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Machine Learning Trends and Its Applications

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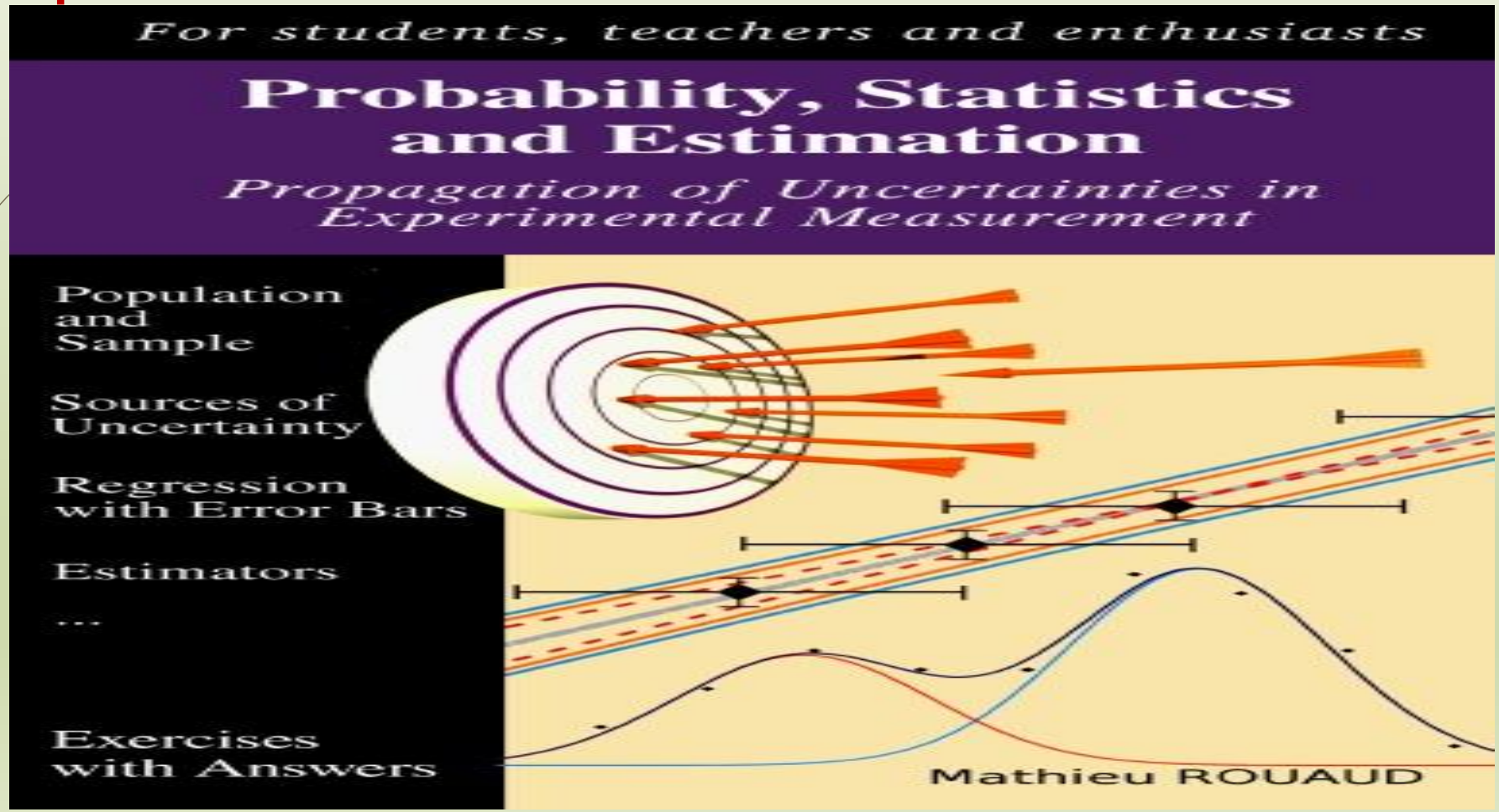

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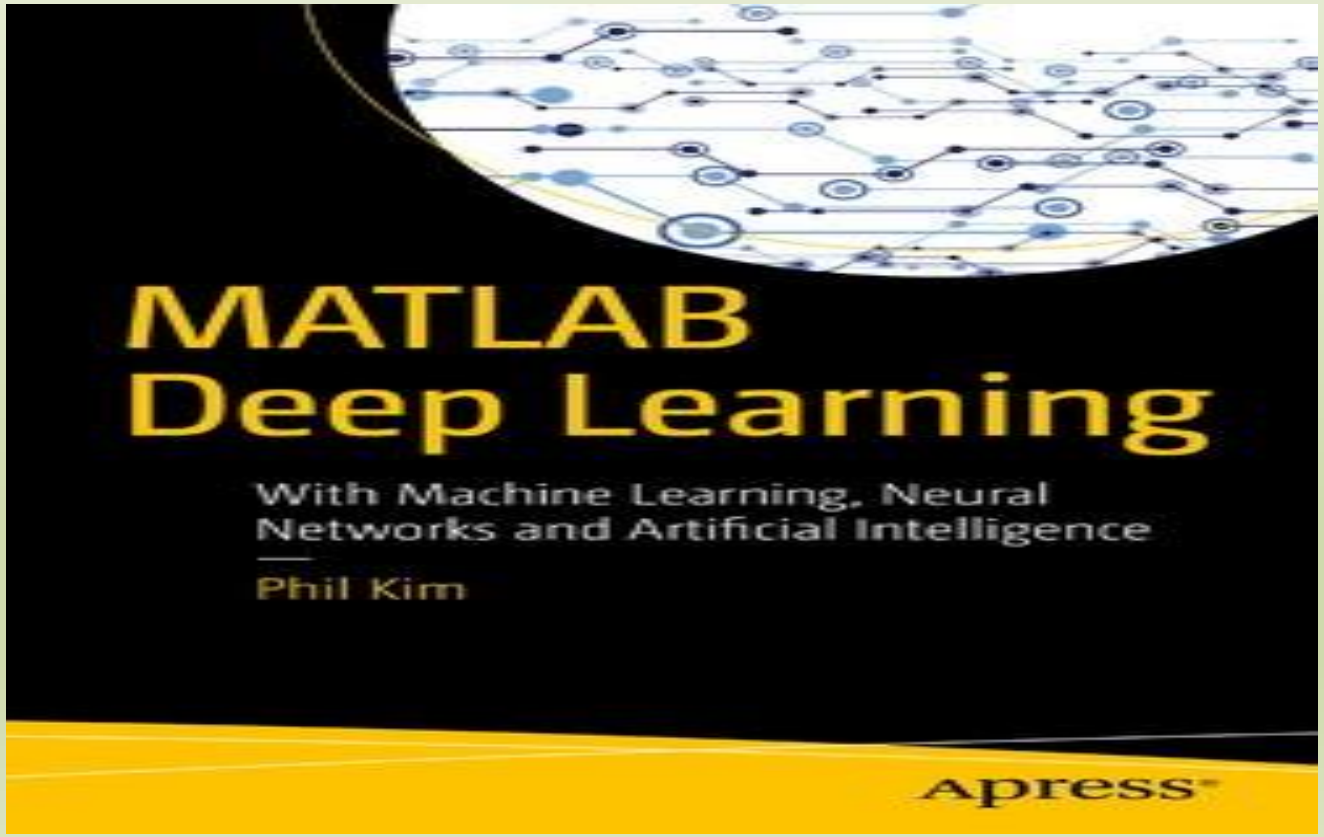

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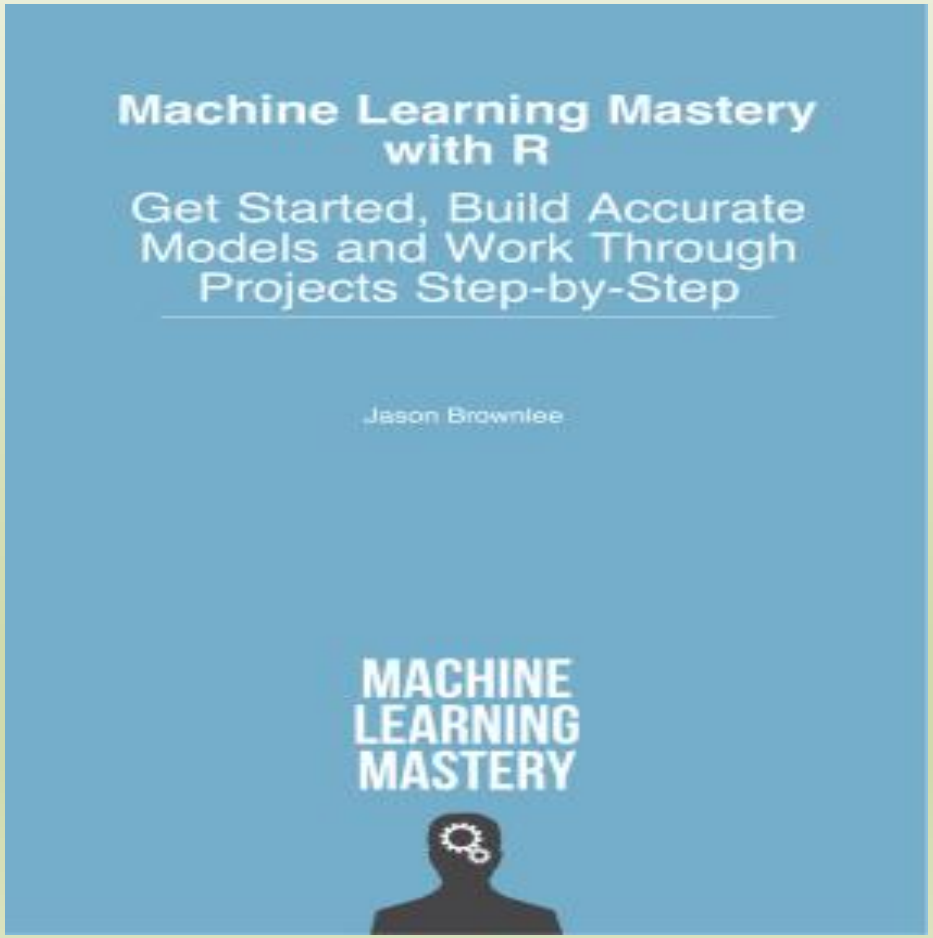

