

A vibrant underwater scene from the TV show SpongeBob SquarePants. In the center, Squidward Tentacles is sitting at his wooden desk, looking disgruntled. Behind him is a large window showing the ocean. To the right, a large orange sunflower-like sea anemone with a purple tentacle is visible. A blue starfish sits on a rock in the foreground. The overall color palette is bright and cartoonish.

IEEE TUNISIA SECTION / TSYP

DATA SCIENCE: A COMPREHENSIVE GUIDE

A Presentation by Manai Elyes

v1.3

Plan

- 1- what is data science? (brief)
- 2- real life implications
- 3- Why now?
- 4- data science jobs
- 5- why is it so important (With example)
- 6- Manual data science
- 7- Data science pipeline (technical)
- 8- Machine learning algorithms(very technical)
- 9- Advanced Machine Learning (Deep learning)
- 10- Technologies
- 11- Resources

“USING DATA TO ANSWER QUESTIONS”

- Some Google Engineer

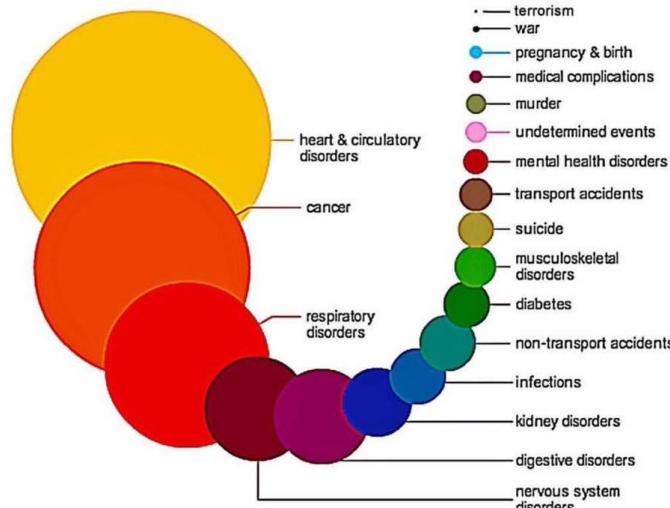
	1 LastName	2 Sex	3 Age	4 Weight	5 Smoker	6 BloodPressure	7 Trials
1	YPL-320	'SMITH'	Male	38	176	1	124
2	GLI-532	'JOHNSON'	Male	43	163	0	109
3	PNI-258	'WILLIAMS'	Female	38	131	0	125
4	MJ-579	'JONES'	Female	40	133	0	117
5	XLK-030	'BROWN'	Female	49	119	0	122
6	TFP-518	'DAVIS'	Female	46	142	0	121
7	LPD-746	'MILLER'	Female	33	142	1	130
8	ATA-945	'WILSON'	Male	40	180	0	115
9	VNL-702	'MOORE'	Male	28	183	0	115
10	LQW-768	'TAYLOR'	Female	31	132	0	118

The first 20 observations of the BACK9 data set:

Output Dataset: BACK9									
Obs	subj	v_type	v_date	b_date	sex	state	country	hospital	id
1	230003	0	07/09/93	10/25/47	2	22	1	23	
2	230004	0	01/04/94	08/15/23	2	38	1	23	
3	230005	0	01/06/94	05/25/49	2	10	1	23	
4	230006	0	01/06/94	04/24/49	2	21	1	23	
5	230008	0	10/03/96	08/09/60	2	38	1	23	
6	230009	0	10/31/96	11/13/50	1	38	1	23	
7	310020	0	06/18/93	08/09/43	2	43	1	31	
8	310032	0	08/03/93	04/02/34	2	13	1	31	
9	310037	0	11/08/93	04/25/39	2	36	1	31	
10	310041	0	10/27/93	11/01/26	2	43	1	31	
11	310049	0	02/04/94	10/03/31	2	25	1	31	
12	310055	0	07/12/94	12/11/56	2	36	1	31	
13	310056	0	04/01/94	11/16/61	2	36	1	31	
14	310059	0	06/13/94	08/22/34	2	43	1	31	
15	310065	0	06/30/94	07/27/56	2	36	1	31	
16	310069	0	09/23/94	07/14/42	2	36	1	31	
17	310072	0	09/08/94	12/20/46	2	43	1	31	
18	310073	0	09/26/94	02/27/33	2	36	1	31	
19	310074	0	11/14/94	12/11/68	2	5	1	31	
20	310080	0	12/16/94	03/14/57	2	36	1	31	

	A	B	C	D	E	F	G	H	I	J	K
1	probeset	ITCC0600	ITCC0601	ITCC0602	ITCC0604	ITCC0607	ITCC0608	ITCC0609	ITCC0611	itcc0001	itcc0002
2	1007_s_at	430.8	226.1	130.6	75	54.9	195.5	124.8	221.5	82.1	57.5
3	1053_at	79.5	95.7	178.8	185.8	144.7	113.1	150.2	157.5	138.4	140.7
4	117_at	65.9	14.9	1.8	28.7	4.7	35.2	3	25.5	39.3	17.3
5	121_at	203.3	79.4	74.1	60.3	79.7	54.5	60.1	113.3	95.6	85.8
6	1255_g_at	5	129.8	177.8	291.1	192.4	20	255.4	5.6	54.9	56.6
7	1294_at	114.6	57.1	40.1	37.1	44.2	50.9	40.4	28.3	56.3	51.6
8	1316_at	113	92.7	115.1	106.5	63.5	103.6	121.6	97.8	26.1	33.2
9	1320_at	12.1	17.9	1.7	1	2.2	11.2	17.2	16.1	33.2	58.1
10	1405_i_at	313.8	135.4	26.1	89.8	164.4	223.2	81	15.7	64.1	29
11	1431_at	18.8	13.7	16.2	8.6	8.2	66	10.3	15.1	33	14.2
12	1438_at	2.4	51.9	5.2	9.4	22	6.2	8.3	38.6	69.7	193.6
13	1487_at	94	88.9	96	52.1	98.3	67.8	92	91.4	63	99.1
14	1494_f_at	30	18.8	33	49	34	33.5	44.9	35.3	26.1	22.9
15	1552256_a_at	33.4	55.5	57.9	53.1	52	60.2	63.7	117	182.2	79.1
16	1552257_a_at	109.2	78.6	70	83.8	62.7	97.1	73.4	245.7	126.6	113.4
17	1552258_at	31.2	8.3	5.3	20.3	7	20.7	35	22.7	22.6	12.2
18	1552261_at	42.2	5.0	5.1	14.1	12.7	6.5	19.9	15.2	19.7	22.5
19	1552261_at	42.2	5.0	5.1	14.1	12.7	6.5	19.9	15.2	19.7	22.5
20	1552261_at	42.2	5.0	5.1	14.1	12.7	6.5	19.9	15.2	19.7	22.5

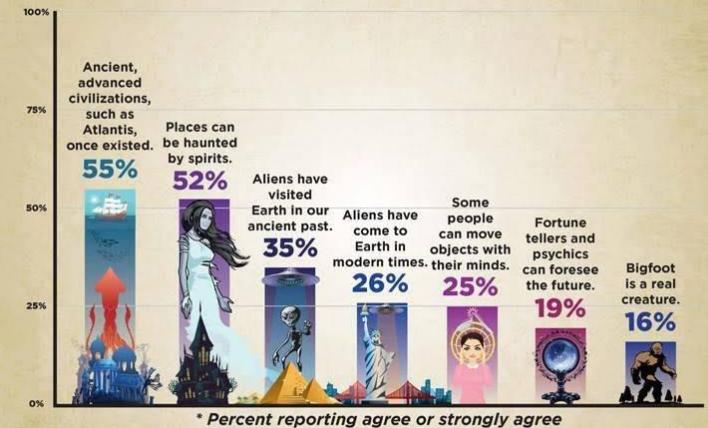
Leading causes of death in perspective



توزيع اعتمادات ميزانية الدولة لسنة 2019



Paranormal Beliefs



The Chapman University Survey of American Fears 2017

CHAPMAN UNIVERSITY
ORANGE, CALIFORNIA



Interpreting the past & present to understand what's going on & take decisions



5 DAY FORECAST

REGION 1

MON	TUE	WED	THU	FRI
32 20	25 12	22 15	18 9	12 3



13.89	+5.34%	593.23	300,000
45.34	-7.89%	251.23	120,000
17.34	+5.97%	100.08	320,000
34.89	+2.13%	564.23	900,000
16.45	+6.43%	765.90	600,000
23.67	-11.6%	120.34	380,000
34.64	+23.1%	893.23	120,000
43.69	+5.56%	128.98	320,000
12.78	-3.67%	765.23	750,000
12.44	+11.3%	432.24	150,000
			120,000
			200,000

Feed

Σ Business Strategy
Daily
q/biz

Startups

Hiring

Computer
Programmers

Rules and
Guidelines

Tips and Hacks

Tips and Hacks for

Elyes Manai

What is your question or link?

Answer · Personal Experiences · Topic you might like

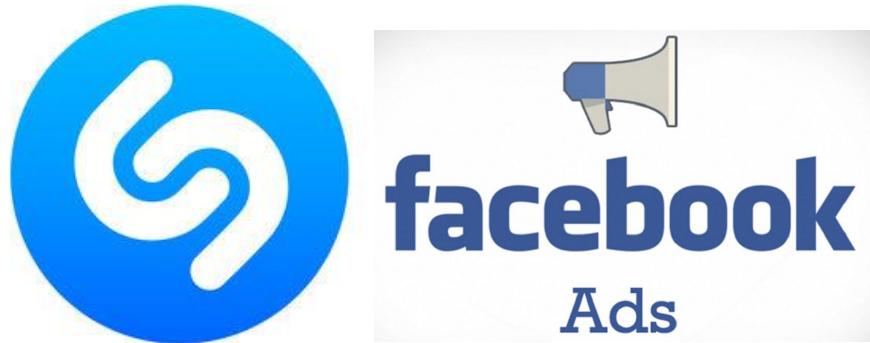
What has someone said to you that literally made your jaw drop?

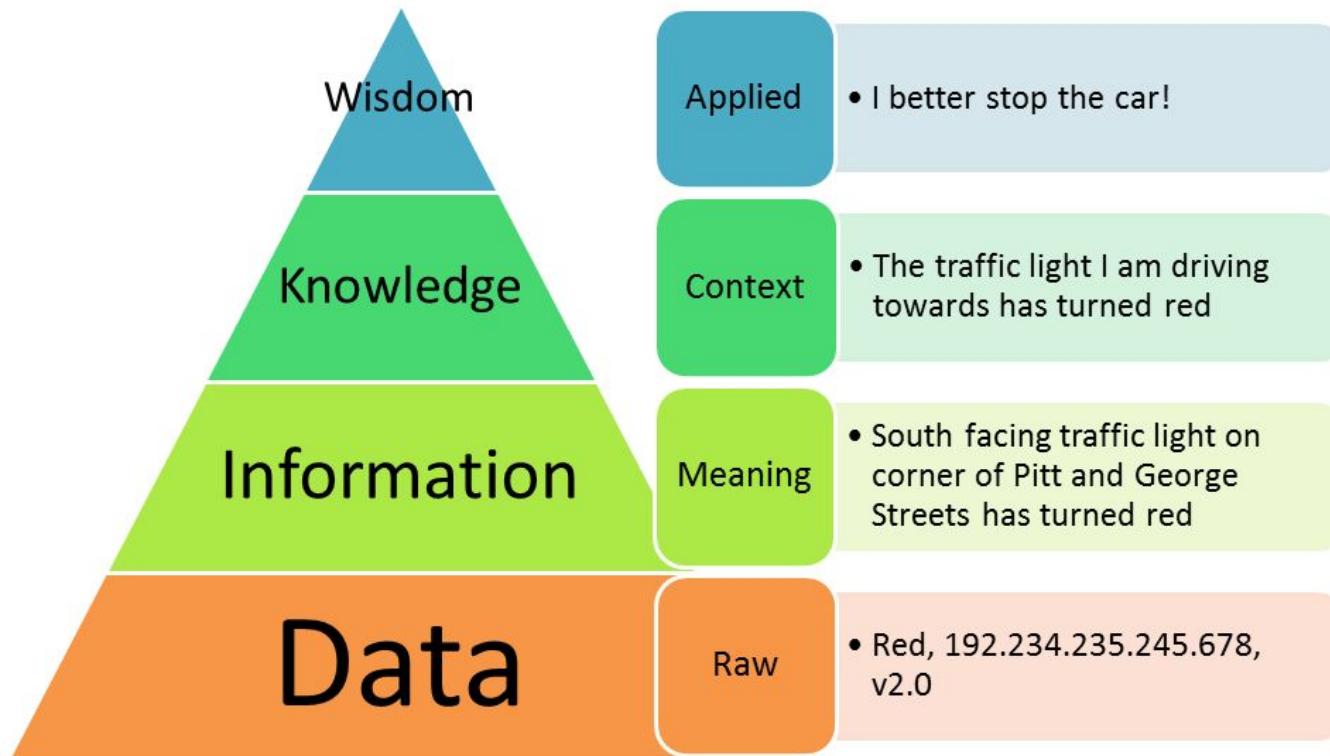


Hunter McCann, Graphic designer living in Canada

Answered 1h ago

Years ago I was sitting in a coffee shop with my close female friend, who happened to be newly engaged to my cousin and was in town to see him. My cousin was only around 20 years old at the time and... (more)





Date	Day	Temperature	Rainfall	Flyers	Price	Sales
1/1/2017	Sunday	27.0	2.00	15	0.30	10
1/2/2017	Monday	28.9	1.33	15	0.30	13
1/3/2017	Tuesday	34.5	1.33	27	0.30	15
1/4/2017	Wednesday	44.1	1.05	28	0.30	17
1/5/2017	Thursday	42.4	1.00	33	0.30	18
1/6/2017	Friday	25.3	1.54	23	0.30	11
1/7/2017	Saturday	32.9	1.54	99	0.50	13
1/8/2017	Sunday	37.5	1.18	28	0.50	15
1/9/2017	Monday	38.1	1.18	20	0.50	17
1/10/2017	Tuesday	43.4	1.05	33	0.50	18
1/11/2017	Wednesday	32.6	1.54	23	0.50	12
1/12/2017	Thursday	38.2	1.33	16	0.50	14
1/13/2017	Friday	37.5	1.33	19	0.50	15
1/14/2017	Saturday	44.1	1.05	23	0.30	17
1/15/2017	Sunday	43.4	1.11	33	0.30	18



Data

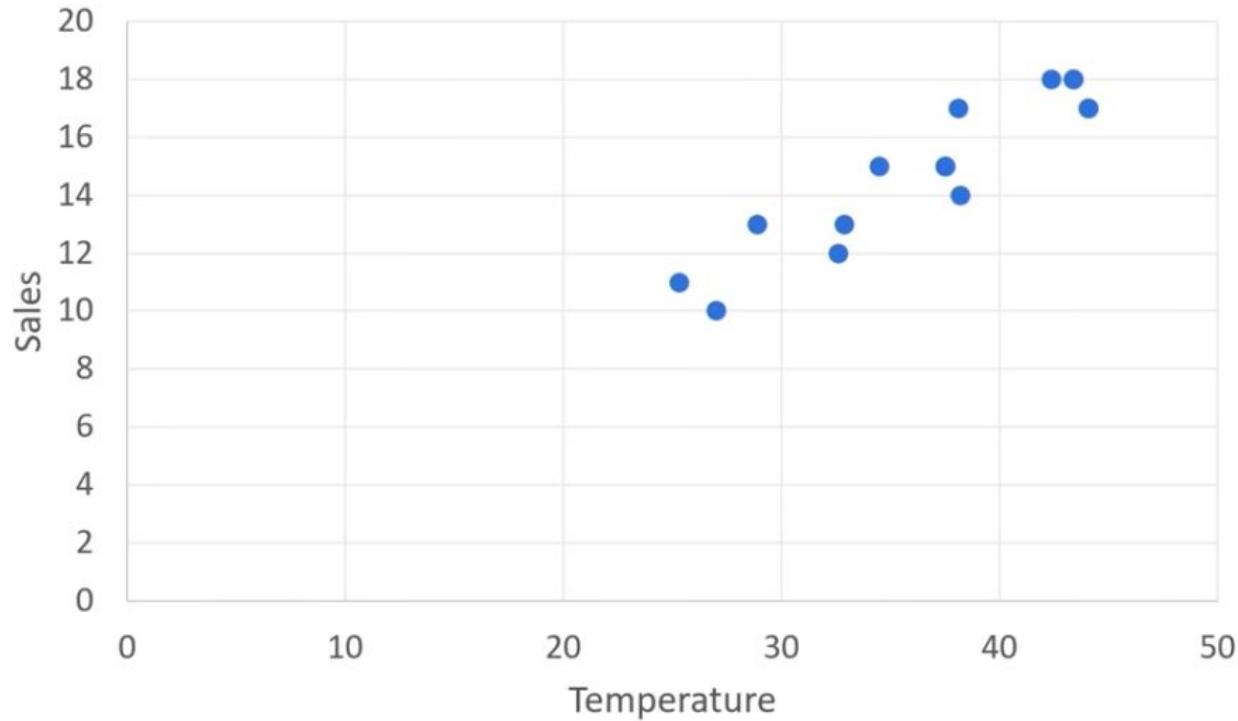
1/1/2017	27.0
Sunday	
15	2.00
0.30	
10	

Information

Date	Day	Temperature	Rainfall	Flyers	Price	Sales
1/1/2017	Sunday	27.0	2.00	15	0.30	10
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1/6/2017	Friday	25.3	1.54	23	0.30	11
1/7/2017	Saturday	32.9	1.54	99	0.50	13
1/8/2017	Sunday	37.5	1.18	28	0.50	15
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1/10/2017	Tuesday	43.4	1.05	33	0.50	18
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1/12/2017	Thursday	38.2	1.33	16	0.50	14
1/13/2017	Friday	37.5	1.33	19	0.50	15
1/14/2017	Saturday	44.1	1.05	23	0.30	17
1/15/2017	Sunday	43.4	1.11	33	0.30	18

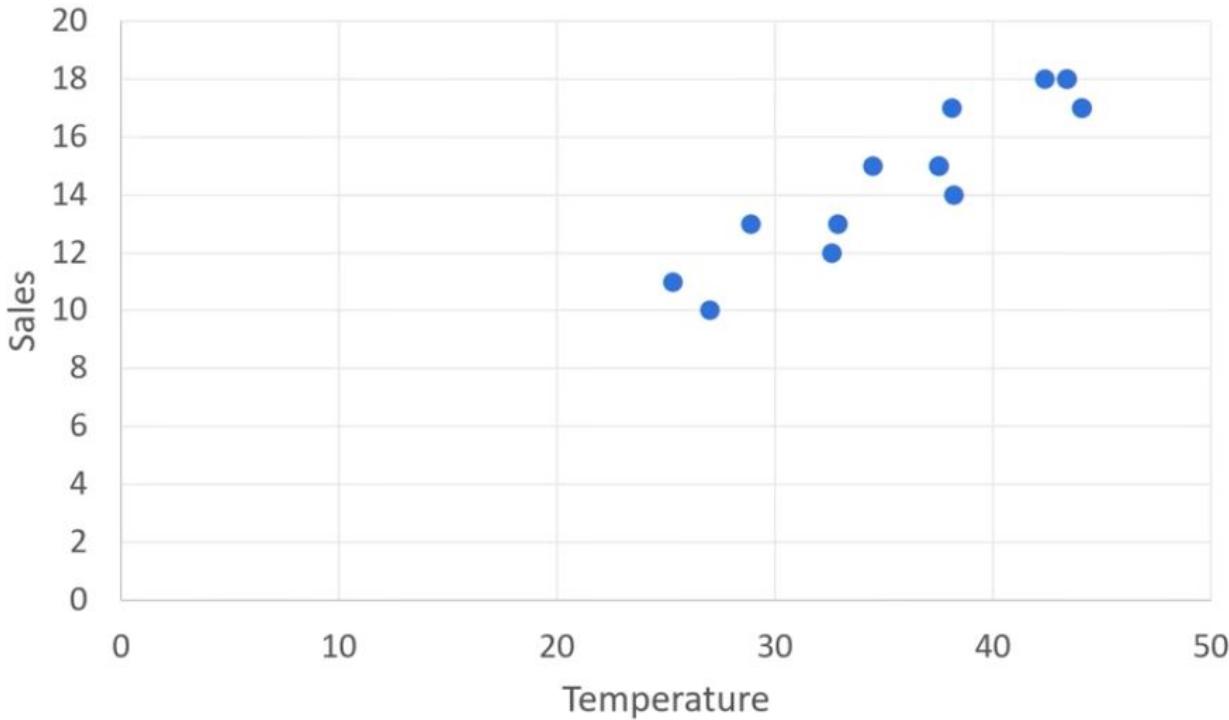
Knowledge

Sales vs Temperature



Wisdom

Sales vs Temperature



If it's hot, i go sell!
No excuses



Temporal Text

Numeric

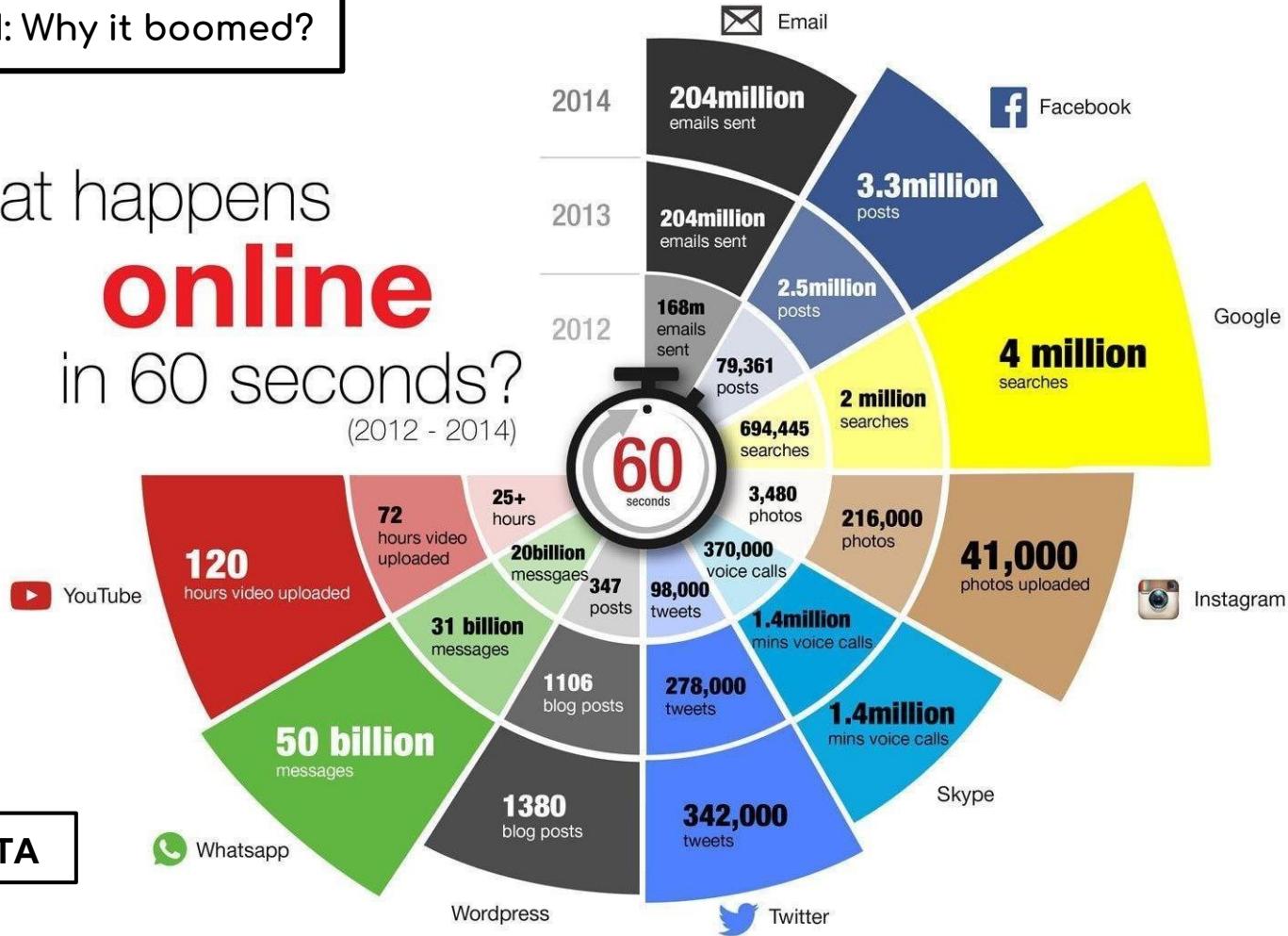
- Qualitative
- Quantitative

Date	Day	Temperature	Rainfall	Flyers	Price	Sales
1/1/2017	Sunday	27.0	2.00	15	0.30	10
1/2/2017	Monday	28.9	1.33	15	0.30	13
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1/5/2017	Thursday	42.4	1.00	33	0.30	18
1/6/2017	Friday	25.3	1.54	23	0.30	11
1/7/2017	Saturday	32.9	1.54	99	0.50	13
1/8/2017	Sunday	37.5	1.18	28	0.50	15
1/9/2017	Monday	38.1	1.18	20	0.50	17
1/10/2017	Tuesday	43.4	1.05	33	0.50	18
1/11/2017	Wednesday	32.6	1.54	23	0.50	12
1/12/2017	Thursday	38.2	1.33	16	0.50	14
1/13/2017	Friday	37.5	1.33	19	0.50	15
1/14/2017	Saturday	44.1	1.05	23	0.30	17
1/15/2017	Sunday	43.4	1.11	33	0.30	18
1/16/2017	Monday	30.6	1.67	24	0.30	12
1/17/2017	Tuesday	32.2	1.43	26	0.30	14
1/18/2017	Wednesday	42.8	1.18	33	0.30	16



MOTIVATION: Why it boomed?

What happens
online
in 60 seconds?
(2012 - 2014)



This is Big DATA



Data Scientist Salaries

About This Data ?

