Application of AI in Healthcare for Heart Attack Prediction in India

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Abstract

Cardiovascular disease is a leading reason of rising mortality rates globally. It is expensive to cure and difficult to predict due to presence of various factors (age, sex, blood pressure, cholesterol level). Patients usually live in their homes and cannot access emergency medical care on time. Another difficulty that springs up is that doctors cannot predict the state of the patient without knowing the real time parameters of the patient. The paper proposes using AI to predict such conditions at an early stage to prevent heart disease or reduce its symptoms allowing the patient to live a longer and more comfortable life. Further studies show a rise in mortality rate due to obesity, rising cholesterol and stress levels and high blood pressure among the people. AI and Data mining are new domains that can help to create models to improve the above situation.

Keywords

Artificial Intelligence, Healthcare, Heart Attack Prediction, Data Mining, Data Preprocessing, Model Building, Score Prediction, Deployment of Model, IoT

Background

Cardiovascular disease is a leading cause of death globally. It is expensive to cure and difficult to predict due to presence of various factors (age, sex, blood pressure, cholesterol level). AI helps to solve both of these problems, it can provide personalized healthcare and predict risk of disease erupting for next 10 years. It can also analyze medical images and provide suggested decisions that a physician can follow. It can assist in surgery, improve efficacy of treatment and mainly reduce cost of treatment of the disease. AI is one of the leading and upcoming industry right now, it makes use of many technologies like Machine Learning (ML), Natural Language Processing (NLP), Support Vector Machines (SVM) and Heuristics Analysis (HA). AI needs to build trust before it can be used in the Healthcare Industry. Explainable AI can give explanations on how it reached the output when given certain inputs. This now can help build trust and accelerate the adoption rates of AI.

AI can be used to predict risk of heart disease over a course of 10 years with the patient's data. Risk calculation is done with various factors like age, sex, blood pressure, behavior (smoking and drinking), total cholesterol, BMI and heart rate. There are many different AI methods - SVM, Logistic Regression, Naive Bayes and XGBoost. In the following methods, XGBoost showed the most promising results with accuracy up to 94%. There are many causes to Heart disease - not working out, eating unhealthy food, increased stress levels due to societal issues, lack of healthcare and lifestyle changes. Indians in general are more prone to heart diseases and diabetes due to their genetic makeup. AI models can be made to tackle this issue and it can be adapted to any local population and it's local parameters. SigTuple, Nuramai, Qure ai, Pharmeasy and Healthify are the top 5 AI startups in India.

Figure 1 explains how predictions are made by given data. First, the required features are selected and missing values are processed. Then, the data is passed through classifiers. The output of the classifiers is gathered in an ensemble classifier. Through majority voting, a result is generated which is the final prediction of the data set.

Prior Art

Heart diseases are chronic illnesses that can happen at any time. Patients usually live in their homes and cannot access emergency medical care on time. Another difficulty that springs up is that doctors cannot predict the state of the patient without continuous assessment of real-time parameters. The paper proposes a solution with help of IoT to get real time parameters of the patient through consistent monitoring and hopes to tackle the above issue. [1] AI is a revolutionary technology and there is a need to start study and research of how AI can be applied to the Healthcare Industry. AI helps in improving patient outcomes by providing clinical decisions that can be undertaken by the physician. It is used to keep medical records in digital format and make sure that the records are safe and can't be stolen. It is also used to track and control infections in the hospital and can reduce the cost of surgery and treatment. [2]

There are many factors to keep track of when predicting risk of heart disease. Traditional machine learning algorithms take time to build a model with high accuracy. The paper proposes an IoT tuned adaptive classifier (TANFIS) which has been optimized by the grasshopper optimization algorithm. The TANFIS classifier provides an accuracy of about 99.76% which is about 5.4% more when compared to traditional algorithms. [3] There is an increase in Heart patients due to unhealthy lifestyle and low health awareness. This increase is happening globally. The paper proposes the potential of 6 machine learning (ML) algorithms to predict heart disease. The algorithms were assessed on 8 different performance scorers (indices)

and the one with the highest accuracy is the Logistic Regression algorithm with accuracy up to 85%. [4]

There is an explosive growth in data gathered by medical applications. There is growth in volume and type of the data. Current solutions of data storage are inefficient and unable to keep up with the growth in data. Thus, Computational Intelligence (CI) is applied to get a better way of dealing with anomalies. There are challenges in making an efficient computational intelligence design. There are 2 approaches to the following - Single & Hybrid, both approaches have their pros and cons but the Hybrid approach gives more accuracy. [5] **Figure 2** shows the different sources which comprise Healthcare Data. It also explains how different types of data compile together to form the required data. The data is then processed and a model is made. The model then gives the predicted result based on the given data.

