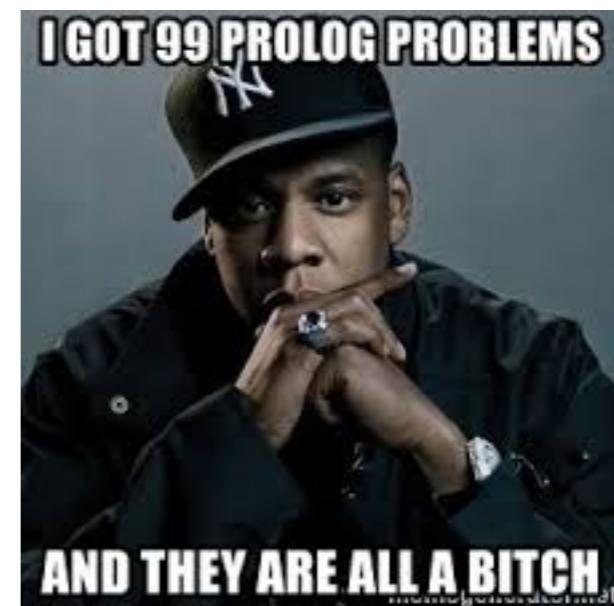


# Try to practices



# Practice python skills

**Project Euler**.net



Weekly  
**Python**  
Exercise



# Project Euler (616 problems)

<https://projecteuler.net/archives>

ID	Description / Title	Solved By
1	Multiples of 3 and 5	749135
2	Even Fibonacci numbers	602067
3	Largest prime factor	431141
4	Largest palindrome product	383883
5	Smallest multiple	392340
6	Sum square difference	394673
7	10001st prime	337853
8	Largest product in a series	285474
9	Special Pythagorean triplet	288258
10	Summation of primes	264489



# 1. Multiples of 3 and 5

<https://projecteuler.net/problem=1>

## Problem 1



If we list all the natural numbers below 10 that are multiples of 3 or 5, we get 3, 5, 6 and 9. The sum of these multiples is 23.

Find the sum of all the multiples of 3 or 5 below 1000.



# 2. Even Fibonacci Numbers

<https://projecteuler.net/problem=2>

## Problem 2

i

Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...

By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.



# 6. Sum square difference

<https://projecteuler.net/problem=6>

Problem 6



The sum of the squares of the first ten natural numbers is,

$$1^2 + 2^2 + \dots + 10^2 = 385$$

The square of the sum of the first ten natural numbers is,

$$(1 + 2 + \dots + 10)^2 = 55^2 = 3025$$

Hence the difference between the sum of the squares of the first ten natural numbers and the square of the sum is  $3025 - 385 = 2640$ .

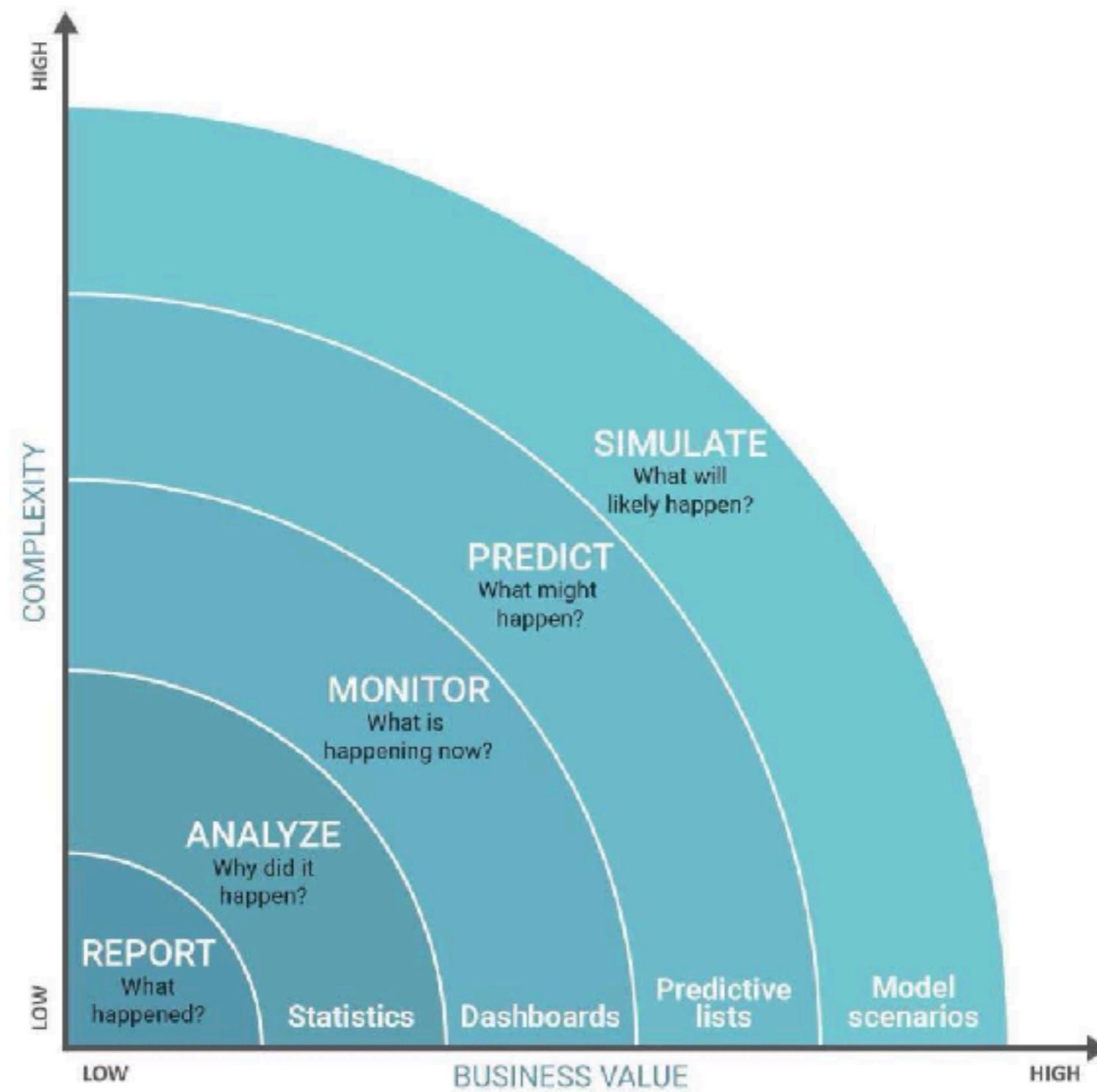
Find the difference between the sum of the squares of the first one hundred natural numbers and the square of the sum.



# Data Science



# Levels of Data Science

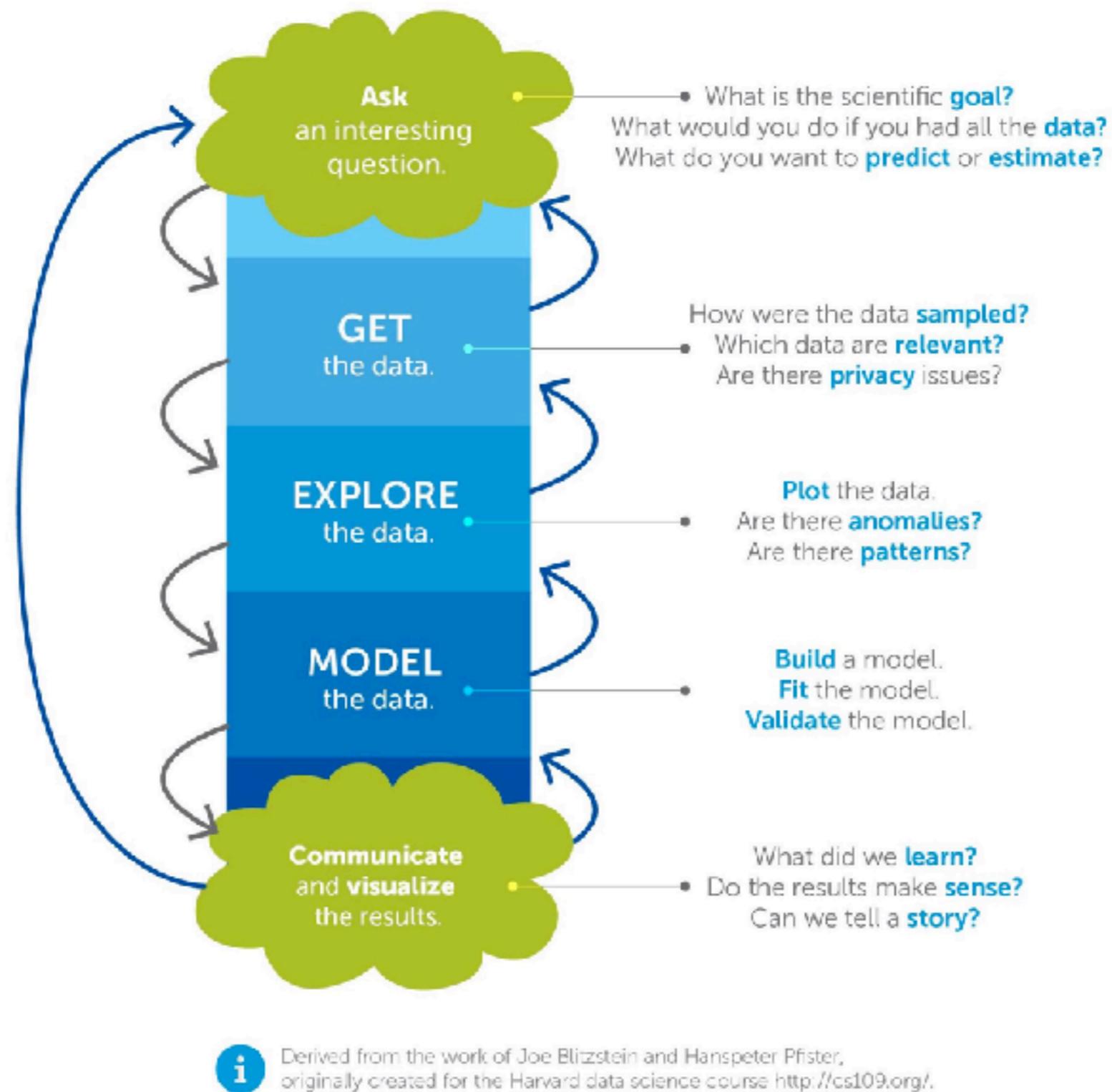


# Data Science Process

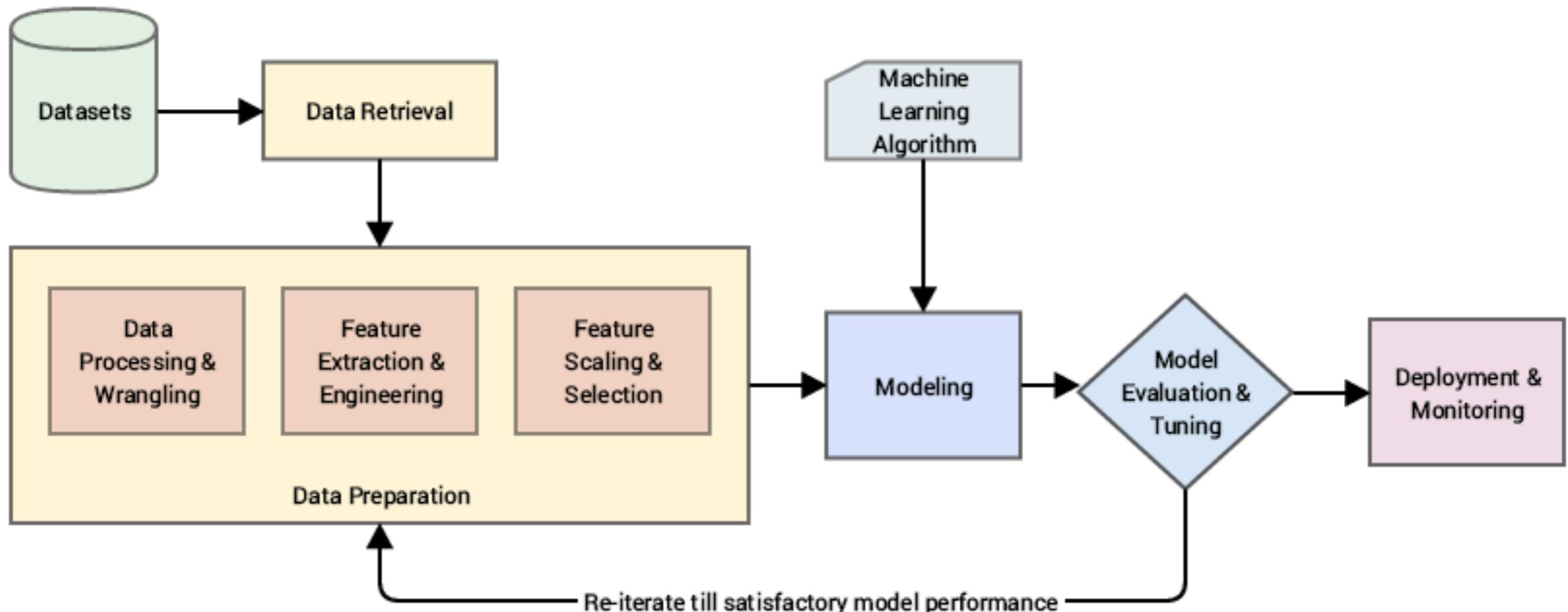
1. Collect the raw data needed to solve problem
2. Process the data (data wrangling)
3. Explore the data (data visualization)
4. Perform in-depth analysis (ML, Statistic, Algorithm)
5. Communicate result of the analysis