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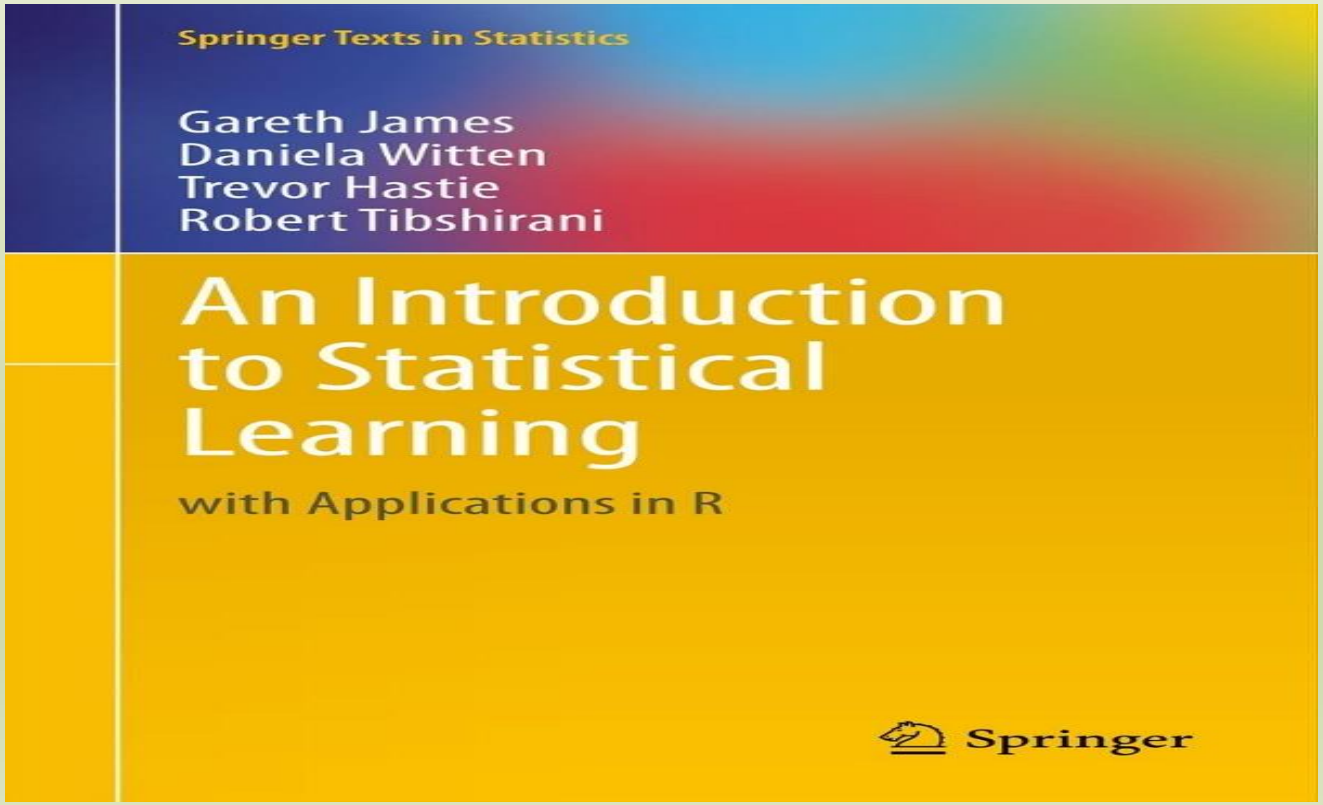


What are neural networks?

Neural networks were vaguely inspired by the inner workings of the human brain. The nodes are sort of like neurons, and the network is sort of like the brain itself. (For the researchers among you who are cringing at this comparison: Stop pooh-poohing the analogy. It's a good analogy.) But Hinton published his breakthrough paper at a time when neural nets had fallen out of fashion. No one really knew how to train them, so they weren't producing good results. It took nearly 30 years for the technique to make a comeback. And boy, did it make a comeback.

What are neural networks?

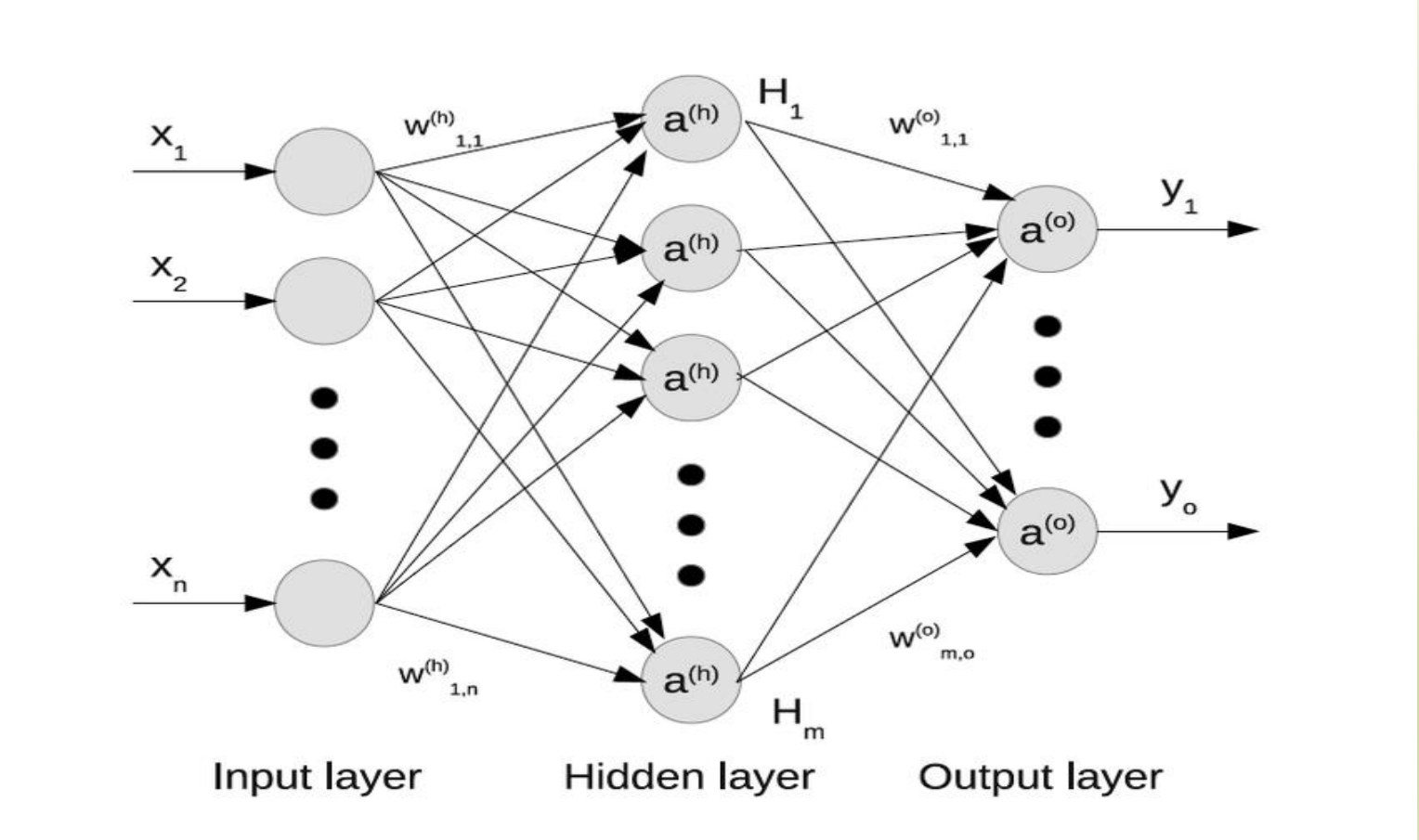
A neural network is a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. In this sense, neural networks refer to systems of neurons, either organic or artificial in nature. Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria. The concept of neural networks, which has its roots in artificial intelligence, is swiftly gaining popularity in the development of trading systems.

What are neural networks?

A single-layer neural network represents the most simple form of neural network, in which there is only one layer of input nodes that send weighted inputs to a subsequent layer of receiving nodes, or in some cases, one receiving node. This single-layer design was part of the foundation for systems which have now become much more complex.

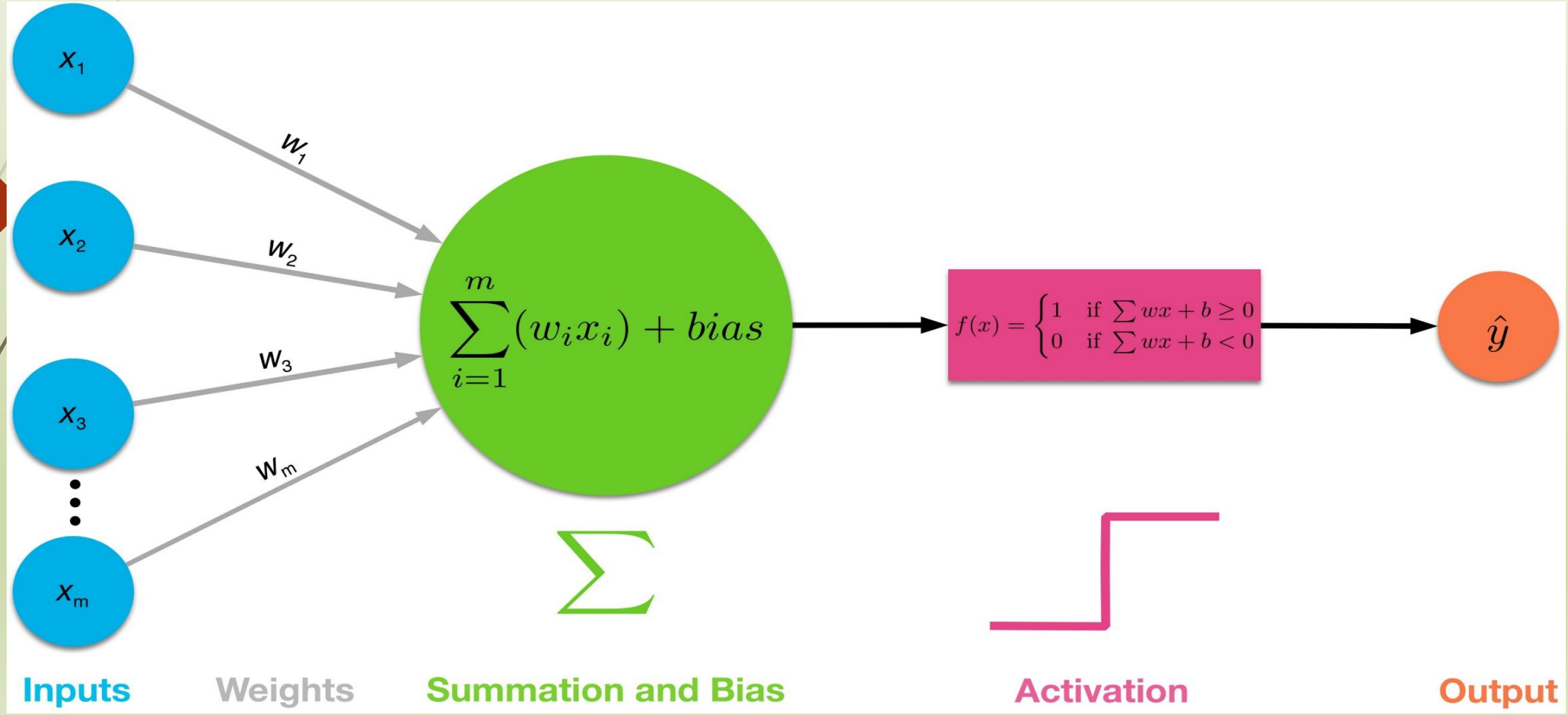
What are neural networks?

Single layer NNs



Procedures of a Single-layer Perceptron Network

A perceptron will either send a signal, or not, based on the weighted inputs.



What is Artificial Intelligence (Definition)?

Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. **Since the development of the digital computer in the 1940s, it has been demonstrated that computers can be** programmed to carry out very complex tasks—as, for example, discovering proofs for mathematical theorems or playing chess—with great proficiency.

Artificial intelligence is the broader concept that consists of everything from Good Old-Fashioned AI (GOFAI) all the way to futuristic technologies such as deep learning.

WHY AI/ML/DP ON DATA?