Methodology

Cardiovascular disease is a leading cause of death globally. Thus, there is a need to predict cardiovascular disease to prevent a patient's loss of life prior to a heart attack. One of the major problems regarding the prediction of heart disease is that there exists a delay in identifying and applying countermeasures for the disease. The paper proposes a solution using 2 sensor nodes to gather data and a BMDA-MKELM approach to identify and classify the heart disease. [6] There is an increased burden on low socioeconomic groups by cardiovascular disease. Machine Learning algorithms are being introduced to the medical field because of their abundant benefits. There is a new approach to include social determinants (sex, race, marital status, income) in machine learning algorithms. Studies have shown better performance and improved accuracy when social determinants are included. [7]

Identification of coronary illness is one of the important frameworks that is being built today. One of the proposed systems comprises of 2 states - Mechanized methodology for era of weighted fuzzy standards and risk prediction using genetic algorithm. The goal of the paper is to help non-specialised doctors to take the correct decisions. [8] Machine Learning is used to improve the accuracy of existing computer systems. The paper explains about the performance of different feature selection methods. Chi squared testing, ReliefF and symmetrical uncertainty are some models to predict heart disease. The best combination is Chi squared testing with accuracy up to 85%. [9]

Early predictions of disease with the help of AI can let doctors make early decisions to save the patient's life. The paper proposes using IoT to boost the power of AI in healthcare. There are 7 classifiers proposed with RF classifier being the most accurate - 97.62%. [10] **Figure 3** explains how Artificial Intelligence can be applied in the different areas of healthcare. AI can be applied for Drug development, vaccine

development, treatment efficacy prediction and personalized diagnosis. AI can also be a virtual nurse and increase the rate of surgery by assisting with robotic arms.

Application

Heart disease comprises of many risk factors and it takes time to get accurate diagnosis to manage the treatment of the disease. Data mining is a technique used to process enormous data. The paper discusses various models to predict heart disease. Results show that K-nearest neighbour algorithm achieves the highest accuracy. [11] There is a huge demand for healthcare technologies (sensor-based prediction) over the last decade. Heart failure has reduced quality of life and has no cure. The paper proposes using AI to predict such conditions at an early stage to prevent heart disease or reduce its symptoms allowing the patient to live a longer and more comfortable life. [12]

MKL-ANFIS based deep learning is one of the approaches for heart diagnosis. The proposed method has 2 steps - MKL method (divide parameters between patients and normal people), MSE method which is used to evaluate MKL with ANFIS method. Results have shown high sensitivity (98%), high specificity (99%) for the KEGG dataset. Specificity is a way to measure how accurately the algorithm identifies false cases while sensitivity measures how accurately the algorithm identifies true cases. [13] The goal of the paper is to develop a wearable technology to provide real-time monitoring to a patient. ECG patterns are monitored by the wearable and with help of machine learning algorithms, prediction of heart risks before they appear is possible. Random Forest algorithm performed the best with accuracy up to 88%. The wearable is targeted towards elderly people as an assistive equipment. [14]

The paper claims that biosensor-based devices will be the future of healthcare. AI is used to analyse and monitor the patient with help of biosensors. The paper proposes using AI with Internet of Things (IoT) for real-time health monitoring. AI provides a key for personalizes medical approach which can improve a patient's life. [15] **Figure 4** explains how to prepare data to apply Machine learning algorithms. First, data has to be collected or downloaded from the internet. Remove duplicates, irrelevant studies and insufficient or incomplete data. The resulting data is optimal for applying machine learning algorithms and to make an AI model which can be used for various purposes.

