INTRO TO AI & MACHINE LEARNING

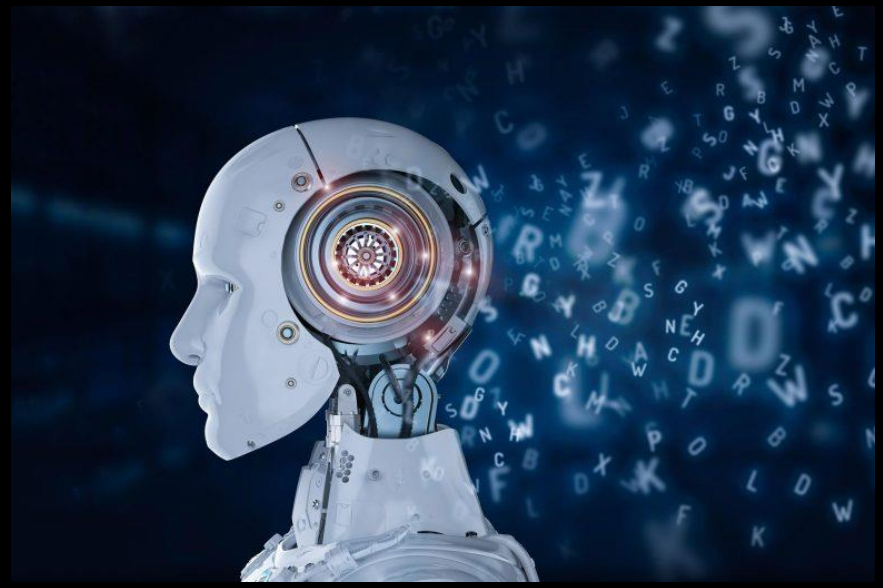
SJU ACM
Student Chapter

Women In Stem SJU

WHAT IS MACHINE LEARNING?

- In simplest terms, ML refers to the methods that allow computers to find patterns in data

- By finding patterns in data, ML can be used to form **predictions** or **recommendations**



IMPORTANCE OF DATA

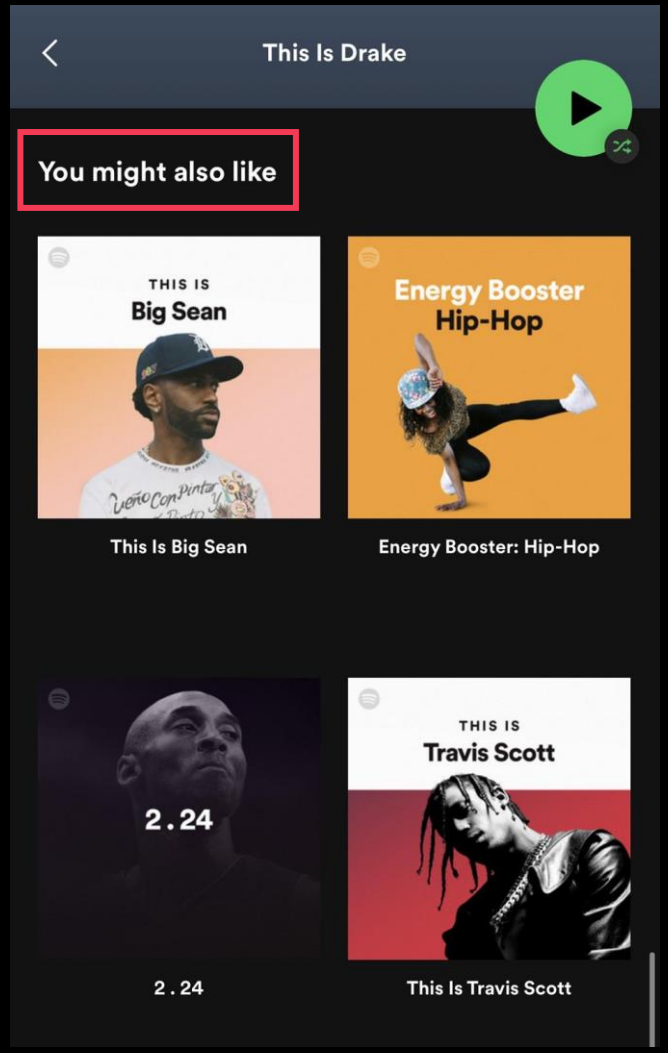
- Companies look to capture as many data points on their users as possible – **this data is extremely valuable**

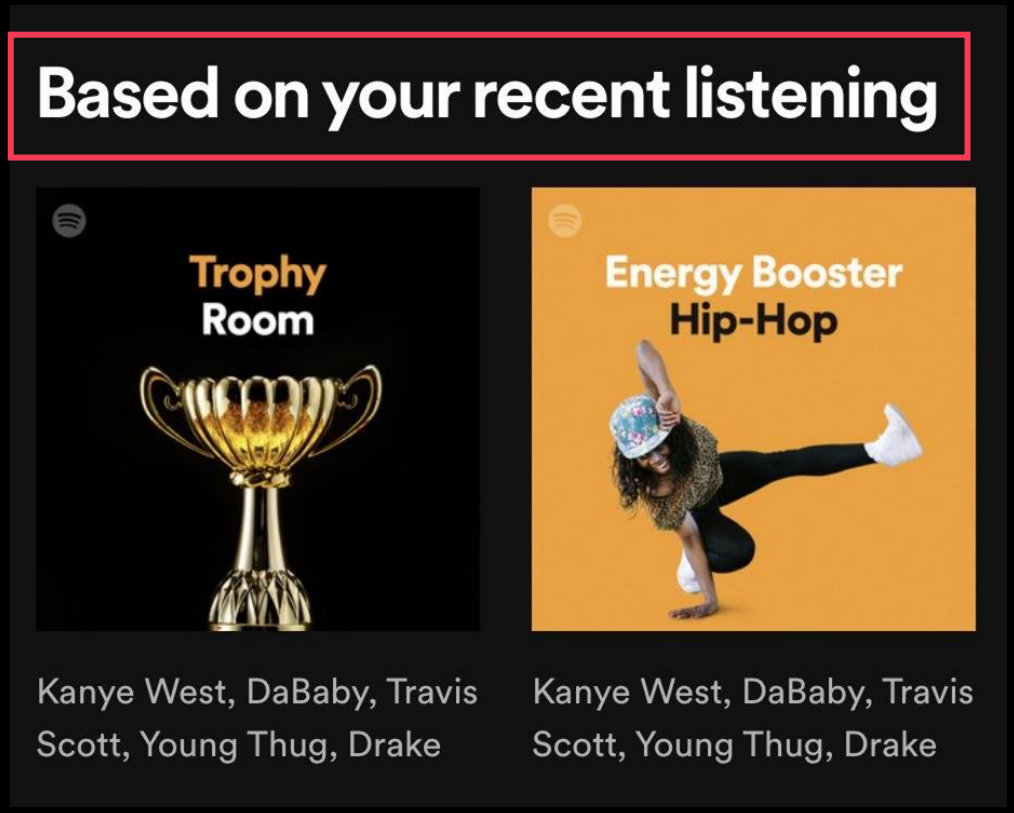
- Companies like Google, Facebook, and Apple have so much of our personal data that they understand us better than we do

MACHINE LEARNING IS EVERYWHERE!