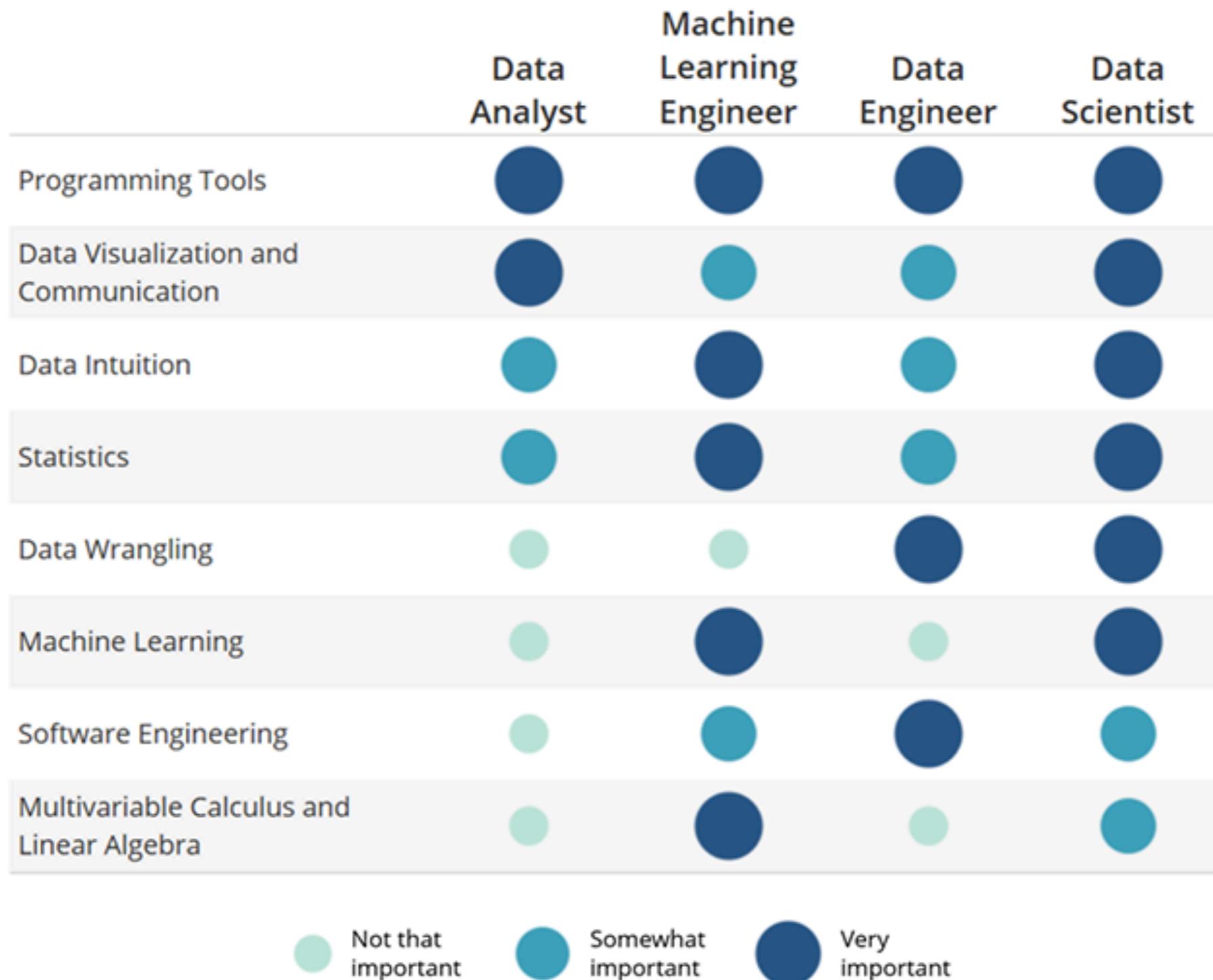
# The Data Science Process



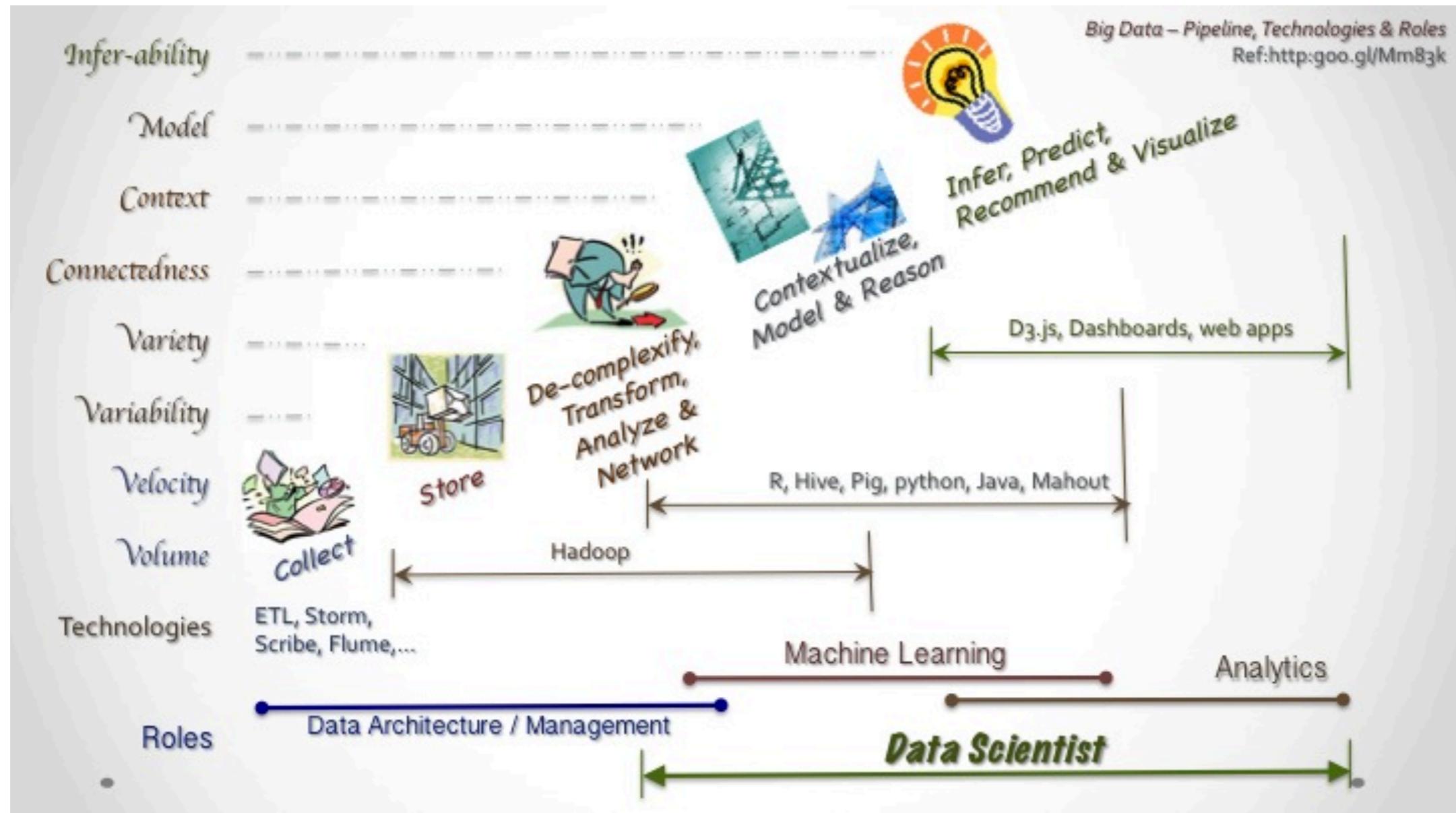
# Data Science Process



# Data Science Skills



# Operation under Data Science



# Exploratory Data Analysis

Check data how it is scattered  
Data dimension  
Column name  
Unique and grouping values  
Missing values



# Feature Engineering

Create additional relevance features from the existing features in the raw data.

Try to increase the predictive power of the learning algorithm.



# Data Manipulation

The process of changing data in an effort to make it easier to read and organize.



# Exploratory Data Analysis (EDA)

Seeing what the data can tell us beyond the formal modeling or hypothesis testing tasks.



# Exploratory Data Analysis (EDA)

The approach to analyzing datasets to summarize their main characteristics, **often with visual methods.**



# Machine Learning (ML)



# Machine Learning

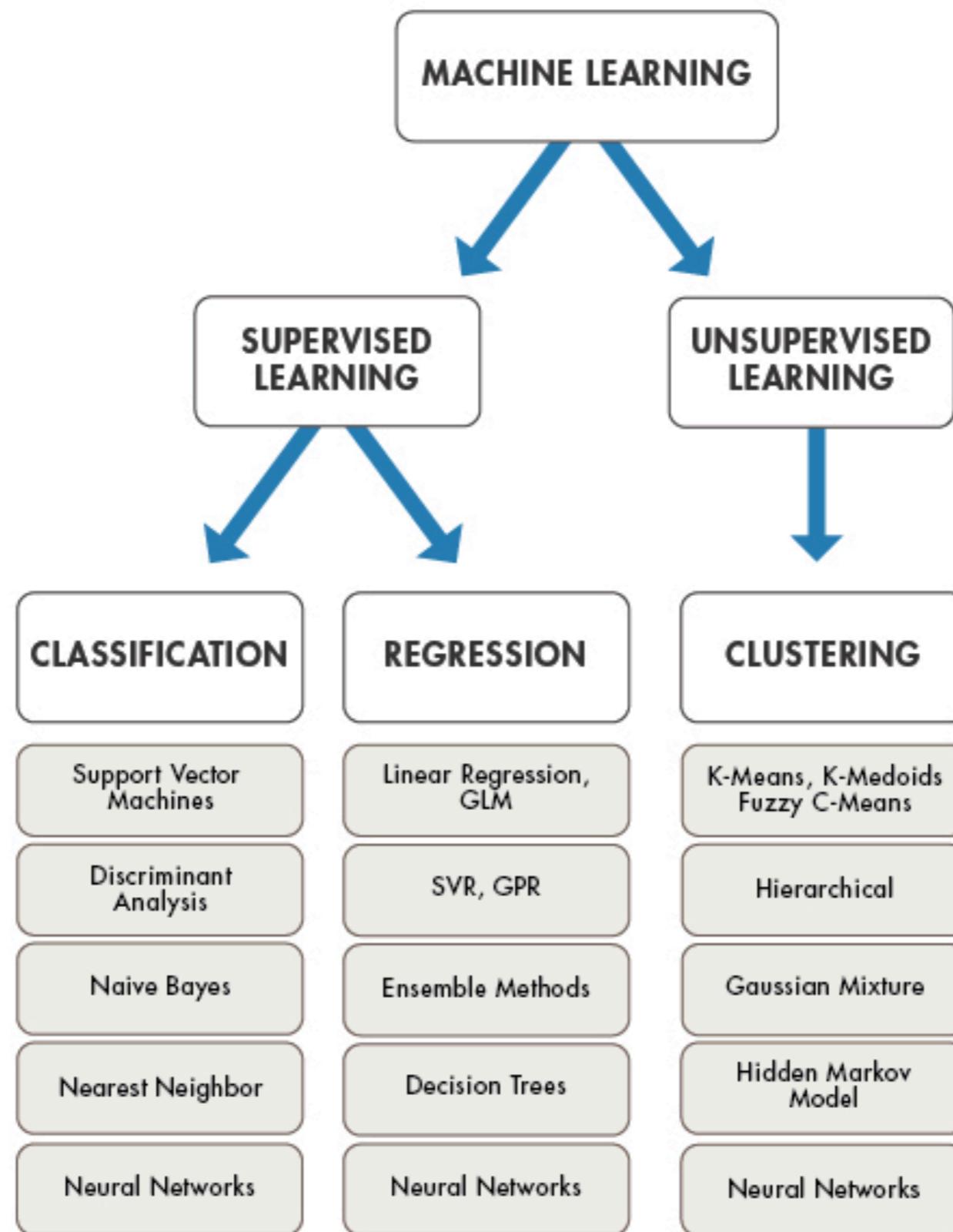
The application of AI that provides system the ability to **automatically learn and improve** experience without explicitly programmed.

