ELECTRONICS & COMMUNICATION ENGINEERING

TECH CONNECT

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LAKIREDDY BALIREDDY COLLEGE OF ENGINEERING
MYLAVARAM

Contents

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1. *Non-Orthogonal Multiple Access Techniques in Emerging Wireless Systems*

Wireless mobile communication systems became an indispensable part of modern lives. However, the number and the variety of devices increase significantly and the same radio spectrum is required to be reused several times by different applications and/or users. Additionally, the demand for the Internet of Tings (IoT) introduces the necessity to connect every person and every object . However, current communication systems have strict limitations, restricting any modifications and improvements on the systems to meet these demands. Recently, researchers have been working on developing suitable techniques that may be integrated in next generation wireless communication systems in order to fundamentally fulfill the emerging requirements, including very high spectral efficiency, very low latency, massive device connectivity, very high achievable data rate, ultrahigh reliability, excellent user fairness, high throughput, supporting diverse quality of services (QoS), energy efficiency, and a dramatic reduction in the cost.

NOMA:

Non-orthogonal multiple access (NOMA) is one of the most promising radio access techniques in next-generation wireless communications. Compared to orthogonal frequency division multiple access (OFDMA), which is the current de facto standard orthogonal multiple access (OMA) technique, NOMA offers a set of desirable potential benefits, such as enhanced spectrum efficiency, reduced latency with high reliability, and massive connectivity. The baseline idea of NOMA is to serve multiple users using the same resource in terms of time, frequency, and space.

The available NOMA techniques can broadly be divided into two major categories, i.e., power-domain NOMA and code-domain NOMA. Code-domain NOMA can further be classified into several multiple access techniques that rely on low-density spreading and sparse code multiple access. Other closely related multiple access schemes in this context are lattice-partition multiple access, multi-user shared access, and pattern-division multiple access.

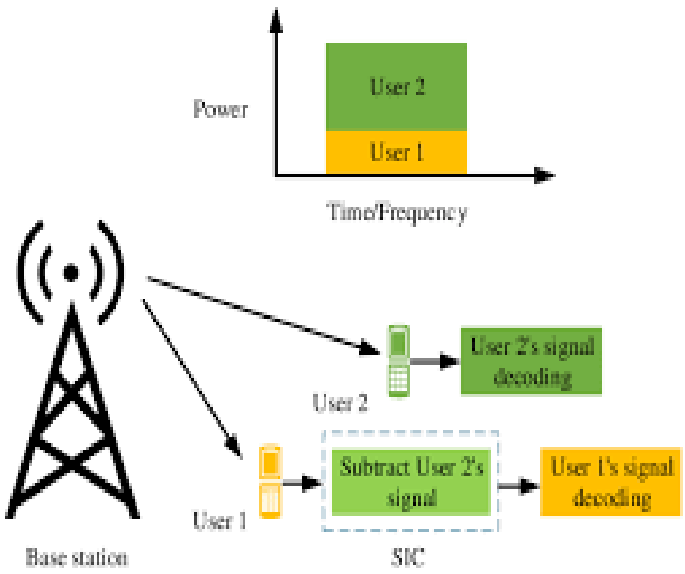


Fig1. Down link for NOMA

In downlink NOMA, the transmit signal from the BS and the received signal at both UE receivers is composed of a superposition of the transmit signals of both UEs. Thus, multi-user signal separation needs to be implemented at the UE side so that each UE can retrieve its signal and decode its own data. This can be achieved by non-linear receivers such as maximum likelihood detection or SIC (Successive Interference Cancellation).

For the case of SIC, the optimal order for decoding is in the order of the decreasing channel gain normalized by noise and ICI power. Based on this order, we can actually assume that any user can correctly decode the signals of other users whose decoding order comes before the corresponding user.In a two-UE case, assuming that, UE-2 does not perform interference cancellation since it comes first in the decoding order. UE-1 first decode UE-2 signal, and subtracts its component from total received signal, and thus it gets its own signal component and decodes it, without interference from UE-2 signal.

NOMA uses the power domain to separate signals from each other. NOMA gives a new dimension in which signals can be separated and given access to a base station. This technique that has not been used within 2G, 3G or 4G before.

COMPARSION OF NOMA AND OMA:

→ Receiver complexity of NOMA is high compared to OMA.

→ NOMA consumes more energy than OMA.

→ The Number of users/cluster in NOMA is less than OMA.

→ Number of user pairs in NOMA is less where as in OMA there are more number of user pairs.

→ System throughput of NOMA is larger than OMA.

By this comparison between NOMA and OMA it is clear that NOMA is better than OMA.

