Introduction to Artificial Intelligence

IBM Skills Build.

- AI records and Analyze things you do everydays
- Fewer eg:

  Alerts about oxygen levels on your smartwatch scanning your social media posts to get more info about it.

Three levels of AI predictions:

- Narrow
- Broad
- General

What is AI?

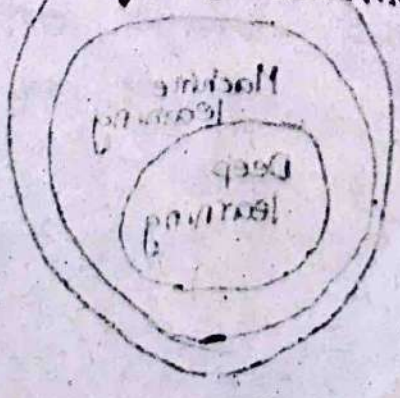
- It often plays an invisible role in everyday life, powering search engines, product recommendations and speech recognization system.

AI: refers to Ability of 'Machine' to learn patterns and make prediction.

AI adds value to human Judgement.

Computer science + Robust datasets (to enable problem solving) = Simplest form of AI.	

Robust dataset - data that is argued, convinced & verifyable.



Difference b/w AI and Augument Intelligence.?

Augumented Intelligence:

Modest goal of helping humans with tasks that are practically not possible.

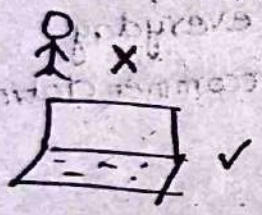
eg: reading 10,000 pages in an hour.

2nd form

Artifical Intelligence

↓

It basically replaces need for human



1st form

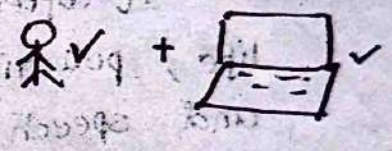
Human Intelligence

3rd form

Augument Intelligence

↓

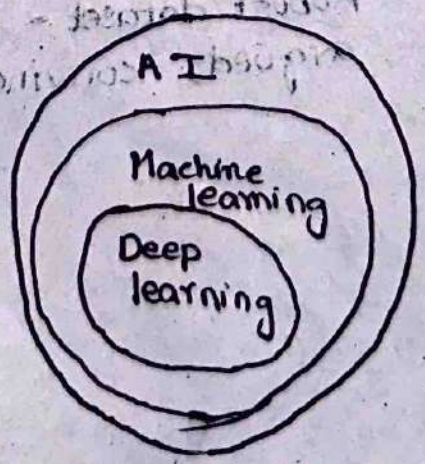
Machines & humans working together



Which intelligence is best? Ans: Both ✓

Machine	Humans
- Ingesting large amounts of data	- Generalizing information
- Repetetive tasks	- Very good at Creativity
- Accurate	- Presence of Emotional Intelligence

What does AI do?



eg: To seperate chicken, pork, beef you create a programming rule

AI : through AI we give some specific pattern of data to Machine & expect the output

ML : - to improve performance of machine
- the more data you provide for algorithm >> the better model gets
- Also minimizes errors.

eg: you define all shape, size, coulor, features to ensure machine is trained on numerous characteristics

Deep learning : It eliminate need for feature extraction
- Feature extraction : built into process without human impact
- Instead of unnessecary features like shape, size you provide deep learning model with dozens of meat pictures.

Analyze :
→ AI can take enormous amount of data. They can apply mathematical calculations in order to analyze data, sorting & organizing it.

Prediction :
→ AI can use their data analysis to make predictions

How AI uses data to make predictions :
Auto Spell Correct feature on mobile - which cannot be often correct but they are useful & can save your time.

More Ways that AI uses data to make predictions;

* Human language:
  - Online chatbots use Natural language processing (NLP) to analyze questions.

* Vision Recognization:
  - AI helps doctors to identify serious diseases based on unusual symptoms & early warning signs.

* Fraud Detection:
  - AI Analyze patterns & "predicts result of identity theft" when thousands of bank customers make credit card purchases.

→ AI can learn from examples & experience, recognize objects, understanding & respond to language & solves problems.

Evolution of AI:

Three levels of AI; (based on Ability to Analyze data & make prediction)

① Narrow AI :- 2010 - 2015
② Broad AI (Mostly used by Enterprise) : Today
③ General AI :- 2050 - beyond

Available

→ Maybe in future

① Narrow AI :

→ focussed on Addressing single task.

eg: planning your day

next purchase (Predicting)

→ It enables robust applications

eg: Using SIRI on iphone

Amazon recommendation engine

Autonomous Vehicles. (EV)

② Broad AI :

→ It is the midpoint b/w Narrow & General AI

→ These systems are versatile & can handle wider range of related tasks

→ Newer Broader AI can :

predict global weather

trade pandemics

help businesses predict future trends.

③ General AI :

→ Machines can perform any intellectual task that a human can

→ There is another level "Artificial superintelligence" (ASI)

ASI : could appear near the end of this century

Machines might become self - aware.

The Era of Tabulation :

"Dark Data" : Information can be very difficult to extract from a very large amount of data.

↳ information without structure : Just a huge & unsorted mess of facts.

- to sort unstructured data : humans built different calculating machines.

- Abacus :- device with beads on wires
  - to break down tax receipts & arrange them into catagories.

- Difference Engine :- Designed to handle complex calculations using logarithms & trignometry.

- Machines :- By 1900's companies used machines to tabulate & analyze census numbers for entire national populations.