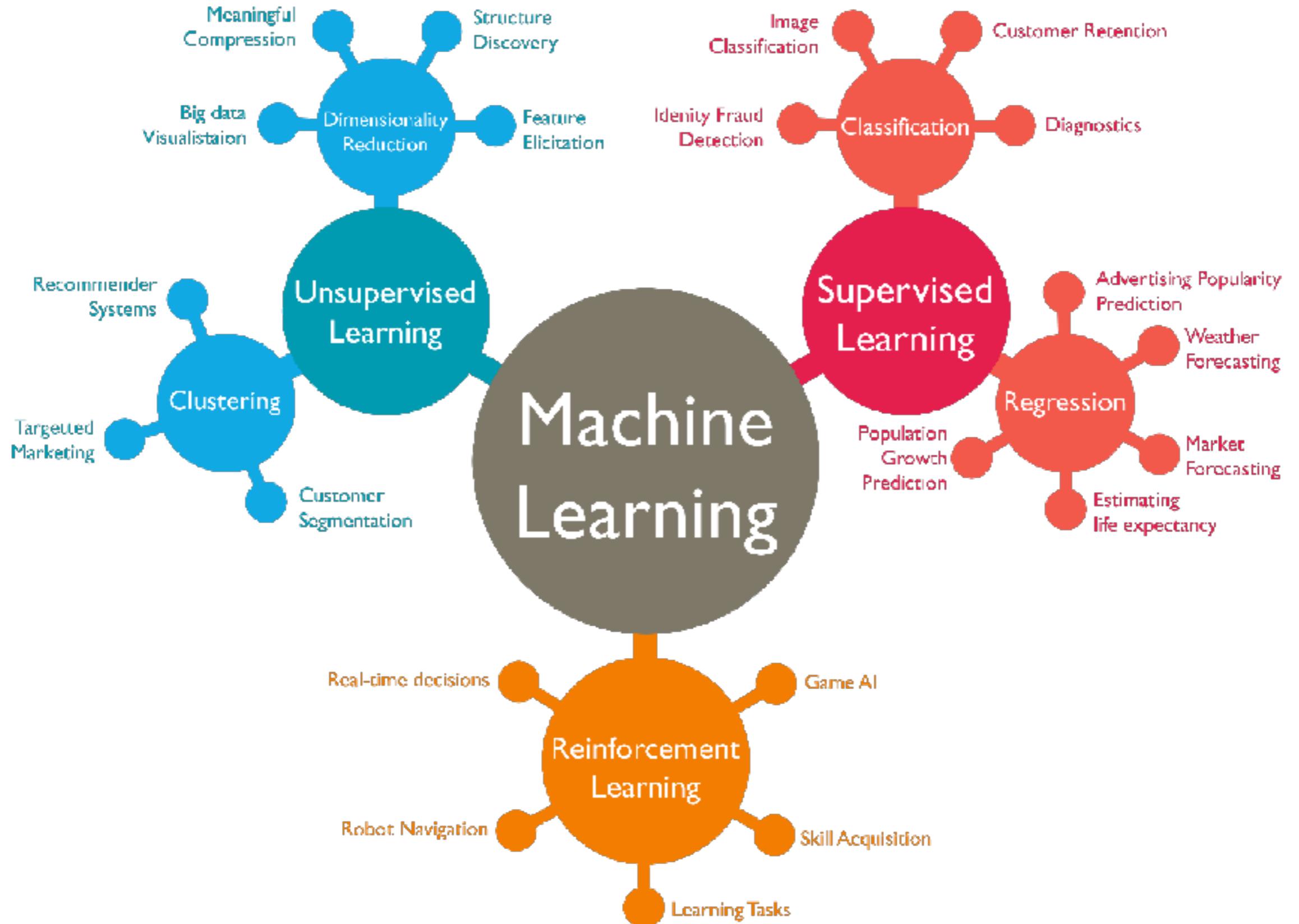


# Machine Learning

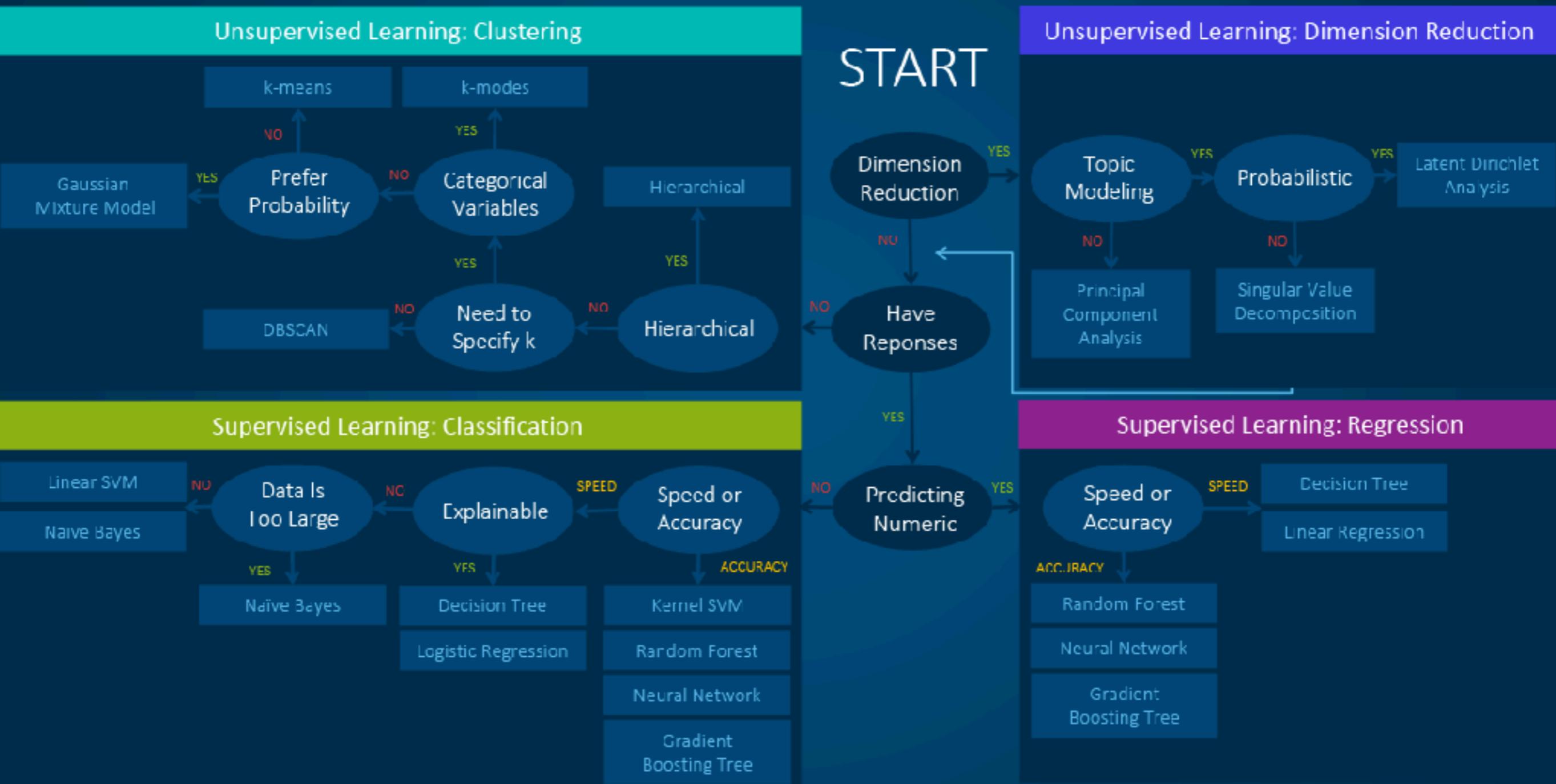
Focus on the development of computer program that can access data and use it to learn themselves.





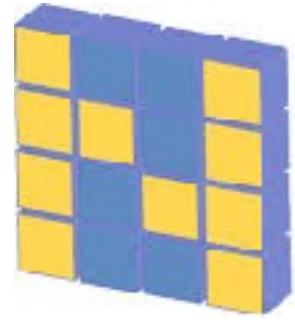


# Machine Learning Algorithms Cheat Sheet



# Libraries for Data Science

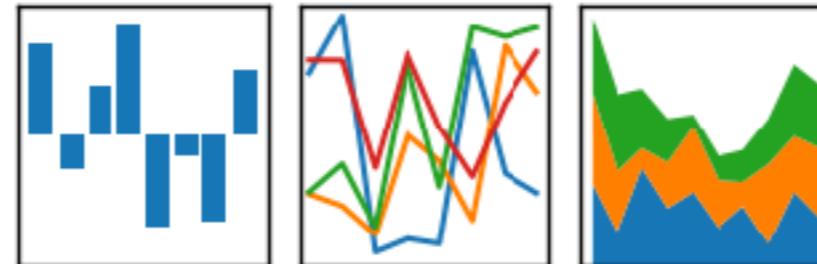




# NumPy

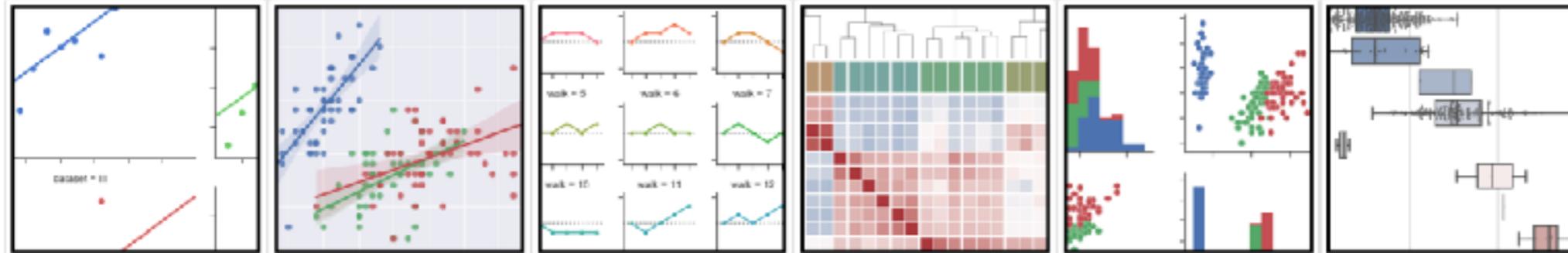
## pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



