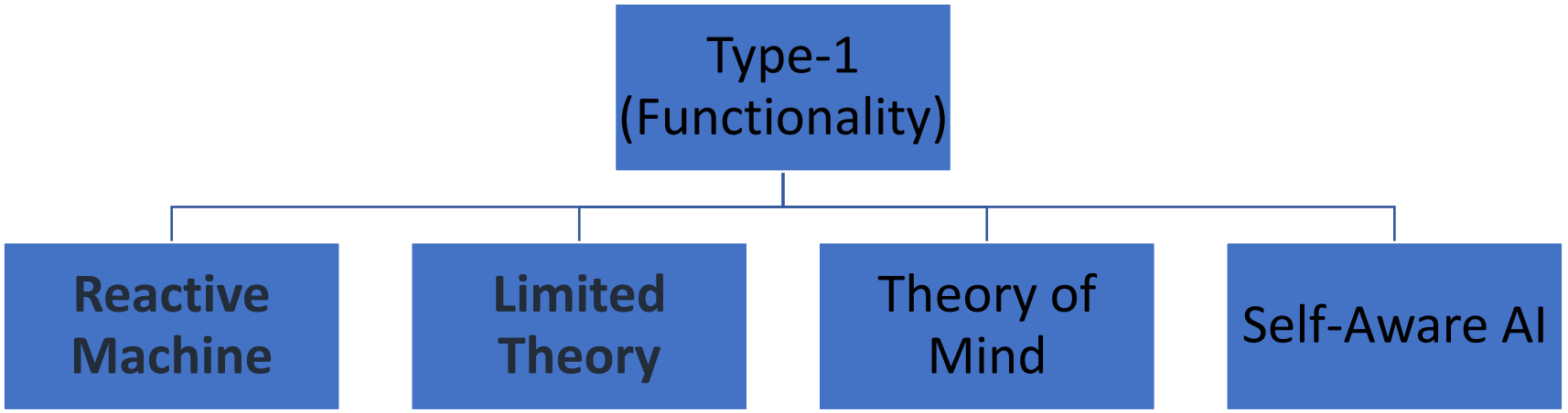
Main Types of AI

Overview

- The main aim of Artificial Intelligence aim is to enable machines to perform a human-like function.
- the primary way of classification of AI is based on how well it can replicate human-like actions.
- AI can be classified based on two types.
- One type of classification which is **“Based on Functionality”** classify AI based on their likeness to the human mind and their ability to think and feel like humans.
- The second way of classification is more prominent in the tech industry which is**” Based on Capabilities”** of AI Vs Human Intelligence.

Types of AI based on Functionality

Types of AI based on Functionality



Reactive Machine

- They are the most basic and oldest type of Artificial Intelligence.
- They replicate a human's ability to react to different kinds of situations.
- This type of AI has no memory power, so they lack the capability to use previously gained information/experience to obtain better results. Therefore these kinds of AI don't have the ability to train themselves like the ones we come across nowadays.

Reactive Machine Example

- **Example:** Deep Blue, IBM's chess-playing supercomputer.
- It is famous for defeating international grandmaster Garry Kasparov in the late 1990s.
- Deep Blue can identify different pieces in the chessboard and how each moves.
- It can identify all the possible legal moves for itself and its opponents.
- Based on the option, it selects the best possible move.
- However, it doesn't have the ability to learn from its past moves as these machines don't have any memory of their own.

Photo from www.wekipedia.com

Photo from www.pri.com

Limited Theory

- These type of AI, along with the ability of Reactive Machines, **have memory capabilities** so they can use past information/experience to make better future decisions.
- **Most of the common applications existing around us fall under this category**.
- These AI applications can be trained by a large volume of training data **which they store in their memory in the form of a reference model.**

Limited Theory Example

- Limited Memory technology is used in many self-driving cars.
- They store data like GPS location
- speed of nearby cars
- Size and lane markings
- Traffic lights
- other kinds of data to drive just like a human does.