Current Scenario

The role of AI is to help in diagnosis and optimal treatment of the disease. traditional methods have found this task very challenging and time consuming. The paper discusses about various AI techniques like fuzzy logic and ANN in a critical health scenario. Concept of deep learning has been explained and suggestions are provided to make the analysis more accurate and effective in the paper. [16] AI is bringing huge changes to the healthcare industry. The paper explains about various AI techniques and it's future scope. AI can be applied to various types of healthcare data (structured and unstructured). Cancer, Cardiology and Neurology are the major areas in healthcare that use AI tools. The paper also discusses about the obstructions for real-life deployment of AI. [17]

Big Data and deep learning are new technologies that can change how any industry works if applied properly. The paper explains about using RNN (LTSM) to predict and diagnose heart diseases like heart failure. The model shows high effectiveness when subjected to real-time data and shows improved accuracy when compared to existing deep learning models. [18] Most people form developing countries are suffering from heart disease. The paper proposes an AGAFL model to predict and diagnose heart diseases at an early stage. Important features which effect heart diseases are selected and passed through the AGAFL classifier. The paper experimented on publicly available data sets and it is shown that the proposed model outperforms existing methods. [19]

The paper proposes Cloud Computing and IoT to be used with ensemble deep learning to create a model to predict heart disease. The paper proposes a framework called HealthFog for integrating all 3 technologies to generate a model. The framework is configurable to give the best quality of service and improved accuracy with regards to different user requirements. [20] **Figure 5** explains about the different technologies used to make AI and its abilities. AI has the ability to sense with computer vision, voice recognition and robotics (ability to move). It also has the ability to learn with various methods. The figure also shows the different ways it can learn by and portrays the different fields where AI can be combined and implemented with.

Future Scope

The objective of the paper is to analyse and predict heart disease at an early stage to prevent it from occurring. Data sets have been taken from Jammu and Kashmir, and stored over the cloud. The proposed model is made to analyse the data sets obtained from IoT sensors to predict cardiovascular disease on a real-time level. [21] AI is applied to ECG and it is one of the ways AI is transforming the healthcare industry. ECG provides valuable insights towards diagnosis of heart disease but it requires human expertise which is not available at certain places. With rise of mobile

and ECG technologies, AI-enhanced ECG is being widely developed as it is cheaper than human diagnosis while being faster at the same time. [22]

Healthcare domain is 'data rich', but not all important parameters are analysed (due to monetary reasons or lack of personnel) which is the irony of the industry. The paper has examined frameworks which utilise more parameters for the prediction of heart disease. Further investigation shows that Gini index prediction models show the most precision in predicting the heart disease. The paper employs a scope of procedures to increase the accuracy of the model further leading to faster and more accurate predictions. [23] Number of deaths due to Heart disease (HD) is the highest around the globe. Rising number of deaths has become a cause of concern for researchers and thus AI has become the hope to improve the situation. The paper provides information on Machine learning (ML) and Deep learning (DL). The paper also highlights the future scope of AI that can be implemented with the help of these technologies. [24]

Studies show a rise in mortality rate due to obesity, rising cholesterol and stress levels and high blood pressure among the people. AI and Data mining are new domains that can help to create models to improve the above situation. The paper explains in detail about the data mining techniques, machine learning (ML) and deep learning (DL) technologies that can be used to create the desired model. The performance and comparisons of different models are reported in the paper. [25] **Figure 6** shows the different types of machine learning algorithms available today and where it can be implemented. The figure shows where to use which algorithm to fit the user’s requirements. The figure shows and explains about the different models that can be used to suit the learning method the user wants to implement.

Conclusion

AI can be used to track and control infections in the hospital and can reduce the cost of surgery and treatment. Early predictions of disease with the help of AI can let doctors make early decisions to save the patient's life. The paper proposes using IoT to boost the power of AI in healthcare. The goal of the paper is to develop a wearable technology to provide real-time monitoring to a patient. ECG patterns are monitored by the wearable and with help of machine learning algorithms, prediction of heart risks before they appear is possible. With rise of mobile and ECG technologies, AI-enhanced ECG is being widely developed as it is cheaper than human diagnosis while being faster at the same time. Biosensor-based devices will be the future of healthcare. AI is used to analyse and monitor the patient with help of biosensors. The paper proposes using AI with Internet of Things (IoT) for real-time health monitoring.