- Most common applications of ML:
  - Instagram Home & Explore Page
  - TikTok For You Page
  - Snapchat Filters
  - Amazon Product Suggestions
  - LinkedIn Jobs & Connections
  - Spotify Music Recommendations
  - YouTube Video Recommendations

SPOTIFY RECOMMENDATIONS





SPOTIFY RECOMMENDATIONS

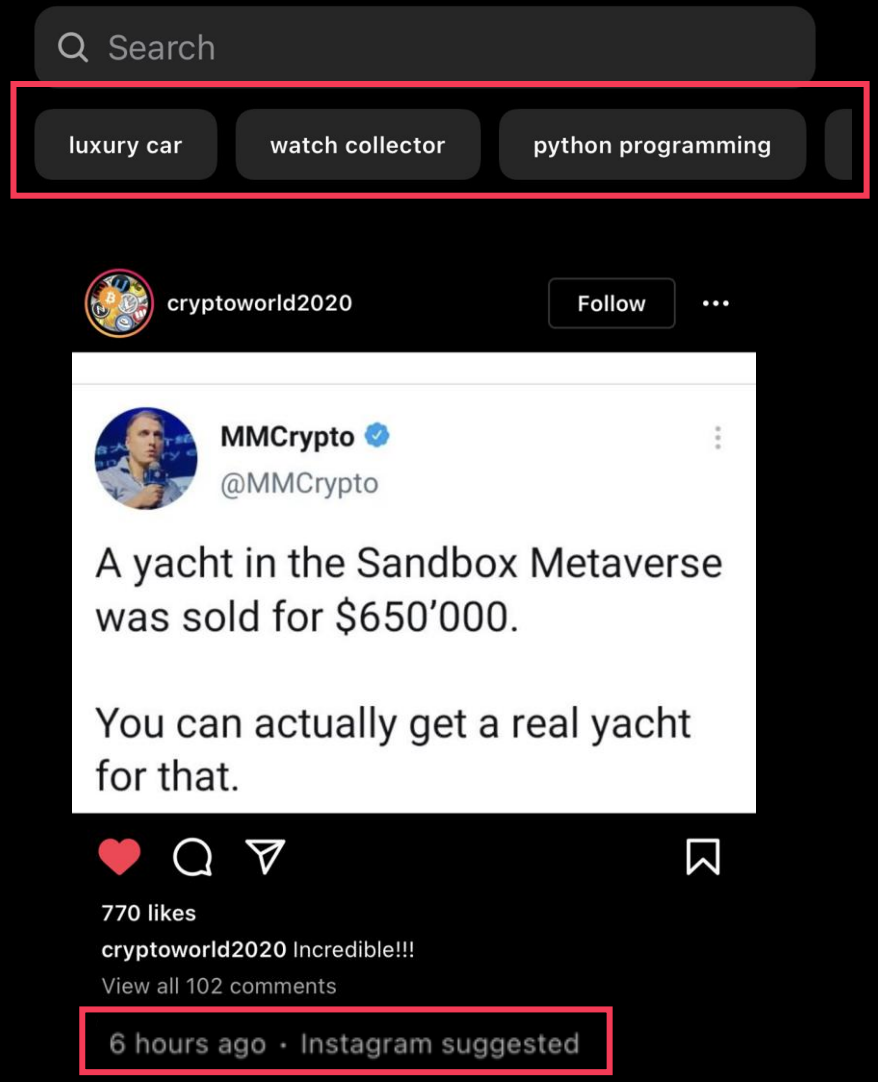
How do we use ML?

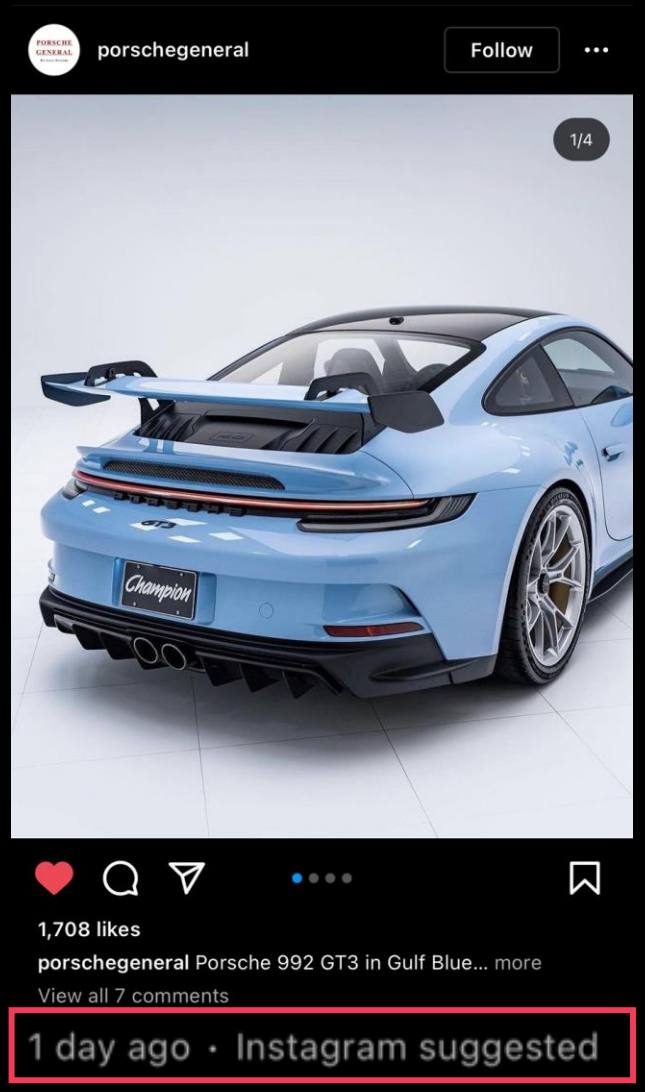
It all starts with data. At the most fundamental level, all sorts of user info — playlists, listening history, interactions with Spotify's UI, etc. — are fed into our ML models, while keeping trust and responsibility top of mind. Every day, nearly half a trillion events are processed, and the more info our models gather, the smarter they become about making associations between different artists, songs, podcasts, and playlists.

Read about how Spotify uses ML here

INSTAGRAM EXPLORE PAGE

Instagram knows exactly what my interests are!





INSTAGRAM EXPLORE PAGE

Instagram explains how it uses AI to choose content for your Explore tab

A peek behind the algorithmic scenes

By James Vincent | Nov 25, 2019, 10:00am EST

To make its recommendations, the Explore system begins by looking at “seed accounts,” which are accounts that users have interacted with in the past by liking or saving their content. It identifies accounts similar to these, and from them, it selects 500 pieces of content. These candidates are filtered to remove spam, misinformation, and “likely policy-violating content,” and the remaining posts are ranked based on how likely a user is to interact with each one. Finally, the top 25 posts are sent to the first page of the user’s Explore tab.

Read how Instagram uses ML here

TIKTOK

How TikTok's algorithm works

TikTok's algorithm fuels the app's recommendation system that determines which videos will appear on the For You page. Each person's feed is unique: TikTok says factors taken into account include videos you have liked or shared and comments you've made; video data such as hashtags and captions; and your device and account settings.

TikTok uses machine learning based techniques to understand what you view and why. The goal is to keep you on the platform for as long as possible and collect more data about what you've watched. "Every time you use the platform, the algorithm is updated with new data so it can understand you more precisely," says Jake Moore, cybersecurity specialist at security company ESET.