3,703 Salaries Updated Dec 14, 2018

Industries 🔒 ▾ Company Sizes 🔒 ▾ Years of Experience 🔒 ▾

i To continue using salary filters, please contribute. [Write a Review](#) or [Add a Salary](#)

Average Base Pay

\$139,840 /yr



Additional Cash Compensation ?

Average \$xx,xxx

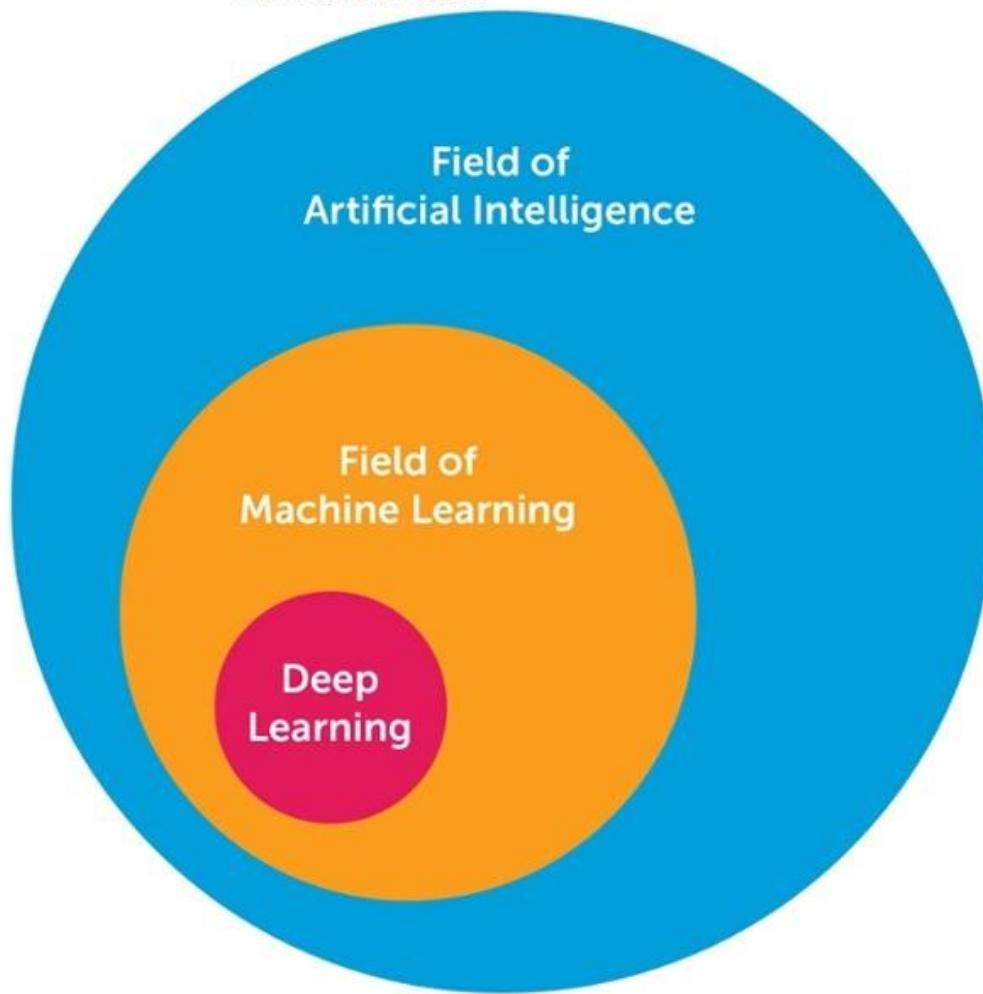
Range \$xx,xxx

How much does a Data Scientist make?
The national average salary for a Data Scientist is \$139,840
in United States. Filter by location to see... [More](#)

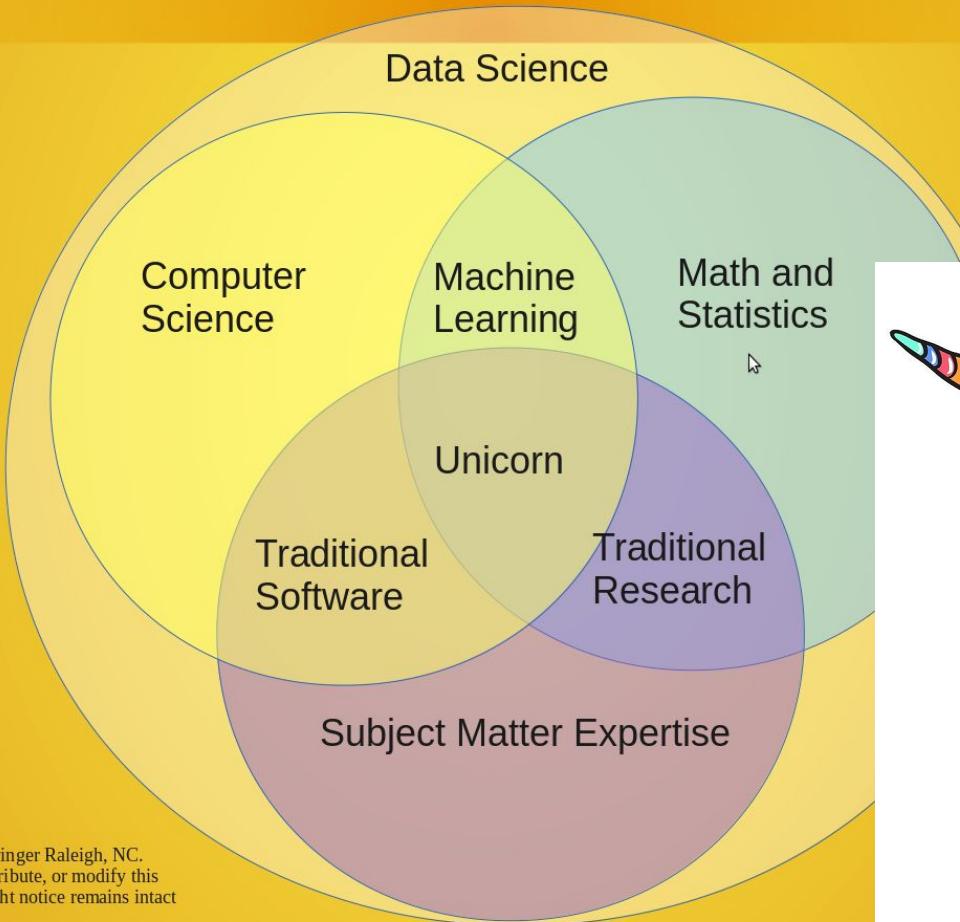
Salaries for Related Job Titles

Data Analyst	\$84K
Data Scientist Intern	\$106K
Quantitative Analyst	\$121K
Senior Data Scientist	\$162K

DATA SCIENCE



Data Science Venn Diagram v2.0



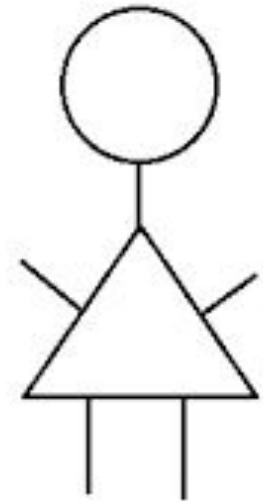
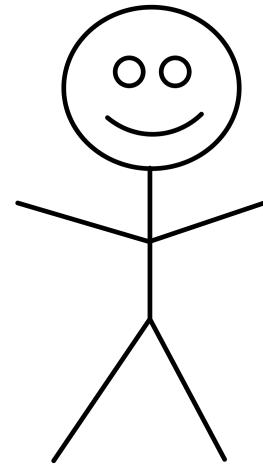
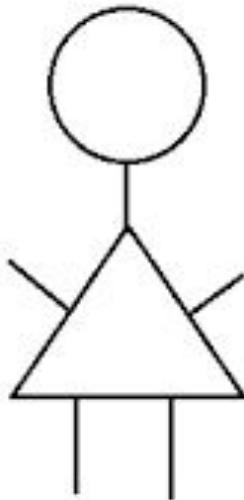
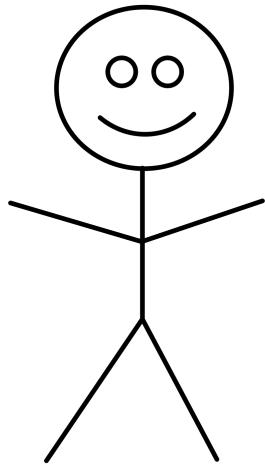
Data Science != Business Intelligence

Business Intelligence == 60% Data Science

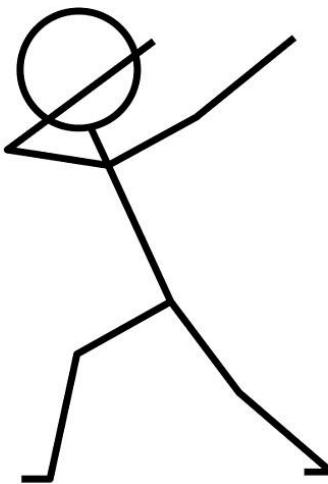
Data Science != Data Mining

Data Mining is part of Data Science

CASE EXAMPLE



CASE EXAMPLE



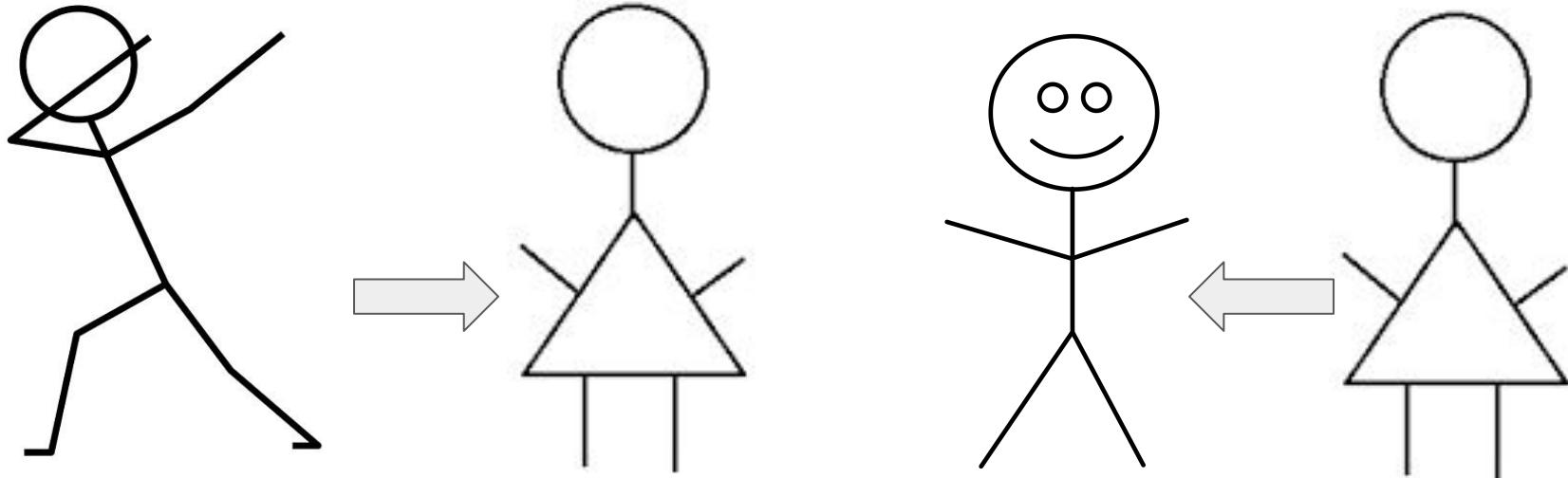
→ 10 years experience

→ 1000 sales pitches / year
→ 730 Successes
→ 270 Fails

73% success rate

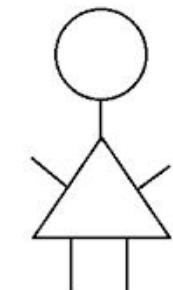
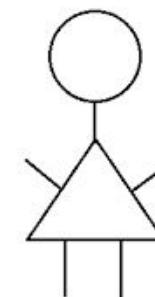
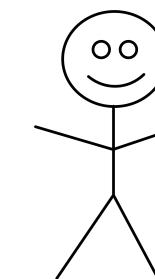
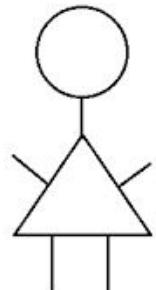
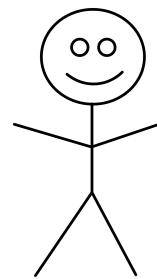
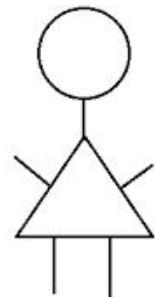
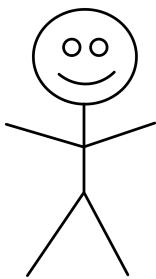
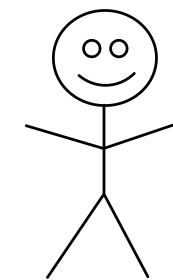
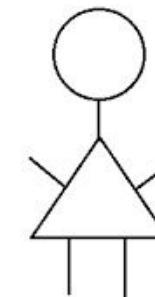
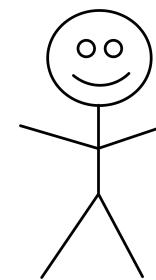
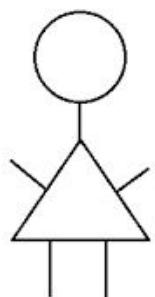
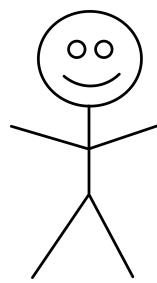
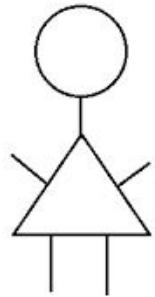
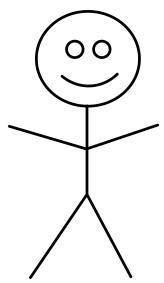
Mahmoud

Train the other salespeople



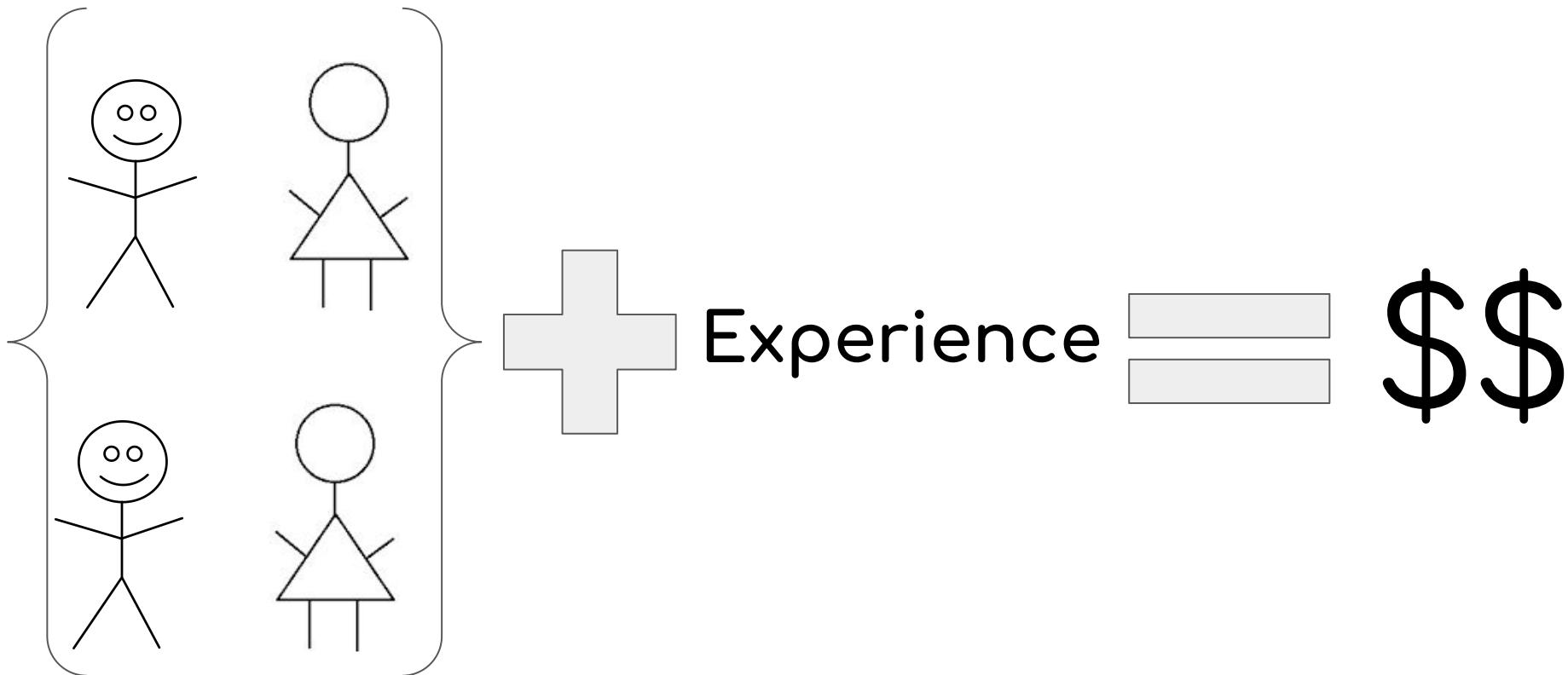
Ideal for Small and medium companies

Hire more seniors



Ideal for big companies

Learn from overachievers' like Mahmoud

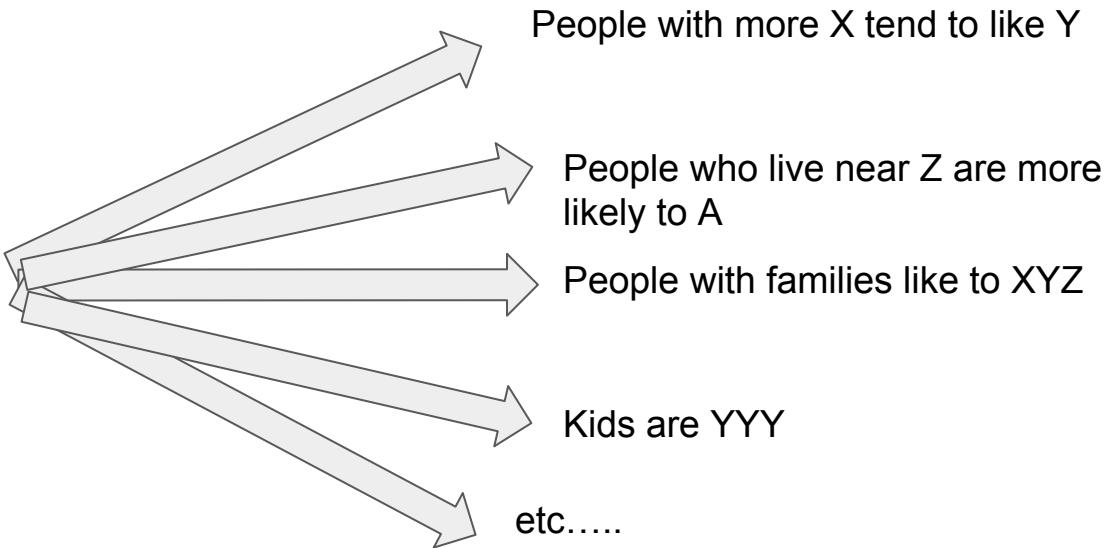


Learn from overachievers' like Mahmoud

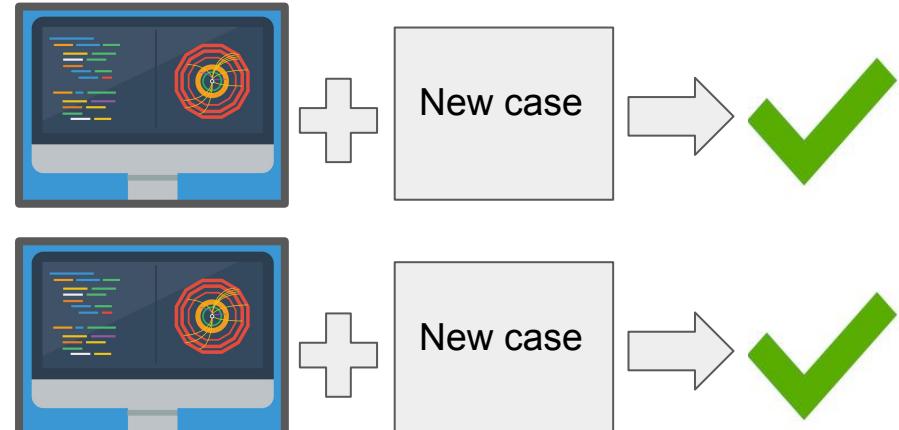
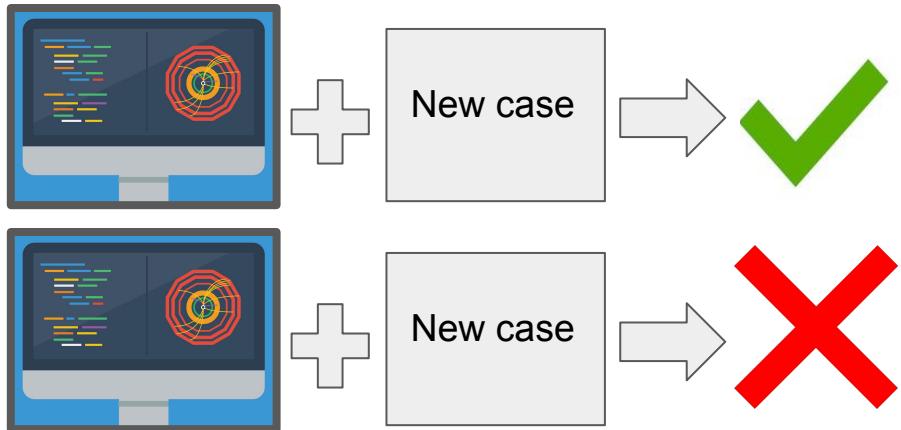
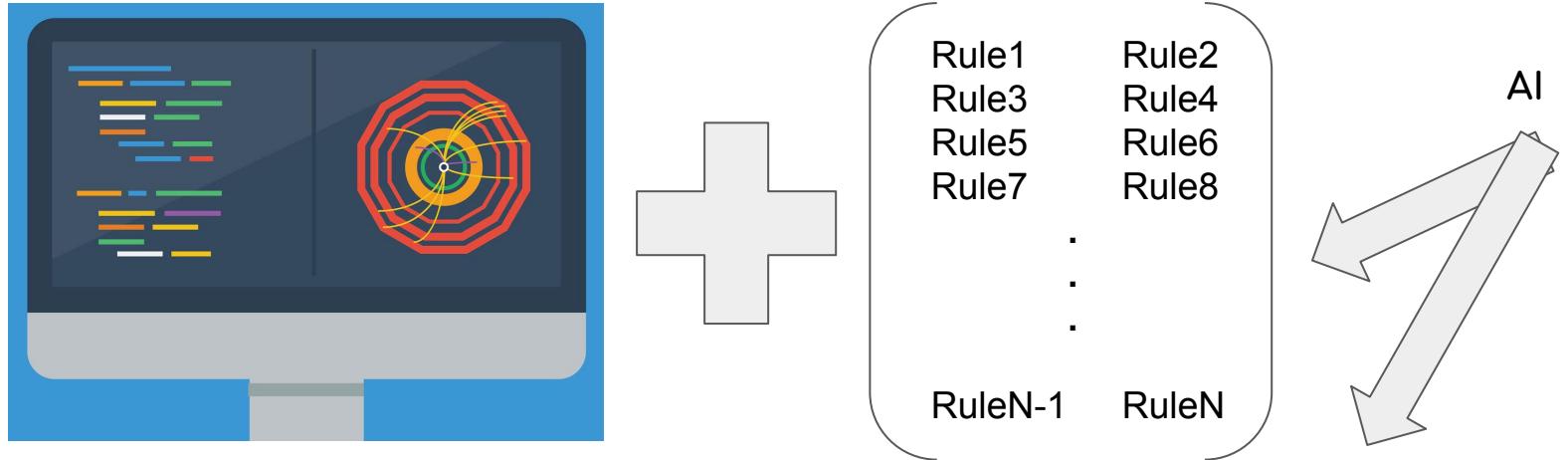
Experience

Experience

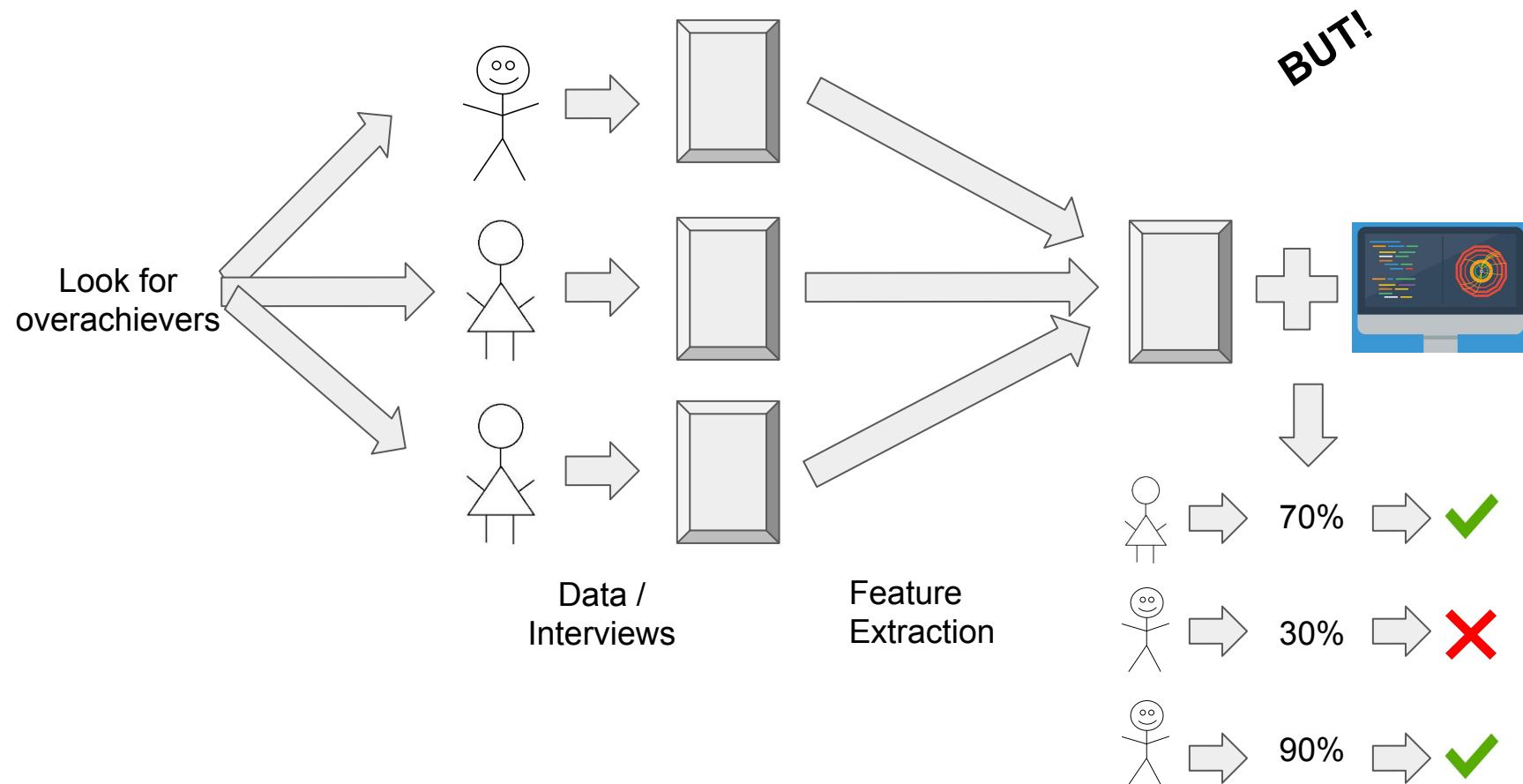
Learn from overachievers' like Mahmoud



Can go to up to millions of rules!!