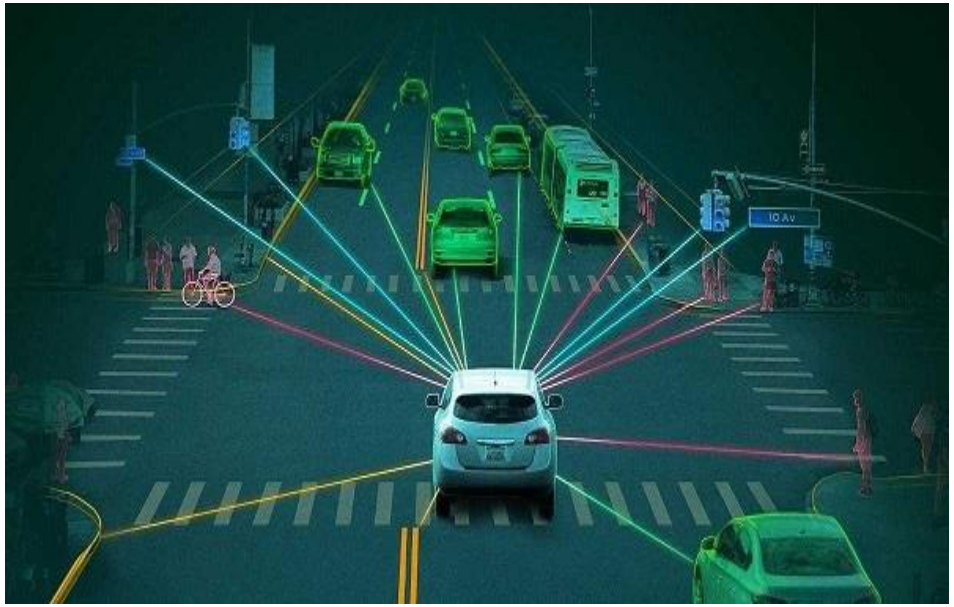


Photo from www.aitrends.com

Theory of Mind

- Theory of Mind is the next level of AI, which has very limited to no presence in our day to day lives.
- These kind of AI are mostly in the “Work in Progress” stage and are usually confined to research labs.
- These kinds of AI once developed will have a very deep understating of human minds ranging from their needs, likes, emotions, thought process, etc. Basis their understanding of Human minds and their whims the AI will be able to alter its own response.

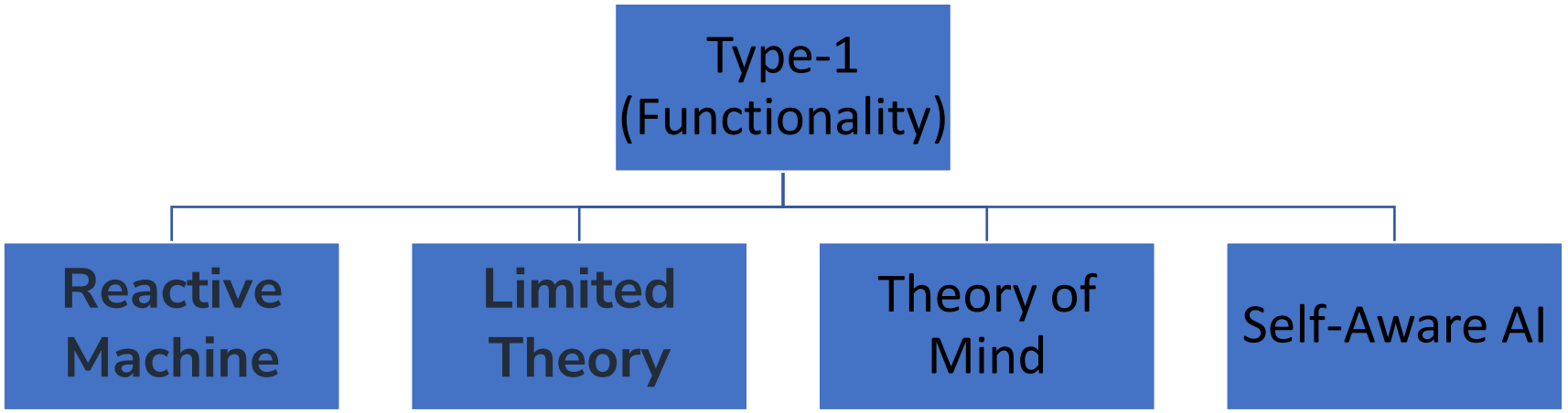
Theory of Mind Example

- A prototype of a robot which can walk down the small corridor with other robots coming from the opposite direction, the AI can foresee other robots' movements and can turn right, left or any other way to avoid a possible collision with the incoming robots.
- This Robot determines its action based on its “common sense” of how other robots will move.