Read more about TikTok here

TIKTOK

How it works: TikTok's algorithm uses machine learning to determine what content a user is most likely to engage with and serve them more of it, by finding videos that are similar or that are liked by people with similar user preferences.

- **When users open TikTok for the first time,** they are shown 8 popular videos featuring different trends, music, and topics. After that, the algorithm will continue to serve the user new iterations of 8 videos based on which videos the user engages with and what the user does.

- **The algorithm identifies similar videos** to those that have engaged a user based on video information, which could include details like captions, hashtags or sounds. Recommendations also take into account user device and account settings, which include data like language preference, country setting, and device type.

- **Once TikTok collects enough data about the user,** the app is able to map a user's preferences in relation to similar users and group them into "clusters." Simultaneously, it also groups videos into "clusters" based on similar themes, like "basketball" or "bunnies."

- **Using machine learning,** the algorithm serves videos to users based on their proximity to other clusters of users and content that they like.

- **TikTok's logic aims** to avoid redundancies that could bore the user, like seeing multiple videos with the same music or from the same creator.

Read more about TikTok's ML algorithm here

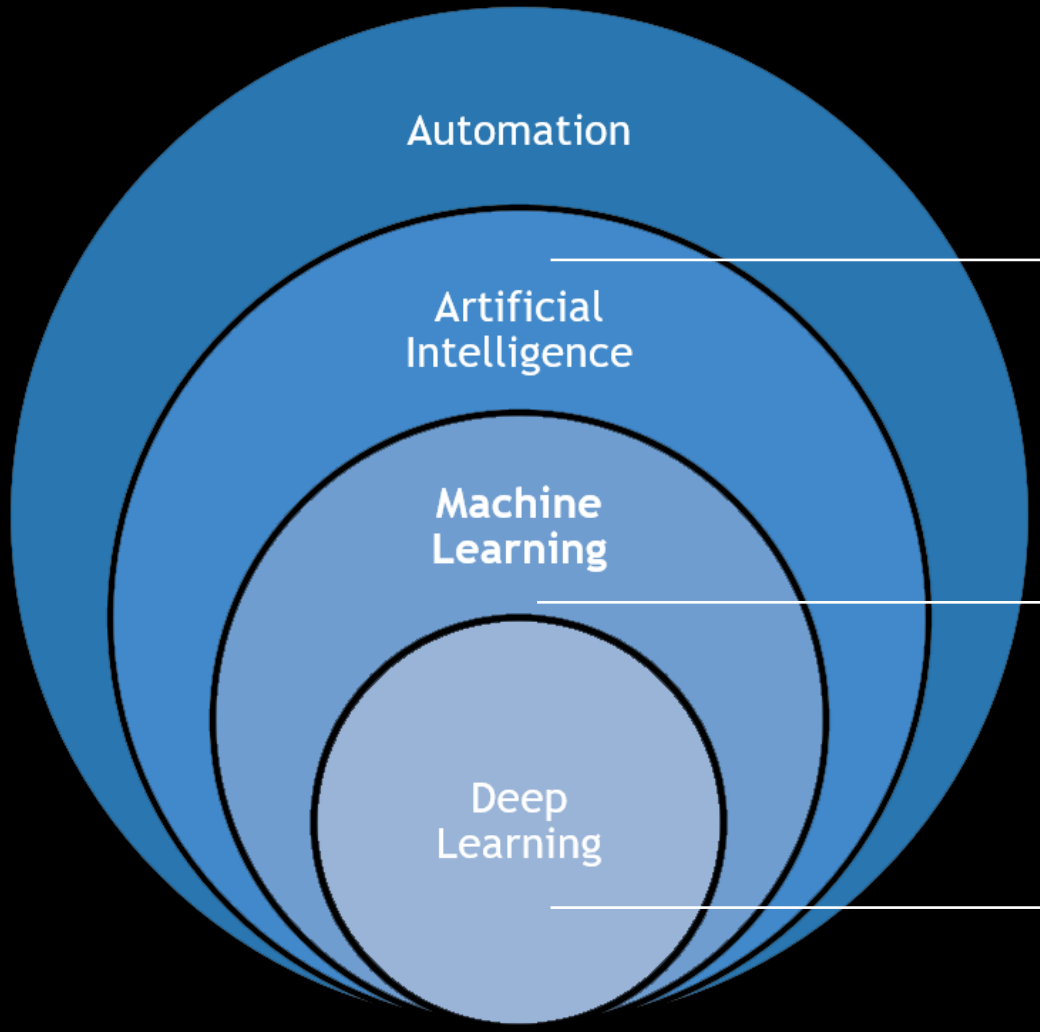
TIKTOK

What TikTok knows about you

TikTok can gather information when you arrive on the site even if you aren't signed up, via cookies and other trackers. Once you've created an account, the social network collects data about your activities and preferences based on the videos you watch.

TikTok knows the device you are using, your location, IP address, search history, the content of your messages, what you're viewing and for how long. It also collects device identifiers to track your interactions with advertisers. TikTok "infers" factors such as your age range, gender and interests based on the information it has about you. In the US, TikTok can collect biometric information including face and voiceprints.

OVERVIEW OF AI & ML



Imitating the intelligence or behavior of humans in computers

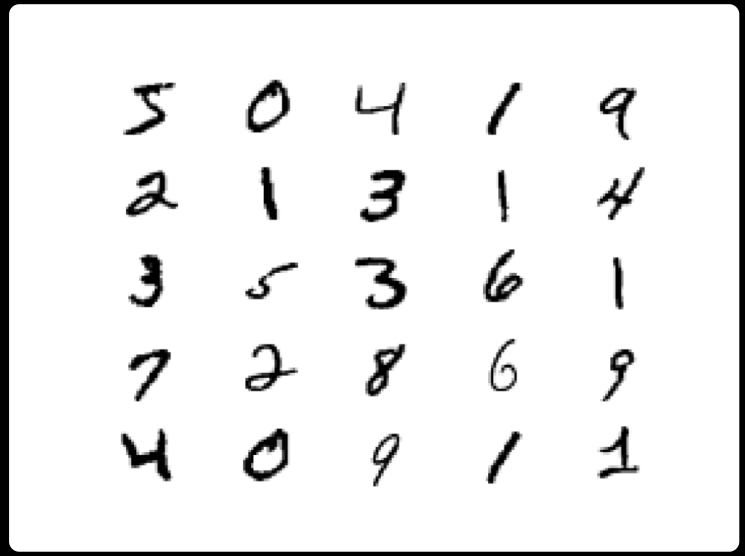
Algorithms that learn to find patterns in data without being explicitly programmed to do so

Technique to perform Machine Learning, inspired by the human brain's network of neurons

HOW DO MACHINES LEARN?