Better case: recruit better members / employees



Overfitting



COURTESY AMAZON

BREAK

Next: Data Science project Pipeline

Every Data Science project's pipeline (or CRISPR)



Every Data Science project's pipeline



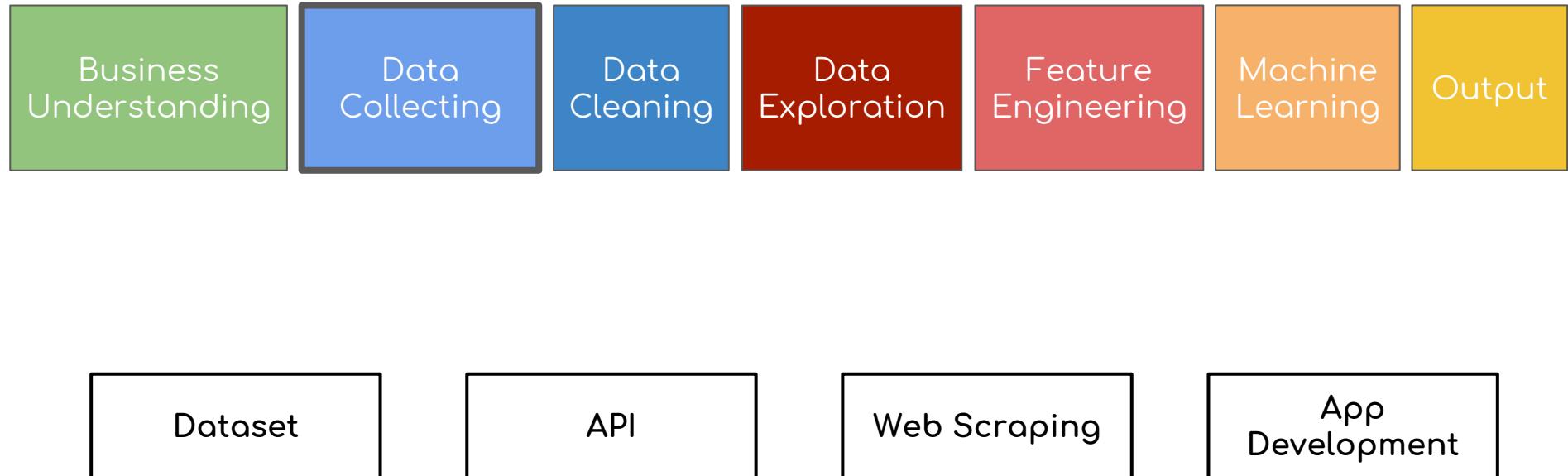
Research the subject

Ask Relevant questions

Define Objectives

Define the needs

Every Data Science projects' pipeline



Every Data Science projects' pipeline



Fill in the
blanks

A	15	7
B		6
C	9	

Every Data Science projects' pipeline



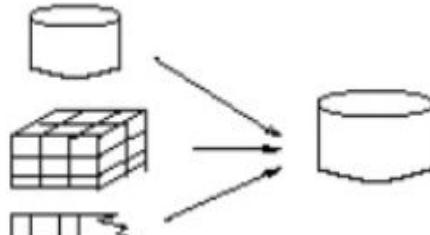
Fill in the blanks

Data Integration

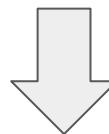
Data Transformation

Data Reduction

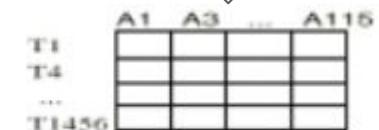
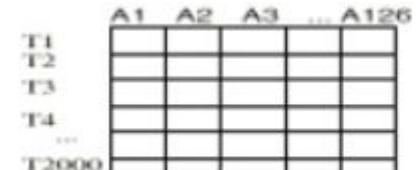
A	15	7
B	13	6
C	9	3



-20, 32, 100, 59, 40



-0.2, 0.32, 1, 0.59, 0.4



Every Data Science projects' pipeline

Business Understanding

Data Collecting

Data Cleaning

Data Exploration

Feature Engineering

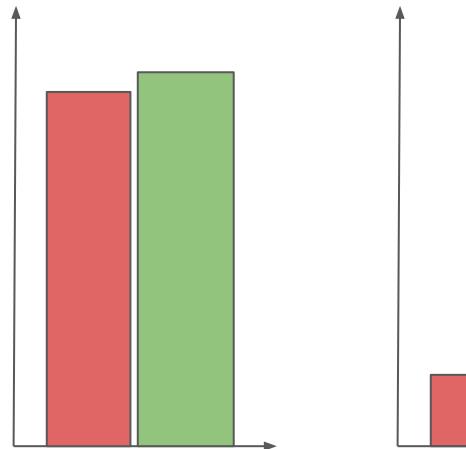
Machine Learning

Output



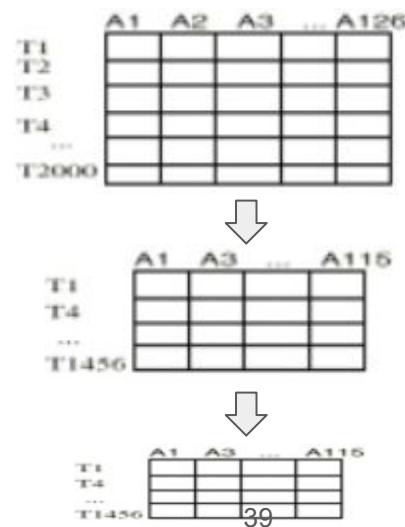
→ Study Correlations
→ Formulate Hypothesis

Every Data Science projects' pipeline

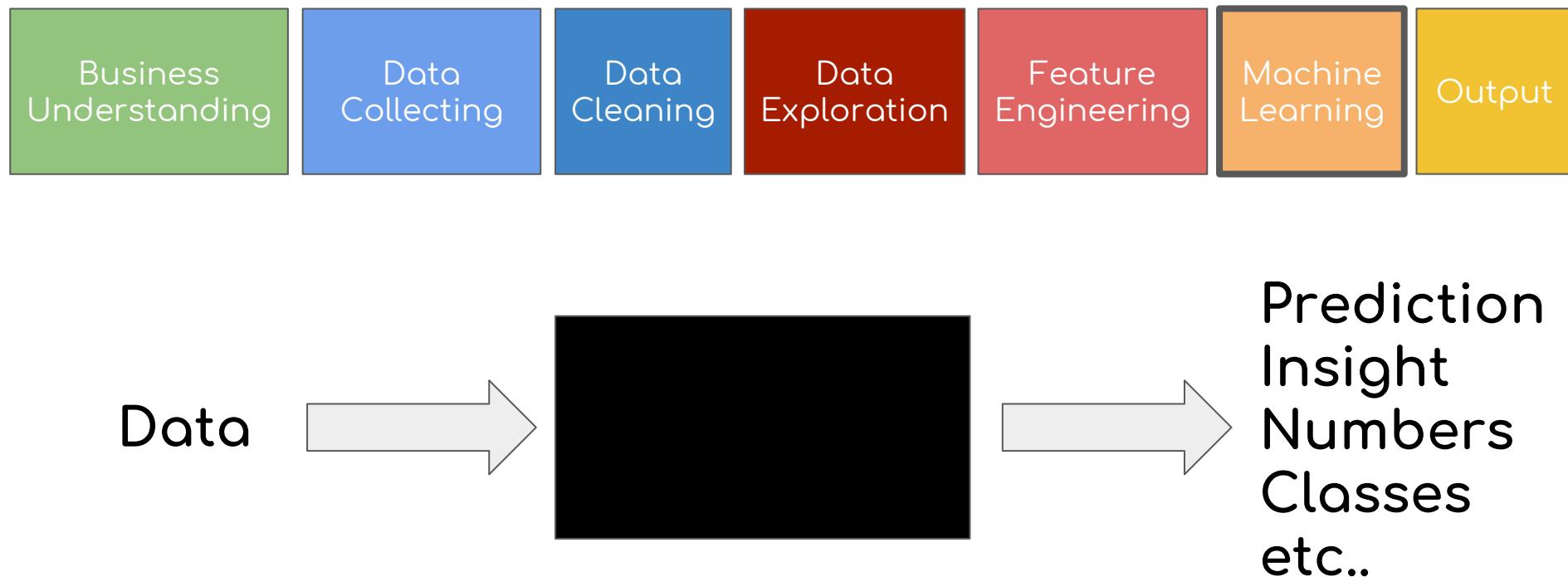


Hourly Rate	Monthly Salary
5\$	200\$
9\$	135\$
2\$	40\$

Monthly work hours
40
15
20



Every Data Science projects' pipeline



Every Data Science projects' pipeline

Business
Understanding

Data
Collecting

Data
Cleaning

Data
Exploration

Feature
Engineering

Machine
Learning

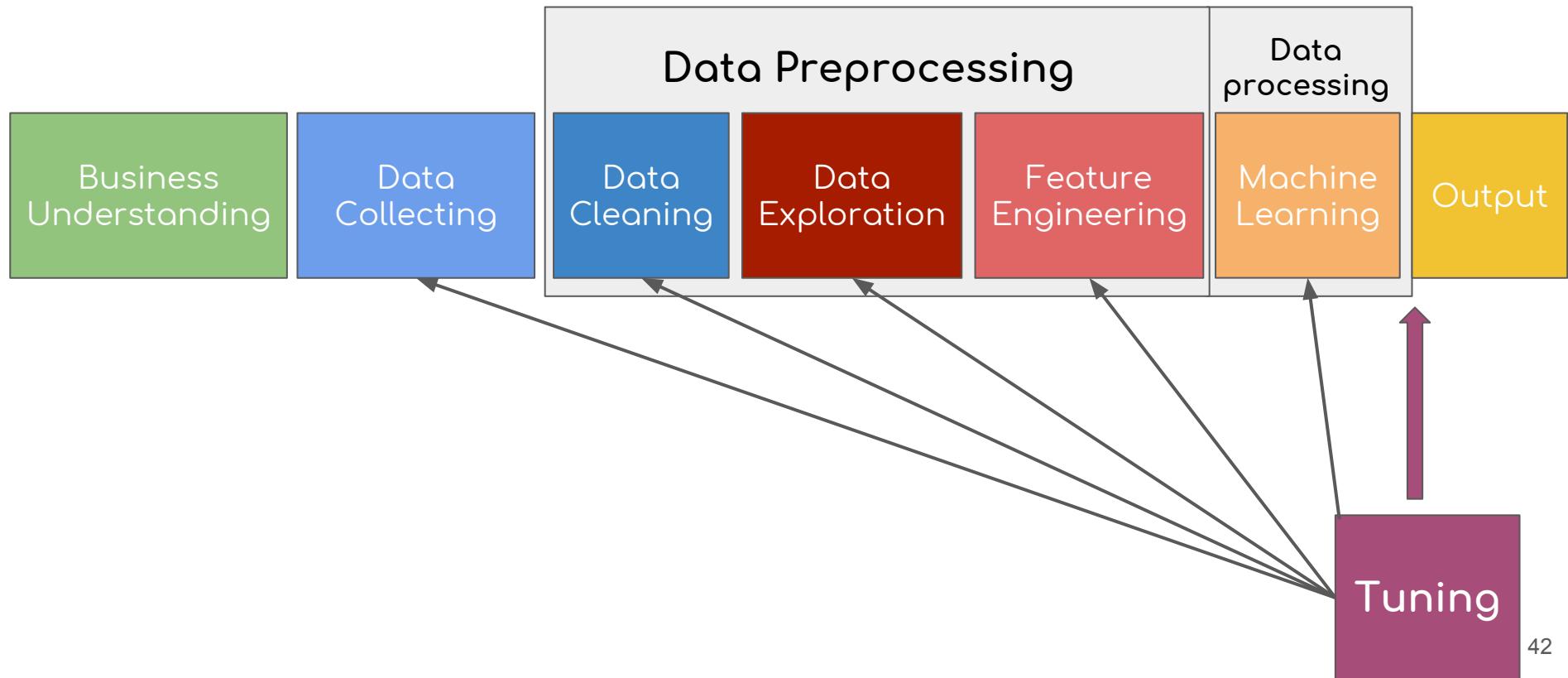
Output



- Numbers
- Percentages
- Classes
- Text

→ Raw Data

Every Data Science projects' pipeline



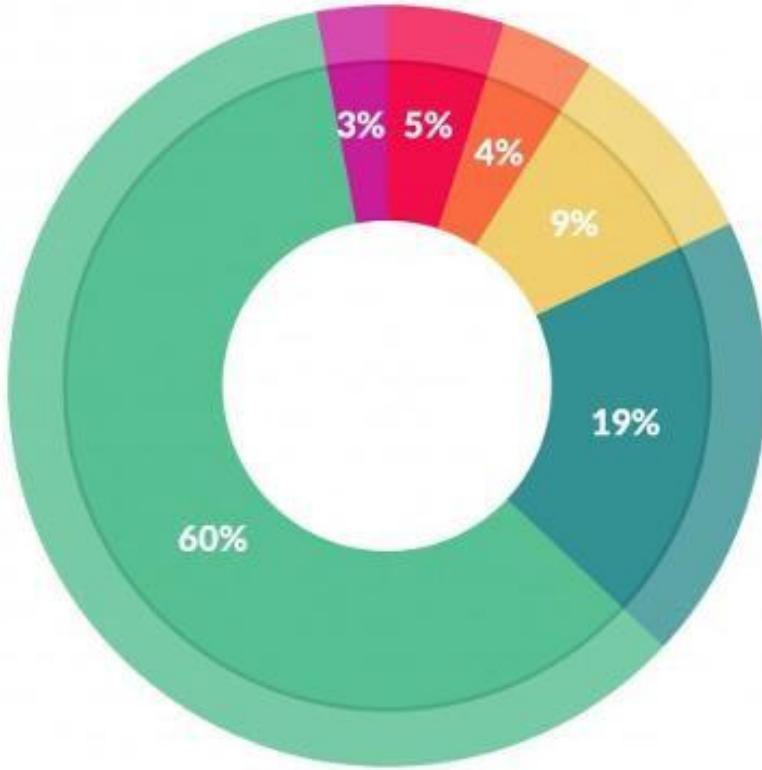
Every Data Science projects' pipeline



Web

Mobile

Embarqué



What data scientists spend the most time doing

- *Building training sets: 3%*
- *Cleaning and organizing data: 60%*
- *Collecting data sets; 19%*
- *Mining data for patterns: 9%*
- *Refining algorithms: 4%*
- *Other: 5%*

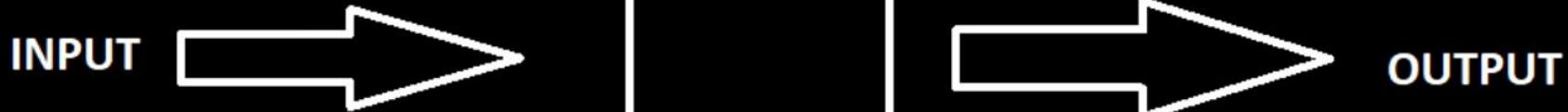
BREAK

Next: Machine Learning

Machine Learning

Human Learning

Learning



LEARNING



Human Learning



Machine Learning





Function 1:

[Redacted text area]

[Redacted text area]

[Redacted text area]

[Redacted text area]

Function 2:

[Redacted text area]

[Redacted text area]

[Redacted text area]

[Redacted text area]

Function 3:

[Redacted text area]

[Redacted text area]

[Redacted text area]

[Redacted text area]

Function 4:

[Redacted text area]

[Redacted text area]

[Redacted text area]

[Redacted text area]





This is All!
Just a bunch of if else

Function 1:

[REDACTED]

[REDACTED]

[REDACTED]

Function 2:

[REDACTED]

[REDACTED]

[REDACTED]

Function 3:

[REDACTED]

[REDACTED]

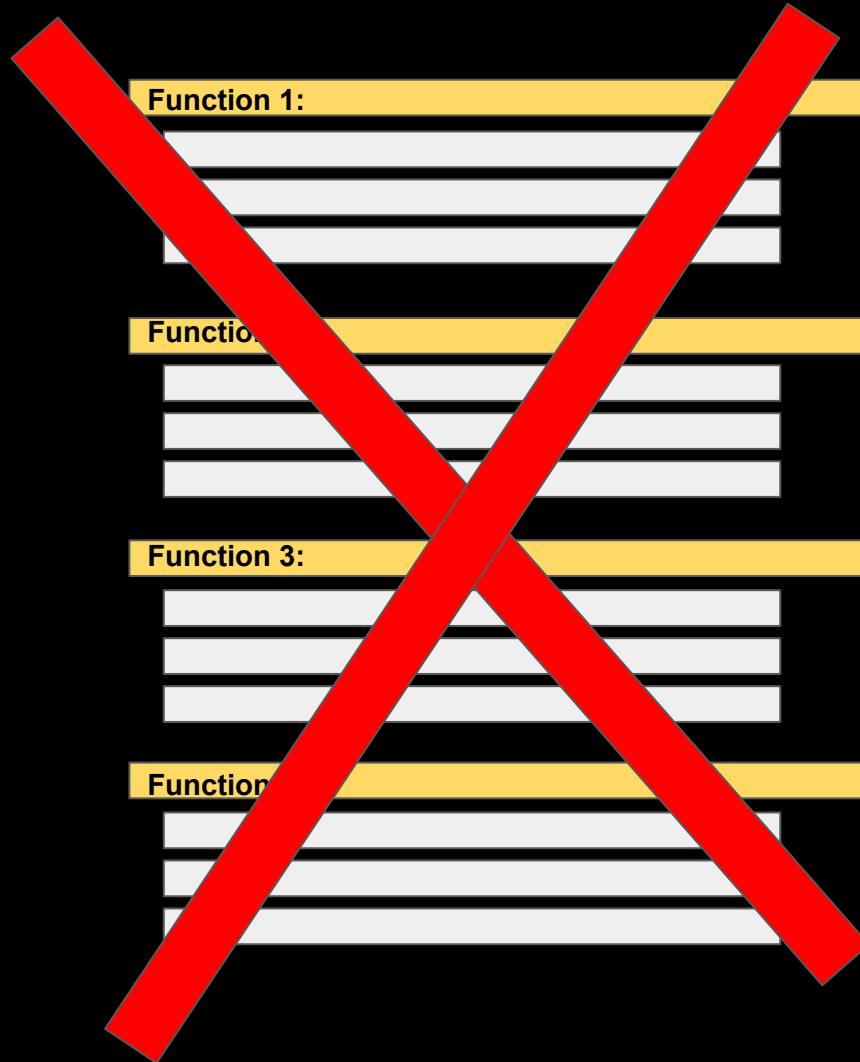
[REDACTED]

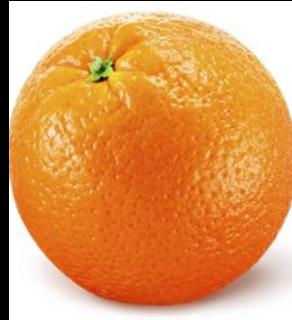
Function 4:

[REDACTED]

[REDACTED]

[REDACTED]