Self-Aware AI

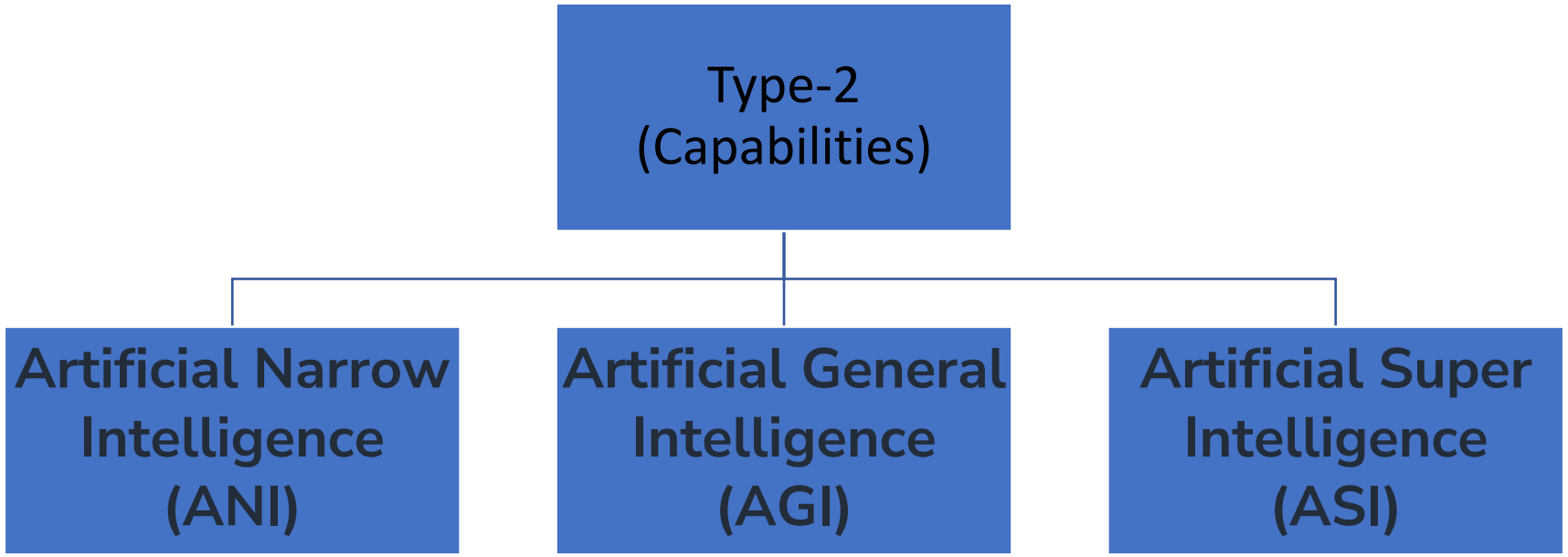
- This is the final stage of AI.
- Its current existence is only hypothetical and can be found only in Science fiction movies.
- These kinds of AI can not only understand and evoke human emotions but can also have emotions of its own.
- These kind of AI are decades if not centuries away from materializing.

Types of AI based on Functionality



Types of AI based on Capabilities

Types of AI based on Capabilities



Artificial Narrow Intelligence (ANI)

- This type of artificial intelligence represents all the existing AI, including even the most complicated and capable AI that has ever been created to date.
- Artificial narrow intelligence refers to AI systems that can only perform a specific task autonomously using human-like capabilities.
- These machines can do nothing more than what they are programmed to do, and thus have a very limited or narrow range of competencies.
- These systems correspond to all the **reactive and limited memory AI**.

Artificial General Intelligence (AGI)

- Artificial General Intelligence is the ability of an AI agent to learn, perceive, understand, and function completely like a human being.
- These systems will be able to independently build multiple competencies and form connections and generalizations across domains, massively cutting down on time needed for training.
- This will make AI systems just as capable as humans **by replicating our multi-functional capabilities**.

Artificial Super Intelligence (ASI)

- The development of Artificial Superintelligence will probably mark the pinnacle of AI research, as AGI will become by far the most capable forms of intelligence on earth.
- ASI, in addition to replicating the multi-faceted intelligence of human beings, will be exceedingly better at everything they do because of overwhelmingly greater memory, faster data processing and analysis, and decision-making capabilities.
- The development of AGI and ASI will lead to a scenario most popularly referred to as the singularity.
- These machines may also threaten our existence or at the very least, our way of life.