# matplotlib

## seaborn: statistical data visualization



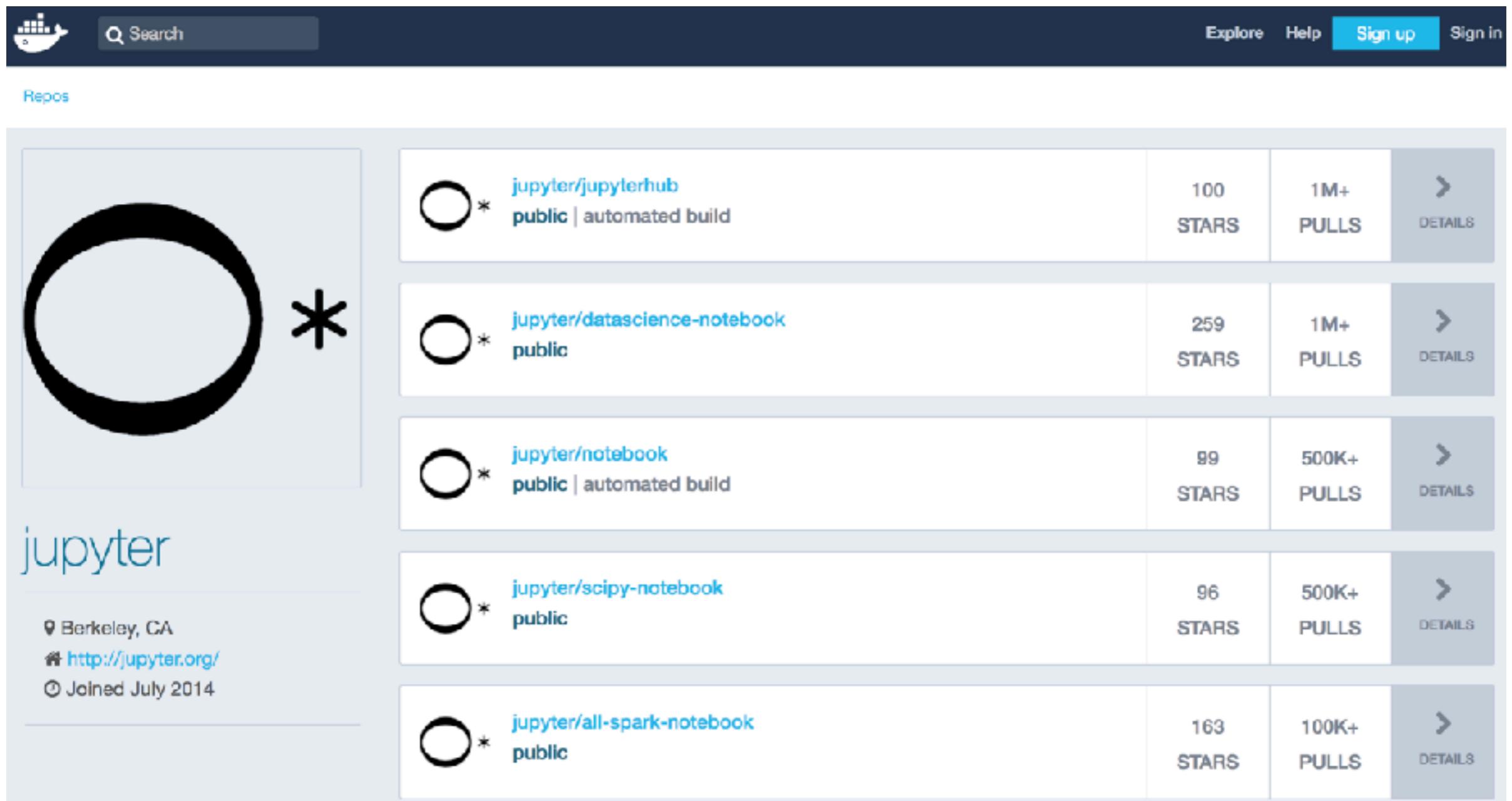
# Tools



# Docker for Data Science



# Jupyter Images



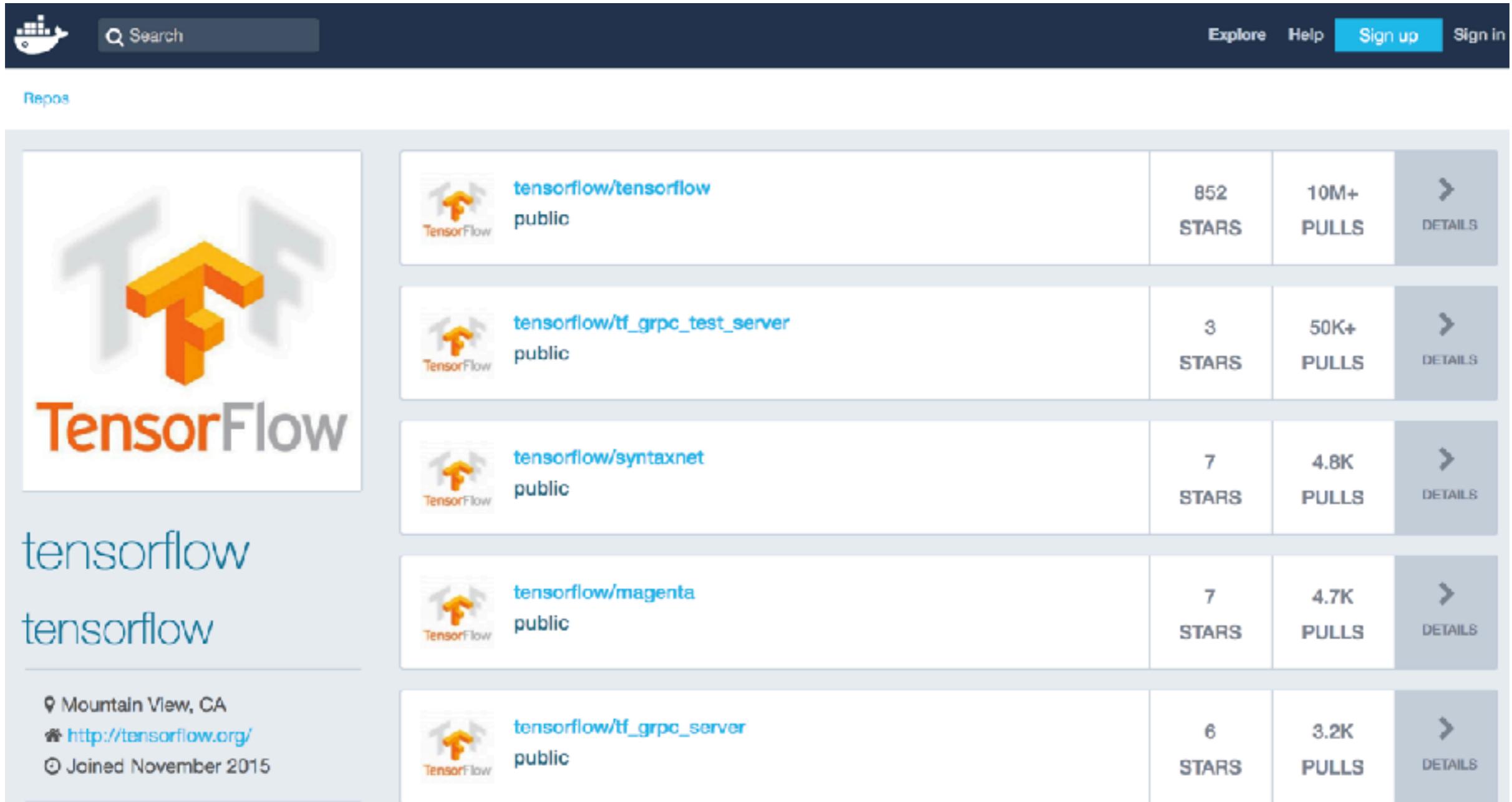
The screenshot shows the Docker Hub interface for the user 'jupyter'. On the left, there's a large placeholder image with a black circle and an asterisk (\*). Below it, the user's name 'jupyter' is displayed, along with location 'Berkeley, CA', website 'http://jupyter.org/', and joining date 'Joined July 2014'. To the right, a list of five Docker images is shown:

Image	Description	Stars	Pulls	Actions
jupyter/jupyterhub	public   automated build	100	1M+	<a href="#">DETAILS</a>
jupyter/datascience-notebook	public	259	1M+	<a href="#">DETAILS</a>
jupyter/notebook	public   automated build	99	500K+	<a href="#">DETAILS</a>
jupyter/scipy-notebook	public	96	500K+	<a href="#">DETAILS</a>
jupyter/all-spark-notebook	public	163	100K+	<a href="#">DETAILS</a>

<https://hub.docker.com/u/jupyter/>



# TensorFlow Images



The screenshot shows the Docker Hub interface for the user 'tensorflow'. On the left, there's a large image of the TensorFlow logo and two smaller 'tensorflow' text links. Below that are user details: location 'Mountain View, CA', website 'http://tensorflow.org/', and joining date 'Joined November 2015'. The main area lists five Docker images from the 'tensorflow' repository:

Image Name	Visibility	Stars	Pulls	Actions
<a href="#">tensorflow/tensorflow</a>	public	852	10M+	<a href="#">DETAILS</a>
<a href="#">tensorflow/tf_grpc_test_server</a>	public	3	50K+	<a href="#">DETAILS</a>
<a href="#">tensorflow/syntaxnet</a>	public	7	4.8K	<a href="#">DETAILS</a>
<a href="#">tensorflow/magenta</a>	public	7	4.7K	<a href="#">DETAILS</a>
<a href="#">tensorflow/tf_grpc_server</a>	public	6	3.2K	<a href="#">DETAILS</a>

<https://hub.docker.com/u/tensorflow/>



# Install Jupyter with Docker

```
$ docker pull jupyter/datascience-notebook
```



# Install Jupyter with Docker

```
$ docker container run -d -p 8888:8888  
-v $(pwd):/home/jovyan/work  
jupyter/datascience-notebook  
start-notebook.sh  
--NotebookApp.base_url=/workshop/
```



# Hello Jupyter

The screenshot shows the Jupyter Notebook interface. At the top, there is a header bar with a 'C' icon, a URL field containing 'localhost:8888/workshop/tree', and a series of small icons for file operations like star, camera, file, folder, etc. Below the header is a navigation bar with a 'jupyter' logo and a 'Logout' button. The main area has tabs for 'Files', 'Running', and 'Clusters', with 'Files' being active. A message 'Select items to perform actions on them.' is displayed above a file tree. The tree shows a root directory '/' with a count of 0 files, and a 'work' folder containing one item. To the right of the tree are buttons for 'Upload', 'New', and a refresh icon. Below the tree, sorting options 'Name' and 'Last Modified' are shown, along with a timestamp '3 minutes ago'.

Name	Last Modified
/	3 minutes ago
work	3 minutes ago



# JupyterLab

The screenshot shows the JupyterLab interface. On the left is a sidebar with tabs for Files, Running, Commands, Cell Tools, and Tabs. The Files tab is active, showing a list of notebooks: Data.ipynb, Fastai.ipynb, Julia.ipynb, Lorenz.ipynb (selected), R.ipynb, iris.csv, lightning.json, and lorenz.py. The Running tab shows no active kernels. The Commands tab lists R.ipynb, iris.csv, lightning.json, and lorenz.py. The Cell Tools tab is empty. The Tabs tab shows tabs for Lorenz.ipynb, Terminal 1, Console 1, Data.ipynb, and README.md.

In the main area, the Lorenz.ipynb tab is active. The notebook content includes:

- A text cell: "In this Notebook we explore the Lorenz system of differential equations:  
 $\dot{x} = \sigma(y - x)$   
 $\dot{y} = \rho x - y - xz$   
 $\dot{z} = -\beta z + xy$
- A code cell: In [4]: 

```
from lorenz import solve_lorenz
t, x_t = solve_lorenz(N=10)
```
- An output cell titled "Output View" showing sliders for sigma (10.00), beta (2.67), and rho (28.00), and a 3D plot of the Lorenz attractor.
- A code editor titled "lorenz.py" containing the implementation of the Lorenz system.

```
def solve_lorenz(N=10, max_time=4.0, sigma=10.0, beta=8./3, rho=28.0):
    """Plot a solution to the Lorenz differential equations."""
    fig = plt.figure()
    ax = fig.add_axes([0, 0, 1, 1], projection='3d')
    ax.axis('off')

    # prepare the axes limits
    ax.set_xlim((-25, 25))
    ax.set_ylim((-35, 35))
    ax.set_zlim(5, 55)

    def lorenz_deriv(x_y_z, t0, sigma=sigma, beta=beta, rho=rho):
        """Compute the time-derivative of a Lorenz system."""
        x, y, z = x_y_z
        return [sigma * (y - x), x * (rho - z) - y, x * y - beta * z]

    # Choose random starting points, uniformly distributed from -15 to 15
    np.random.seed(1)
    x0 = -15 + 30 * np.random(N, 3)
```

<http://jupyterlab.readthedocs.io/en/stable/>



# Working with data



# Python for Data Science Cheat Sheet

[https://s3.amazonaws.com/assets.datacamp.com/blog\\_assets/  
PythonForDataScience.pdf](https://s3.amazonaws.com/assets.datacamp.com/blog_assets/PythonForDataScience.pdf)

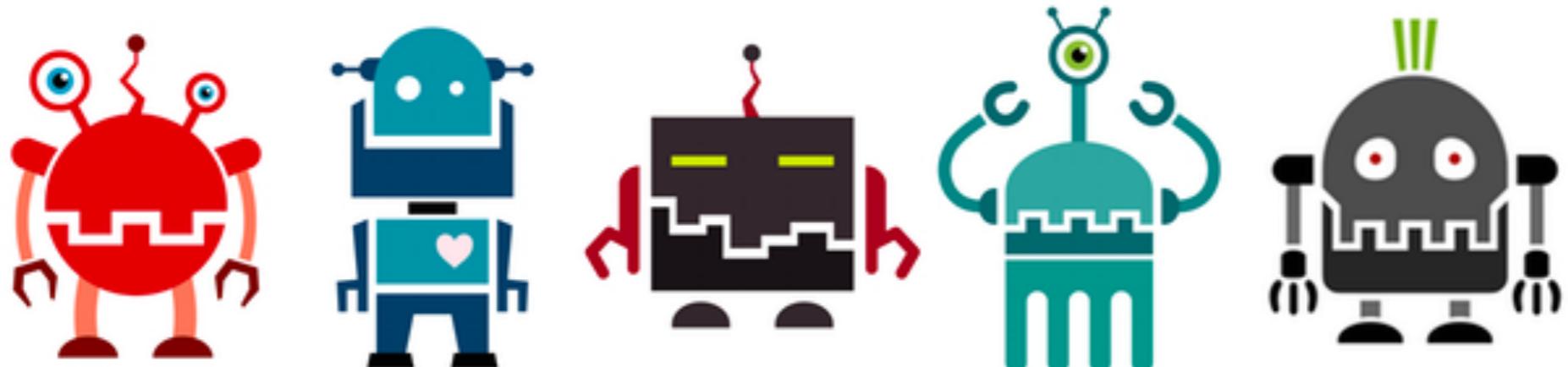


# Choosing the good charts

[http://extremepresentation.typepad.com/blog/files/  
choosing\\_a\\_good\\_chart.pdf](http://extremepresentation.typepad.com/blog/files/choosing_a_good_chart.pdf)



# kaggle



# Home of Data Science

## Welcome to Kaggle Competitions

Challenge yourself with real-world machine learning problems



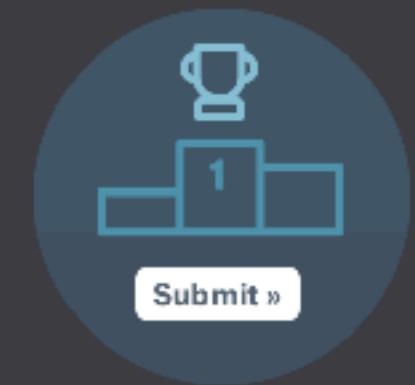
### New to Data Science?

Get started with a tutorial on our most popular competition for beginners, [Titanic: Machine Learning from Disaster](#).



### Build a Model

Get the data & use whatever tools or methods you prefer to make predictions.



### Make a Submission

Upload your prediction file for real-time scoring & a spot on the leaderboard.

[Learn more](#) [InClass](#)



# Working with Data

<https://www.kaggle.com/c/titanic/>



# Exploratory Data Analysis



# Exploratory Data Analysis (EDA)

Seeing what the data can tell us beyond the formal modeling or hypothesis testing tasks.