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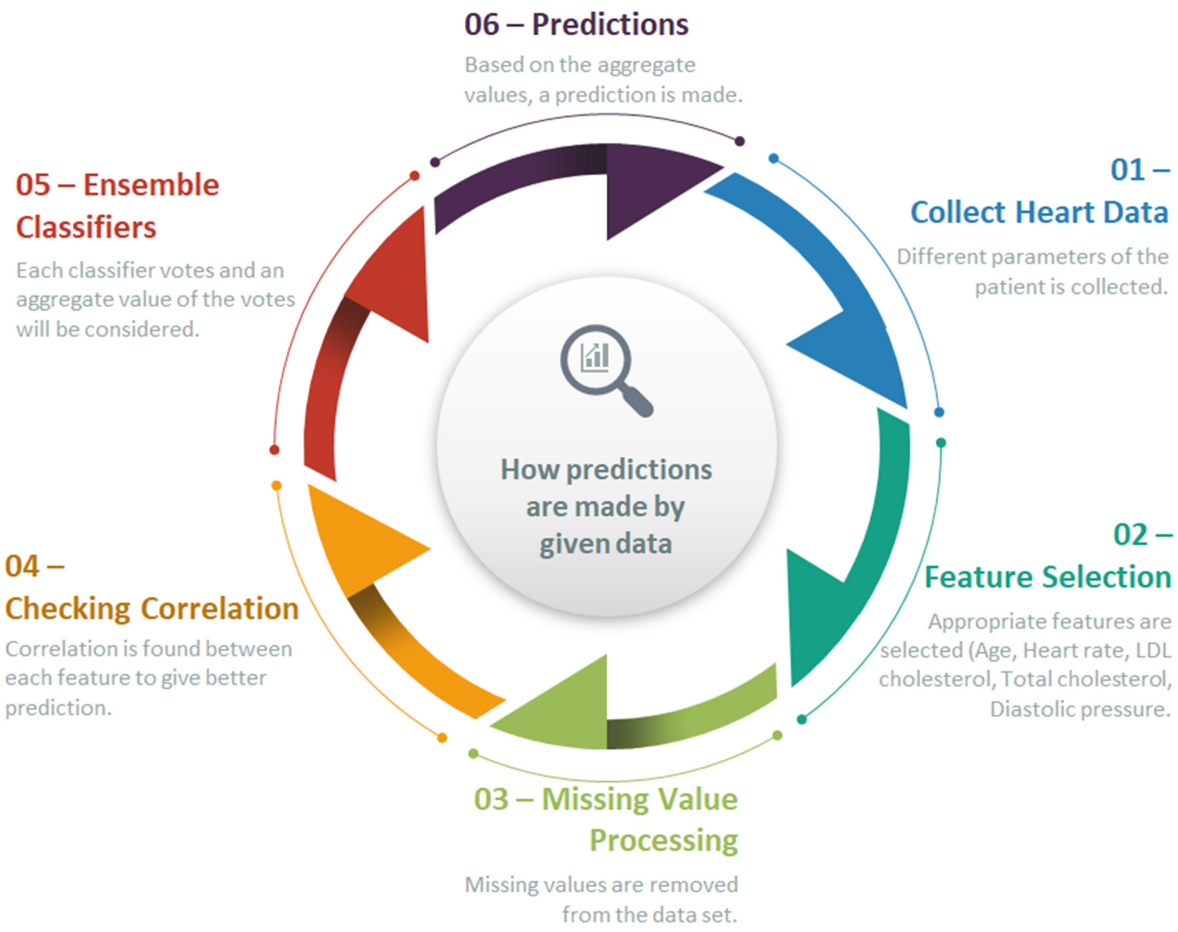