Natural Language Understanding (NLU)

Natural Language Understanding

- NLU is a branch of AI that uses computer software to understand input made in the form of sentences in text or speech format.
- NLU understanding of natural human languages enables computers to understand commands without the formalized syntax of computer languages and for computers to communicate back to humans in their own languages.
- NLU uses algorithms to reduce human speech into a structured ontology. AI fishes out such things as intent, timing, locations and sentiments. For example, a request for an island camping trip on Vancouver Island on the 18th of august might break down something like this: Ferry tickets [intent] / need: camping lot reservation [intent] / Vancouver Island [location] / August 18th [date].
- The main drive behind NLU is to create chat and speech enabled bots that can interact effectively with the public without supervision. NLU is a pursuit of many start up and major IT companies. Companies working on NLU include Medium's Lola, Amazon's with Alexis and Lex, Apple's Siri, Google's Assistant and Microsoft's Cortana.

Natural Language Understanding

- AI techniques have come a long way toward bringing humans and computers closer to each other.
- We can break down the field of NLU into subdomains to understand the true depth of AI's relation with human language.
- Speech to text
- Speech synthesis
- Processing human language commands
- Speaking in human language
- Machine translation

Speech to text

- Voice transcription is one of the areas where AI algorithms have made the most progress.
- With neural networks, instead of coding the rules, you provide plenty of voice samples and their corresponding text.
- The neural network finds the common patterns among the pronunciation of words and then “learns” to map new voice recordings to their corresponding texts.
- These advances have enabled many services to provide real-time transcription services to their users.
- Google presented **Call Screen**, a feature on Pixel phones that handles scam calls and shows you the text of the person speaking in real time.
- YouTube uses deep learning to provide automated close captioning.

Speech synthesis

- Speech synthesis has existed for quite a long time.
- Patients who have lost their voice have been using the technology for decades communicate by typing sentences and having a computer read it for them.
- The blind also using the technology to read text they can’t see.
- In the old days, the voice generated by computers did not sound human, and the creation of a voice model required hundreds of hours of coding and tweaking.
- Now, with the help of neural networks, synthesizing human voice has become less cumbersome.
- A neural network ingests numerous samples of a person’s voice until it can tell whether a new voice sample belongs to the same person.
- Then, a second neural network generates audio data and runs it through the first one to see if validates it as belonging to the subject.
- If it doesn’t, the generator corrects its sample and re-runs it through the classifier.
- The two networks repeat the process until they are able to generate samples that sound natural.

Processing human language commands

- NLP is a subset of artificial intelligence that enables computers to detect the meaning of written words, whether after they convert speech to text, receive them through a text interface such as a chatbot, or read them from a file. They can then use the meaning behind those words to perform a certain action.
- At its simplest form, NLP will help computers perform commands given to them through text commands.
- Smart speakers and smartphone AI assistants use NLP to process users' commands.
- Basically, what this means is that the user doesn't have to remain true to a strict sequence of words to trigger a command and can use different variations of the same sentence.
- NLP is proving very useful are in analytics tools such as Google Analytics and IBM Watson, where users can use natural language sentences to query their data instead of writing complicated query sentences.

- An interesting use of NLP is Gmail's Smart Reply feature. Google examines the content of an email and presents suggestions for answers. The feature is limited in scope and only works for emails where short answers make sense, such as when Google's AI algorithms detect a scheduled meeting or when the sender expects a simple "Thank you" or "I'll take a look." But sometimes, it comes up with pretty neat answers that can save you a few seconds of typing, especially if you're on a mobile device.

Speaking in human language

- The other side of NLP is natural language generation (NLG), the AI discipline that enables computers to generate text that is meaningful to humans.
- This field too has benefited from advances in AI, particularly in deep learning.
- The output of NLG algorithms can either be displayed as text, as in a chatbot, or converted to speech through voice synthesis and played for the user.
- AI assistants such as Siri and Alexa use NLG to generate responses to queries.
- Gmail’s autocomplete feature uses NLG in a very interesting way. When you’re typing a sentence, Gmail will provide you with a suggestion to complete the sentence, which you can select by pressing tab or tapping it.
- The suggestion takes into consideration the general topic of your letter, which means there’s NLP involved too.

