AI for AI

By Sriram Krishnamoorthy

Outline

- What is AI?
- Examples of AI?
  - Applications of AI in daily life
- Stages of AI (and what we are on now)
- Branches of AI (Machine/deep learning, virtual assistance etc.)
- Sectors of AI
  - Types of AI
  - What companies use AI and why
  - Quiz
- History of AI
  - Progress from the first instance of AI and the first mathematical solvers to deep learning and implementation used by Apple, OpenAI and NVIDIA for their applications
- Is AI Reliable?
  - How far is each branch in AI?
  - Pros and cons of AI
  - Why you should not be afraid
- Trends for AI/Future
- Conclusion

What is AI?

- It is something that can learn and adapt
  - More than just a program that follows rules
  - It is a way to simulate the decision making of humans that write the software for your appliances you use in daily life
- They exhibit signs of human-like intelligence
- It is found in diverse applications such as medical diagnosis, search engines or chatbots, and image recognition
- AI consists of multiple types of learning, ranging from problem solving, perception and reasoning
  - Most common type of learning in AI is done through trial and error, whose applications we will talk about later

Types of AI based on capabilities

- Narrow AI
  - Perform task specific to a set range of tasks
- General AI
  - Broad humanlike cognition to learn and solve challenges autonomously
- Superintelligent AI
  - Surpassing human cognitive ability in creativity, wisdom and problem-solving

Types of AI based on functionality

- Reactive machines
  - Machines to analyze and respond to different situations in a set domain
  - They do not store information, but take in bouts of information and solve
- Limited Memory
  - Machines to collect data and draw conclusions based on said data
  - Based on structured and unstructured datasets of finite values
- Theory of mind
  - Collecting and understanding emotional and psychological data and making decisions
  - Based on visual cues and nerve signals
  - Still in development
- Self-aware AI
  - Machines with their own consciousness and self-awareness
  - Can form their own beliefs and ideals as a basis for their actions
  - Based on all data outlined above
  - Theoretical AI
  - Still theoretical and end of trajectory for AI

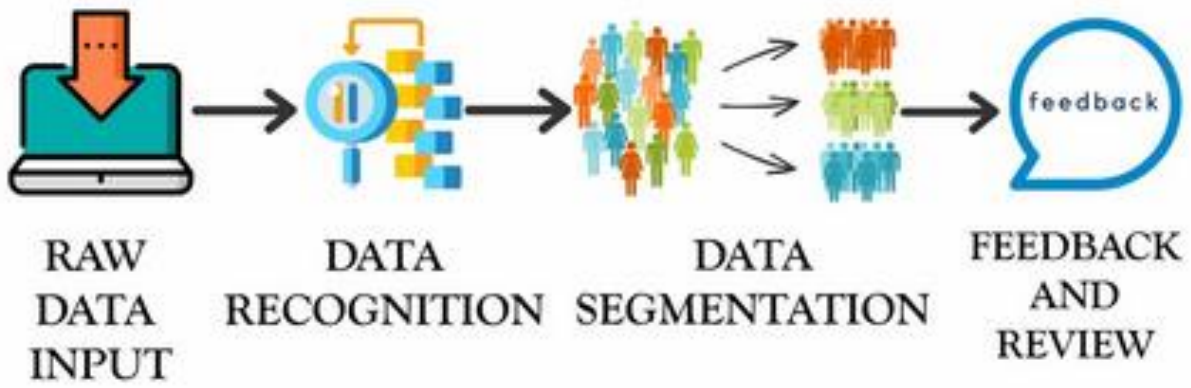
Computer Science Behind AI

Reinforcement Learning: This is a reward-based learning system where teaching is optimized via layered network formation based on characteristics of the external environment

Machine learning: A databased system that can improve its performance as it progresses (through more data, more tuning or other factors)

Types of Machine learning

- Supervised learning:
  - The simplest form of machine learning, where given a set of inputs and a set of outputs, rules are given to map said inputs to outputs, which predict more outputs for any given inputs
  - Formats:
    - Regression
    - Classification



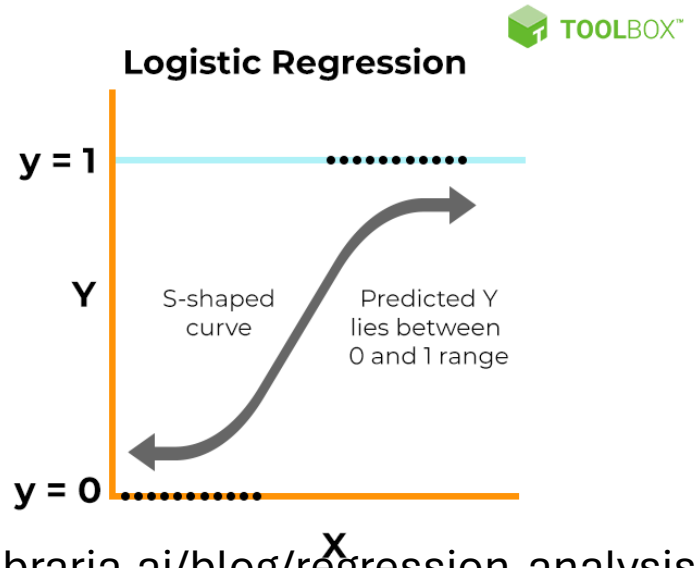
https://www.cronj.com/blog/wp-content/uploads/Supervised-Learning-2048x1182.jpg

Types of Machine learning

Supervised Learning

- Regression:
  - a statistical model that models the log-odds of an event as a linear combination of one or more independent variables
  - Considers a dataset and models the relationships between data points and inputs to interpolate future points

Component	Description
Dependent Variable	The outcome variable to be predicted.
Independent Variables	Factors that influence the dependent variable.
Coefficients	Quantify the relationship between variables.

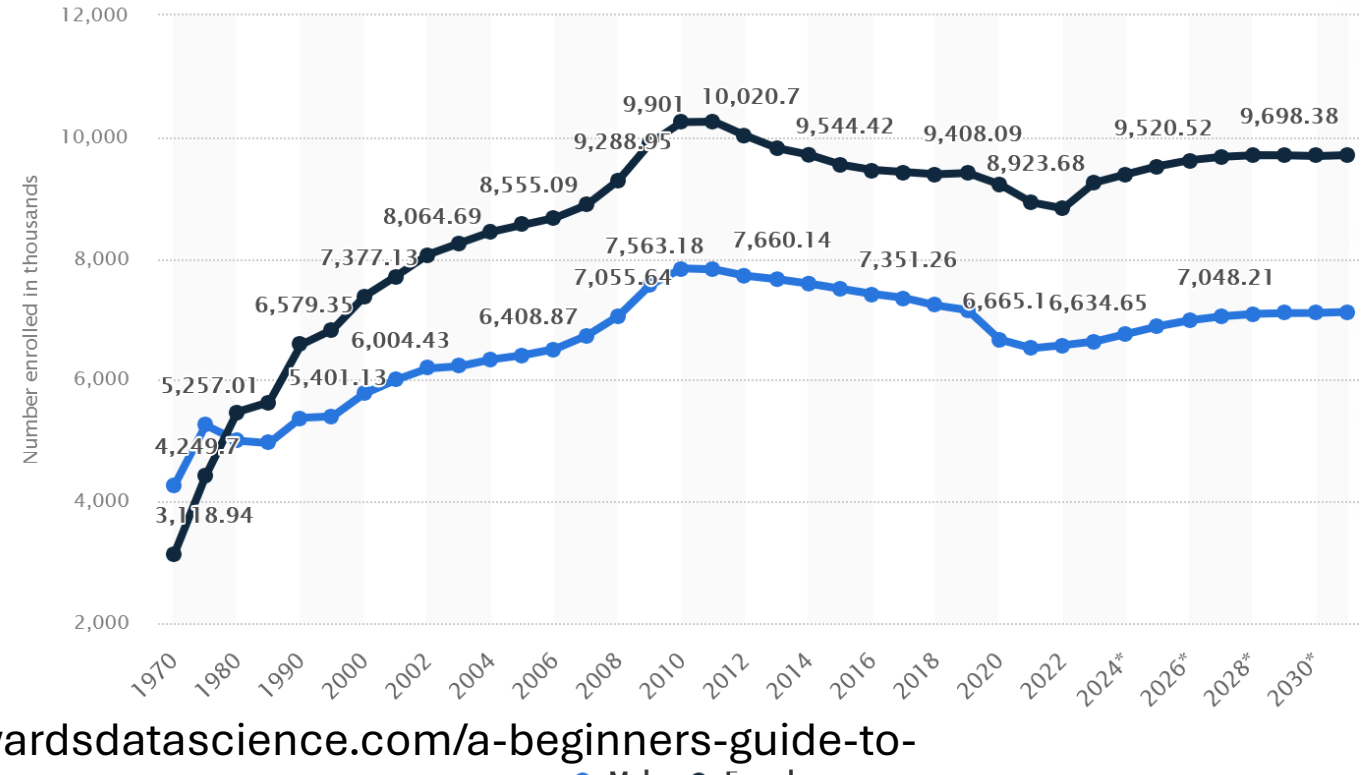


https://libraria.ai/blog/regression-analysis-in-ai-predicting-outcomes-accurately/

Types of Machine learning

Supervised Learning

- Regression:
  - Example: Estimate gender distribution of undergraduate students:



Important:

- This is given the trends stay the same
- They can be of varying orders of change
- This assumes stable conditions

https://towardsdatascience.com/a-beginners-guide-to-regression-analysis-in-machine-learning-8a828b491bbf

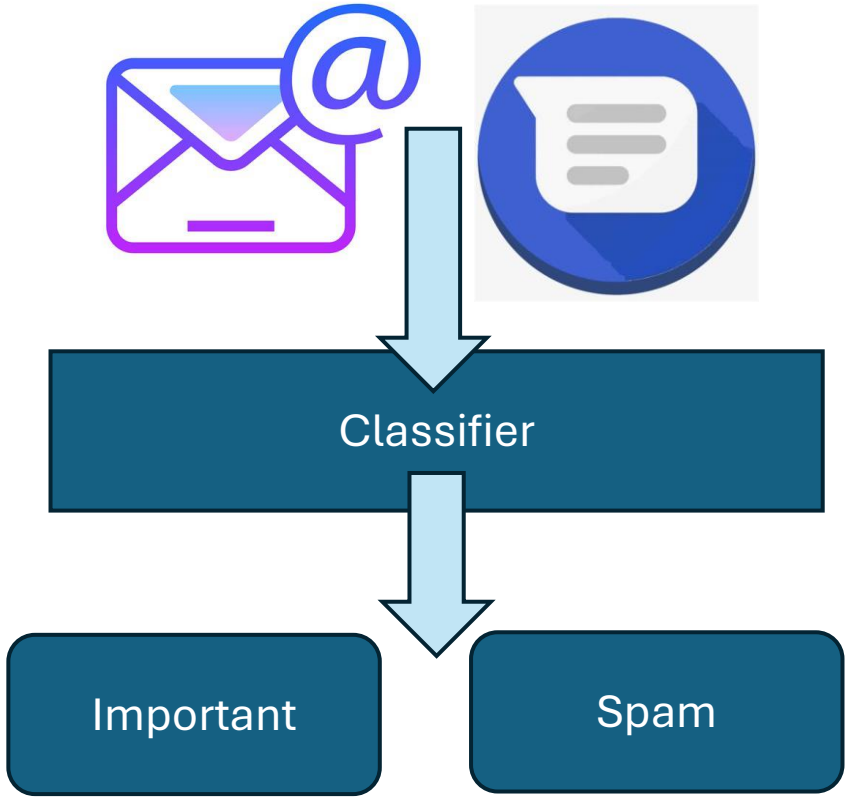
Types of Machine learning

Supervised Learning

- Classification
  - Categorizes output based on structured and unstructured input
  - Steps:

1. Model is trained on the data, and evaluated
2. Prediction is performed on unseen data

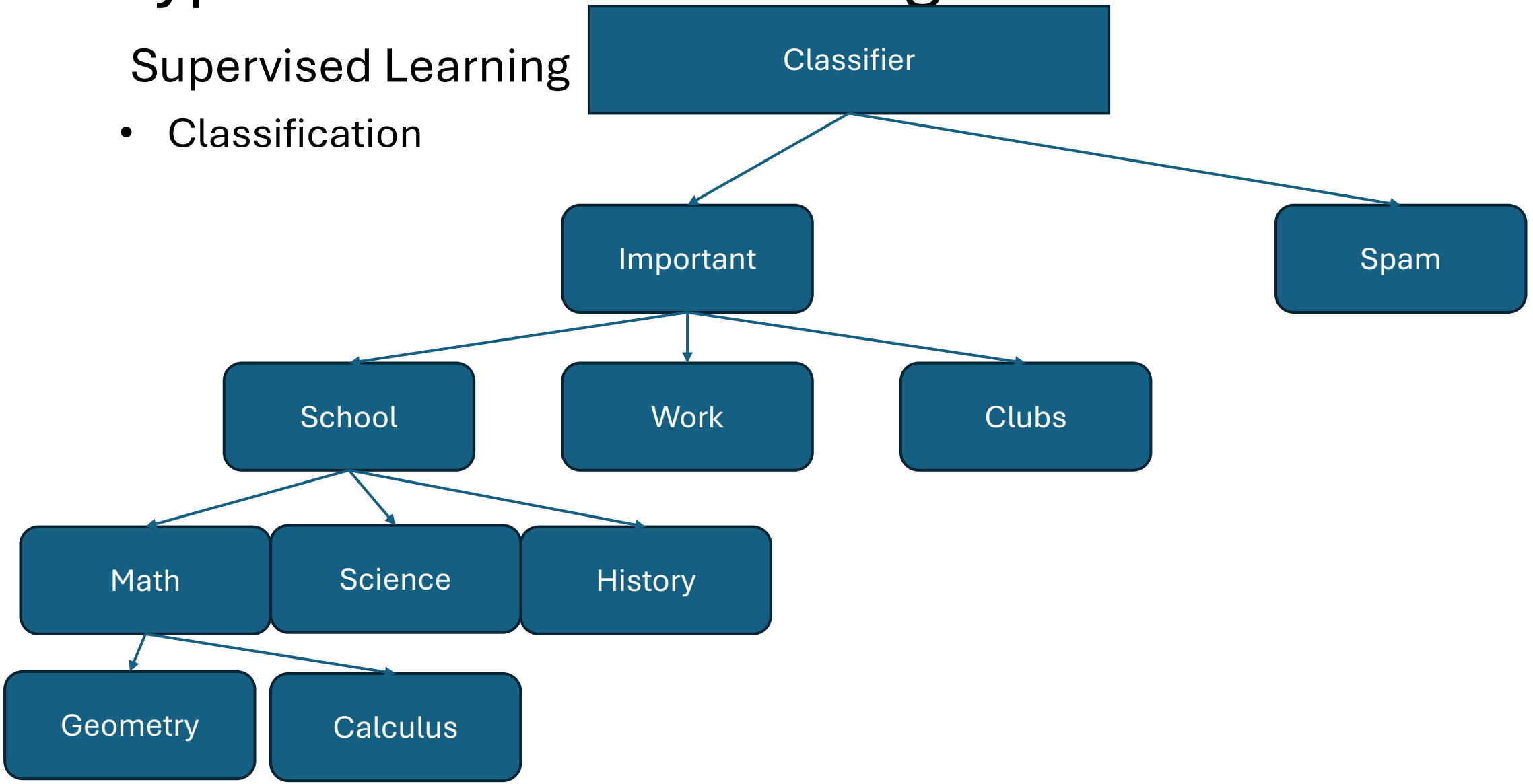
Examples: Given a series of emails, classifying if spam or not