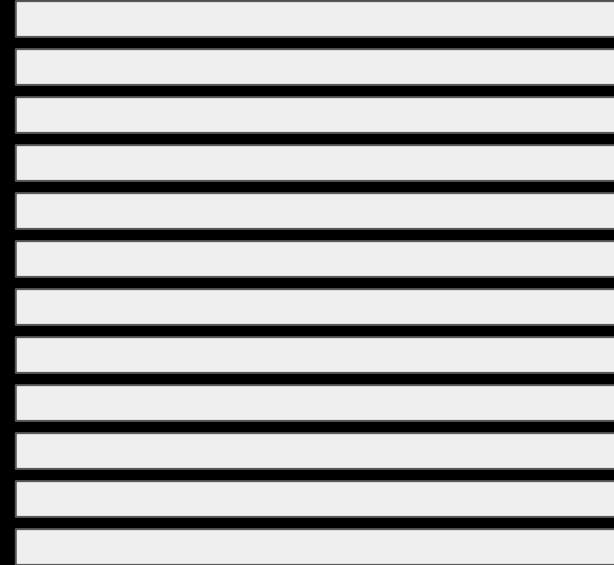


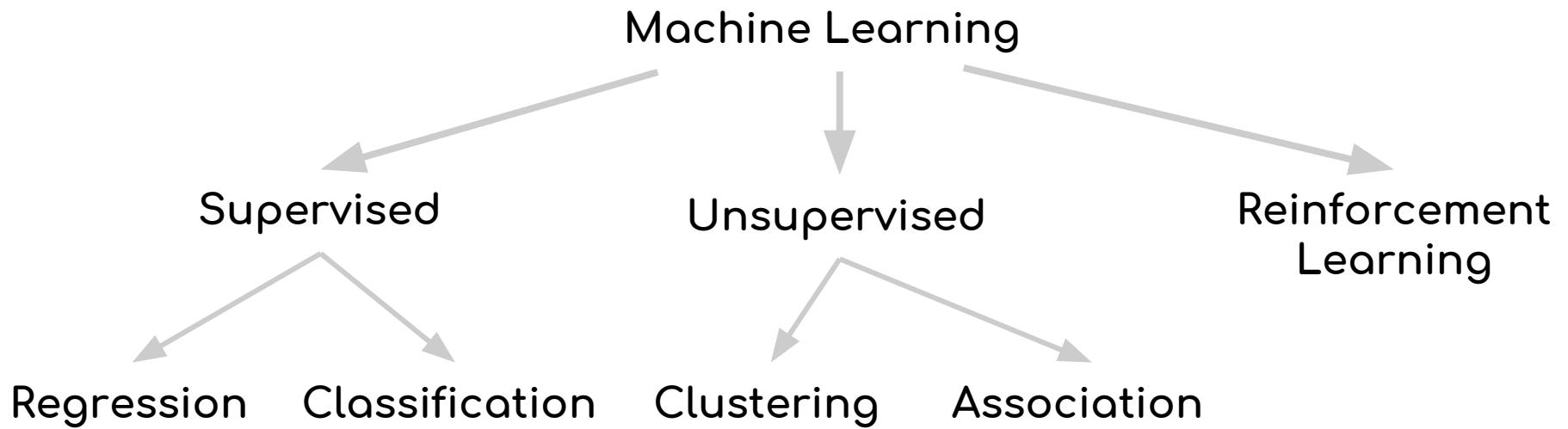
Classifier

Import Images



Machine Learning Function





Supervised Learning

The right answers were given

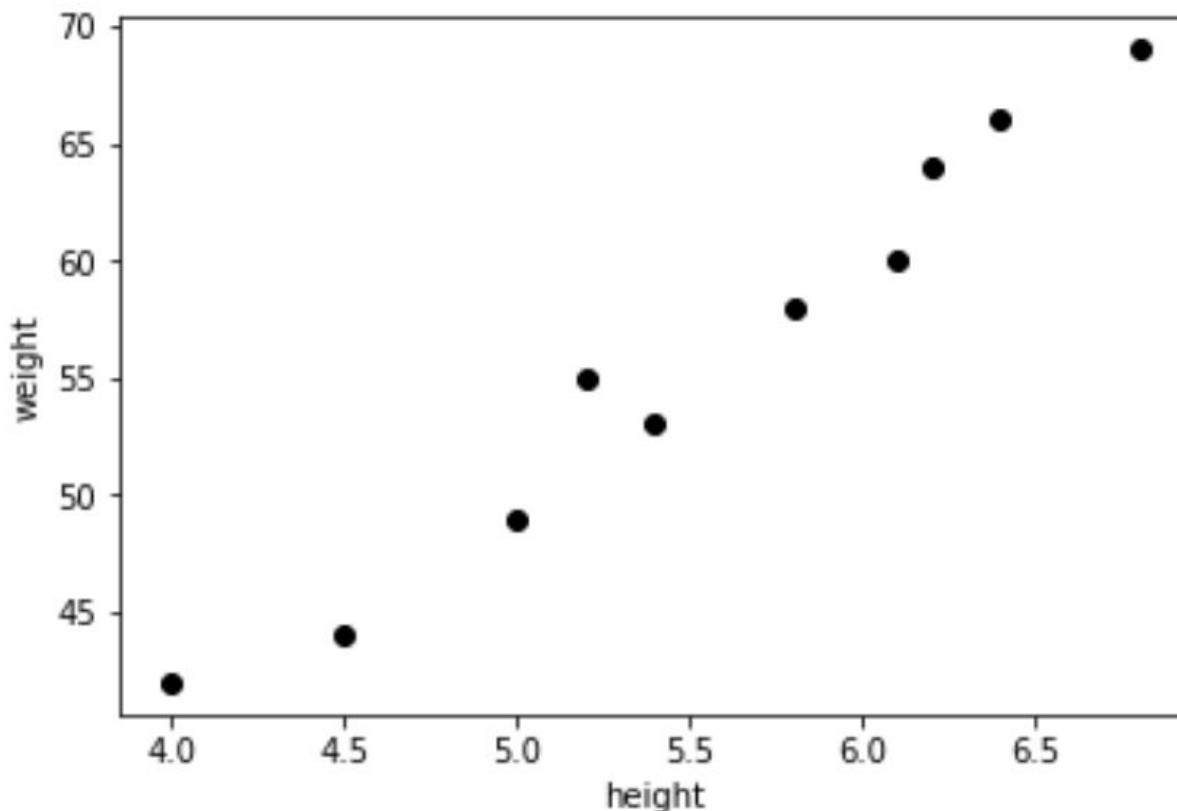
Goal: produce more right answers

Regression

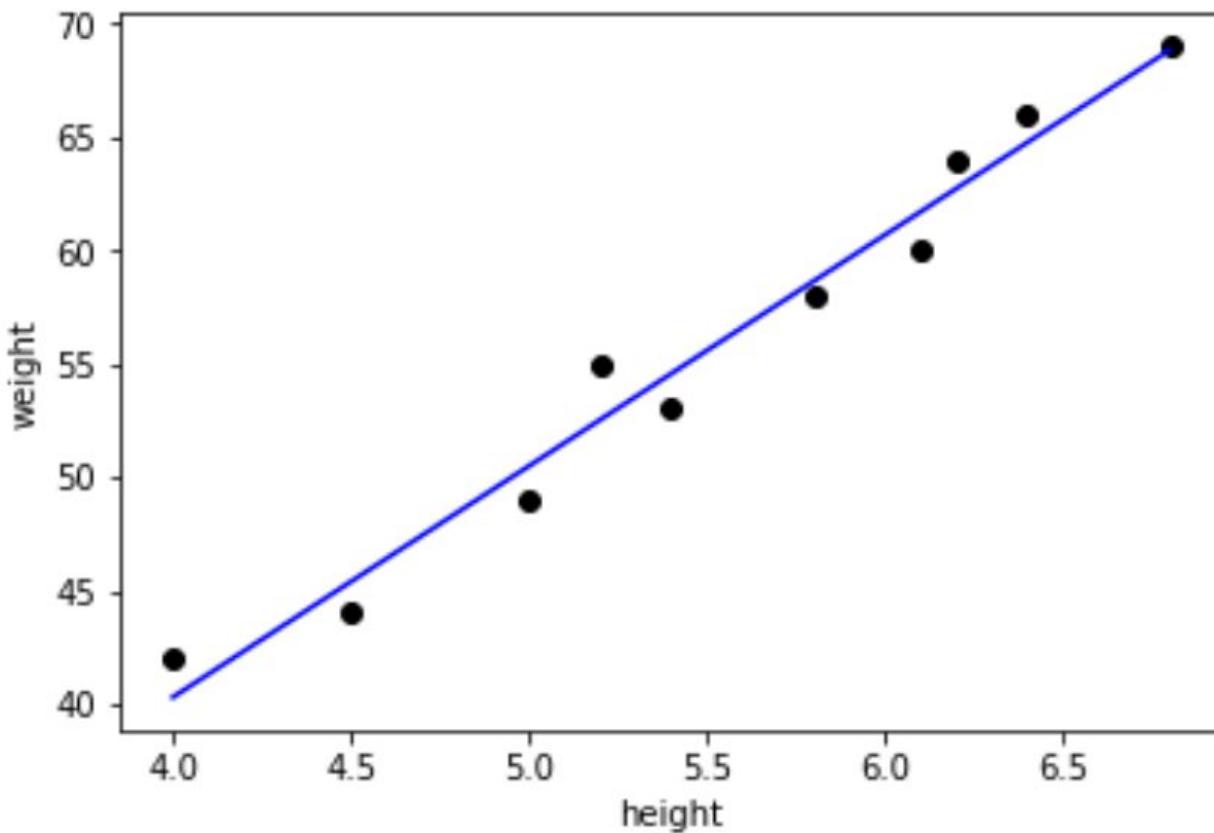


Predict Continuous values:
2.4 / 0.4 / 13.5

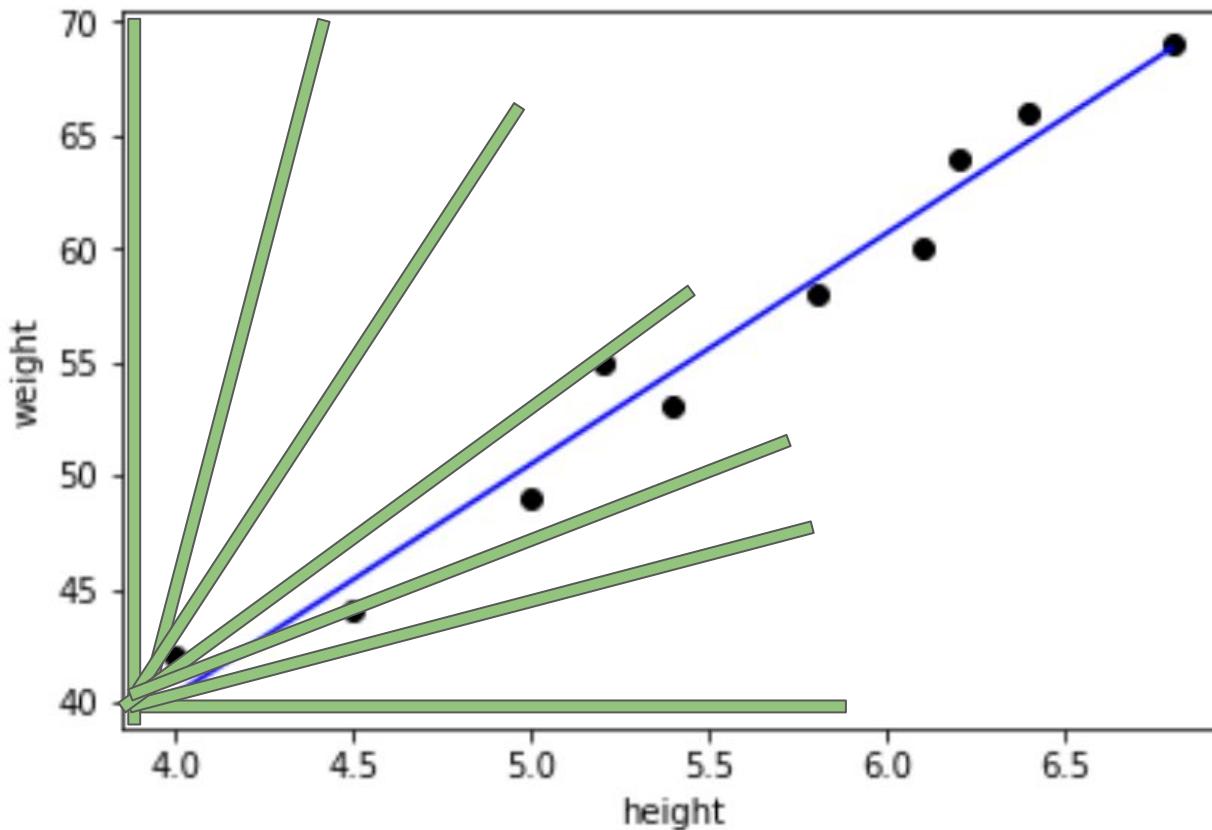
Regression - Linear Regression



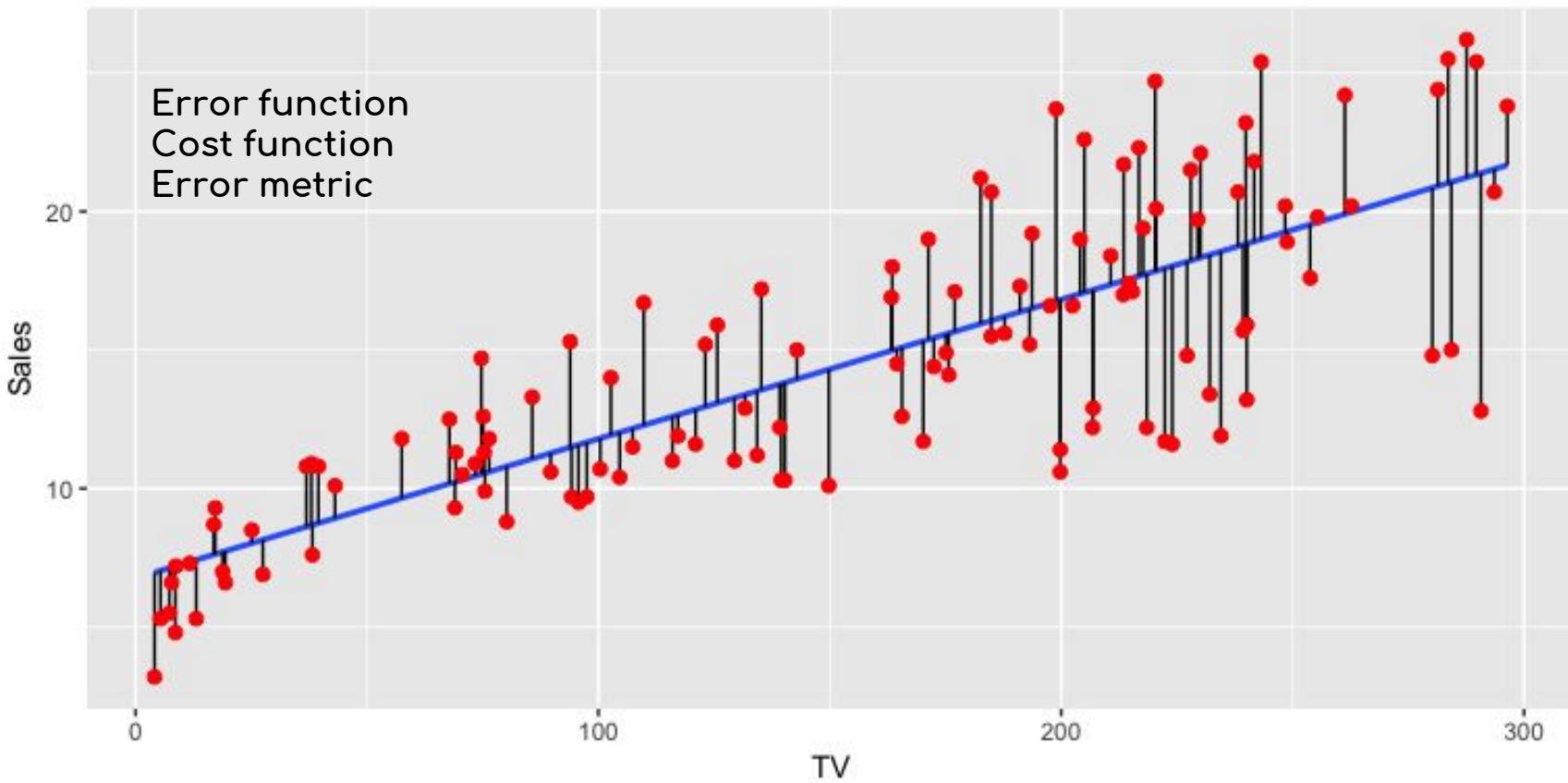
Regression - Linear Regression



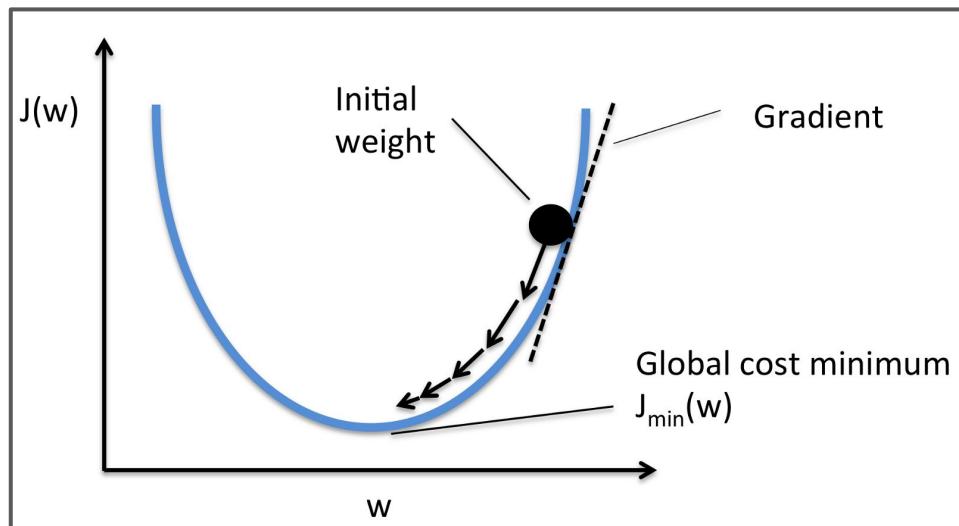
Regression - Linear Regression



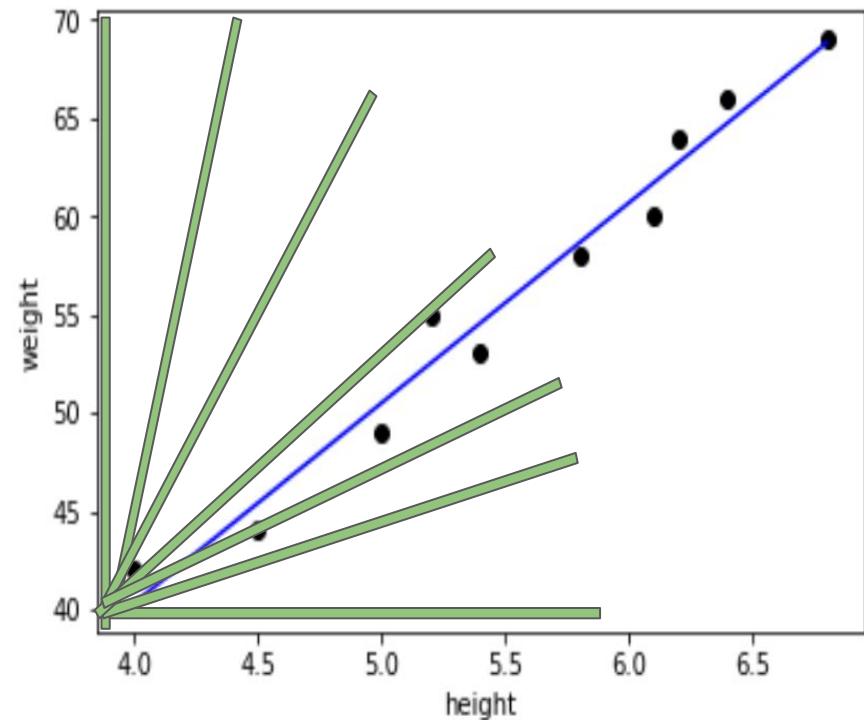
Regression - Linear Regression



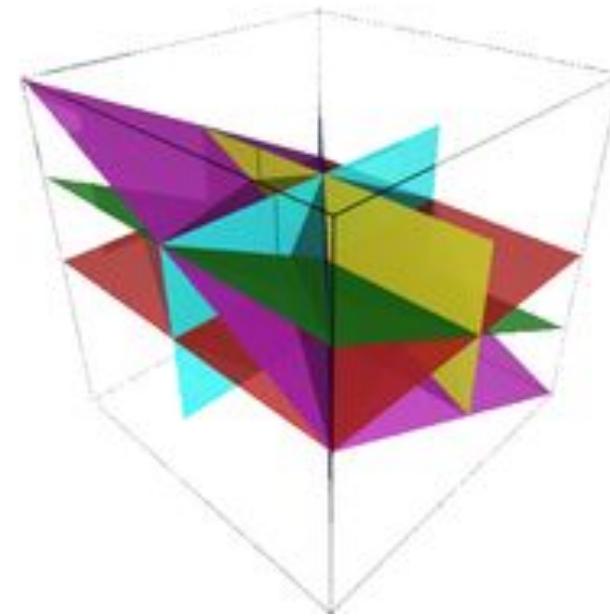
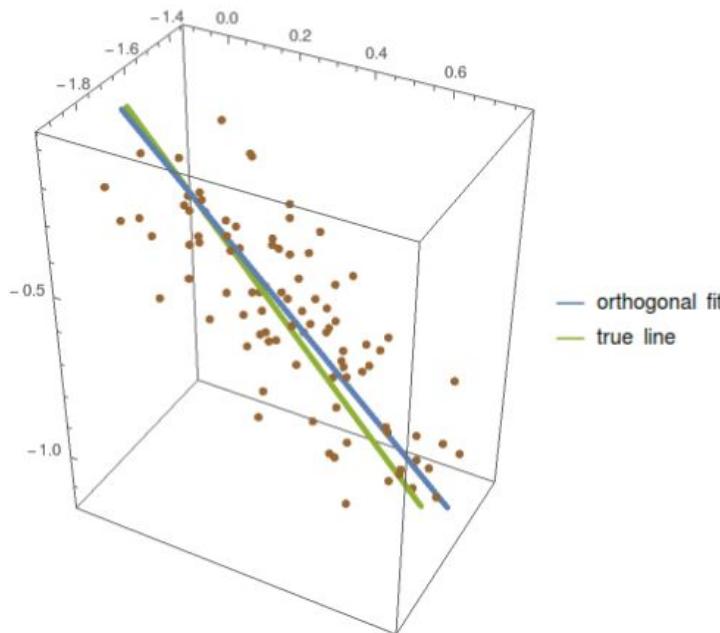
Regression - Linear Regression - Gradient Descent



Univariate → 1 variable

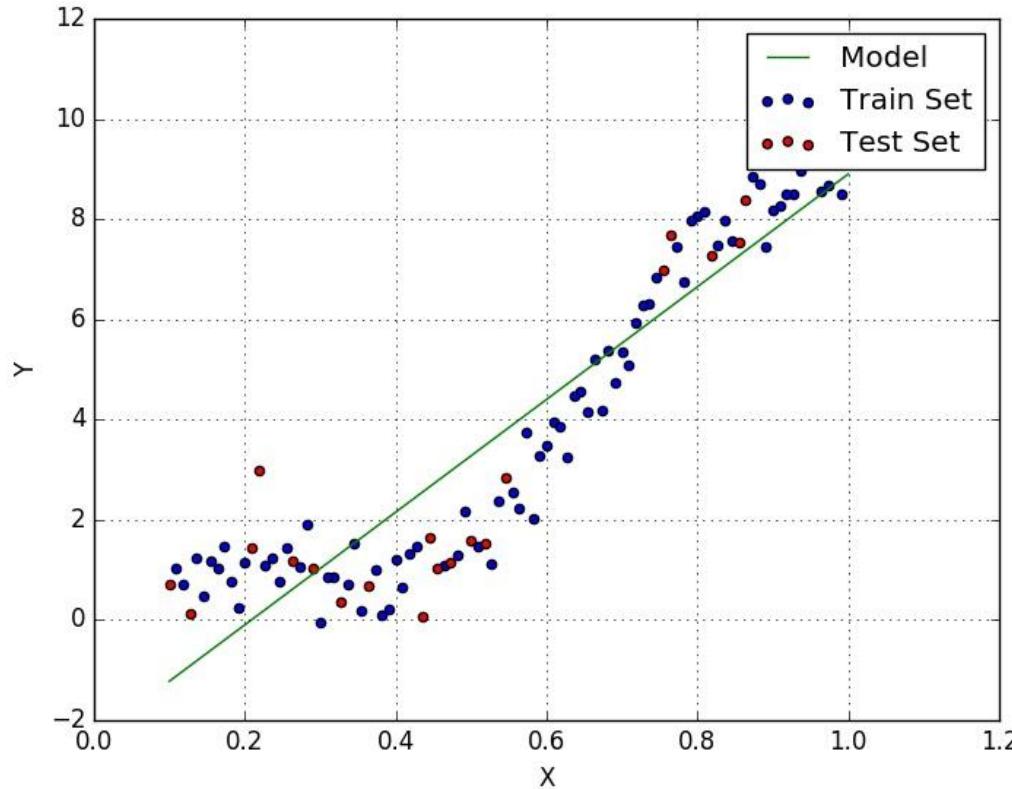


Regression - Linear Regression

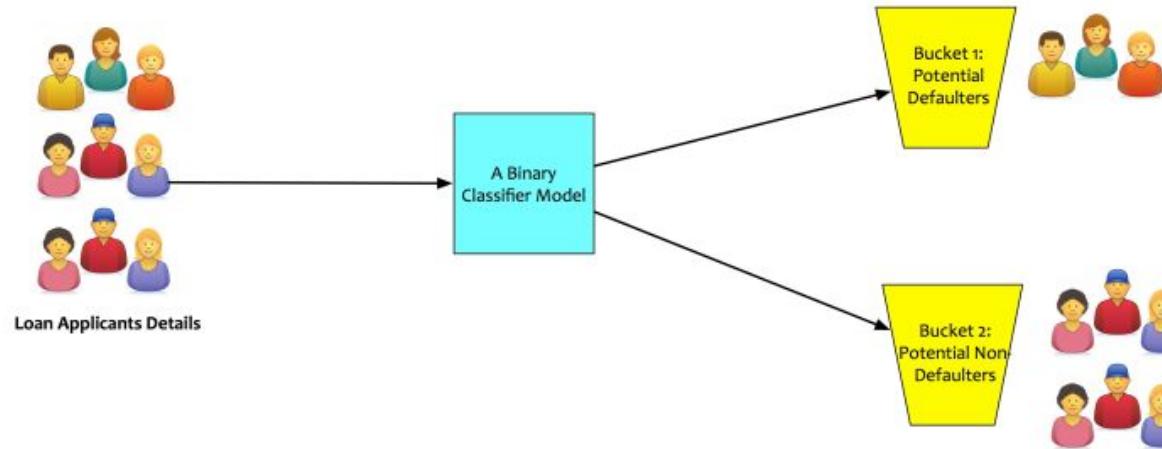


Multivariate → 2+ variables

Linear Regression



Classification



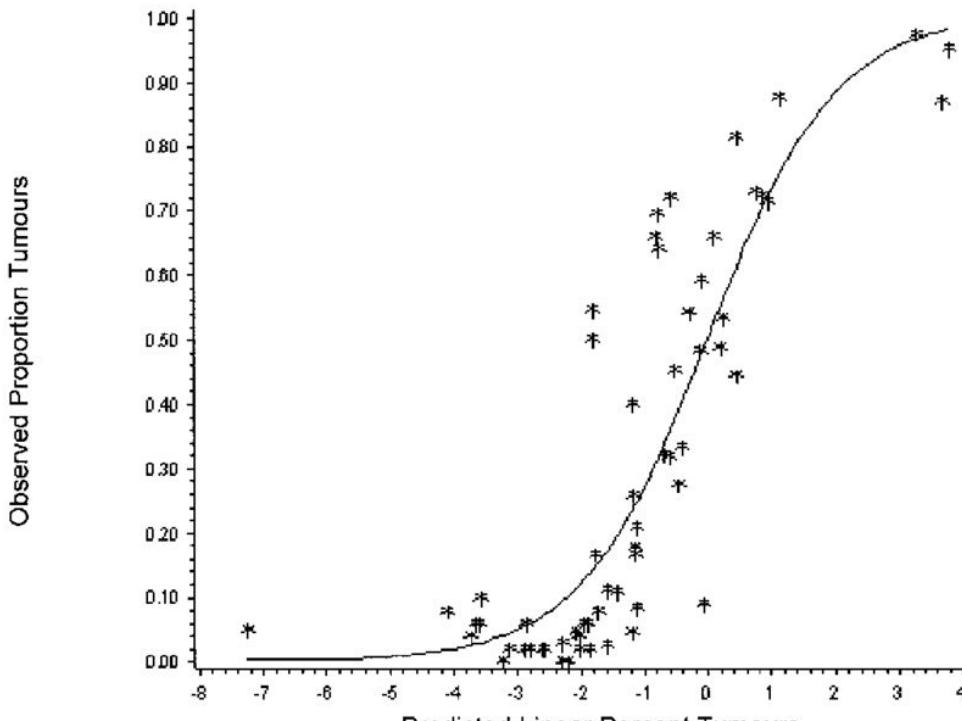
Discrete: 0 / 1 / 20



Class: "dog" / "Spam" / "Darbouka"

Classification - Logistic Regression

The Predicted Versus the Observed Proportion of Tumours
(Fiber Number Injected, Median Fiber Length and INH-WT_{1/2} L>20 μm)



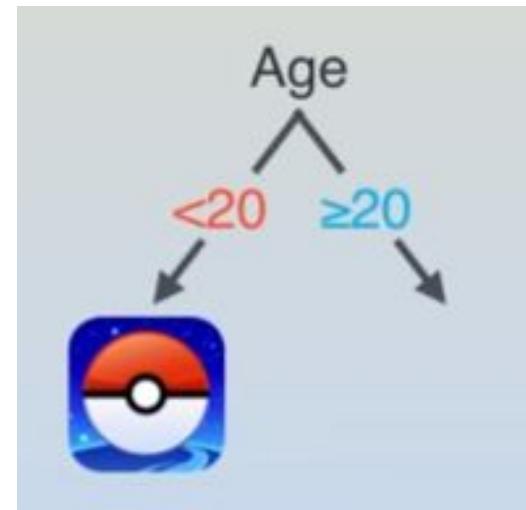
Linear Predictor = Intercept + b1 * Length + b2 * Ln(Fib No) + b3 * T_{1/2}