Machine translation

- Neural networks translate different languages using a mechanical, statistical process.
- They example the different patterns that words and phrases appear in target languages and try to choose the most convenient one when translating.
- In other words, they’re mapping based on mathematical values, not translating the meaning of the words.
- AI translation has plenty of very practical uses.
- You can use it frequently to speed your work when translating from Arabic to English.
- It’s almost perfect when translating simple, factual sentences. For instance, if you’re communicating with people who don’t speak your language and you’re rather interested in grasping the meaning of a sentence rather than the quality of the translation, AI applications such as Google Translate can be a very useful tool.

Machine Learning

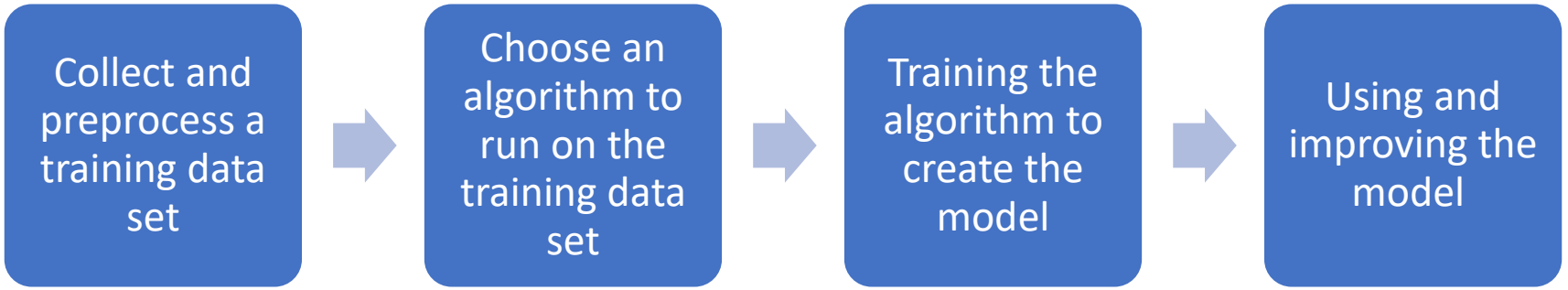
Machine Learning (ML)

- Machine learning is a branch of artificial intelligence (AI) **focused on building applications that learn from data and improve their accuracy over time without being programmed to do so.**
- In data science, **an algorithm is a sequence of statistical processing steps.**
- In machine learning, algorithms are 'trained' to find patterns and features in massive amounts of data in order to make decisions and predictions based on new data.
- The better the algorithm, the more accurate the decisions and predictions will become as it processes more data.

Machine Learning Examples

- Today, examples of machine learning are all around us.
- Digital assistants search the web and play music in response to our voice commands.
- Websites recommend products and movies and songs based on what we bought, watched, or listened to before. Robots vacuum our floors while we do . . . something better with our time.
- Spam detectors stop unwanted emails from reaching our inboxes. Medical image analysis systems help doctors spot tumors they might have missed. And the first self-driving cars are hitting the road.

How machine learning works



Data Collection and Preparation

Importance Of Data Preparation

- Most machine learning algorithms require data to be formatted in a very specific way, so datasets generally require some amount of preparation before they can yield useful insights.
- Some datasets have values that are missing, invalid, or otherwise difficult for an algorithm to process.
- If data is missing, the algorithm can’t use it.
- If data is invalid, the algorithm produces less accurate or even misleading outcomes.
- Some datasets are relatively clean but need to be shaped (e.g., aggregated or pivoted) and many datasets are just lacking useful business context (e.g., poorly defined ID values), hence the need for feature enrichment.
- Good data preparation produces clean and well-curated data which leads to more practical, accurate model outcomes.

Collect Dataset

- **Use Open-Source Datasets**

  The internet contains thousands of publicly available datasets ready to be used, analyzed and enriched.

- **Scrape Web Data**

  Web scraping describes the automated, programmatic use of an application to extract data or perform actions that users would usually perform manually. These tools look for new data automatically, fetching any new or updated data and storing them for future access. (legal Concerns)

- **Build Synthetic Datasets**

  Particularly useful in the absence of adequate real-world data, programmatically generated data is used to obtain large enough sample sizes of data to train neural networks.