Figure 1: How Predictions are made by given Data

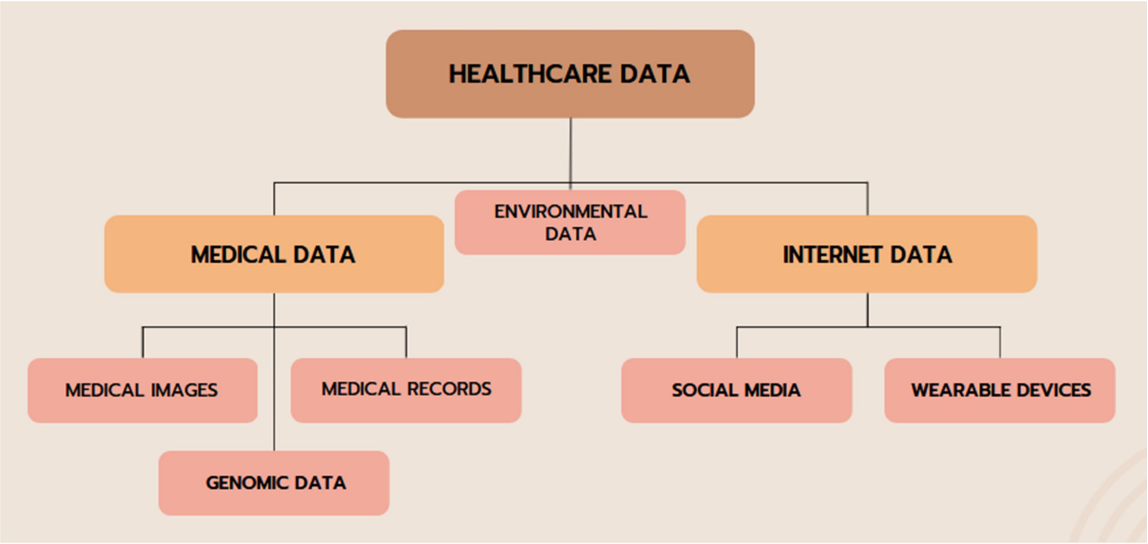

Figure 2: Sources of Healthcare Data

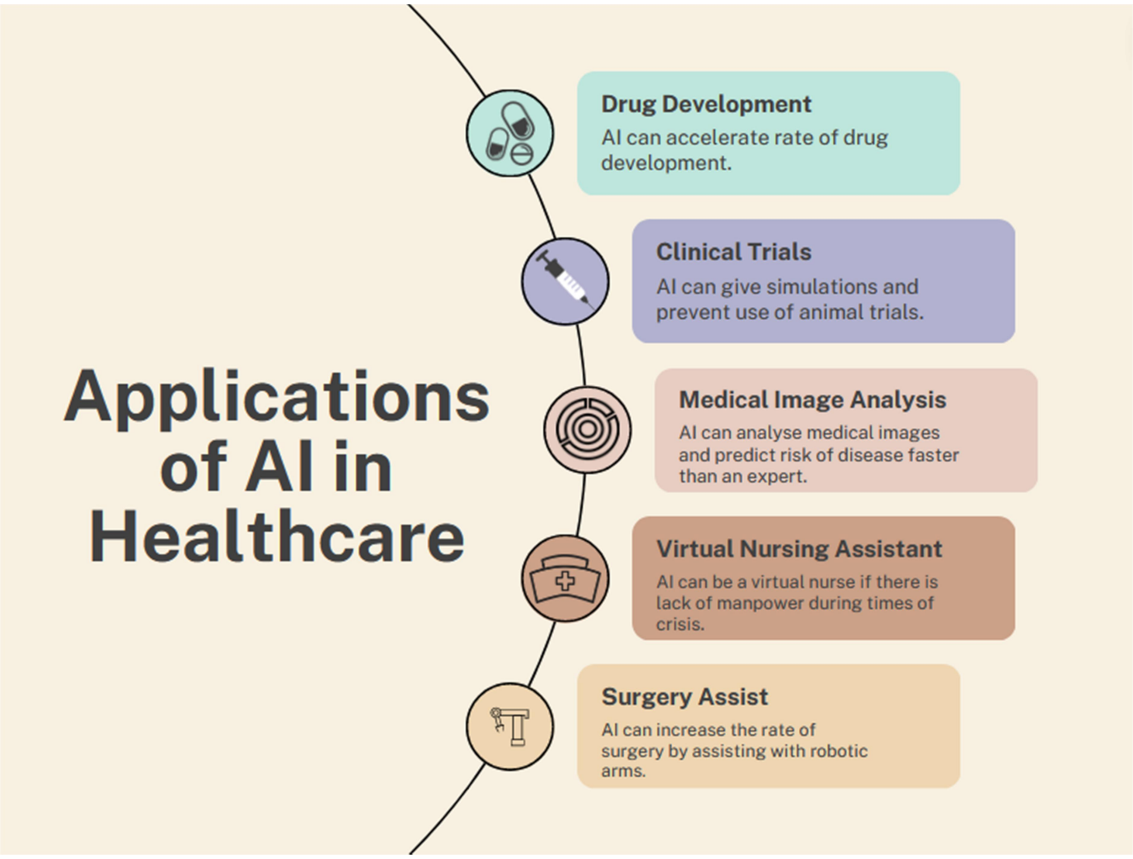