Types of Machine learning

Supervised Learning

- Classification



Types of Machine learning

Unsupervised learning

- Given many sets of unorganized data, the model finds similarity between data points by clustering the points together
- The model performs its own classification
- Examples:
  - Customer divisions: Given a set of customers entering a store, customers are divided by gender, age, height, any visual features you see
  - Undergraduate admissions: Given a set of applicants into a college, more data is available such as academic, athletic and extracurricular performance, family wealth, background, general interest, and presentability
  - Blood drive participants: Given a set of donors, divisions done on gender, weight, height, body fat, blood type, blood sugar etc.

https://www.ibm.com/topics/unsupervised-learning

Types of Machine learning

Unsupervised learning

- Techniques:
  - K-means clustering: Data points assigned into K groups based on the distance from the group's centroid
  - Data points closest to a given centroid will be clustered under the same category, and a larger K-value means smaller groupings with more deviation
  - Most common type of unsupervised learning
  - Similar to trial-and-error exploration

https://www.ibm.com/topics/unsupervised-learning

Types of Machine learning

Unsupervised learning

- K-means clustering
  - Originated as a statistical grouping method for signal processing in 1957
  - Refers to the number of clusters specified where observations are assigned to the cluster of the nearest center or mean
  - Groups are formed to minimize variances between data points and cluster centroid

Steps:

1. Assign each data point to an initial group, which can be formed through any characteristic, and calculate the centroid for each group
2. Evaluate each observation relating to their distance from the cluster, and recalculate the centroid with each additional observation
3. Repeat until all data points are mapped to a dataset

https://statisticsbyjim.com/basics/k-means-clustering/
https://www.sciencedirect.com/science/article/abs/pii/S1574013720304068

Types of Machine learning

Unsupervised learning

- Anomaly detection: Identifies outliers
  - Important in fraud detection and network intrusion detection
  - Data points are found when they stand out significantly from the rest of the data

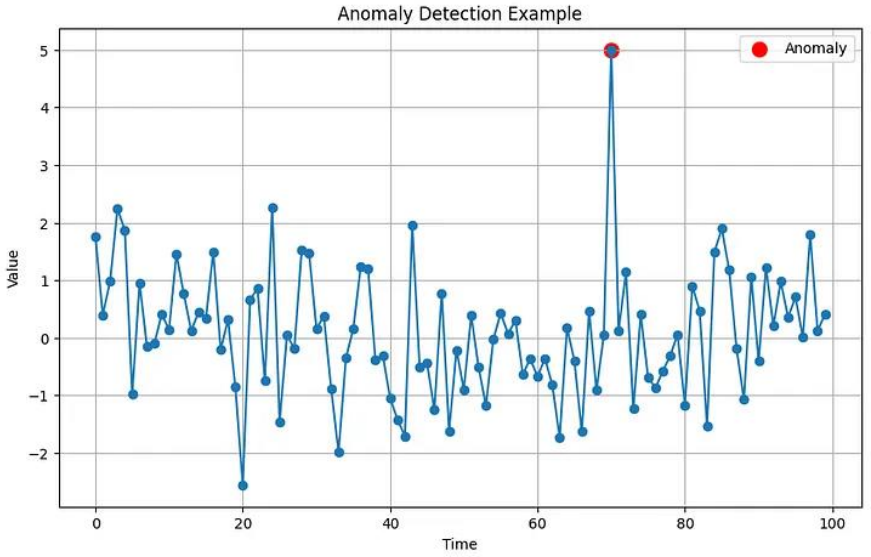
Examples:

- Collection of smartphones with Androids where you see one iPhone, so the anomaly is based on brand
- Website traffic spiking at a certain point unlike usual trends (i.e. traffic at certain hours, maintenance, or any special event), so anomaly is based on volume of traffic

Uses:

- IoT network linking, fraud detection, social media hacking, data breaches

https://www.ibm.com/topics/unsupervised-learning



Types of Machine learning

Unsupervised learning

- Anomaly detection: Identifies outliers
- How to detect?

  Machine learning algorithms for structured data

  - Bayesian networks: Probabilistic graph with codependent random variables connected in a cycle, to infer probability of a certain situation, usually applied in bioinformatics and natural language processing
  - K-nearest neighbors: Given prior data, classify coordinates into groups based on one attribute or label, and given testing data allocate these points to a group through analyzing the data set, keep classifying for any new points
  - Decision trees: Similar to a tree, stems from one node to branch off to several outcomes, including internal decision nodes, until it reaches a final terminal node

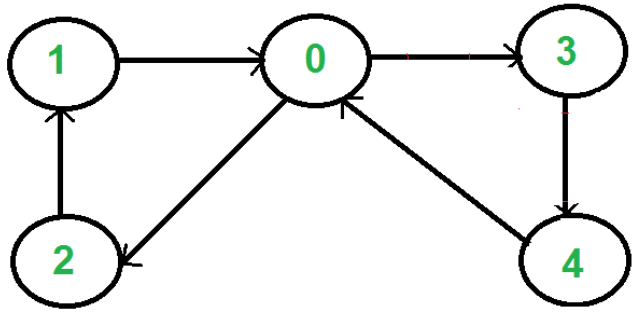
https://medium.com/simform-engineering/anomaly-detection-with-unsupervised-machine-learning-3bcf4c431aff
https://machinelearningmastery.com/introduction-to-bayesian-belief-networks/
https://www.coursera.org/articles/decision-tree-machine-learning

Types of Machine learning

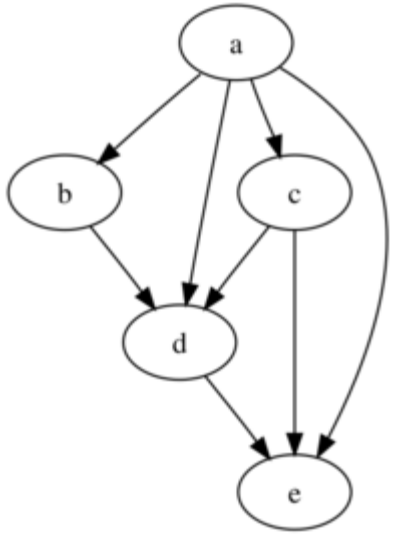
Unsupervised learning

- Anomaly detection: Identifies outliers

Directed cyclic graph:



Directed acyclic graph:



- Tackles systems of tasks with scheduling or ordering restraints, and are often dependent on each other

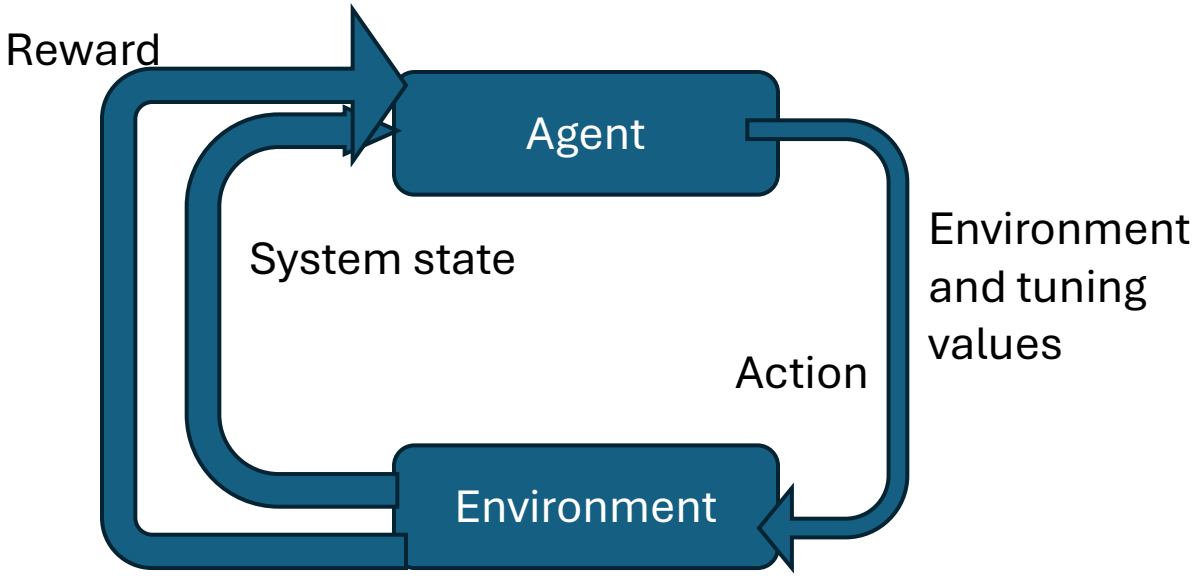
https://medium.com/simform-engineering/anomaly-detection-with-unsupervised-machine-learning-3bcf4c431aff
https://machinelearningmastery.com/introduction-to-bayesian-belief-networks/

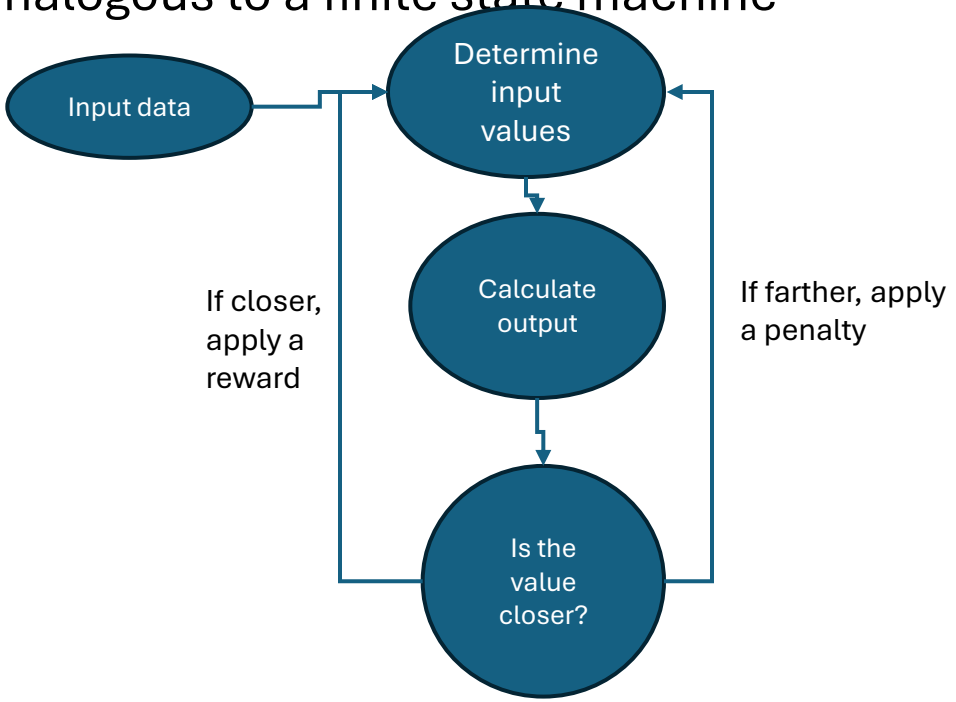
Types of Machine learning

Reinforcement Learning

Premise: Maximize the cumulative reward in a dynamic environment to incentivize accuracy

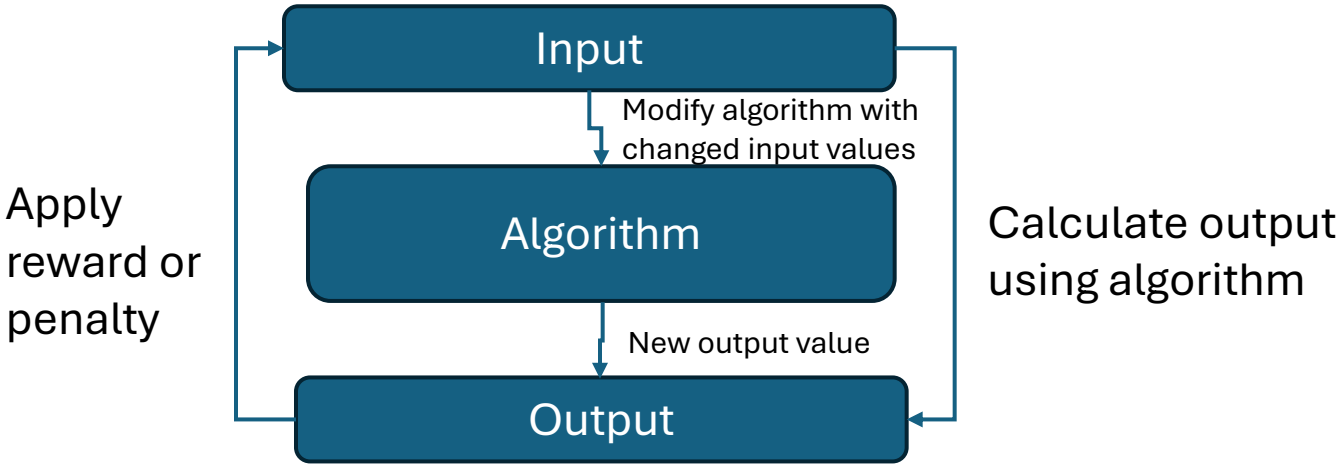
- Involves trial and error determination of what is correct
- Feedback loop from agent and environment, analogous to a finite state machine





Types of Machine learning

Reinforcement Learning



Applications

- Path planning
- Game development
- Healthcare and medicine (treatments)
- Industry automation
- Natural language processing and chatbots
- Social media recommendations (marketing and advertising)