- Tabulate : By 20th century (Era of Tabulation) - tabulation of data : "slicing & dicing" data to give it a structure.

→ Era of Programming :

- by the time of World War - II, it is the new approach to dark data emerged.

- Electronic Numerical integrator & Computer (ENIAC) - Programs (could run more than one kind of instruction)

huge breakthroughs: Apollo 13's troubled mission bring its astronauts safely back to earth.

Dark data problem has grown

- Modern buisiness & tech generate so much data that even the finest programmable supercomputer can't Analyze.

The Era of AI :

The term 'AI' coined by a small group of researchers led by John McCarthy and Marvin Minsky in early 1956 at Dartmouth College in New Hemisphere.

They proposed;

"Every aspect of learning or any other feauture of intelligence can be so precisely described that a machine can be made to simulate it.

They developed an AI that can;

- Prove geometry theorms
- speak simple english
- Solve word Problems with Algebra

By early 1970's, there were Problems;

- fundamental limits that no amount of money & effort could solve

Those limits;

- Limited Calculating power
- Limited information storage

L.C.P :

- In early 1976, even most successful computers of the days working with natural language

* could only manipulate a vocabulary of 20 words

* Also task like matching the performance of human retina might require millions of instructions per sec.

L.I.S :

* No backup
* Early no one in 1970 know how to built a database large enough to hold. (even the information known by a 2yr old child)

→ The Money dried up for the first winter of AI

→ It took a decade for match up tech & AI to catch up with new form : "expert system"

↓

Limited to specific knowledge that could be manipulated with set of rules.

became popular in 1980's

→ but they failed once again soon the needs of scientist, businesses & government outgrew

→ Due to rise of personal computers the boom in AI research cooled down in 1980's.

* Over 300 companies (AI companies) shut down / went bankrupt during Second Winter of AI

Mid-1990's (After Dartmount research project)

- Computer processing finally reached speeds fast enough for machine to solved complex problems.

1997 - IBM's deepBlue beats world chess champion (by processing over 200 million possible moves per second)

2005 - Standford university robot drove itself down a 131-mile desert trail

2011 - IBM's watson defeated two 'grand' champions' in game of Jeopardy

Today AI has became the hottest feilds of CS.

The two winters of AI ended

Order of three areas of computing:

Tabulation, programming, AI

AI in first winter failed due to

Unable to meet high expectation! Also lack of funding

* Structured, Semi-structured & Un-structured data:

Data :- raw information (like facts, statistics, opinions)

eg: Voice, photos, names & dance moves.

Data can be organized in three following ways;

- Structured data
- Semi-structured data
- Unstructured data

① structured data: Quantitative data & highly organized information organized: in rows & columns

eg: data in spreadsheets like google sheets or Microsoft Excel.

data includes names, dates, addresses, credit card numbers, stock information, hotel & ticket reservation data

② Unstructured data: (Also called Dark data)

- Qualitative data → contains irrelavent data
- Information without any structure
- cannot be processed & analyzed by conventional data tools & methods.

eg: images, text, medical records, customer comments also song lyrics, social media posts.

③ Semi-structured data:

- Bridge b/w structured & un-structured data
- combines features of both models.
- More complex than structured data, yet easier to store than unstructured data.
- Uses metaData to identify specific characteristics of data & scale data into records & present feilds.

eg: Video on Social media site.

video itself is unstructured data. but has text for the internet to easily categorize that info (i.e through # to identify a location)

Applications:

- A sneaker design looking for new trends
- Govt searching for possible terrorist
- Pandamic experts trying to anticipate disease outbreaks
- Financial institutions prep for good times / recession

* 80% of all data in today's world is unstructured.

AI uses new kinds of computing - some modeled on human brain - to rapidly give dark data a structure

Machine learning:

Two ways to solve dark data problems;
through AI -
or ML - can analyze dark data far more quickly than programmable computer can.

Approach to a problem:

(*) Programmable computer:
From an enormous collection of structured data, the entire project require astronomical time & resources to accomplish.

(*) AI with ML

- These treat a problem like climbing tree
- route from base (root) to branch
- Compare all possible routes to identify shortest one

→ It requires fewer resources & can be completed more quickly

Advantages of ML:

- It doesn't require any database (for all possible routes from one place to another).
  It just need to know where places on map.
- It can respond to traffic problems quickly (through trial & error notes slowdowns & way around)
- Works very quickly (can work through millions of tiny calculations at one at a time)

Also;

- ML can predict
- ML learns.

} Advantages that ~~Programs~~ programmable computers lack.

ML Learning Systems: ① Deterministic
② Probabilistic

① Deterministic ~~Value~~ System:

- A gigantic database of possibilities from which the machine can make its choice
- binary thinking (either true or false) Yes/No (Y/N) type

Not Confident value.

② Probabilistic system:

- It never says Yes or No.
- ML is analog (like waves going up & down) rather than binary

eg: I does'nt say that is fastest route
insted it says, I am 84% Confident that

this route will get you there in shortest time.

- ML leaves a room for us humans to take the final choice.
- ML enables a rich partnership b/w technology & humans.

Human Capabilities

- Compassion
- Generalization
- Abstraction
- Dreaming

AI capabilities

- pattern
- Structuring information
- Endless memory capacity
- Machine learning

Common Sense: complex generalization mixed with compassion & abstraction.

Three methods of Machine learning:

1. Supervised learning
2. Unsupervised "
3. Reinforcement learning

eg: training google photos to identify people in photographs.

Supervised learning:

→ Providing AI with enough examples to make accurate predictions

→ All supervised Algorithms need labelled data

(labelled data: the data that is grouped into samples that are tagged with one or more ~~data~~) labels.