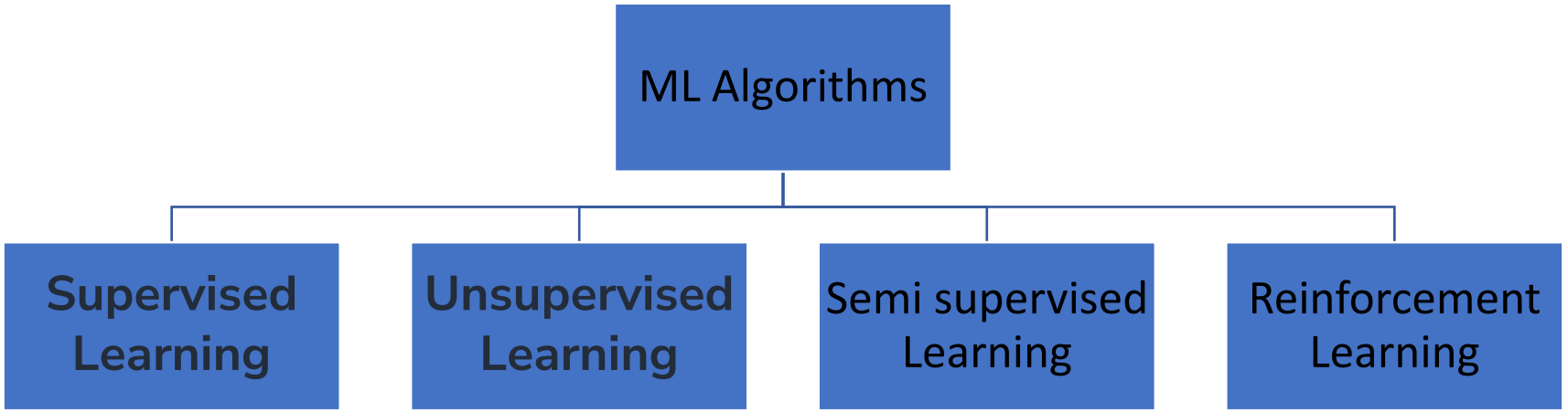
- **Take Advantage of Internal Data**

  Internal unstructured data available represents a huge opportunity for large organizations. This potential goldmine of information can be used to develop useful machine learning applications. Machine learning models based on internal data can be very helpful in streamlining business processes and increasing productivity. (legal Concerns)

Data Preprocessing

- **Data preprocessing** is the act of cleaning and preparing your data for training and it is a way to make sure your training data is accurate, complete, and relevant.
- **Preprocessing Data includes:**
- **Fixing up formats** – Often when data is saved or translated from one format to another some data may not be translated correctly.
- **Filling in missing values** –it is quite common for some values to be missing from datasets. This typically means that a piece of information was simply not collected.
- **Correcting erroneous values** –there are values that can be identified as obviously incorrect. These values either need to be corrected (if the correct value can be determined) or assumed to be missing.
- **Standardizing categories** –spelling mistakes, language differences or other factors will result in a given answer being provided in multiple ways. For example, when collecting data on country of birth, if users are not provided with a standardized list of countries, the data will inevitably contain multiple spellings of the same country (e.g. USA, United States, U.S. and so on).

Types of Machine Learning Algorithms



Supervised Machine Learning Algorithms

- Supervised Learning Algorithms are the easiest of all the four types of ML algorithms.
- These algorithms require the direct supervision of the model developer.
- The developer labels the sample data quantity and sets strict boundaries upon which the algorithm will operate.
- The developer select what kind of information output (samples) to “feed” the algorithm
- The developer determine what kind of results are desired (for example “yes/no” or “true/false” or “the value of sales/net credit loss/house price” etc).
- From the machine’s point of view, this process is more or less a “connect the dots” routine.

Supervised Machine Learning Algorithms

- Supervised machine learning includes two major processes: **classification** and **regression**.
- **Classification** is the process of learning from past data samples and manually train the model to predict the essentially binary outcomes (yes/no, true/false, 0/1).
- The classification algorithm recognizes certain types of objects and categorizes them accordingly to predict one of the two possible outcomes.
- **Regression** is the process of identifying patterns and calculating the predictions of continuous outcomes. For example: predicting the house rates or next month's sales forecast etc.
- **Most used Algorithms for Supervised Learning:**

  Linear Regression, Logistical Regression, Random Forest, Gradient Boosted Trees, Support Vector Machines (SVM), Neural Networks, Decision Trees, Naive Bayes, and Nearest Neighbor.