Types of Machine learning

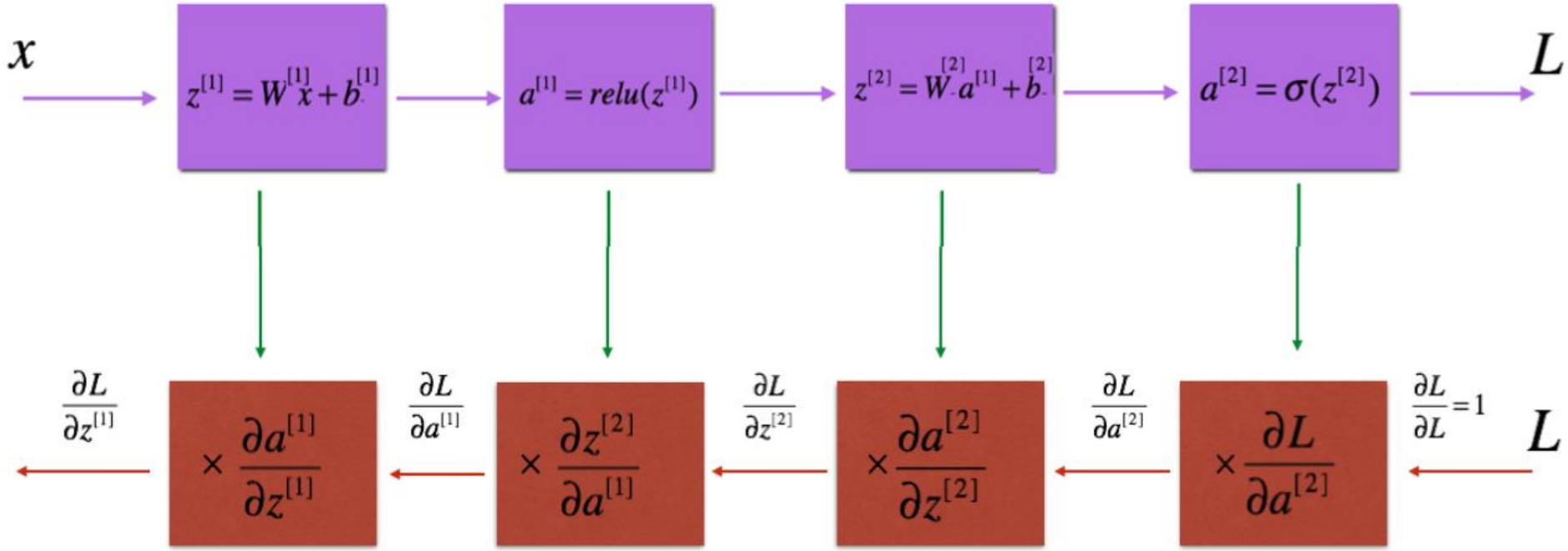
Reinforcement Learning

- Exercise!
  - Write a basic algorithm for reinforcement learning to see how to get from one place to a goal
  - Add obstacles and edges that need to be figured out by the user
  - Add a goal
- If needed, you can just write the pseudocode.

Types of Machine learning

Deep Reinforcement Learning

- This is a deeper form of reinforcement learning using neural networks with more layers to predict outputs given a list of input
- Basic neural network structure:



Types of Machine learning

Deep Reinforcement Learning

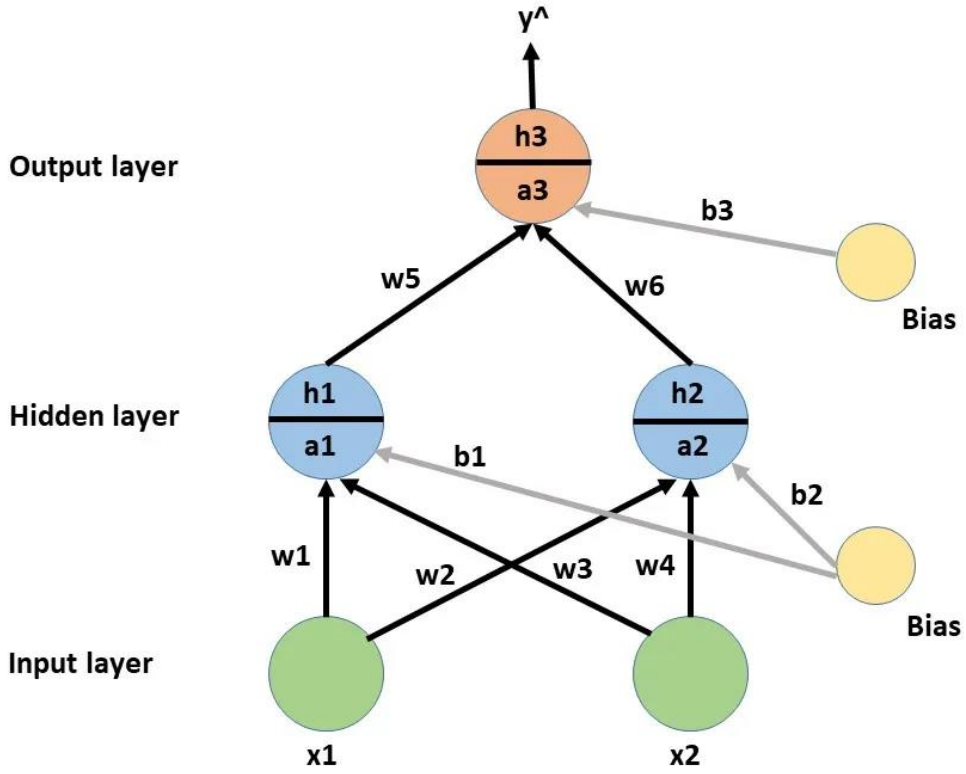
1. Input a dataset and corresponding outputs
    1. Purpose: To teach the neural network what to output given a standard input
2. Layers of nodes
    2. Layer types:
        2. Input layer
        3. Hidden layers
        4. Output layers
    3. Weights: Sets of matrices that contain randomly generated nodes to put more importance on set features of your input
    4. Biases: Sets of nodes to skew your neural network to a certain value in case you have more than one value to correlate to an output
    5. Activations: Calculate the actual outputs of the nodes based on weights and biases

Types of Machine learning

Deep Reinforcement Learning

Phases of a neural network

1. Forward propagation
    1. Input layer: Is fed input examples and corresponding outputs. Consists of a few nodes.
    2. Hidden layer: Given the product of the input samples as a FULL SET, and the addition of biases, and applying an activation function, outputs a predicted value for the function output. Consists of multiple nodes, usually more than the input layer.
    3. Output layer: Outputs the final predicted output of the image set from the activation function. Consists of one node.



Types of Machine learning

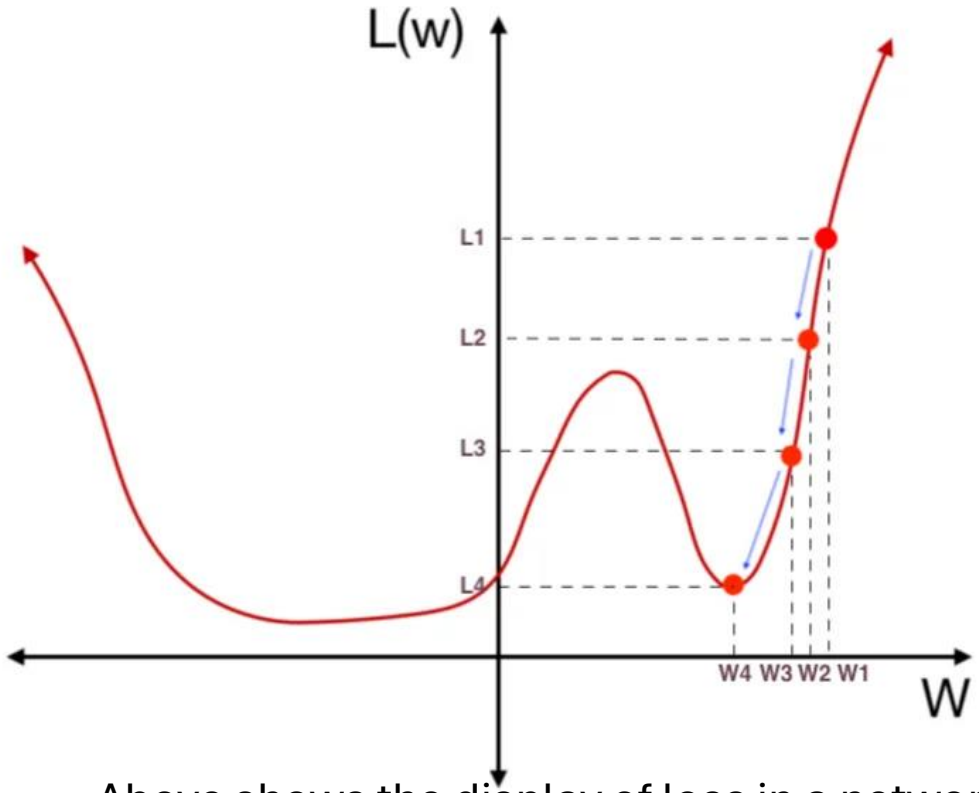
Deep Reinforcement Learning

Phases of a neural network

1. Cost calculation
    1. Fairly simple, you take the standard deviation of the outputs and predictions.
    2. Different types of cost fucntions to select from.

$$J = -\frac{1}{m}\sum_{i=1}^{m}\left(y^{(i)}\log(a^{(i)}) + (1-y^{(i)})\log(1-a^{(i)})\right)$$

y^i: inputted outputs to the neural network
a^i: Calculated outputs of the network based on your input dataset only



Above shows the display of loss in a network over application of several weights and biases over several iterations of the network

Types of Machine learning

Deep Reinforcement Learning

Phases of a neural network

1. Backpropagation
    1. Full of chain rule calculations
    2. Involves using existing calculated and inputted outputs to find change in weights, biases and outputs to converge your neural network
2. Updating parameters
    1. Subtracting the change in parameters multiplied by your learning rate from the actual parameters themselves.

Summary of gradient descent

$dz^{[2]} = a^{[2]} - y$	$dZ^{[2]} = A^{[2]} - Y$
$dW^{[2]} = dz^{[2]} a^{[1]^T}$	$dW^{[2]} = \frac{1}{m} dZ^{[2]} A^{[1]^T}$
$db^{[2]} = dz^{[2]}$	$db^{[2]} = \frac{1}{m} np.sum(dZ^{[2]}, axis = 1, keepdims = True)$
$dz^{[1]} = W^{[2]T} dz^{[2]} * g^{[1]\prime}(z^{[1]})$	$dZ^{[1]} = W^{[2]T} dZ^{[2]} * g^{[1]\prime}(Z^{[1]})$
$dW^{[1]} = dz^{[1]} x^T$	$dW^{[1]} = \frac{1}{m} dZ^{[1]} X^T$
$db^{[1]} = dz^{[1]}$	$db^{[1]} = \frac{1}{m} np.sum(dZ^{[1]}, axis = 1, keepdims = True)$

Above shows the calculation of the changes in different parameters of the neural network, with these changes being applied to the main neural network for improving and converging it.

$$w := w - \epsilon \frac{\partial C}{\partial w}$$

$$b := b - \epsilon \frac{\partial C}{\partial b}$$

Types of Machine learning

Deep Reinforcement Learning

- Repeat these steps for as many iterations as you want, changing the layer sizes to accommodate your inputs.
- Training: Forward propagation, backpropagation, cost calculation and parameter updating
- Testing: Forward propagation
  - This just gets output using the trained weights and biases
- Now lets get into some more details!

Types of Machine learning

Deep Reinforcement Learning

- Step 1: Input your dataset.
  - Any formattable data or file type
- Step 2. Choose your activation function
  - This depends on your deep learning problem
  - Different types per each type of layer
- 3 types:
  - Sigmoid
  - ReLU
  - Softmax

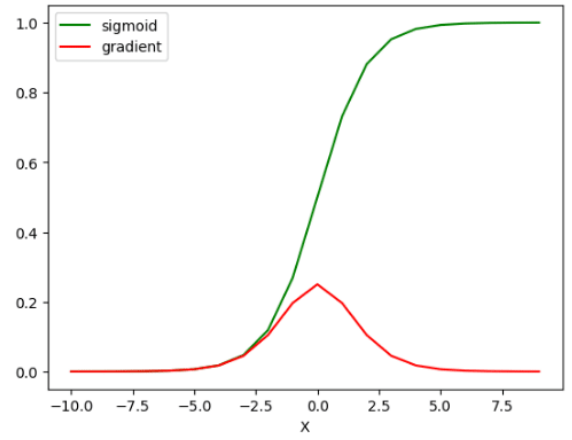
Types of Machine learning

Deep Reinforcement Learning

- Activation function: Sigmoid

Sigmoid Activation Function

$$f(x) = \frac{1}{1 + e^{-x}}$$



Following chain rule to find derivative

$f(x) = \frac{1}{x} \rightarrow f'(x) = \frac{-1}{x^2}$

$f(x) = e^x \rightarrow f'(x) = e^x$

$$f'(x) = \frac{-1}{(1+e^{-x})^2} * (-e^{-x}) = \frac{e^{-x}}{(1+e^{-x})^2} = \frac{1}{(1+e^{-x})} * (1 - \frac{1}{(1+e^{-x})}) = f(x) * (1 - f(x))$$

Sigmoid:

```
s = 1/(1+np.exp(-x))
```

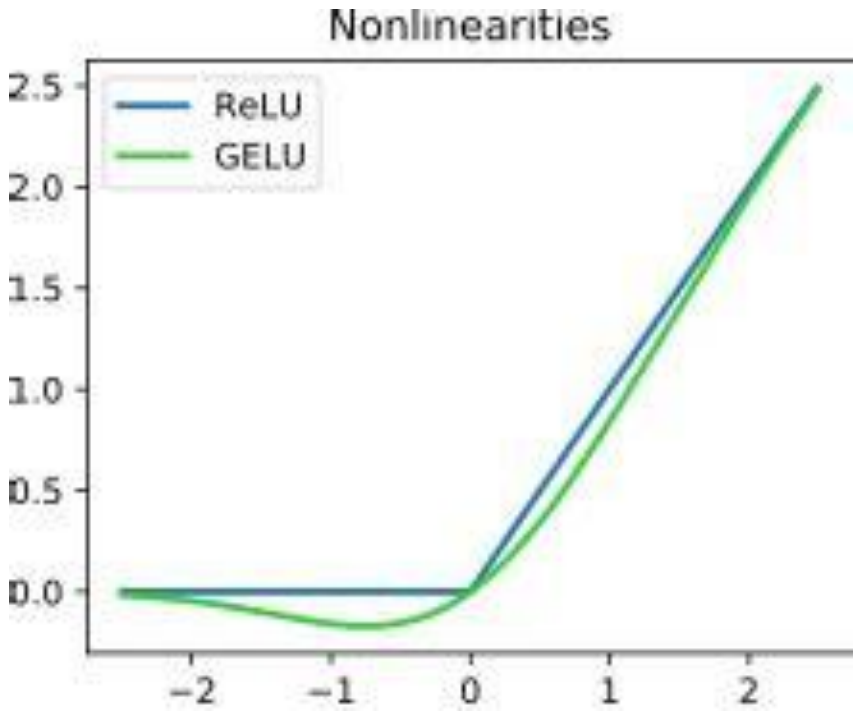
Derivative of sigmoid:

```
s = sigmoid(x)
ds = s * (1 - s)
```