Applying SL requires to tell your model:

1) key characteristics ; features
2) What the thing actually is

eg: if we provide machine the info about dog with help of drawing of pictures with label dog.

The Machine learn by identifying a pattern for dog.

And now if we provide new dog photo & ask what is this? it will respond dog.

— this is classification problem

Unsupervised learning:

- Feeding the Machine large amount of information
- Unlabelled data

eg: Machine might fed with many photos & articles about dog, Netflix & Youtube recommendations.

- It will classify & cluster information about all of them.

- Un-supervised learning occurs when the Algorithm is given Un-labelled data.

- Unsupervised learning has the ability to discover similarities & differences in information

which makes it ideal sol for;

- exploratory data analysis
- cross-selling strategies
- customer segementation
- image recognition

Reinforcement learning:

- Similar to supervised learning
- This model learns using "trail & error"
- A sequence of successful outcomes is re-inforced to develop the best recommendation of given problem.
- The foundation for reinforcement learning is rewarding 'right' behaviour (+ve reinforment for performing right thing)

punishing 'wrong' behaviour (-ve rein "wrong things")

As Machine learns through trial & error, it tries a prediction & compares it with data in corpus.

- Each time comparision is positive - Machine recieves reward (positive numerical feedback)
- Each time comparission is negative - Machine receive penality (negative numerical feedback)

-> Overtime machine's prediction will automatically grow to be more accurate.

Ideal relationship b/w humans & machine learning;

AI researcher Nick Bostrom defines "Superintelligence" as; "an intellect that is much smarter than the best human brains in practically every feild"

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* General AI will enable supersmart bots & technologies to link AI with IoT through "embodied cognition"

This will give the machine ability to interact with humans.

* AI everywhere:
  - AI will move into all industries, from finance to education to healthcare.
  - AI enables productivity & increase new opurtunities.

* Deeper insights:

* Engagement re-imagined

* Personalization

* Instrumented planet.

Natural Language Processing & Computer Vision.

Module 1: The project Debater. (birth: 2012)

↳ hoping to build an machine that could do more than win debates with humans

- IBM's ultimate goal was to build a system that could help people make evidence-based, bias-free decisions on difficult topics

Four debate steps:

- learn & understand the topic
- build a position
- organize your proof
- Respond to your opponent

An collection of learned materials (several billion passages from newspapers, books & Journals) → called "Corpus"

* Cognitive Systems

1) Understand : They understand like humans do
2) Reason : They debate. They infer & extract concepts
3) learn : They never stop learning, they develop "expertise".
4) Interact : Allowing them to interact with humans.

→ Machines require "Natural language processing" (NLP) to understand Human Language (Which is more complex).

eg: IBM project Debater was most complex AI system IBM research have ever built to understand Human language.

→ Computers are best at working with structured data in which everything is neatly grouped & labelled.

→ In NLP machines segment sentence & extract meaning from "tokens" of human language.

Sentence segementation: Computer begin with one sentence at a time.

Tokens: Computer break the information into small chunks of information.

1) Entities:
   - Noun representing person, place or thing.

2) Relationships:
   - A relationship is group of two or more entities that have strong connection to one another.

3) Concepts:
   - A concept is something implied in sentence but not actually stated.

Emotion detection:

→ identifies distinct human emotion types.

eg: emotions expressed after reading user's rating & comments in online customer satisfaction survey.

Sentiment analysis:

→ Its a measure of the strength of an Emotion.

→ Sliding scale b/w positive & negative with neutral in middle

Classification problems:

Human Language is full of terms that are vague or have double meanings.

* chatbots uses NLP to interact with humans
it works in either of two ways.

1) For eg in shopping websit you ask like how to get replacement It gives valid answers.

2) but if you ask unrelated quetions it give a response Im sorry I did'nt understand your quetion.

chatbots are;

- Useful in wide range from retail sales to immediate care medicine.
- engage with chatbot online at any time.
- A chatbot is always ready for your quetion.
- They work with "small data" (their scale is much more limited)

Components of ChatBot:

- Frontend (user interaction) - messaging channel
- Backend (logic, data)

→ A chatBot's backend does the hardwork of understanding & responding

* One chatbot's response can trigger a large number of user queries.

Classifiers:

- They can map many different ways of asking a quetion to very small set of answers

A chatBot's backend include;

1) Intents
2) Entities
3) Dialog

- chatbots understand a question by breaking it into parts & relating those parts to things in its memory.

- chatbot goal is to identity entities & intents then use wahat its found to trigger a diglog.

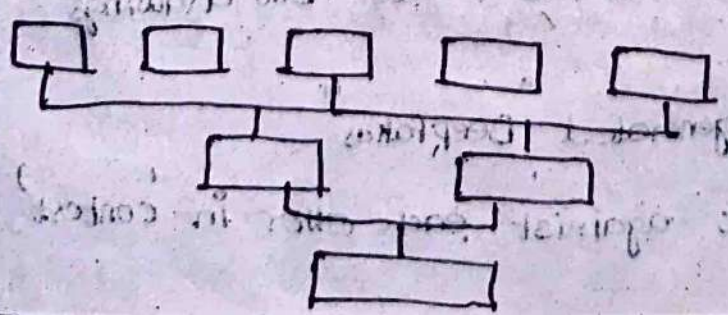
<u>Intent</u> - its a purpose (the reason why user is contacting the chatbot)
- its something like a verb ; A Kind of Action

eg: What are the hours for Austin location?
intent: Providing buisness hours
entity: Austin

Intent	Possible user inputs	Entities
open	When do you open?	Austin
	What are hours?	Schedule
	You open Now?	Time
	How late do you open?	Time

<u>Entity</u>: its like noun, name of person, animal place or thing.