Various sources and formats of data:

Data Format

Data Source	Structured	Unstructured
Internal	**Human-Generated** • Survey ratings • Aptitude testing **Machine-Generated** • Web metrics from Web logs • Product purchase from sales Records • Process control measures	**Human-Generated** • Emails, letters, text messages • Audio transcripts • Customer comments • Voicemails • Corporate video/communications • Pictures, illustrations • Employee reviews
External	**Human-Generated** • Number of Retweets, Facebook likes, Google Plus +1s • Ratings on Yelp • Patient ratings ratings **Machine-Generated** • GPS for tweets • Time of tweet/updates/postings	**Human-Generated** • Content of social media updates • Comments in online forums • Comments on Yelp • Video reviews • Pinterest images • Surveillance video

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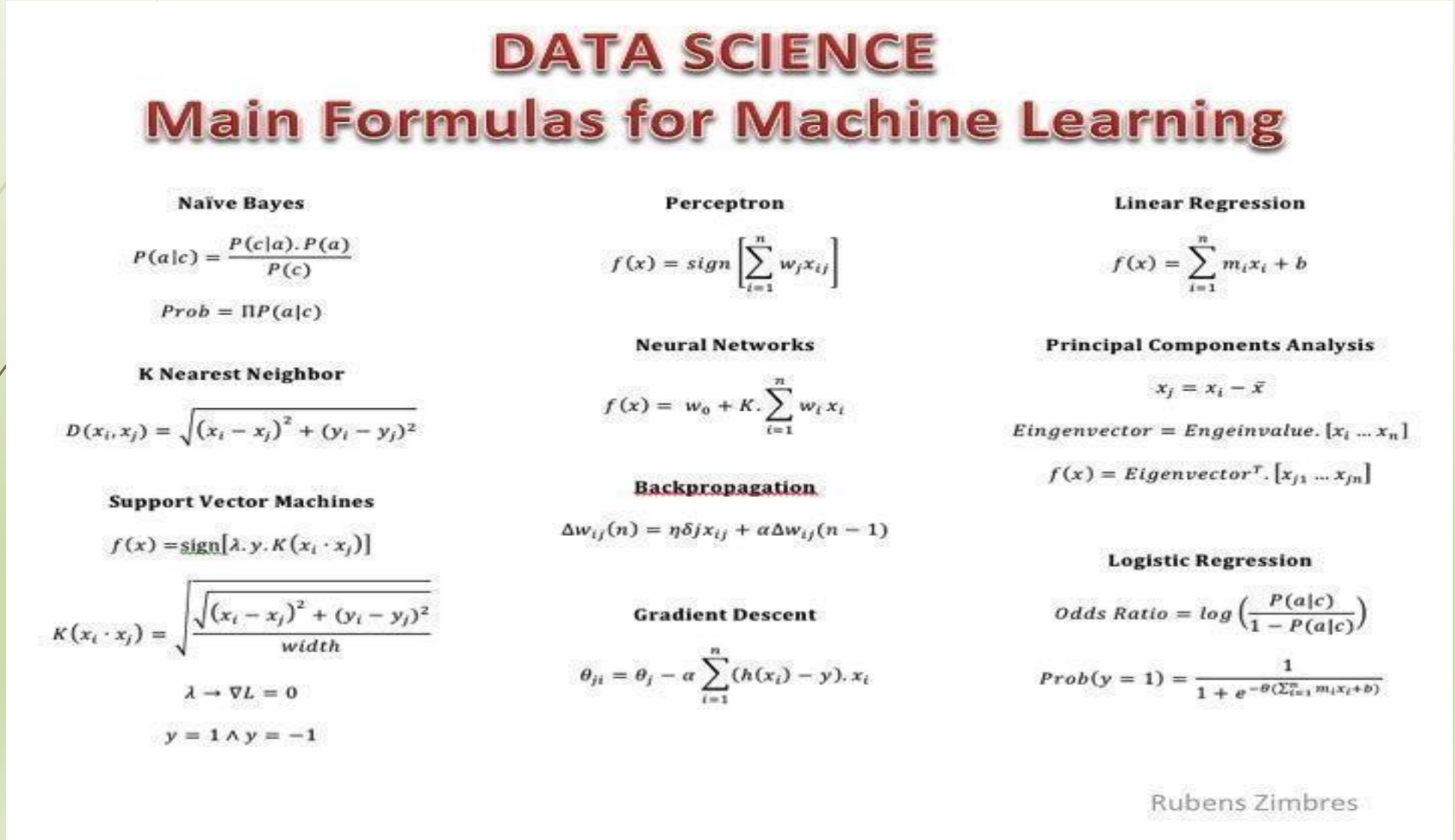
MAIN FORMULAS FOR MACHINE LEARNING

ML in one Look



What is Artificial Intelligence (Definition)?

- As the name suggests, artificial intelligence can be loosely interpreted to mean incorporating human intelligence to machines.
- Still, despite continuing advances in computer processing speed and memory capacity, there are as yet no programs that can match human flexibility over wider domains or in tasks requiring much everyday knowledge. On the other hand, some programs have attained the performance levels of human experts and professionals in performing certain specific tasks, so that artificial intelligence in this limited sense is found in applications as diverse as medical diagnosis, computer search engines, and voice or handwriting recognition.

Note:

- Whenever a machine completes tasks based on a set of stipulated rules that solve problems (algorithms), such an “intelligent” behavior is what is called artificial intelligence.
- For example, such machines can move and manipulate objects, recognize whether someone has raised the hands, or solve other problems.
- AI-powered machines are usually classified into two groups — general and narrow. The general artificial intelligence AI machines can intelligently solve problems, like the ones mentioned above.
- The narrow intelligence AI machines can perform specific tasks very well, sometimes better than humans — though they are limited in scope.
- The technology used for classifying images on Pinterest is an example of narrow AI.(As a social media analysis).

What is Machine Learning Definition ?

Machine-learning algorithms use statistics to find patterns in massive amounts of data. And data, here, encompasses a lot of things—numbers, words, images, clicks, what have you. If it can be digitally stored, it can be fed into a machine-learning algorithm.

Machine learning is the process that powers many of the services we use today—recommendation systems like those on Netflix, YouTube, and Spotify; search engines like Google and Baidu; social-media feeds like Facebook and Twitter; voice assistants like Siri and Alexa. The list goes on.

What is Machine Learning Definition ?

- In all of these instances, each platform is collecting as much data about you as possible. what genres you like watching, what links you are clicking, which statuses you are reacting to—and using machine learning to make a highly educated guess about what you might want next. Or, in the case of a voice assistant, about which words match best with the funny sounds coming out of your mouth. Main Process:
- Frankly, this process is quite basic: find the pattern, apply the pattern. But it pretty much runs the world. That's in big part thanks to an invention in 1986, courtesy of Geoffrey Hinton, today known as the father of deep learning.(Also Alan Turing Efforts).

What is Machine Learning Definition ?

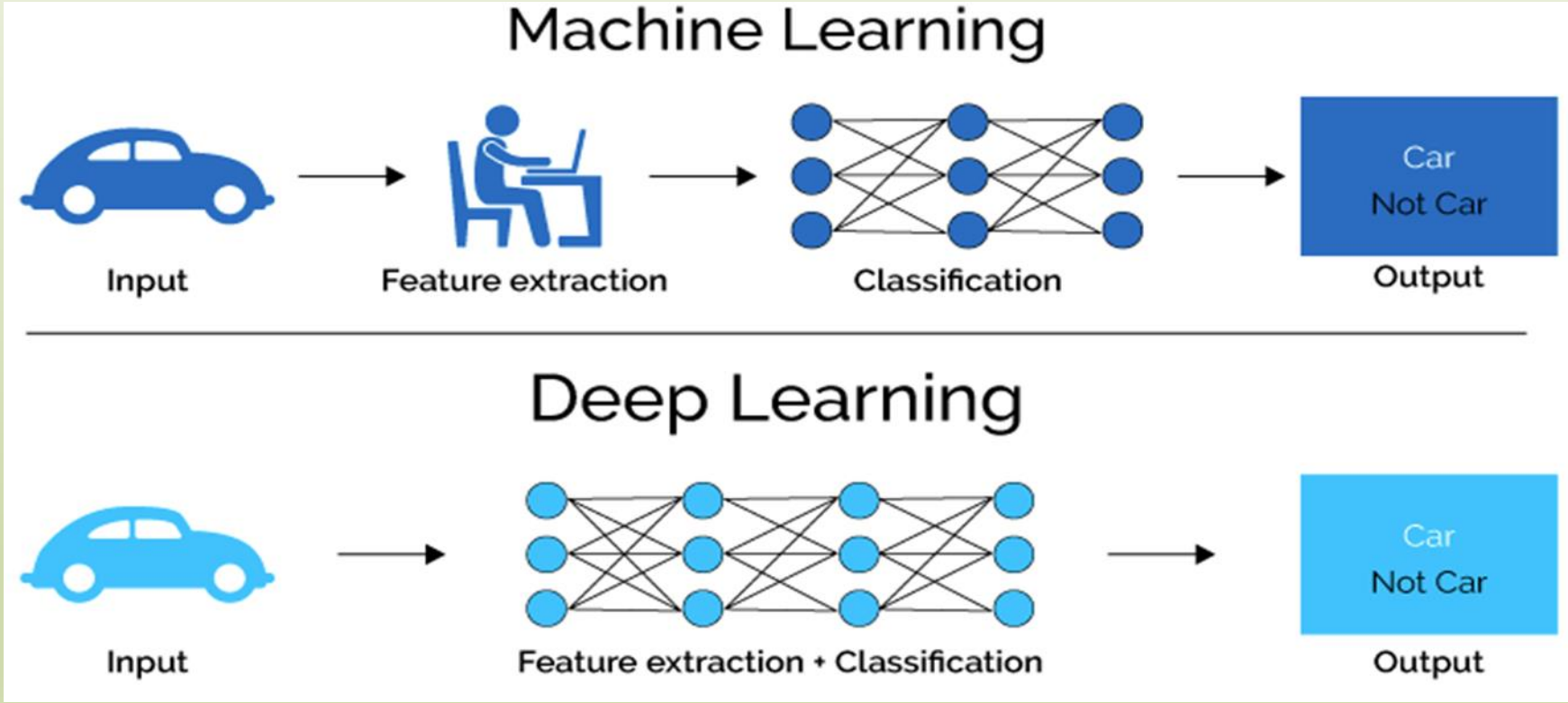
- As the name suggests, machine learning can be loosely interpreted to mean empowering computer systems with the ability to “learn”.
- The intention of ML is to enable machines to learn by themselves using the provided data and make accurate predictions.ML is a subset of artificial intelligence; in fact, it’s simply a technique for realizing AI.
- It is a method of training algorithms such that they can learn how to make decisions.
- Training in machine learning entails giving a lot of data to the algorithm and allowing it to learn more about the processed information.

What is deep learning?

Deep learning is machine learning algorithm that uses a technique at which gives machines an enhanced ability to find—and amplify—even the smallest patterns. This technique is called a deep neural network—deep because it has many, many layers of simple computational nodes that work together to munch through data and deliver a final result in the form of the prediction.