- Humans and computers learn in a similar fashion – through experience

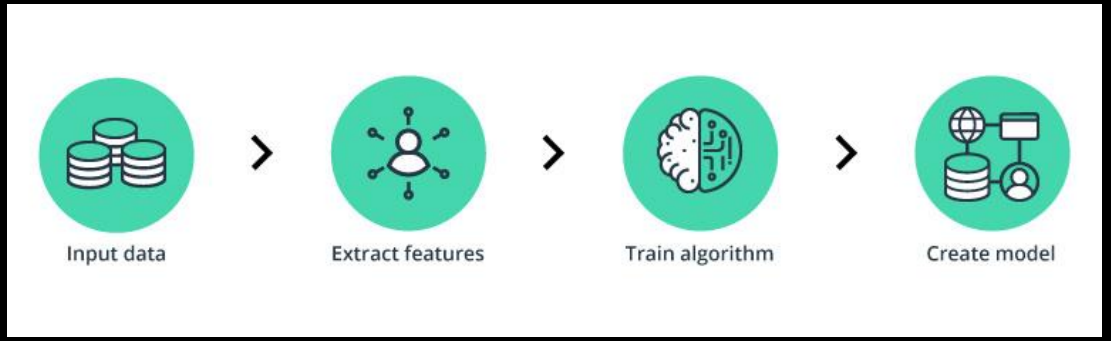
- Computers require vast amounts of data to be able to find trends and patterns



HOW DO MACHINES LEARN?

- Computers learn by being trained, by being fed data and being told what it is

- Computers utilize statistical techniques to find patterns in data that would be impossible to find by hand



UNDERSTANDING ML

- Suppose you had to write a computer program where given an image, you have to determine whether it is of a cat or a dog. What would you do?

- You would have to start by defining a set of **rules** that specify which attributes are unique to cats and dogs

UNDERSTANDING ML

- How would your rules work for images where the full body of the animal is not shown? Or if there is another object in the image?

- For every rule you could make, there will always be images to bypass those rules because you did not account for something

UNDERSTANDING ML

- By feeding a machine learning algorithm thousands of images of cats and dogs, **it will learn the rules itself** and be able to classify new images with very high accuracy.

Sample of cats & dogs images from Kaggle Dataset

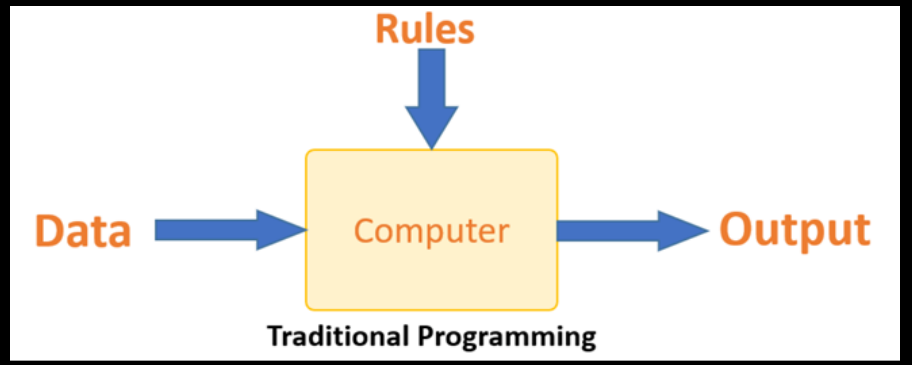
This is a common project in Computer Vision, we held a meeting on this topic last year, check out the recording here

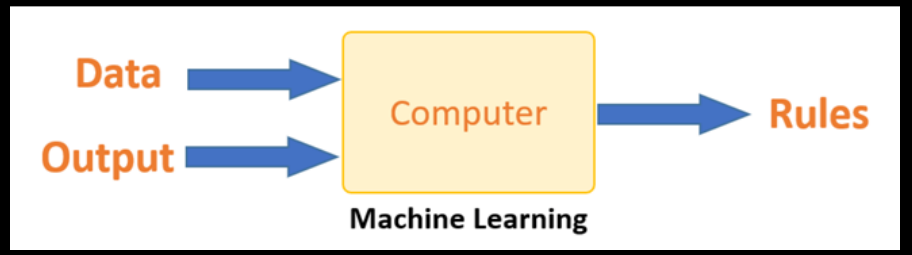
UNDERSTANDING ML

- In traditional programming, a developer manually writes all the rules for the data.

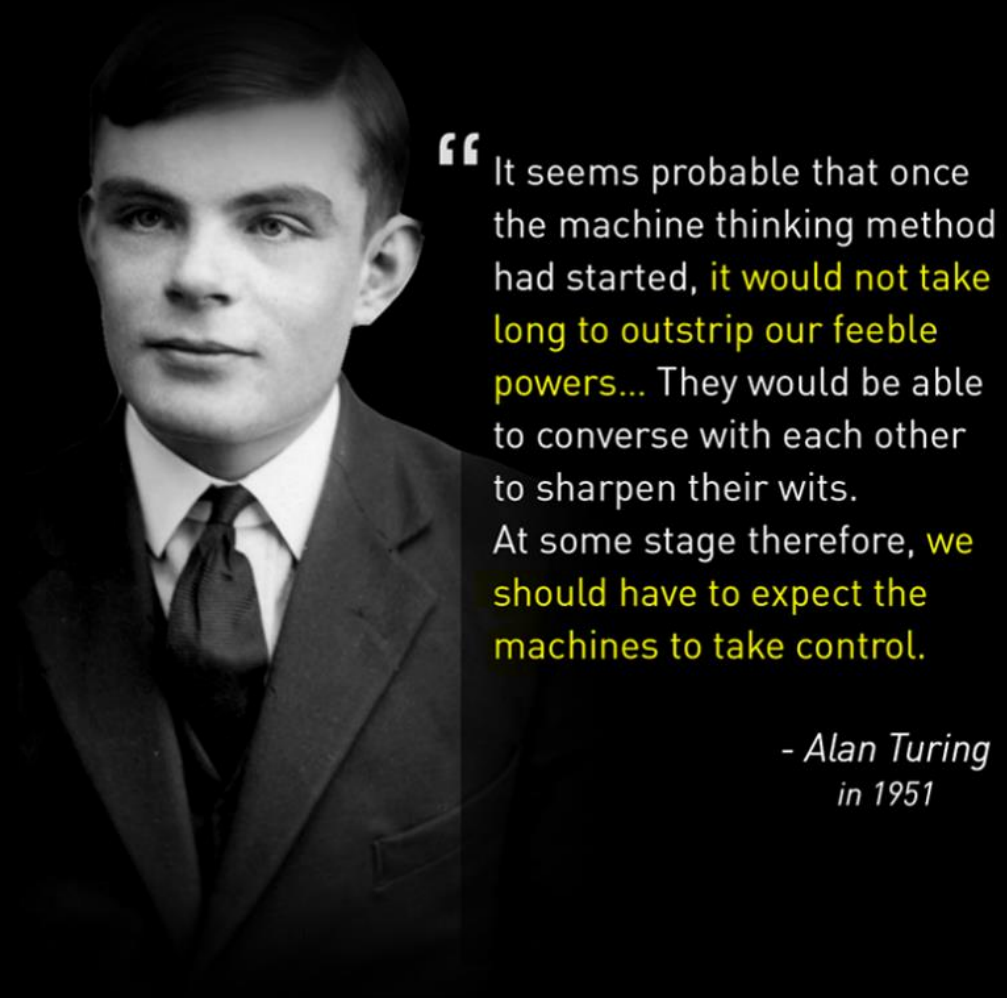
- In machine learning, the data and output are fed to the computer so it can be trained

- The computer learns how the data and output are correlated and generates rules based on those correlations





WILL MACHINES TAKE OVER?