<u>Dialog</u>: its a flowchart ; an IF/THEN Tree structure that illustrate how a machine will respond to user intents.



- Node: each moment of conversation
  : it contains a statement by the chatbot and a long, expandle list of possible replies

- A large no. of possible quetions would be mapped onto a small number of possible answers until conversation is ended.

→ Intents, entities & dialogs make a quick work for NLP.

* convolutional Neural Network (CNN):

→ An AI system uses CNN to analyze images
→ Digital photos & videos build images with millions of pixels

pixels: tiny dots, taken together, give the human-eye an illusion of two-Dimensional image.

The problem is caused by those millions of pixels with their color & brightness levels.
The add up to numbers so large that would overwhelm most AI research.

To avoid this, we use CNN → makes it possible for visible recognition systems to identity things in image, as in facial recognition. (using Filters)

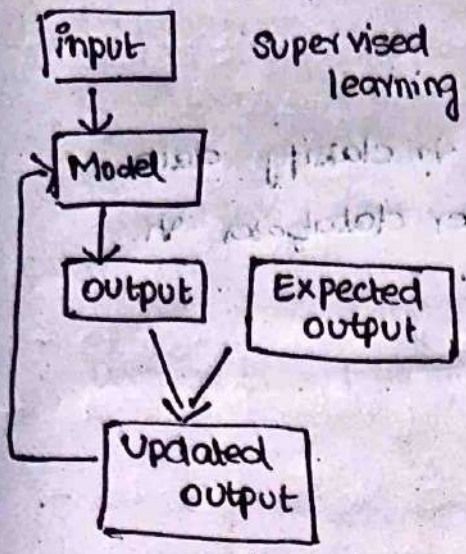
These filters map with every pixel present in image
↳ also basic object recognitions

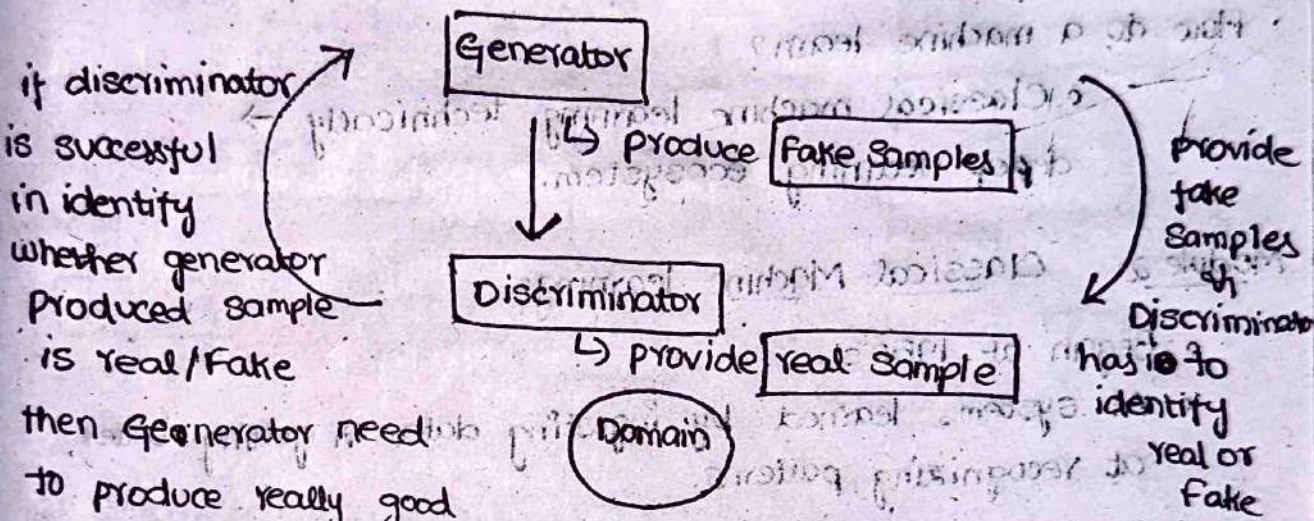
* Generative adversarial networks (GAN);

→ A visual recognition system can use generative adversarial networks to create new drawings & photos.

eg. computer - generated Deepfakes

- Pitting two CNN's against each other in contest is GAN





then Generator need to produce really good Fake one until no one accepts their defeat.

→ A GAN battle ends with an image that's ready to be shown to a human.

* Computer Vision Applications :

1) spotting a dangerous but difficult to detect flaw in airplane's wing.

2) Monitoring water flow accross a dairy farm to ensure it does'nt reach nearby food crops.

3) Counting no of people in unruly crowd.

4) performing lip-read for people who cant hear or speak

Machine learning & Deep learning

→ AI systems use Algorithms to predict & classify data points collected both from computer databases & natural occurences.

Machine learn in ③ general ways:

- Supervised
- Unsupervised
- Reinforcement

How do a machine learn?

- Classical machine learning technically → deep learning ecosystem.