Types of Machine learning

Deep Reinforcement Learning

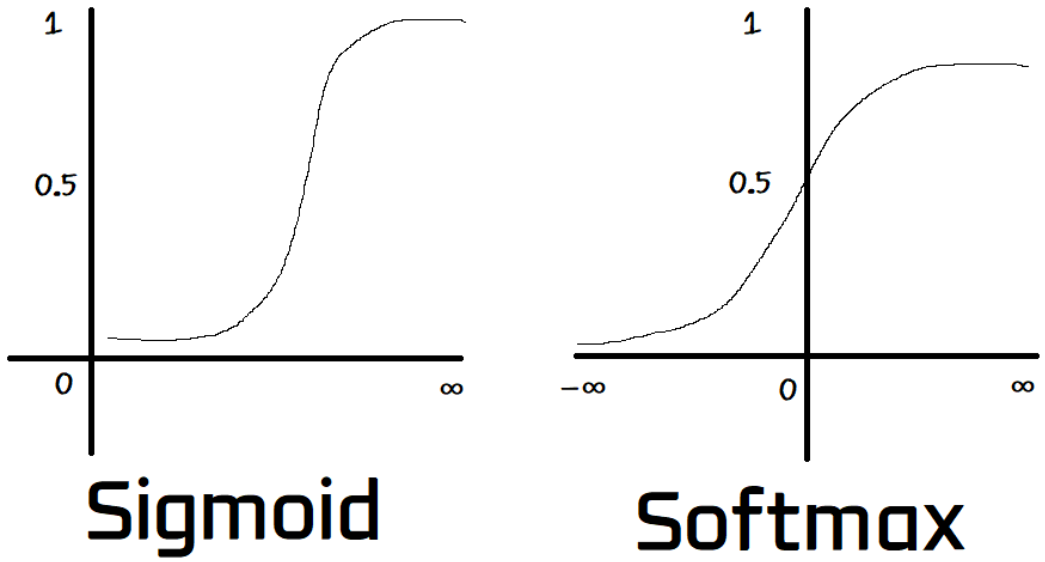
- Activation function: ReLU



Types of Machine learning

Deep Reinforcement Learning

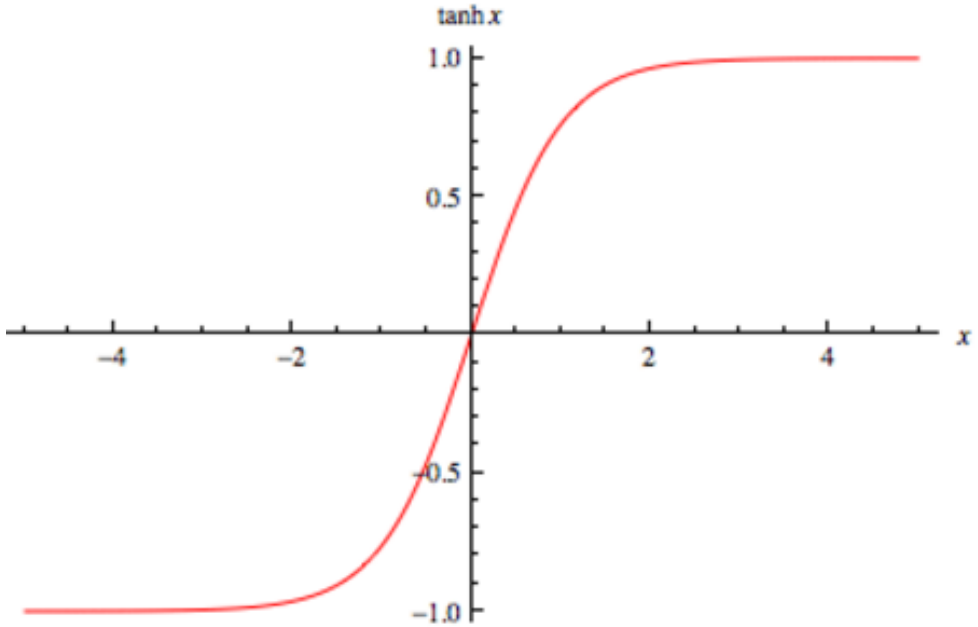
- Activation function: Softmax



Types of Machine learning

Deep Reinforcement Learning

- Activation function: Tanh



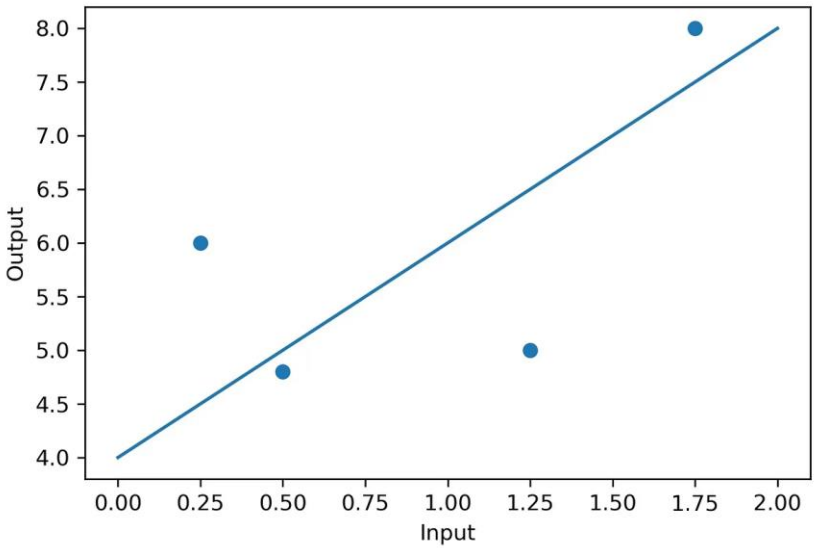
$$\mathrm{Tanh}(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

Types of Machine learning

Deep Reinforcement Learning

- Cost function

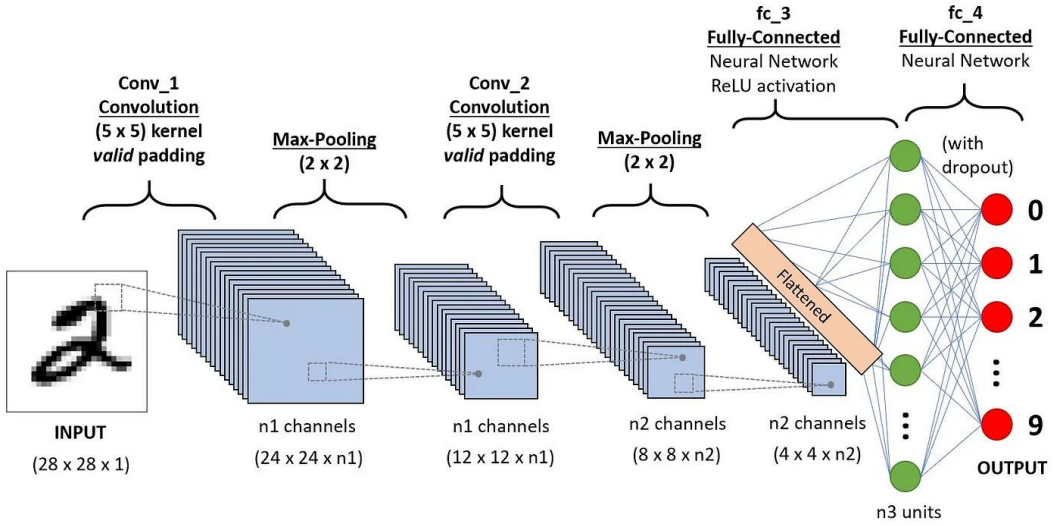
Linear regression

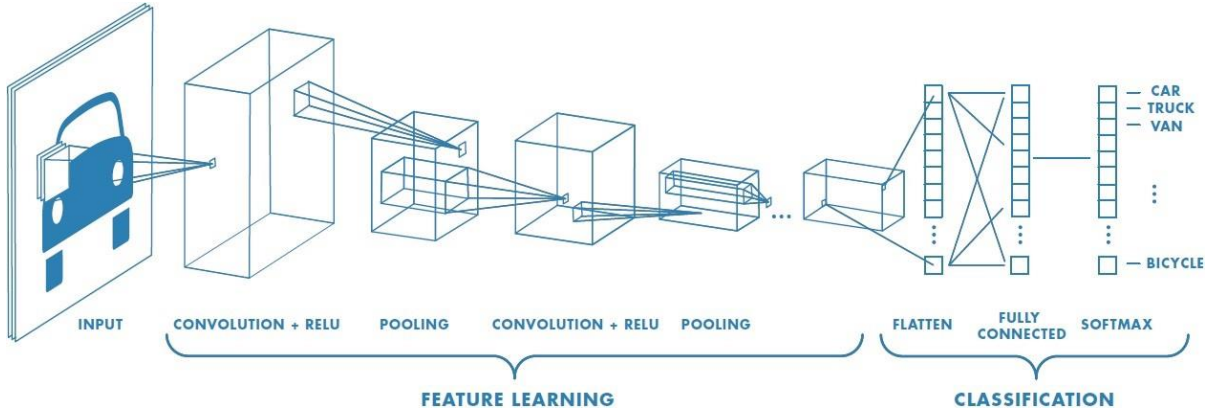


Types of Machine learning

Neural networks

- Convolutional neural networks:





Types of Machine learning

Neural networks

- Convolutional neural networks:

1. Convolution: Applies a kernel of an even size on a series of equally sized images to find edges based on pixel intensity or averaging pixel intensities
    1. You can do this as many times as you want to isolate edges
2. Pooling: reduce the size of any image while maintaining the most important features to isolate specific areas
3. Activation functions: Typically rectified linear units to further isolate edges
4. Fully connected layers: Applies the softmax activation to normalize and process the functions in a single-row array to be used for **forward propagation**
5. Backward propagation: Calculates changes in outputs, weights and biases recursively to match the output change for all inputs
    1. Essentially the same as artificial neural network backpropagation

Types of Machine learning

Neural networks

- Convolutional neural networks:

Artificial neural network	Convolutional neural network
Use multiple layers	Use multiple layers
Apply an activation function to the end of the simplified image	Apply an activation function to the end of a broken down and connected image
Apply the activation function in the hidden layers	Apply convolution and masking in multiple layers
Better suited with ReLU functions for forward propagation	Better suited with ReLU for forward propagation
Sigmoid applied on final output	Softmax applied on final output
Suited for binary classification or discrete identification	Better suited for diverse and specific classification of datasets

Types of Machine learning

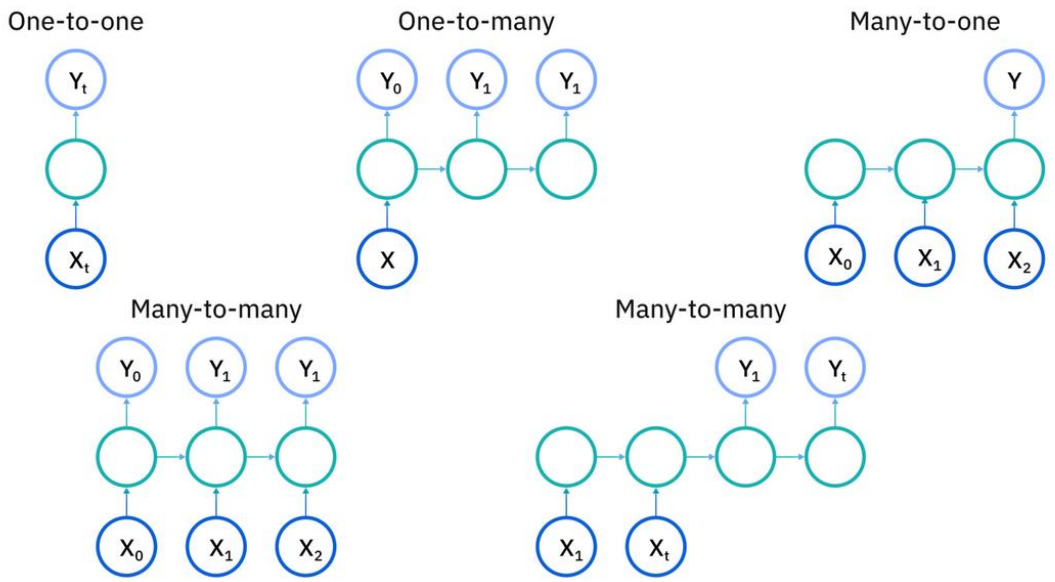
Neural networks

- Convolutional neural networks terms:
  - Softmax: Collapses the list of output floats in the collapsed vector of the trainee images into a list of probabilities each for what the model could output
  - Cross-Entropy Loss: Dictates the difference between predictions and outputs, and must be minimized for optimization
    - Entropy is the uncertainty of a variable, so the logarithm will highlight differences in outputs and predictions
  - Pooling and connection: Splits the image into equally sized kernels and resizes them for processable formats to apply activation functions on in order to calculate outputs of the function
    - This way you can compare them to your inputted outputs, just like ANNs (artificial neural networks)

Types of Machine learning

Neural networks

- Recurrent neural networks:
  - Trained on sequential or time-based data to create a model to make predictions based on time-based inputs
  - used to solve ordinal or temporal problems such as language translation, natural language processing (NLP), sentiment analysis, speech recognition and image captioning



Types of Machine learning

Neural networks

- Recurrent neural network types
  - Standard: Good for linear claculations and predictions
    - Only use equal-sized layers
  - Bidirectional: Good for AI writers, grammar checkers, or chatbots
    - Reliant on past and future data
  - LSTM: Good for story writing and essay writing
    - Consist of 3 gate nodes to control flow of information
    - A solution to the vanishing gradient problem
  - Gated recurrent units: Good for time-sensitive processing
    - Nodes with 2 gates: reset and update, manual version of binary weight nodes
  - Encoder-decoder: Good for translation and language
    - Used for sequential inputs and outputs, relying only on one input at a time