Difference Between ML and DP

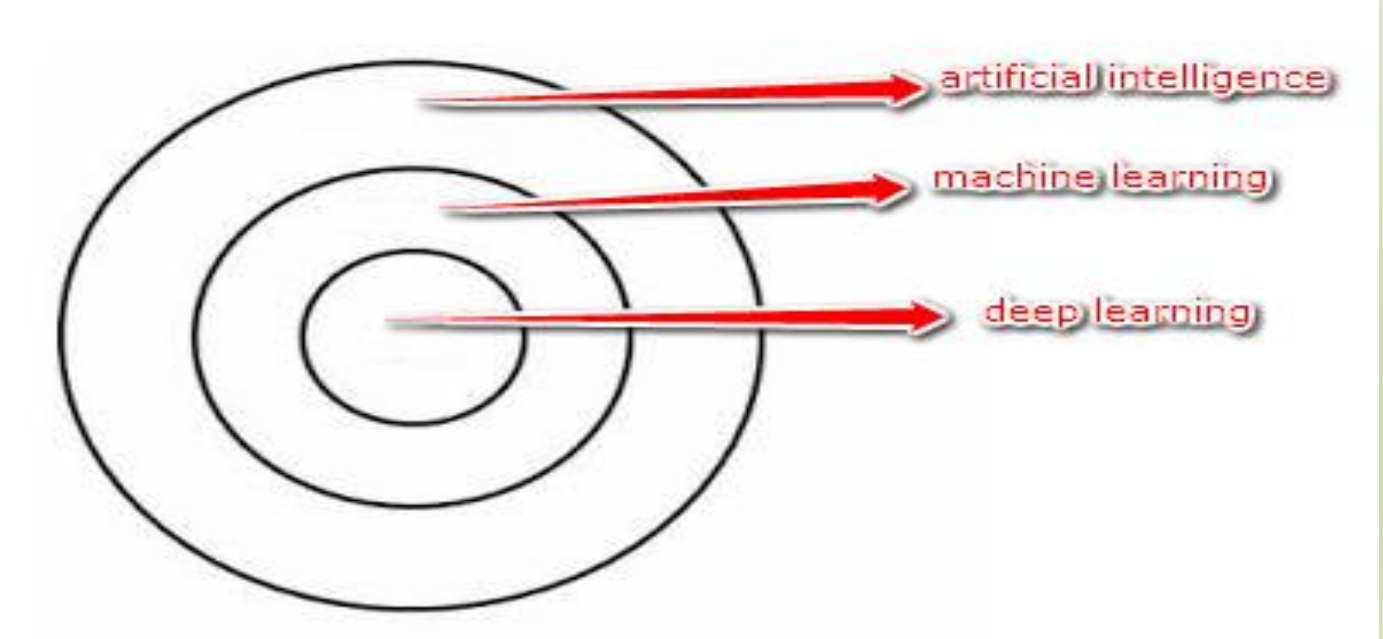
ML VS DP



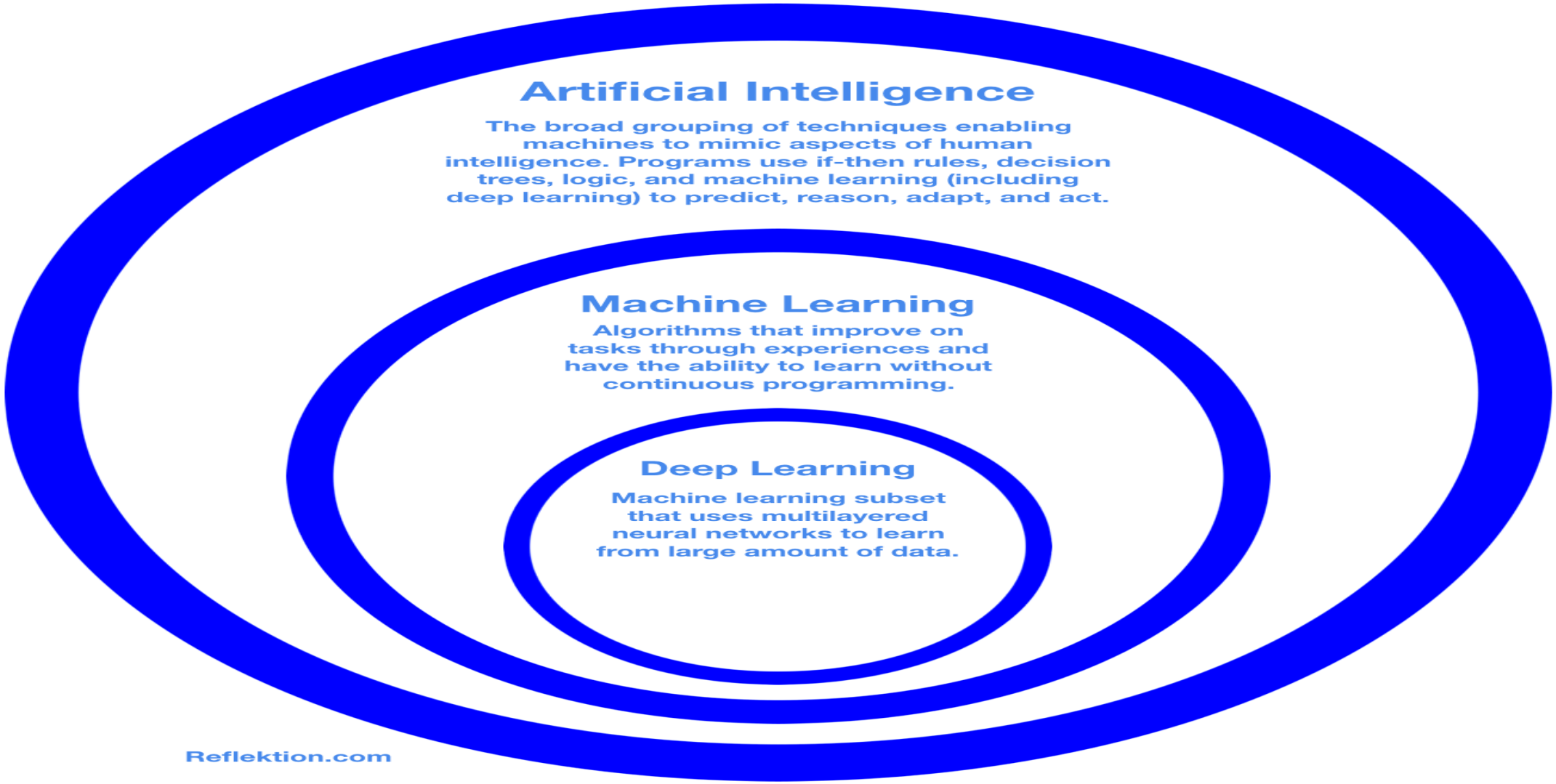
Differences Between Machine Leaning (ML), Artificial Intelligence (AI) and Deep Learning (DL)

AI vs Machine Learning vs Deep Learning Differences

Here is an image that attempts to visualize the distinction between them:



Differences Between Machine Leaning (ML), Artificial Intelligence (AI) and Deep Learning(DP)



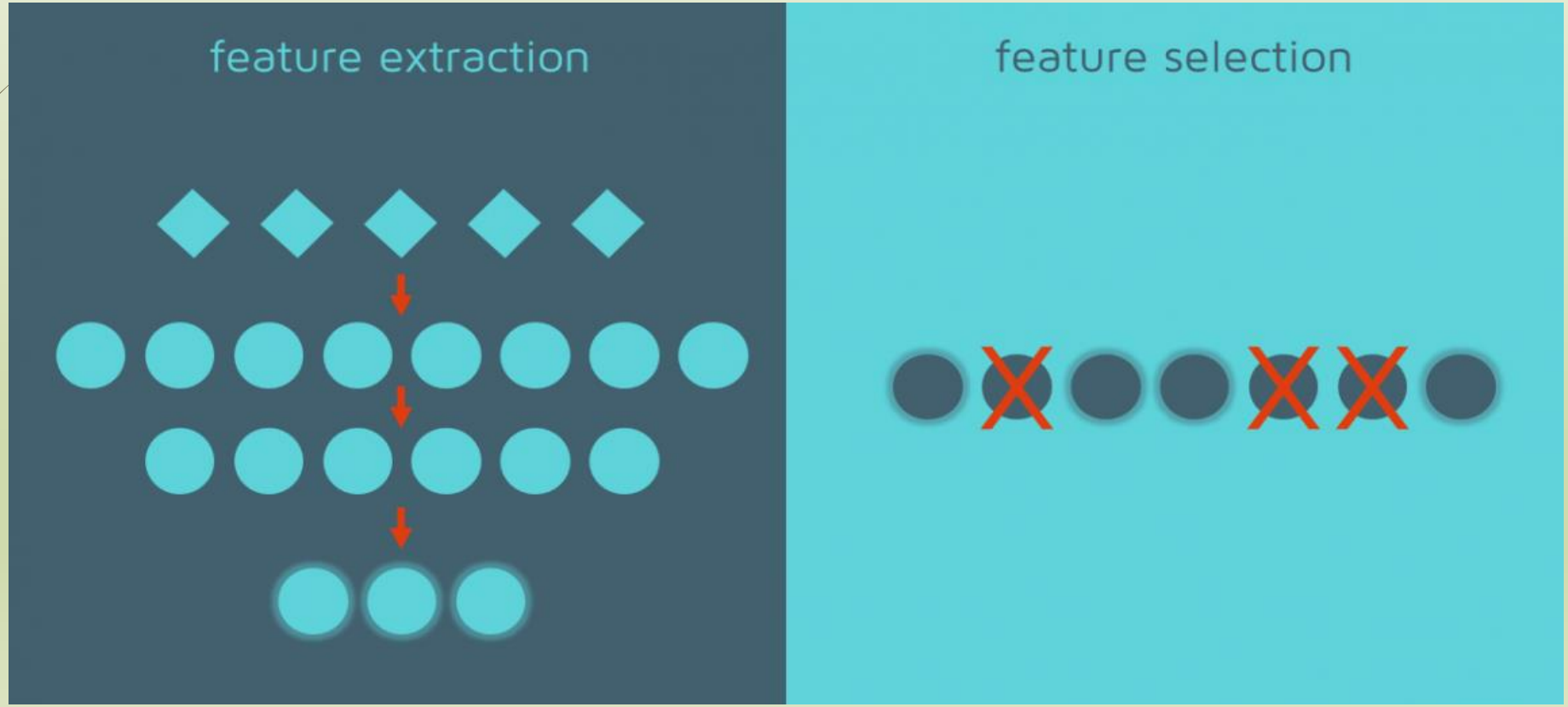
What this picture says to us ?

- AI means getting a computer to mimic human behavior in some way.
- Machine learning is a subset of AI, and it consists of the techniques that enable computers to figure things out from the data and deliver AI applications.
- Deep learning, meanwhile, is a subset of machine learning that enables computers to solve more complex problems.

What is feature extraction/selection?

Straight to the point:

- **Extraction: Getting useful features from existing data.**
- **Selection: Choosing a subset of the original pool of features.**



Why must we apply feature extraction/selection?

- Feature extraction is a quite complex concept concerning the translation of raw data into the inputs that a particular Machine Learning algorithm requires. The model is the motor, but it needs fuel to work. Features must represent the information of the data in a format that will best fit the needs of the algorithm that is going to be used to solve the problem.
- While some inherent features can be obtained directly from raw data, we usually need derived features from these inherent features that are actually relevant to attack the underlying problem. A poor model fed with meaningful features will surely perform better than an amazing algorithm fed with low-quality features – "garbage in, garbage out".

Why must we apply feature extraction/selection?

- Feature extraction fills this requirement: it builds valuable information from raw data – the features – by reformatting, combining, transforming primary features into new ones… until it yields a new set of data that can be consumed by the Machine Learning models to achieve their goals.
- Feature selection, for its part, is a clearer task: given a set of potential features, select some of them and discard the rest. Feature selection is applied either to prevent redundancy and/or irrelevancy existing in the features or just to get a limited number of features to prevent from overfitting.

Why must we apply feature extraction/selection?

- Feature extraction is for creating a new, smaller set of features that stills captures most of the useful information. Again, feature selection keeps a subset of the original features while feature extraction creates new ones.
- As with feature selection, some algorithms already have built-in feature extraction. The best example is Deep Learning, which extracts increasingly useful representations of the raw input data through each hidden neural layer.

Note:

- Note that if features are equally relevant, we could perform PCA technique to reduce the dimensionality and eliminate redundancy if that was the case. Here we would be doing feature extraction, as we were transforming the primary features and not just selecting a subset of them.
- PCA=(Principal Component Analysis)
- Principal component analysis (PCA) is an unsupervised algorithm that creates linear combinations of the original features. The new features are orthogonal, which means that they are uncorrelated. Furthermore, they are ranked in order of their "explained variance." The *first principal component* (PC1) explains the most variance in your dataset, PC2 explains the second-most variance, and so on.

For More Info, Please visit:

https://quantdare.com/what-is-the-difference-between-feature-extraction-and-feature-selection/

Note: What are labels on data?

Labels can be obtained by asking humans to make judgments about a given piece of unlabeled data (e.g., "Does this photo contain a horse or a cow?"), and are significantly more expensive to obtain than the raw unlabeled data.

After obtaining a labeled dataset, machine learning models can be applied to the data so that new unlabeled data can be presented to the model and a likely label can be guessed or predicted for that piece of unlabeled data.

Regression and Classification problems

- Classification problems ask the algorithm to predict a discrete value, identifying the input data as the member of a particular class, or group. In a training dataset of animal images, that would mean each photo was pre-labeled as cat, koala or turtle. The algorithm is then evaluated by how accurately it can correctly classify new images of other koalas and turtles.
- On the other hand, regression problems look at continuous data. One use case, linear regression, should sound familiar from algebra class: given a particular x value, what's the expected value of the y variable?
- A more realistic machine learning example is one involving lots of variables, like an algorithm that predicts the price of an apartment in San Francisco based on square footage, location and proximity to public transport.