Module 2: Classical Machine learning:

- Began at 1950's
- AI systems learned by ingesting data & getting better at recognizing patterns.
- Depends on Algorithms
  ↳ Mathematical expressions that output as a result.
- CML uses small number of Algorithms in a relatively simple arrangement
- Output: 1 or 0 / Y/N / T/F

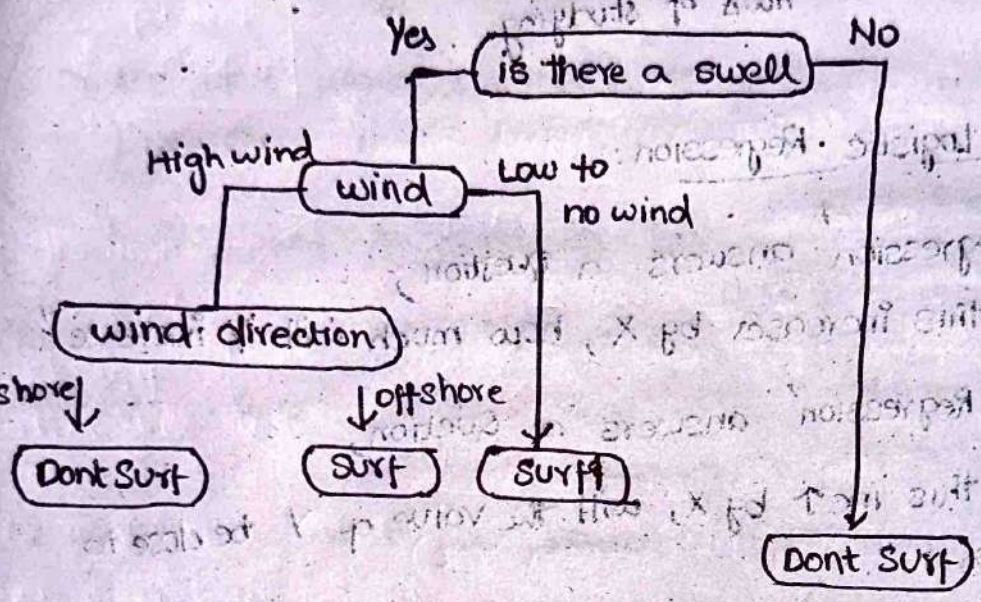
Three typical Algorithms that are used in classical computing:

1) Decision Tree
2) Linear Regression
3) Logistic Regression

1) Decision-tree :

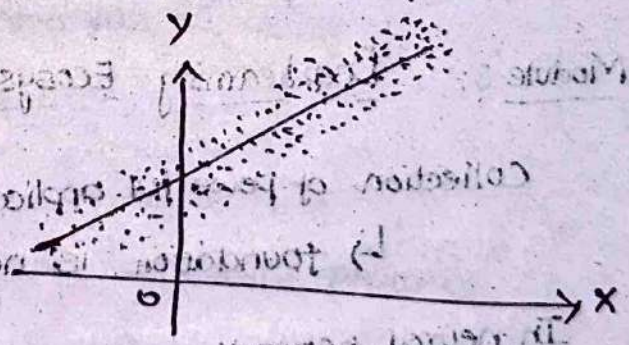
- Supervised Learning Algorithm
- It operates like flowchart
- Upside-down decision tree. (contains root, node internal nodes, leaf nodes)

Decision tree (is this a good time to surf on ocean)



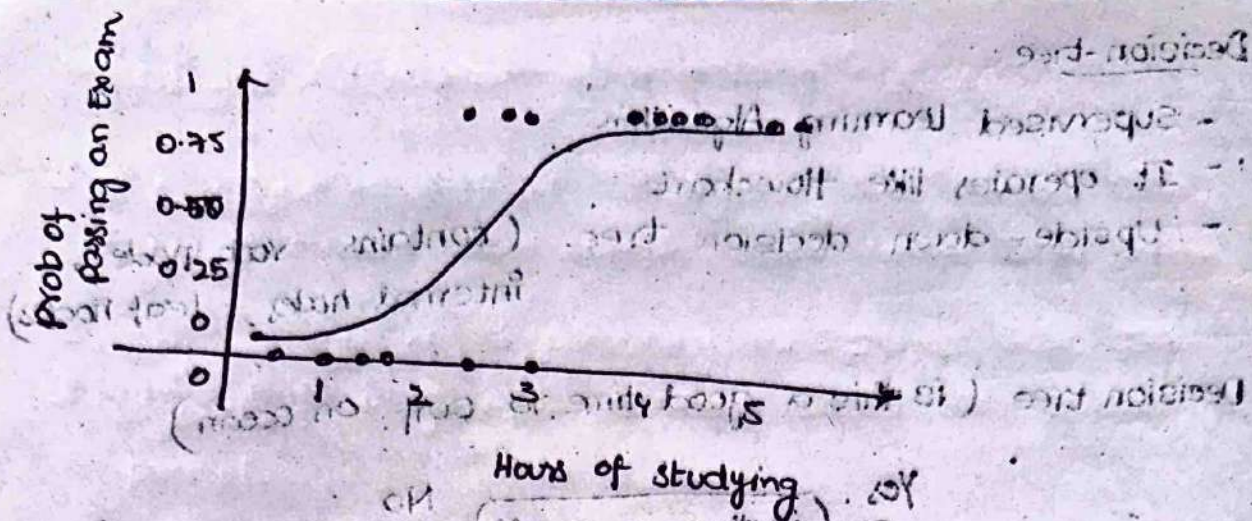
2) Linear-Regression:

- An Algorithm related to data that might be graphed as a straight line.
- the output is graphed as series of dots that form a raising st. line.