Types of Machine learning

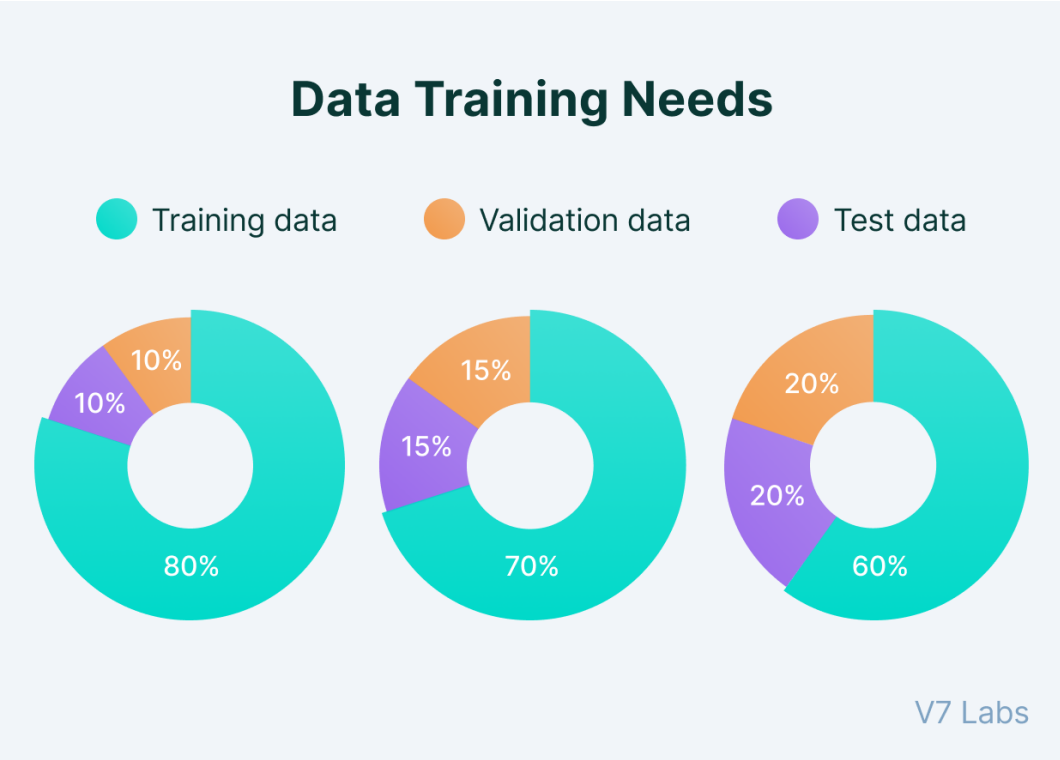
Neural networks – Common pitfalls

- Vanishing gradient: Overall error and final output vs input relation inconsistent
- Overfitting: Too many similar examples
  - Solution:
    - Dropout regularization: randomizing values to dropout
    - Augmentation: Editing the image to vary the output
- Irregularization: Not the same type or scale of image
  - Solution: Normalization and penalty inductance

Types of Machine learning

Neural networks – Tips

- Make sure that training and test sets come from the same distribution
- Have a high variance in your training set and a low bias, but include lots of training samples
- Maximize your training set(80% training set, 10% validation set, 10% test set)
- Incentivize rewards and penalties through regularization and dropout

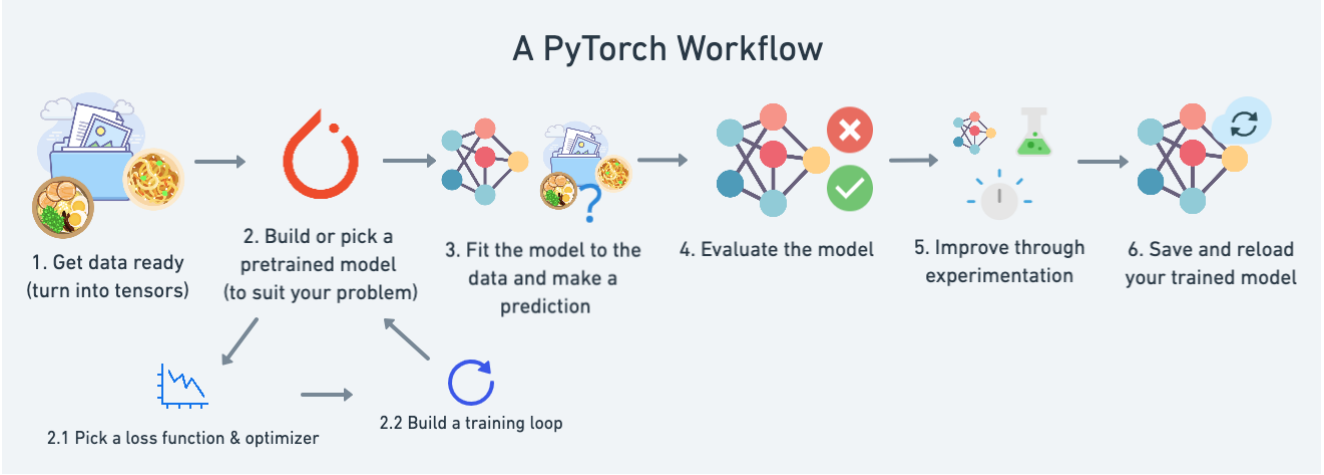


Types of Machine learning

Neural networking libraries:

PyTorch

- Used in computer vision and NLP
- Tensor computing and GPU-powered acceleration
- Built and governed by subsidiary of Linux
- Training supports tensor-based applications, enabling high-density neural network development



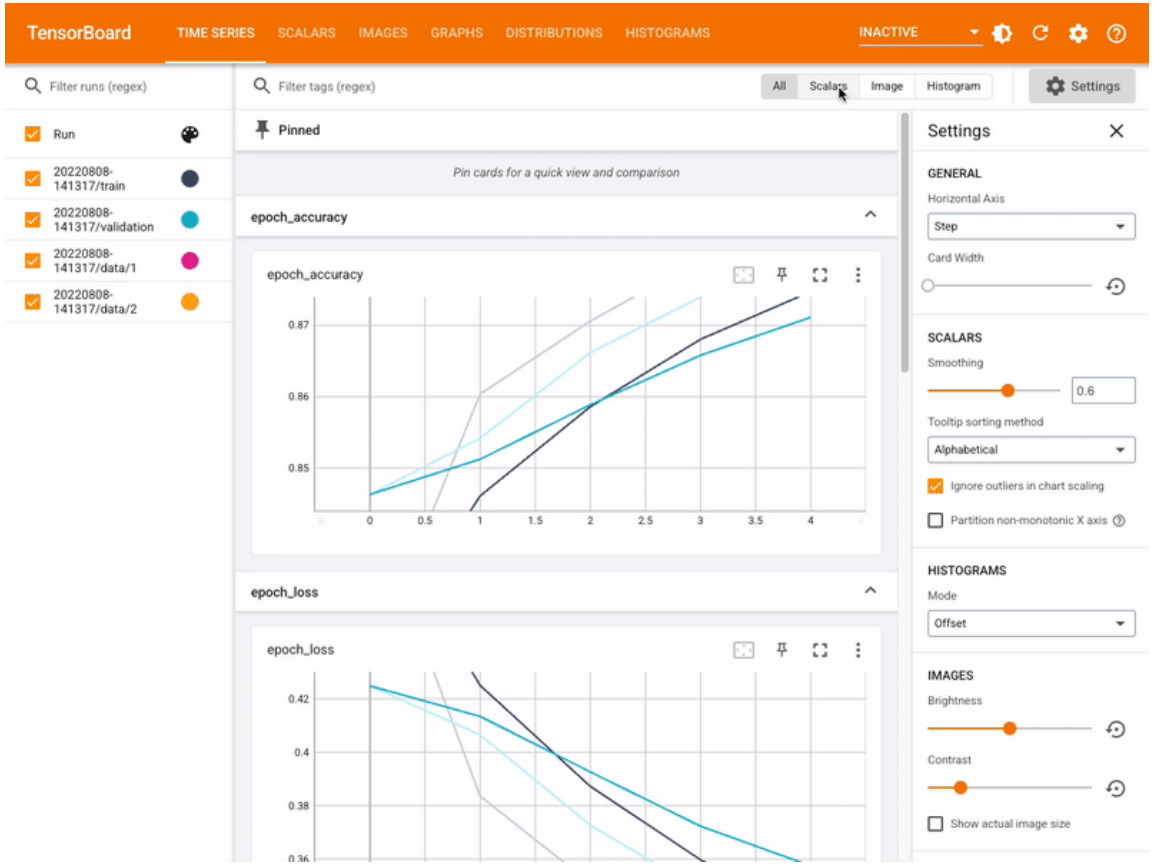
- Use tensors, a NumPy-based array of numerical data types that can be operated on NVIDIA GPUs to access machine instructions
  - Contain C processing compatibility

Types of Machine learning

Neural networking libraries:

TensorFlow

- Open-source visualization and organization
- Supports Keras as high-level API
- Contain datasets for training, testing and allows for validation and transformation of these datasets
- Uses TensorBoard visualization of connections, performance and cost of examples and the network
- Uses LiteRT to run on mobile devices, edge computing devices, and even microcontrollers

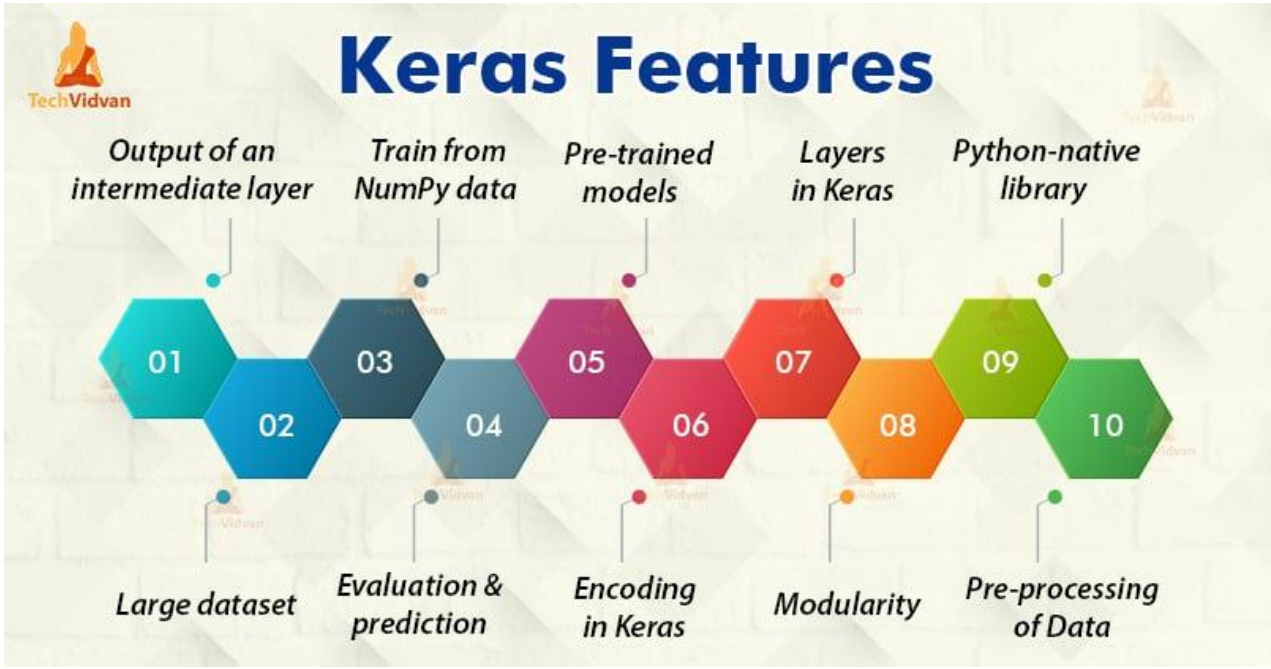


Types of Machine learning

Neural networking libraries:

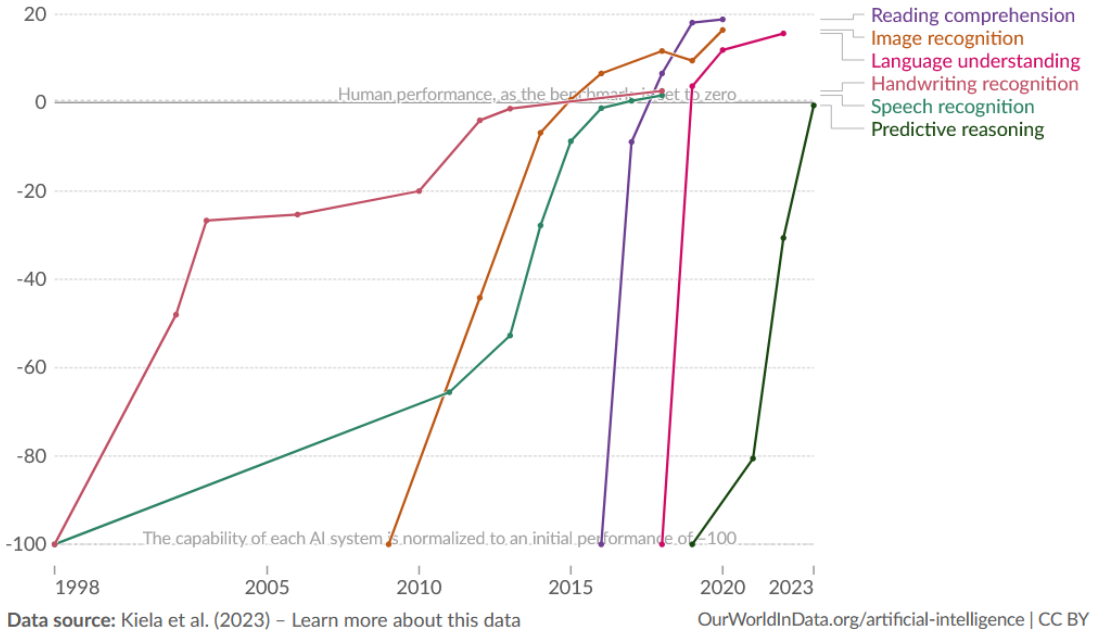
Keras

- Accessible thorugh TensorFlow as “tf.keras” module
- your codebase is smaller, more readable, easier to iterate on
- Built on top of high-level computations
- Contain pretrained models on large datasets
- Works on C-parallelism environment for GPU processors
- Use transformer-based models



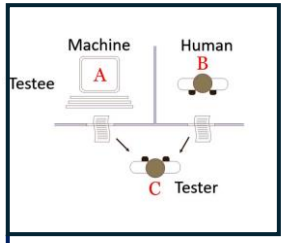
History of AI

- Branch of computer science focusing on smart machine
- Coined “artificial intelligence” in 1956, to distinguish from cybernetics
- Considered the “big data equalizer” in collection, analysis and broadcasting of information
- The first chatbot was invted in 1966, simulating a conversation between a psychotherapist and users as text-based conversations
    - This was the foundation of natural language processing
- AI fell off in the ’80s due to lack of funding and progress, but was revived with neural networks and genetic algorithms laying the foundation of AI
- Big data only came up in the 2000s, where the availability of large amounts of data across the Internet paved the way for GPUs, computer vision and language processing, allowing for the everyday applications of AI we all know