Classification - Decision Tree

Gender	Age	App	Gender	Age	App	Gender	Age	App
F	15	Pokémon GO	F	15	Pokémon GO	F	15	Pokémon GO
F	25	WhatsApp	F	25	WhatsApp	F	25	WhatsApp
M	32	Snapchat	M	32	Snapchat	M	32	Snapchat
F	40	WhatsApp	F	40	WhatsApp	F	40	WhatsApp
M	12	Pokémon GO	M	12	Pokémon GO	M	12	Pokémon GO
M	14	Pokémon GO	M	14	Pokémon GO	M	14	Pokémon GO

Classification - Decision Tree

Gender	Age	App
F	15	
F	25	
M	32	
F	40	
M	12	
M	14	



Classification - Decision Tree

Gender	Age	App
F	25	
M	32	
F	40	

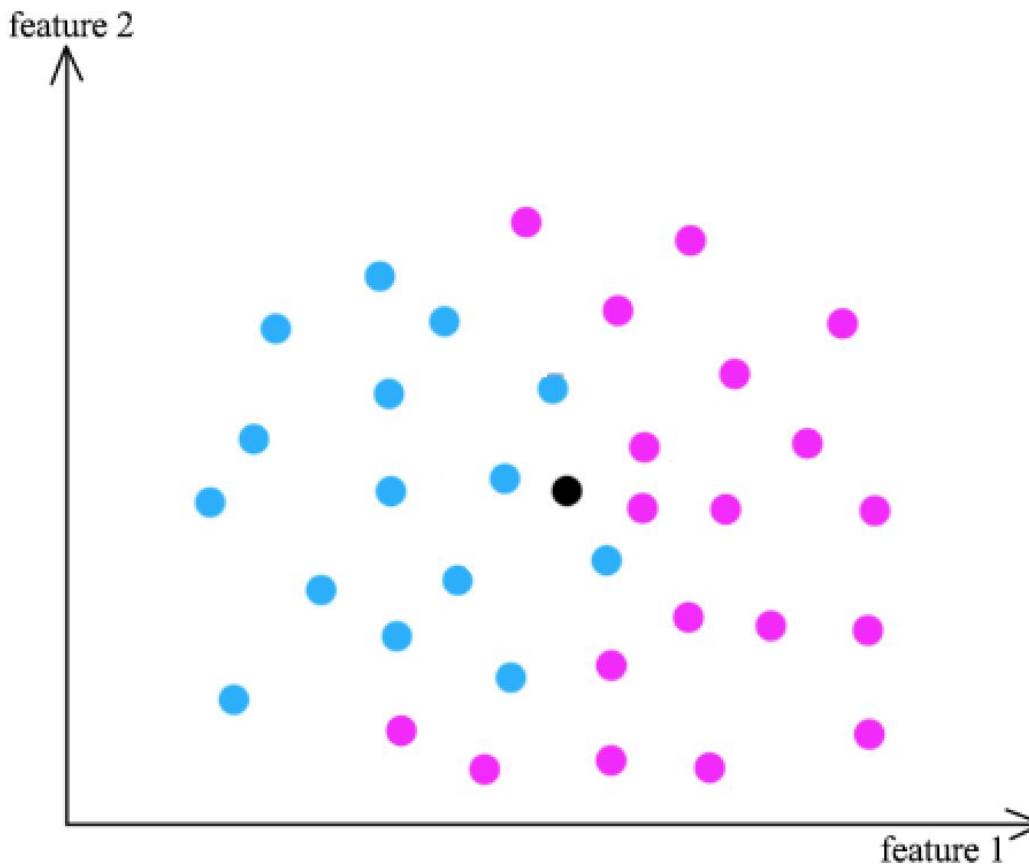


Classification - Decision Tree

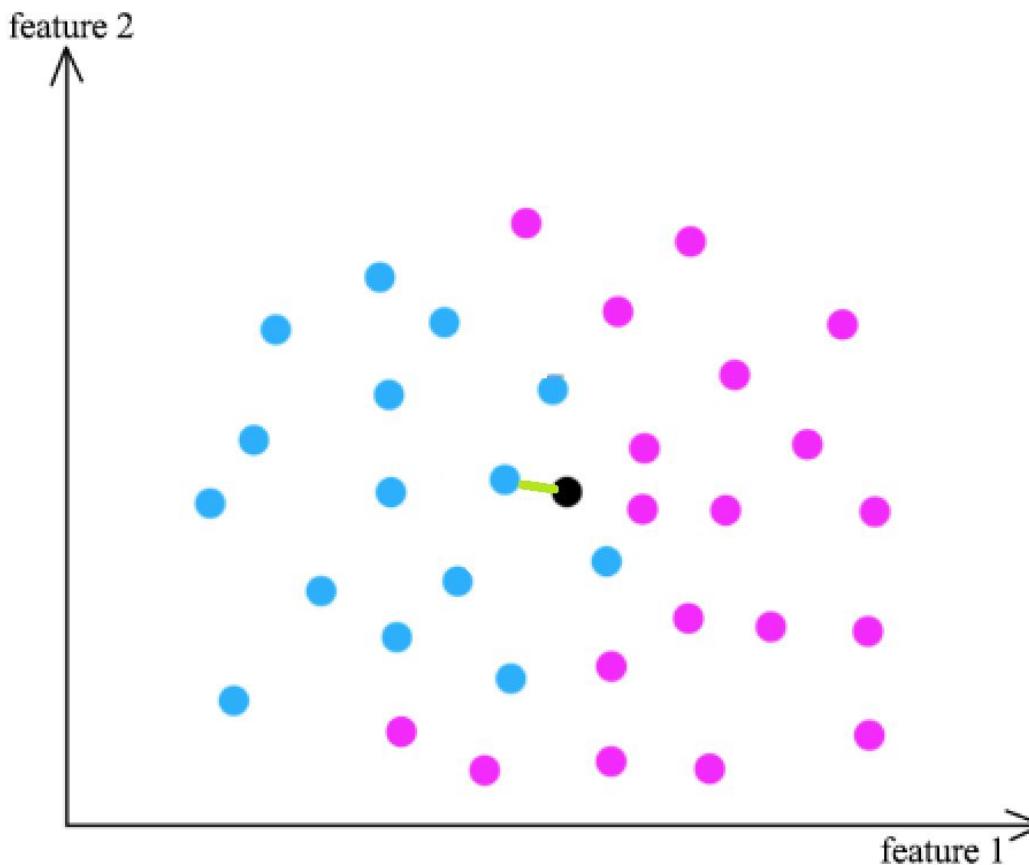
JUST A BUNCH OF IF ELSE
But here it's the computer that chooses the ifs and elses.
So it's the closest transition between AI and Machine Learning



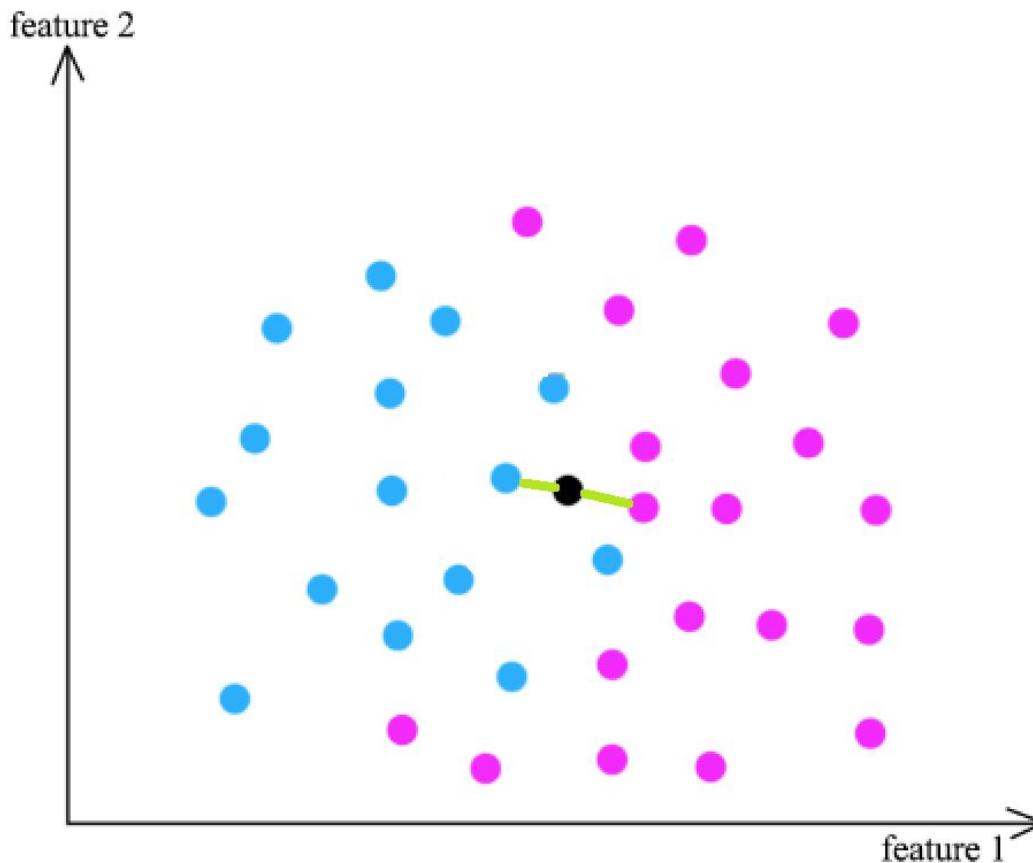
Classification - K Nearest Neighbors (KNN)



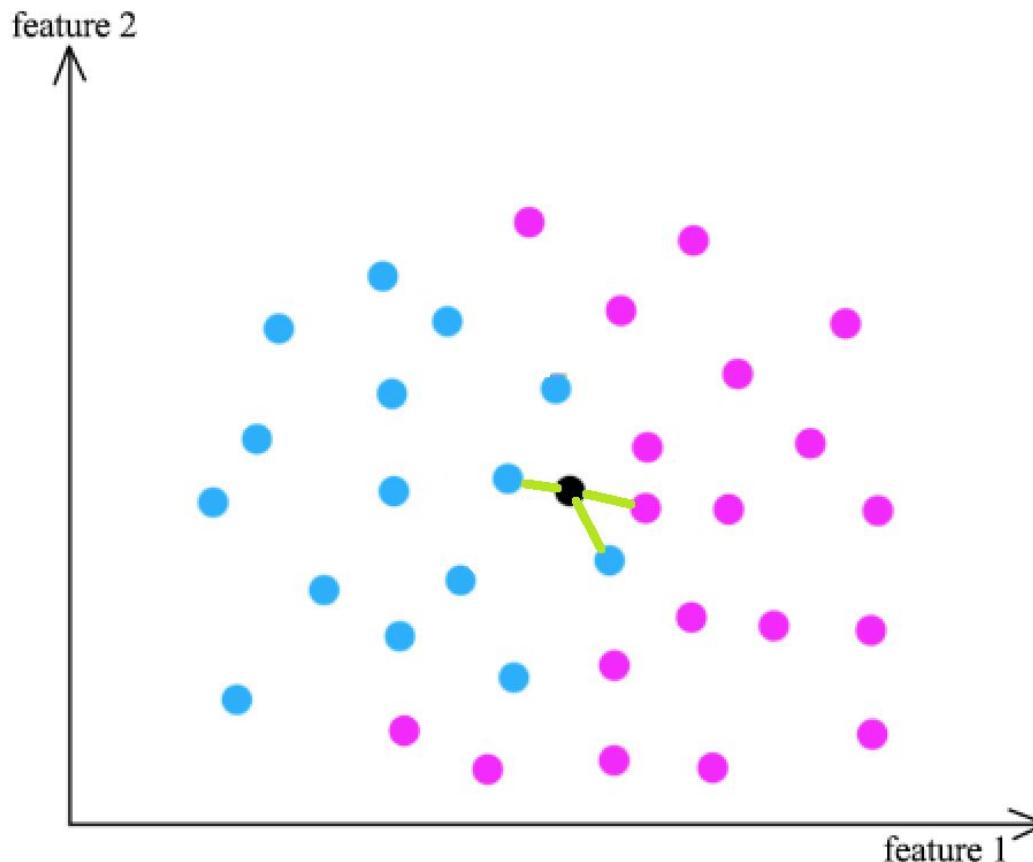
Classification - K Nearest Neighbors (KNN)



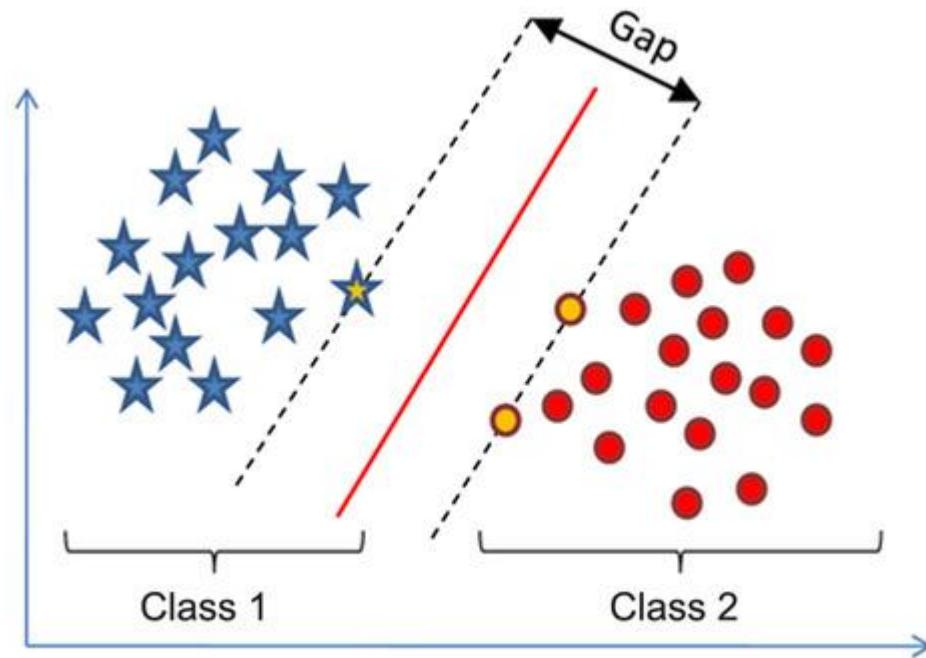
Classification - K Nearest Neighbors (KNN)



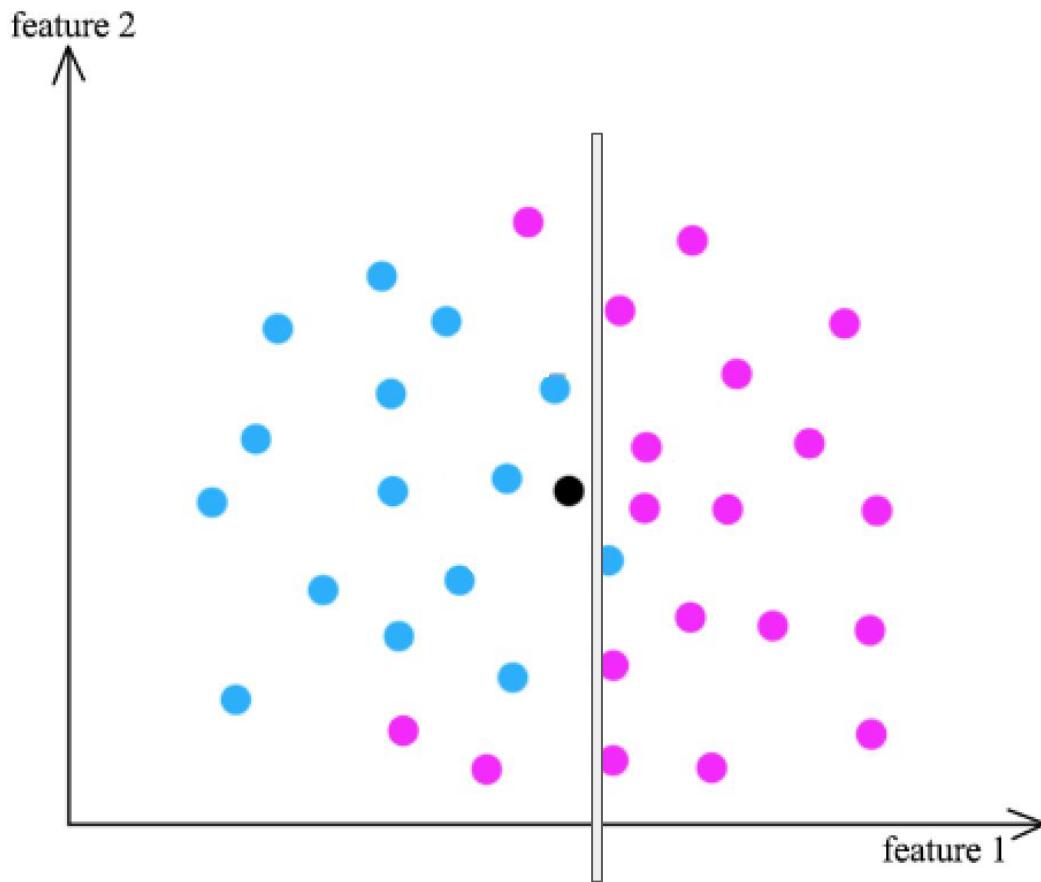
Classification - K Nearest Neighbors (KNN)



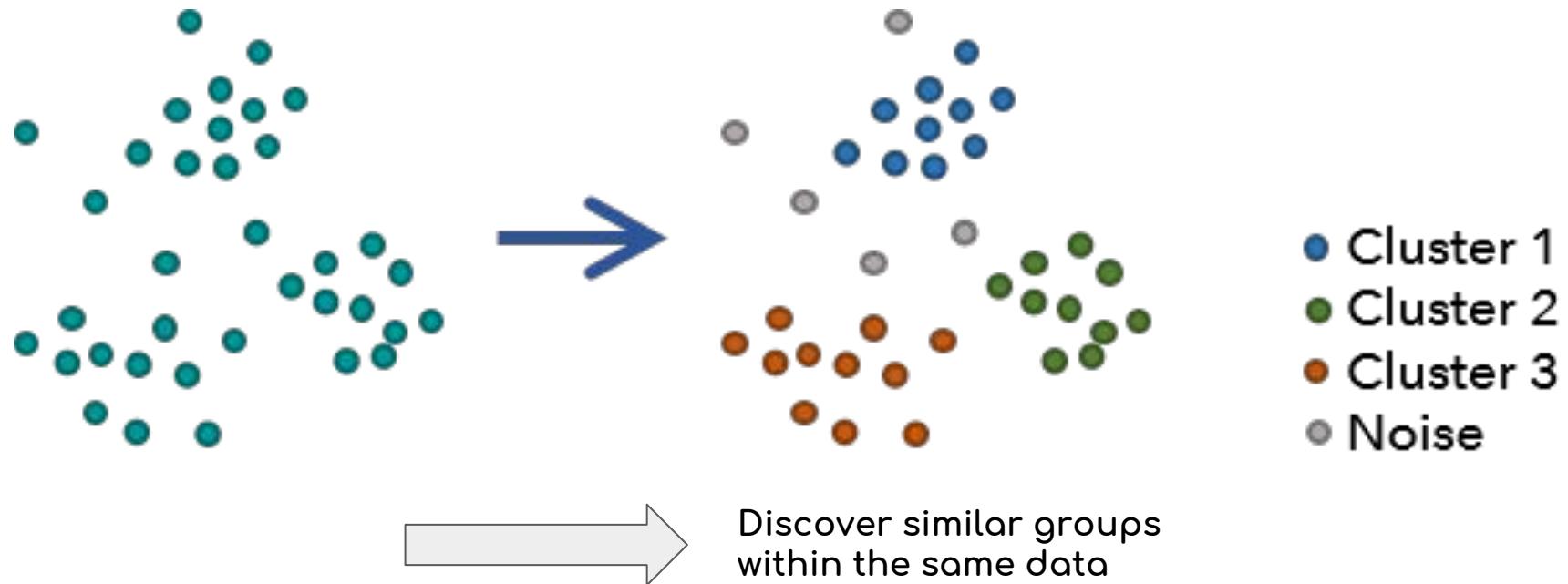
Classification - Support Vector Machine



Classification - Support Vector Machine (SVM)



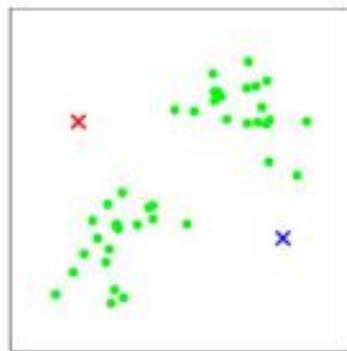
Clustering



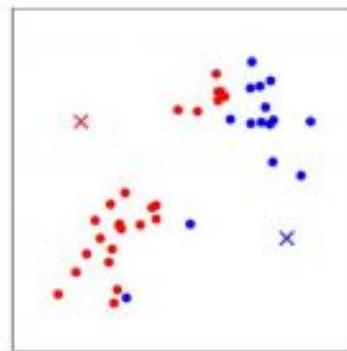
Clustering - K Means



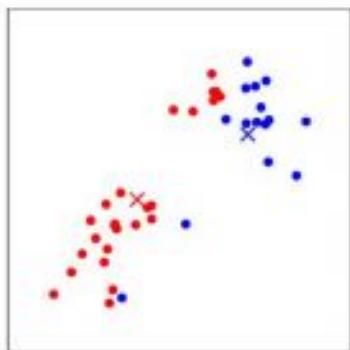
(a)



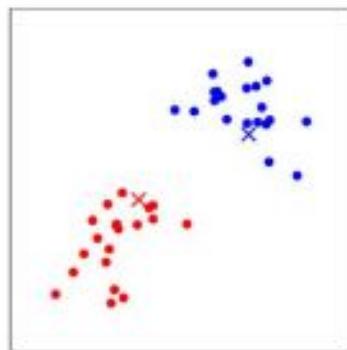
(b)



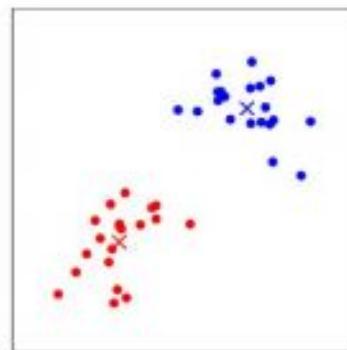
(c)



(d)



(e)

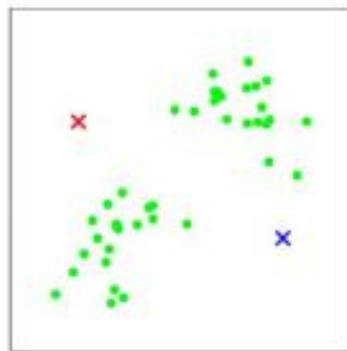


(f)

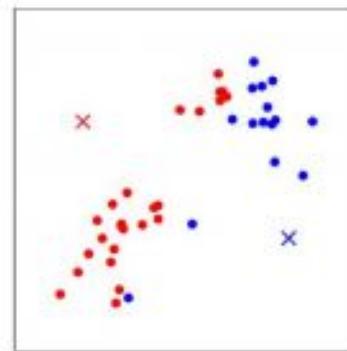
Clustering - K Means



(a)

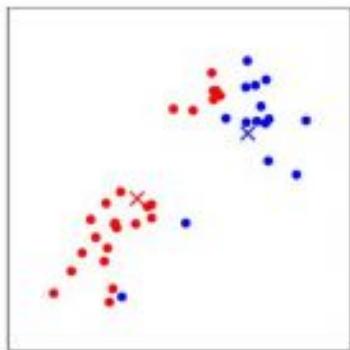


(b)

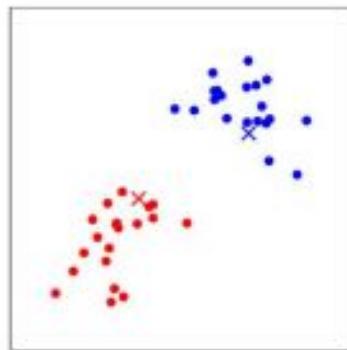


(c)

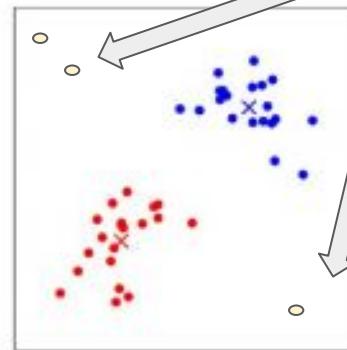
Outliers



(d)