Unsupervised Machine Learning Algorithms

- Unsupervised learning algorithms do not involve direct control from the developer.
- The main point of the requirement for supervised machine learning is that we should know the results beforehand for the past data to be able to predict the results on unseen data but in case of unsupervised machine learning algorithms the desired results are unknown and yet to be defined.
- There are times when you don’t want to exactly predict an outcome. you just want to perform a segmentation or clustering. For example- A bank would want to have segmentation of its customers to understand their behavior. This business problem requires the use of unsupervised machine learning algorithms as there are no specific outcomes being predicted here.
- **The unsupervised machine learning algorithm is used for:**

  Exploring the structure of the information, extracting valuable insights, detecting patterns, and implementing this into its operation to increase efficiency.

Unsupervised Machine Learning Algorithms

- Unsupervised learning algorithms apply the following techniques to describe the data:
- **Clustering**: It is an exploration of data used to segment it into meaningful groups (i.e., clusters) based on their internal patterns without any prior knowledge of group credentials. The credentials are defined by similarity of individual data objects and also aspects of its dissimilarity from the rest (which can also be used to detect anomalies).
- **Dimensionality reduction**: Most of the time, there is a lot of noise in the incoming data. Machine learning algorithms use dimensionality reduction to remove this noise while distilling the relevant information.
- **The most widely used unsupervised algorithms are:**

  K-means clustering, t-SNE (t-Distributed Stochastic Neighbor Embedding),PCA (Principal Component Analysis), and Association rule.

Semi-Supervised Machine Learning Algorithms

- Semi-supervised learning algorithms represent a middle ground between supervised and unsupervised algorithms. In essence, the semi-supervised model combines some aspects of both into a thing of its own.
- A semi-supervised machine-learning algorithm uses a limited set of labeled sample data to shape the requirements of the operation (i.e., train itself).
- The limitation results in a partially trained model that later gets the task to label the unlabeled data.
- Due to the limitations of the sample data set, the results are considered pseudo-labeled data.
- Finally, labeled and pseudo-labeled data sets are combined, which creates a distinct algorithm that combines descriptive and predictive aspects of supervised and unsupervised learning.

Semi-Supervised Machine Learning Algorithms

- **Semi-supervised Learning Algorithms Use Cases**
- Legal and Healthcare industries, manage web content classification, image, and speech analysis with the help of semi-supervised learning.
- In the case of web content classification, semi-supervised learning is applied for crawling engines and content aggregation systems. In both cases, it uses a wide array of labels to analyze content and arrange it in specific configurations. However, this procedure usually requires human input for further classification.
- In the case of image and speech analysis, an algorithm performs labeling to provide a viable image or speech analytic model with coherent transcription based on a sample corpus. For example, it can be an MRI or CT scan. With a small set of exemplary scans, it is possible to provide a coherent model that can identify anomalies in the images.

Reinforcement Machine Learning Algorithms

- Reinforced ML employs a technique called exploration/ exploitation.
- The mechanism is simple — the action takes place, the consequences are observed, and the next action considers the results of the first action. It's an iterative algorithm.
- Using this algorithm, the machine is trained to make specific decisions.
- It works this way: The machine is exposed to an environment where it trains itself continually using trial and error. The machine learns from past experience and tries to capture the best possible knowledge to make accurate business decisions.
- **Most common reinforcement learning algorithms include:**

  Q-Learning, Temporal Difference (TD), Monte-Carlo Tree Search (MCTS), and Asynchronous Actor-Critic Agents (A3C).

Reinforcement Machine Learning Algorithms

- **Reinforcement Learning Algorithms Use Cases**
- Reinforcement Machine Learning fits for instances of limited or inconsistent information available. In this case, an algorithm can form its operating procedures based on interactions with data and relevant processes.
- Modern video games use this type of machine learning model a lot. Reinforcement Learning provides flexibility to the AI reactions to the player's action thus providing viable challenges.
- Self-driving cars also rely on reinforced learning algorithms as well. For example, if the self-driving car (Waymo, for instance) detects the road turn to the left — it may activate the "turn left" scenario and so on.