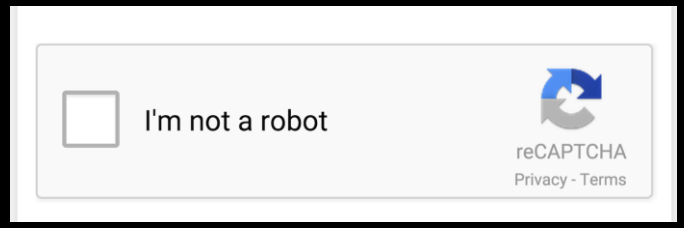


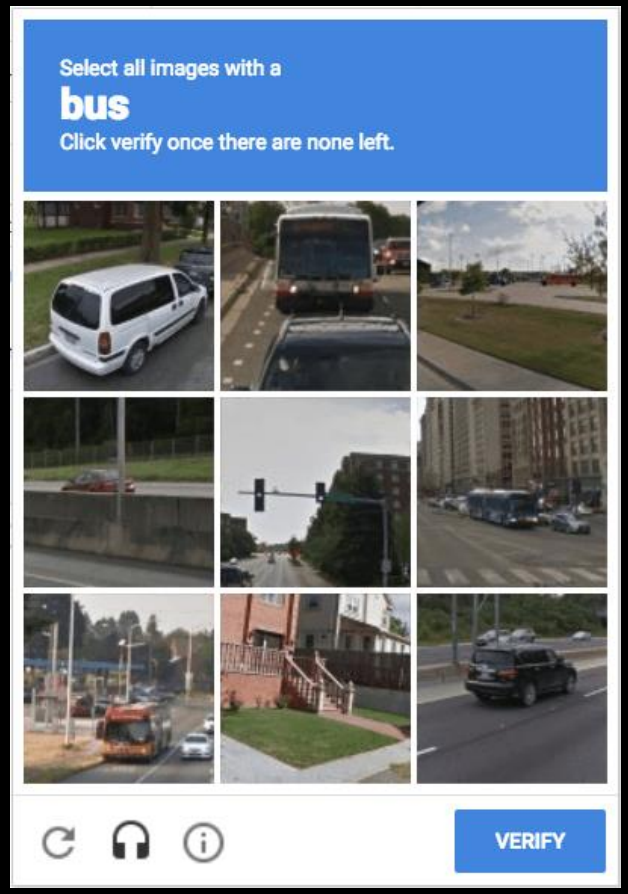
For context, Turing conceived the idea of the modern computer in 1936 - known as the Turing Machine

Turing Machines laid the groundwork for the creation of Computer Science and lead to the creation of all modern computational devices!

CAPTCHA

Completely
Automated
Public
Turing Test to Tell
Computers and
Humans
Apart





Google uses CAPTCHA to train ML models for their self driving cars! Read more here

ONTO THE LAB!

How is breast cancer traditionally diagnosed?

- Breast ultrasound
- Diagnostic mammogram
- Breast magnetic resonance imaging (MRI)
- Biopsy

What tests are traditionally used to assign stages to breast cancer?

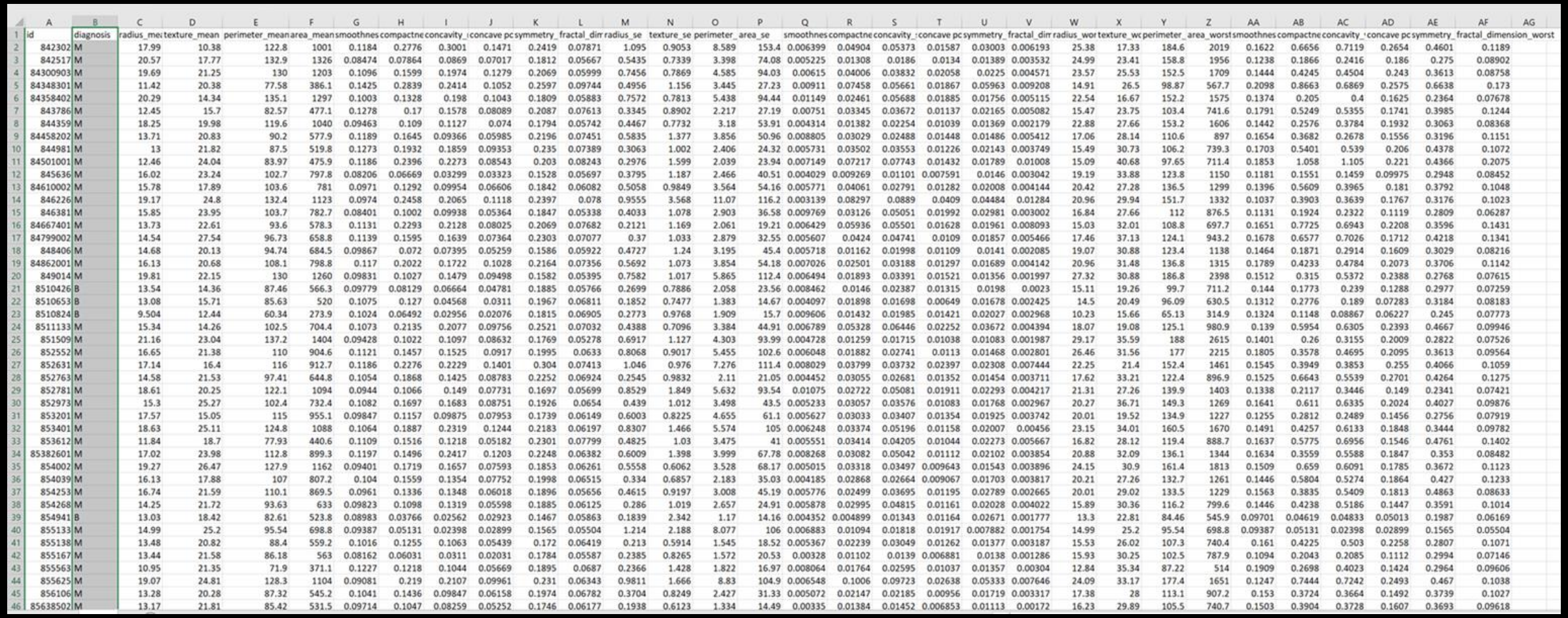
- Blood tests (complete blood count)
- Mammograms of the other breast to look for indications of cancer
- Breast MRI
- CT scans
- PET scans

Breast Cancer Statistics Worldwide

- About 1 in 18 (13% of the population) women will develop breast cancer.
- Recent 2020 studies have shown that more than 2.3 million women worldwide were diagnosed with a fatality rate of 685,000 (29.7%)
- As of the end of 2020 7.8 million women alive were diagnosed with breast cancer in the past 5 years, proving it to be the world's most prevalent cancer.
- Every 14 seconds a woman is diagnosed with breast cancer
- 5 year survival rate: 90%, 10 year survival rate: 84%,