Figure 3: Applications of Artificial Intelligence in Healthcare

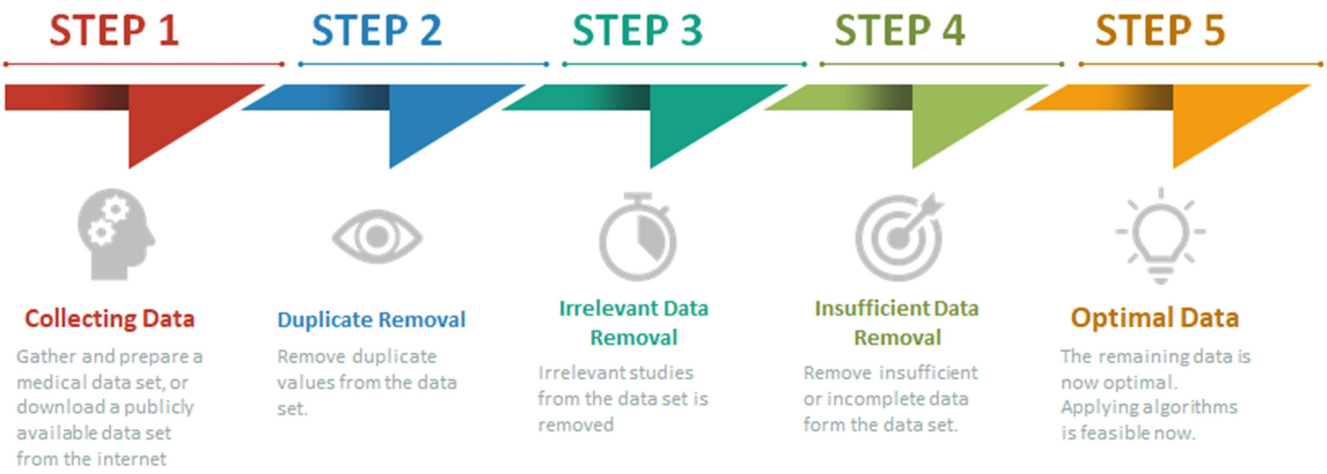

Figure 4: How to Prepare Data to use Machine Learning Algorithms