3) Logistic Regression:

- Sometimes a relationship does'nt fall in straight line
- output can be Yes/No, 0/1 etc.
- in this situation graph can form a Sigmoid function or S-shaped curve. (falls b/w 0 & 1)



Linear Vs Logistic Regression:

- A Linear regression answers a Question;
  - "If this increases by X, how much will Y increase"
- A 'Logistic Regression' answers a Quetion;
  - "If this inc↑ by X, will the value of Y be close to 0 or 1"

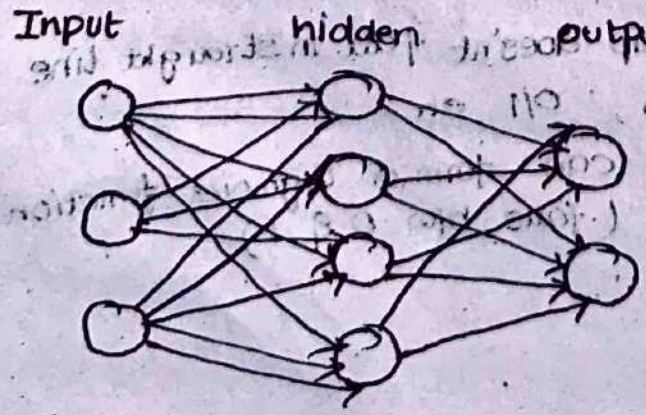
Reasons to use Classical machine learning;

1) Work with structured data
2) Lower expense to operate
3) Easier to interpret

Module 3: Deep Learning Ecosystem:

Collection of powerful application = Deeplearning Ecosystem
↳ foundation is neural network.

In neural network:



perceptron is building block

↳ contains; a input Layer. (signal enters in input layer)
one or more hidden layers (runs algo on signal)
a output Layer. (result is passed here)

hidden layers; resemble as group
contain nodes

nodes uses "sigmoid function" to determine whether on not to fire

→ Also uses activation algorithm ; algorithm reaches at a certain threshold.

The Node actually do Mathematical calculation insted of thinking (this is Machine learning)

How does neural network learns in first place?

by continuosly adjusting itself (trial & error)

→ Deeplearning relys on multiple layers of nodes to finish work in reasonable time.

* Deep Neural Network (DNN) : Advanced AI systems use many hidden layers whose Algo pass the result of sophisticated calculations.
- Arranged in groups

- Techies can use DNN to examine a historic photo of unknown persons or places.
- DNNs can help real-estate companies predict buisiness trends & determine how to invest in material & labours
- self-driving cars use DNNs
- cancer treatment : identify variations in MRI images that are invisible to human eye

→ Many forms of DNN make up modern deep learning ecosystems

Module 4: Generative AI:

- It is a type of Artificial intelligence that creates new, original content that people have never seen before.
- they are type of deep learning AI systems that uses algorithms to generate content based on submitted prompt.

Generative AI's output has gained global attention due to

1) uniqueness
2) high quality
3) speed of content generation

Types of Generative AI models;

1) Variational autoencoder (VAE)
2) Generative adversarial network (GAN)
3) Auto regressive.

VAE's:

→ "Encoder" network compresses the input data into a lower dimensional representation

→ "Decoder" network reconstructs the original data from this compressed representation.

Autoregression:

→ These models generate new content by predicting the next element in sequence based on previous elements

→ particularly well suited for generating text.

Examples of generative AI

1) ChatGPT
2) IBM Watson Discovery

3) DALL-E & DALL-E2 - OpenAI / image generator

4) Google Bard.

→ generative AI is impacting today's world, across many industries.

Industry uses ; 1) Sports
2) Entertainment
3) Healthcare
4) Business

Limitations ; 1) Lack of Originality
2) Incompleteness
3) Bias
4) Computational resources.

Ethical concerns ; 1) Misinformation & fake content
2) Intellectual property & copyright
3) Privacy
4) Loss of human touch
5) Unemployement & Job displacement

Module 5: Future AI trends:

We are currently living in Second level of AI (Broad AI)
↓
begun to appear in your everyday life

General AI : the goal is to create systems that can perform any intellectual task a human can.

AI everywhere : Soon AI take up each & every industry help people to work more productively

Deeper Insights : New technologies will able to sense &

analyze things at level of understanding.

Engagement Re-imagined : New forms of human - machine communication.

Personalization at scale

Instrumented planet

Run AI Models with IBM Watson Studio

Machine Learning Models:

→ Machine learning algorithm is a set of program code the analysis has a specific goal : to recognize patterns in datasets

→ Machine learning model is a group of machine learning algorithms.

operating together, they detect pattern among their algorithms output & use those patterns to make predictions

→ Machine learning model can reprogram itself

- IBM watson's studio solution is what researchers call an integrated devolopment environment (IDE)
- It solves AI devolopment problems.
- Watson studio gives devolopers:
  1) A collaborative data science & machine learning environment
  2) Easy visualization with drag and drop code
  3) An efficient work flow
  4) Built-in neural network modeler
  5) Open-source Tools (Jupyter Notebook & Rstudio)

- IBM Watson Studio helps developers collaborate & visualize their work.

- IBM Watson studio speeds data input & insights output

↳ features: 1) Automated data preparation (Auto AI prepares raw data for ML)

2) Visualize neural network design (simple drag-and-drop interface)

3) Sophisticated analysis & prediction

4) Unified dashboard displays

AI machine learning project to-do-list:

1) set up a new project

2) Create a learning model

3) Train your model

4) Test the model

5) Save the final model

Confusion Matrix:

Terms to understand confusion matrix you need to understand;

	Risk (observed)	No Risk (observed)
Risk (Predicted)	True Positive	False Positive
No Risk (Predicted)	False Negative	True Negative

AI Ethics :

Trust in AI is built on five ethical pillars :

- Fairness
- Robustness
- Explainability
- Transparency
- Privacy

} Focus areas that help make AI trustworthy.