  5 year survival rate(invasive found only in breast): 99%

This is a real breast cancer diagnostic data set



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	id	diagnosis	radius_mea	texture_mean	perimeter_mean	area_mean	smoothnes	compactne	concavity_	concave pc	symmetry_	fractal_dim	radius_se	texture_se	perimeter_	area_se	smoothnes	compactne	concavity_	concave pc	symmetry_	fractal_dim	radius_wor	texture_wo	perimeter_	area_worst	smoothnes	compactne	concavity_	concave pc	symmetry_	fractal_dimension_worst	
2	842302	M	17.99	10.38	122.8	1001	0.1184	0.2776	0.3001	0.1471	0.2419	0.07871	1.095	0.9053	8.589	153.4	0.006399	0.04904	0.05373	0.01587	0.03003	0.006193	25.38	17.33	184.6	2019	0.1622	0.6656	0.7119	0.2654	0.4601	0.1189	
3	842517	M	20.57	17.77	132.9	1326	0.08474	0.07864	0.0869	0.07017	0.1812	0.05667	0.5435	0.7339	3.398	74.08	0.005225	0.01308	0.0186	0.0134	0.01389	0.003532	24.99	23.41	158.8	1956	0.1238	0.1866	0.2416	0.186	0.275	0.08902	
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5	84348301	M	11.42	20.38	77.58	386.1	0.1425	0.2839	0.2414	0.1052	0.2597	0.09744	0.4956	1.156	3.445	27.23	0.00911	0.07458	0.05661	0.01867	0.05963	0.009208	14.91	26.5	98.87	567.7	0.2098	0.8663	0.6869	0.2575	0.6638	0.173	
6	84358402	M	20.29	14.34	135.1	1297	0.1003	0.1328	0.198	0.1043	0.1809	0.05883	0.7572	0.7813	5.438	94.44	0.01149	0.02461	0.05688	0.01885	0.01756	0.005115	22.54	16.67	152.2	1575	0.1374	0.205	0.4	0.1625	0.2364	0.07678	
7	843786	M	12.45	15.7	82.57	477.1	0.1278	0.17	0.1578	0.08089	0.2087	0.07613	0.3345	0.8902	2.217	27.19	0.00751	0.03345	0.03672	0.01137	0.02165	0.005082	15.47	23.75	103.4	741.6	0.1791	0.5249	0.5355	0.1741	0.3985	0.1244	
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9	84458202	M	13.71	20.83	90.2	577.9	0.1189	0.1645	0.09366	0.05985	0.2196	0.07451	0.5835	1.377	3.856	50.96	0.008805	0.03029	0.02488	0.01448	0.01486	0.005412	17.06	28.14	110.6	897	0.1654	0.3682	0.2678	0.1556	0.3196	0.1151	
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28	852763	M	14.58	21.53	97.41	644.8	0.1054	0.1868	0.1425	0.08783	0.2252	0.06924	0.2545	0.9832	2.11	21.05	0.004452	0.03055	0.02681	0.01352	0.01454	0.003711	17.62	33.21	122.4	896.9	0.1525	0.6643	0.5539	0.2701	0.4264	0.1275	
29	852781	M	18.61	20.25	122.1	1094	0.0944	0.1066	0.149	0.07731	0.1697	0.05699	0.8529	1.849	5.632	93.54	0.01075	0.02722	0.05081	0.01911	0.02293	0.004217	21.31	27.26	139.9	1403	0.1338	0.2117	0.3446	0.149	0.2341	0.07421	
30	852973	M	15.3	25.27	102.4	732.4	0.1082	0.1697	0.1683	0.08751	0.1926	0.0654	0.439	1.012	3.498	43.5	0.005233	0.03057	0.03576	0.01083	0.01768	0.002967	20.27	36.71	149.3	1269	0.1641	0.611	0.6335	0.2024	0.4027	0.09876	
31	853201	M	17.57	15.05	115	955.1	0.09847	0.1157	0.09875	0.07953	0.1739	0.06149	0.6003	0.8225	4.655	61.1	0.005627	0.03033	0.03407	0.01354	0.01925	0.003742	20.01	19.52	134.9	1227	0.1255	0.2812	0.2489	0.1456	0.2756	0.07919	
32	853401	M	18.63	25.11	124.8	1088	0.1064	0.1887	0.2319	0.1244	0.2183	0.06197	0.8307	1.466	5.574	105	0.006248	0.03374	0.05196	0.01158	0.02007	0.00456	23.15	34.01	160.5	1670	0.1491	0.4257	0.6133	0.1848	0.3444	0.09782	
33	853612	M	11.84	18.7	77.93	440.6	0.1109	0.1516	0.1218	0.05182	0.2301	0.07799	0.4825	1.03	3.475	41	0.005551	0.03414	0.04205	0.01044	0.02273	0.005667	16.82	28.12	119.4	888.7	0.1637	0.5775	0.6956	0.1546	0.4761	0.1402	
34	85382601	M	17.02	23.98	112.8	899.3	0.1197	0.1496	0.2417	0.1203	0.2248	0.06382	0.6009	1.398	3.999	67.78	0.008268	0.03082	0.05042	0.01112	0.02102	0.003854	20.88	32.09	136.1	1344	0.1634	0.3559	0.5588	0.1847	0.353	0.08482	
35	854002	M	19.27	26.47	127.9	1162	0.09401	0.1719	0.1657	0.07593	0.1853	0.06261	0.5558	0.6062	3.528	68.17	0.005015	0.03318	0.03497	0.009643	0.01543	0.003896	24.15	30.9	161.4	1813	0.1509	0.659	0.6091	0.1785	0.3672	0.1123	
36	854039	M	16.13	17.88	107	807.2	0.104	0.1559	0.1354	0.07752	0.1998	0.06515	0.334	0.6857	2.183	35.03	0.004185	0.02868	0.02664	0.009067	0.01703	0.003817	20.21	27.26	132.7	1261	0.1446	0.5804	0.5274	0.1864	0.427	0.1233	
37	854253	M	16.74	21.59	110.1	869.5	0.0961	0.1336	0.1348	0.06018	0.1896	0.05656	0.4615	0.9197	3.008	45.19	0.005776	0.02499	0.03695	0.01195	0.02789	0.002665	20.01	29.02	133.5	1229	0.1563	0.3835	0.5409	0.1813	0.4863	0.08633	
38	854268	M	14.25	21.72	93.63	633	0.09823	0.1098	0.1319	0.05598	0.1885	0.06125	0.286	1.019	2.657	24.91	0.005878	0.02995	0.04815	0.01161	0.02028	0.004022	15.89	30.36	116.2	799.6	0.1446	0.4238	0.5186	0.1447	0.3591	0.1014	
39	854941	B	13.03	18.42	82.61	523.8	0.08983	0.03766	0.02562	0.02923	0.1467	0.05863	0.1839	2.342	1.17	14.16	0.004352	0.004899	0.01343	0.01164	0.02671	0.001777	13.3	22.81	84.46	545.9	0.09701	0.04619	0.04833	0.05013	0.1987	0.06169	
40	855133	M	14.99	25.2	95.54	698.8	0.09387	0.05131	0.02398	0.02899	0.1565	0.05504	1.214	2.188	8.077	106	0.006883	0.01094	0.01818	0.01917	0.007882	0.001754	14.99	25.2	95.54	698.8	0.09387	0.05131	0.02398	0.02899	0.1565	0.05504	
41	855138	M	13.48	20.82	88.4	559.2	0.1016	0.1255	0.1063	0.05439	0.172	0.06419	0.213	0.5914	1.545	18.52	0.005367	0.02239	0.03049	0.01262	0.01377	0.003187	15.53	26.02	107.3	740.4	0.161	0.4225	0.503	0.2258	0.2807	0.1071	
42	855167	M	13.44	21.58	86.18	563	0.08162	0.06031	0.0311	0.02031	0.1784	0.05587	0.2385	0.8265	1.572	20.53	0.00328	0.01102	0.0139	0.006881	0.0138	0.001286	15.93	30.25	102.5	787.9	0.1094	0.2043	0.2085	0.1112	0.2994	0.07146	
43	855563	M	10.95	21.35	71.9	371.1	0.1227	0.1218	0.1044	0.05669	0.1895	0.0687	0.2366	1.428	1.822	16.97	0.008064	0.01764	0.02595	0.01037	0.01357	0.00304	12.84	35.34	87.22	514	0.1909	0.2698	0.4023	0.1424	0.2964	0.09606	
44	855625	M	19.07	24.81	128.3	1104	0.09081	0.219	0.2107	0.09961	0.231	0.06343	0.9811	1.666	8.83	104.9	0.006548	0.1006	0.09723	0.02638	0.05333	0.007646	24.09	33.17	177.4	1651	0.1247	0.7444	0.7242	0.2493	0.467	0.1038	
45	856106	M	13.28	20.28	87.32	545.2	0.1041	0.1436	0.09847	0.06158	0.1974	0.06782	0.3704	0.8249	2.427	31.33	0.005072	0.02147	0.02185	0.00956	0.01719	0.003317	17.38	28	113.1	907.2	0.153	0.3724	0.3664	0.1492	0.3739	0.1027	
46	85638502	M	13.17	21.81	85.42	531.5	0.09714	0.1047	0.08259	0.05252	0.1746	0.06177	0.1938	0.6123	1.334	14.49	0.00335	0.01384	0.01452	0.006853	0.01113	0.00172	16.23	29.89	105.5	740.7	0.1503	0.3904	0.3728	0.1607	0.3693	0.09618	