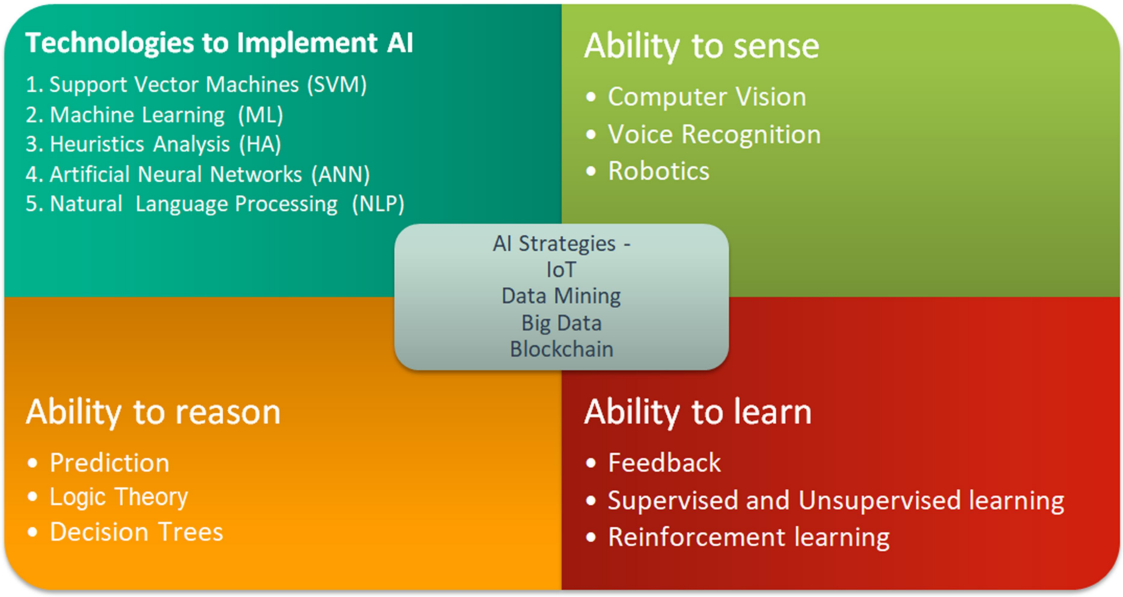

Figure 5: Abilities of Artificial Intelligence

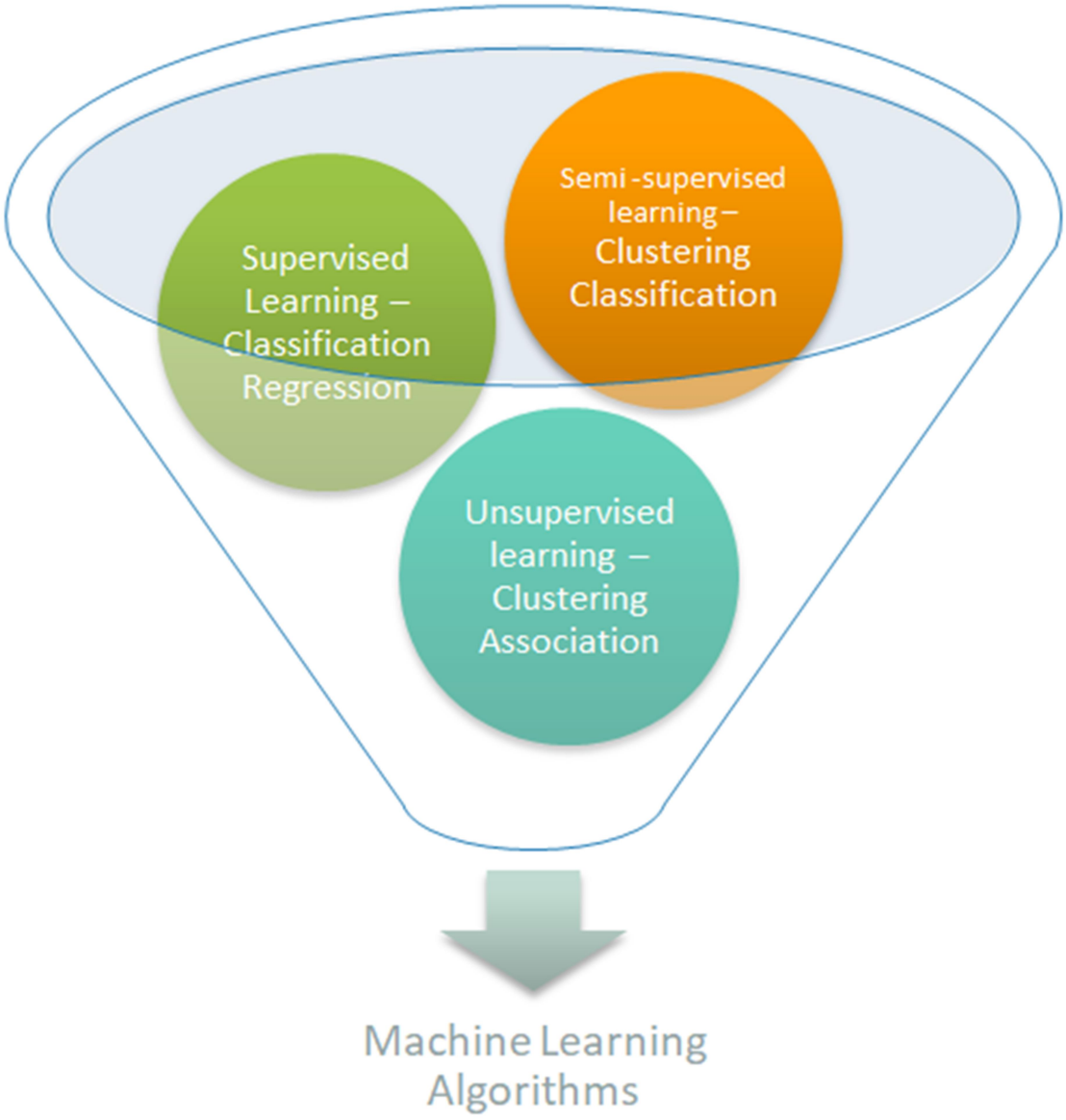

Figure 6: Types of Machine Learning Algorithms