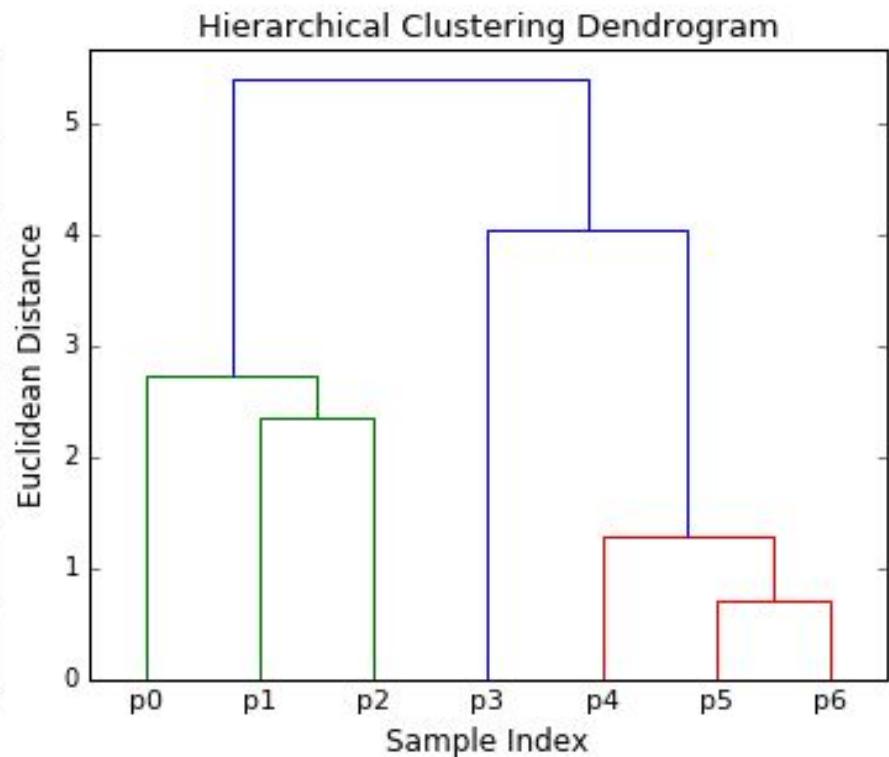
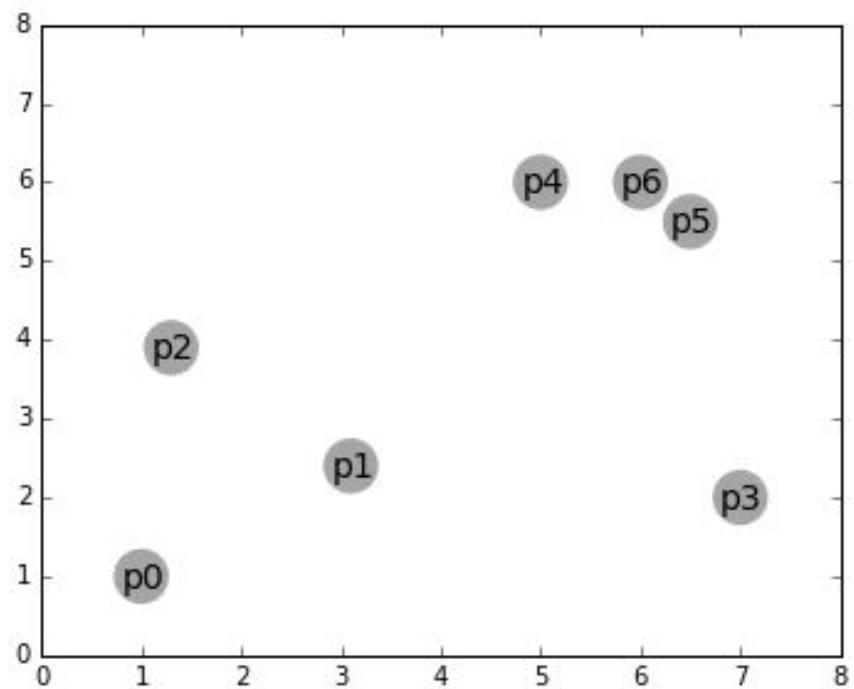


(e)

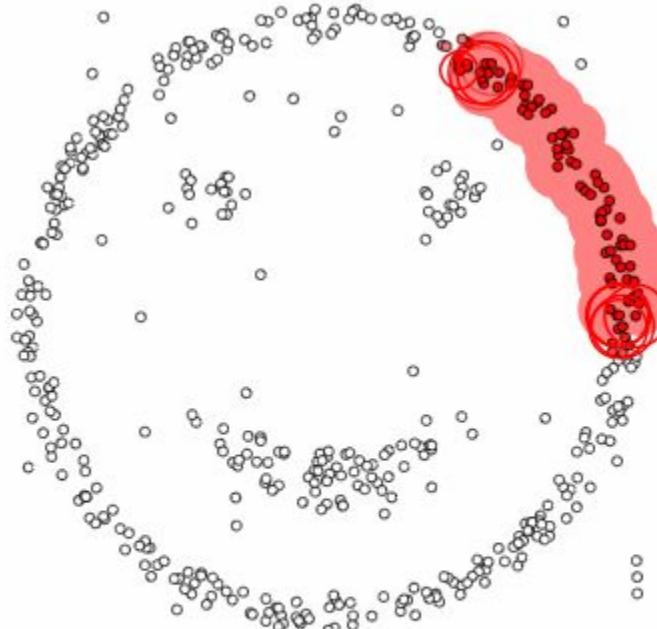


(f)

Clustering - Hierarchical Clustering



Clustering - Dbscan



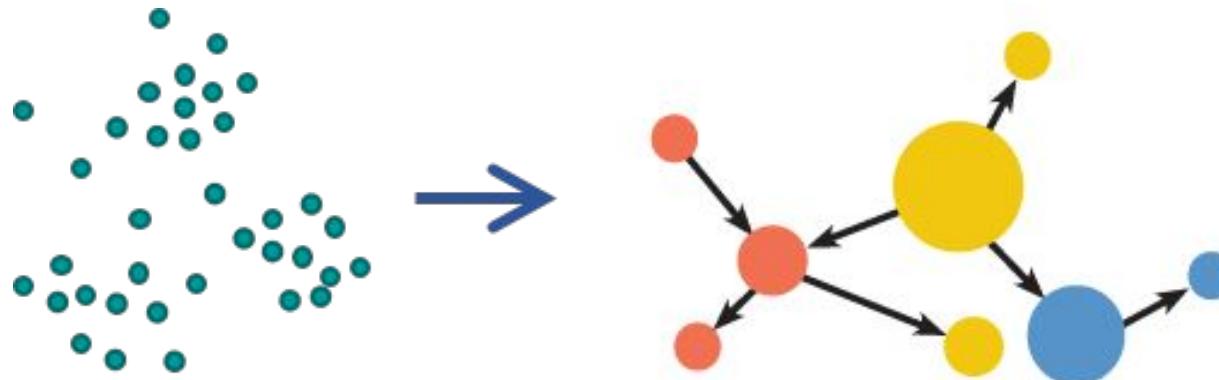
epsilon = 1.00
minPoints = 4

Restart



Pause

Association



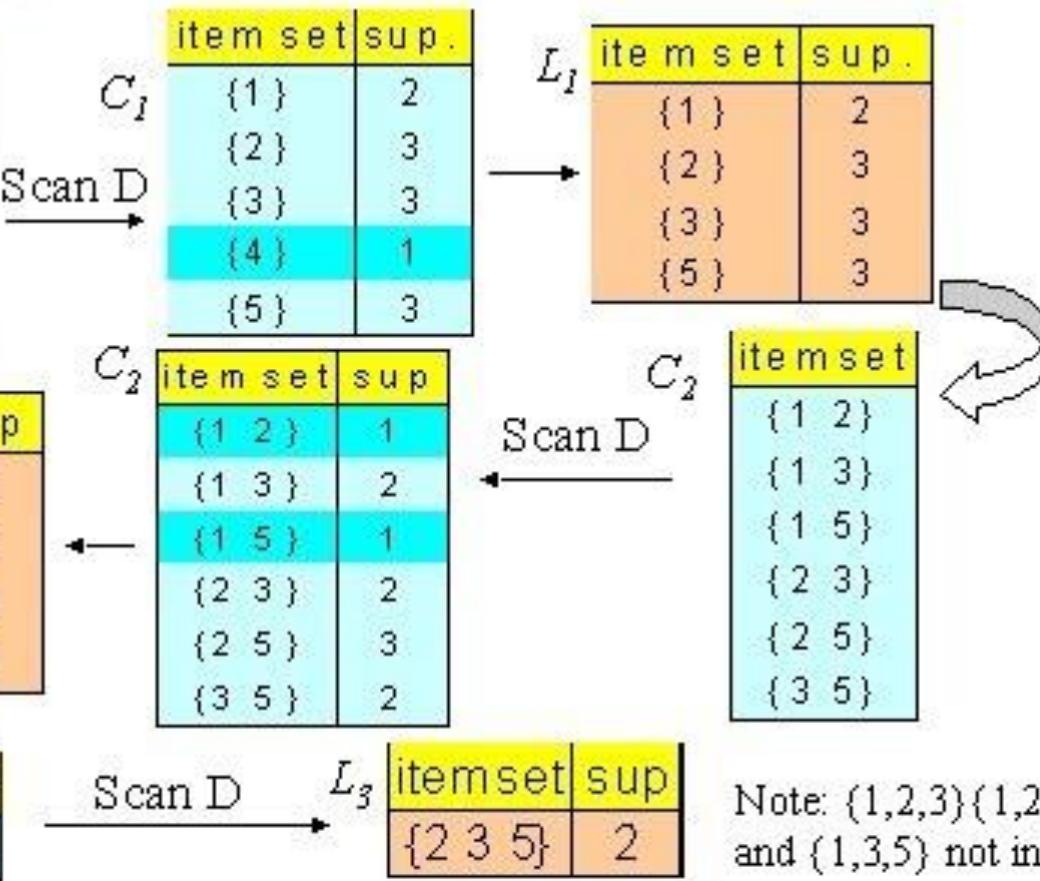
Discover patterns within
the same data



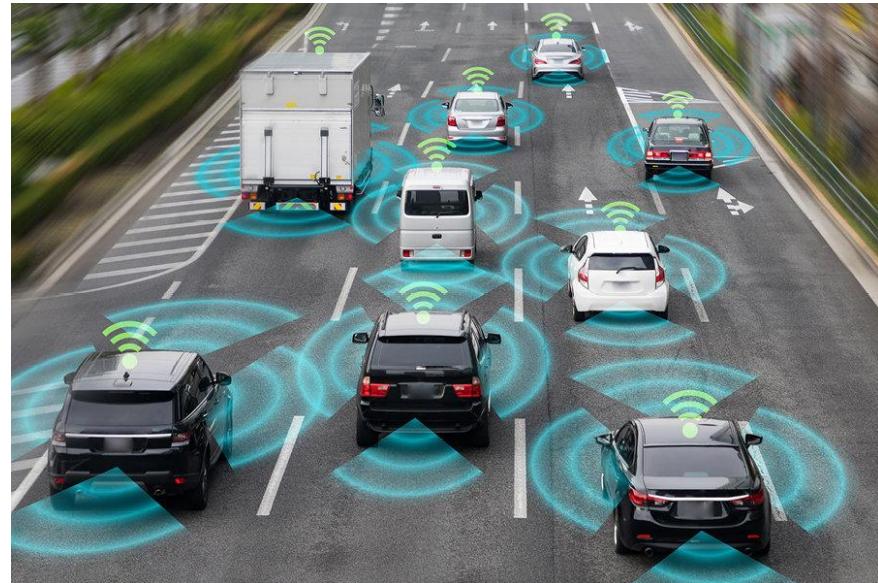
Association - Apriori

Database D

T ID	Items
100	1 3 4
200	2 3 5
300	1 2 3 5
400	2 5

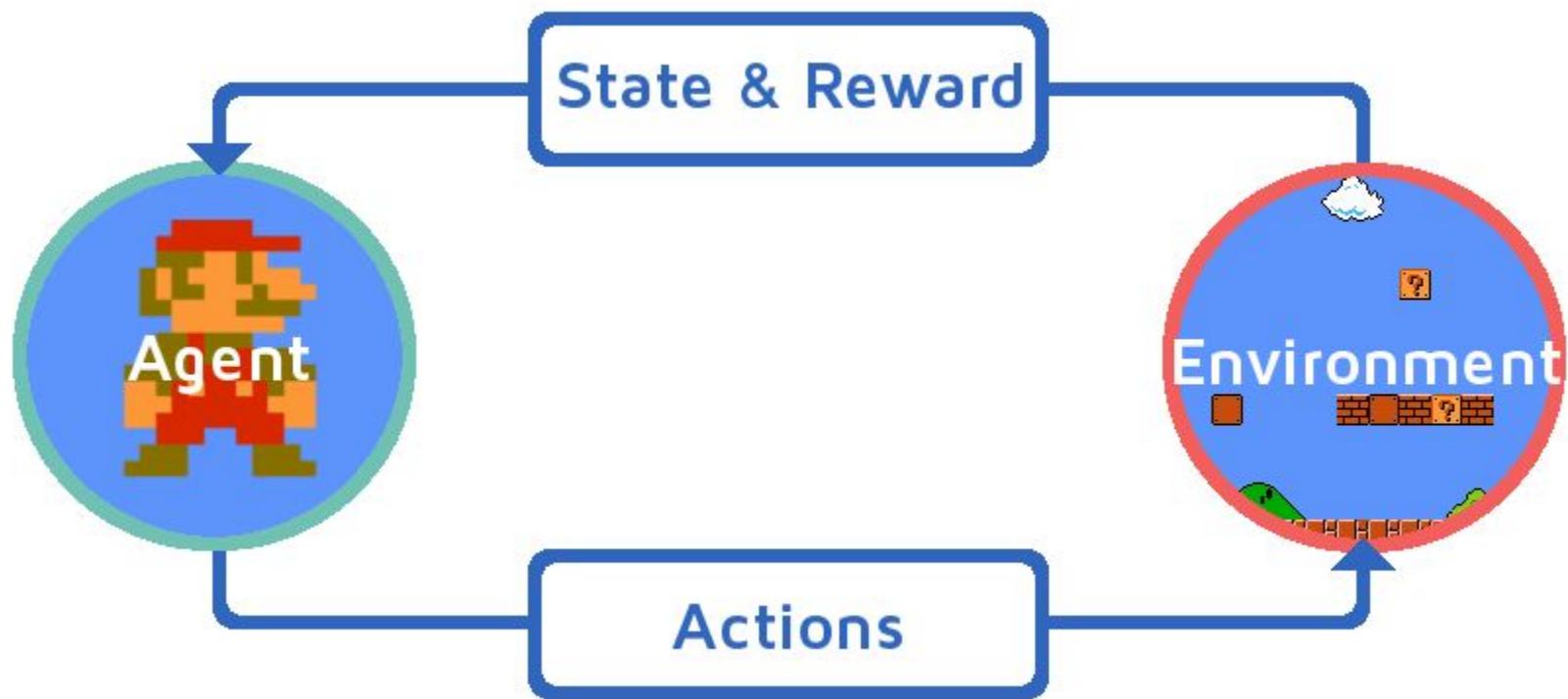


Reinforcement Learning



Machine Learns from mistakes

Reinforcement Learning



BREAK

Next: Machine Learning Pipeline

Every Data Science project's pipeline (or CRISPR)



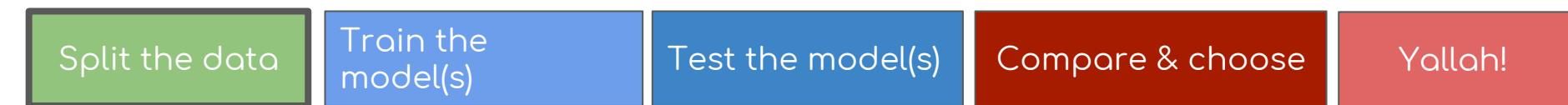
Every Machine Learning project pipeline



Every Data Science project's pipeline (or CRISPR)



Every Machine Learning project pipeline



Machine Learning is all about Data!

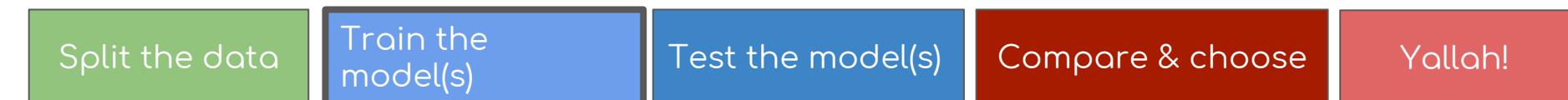
Data is rare & expensive.

Split 80/20

Every Data Science project's pipeline (or CRISPR)



Every Machine Learning project pipeline



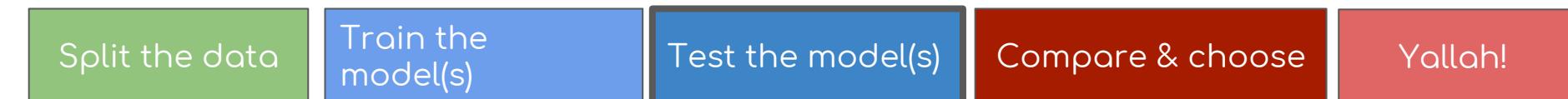
Choose the ML algorithms that fit

Let it learn

Every Data Science project's pipeline (or CRISPR)



Every Machine Learning project pipeline



On the 20%

Cross Validation

Cross validation



Every Data Science project's pipeline (or CRISPR)



Every Machine Learning project pipeline



Every Data Science project's pipeline (or CRISPR)



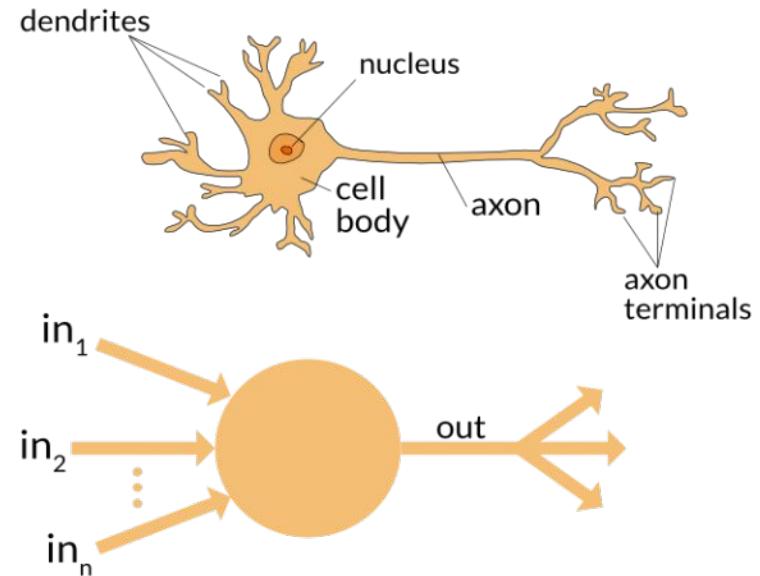
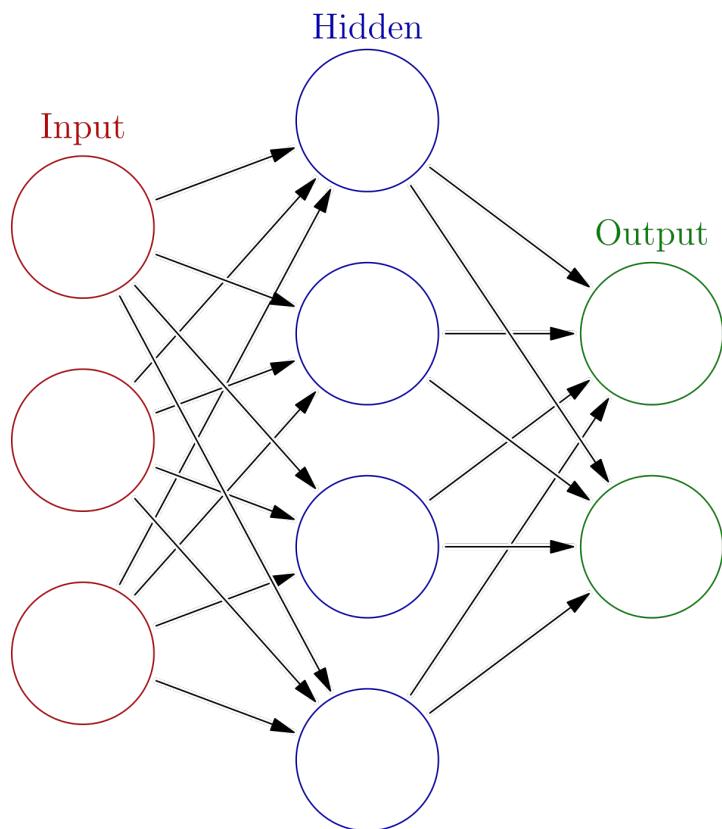
Every Machine Learning project pipeline



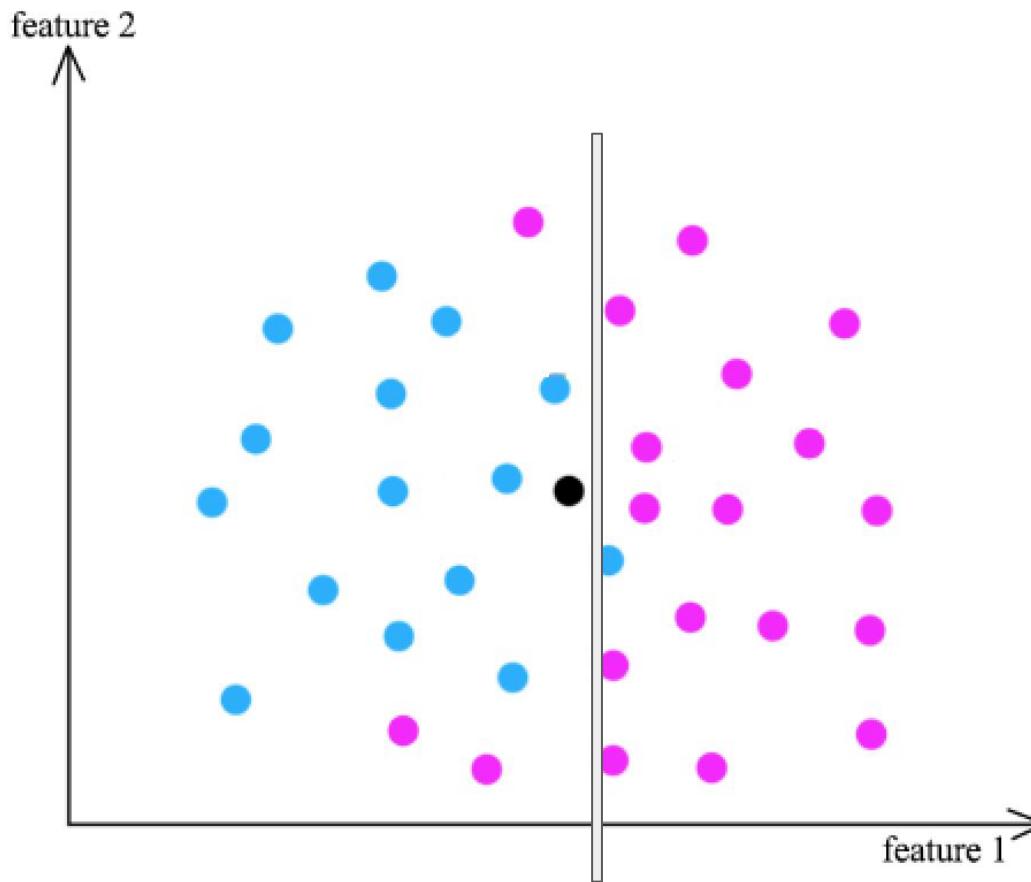
BREAK

Next: Deep Learning

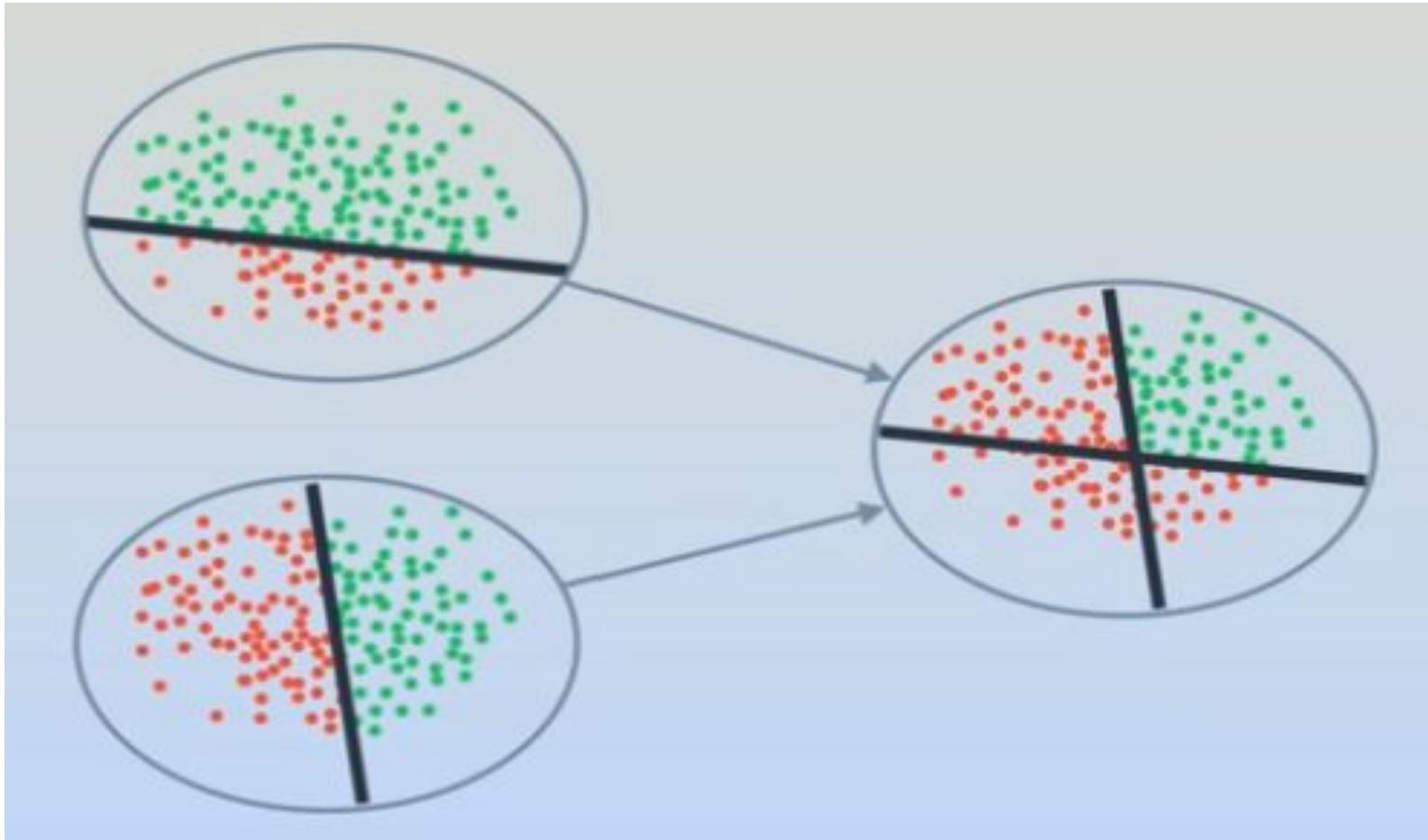
Artificial Neural Networks (ANN)