10 AI and Machine Learning Trends To Impact Business in 2020

- AI Is Helping Combat COVID-19
- ML Framework Competition
- AI Analysis for Business Forecasts
- Reinforcement Learning
- AI-driven Biometric Security Solutions
- Automated Machine Learning
- Explainable AI
- Conversational AI
- Generative Adversarial Networks
- Convergence of IoT and AI

Trend 1. AI Is Helping Combat COVID-19

A World Health Organization report from February 2020 revealed AI and big data are playing an important role in helping healthcare professionals respond to the coronavirus (COVID-19) outbreak in China.

So, how is AI and machine learning helping combat COVID-19? There are many applications, including:

Thermal cameras and similar technologies are being used to read temperatures before individuals enter busy places like public transport systems, government buildings, and other important areas. In Singapore, one hospital is leveraging KroniKare's technology to provide on-the-go temperature checks using smartphones and thermal sensors.

Trend 1. AI Is Helping Combat COVID-19

Chinese tech company Baidu created an AI system that uses infrared technology to predict passengers temperatures at Beijing's Qinghe Railway Station.

Robots are being deployed to implement "contactless delivery" for isolated individuals, helping medical staff ensure that key areas stay disinfected and safe for use.

Many diagnosis algorithms have been developed around the world along with creating vaccines in many institutes and research centers and it will be expected that AI can be one of factors that specifies and detects many behaviors of COVID 19.

Trend 1. AI Is Helping Combat COVID-19

E-commerce giant Alibaba created the StructBERT NLP model to help combat COVID-19. This platform provides healthcare data analysis using the company's existing platforms and search engine capabilities, which proved instrumental in expediting the country's ability to disseminate medical records.

Solutions like these provide a proactive approach to threat detection, which can limit the spread of infectious diseases. And when it comes to something as contagious as COVID-19, a pro-active approach isn't just important—it's essential.

Trend 2. ML Framework Competition

In 2019, one of the key trends in the ML was PyTorch vs. TensorFlow competition. During 2019, TensorFlow 2 arrived with Keras integrated and eager execution default mode. PyTorch eventually overtook TensorFlow as the framework of choice for AI research.

Why is PyTorch better for research? PyTorch integrates easily with the rest of Python. And it is simple and easy to use, making it accessible without requiring too much effort to set it up. In contrast, TensorFlow crippled itself by repeatedly switching APIs, making it more difficult to use.

When it comes to performance, PyTorch has comparable speed to TensorFlow, which makes it technologically superior. Still, TensorFlow is compatible with more business solutions, though, so most businesses have not made the switch yet. While PyTorch is now the common framework used for research, businesses are still using TensorFlow well into 2020.

Trend 3. AI Analysis for Business Forecasts

ML-based time series analysis is a hot AI trend in 2020. This technique collectively analyzes a series of data over time. When used correctly, it aggregates data and analyzes it in such a way that allows managers to easily make decisions based on their data.

Using an ML network to process the complex calculations required to apply statistical models to your business's structured data is a major improvement over traditional methods. This ML-boosted analysis offers high-accuracy forecasts that are 90-95% accurate. When the AI network you're using is properly trained, it can capture features of your business, such as seasonality and cross-correlation in demand forecasting for retail.

Trend 3. AI Analysis for Business Forecasts

In 2020 we'll see a growing trend for applying recurrent neural networks for time series analysis and forecasting. Recurrent neural networks, which are an application of deep learning, are one reason we believe that deep learning will end up replacing traditional machine learning. For example, deep learning can forecast data, such as future exchange rates for currency with a surprisingly high degree of accuracy.

The research into time series classification has made substantial progress in recent years. The problem being solved is complex, offering both high dimensionality and large numbers. So far, no industry applications have been achieved. However, this is set to change as the research into this field has produced many promising results.

Trend 3. AI Analysis for Business Forecasts

Another type of artificial intelligence that has been recently developed is the convolutional neural network (CNN). This type of ML network discovers and extracts the internal structure that is required to generate input data for time series analysis.

Along with forecasting the future, there's another technology that could be widely applied: anomaly detection based on autoencoders that run artificial neural networks using unsupervised learning algorithms. These systems are capable of capturing common patterns while ignoring "noise." Encoded feature vectors allow businesses to separate anomalies, such as financial, political, and even social data.

Trend 4. Reinforcement Learning

Reinforcement learning (RL) is leading to something big in 2020. RL is a specialized application of deep learning that uses its own experiences to improve itself, and it's effective to the point that it may be the future of AI.

When it comes to reinforcement learning AI, the algorithm learns by doing. Initially, actions are tried at random, but eventually, this becomes a logical process as it attempts to attain specific goals. The operator rewards or punishes these actions, and the results are fed back into the network to "teach" the AI.

No predefined suggestions are given to the reinforcement learning agent. Instead, the AI starts out by acting completely randomly, and eventually learns how to maximize its reward through repetition. Reinforcement learning allows the algorithm to develop sophisticated strategies.

Trend 4. Reinforcement Learning

- Reinforcement learning is the best way to simulate human creativity in a machine by running many possible scenarios. The model can even be adapted to complete complex behavioral tasks. It's an ideal solution for solving all kinds of optimization problems.
- Self-improving chatbots are one example of reinforcement learning's effect. A goal-oriented chatbot is one that is designed to help a user solve a specific problem, such as making an appointment or booking a ticket to an event. A chatbot can be trained using reinforcement learning through trial and error to become a fully functional automated assistant to customers.

Trend 5. AI-driven Biometric Security Solutions

- Significant advancements have been made in biometric verification. Bio-ID is no longer something you'd expect to see in sci-fi films. This emerging ML trend is one to keep your eye on.
- ML's efficient approach to gathering, processing, and analyzing large data sets can improve the performance of your biometric systems. Running an efficient biometrics system is all about performing matching tasks quickly and accurately, and this is a task that ML networks excel at.
- The reliability of AI based biometric security is also increasing. Here's an example: a deep learning-based face anti-spoofing system allows you to secure any face recognition solution from any attempt to imitate a real face.(ANOTHER EXAMPLE: Carved ID ON BORN CHILDREN IN SWEDEN).

Trend 5. AI-driven Biometric Security Solutions

Another example of biometrics ML applications is Amazon's Alexa, which is now able to tell who is speaking by comparing the speaker to a predetermined voice profile. No extra hardware is necessary to help a properly trained neural network to accurately identify the speaker.

In 2020, we predict that various biometrics will be combined with ML to create a comprehensive security solution. Multimodal biometric recognition is within our reach, thanks to advancements in AI technology.

Trend 6. Automated Machine Learning

- AutoML is adapted to execute tedious modeling tasks that once required weeks or months of work by professional data scientists.
- AutoML runs systematic processes on the raw input data to choose the model that makes the most sense. AutoML's job is to find a pattern in the input data and decide what model is best applied to it. Previously these activities were processed by hand.(Not Manual)
- AutoML applies several different machine learning techniques. Google's AutoML (a combination of recurrent neural network (RNN) and reinforcement learning) is one example. After extensive repetition, a high degree of accuracy can be achieved automatically.

Trend 6. Automated Machine Learning

- Major cloud computing services offer a type of AutoML. Google AutoML and Azure Automated Machine Learning are two popular examples. Other options include the open-source AutoKeras, tpot, and AutoGluon MLaaS platforms. The best choice for your business will depend on your business's goals and budget.
- So, is AutoML effective? The answer in practice is often yes. For example, Lenovo was able to use DataRobot by AWS to reduce model creation time for their demand forecasts from 3-4 weeks to 3 days—representing an impressive sevenfold improvement. Model production time was lowered by an even larger factor, all the way from two days to five minutes! The prediction accuracy of these models has also increased.

Trend 7. Explainable AI

- The European Union tasked ML designers, known as the Right to Explanation, to make artificial intelligence more transparent to consumers and users. Explainable AI is a type of AI technology that has been designed to fit these criteria.
- Unlike regular black-box machine learning techniques, where it's often impossible to explain how the AI came to a certain conclusion, explainable AI is designed to simplify and visualize how ML networks make decisions.
- What does "black box" mean? In traditional AI models, the network is designed to produce either a numerical or binary output. For example, an ML model designed to decide whether to offer credit in specific situations will output either "yes" or "no," with no additional explanation. The output with explainable AI will include the reasoning behind any decision made by the network, which using our example, allows the network to provide a reason for approving or denying the credit request.

Explainable AI: Credit Approval

NO

OUTPUT

NO, BECAUSE

AGE < 30

SALARY < $20,000

UNPAID BILLS > 5

EXPLAINABLE OUTPUT

mobidev

Trend 7. Explainable AI

- Businesses are starting to rely on various trending machine learning algorithms to make decisions. According to Gartner, around 30% of large enterprise contracts are likely to require these solutions by 2025. Explainable AI is necessary if companies require proper accountability during these processes.
- One example of this future trend in AI is Local Interpretable Model-Agnostic Explanation (LIME). This Python library explains the predictions of any classifier by learning a special human-readable model around the predictions. With LIME and other techniques, even non-experts in the field are able to find and improve inaccurate models. This is still a very new field with plenty of room for improvement.

Trend 8. Conversational AI

- Throughout 2019 and 2020, artificial intelligence has developed to a point where it can now compete with the human brain when it comes to everyday tasks, such as writing. Researchers at OpenAI claim that their AI-based text generator is able to generate realistic stories, poems, and articles. Their GPT-2 network was trained using a large writing data set and can adapt to different writing styles on demand.
- Bidirectional Encoder Representations from Transformers (BERT) is another significant outcome in the AI field. This is another text AI that is designed to pre-train models using given text. The major advancement is how BERT processes text.

Trend 8. Conversational AI

Unlike previous approaches, which read the text either from left to right or right to left, but never both, BERT brings a language model that allows for bidirectional training. BERT has a deeper understanding of language than any network that came before it and uses several types of preceding architecture to generate accurate predictions for text.(Like Microsoft Word Text Prediction)

The better the computer understands text that is fed into it, the higher-quality the machine's responses will be. BERT is a step closer to an AI that is able to accurately understand and answer questions that are fed into it, just like a human could.

XLNet is an autoregressive pre-training model that's able to predict words from a set of text using context clues. Despite being only a simple feed-forward algorithm, it has managed to outperform BERT in many NLP tasks.(Used as NLP Algorithms to process languages)

Trend 8. Conversational AI

- One clear application is voice-enabled AI. Voice activation and voice commands all function on the basis of the computer understanding the voice-to-text transcript of the spoken command. The better the computer can understand the text, the more accurately it can perform spoken commands as well.
- With over 110 million virtual assistant users in the USA alone, there is a massive market for improving voice recognition. Today, voice-enabled devices, such as the Amazon Echo and Google Home, are common in homes. Any improvement to the voice assistant technology will lead to an increase in business in this sector, and ML is the quickest path to achieving these improvements.

Trend 9. Generative Adversarial Networks

Generative Adversarial Networks are a way to generate new data using existing data in such a way that the new product resembles the original. This may not seem too impressive at first—after all—copying is easy, right? Well, not quite.

By generating similar but non-identical data, GANs are able to produce amazing data, such as synthetic photos of a human face that are indistinguishable from a real human.

Since being invented by Ian Goodfellow in 2014, GANs have achieved significant progress in the field of synthetic face generation.

Trend 9. Generative Adversarial Networks

There is an impressive example of GAN technology at work. A fake face generator was developed by Nvidia. It's known as This Person Does Not Exist, and has gained some traction online. Other examples are facial processing apps that can produce aged or gender-swapped versions of an existing photo.

So, how do GANs work? A GAN is an ML network that is trained using two neural network models: a generator model and a discriminator model. One of these models, the generator, is responsible for creating new data samples. The discriminator's job is to decide whether the generated data is distinguishable from real data samples. During training, the two models are competing against each other, with the generator trying to fool the discriminator.