How would you determine the factors that lead to the diagnosis being malignant or benign?

- A multitude of if statements?

Features

(Radius, Texture, Concavity, Area, Perimeter, Smoothness, Compactness, etc.)

Diagnosis:

Malignant or Benign

(Labels)

LAB INSTRUCTIONS

- Go to https://t.ly/PLwd

Check out the completed code here

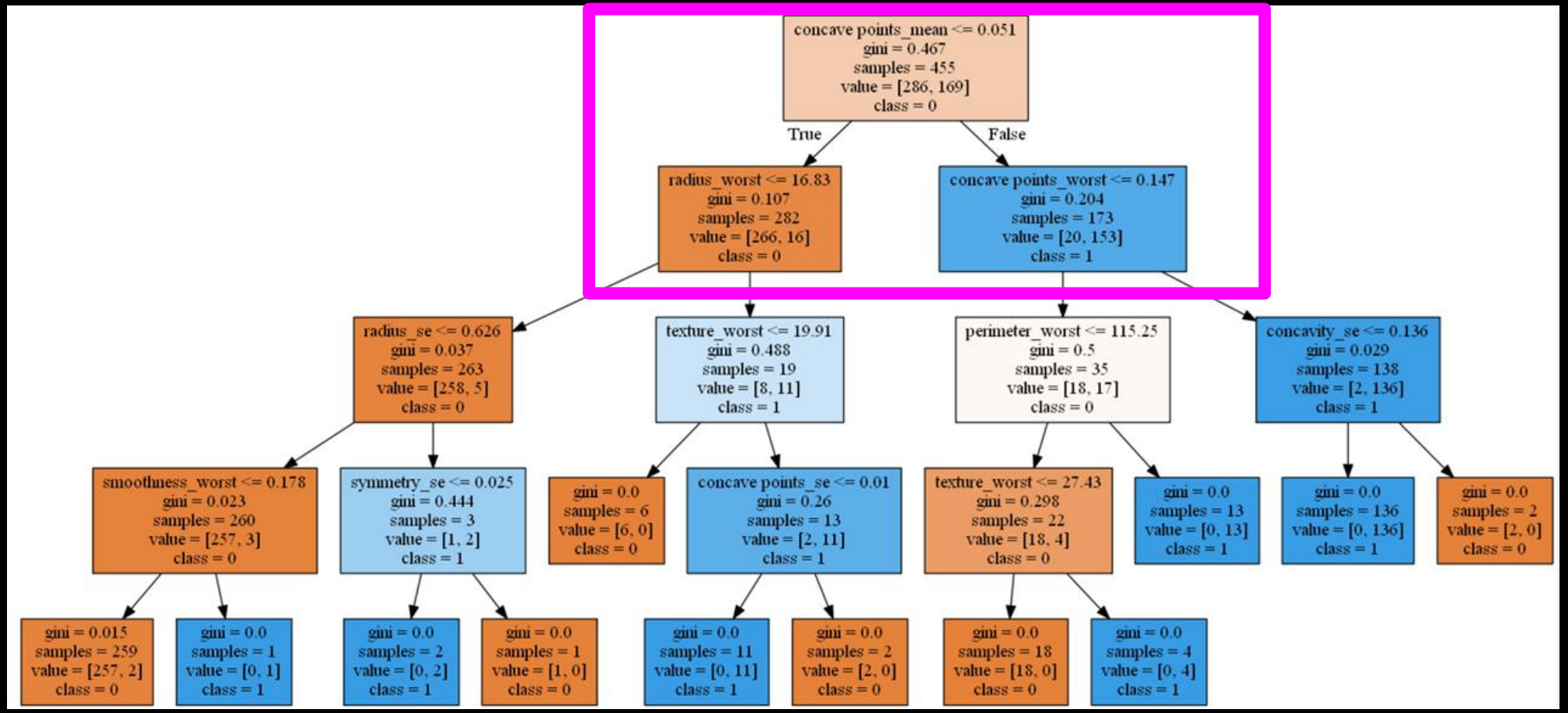
- Follow along on Google Colab
- Google Colab is a cloud platform where we can run **Python** code
    - Python is the most popular programming language for ML

DECISION TREE

Rules the Computer Learned from the Data

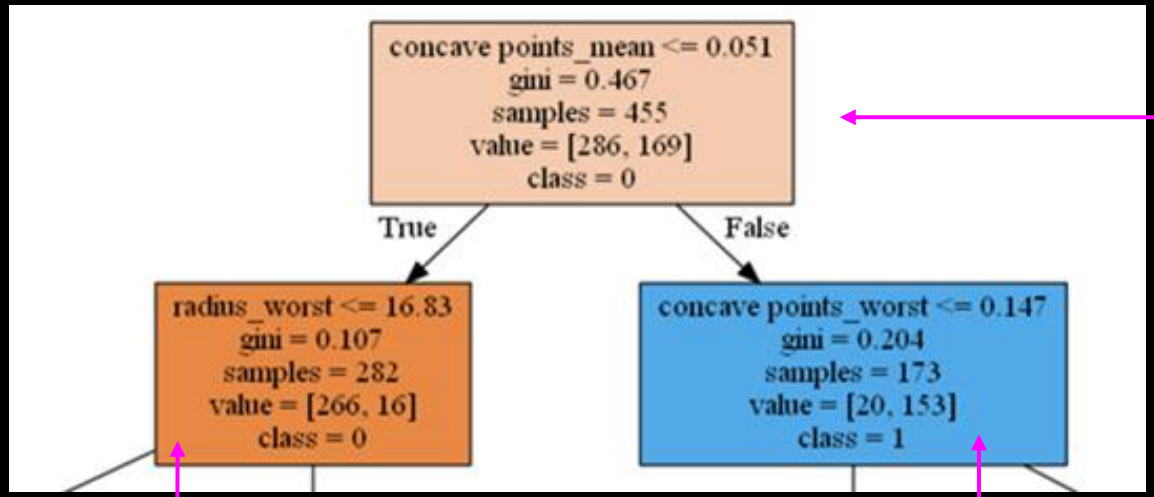
Orange: Benign

Blue: Malignant



DECISION TREE

This would've been unfeasible to find manually without the use of ML!