The Age of AI ;

- AI is everywhere
- AI can make life easier and safer by helping people make more informed decisions.
- AI also has the potential to do harm

AI ethics : Multidisciplinary feild that inverstigate how to optimize AI's benificial impact while reducing unintended or adverse outcomes.

Fairness : Ensures models & outcomes are impartial and avoid bias

Robustness : Handle exception conditions effectively & with easey

(Robust AI should be able to evaluate & defend itself againist a variety of threats)

Privacy : Follow high integrity data & buisiness compliance guidlines.

Explainability : provide explanations to understand outcomes & decisions (also behaviour of model)

Transparency : Transparent results mean that, users can increase their understanding of why & how AI was created.

Overcoming challenges to acheive Trustworthy AI;

1) Technology
2) People
3) Process

Module 2: What is Fairness?

- The equitable treatment of induvidvals or group of induvidvals
- Acheived when unwanted Bias is mitigated

Protected Attribute: The attribute that seperates the population into groups
eg: Race, age, sex at birth, gender & ethnicity.

Privileged Group: The group that traditionally receives more favourable outcomes

Unprivileged Group: The group that traditionally receives less favourable outcomes

→ To acheive fairness, unwanted bias need to be reduced
→ Un-wanted Bias is a systematic error in AI systems that may result in unfair outcomes.

Adversarial Attacks:

- They are intentionally carried on AI systems to acomplish a malicious end goal by taking advantage of the AI system vulnerabilities.
- Aims to negatively impact the system performance, exploit data used & corrupt model logic
- The one who takes advantages of AI system to vulnerabilities to acomplish their motive is called an adversary.

- Two types of Adversarial Attack
  1) poisoning
  2) evasion

Poisoning can happen in following ways during model training phase

- Injecting malicious samples into training data
- Updating features & labels on training data
- Modifying AI model architecture, parameters, and logic.

Evasion can happen after model deployment phase

- Sending malicious test samples to deployed model
- Corrupting test data sent to deployed model

Interpretability:

- degree to which observer can understand cause of decision
- it is the success rate that humans predict the result of AI output

Explainability:

- looks at how AI system arrived at result.

Interpretable model is comparitively easier than Explainable model

Transparency:

- disclosing information related to data used for building AI systems, design, decision made, throughout the process, model creation, model evaluation & model deployment

Governance:

- ensures the process followed during creation & ~~display~~ deployment follows the internal policies & regulations.

→ By increasing transparency we can enable governance

Personal Information: (PI)

- Information related to identified individual like a name or post code.

Sensitive personal information (SPI):

- Information that, if compromised, could be misused to significantly harm or inconvenience an individual like bank account number

Profession - PI

Credit card No - SPI

Telephone No - PI

health history of person - SPI

Membership inference Attack:

- an attacker tries to determine whether a specific individual was part of training data set

Privacy Controls:

- Model anonymization (during model training)
  - Anonymize the training data with minimal accuracy lost.

- Differential privacy (during model training)
  - random noice is added during model training to reduce impact on single individual on model's outcome.

- Data Minimization (after model training)
  - only data that is needed being collected

Large Language Models:

LLM is a type of Artificial intelligence trained on large dataset of text to generate language outputs that are coherent & natural sound.

Large: enormous scale of model

Language: designed to understand & interact using human language.

Model: Algorithm that processes input & produce output

LLM's are designed to understand & generate text like human.

They have ability to infer from context, generate coherent and contextually relavent responses, translate to language other than english, summarize text, answer quetions

*Machine Learning:

- is a branch of Artificial intelligence & ~~machine learning~~ computer science which focuses on use of data & Algorithms to imitate the way that humans learn gradually increasing its accuracy.

Semi-supervised learning: uses ~~dataset~~ training dataset with both labelled & un-labelled data.

*Deep learning:

- it is a subset of machine learning, which is esentially a neural network with three or more layers

- Machine learning relies on structured, labeled data with predefined features organized into tables.
- Deeplearning excels at processing unstructured data such as text & images.

Evolution of Generative AI :

1943 : Birth of Artifical neuron
1949 : Hebbian learning
1950 : The Tuning Test (About Debates)
1959 : ML spoken into existence
1965 : Multi-layer perceptron
1973 : Winter comes
1985 : Baby Talk
1997 : IBM's Deep Blue (Chess)
1997 : MNIST database
2009 : ImageNet
2016 : Google's DeepMind's AlphaGo AI
2021 : AlphaFold 2
2022 : ChatGPT
2023 : IBM Watsonx

* Foundation Models :

→ Pre-trained language models that serve as basis for various downstream languages understanding generative tasks.

eg: BERT , GPT

Downstream Language : tasks involve taking these pre-trained models & fine-tuning them for specific NLP applications

* Large Language Models (LLM's):

- LLM's are type of generative AI engine designed to process & generate text.

eg: OpenAI's GPT-4, Google's PaLM.

Two Types of LLM's:

1) Proprietary LLM
2) open-source LLM

1) Proprietary LLM;

- owned & controlled by specific company or org & can only be used by customers who purchase licence

2) open-source LLM;

- they are made available to the public for free under open source licenses.

* Tokenization:

- crucial phase in fine-tuning the LLM
- it is the process of breaking down the text documents or sequence of words into small chunks of information called Tokens.

Tokenization helps in various language-related tasks i.e text classification
sentiment analysis

- it is fundamental step in NLP (Natural Language processing) because it transform text data into a format that can be understood by machine learning models.