But it's not all perfect. Advancements in GANs have caused concern in the industry through their ability to synthesize totally fabricated, but realistic images. The DeepFakes scandal is an example of how GANs can be misused.

Trend 9. Generative Adversarial Networks

A properly used GAN is able to generate new images from only a description. Soon enough, these networks will be used for applications such as police sketches. Aside from generating new images, the discriminator of a GAN is a good way to detect anomalies and holds plenty of applications in quality control and other inspection-based work.

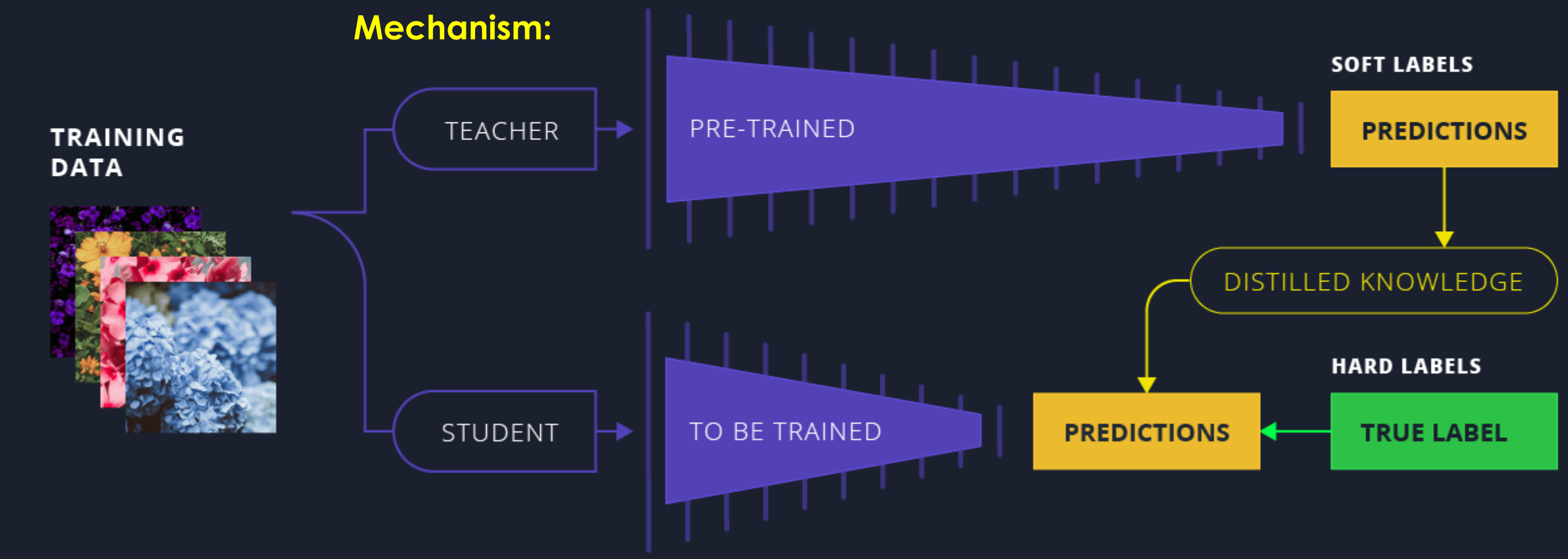
Trend 10. Convergence of IoT and AI

- Industrial IoT processes are generally not as efficient as they could be. This leaves plenty of room for AI algorithms to help increase efficiency and reduce downtime for various businesses through methods such as predictive maintenance or defect detection. Overall, the addition of AI to a manufacturing process can only increase its efficiency.
- The current IoT trends reveal that businesses are accepting the potential of ML. Rolls Royce partnered with Azure IoT Solutions to use the cloud and IoT devices to their advantage. The power of predictive maintenance shouldn't be underestimated, and Rolls Royce is taking advantage of their IoT devices to check the health of their aircraft engines to keep their uptime at a maximum.

Trend 10. Convergence of IoT and AI

- Another company that has jumped onto the IoT-AI bandwagon is Hershey. In Hershey's production facilities, even a 1% variance in weight can cost a lot. Using Microsoft Azure machine learning network, Hershey was able to significantly reduce the variability of their product weight, resulting in major savings.
- One important machine learning option to improve the IoT software development process is knowledge distillation.

Knowledge Distillation in Neural Networks



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Trend 10. Convergence of IoT and AI

- In this type of learning, ML network learns how to produce desired results through techniques such as reinforcement learning. Then, a small ML network is trained to produce identical results to the large ML network. The point of knowledge distillation is model compression. This smaller ML network is easier to run on less powerful devices, such as IoT sensors and other mobile devices. With knowledge distillation, it's possible to decrease an ML model's weight on a given device by up to 2000%, saving both on energy and hardware budget.
- An example of knowledge distillation is a video surveillance system that needs to detect the genders of people on camera in real-time. Detecting a person's gender takes a large neural network, which is best run on the cloud. However, for real-time detection, you can't always rely on the cloud. By distilling the larger network's knowledge into the smaller one, the same gender detection task can be performed by a network small enough to fit onto a small mobile or edge device, resulting in large savings.

Distilling Knowledge in ML-based Video Surveillance System

STUDENT MODEL

MOBILE DEVICES

EDGE DEVICES

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The Future of AI: It Is Only Getting Started

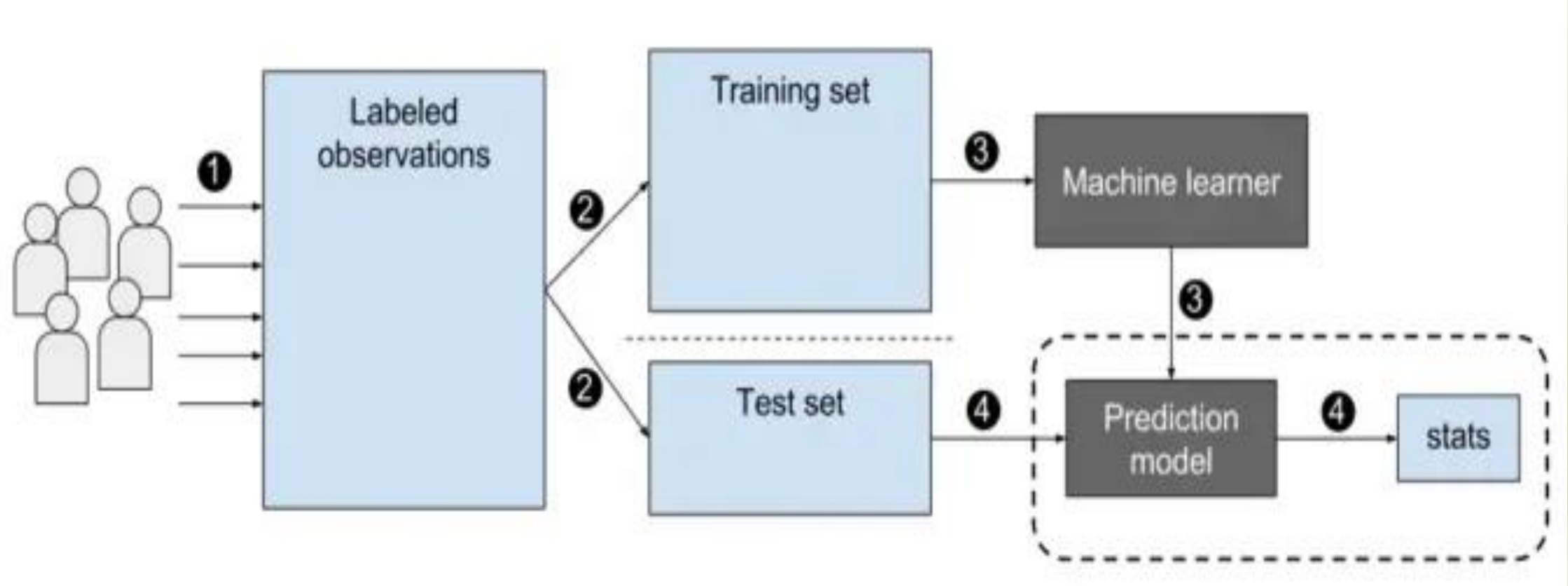
Advancements in hardware, computing power, and other technical specifications will continue to fuel the rise of AI technologies.

What is supervised learning?

Machine (and deep) learning comes in three flavors: supervised, unsupervised, and reinforcement. In supervised learning, the most prevalent, the data is labeled to tell the machine exactly what patterns it should look for. Think of it as something like a sniffer dog that will hunt down targets once it knows the scent it's after. That's what you're doing when you press play on a Netflix show—you're telling the algorithm to find similar shows.

With supervised machine learning, the algorithm learns from labeled data.

Labelling data needs more human action and its not beneficial rather than Automation.



What is supervised learning?

- We think of supervised learning with the concept of function approximation, where basically we train an algorithm and in the end of the process we pick the function that best describes the input data, the one that for a given X makes the best estimation of y (X -> y).
- Most of the time, we are not able to figure out the true function that always make the correct predictions and other reason is that the algorithm rely upon an assumption made by humans about how the computer should learn and this assumptions introduce a bias.

What is supervised learning?

- Here the human experts acts as the teacher where we feed the computer with training data containing the input/predictors and we show it the correct answers (output) and from the data the computer should be able to learn the patterns.
- Supervised learning algorithms try to model relationships and dependencies between the target prediction output and the input features such that we can predict the output values for new data based on those relationships which it learned from the previous data sets.

Applications of Supervised Learning

- Predictive Model.
- we have labeled data.
- The main types of supervised learning problems include regression and classification problems.
- Nearest Neighbor (In Analyzing Scatted Data in Statistics)-KNN
- Naive Bayes (Classification Algorithms based on bayes Theorem in Probability Courses)

https://www.analyticsvidhya.com/blog/2017/09/naive-bayes-explained/

- Decision Trees (In Graph Algorithms)
- Linear Regression (In Statistics)
- Support Vector Machines (SVM):To analyze data for classification and Regression in order to train Data

https://monkeylearn.com/blog/introduction-to-support-vector-machines-svm/

- Neural Networks

Applications of Supervised Learning

Labeled data: Data consisting of a set of *training examples*, where each example is a *pair* consisting of an input and a desired output value (also called the *supervisory signal, labels, etc*)

Classification: The goal is to predict discrete values, e.g. {1,0}, {True, False}, {spam, not spam}.

Regression: The goal is to predict continuous values, e.g. home prices.

What is unsupervised learning?