# Exploratory Data Analysis (EDA)

Data extraction  
Data cleaning  
Data plotting  
Make assumption



# Read data

Using Pandas for read data to data frame

```
import pandas as pd  
  
titanic_df = pd.read_csv("train.csv")  
  
print(titanic_df)  
print(titanic_df.head())  
print(titanic_df.info())
```



# Understanding data

Variable name	Description	Possible value
Survived		0 = No 1 = Yes
Pclass	Passenger class	1 = First 2 = Second 3 = Third
Name	Prefix + name	
Sex	Sex	male female
Age	Age	
SibSp	Number of sibling/spouse	



# Understanding data

Variable name	Description	Possible value
Parch	Number of parent/children	
Ticket	Ticket number	
Fare	Passenger fare	
Cabin	Cabin	
Embarked	Port of embarkation	C = Cherbourg Q = Queenstown S = Southampton



# Understanding data

The overall chance of survival for a passenger

```
In [4]: titanic_df[ 'Survived' ].mean()  
Out[4]: 0.38383838383838381
```

*38% of passengers survived*



# Understanding data

Class of passenger vs. % of survived ?

```
titanic_df.groupby('Pclass').mean()
```

Pclass	PassengerId	Survived	Age	SibSp	Parch	Fare
1	461.597222	0.629630	38.233441	0.416667	0.356481	84.154687
2	445.956522	0.472826	29.877630	0.402174	0.380435	20.662183
3	439.154786	0.242363	25.140620	0.615071	0.393075	13.675550

*First class has a 62% chance of survival*



# Understanding data

Class of passenger vs. % of survived ?

```
titanic_df[['Pclass', 'Survived']].groupby(  
    ['Pclass'], as_index=False).mean()
```

Pclass	Survived	
0	1	0.629630
1	2	0.472826
2	3	0.242363

*First class has a 62% chance of survival*



# Understanding data

Class of passenger vs. % of survived ?

```
titanic_df.groupby('Pclass').mean()
```

Pclass	PassengerId	Survived	Age	SibSp	Parch	Fare
1	461.597222	0.629630	38.233441	0.416667	0.356481	84.154687
2	445.956522	0.472826	29.877630	0.402174	0.380435	20.662183
3	439.154786	0.242363	25.140620	0.615071	0.393075	13.675550

*Lower classes consisted of younger people*



# Understanding data

## Grouping data of Pclass and Sex

```
pclass_sex = titanic_df.groupby(["Pclass", "Sex"]).mean()  
pclass_sex
```

Pclass	Sex	PassengerId	Survived	Age	SibSp	Parch	Fare
1	female	469.212766	0.968085	34.611765	0.553191	0.457447	106.125798
	male	455.729508	0.368852	41.281386	0.311475	0.278689	67.226127
2	female	443.105263	0.921053	28.722973	0.486842	0.605263	21.970121
	male	447.962963	0.157407	30.740707	0.342593	0.222222	19.741782
3	female	399.729167	0.500000	21.750000	0.895833	0.798611	16.118810
	male	455.515850	0.135447	26.507589	0.498559	0.224784	12.661633

*Female > Male of survival*

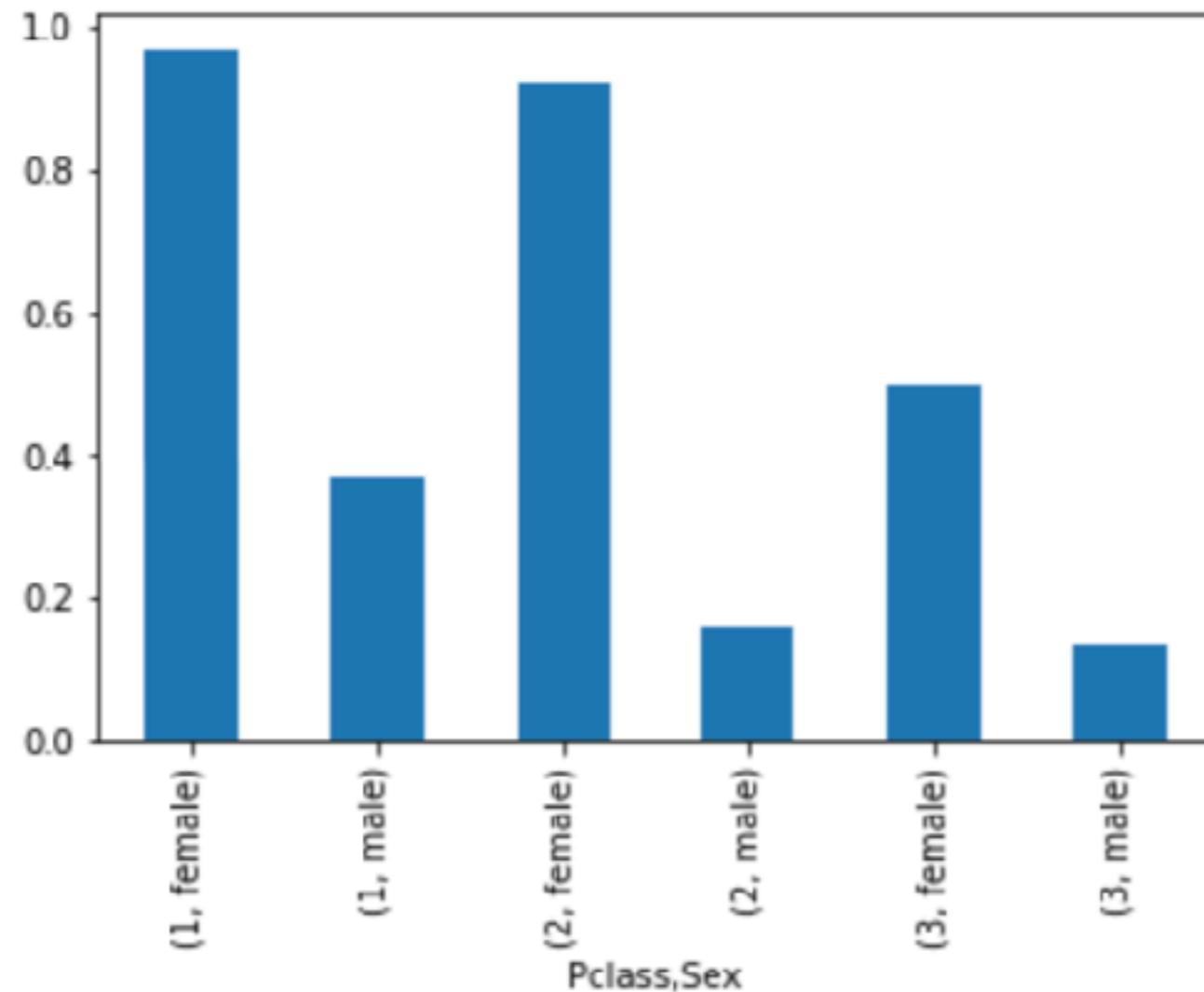


# Understanding data

## Grouping data of Pclass and Sex

```
pclass_sex[ "Survived" ].plot.bar()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fcf54c68710>
```



# Understanding data

## Female and children first ?

```
pclass_sex = titanic_df.groupby( [ "Pclass" , "Sex" ] ).mean()  
pclass_sex
```

		PassengerId	Survived	Age	SibSp	Parch	Fare
Pclass	Sex						
1	female	469.212766	0.968085	34.611765	0.553191	0.457447	106.125798
	male	455.729508	0.368852	41.281386	0.311475	0.278689	67.226127
2	female	443.105263	0.921053	28.722973	0.486842	0.605263	21.970121
	male	447.962963	0.157407	30.740707	0.342593	0.222222	19.741782
3	female	399.729167	0.500000	21.750000	0.895833	0.798611	16.118810
	male	455.515850	0.135447	26.507589	0.498559	0.224784	12.661633



# Understanding data

## Female and children first ?

```
group_age = pd.cut(titanic_df["Age"],  
                    np.arange(0, 90, 10))  
age_grouping = titanic_df.groupby(group_age).mean()
```

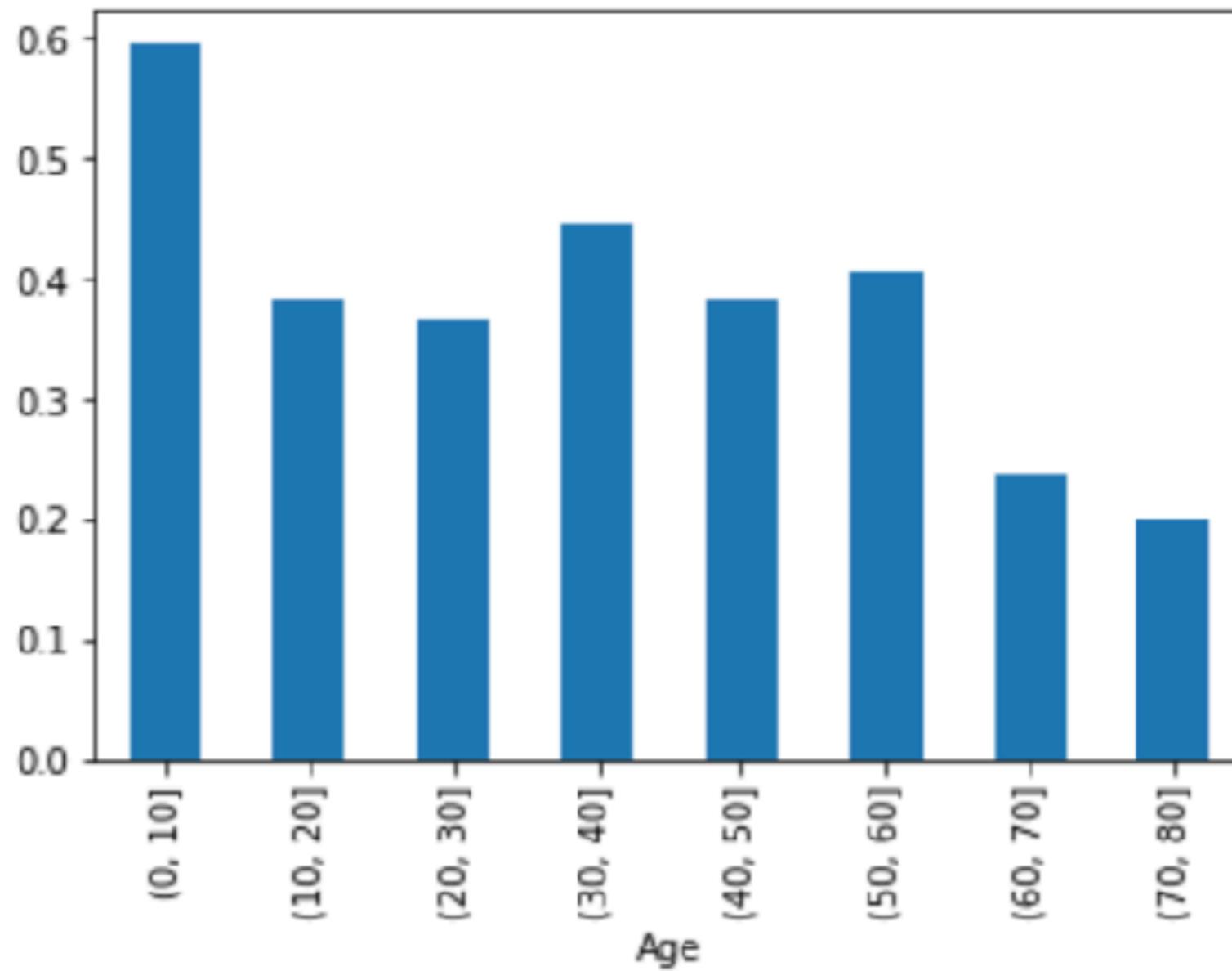
	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
Age							
(0, 10]	430.843750	0.593750	2.640625	4.268281	1.843750	1.421875	30.434439
(10, 20]	447.660870	0.382609	2.530435	17.317391	0.591304	0.391304	29.529531
(20, 30]	428.682609	0.365217	2.386957	25.423913	0.321739	0.239130	28.306719
(30, 40]	468.690323	0.445161	2.090323	35.051613	0.374194	0.393548	42.496100
(40, 50]	483.500000	0.383721	1.918605	45.372093	0.372093	0.430233	41.163181
(50, 60]	449.809524	0.404762	1.523810	54.892857	0.309524	0.309524	44.774802
(60, 70]	430.882353	0.235294	1.529412	63.882353	0.176471	0.352941	45.910782
(70, 80]	438.200000	0.200000	1.800000	73.300000	0.000000	0.000000	25.936680



# Understanding data

```
age_grouping[ "Survived" ].plot.bar()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc1ea9c8d0>
```



# See your data

```
titanic_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
PassengerId    891 non-null int64
Survived        891 non-null int64
Pclass          891 non-null int64
Name            891 non-null object
Sex             891 non-null object
Age             714 non-null float64
SibSp           891 non-null int64
Parch           891 non-null int64
Ticket          891 non-null object
Fare            891 non-null float64
Cabin           204 non-null object
Embarked        889 non-null object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.6+ KB
```

Missing value

Missing value



# Pclass

No missing value, numeric value

```
titanic_df[['Pclass', 'Survived']].groupby(  
    ['Pclass'],  
    as_index=False).mean()
```

Pclass	Survived	
0	1	0.629630
1	2	0.472826
2	3	0.242363



# Sex

No missing value

```
titanic_df[['Sex', 'Survived']].groupby(  
    ['Sex'],  
    as_index=False).mean()
```

	Sex	Survived
0	female	0.742038
1	male	0.188908



# Handling Missing Values



# See your data

```
titanic_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
PassengerId    891 non-null int64
Survived        891 non-null int64
Pclass          891 non-null int64
Name            891 non-null object
Sex             891 non-null object
Age             714 non-null float64
SibSp           891 non-null int64
Parch           891 non-null int64
Ticket          891 non-null object
Fare            891 non-null float64
Cabin           204 non-null object
Embarked        889 non-null object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.6+ KB
```

Missing value

Missing value



# Age

Age have missing value

```
titanic_df.Age.unique()
```

Outlier ?

```
array([ 22. ,  38. ,  26. ,  35. ,  nan,  54. ,  2. ,  27. ,  
       14. ,   4. ,  58. ,  20. ,  39. ,  55. ,  31. ,  34. ,  
       15. ,  28. ,   8. ,  19. ,  40. ,  66. ,  42. ,  21. ,  
       18. ,   3. ,   7. ,  49. ,  29. ,  65. ,  28.5 ,   5. ,  
       11. ,  45. ,  17. ,  32. ,  16. ,  25. ,  0.83,  30. ,  
       33. ,  23. ,  24. ,  46. ,  59. ,  71. ,  37. ,  47. ,  
      14.5 , 70.5 , 32.5 , 12. ,   9. ,  36.5 ,  51. ,  55.5 ,  
      40.5 , 44. ,   1. ,  61. ,  56. ,  50. ,  36. ,  45.5 ,  
      20.5 , 62. ,  41. ,  52. ,  63. ,  23.5 ,  0.92,  43. ,  
      60. ,  10. ,  64. ,  13. ,  48. ,  0.75,  53. ,  57. ,  
      80. ,  70. , 24.5 ,   6. ,  0.67,  30.5 ,  0.42,  34.5 ,  7  
4. ])
```

*How to handling missing value of Age ?*



# Age

Q: How to handling missing value ?