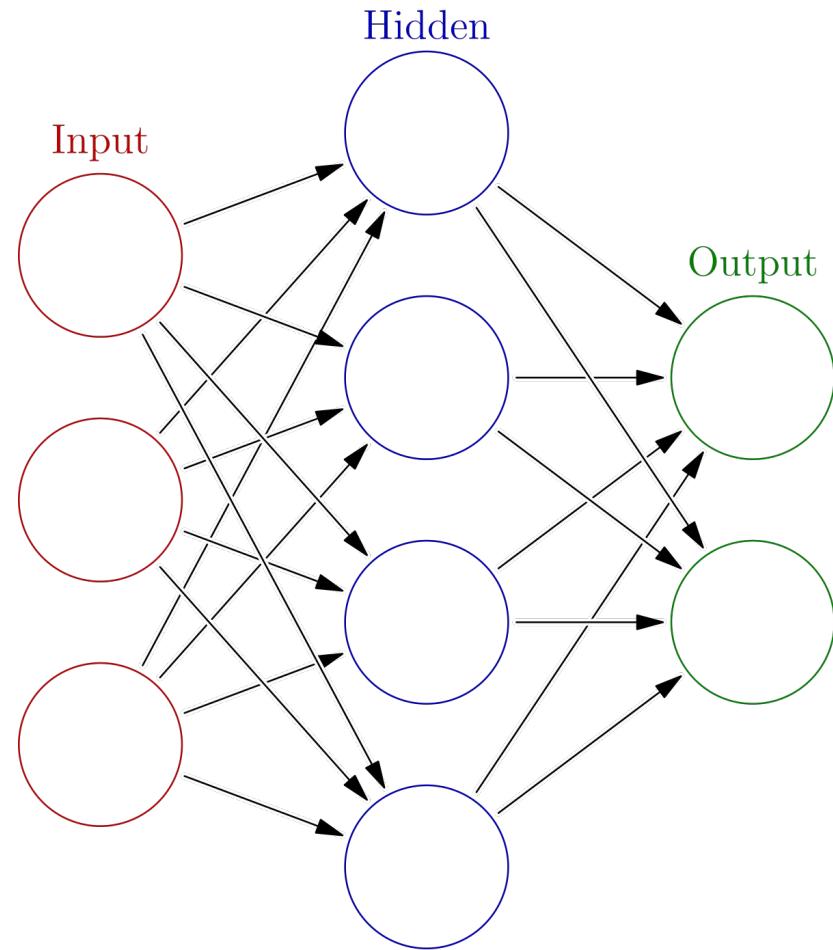
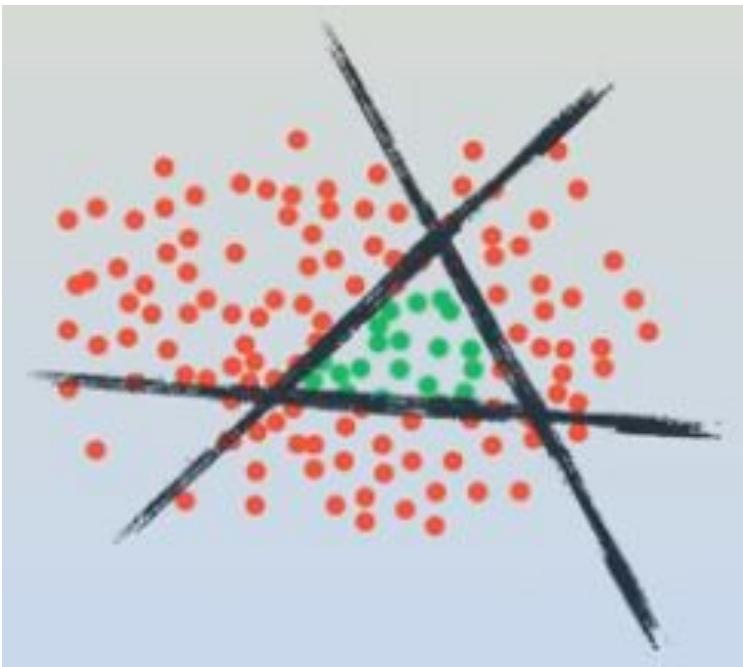


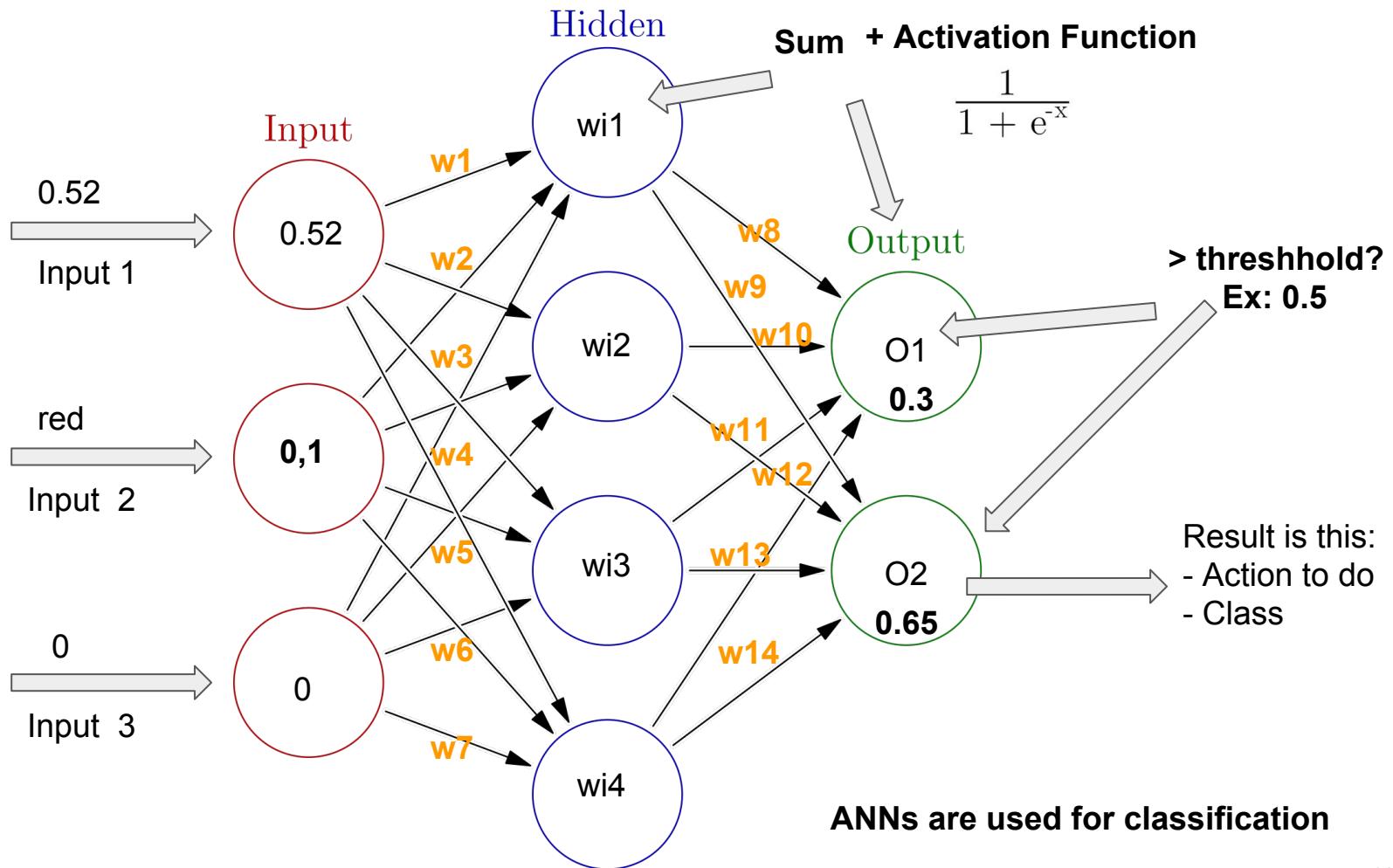
Classification - Support Vector Machine (SVM)

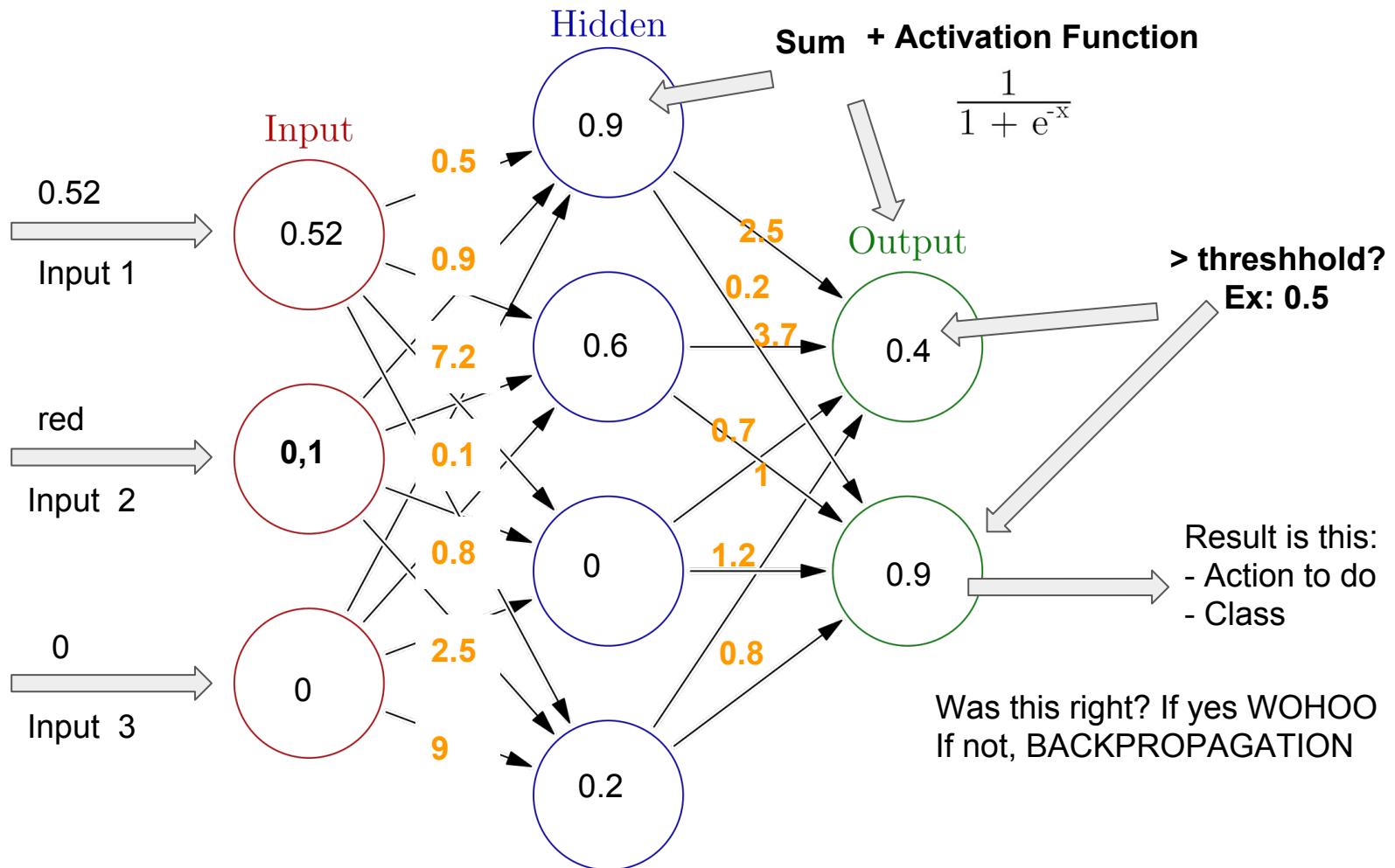


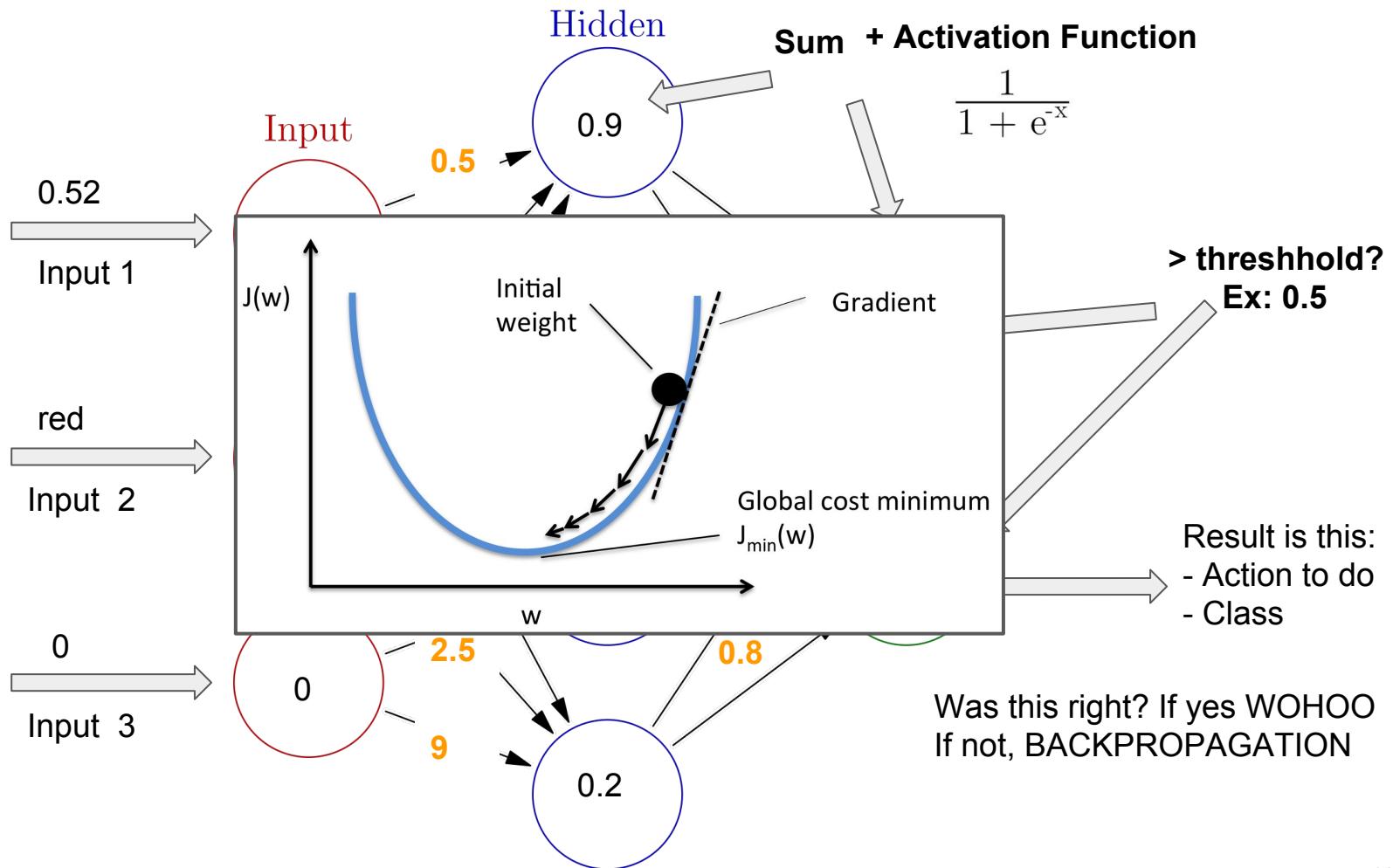


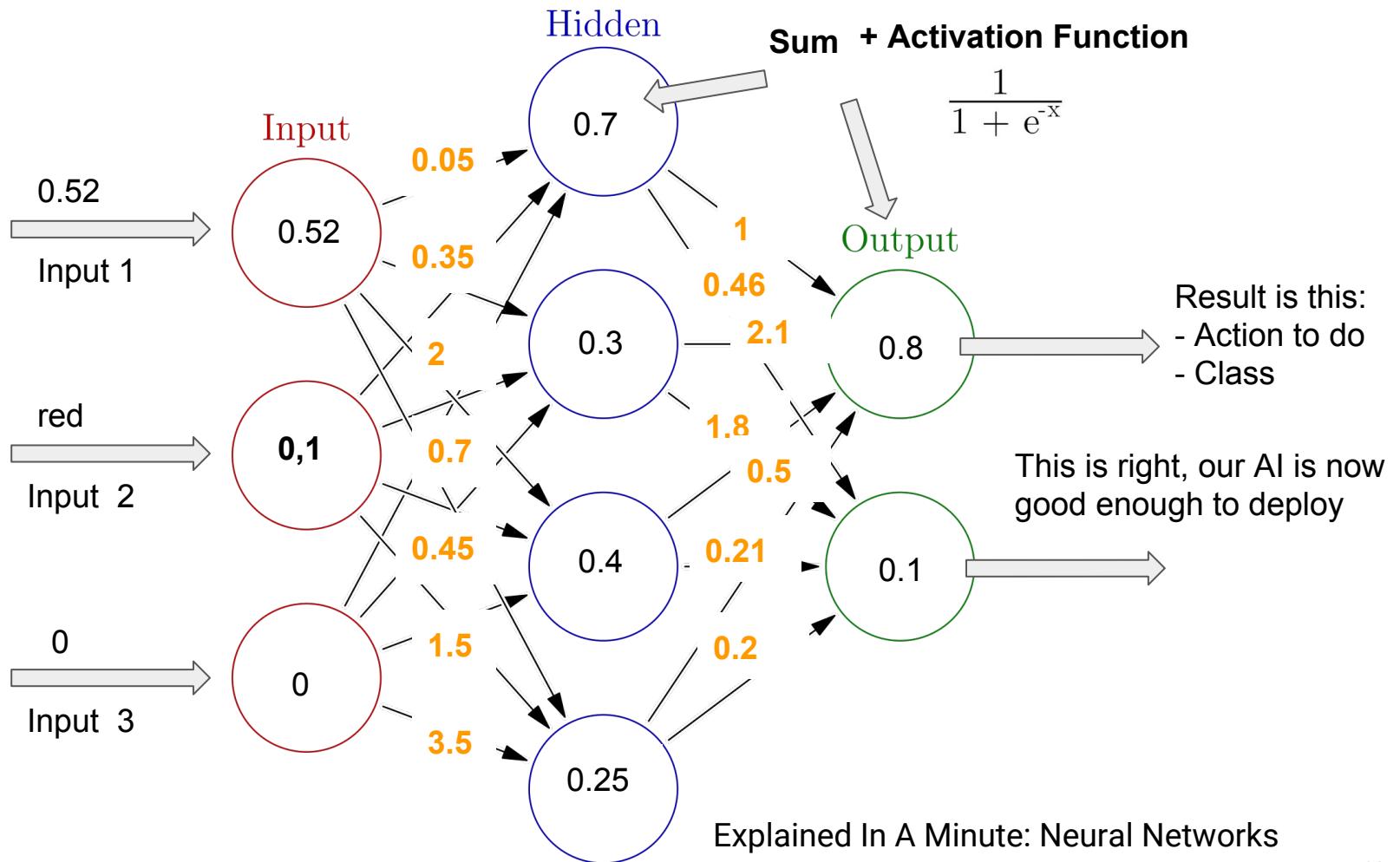


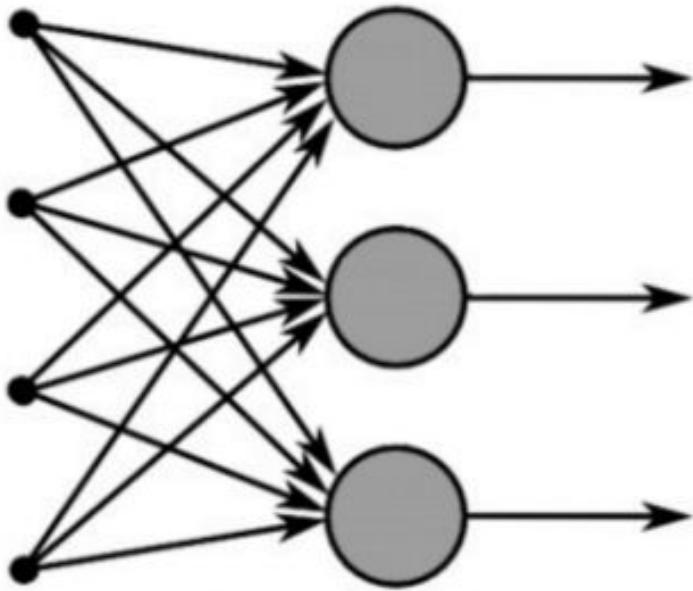




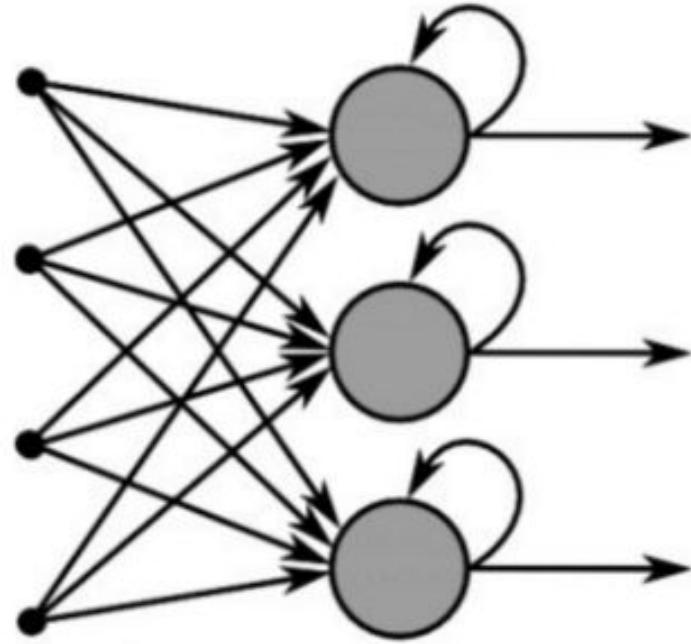








Feed-Forward Neural Network

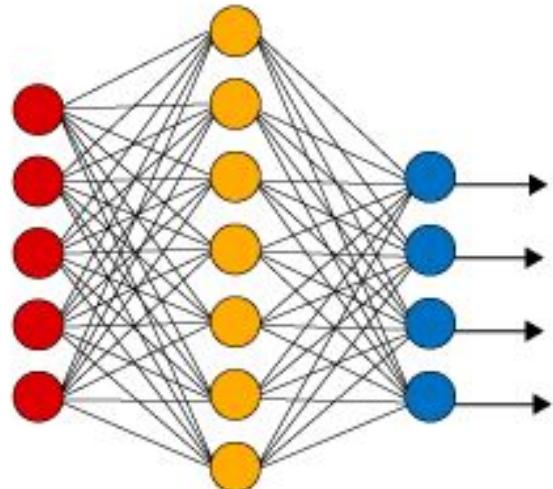


Recurrent Neural Network

- ANN with memory of the last output
- Useful for simple games and weather prediction