Sub-word Tokenization Algorithms:

- These algorithms work by breaking down words into smaller sub-words units.

Some examples of Subword Tokenized Algorithms;

1) Byte Pair Encoding (BPE);

→ variable-length subword units based on the frequency of their occurences in training data.

eg: say 'Chatbot'

1) ('c', 'h') : chatbot
2) ('cha', 't') : chatbot
3) ('chat', 'b') : chatbot
4) ('chatb', 'o') : chatbot

Final set: {'c', 'h', 'cha', 't', 'chat', 'b', 'chatb', 'o'}

eg: GPT-2, ROBERTa.

2) Word piece

→ Start with induvidual characters as tokens and iteratively merge them based on likelihood of their co-occurences in traing data

1) 'c', 'h', 'a', 't', 'b', 'o' → 'cha', 't', 'b', 'o'
2) 'cha', 't', 'b', 'o' → 'chat', 'b', 'o'

Final set: {'c', 'h', 'a', 't', 'b', 'o', 'cha', 'chat'}.

eg: BERT

3) Sentence piece:

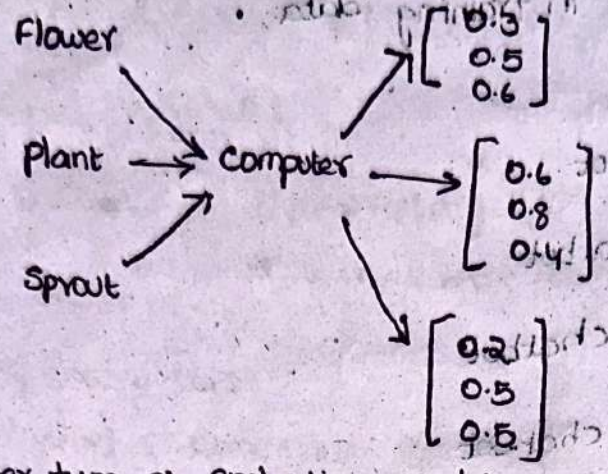
- More recent version (extended version of BPE & word piece algorithms)

Fewer examples of Tokenization;

- Sentence Tokenization
- Word Tokenization
- SubWord Tokenization
- Character Tokenization

* Embeddings:

→ Mathematical representation of word or sequence of words in numerical vector space.



Other type of embeding models;

Word embeddings

Sentence " "

Image " "

Document " "

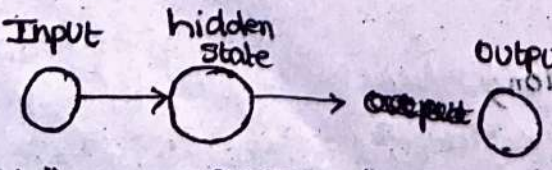
* Transformers: (2017)

- Transformers refers to specific type of neural network architecture called 'Transformer Model' i.e designed to process sequential data, such as NLP's

Basically traditional methods relied on

- Reccurent Neural Networks (RNN)
- Convolutional Neural Networks (CNN)

i) **RNN**: is a class of Neural Networks that includes weighted connections within a Layer



eg: When you prepare for exam notebook is like memory (hidden state) of RNN

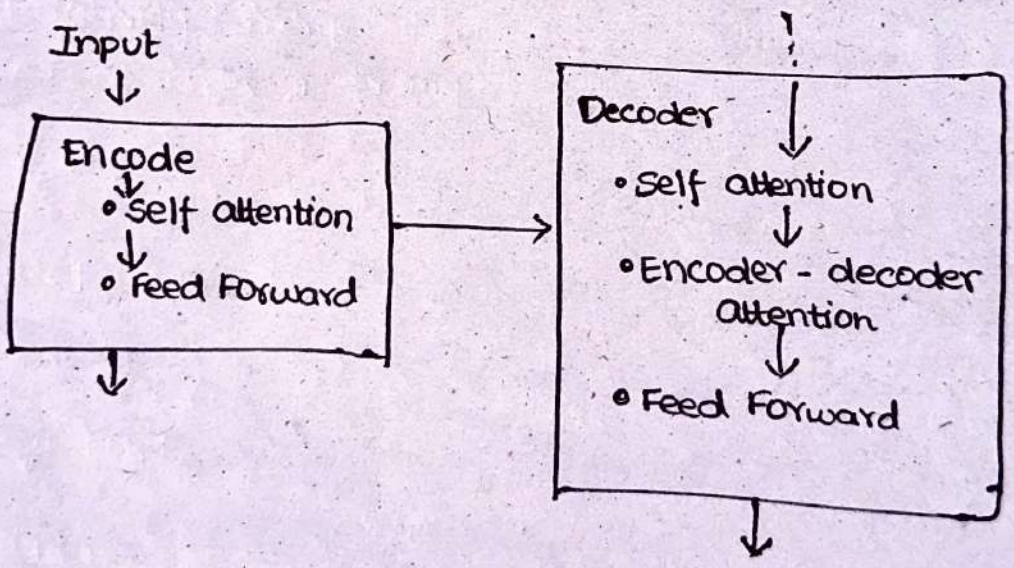
- RNN process information step by step

- RNN uses its hidden state to predict what comes next in a sequence, and output represents it prediction

* RNN are commonly used for NLP & speech recognition

2) <u>CNN</u> : It is an extention of Artificial neural networks (ANN) and is predominantly used for image-recognition based tasks.

Encoder & Decoder are the two components of Transformers:

- <u>Encoder</u>: A module that processes input data & converts it into a structured representation that can be understood & used by model.

- <u>Decoder</u>: A module that processes the input from Encoder & producing output sequence.