A: Replace with mean, medium, mode value

## mean

The mean is the average or norm.

- Add up all of the values to find a total.
- Divide the total by the number of values you added together.

$$2 + 2 + 3 + 5 + 5 + 7 + 8 = 32$$

There are 7 values

$$32 \div 7 = 4.57$$

Divide the total by 7

The mean is 4.57



## median

The median is the middle value.

- Put all of the values into order.
- The median is the middle value.
- If there are two values in the middle, find the mean of these two.

2, 2, 3, **5**, 5, 7, 8

The median is 5

SpiralNote ©Crown DE SpiralNote TeacherResources www.gutenberg.org



## mode

The mode is the most frequent value.

- Count how many of each value appears.
- The mode is the value that appears the most.
- You can have more than one mode.

2, 2, 3, 5, 5, 7, 8      **2**    **5**

The modes are 2 and 5



# Age

Replace missing value with median

```
titanic_df['NewAge'] =  
    titanic_df.Age.fillna(titanic_df.Age.median())
```

```
titanic_df[['Age', 'NewAge']].describe()
```

	Age	NewAge
count	714.000000	891.000000
mean	29.699118	29.361582
std	14.526497	13.019697
min	0.420000	0.420000
25%	20.125000	22.000000
50%	28.000000	28.000000
75%	38.000000	35.000000
max	80.000000	80.000000



# Embarked

## Embarked have missing value

```
print('Survived =>', titanic_df.Survived.unique())
print('Pclass =>', titanic_df.Pclass.unique())
print('Sex =>', titanic_df.Sex.unique())
print('SibSp =>', titanic_df.SibSp.unique())
print('Parch =>', titanic_df.Parch.unique())
print('Embarked =>', titanic_df.Embarked.unique())
```

```
Survived => [ 0  1]
Pclass => [ 3  1  2]
Sex => [ 'male' 'female']
SibSp => [ 1  0  3  4  2  5  8]
Parch => [ 0  1  2  5  3  4  6]
Embarked => [ 'S' 'C' 'Q' nan]
```



# Embarked

How to handling missing value ?

```
titanic_df[ [ 'Embarked' ] ].describe( )
```

Embarked	
count	889
unique	3
top	S
freq	644

Replace with popular value ?



# Embarked

Replace missing value with D

```
titanic_df['Embarked'] = titanic_df['Embarked'].fillna('S')  
titanic_df[['Embarked']].describe()
```

Embarked	
count	891
unique	3
top	S
freq	646



# Cabin

## TODO



# Feature Engineering



# Feature Engineering

Create additional relevance features from the existing features in the raw data.

Try to increase the predictive power of the learning algorithm.



# Name

Try to see data of Name

```
titanic_df.Name.tail()
```

```
886             Montvila, Rev. Juozas
887             Graham, Miss. Margaret Edith
888    Johnston, Miss. Catherine Helen "Carrie"
889                 Behr, Mr. Karl Howell
890                 Dooley, Mr. Patrick
```

Name: Name, dtype: object

*Bad data have Title and Name*



# Name

## Working with regular expression !!

```
import seaborn as sns  
import re
```

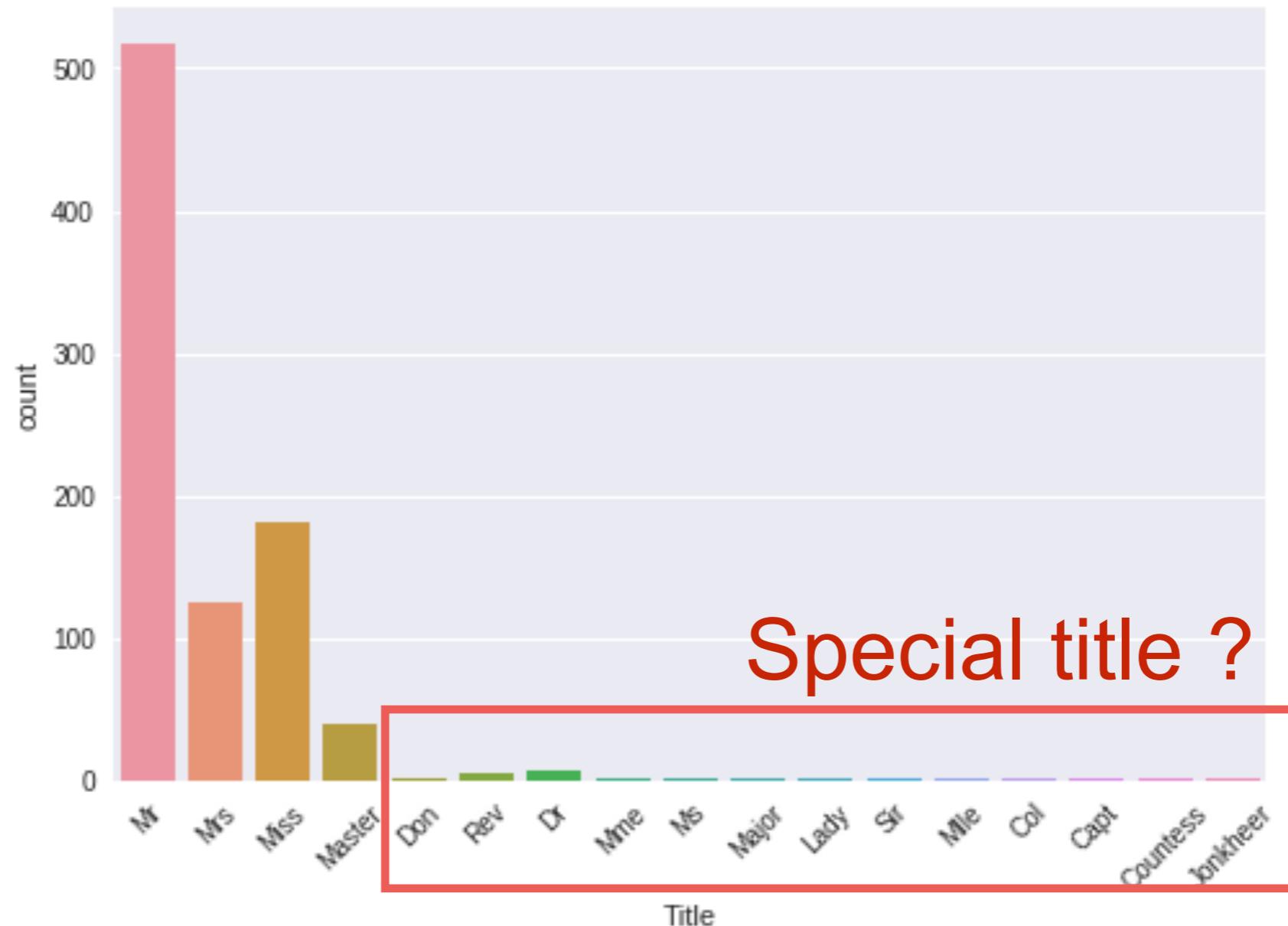
```
titanic_df['Title']  
= titanic_df.Name.apply(  
    lambda x: re.search(' ([A-Z][a-z]+)\. ', x).group(1))
```

```
sns.countplot(x='Title', data=titanic_df);  
plt.xticks(rotation=45);
```



# Name

Try to grouping title of name



# Name

Extract to new function, make easier to read

```
import pandas as pd  
import re
```

```
def get_title(name):  
    title = re.search(' ([A-Za-z]+)\.', name)  
    if title:  
        return title.group(1)  
    return ""
```

```
if __name__ == "__main__":  
    titanic_df = pd.read_csv("train.csv")  
    titanic_df['Title'] = titanic_df['Name'].apply(get_title)  
    print(pd.crosstab(titanic_df['Title'], titanic_df['Sex']))
```



# Name

Try to grouping title of name

```
pd.crosstab(titanic_df['Title'], titanic_df['Sex'])
```

Sex	female	male			
Title			Master	0	40
Capt	0	1	Miss	182	0
Col	0	2	Mlle	2	0
Countess	1	0	Mme	1	0
Don	0	1	Mr	0	517
Dr	1	6	Mrs	125	0
Jonkheer	0	1	Ms	1	0
Lady	1	0	Rev	0	6
Major	0	2	Sir	0	1



# Name

Try to grouping title of name  
Special title ?

Capt	1	Master	40
Col	2	Miss	182
Countess	1	Mlle	2
Don	1	Mme	1
Dr	7	Mr	517
Jonkheer	1	Mrs	125
Lady	1	Ms	1
Major	2	Rev	6
		Sir	1

Special title ?



# Name

Replace title with new title ?

```
pd.crosstab(titanic_df['Title'], titanic_df['Sex'])
```

Sex	female	male		
Title				
Capt	0	1	Master	0 40
Col	0	2	Miss	182 0
Countess	1	0	Mlle	2 0
Don	0	1	Mme	1 0
Dr	1	6	Mr	0 517
Jonkheer	0	1	Mrs	125 0
Lady	1	0	Ms	1 0
Major	0	2	Rev	0 6
			Sir	0 1



# Mlle

## Abbreviation of Mademoiselle

**Noun** [ [edit](#) ]

**Mademoiselle** *f* (plural [Mesdemoiselles](#) or [Mademoiselles](#))

1. *A title or form of address for a girl or a young woman, [Miss](#).*

<https://en.wiktionary.org/wiki/Mademoiselle#French>



# Ms

## Ms.

From Wikipedia, the free encyclopedia

*This article is about the title. For the magazine, see [Ms. \(magazine\)](#). For other uses, see [MS \(disambiguation\)](#).*

"Ms" or "Ms." (normally /mɪz/, but also /məz/, or /məs/ when unstressed)<sup>[1][2]</sup> is an English honorific used with the last name or full name of a woman, intended as a default form of address for women regardless of their marital status.<sup>[3]</sup> Like "Miss" and "Mrs.", the term "Ms." has its origins in the female English title once used for all women, "Mistress". It has its origin in the 17th century and was revived into mainstream usage in the 20th century.<sup>[4]</sup> In the UK and the majority of Commonwealth countries, a full stop (period) is usually not used with the title; in the United States and Canada a period is usually used (see [Abbreviation](#)).<sup>[1][5]</sup>

### Contents [hide]

- 1 Historical development and revival of the term
- 2 Usage
- 3 Notes
- 4 External links

<https://en.wikipedia.org/wiki/Ms.>



# Mme

## Madam, a married woman

**MME** may stand for:

- *M<sup>me</sup>* or *Mme*, the French abbreviation for *Madame*
- MME, the IATA code for [Durham Tees Valley Airport](#), England
- [MME \(psychedelic\)](#), 2,4-dimethoxy-5-ethoxyamphetamine, a p
- [Madam](#), a married woman or a female brothel manager
- Magyar Madártani és Természetvédelmi Egyesület, [Hungarian](#)
- [Mass mortality event](#), the naturally occurring death of large nu

<https://en.wikipedia.org/wiki/MME>



# Name

Replace **Mlle** with **Miss**

Replace **Ms** with **Miss**

Replace **Mme** with **Mrs**

Replace **Special** with **rare titles !!**



# Name

## Replace title with new title

```
titanic_df['Title']
 = titanic_df['Title'].replace({'Mlle':'Miss', 'Mme':'Mrs', 'Ms':'Miss'})
```

```
titanic_df['Title']
 = titanic_df['Title'].replace(['Don', 'Dona', 'Rev', 'Dr',
                               'Major', 'Lady', 'Sir', 'Col',
                               'Capt', 'Countess', 'Jonkheer'], 'Special')
```