Deep Learning

Simple Neural Network

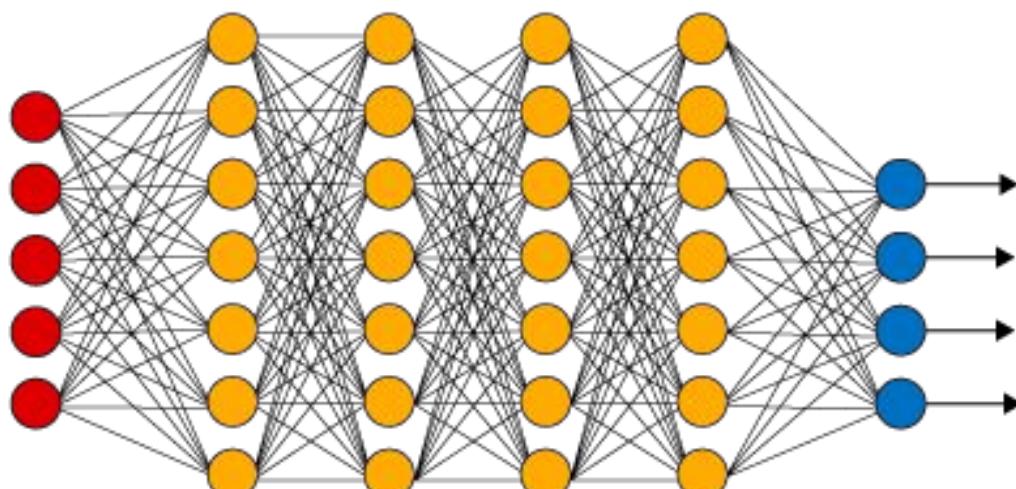


● Input Layer

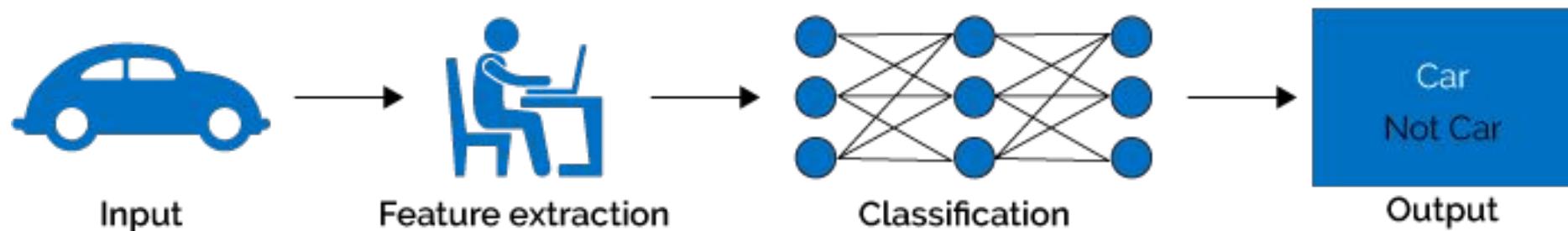
● Hidden Layer

● Output Layer

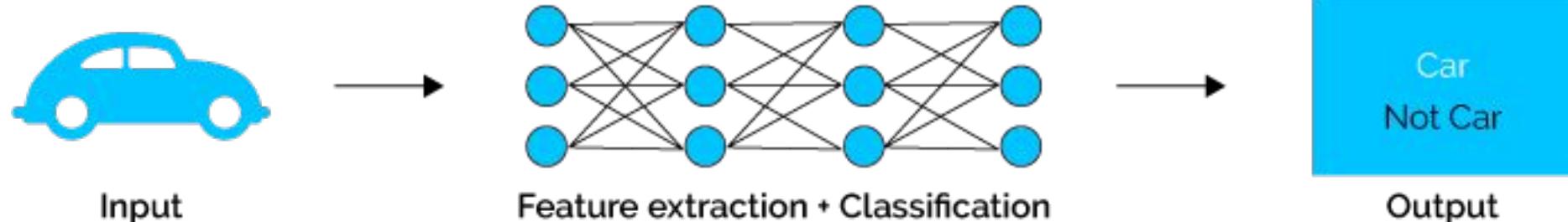
Deep Learning Neural Network

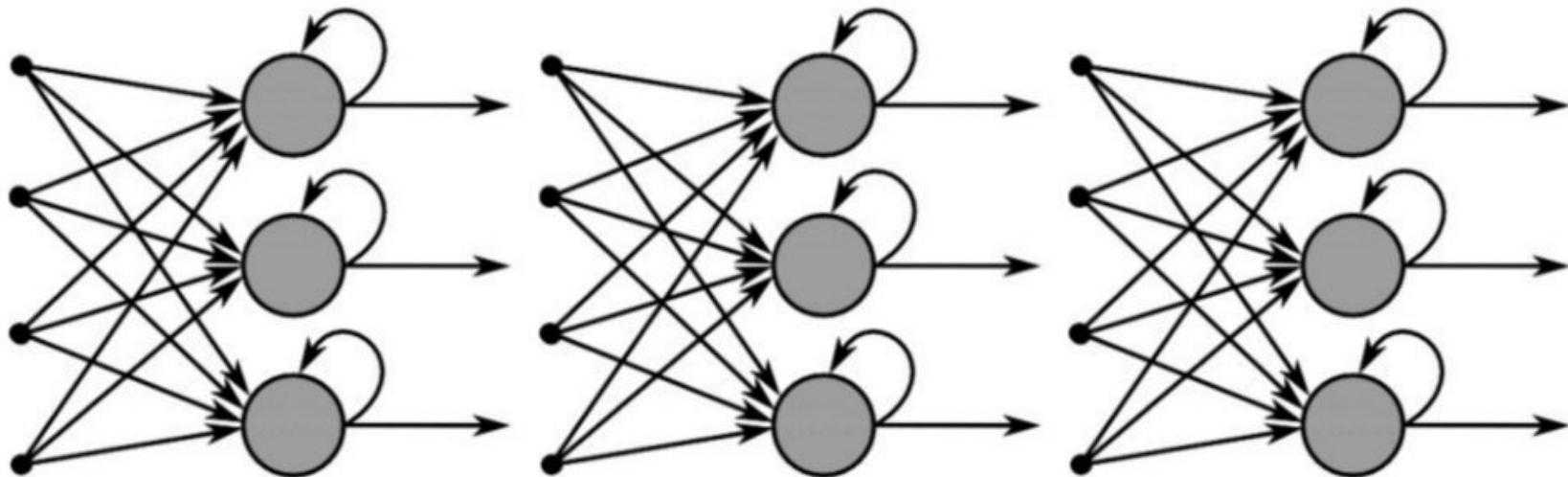


Machine Learning



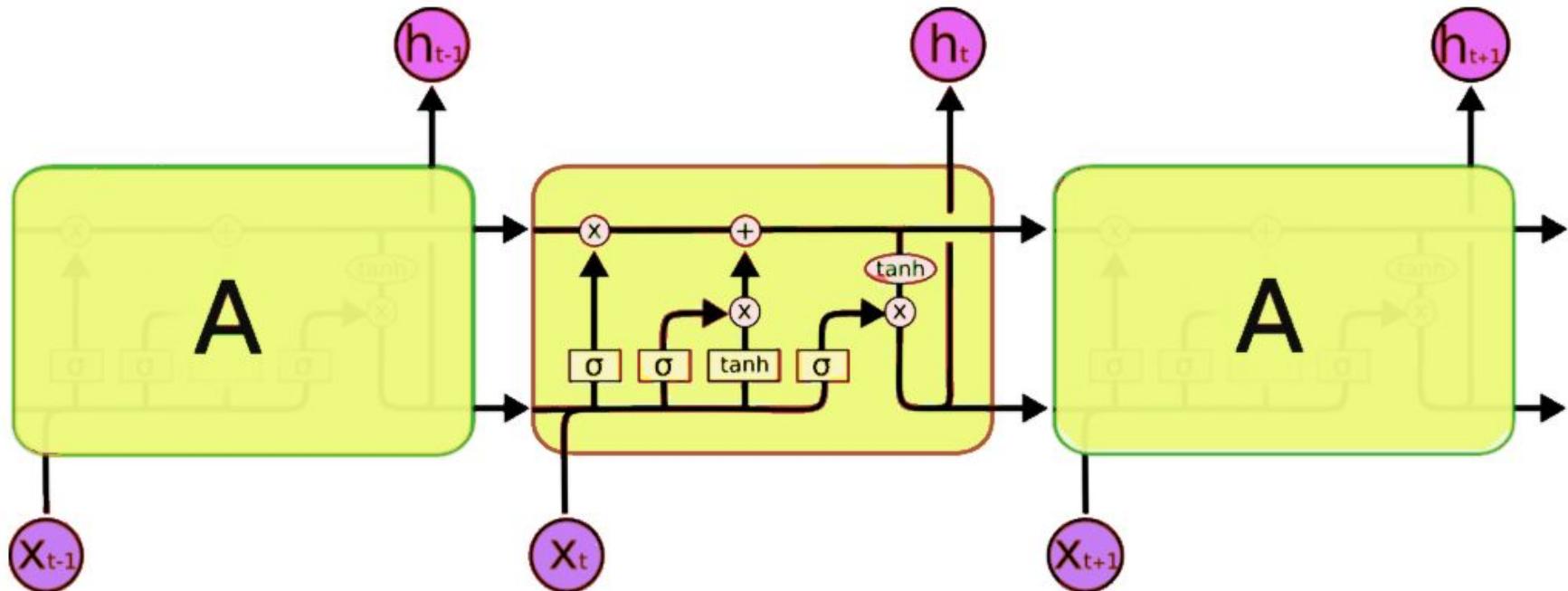
Deep Learning





Recurrent Neural Network

Long Short-Term Memory ANN (LSTM ANN)

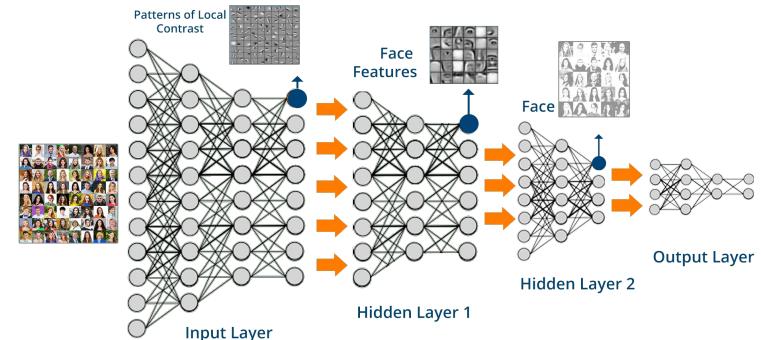
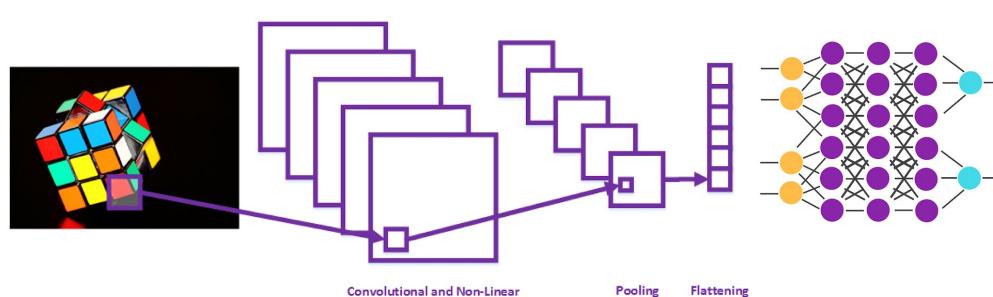
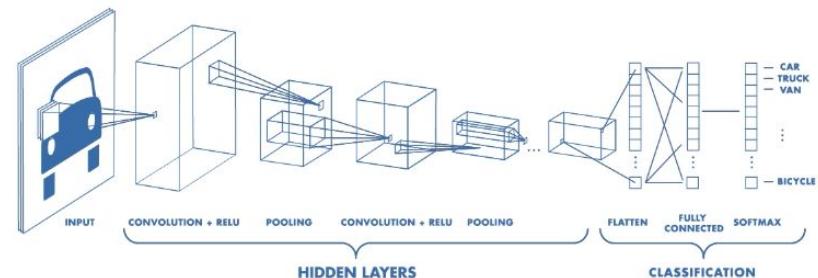
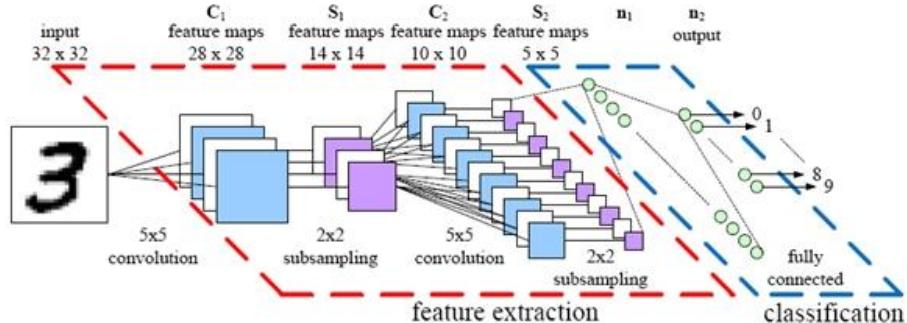


→ Multiple recurrent ANNs
→ memory (memory > 1)



DATAVORA

Convolutional Neural Network (CNN)



-> for images



JUST DANCE® 2018





Gå med



JAZZY



CRAZY



Gå med

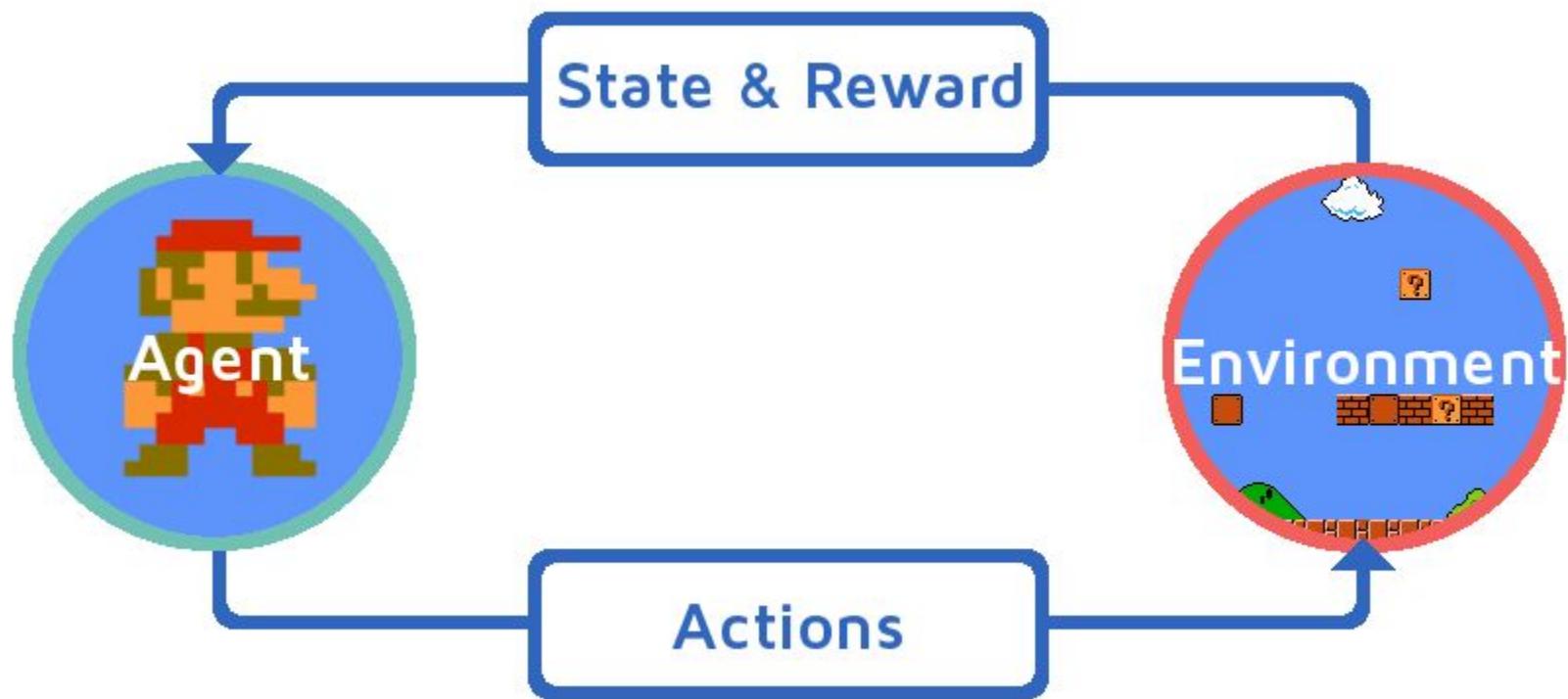
Ställ dig på plats för att välja dansare



Tillbaka



Reinforcement Learning

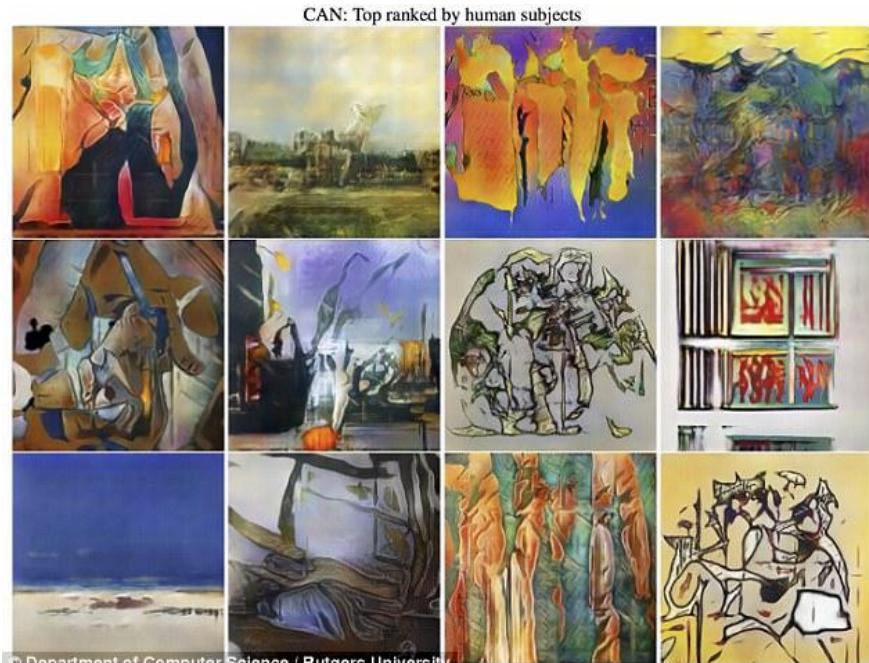
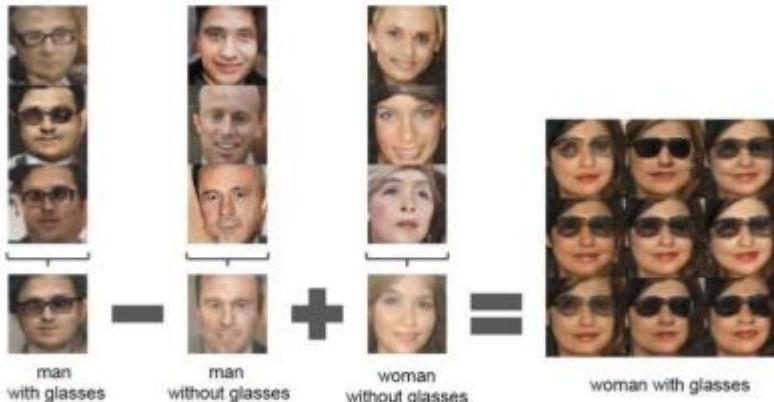




Generative Adversarial Networks (GANS)

DCGAN – Vector Arithmetic

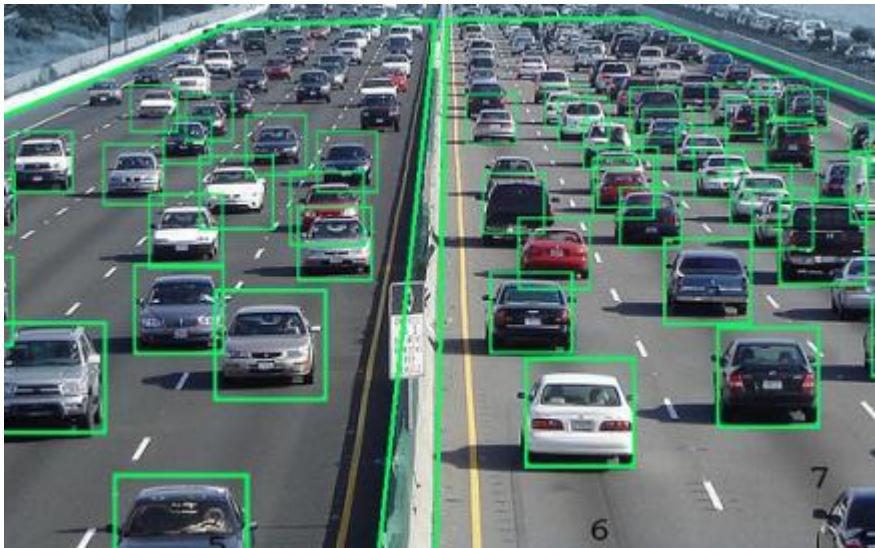
Deep Convolutional GAN – Alec Radford et al. (2016)



BREAK

Next: Applications, resources and conclusion

Computer Vision (CV)

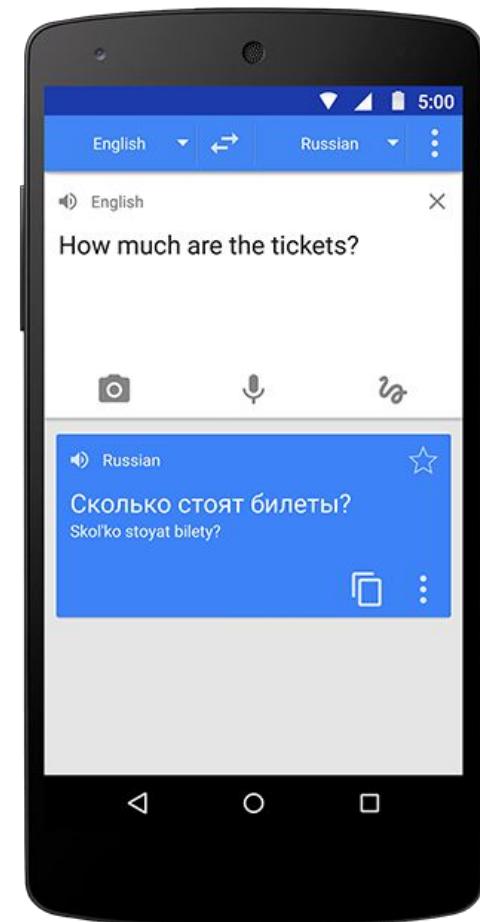
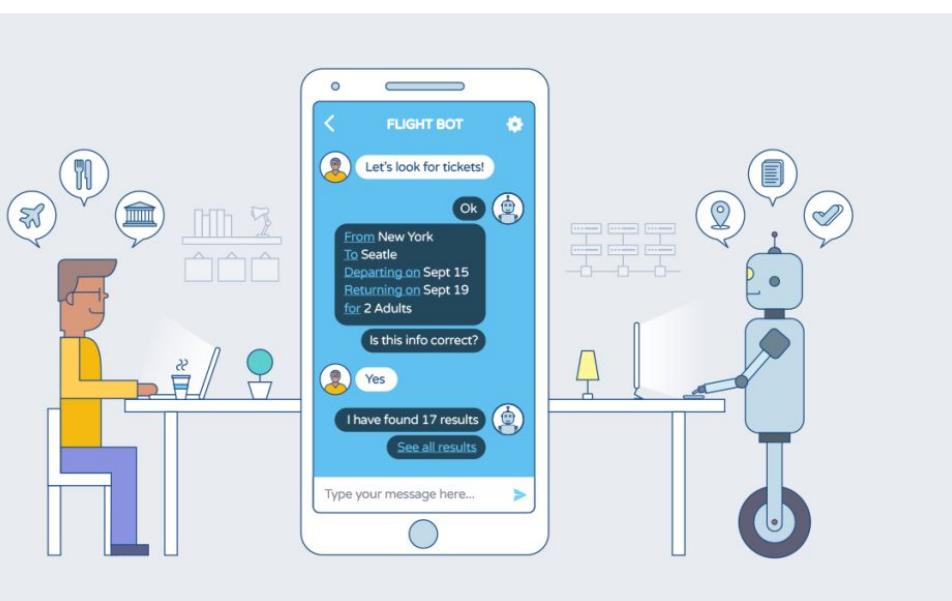


6



120

Natural Language Processing (NLP)



Recommender Systems



NETFLIX

facebook



Spotify®

Finance : bank, fintech, stocks

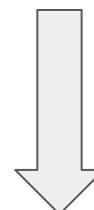
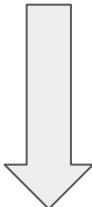
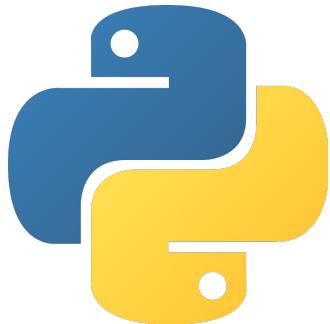
Medicine: disease detection, tumor finding, cancer prediction

Retail: association, CRM,

Military: friend/enemy detection, airspace awareness

-
-
-
-

Data Science Technologies



Resources - courses

Microsoft Professional Program for Data Science



DataCamp



deeplearning.ai

Resources - videos



Machine Learning Recipes

Julian Kercsik

Hello World - Machine Learning Recip

Visualizing a Decision Tree - Machine

[VIEW FULL PLAYLIST \(16 VIDEOS\)](#)



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Luis Serrano

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Augmented Startups

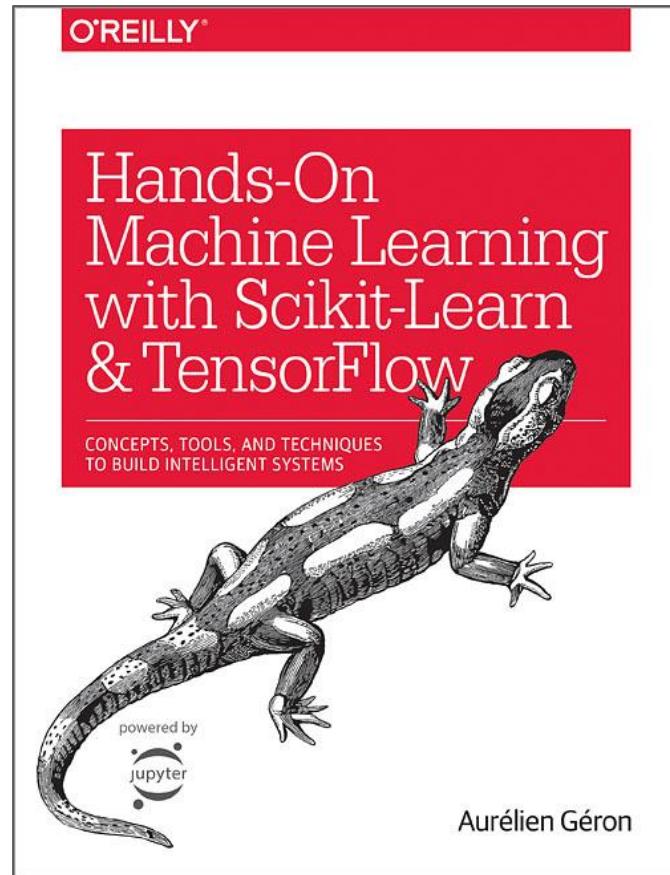
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Resources - books



kaggle

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144



Students Performance in Exams

Marks secured by the students in various subjects
SPScientist updated a month ago (Version 1)

eda
data visuali...
● OtherCSV
7.9 KB↳ 77
2
28k

422



Black Friday

A study of sales through consumer behaviours
Mehdi Dagdoug updated 5 months ago (Version 1)

business
regression ...
● CCOCSV
5.4 MB↳ 69
8
117k

Competitions

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18 Active Competitions



TWO SIGMA

Two Sigma: Using News to Predict Stock Movements

Use news analytics to predict stock price performance

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\$100,000
2,353 teams

NFL Punt Analytics Competition

Analyze NFL game data and suggest rules to improve player safety during punt plays
Analytics · 24 days to go · health, american football, sports, safety

\$80,000

128

“USING DATA TO ANSWER QUESTIONS”

- Some Google Engineer

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