Just from this one metric, we can get a very good prediction of the diagnosis!

Out of 282 samples that have a concave points_mean less than 0.051, 266 of them (94%) have a benign diagnosis!

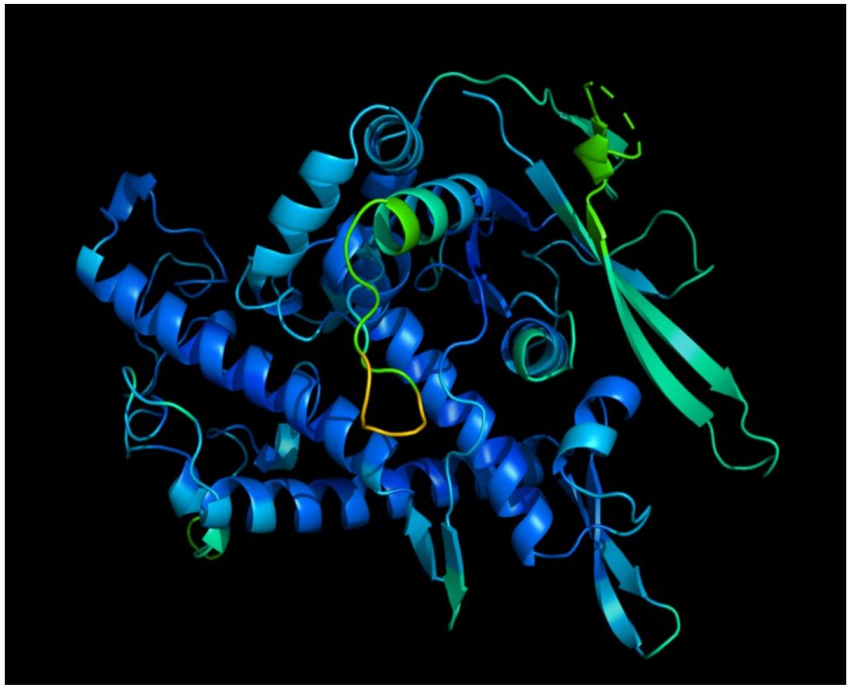
Out of 173 samples that have a concave points_mean greater than 0.051, 153 of them (88%) have a malignant diagnosis!

AI IS REVOLUTIONIZING THE MEDICAL INDUSTRY

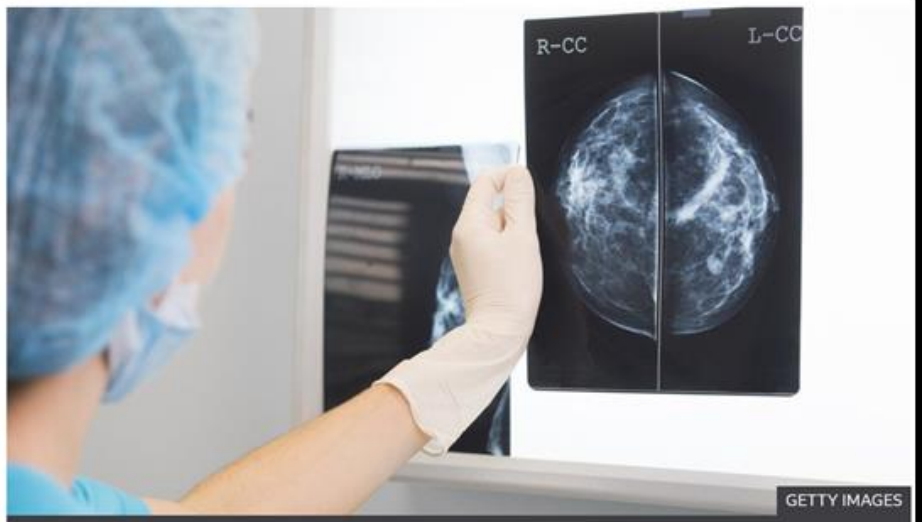
NEWS · 30 NOVEMBER 2020

‘It will change everything’: DeepMind’s AI makes gigantic leap in solving protein structures

Google’s deep-learning program for determining the 3D shapes of proteins stands to transform biology, say scientists.



AI 'outperforms' doctors diagnosing breast cancer



AI was as accurate as two doctors working together

An international team, including researchers from **Google Health** and **Imperial College London**, designed and trained a computer model on X-ray images from nearly 29,000 women.

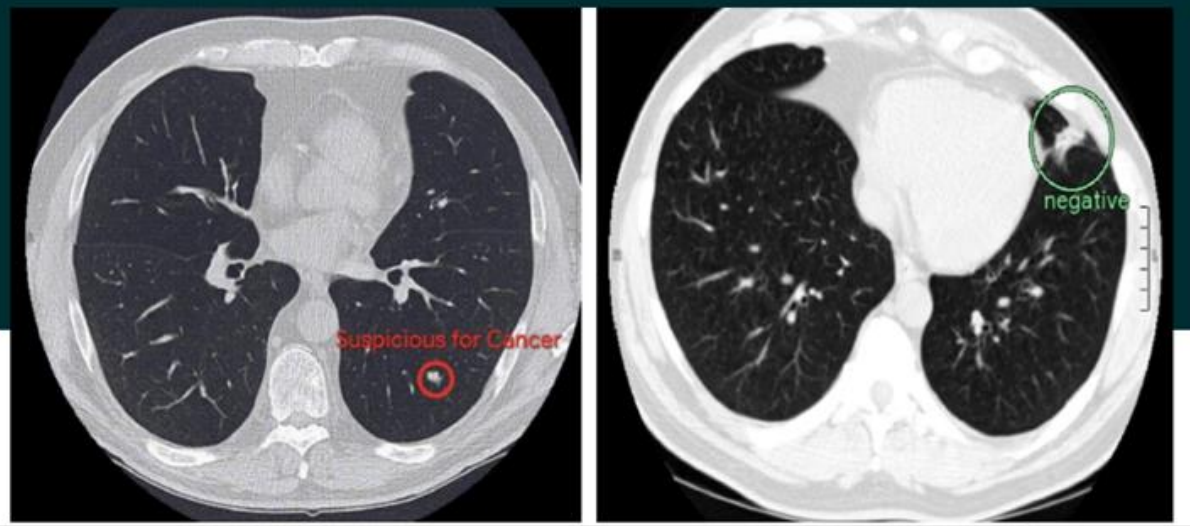
The algorithm **outperformed six radiologists** in reading mammograms.

AI was still as good as two doctors working together.

Unlike humans, AI is tireless. Experts say it could improve detection.

Google's lung cancer detection AI outperforms 6 human radiologists

Khari Johnson @kharijohnson May 20, 2019 8:00 AM



Google AI researchers working with Northwestern Medicine created an AI model capable of detecting lung cancer from screening tests better than human radiologists with an average of eight years experience.

AUTOMATED COVID-19 DETECTION WITH ML

Check out the source code here

We taught
computers how to
learn,
Now computers are
helping us learn.

Additional Resources

- Stanford HAI: The Future of Artificial Intelligence in Medicine and Imaging
- How AI & Neuroscience Drive Each other Forwards
- How Machine Learning is Transforming Healthcare
- Google AI: Advancing Healthcare Research & AI in Medicine