History of AI

1950
Alan Turing proposes the Turing Test

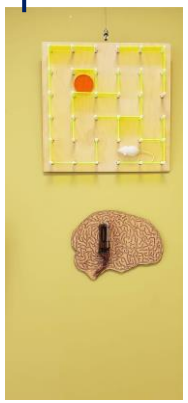


1960
First mathematical AI integration program developed

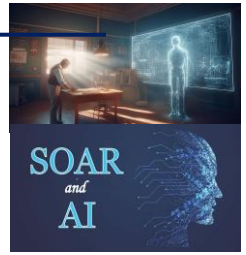
1963
First self-adjusting AI program developed

1965
First interactive AI conversational program in English

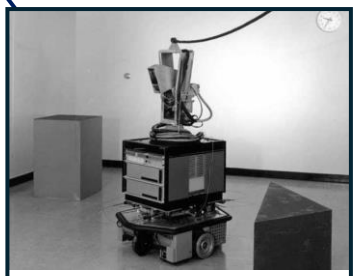
1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2010s | 2020s



1951
Theseus, the first inspiration of AI



1956
The first AI program, the Logic Theorist, to solve complex math problems



1968
Shakey, the first mobile robot programmed with AI

History of AI

1986
First self-driving car developed in Germany, as a Mercedes Benz

1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2010s | 2020s

1970
SCHOLAR developed to relate input to each other based on keywords

1980
First Lisp machine developed, and connection machine designed for aI

1989
Development of metal-oxid semicondjuctor technology for very large scale integration to use an artificial neural network

History of AI

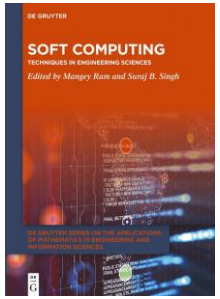
1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2010s | 2020s

1995
Semiautonomous car drives 1000 miles from Munich to Copenhagen and back

1991
Gulf War AI scheduling application for DARPA

1997
Deep Blue chess AI computer beats Garry Kasparov

1990
First backgammon program demonstrating AI in gaming



1994
Introduction of sot computing and relation of artificial intelligence to biology

1998
First domestic toy robot developed by Tiger Electronics

1999
Web crawlers and data extraction becomes integrated in search engines

History of AI

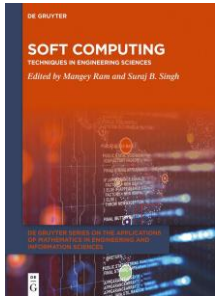
1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2010s | 2020s

1995
Semiautonomous car drives 1000 miles from Munich to Copenhagen and back

1991
Gulf War AI scheduling application for DARPA

1997
Deep Blue chess AI computer beats Garry Kasparov

1990
First backgammon program demonstrating AI in gaming



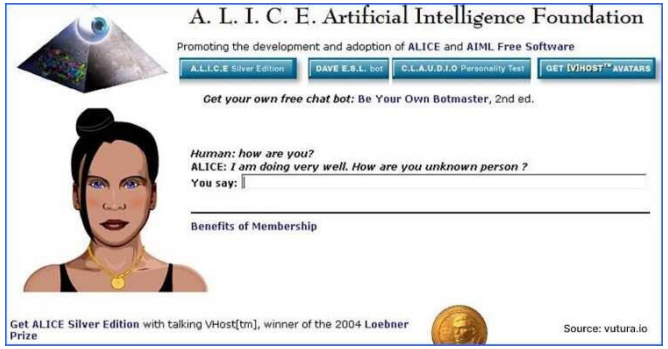
1994
Introduction of sot computing and relation of artificial intelligence to biology

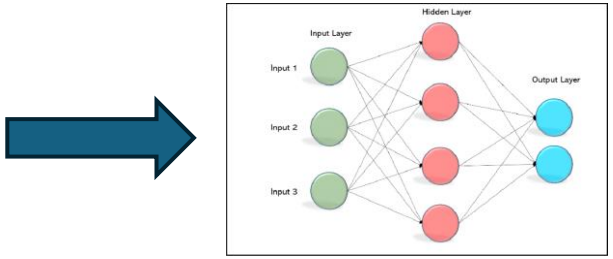
1998
First domestic toy robot developed by Tiger Electronics

1999
Web crawlers and data extraction becomes integrated in search engines

Stages of AI

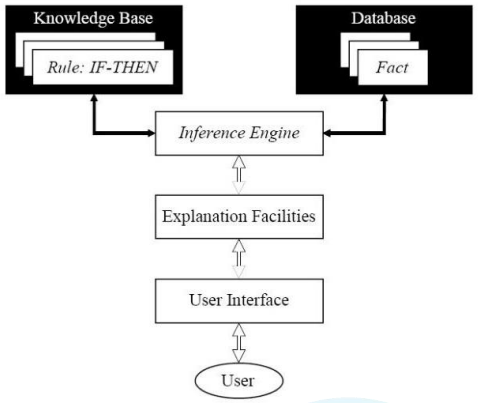
Chatbots

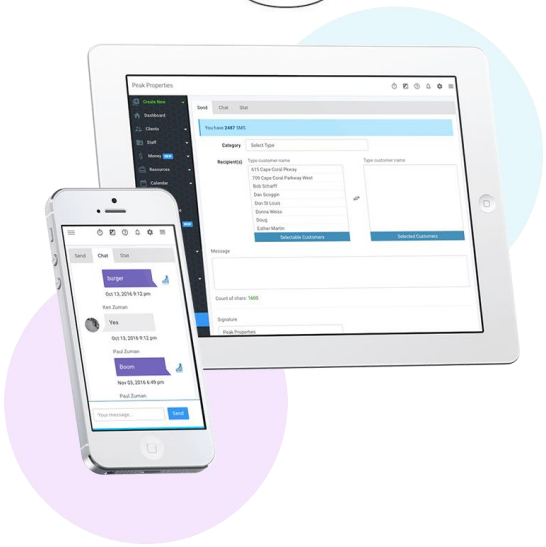




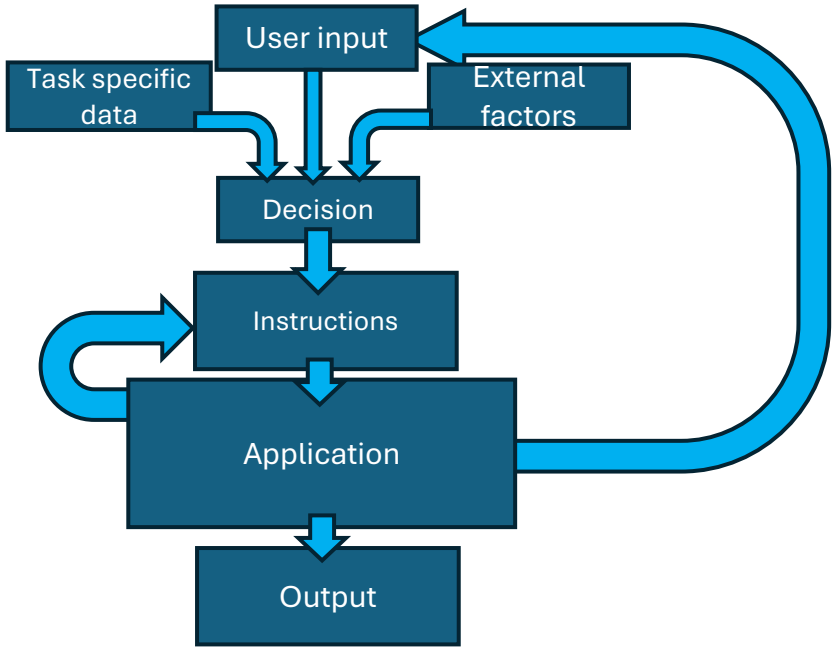
Stages of AI

Decision-based systems





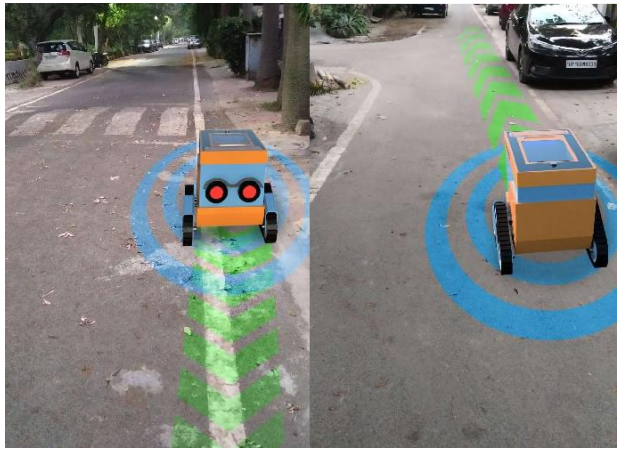
Context-awareness based systems

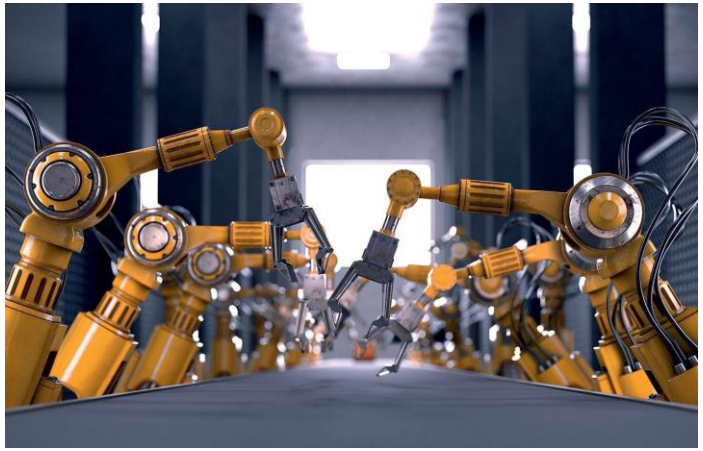


Domain Specific Expertise

OpenAI ChatGPT **4.0**

How has AI changed the world?





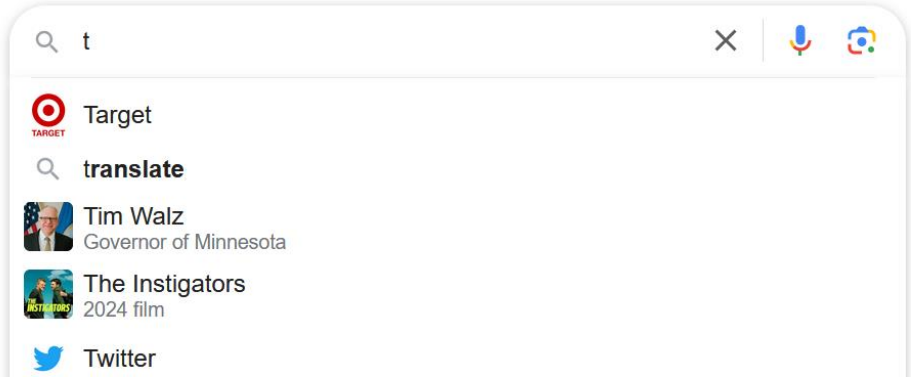
AI Progression

- Applications:
  - Vision: Understanding or creating images/video
    - Object tracking, object detection, facial recognition, self-driving cars
  - Language processing: Understanding or creating speech/text
    - Siri, Alexa, text-to-image
  - Machine learning: Allows computers to learn from data and improve performance
    - ChatGPT, fraud detection, healthcare (diagnosis and prognosis) and recommendation systems
  - Robotics: Design, testing and development of robots
    - Most broad application of all, can include any and all of the above fields
  - Business intelligence:
    - Acquiring, visualizing and analyzing data
  - Healthcare:
    - Diagnosis, prognosis, personalization of care to patients
  - Education:
    - Student engagement, real-time feedback, administrative tasks for school
  - Finance:
    - Document processing, risk and fraud protection, investment advice and financial goal analysis

Ways AI is Used

Computer Vision:

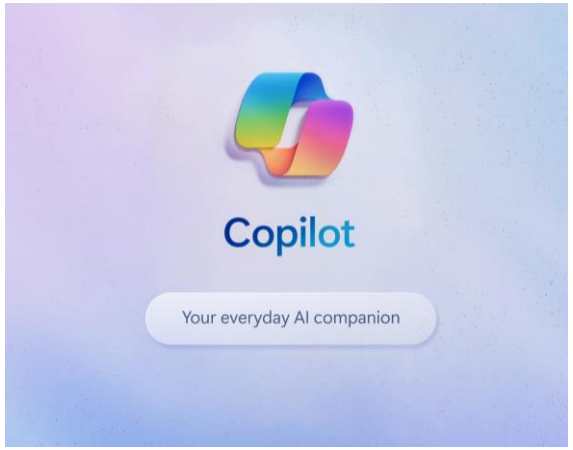
Search and Query:



Natural language processing:

Ways AI is Used

Writing:

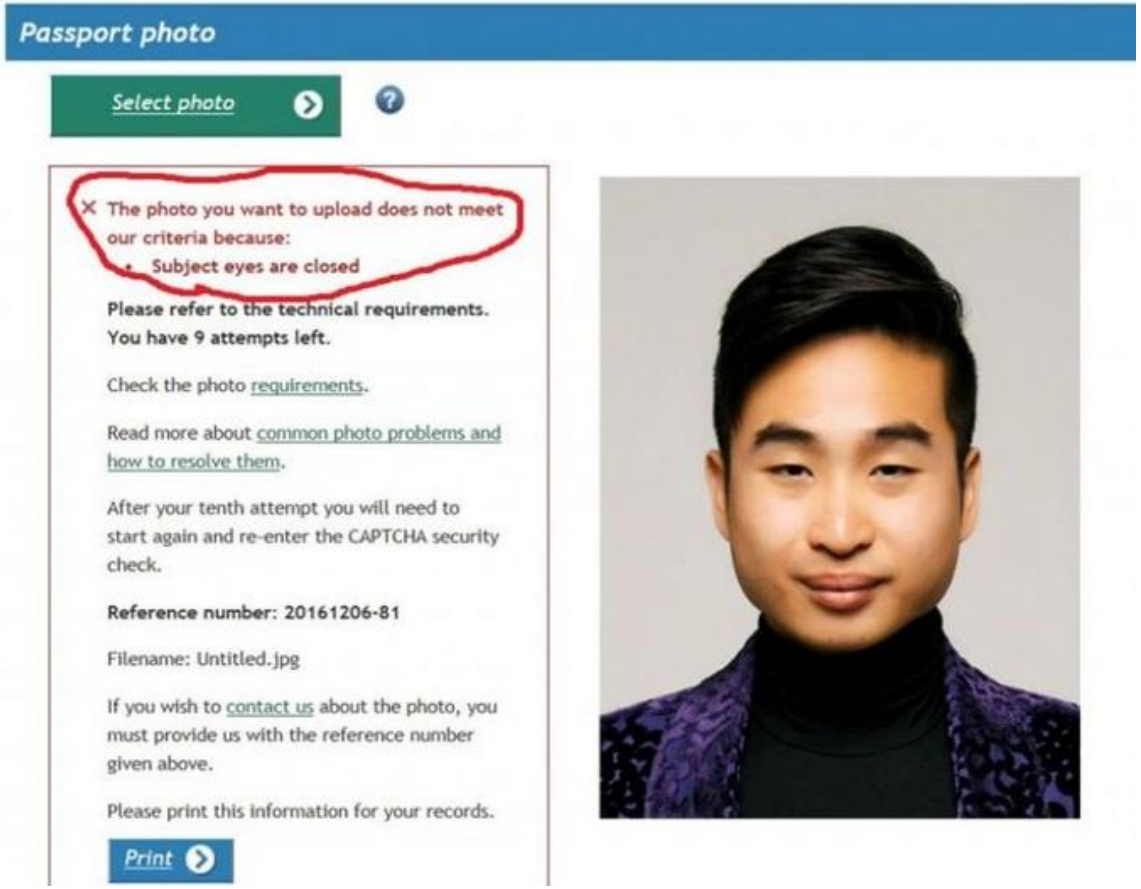


Business Intelligence:

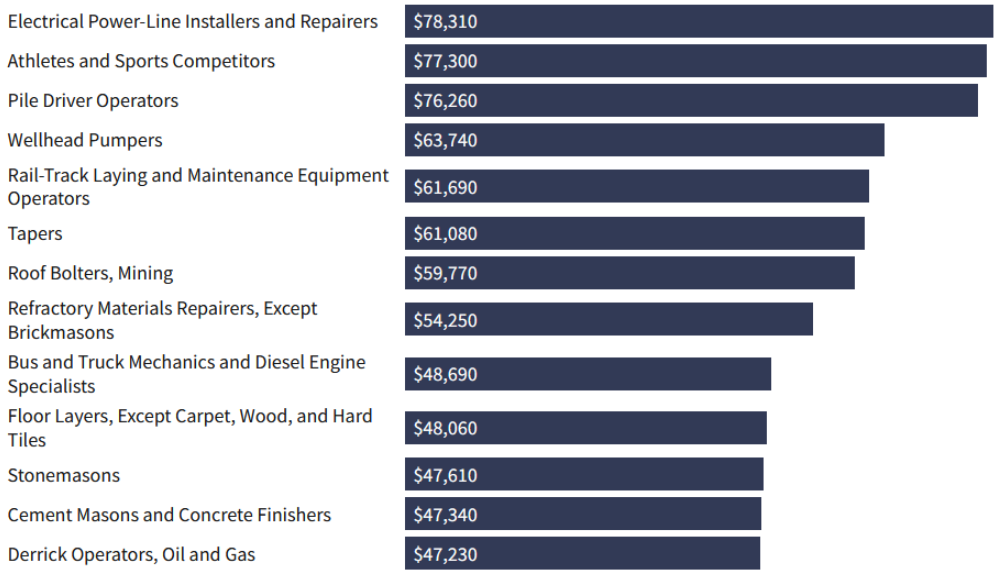
Natural language processing:

There is no such thing as general AI

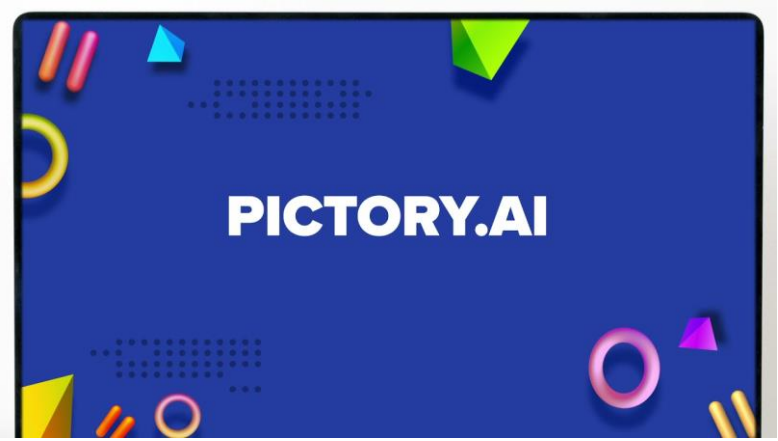
AI is not that intelligent

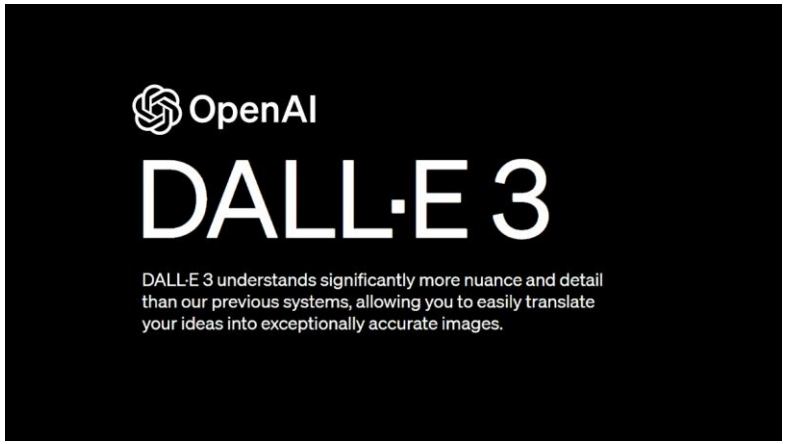


AI can’t replace all jobs



AI provides a foundation





How can an AI learn?

- Choose the purpose and the data for the AI
- Most AI is narrow and single-purposed

Types of AI

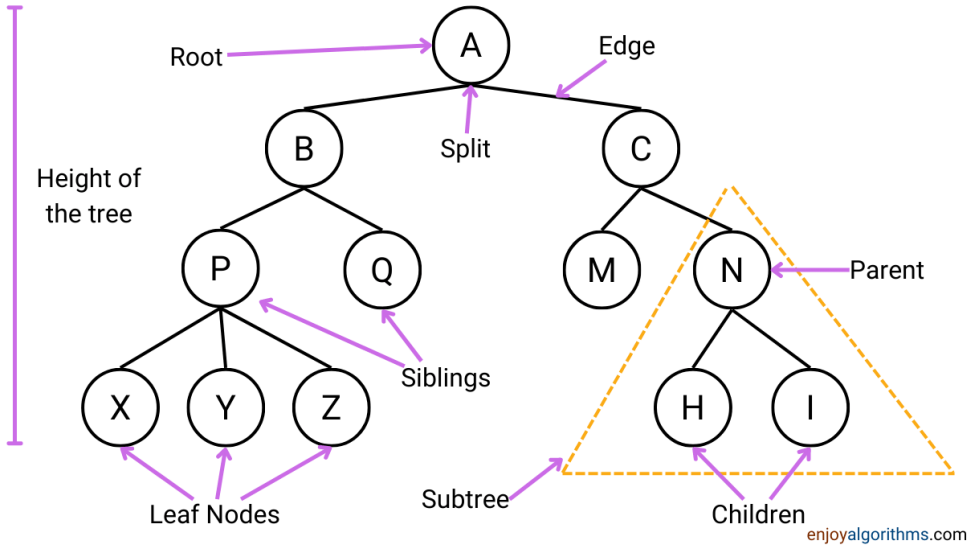
- Deep learning: A way of organizing information layer by layer to teach a computer
  - The deeper the network, the more complex and intricate the detail is
  - The more layers there are, the less time it takes to learn
  - Neural networks are the alternate ways to teach students of these issue
- Machine learning: Training algorithms on data sets to perform human-like tasks

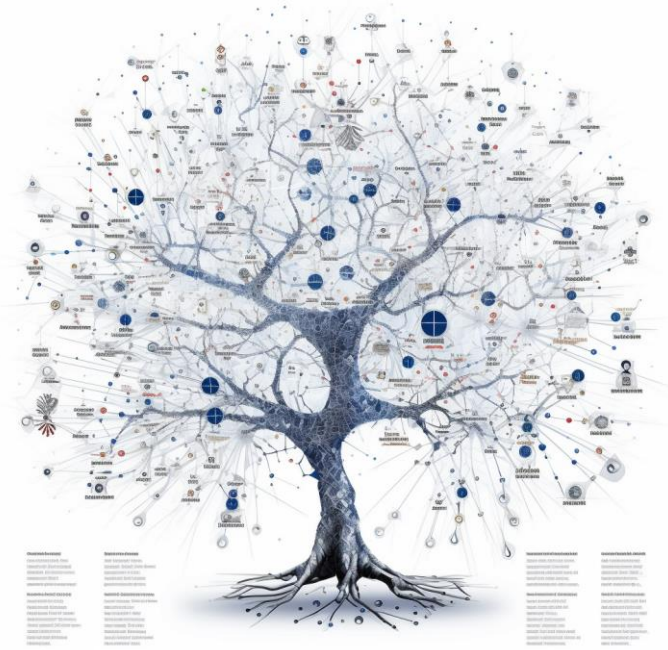
Ways to implement AI

- Two classical ways:
  - Expert system: A person writing a list of rules (if this, then that)
    - Can be useful to determine one-step choices
    - Can be used to map out conditions
    - BUT….Most of our choices we make are actually quite complex, such as identification
    - We need to add in the background assumptions we humans have to the machine to make the same choices we do, which takes a long time
    - Some problems where heuristics are the best solution (Interpretable, know it will happen, no need for a neural network for every problem)
    - Can’t solve every problem

Ways to implement AI

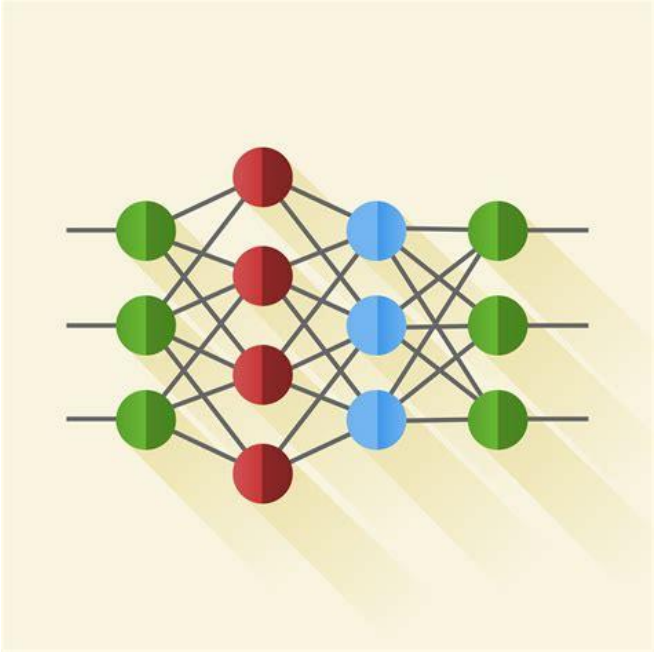
- Two classical ways:
  - Tree search
    - Start from one state and enumerate all options from each stae
    - Multiple loops in the state
    - Different paths formed from start to goal state with all nodes in tree

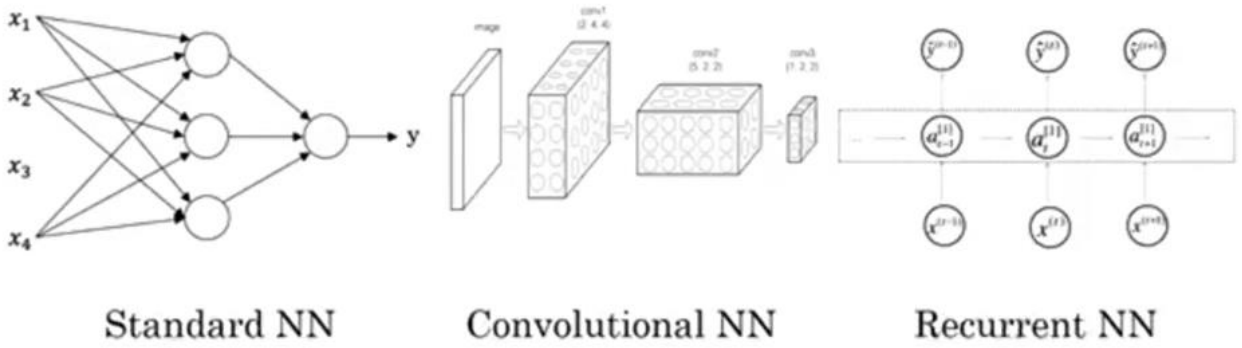




What is A Neural Network?

- A group of interconnected units, or neurons, that send signals to one another
  - Can consist of mathematical nodes or biological nodes
  - Similar to the nerves inside your body





Standard NN Convolutional NN Recurrent NN

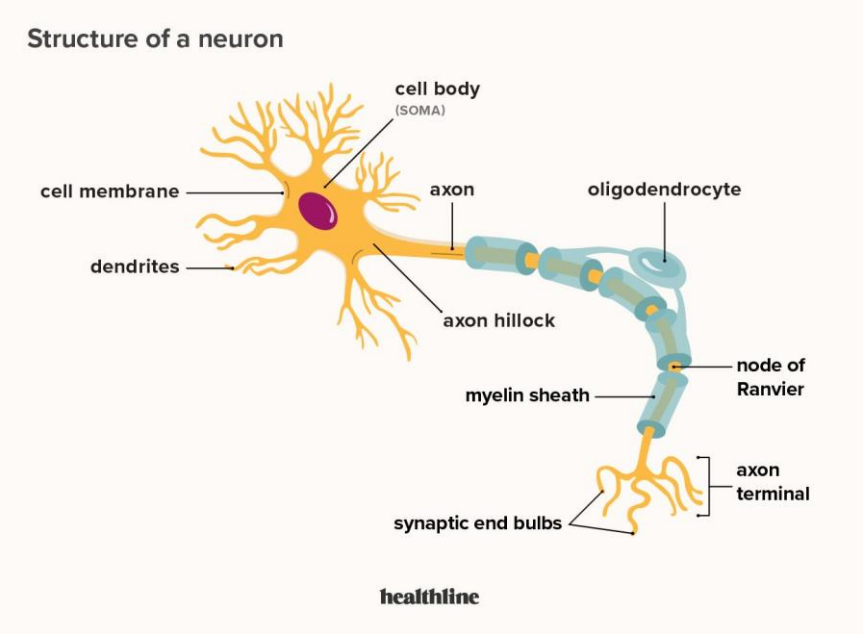
Your Neural Network

How does a neuron work?

- Consists of a cell body, dendrites and an axon
- Each neuron connection comprises the electrical circuit that makes up the body with many inputs and outputs

How does this relate to AI?