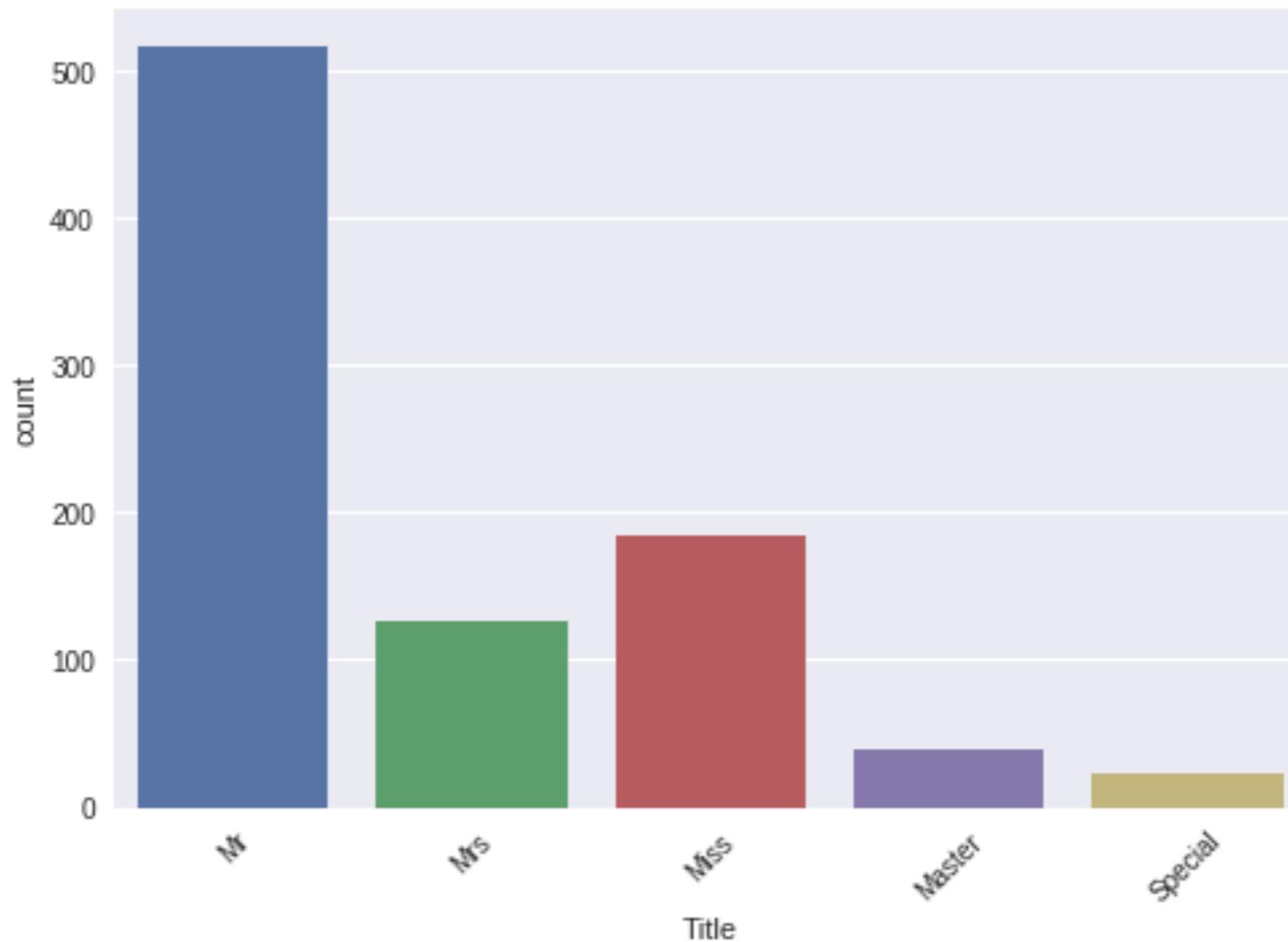
  

```
sns.countplot(x='Title', data=titanic_df);
plt.xticks(rotation=45);
```



# Name

Replace title with new title



# SibSp and Parch

We can create new feature !!

```
titanic_df['FamilySize']  
= titanic_df['SibSp'] + titanic_df['Parch'] + 1
```

```
titanic_df[['FamilySize', 'Survived']].groupby(  
    ['FamilySize'])  
    .mean()
```

*Size of family ?*



# SibSp and Parch

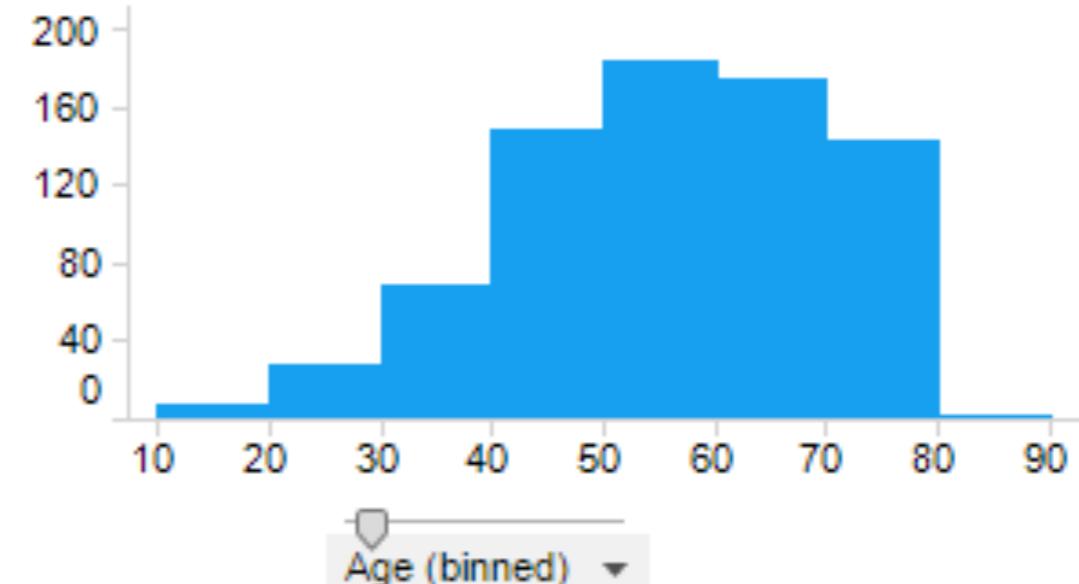
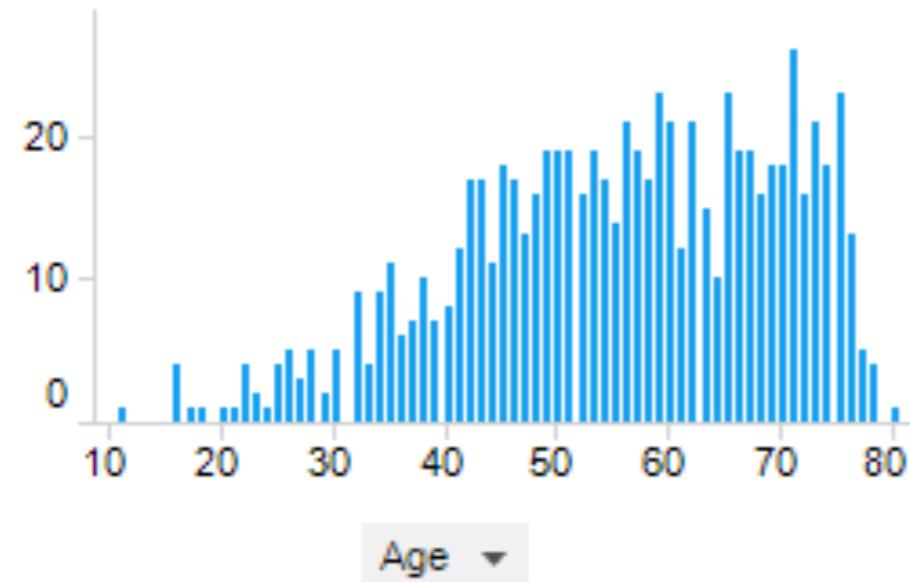
## Size of family vs survival ?

```
titanic_df['FamilySize'] = titanic_df['SibSp'] + titanic_df['Parch'] + 1  
titanic_df[['FamilySize', 'Survived']].groupby(  
    ['FamilySize'])  
    .mean()
```

FamilySize	Survived
1	0.303538
2	0.552795
3	0.578431
4	0.724138
5	0.200000
6	0.136364
7	0.333333
8	0.000000
11	0.000000



# Bin numerical data



# Fare and Age

Range of fare and age ?

Using function **qcut()** of pandas library

```
titanic_df['CategoricalFare']  
    = pd.qcut(titanic_df['Fare'], 4, labels=False)
```

```
titanic_df['CategoricalAge']  
    = pd.qcut(titanic_df['Age'], 4, labels=False)
```

CategoricalFare	Survived
0	0 0.197309
1	1 0.303571
2	2 0.454955
3	3 0.581081

CategoricalAge	Survived
0	0 0.424242
1	1 0.331169
2	2 0.437037
3	3 0.382488

<https://pandas.pydata.org/pandas-docs/stable/generated/pandas.qcut.html>



# Transform datas to numerical



# Transform data to numerical

1. Missing value
2. Binned numerical data
3. Transform all variables to numerical



# Transform data to numerical

Using `get_dummies()` from pandas library

```
data_dummy = pd.get_dummies(titanic_df, drop_first=True)  
data_dummy.head()
```

	Survived	Pclass	SibSp	Parch	FamilySize	NewAge	CategoricalFare	CategoricalAge
0	0	3	1	0	2	22.0	0	0
1	1	1	1	0	2	38.0	3	3
2	1	3	0	0	1	26.0	1	1
3	1	1	1	0	2	35.0	3	2
4	0	3	0	0	1	35.0	1	2



# More ...



# **End up with More features !!**



# Delete useless informations



# Delete useless informations

```
titanic_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
PassengerId      891 non-null int64
Survived          891 non-null int64
Pclass             891 non-null int64
Name               891 non-null object
Sex                891 non-null object
Age                714 non-null float64
SibSp              891 non-null int64
Parch              891 non-null int64
Ticket             891 non-null object
Fare                891 non-null float64
Cabin              204 non-null object
Embarked           889 non-null object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.6+ KB
```



# Delete useless informations

Name, PassengerID, Ticket, Cabin

```
titanic_df.drop(['Cabin', 'Name', 'PassengerId', 'Ticket'], axis=1, inplace=True)
titanic_df.head()
```

	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked	FamilySize	Title	Prefix
0	0	3	male	22.0	1	0	7.2500	S	2	Mr	Mr
1	1	1	female	38.0	1	0	71.2833	C	2	Mrs	Mrs
2	1	3	female	26.0	0	0	7.9250	S	1	Miss	Miss
3	1	1	female	35.0	1	0	53.1000	S	2	Mrs	Mrs
4	0	3	male	35.0	0	0	8.0500	S	1	Mr	Mr



# **End up with More features !!**



# Feature selection



# Feature Selection

After feature engineering process is done,  
Dimension of data should be decreased  
by selecting the **right features**



# Benefits

Decrease redundancy of data  
Speed up the training process  
Reduce overfit

<https://machinelearningmastery.com/overfitting-and-underfitting-with-machine-learning-algorithms/>