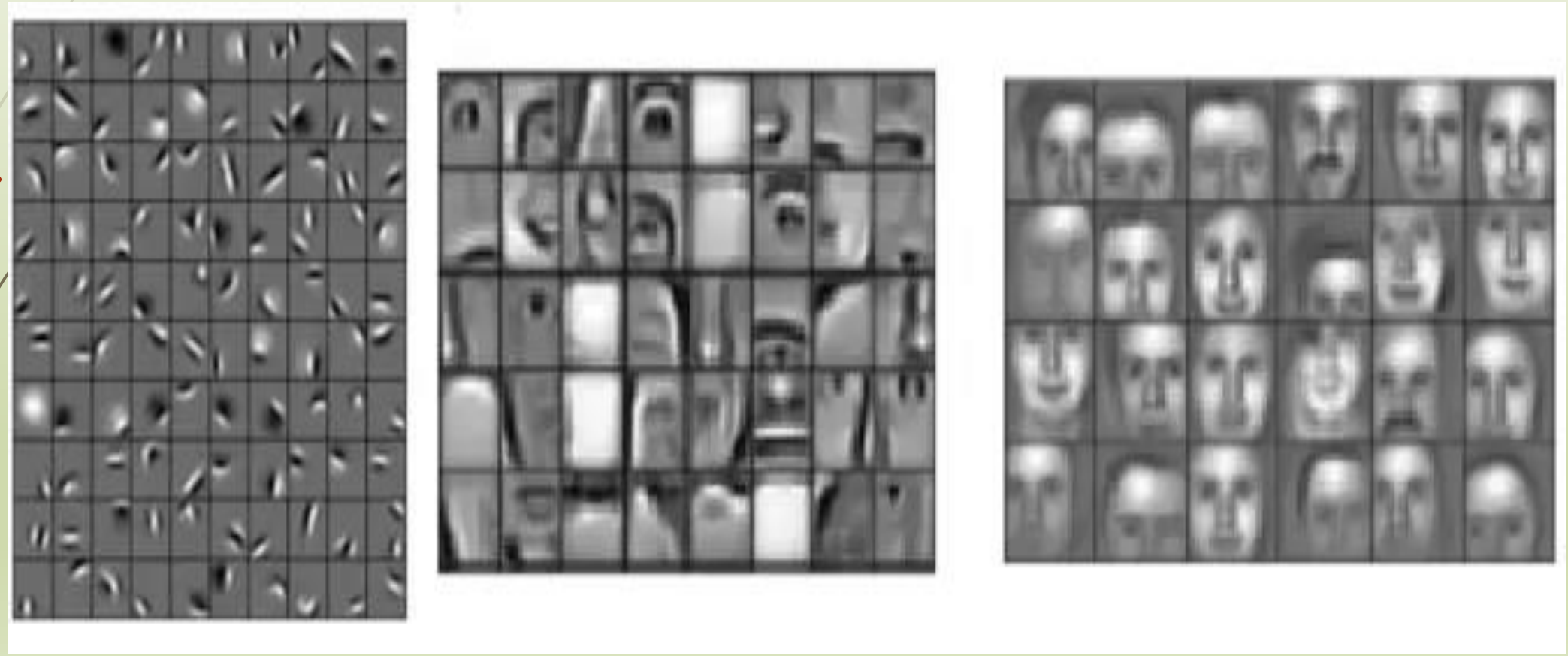
- In unsupervised learning, the data has no labels. The machine just looks for whatever patterns it can find. This is like letting a dog smell tons of different objects and sorting them into groups with similar smells. Unsupervised techniques aren't as popular because they have less obvious applications. Interestingly, they have gained traction in cybersecurity.
- The computer is trained with unlabeled data.
- Here there's no teacher at all, actually the computer might be able to teach you new things after it learns patterns in data, these algorithms a particularly useful in cases where the human expert doesn't know what to look for in the data.

What is unsupervised learning?

They are the family of machine learning algorithms which are mainly used in pattern detection and descriptive modeling. However, there are no output categories or labels here based on which the algorithm can try to model relationships. These algorithms try to use techniques on the input data to mine for rules, detect patterns, and summarize and group the data points which help in deriving meaningful insights and describe the data better to the users.

Unsupervised learning models automatically extract features and find patterns in the data.

Unsupervised Learning based on different patterns and datasets



What is unsupervised learning?

Applications:

- Descriptive Model
- The main types of unsupervised learning algorithms include Clustering algorithms and Association rule learning algorithms.
- k-means clustering, Association Rules

What is reinforcement learning?

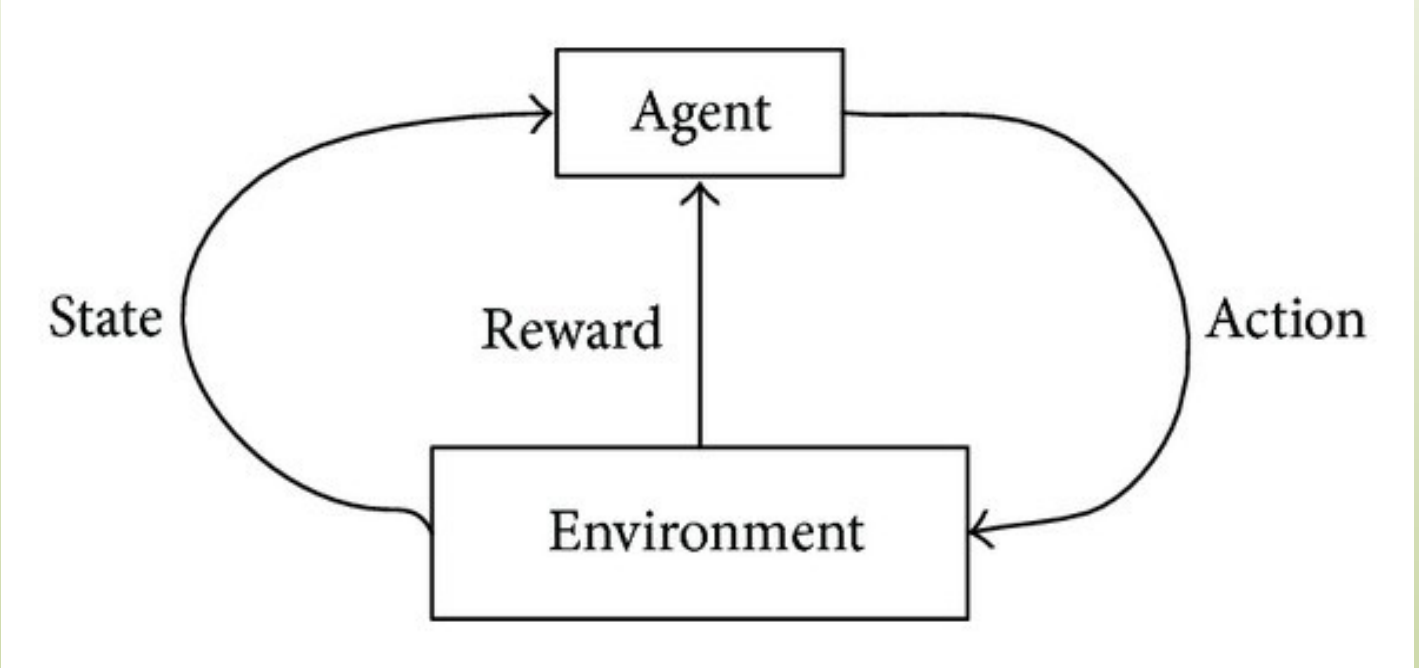
A reinforcement algorithm learns by trial and error to achieve a clear objective. It tries out lots of different things and is rewarded or penalized depending on whether its behaviors help or hinder it from reaching its objective. This is like giving and withholding treats when teaching a dog a new trick. Reinforcement learning is the basis of Google's AlphaGo, the program that famously beat the best human players in the complex game of Go.

What is reinforcement learning?

Method aims at using observations gathered from the interaction with the environment to take actions that would maximize the reward or minimize the risk. Reinforcement learning algorithm (called the agent) continuously learns from the environment in an iterative fashion. In the process, the agent learns from its experiences of the environment until it explores the full range of possible states.

Reinforcement Learning is a type of *Machine Learning*, and thereby also a branch of Artificial Intelligence. It allows machines and software agents to automatically determine the ideal behavior within a specific context, in order to maximize its performance. Simple reward feedback is required for the agent to learn its behavior; this is known as the reinforcement signal.

What is reinforcement learning?



What is reinforcement learning?

There are many different algorithms that tackle this issue. As a matter of fact, Reinforcement Learning is defined by a specific type of problem, and all its solutions are classed as Reinforcement Learning algorithms. In the problem, an agent is supposed decide the best action to select based on his current state. When this step is repeated, the problem is known as a *Markov Decision Process*.

In order to produce intelligent programs (also called agents), reinforcement learning goes through the following steps:

What is reinforcement learning?

Steps:

Input state is observed by the agent.

Decision making function is used to make the agent perform an action.

After the action is performed, the agent receives reward or reinforcement from the environment.

The state-action pair information about the reward is stored.

What is reinforcement learning?

List of Common Algorithms

Q-Learning

Temporal Difference (TD)

Deep Adversarial Networks

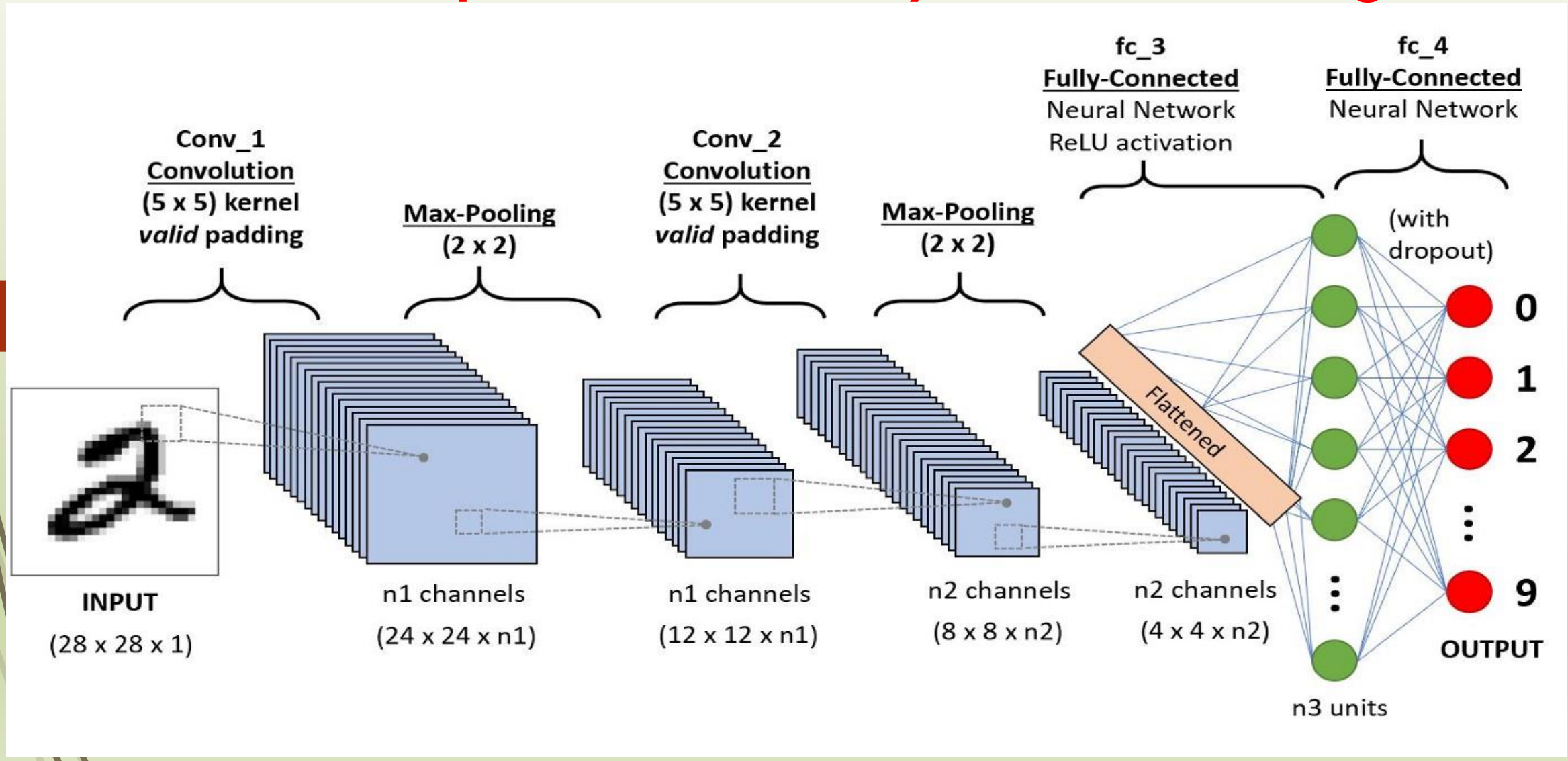
Use cases:

Some applications of the reinforcement learning algorithms are computer played board games (Chess, Go), robotic hands, and self-driving cars.

What are Convolutional Neural Networks?

- A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.
- The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlap to cover the entire visual area.