- Machine learning consists of nodes connected to each other to form a network for learning information
- Nodes are arranged in layers where the deeper the layer, the finer the details of the input data are



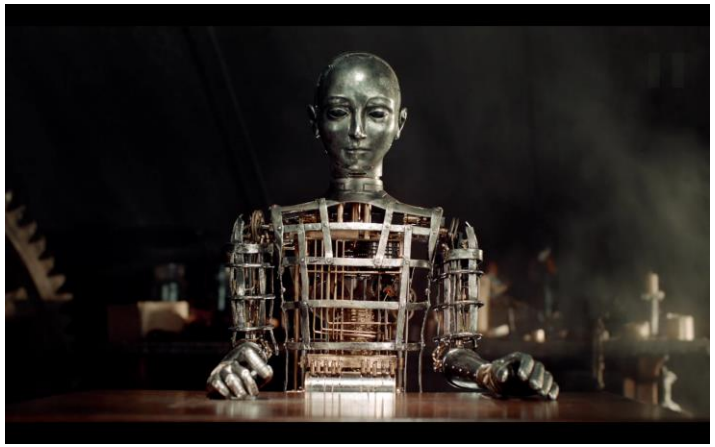
Cell Body: Contains genetic information and energy to drive activities

Dendrite: Roots that receive and process signals from axons of other neurons

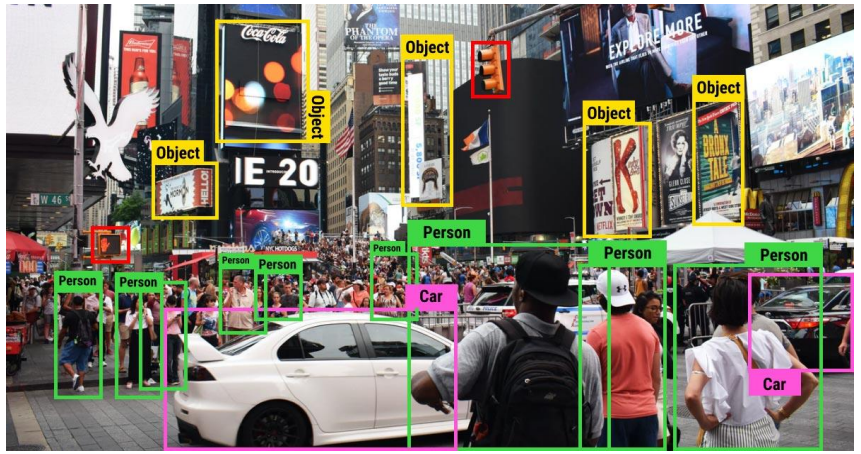
Axon: Coated with myelin sheath, helps axons conduct an electrical signal, usually have one main axon

Quiz!

- Automaton



- Image recognition

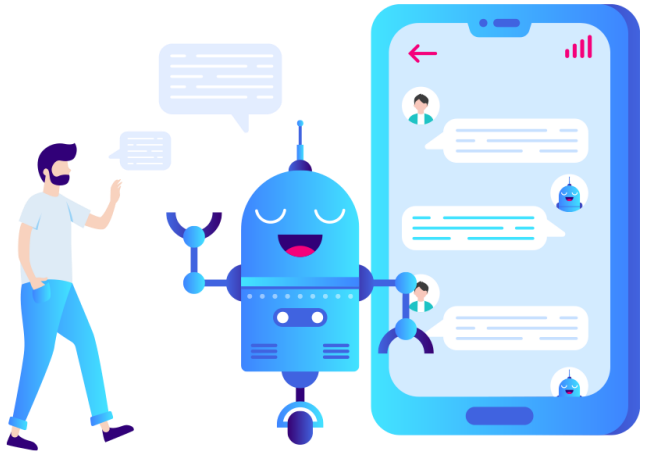


- Data analytics

Quiz

- Sound detection

- Virtual assistant



- Robotic guide dog

Quiz

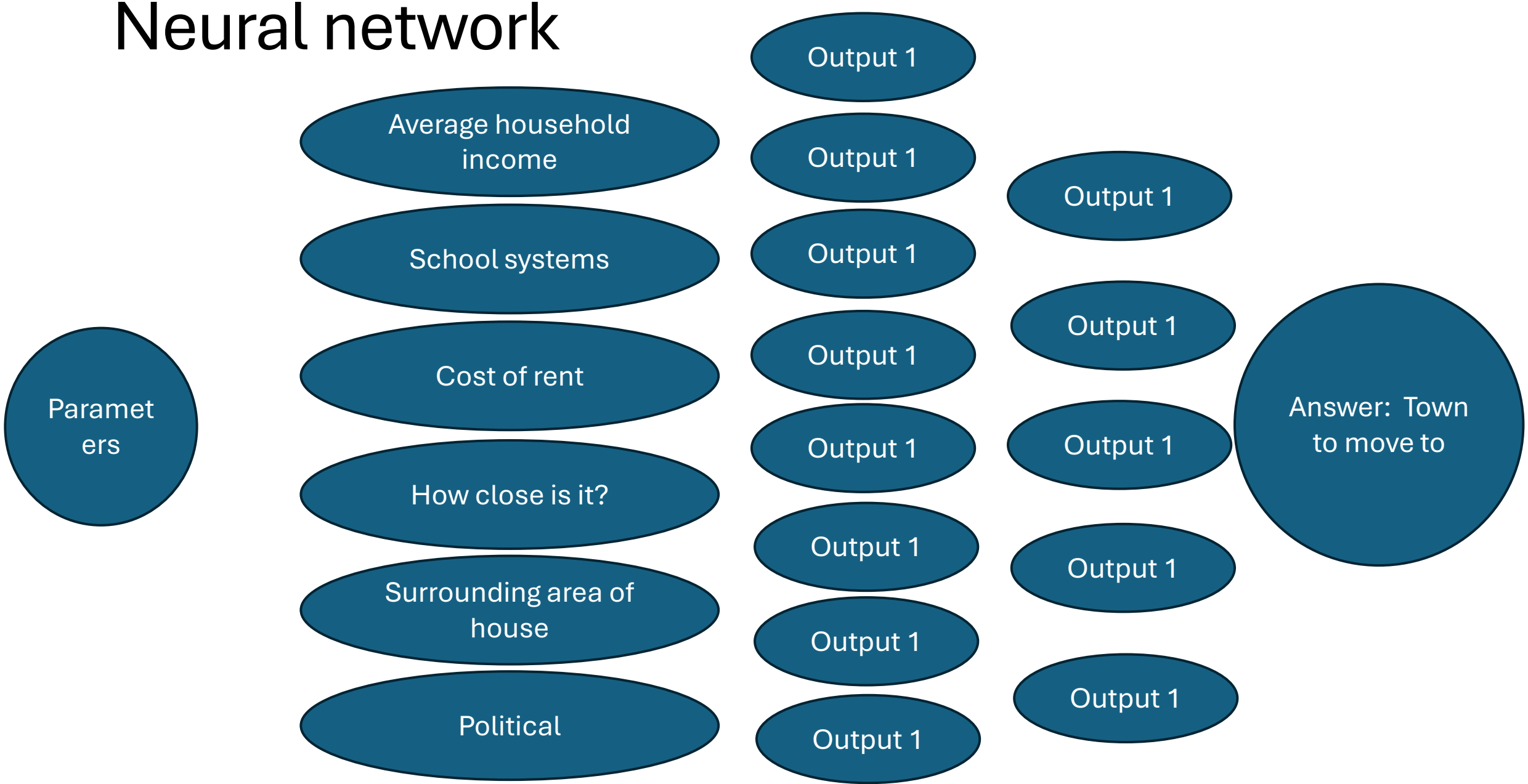
- Smart home

- Roomba

How does neural networking work?

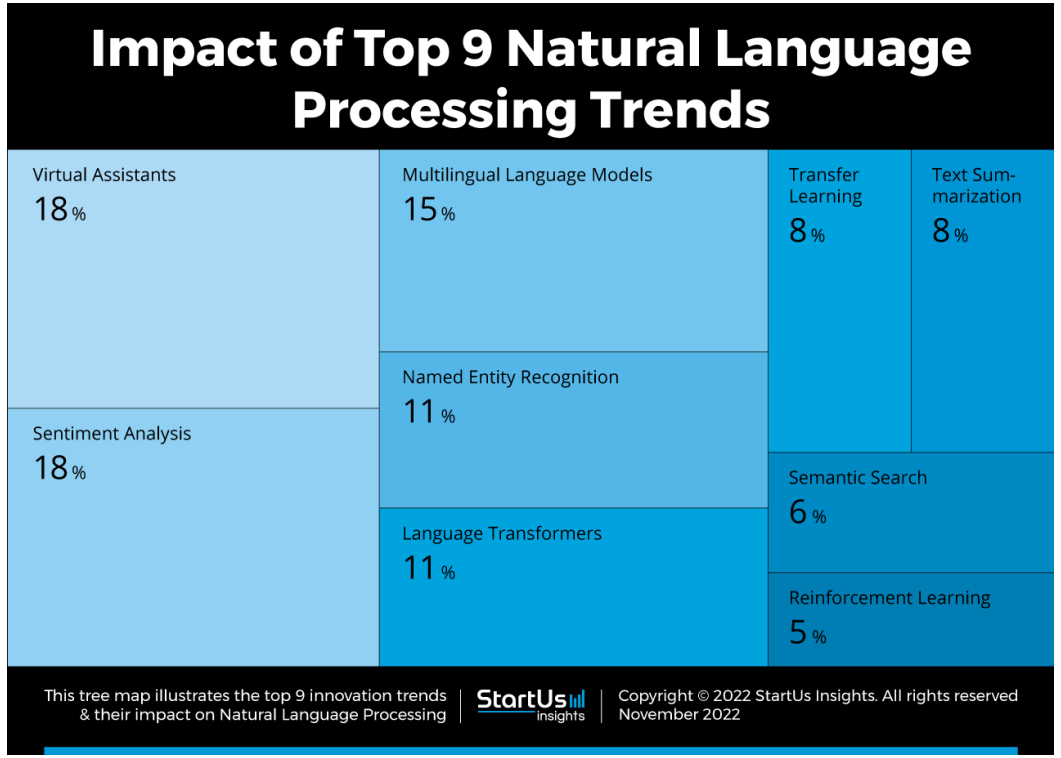
- Premise: Given a solution to a problem, how can we break it down?
- Neural networks is not just for quantifying the relationship between an question and a target, but it automatically finds the best factors for a task
- Example: You are moving to another town. Given a list of towns, we need to figure out the best place to move to. Let’s demonstrate it!

Neural network



Trends of AI

- Natural language processing
  - Sentiment analysis: Leraning and adapting emotional state of chatbots
  - Multilingual language models: Understanding unstructured data in context to learn grammar and structure of different languages
  - Transfer learning: transferring what an AI has learned to speed up training of new modles, similar to a teacher



Trends of AI

- Robotics
  - Autonomous mobile robots: Manufacturing automation, adapting to different environments and goods
  - Robotics as a Service: Democratization of robotics to firms without large investments, essentially a subscription
  - Humanoid robots: Implementation of NLP, natural and intuitive communication with any group by age, demographic, income, nationality, or location
  - Collaborative robots: Robots that work together on automation to allow for more creativity in automation

Trends of AI

- Healthcare
  - Virtual chatbots: Providing advice on diagnosis, treatments and medications, analogous to Baymax
  - Digital twins: Clones of individual organs, human body sstems, and processes to simulate treatment and lifestyle choices
  - IoT-powered hospitals: Remote monitoring of patients, telemedicine and more streamlined communication
  - 3D printing: Physical modelling of organs via body tissue, or printing implants, tools, devices, and prosthetics
  - Computer vision: Using object detection and convolutional neural networks for classification of symptoms

Trends of AI

- Entertainment and Media
  - Personalized recommendations
  - Virtual and interactive experiences: Virtual reality in games, 3D-simulated reality, and digital avatars, emblematic in “Ready Player One”
    - Tech giants have grown their AR/VR focused patent filings by over 90% since 2019. 5.2 million AR/VR headsets were sold globally in Q4 2022
  - **Generative AI**: **Using existing models (Stable Diffusion, GPT-3), to generate content based on existing content**
    - Usage of automatic text generation, photo-realsitc images and videos, chatbots, and personalized content
  - Fraud detection: Detection of bots, piracy and fakes via anomaly detection and preserve authenticity
    - Involves network traffic, authentication tracking and correlation of computer accesses

Conclusion

- AI is a dangerous, but useful tool for several departments
  - Robotics
  - Natural language processing
  - Healthcare
  - Entertainment
- Many different implementations
  - Neural networks
  - Machine learning models
  - Transformer-based learning
  - Supervised Learning
- Technology progress: Make it smaller, make it automated
- Job trends: Working around AI and applying machine learning

Conclusion

- Learn how to use neural networks, general-purpose transformers, and about machine learning
- Read up on trends
- Look into datasets such as CIDAR-100
- Look into and implement Google learning models such as GPT-3, Gemini, and DeepMind
- Experiment with as many training, test and validation sets as you can
- And have fun!

References

- https://www.healthline.com/health/neurons#anatomy
- https://www.ibm.com/topics/neural-networks
- https://ourworldindata.org/brief-history-of-ai
- https://www.techtarget.com/searchEnterpriseAI/tip/The-history-of-artificial-intelligence-Complete-AI-timeline
- https://petapixel.com/2022/09/14/man-asks-ai-to-recreate-his-photos-and-the-results-are-astounding/
- https://www.investopedia.com/jobs-ai-cant-do-7375111
- https://www.forbes.com/sites/jackkelly/2024/02/28/what-white-collar-jobs-are-safe-from-ai-and-which-professions-are-most-at-risk/
- https://arstechnica.com/tech-policy/2023/05/lawyer-cited-6-fake-cases-made-up-by-chatgpt-judge-calls-it-unprecedented/
- https://www.npr.org/sections/planet-money/2024/08/06/g-s1-15245/10-reasons-why-ai-may-be-overrated-artificial-intelligence
- https://www.newscientist.com/article/2118526-when-computers-were-human-the-black-women-behind-nasas-success/
- https://www.popsci.com/technology/the-first-ai-logic-theorist/
- https://www.reliablesoft.net/how-search-engines-work/
- https://www.nvidia.com/en-us/on-demand/session/gtc24-s62554/
- https://www.coursera.org/articles/ai-in-health-care
- https://approachableai.com/branches-of-ai/
- https://towardsdatascience.com/forward-propagation-in-neural-networks-simplified-math-and-code-version-bbcfef6f9250
- https://machinelearningmastery.com/choose-an-activation-function-for-deep-learning/
- https://hussenmi.medium.com/why-there-are-different-cost-functions-in-neural-networks-28818fad29f8
- https://medium.com/@sue_nlp/what-is-the-softmax-function-used-in-deep-learning-illustrated-in-an-easy-to-understand-way-8b937fe13d49
- https://www.digitalocean.com/community/tutorials/writing-cnns-from-scratch-in-pytorch#cnn-from-scratch