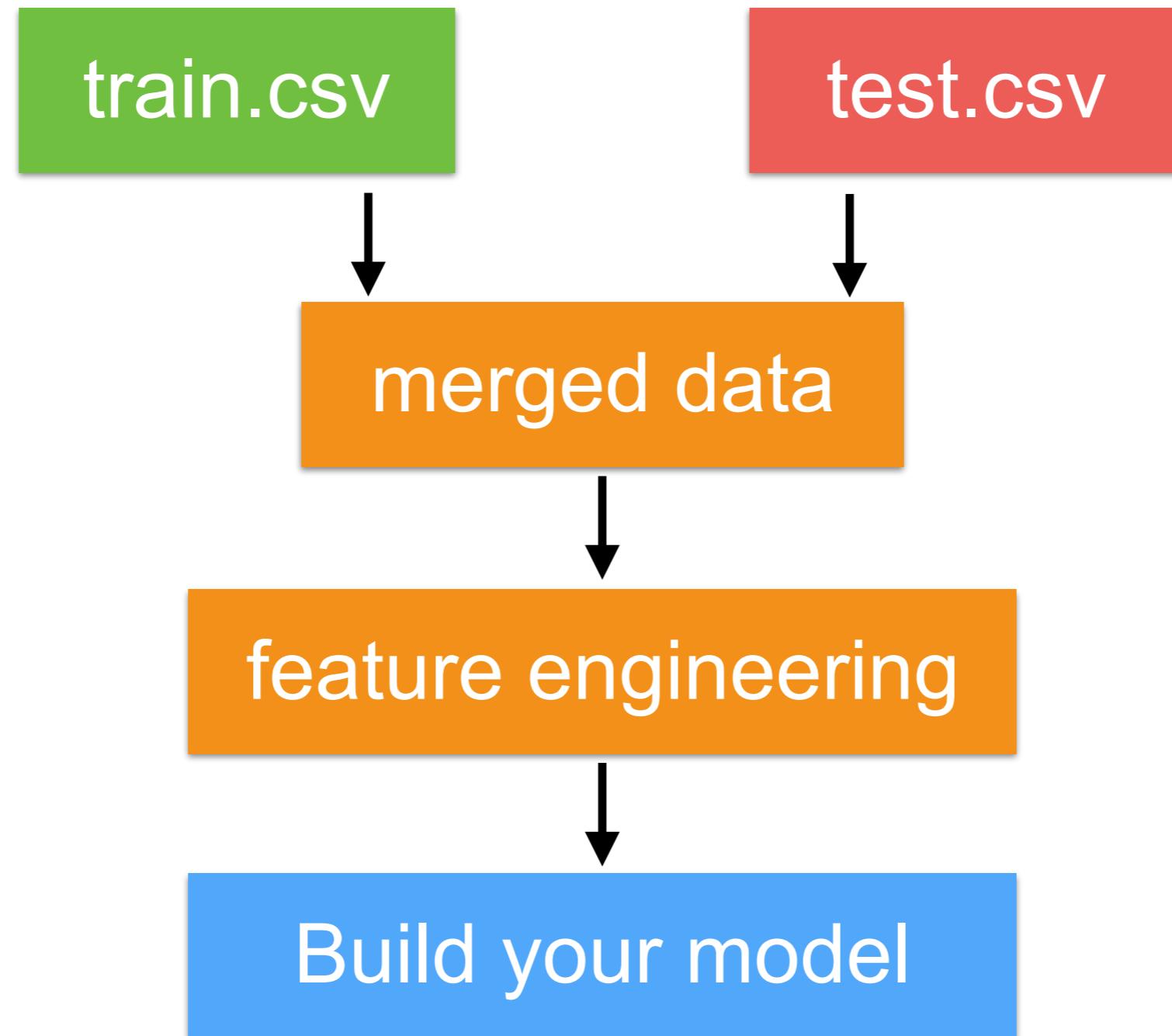
# Build your model



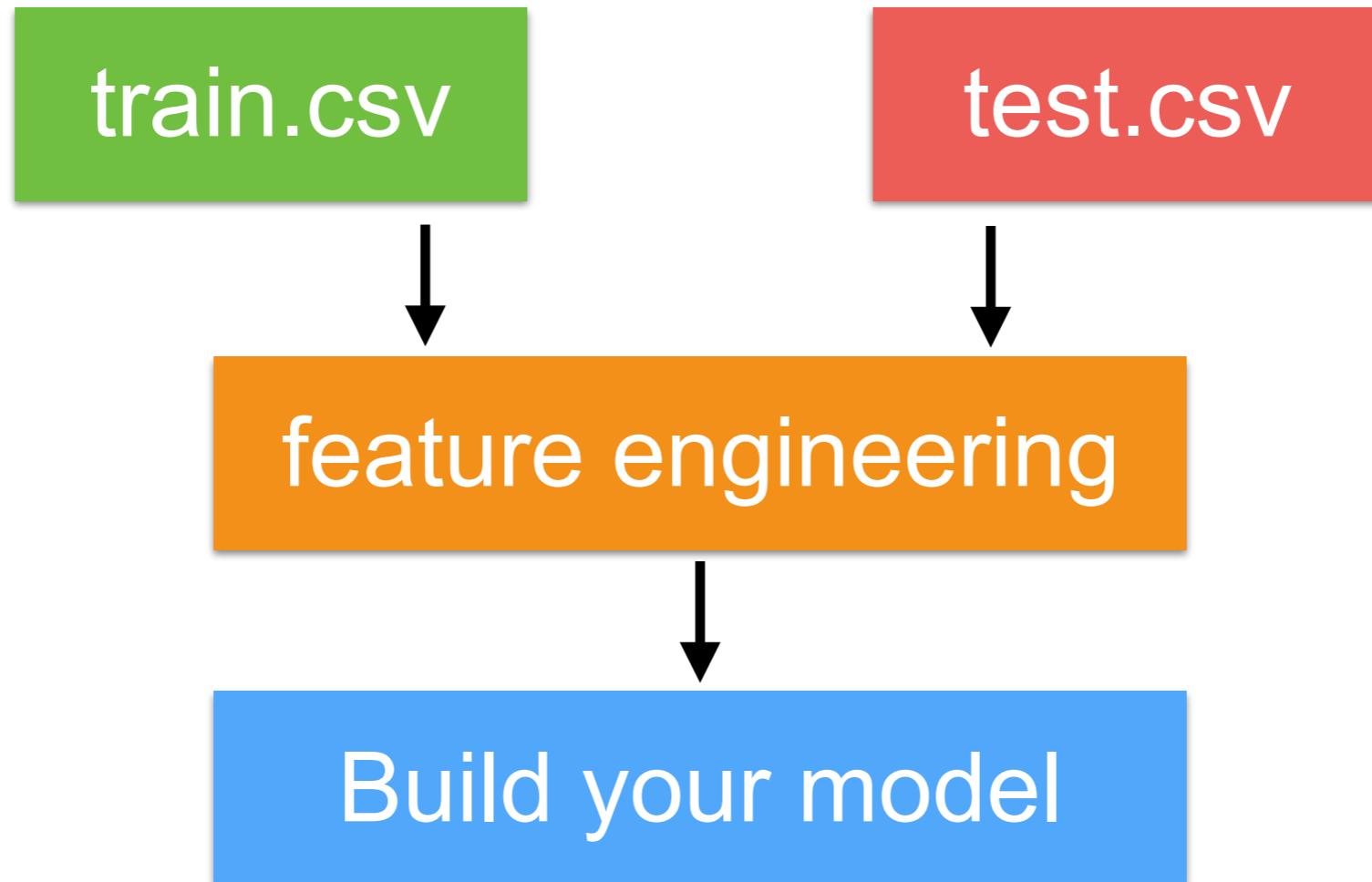
# **Build simple Machine Learning Model**



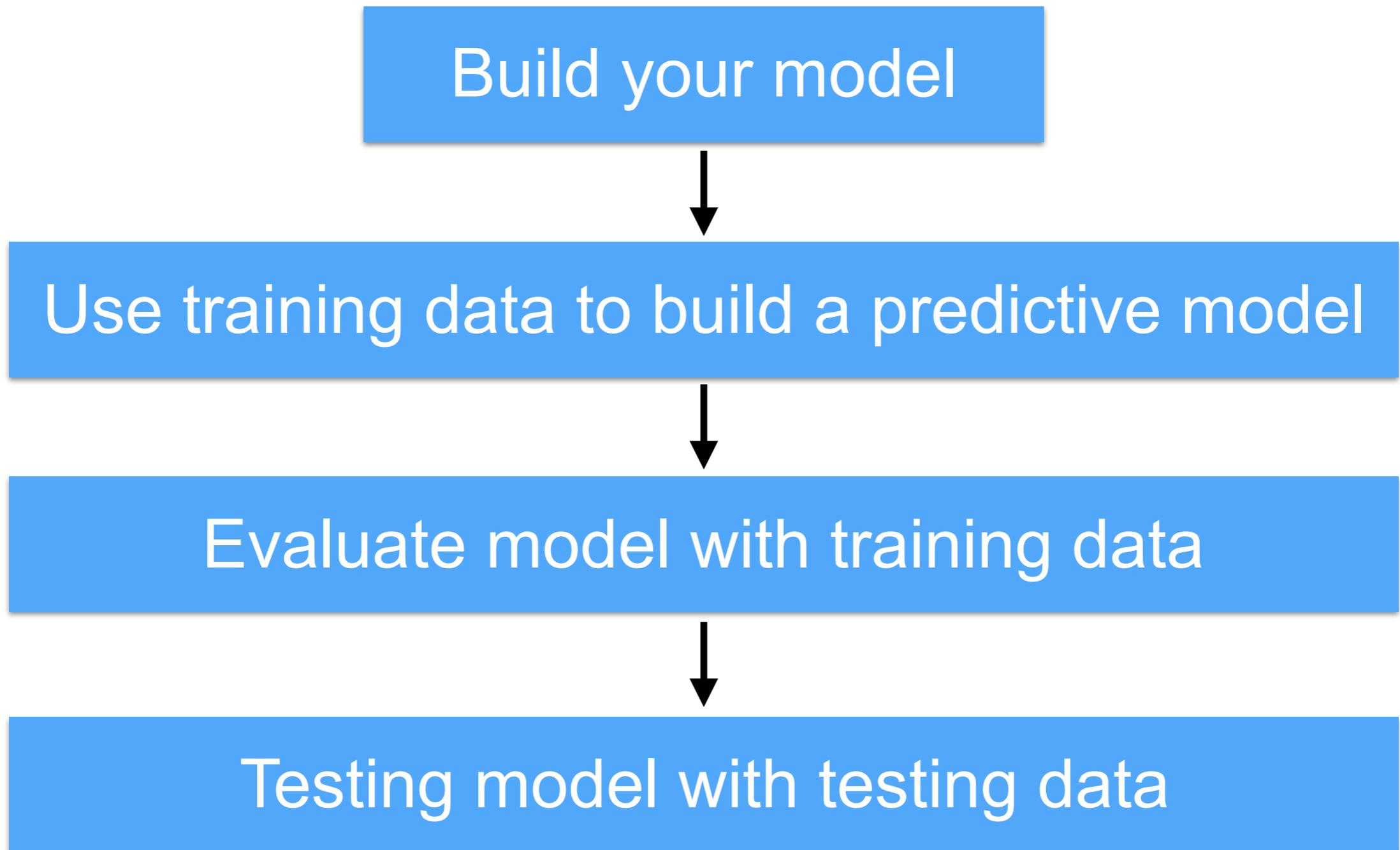
# Build your model



# Build your model



# Build your model



# Try to modeling



# 1. Combine data

Training and testing data for easy to manage

```
import pandas as pd

def combine_data():
    train_data = pd.read_csv('train.csv')
    testing_data = pd.read_csv('test.csv')

    train_data.drop('Survived', inplace=True, axis=1)

    data = pd.concat([train_data, testing_data], sort=False)
    data.drop(['PassengerId'], inplace=True, axis=1)
    return data

if __name__ == "__main__":
    data = combine_data()
```



# 2. Feature engineering

Try to clean data and create new features from existing features

```
if __name__ == "__main__":
    data = process_with_name(data)
    data = process_with_sex(data)
    data = process_with_age(data)
    data = process_with_fare(data)
    data = process_with_embarked(data)
    data = process_with_cabin(data)
    data = process_with_pclass(data)
    data = process_with_family(data)
    data = process_with_ticket(data)
```



# 3. Create Machine Learning Model

Using some algorithm to build first model

```
from sklearn.ensemble import RandomForestClassifier

def create_model(data, survived):
    training_data = data.iloc[:891].copy()
    testing_data = data.iloc[891: ].copy()

    parameters = {'bootstrap': False, 'max_depth': 8,
                  'max_features': 'log2', 'min_samples_leaf': 3,
                  'min_samples_split': 3, 'n_estimators': 10}
    model = RandomForestClassifier(**parameters)

    model.fit(training_data, survived)
    prediction_results = model.predict(testing_data)

    return prediction_results
```



# 4. Compare with other algorithms

Using many algorithm to build model

```
from sklearn.neural_network import MLPClassifier  
from sklearn.neighbors import KNeighborsClassifier  
from sklearn.svm import SVC  
from sklearn.gaussian_process import GaussianProcessClassifier  
from sklearn.tree import DecisionTreeClassifier  
from sklearn.ensemble import RandomForestClassifier, AdaBoostClassifier  
from sklearn.naive_bayes import GaussianNB  
from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
```



# 4. Compare with other algorithms

Using many algorithm to build model

```
models = [  
    KNeighborsClassifier(3),  
    SVC(kernel="linear", C=0.025),  
    SVC(gamma=2, C=1),  
    DecisionTreeClassifier(max_depth=10),  
    RandomForestClassifier(n_estimators=100),  
    MLPClassifier(),  
    AdaBoostClassifier(),  
    GaussianNB(),  
    QuadraticDiscriminantAnalysis()  
]  
for model in models:  
    value = cross_val_score(model, training_data, survived, cv=5,  
scoring='accuracy')  
    print(model.__class__ , " have score ", np.mean(value))
```



# 4. Compare with other algorithms

Using many algorithm to build model

```
<class 'sklearn.neighbors.classification.KNeighborsClassifier'> have score 0.8316596962820242
<class 'sklearn.svm.classes.SVC'> have score 0.8316596962820242
<class 'sklearn.svm.classes.SVC'> have score 0.639703991826333
<class 'sklearn.tree.tree.DecisionTreeClassifier'> have score 0.79018003
<class 'sklearn.ensemble.forest.RandomForestClassifier'> have score 0.81
<class 'sklearn.neural_network.multilayer_perceptron.MLPClassifier'> have score 0.7891324770275202
<class 'sklearn.ensemble.weight_boosting.AdaBoostClassifier'> have score 0.7891324770275202
<class 'sklearn.naive_bayes.GaussianNB'> have score 0.7891324770275202
<class 'sklearn.discriminant_analysis.QuadraticDiscriminantAnalysis'> have score 0.7891324770275202
-
```



# Tuning parameters of algorithm



# Tuning parameters

Called hyperparameters tuning

Example How to tuning parameters for Random Forest algorithm ?

[http://scikit-learn.org/stable/modules/grid\\_search.html](http://scikit-learn.org/stable/modules/grid_search.html)



# Tuning parameters with GridSearchCV

```
parameter_grid = {  
    'max_depth' : [4, 6, 8],  
    'n_estimators': [50, 10],  
    'max_features': ['sqrt', 'auto', 'log2'],  
    'min_samples_split': [2, 3, 10],  
    'min_samples_leaf': [1, 3, 10],  
    'bootstrap': [True, False],  
}  
  
forest = RandomForestClassifier()  
cross_validation = StratifiedKFold(n_splits=5)  
  
grid_search = GridSearchCV(forest,  
                           scoring='accuracy',  
                           param_grid=parameter_grid,  
                           cv=cross_validation,  
                           verbose=1  
)  
  
grid_search.fit(training_data, survived)
```

[http://scikit-learn.org/stable/modules/generated/sklearn.model\\_selection.GridSearchCV.html#sklearn.model\\_selection.GridSearchCV](http://scikit-learn.org/stable/modules/generated/sklearn.model_selection.GridSearchCV.html#sklearn.model_selection.GridSearchCV)



# Tuning parameters

Take long time to proceed

```
[Parallel(n_jobs=1): Done 1620 out of 1620 | elapsed: 1.9min finished
Fitting 5 folds for each of 324 candidates, totalling 1620 fits
Best score: 0.8383838383838383
Best parameters: {'bootstrap': False, 'max_depth': 8, 'max_features': 'sqrt',
'min_samples_leaf': 3, 'min_samples_split': 3, 'n_estimators': 50}
```

[http://scikit-learn.org/stable/modules/grid\\_search.html](http://scikit-learn.org/stable/modules/grid_search.html)



# Submit your result to Kaggle



**Step 1**

Upload submission file

**Upload Submission File****File Format**

Your submission should be in CSV format. You can upload this in a zip/gz/rar/tar archive, if you prefer.

**Number of Predictions**

We expect the solution file to have 418 prediction rows. This file should have a header row. Please see sample submission file on the [data page](#).

**Step 2**

Describe submission

**M** Styling with Markdown supported

Briefly describe your submission.

**Make Submission**<https://www.kaggle.com/c/titanic/submit>

# Share your ranking

3590 ▲ 3215 somkiat  0.78947 11

**Your Best Entry ↑**  
You advanced 1,974 places on the leaderboard!  
Your submission scored 0.78947, which is an improvement of your previous score of 0.77990. Great job!  Tweet this!

<https://www.kaggle.com/c/titanic/leaderboard>