A CNN sequence to classify handwritten digits



Applications of Convolutional Neural Networks

- Decoding Facial Recognition
- Analyzing Documents
- Historic and Environmental Collections
- Understanding Climate
- Grey Areas(Better Image resolution about what human being sees)
- Advertising
- brain cancer detection and many issues in Healthcare

Recurrent neural networks

- A recurrent neural network (RNN) is a type of artificial neural network commonly used in speech recognition and natural language processing (NLP). RNNs are designed to recognize a data's sequential characteristics and use patterns to predict the next likely scenario.
- RNN converts the independent activations into dependent activations by providing the same weights and biases to all the layers, thus reducing the complexity of increasing parameters and memorizing each previous outputs by giving each output as input to the next hidden layer.
- Hence these three layers can be joined together such that the weights and bias of all the hidden layers is the same, into a single recurrent layer.

Recurrent neural networks

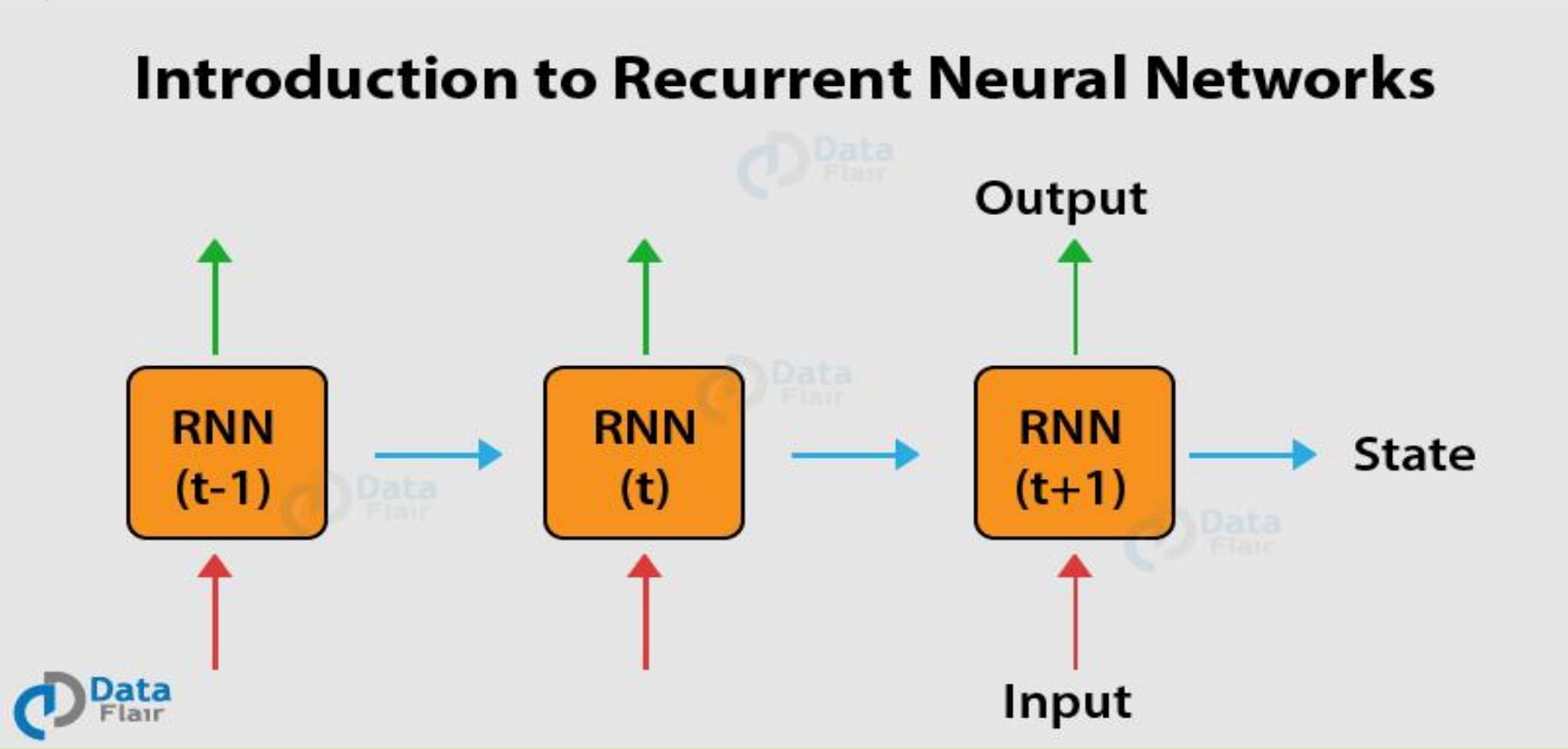
- RNN have a “memory” which remembers all information about what has been calculated. It uses the same parameters for each input as it performs the same task on all the inputs or hidden layers to produce the output. This reduces the complexity of parameters, unlike other neural networks.
- RNNs are used in deep learning and in the development of models that simulate the activity of neurons in the human brain. They are especially powerful in use cases in which context is critical to predicting an outcome and are distinct from other types of artificial neural networks because they use feedback loops to process a sequence of data that informs the final output, which can also be a sequence of data . These feedback loops allow information to persist; the effect is often described as memory.

Recurrent neural networks

- RNN use cases tend to be connected to language models in which knowing the next letter in a word or the next word in a sentence is predicated on the data that comes before it. A compelling experiment involves an RNN trained with the works of Shakespeare to produce Shakespeare-like prose -- successfully. Writing by RNNs is a form of computational creativity. This simulation of human creativity is made possible by the AI's understanding of grammar and semantics learned from its training set.

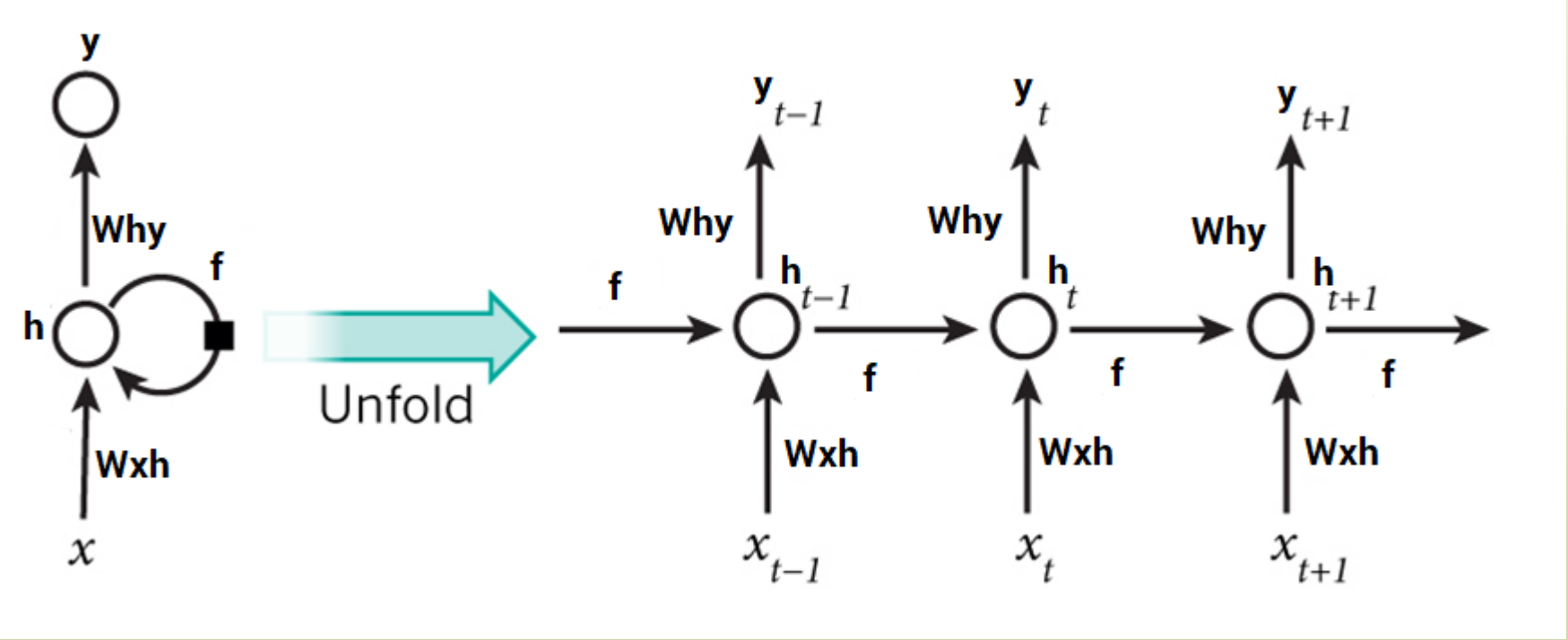
Applications of Recurrent Neural Networks

https://vinodsblog.com/2019/01/07/deep-learning-introduction-to-recurrent-neural-networks/



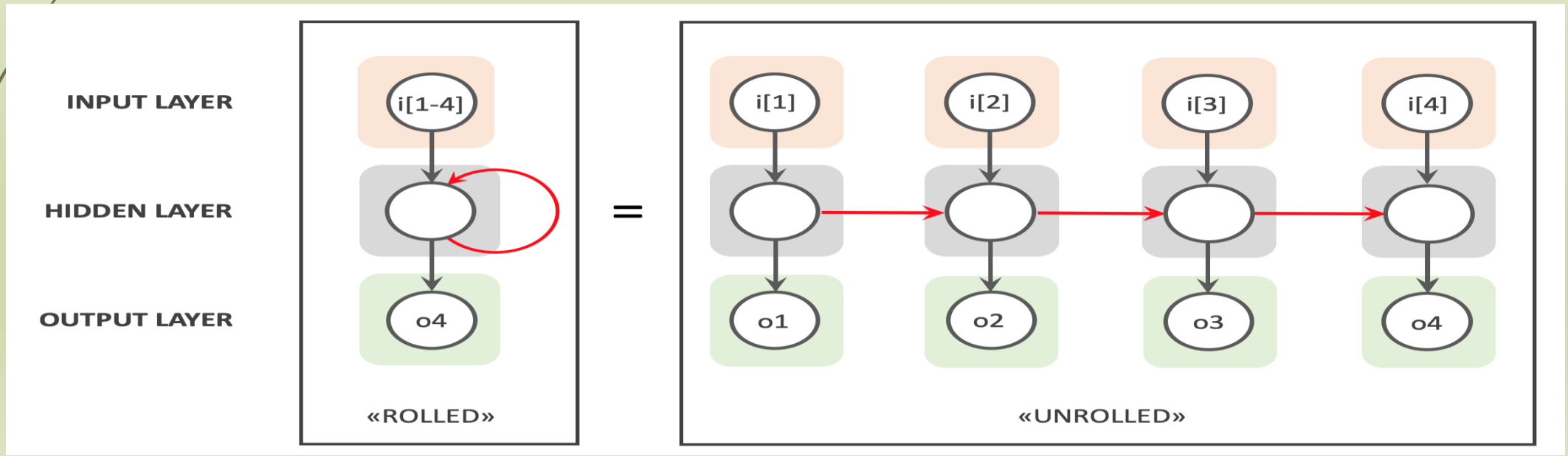
Applications of Recurrent Neural Networks

RNNs



Applications of Recurrent Neural Networks

RNNs support processing of sequential data by the addition of a loop. This loop allows the network to step through sequential input data whilst persisting the state of nodes in the Hidden Layer between steps - a sort of *working memory*. The following image gives a conceptual representation of how this works. A RNN can be viewed as many copies of a Feed Forward ANN executing in a chain.



Applications of Recurrent Neural Networks

RNNs are widely used in the following domains/ applications:

- Prediction problems
- Language Modelling and Generating Text
- Machine Translation
- Speech Recognition
- Generating Image Descriptions
- Video Tagging
- Text Summarization
- Call Center Analysis
- Face detection, OCR Applications as Image Recognition
- Other applications like Music composition

Welcome

Thank you so much for your attention in this webinar. Other information about each section and topic can be shared and sent to you by having this initial background about Machine Learning and Artificial Intelligence.

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