ADVANTAGES OF NOMA:

- Higher spectral efficiency due to use of multiple users on same frequency resource.
- Offers massive connectivity by serving more uses simultaneously at the same time.
- Offers lower latency due to simultaneous transmission all the time rather than dedicated scheduled time slot.
- Offers better QoS (Quality of Service) to all the users using flexible power control algorithms.
- Helps in increasing cell-edge throughput and better user experience at cell-edges. The NOMA along with MIMO delivers enhanced performance.

DISADVANTAGES OF NOMA:

Each of the users within the cluster need to decode information of all the other users even one having worst channel gains. This leads to complexity in the receiver.

Higher energy consumption Moreover energy consumption is higher. If error occurs in single user due to SIC, decoding of all the other users information will be erroneous. This limits maximum number of users to be served by each of the clusters of the cell.

In order to achieve desired functionalities of power domain concept in NOMA at the receiver, channel gain difference between users should be adequate. This limits effective number of user pairs.

APPLICATIONS OF NOMA:

- NOMA Applied to Device-To-Device Communications
- NOMA Applied to Wireless Sensor Networks
- NOMA Applied to Cellular Networks

~AiswaryaViswanath(18761A0456)

2. Block Chain technology -The Invisible Technology Changing the World

Block chain is answer to the question we have been asking since the raise of internet age .Every year most of our activities like banking, shopping, using apps are on Internet. The Block chain records everything that happens underneath- every digital transaction; exchange of value, goods and services; or private data—exactly as it occurs. Then the chain stitches that data into encrypted blocks that can never be modified and scatters the pieces across a worldwide network of distributed computers or "nodes".

A Block chain is made up of two primary components: a decentralized network facilitating and verifying transactions and the immutable ledger that network maintains. Everyone in the network can see this shared transaction ledger, but there is no single point of failure from which records or digital assets can be hacked or corrupted. This technology has applications across every kind of digital record and transaction, and we're already beginning to see major industries leaning into the shift.

Implementing Block chain for Large Enterprises:

Block chains are creating a massive hype in the market. Many enterprises are highly interested in this type of networking. Till now, the focus was mainly on governance solutions for public Block chain platforms like Ethereum. There are different types of Block chains the companies can use. They are public, private and consortium Block chains.

Public Block chain:

Public Block chain is permission-less, non-restrictive ledger which means anyone who is connected to internet can join a Block chain and be a part of it. The basic use of such a Block chain is in exchanging crypto currencies.

The first example of this Block chains is Bit coin that enabled everyone to perform transactions. Etherum, Lit coin are also public Block chains.

Private Block chain:

Unlike the public block chain, a private block chain is permission-needing and a restrictive ledger that operates in a closed network. Such Block chains are mostly used within the organizations.

Consortium Block chain:

It is suited for organizations which needs both public and private. In this type, there is no one central in-charge or more than one organization involved who provides access to pre-selected nodes for reading and writing. Few companies have implemented this type of block chain.

Few start-ups using this technology:

Brave: Founded by Mozilla co-founder Brendan Eich, Brave is a new kind of browser that automatically blocks ads and trackers and instead helps drive publisher revenue through block chain.

Credit Dream: Access to credit can be difficult to come by in developing nations, and carry enormous interest if you're lucky enough to get it. Currently active in Brazil it is a mobile-based block chain platform for connecting investors in any country to loan borrowers in any country.

Enigma: A stealth start-up from MIT Media Lab, It takes the Block chain's privacy and security advantages and rolls them into a decentralized cloud platform that guarantees privacy. Enigma encrypts and protects data even when you share it with others, allowing data to be stored, shared, and analyzed without ever being fully revealed to any party. The change block chain represents to our digital world is tremendous. Block chain is broad and coming to the fore on such a massive scale that explaining it often falls back on the abstract, rather than grounding it in the kind of foundational change the technology will have on the culture of how we interact online.

Web1.0 - Was a read-only Internet of static web pages.

Web2.0 - Where we are now, added dynamic user-generated content and the rise of social media.

Web3.0 - It has many definitions, but one of the most popular is that of connective intelligence: where the next generation of applications, data, concepts, and people are connected by a technology where you don't need a trust broker like a bank or tech company in the middle to ensure privacy and security. In block chain, we finally have the technology to power Web 3.0.

~(K.Harshita)18761A0419

3. Random forest Algorithm

INTRODUCTION:

Random forests or random decision forests are an ensemble learning method for classification, regression and other tasks that operates by constructing a multitude of decision trees at training time. For classification tasks, the output of the random forest is the class selected by most trees. For regression tasks, the mean or average prediction of the individual trees is returned. Random decision forests correct for decision trees' habit of overfitting to their training set.

Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML. It is based on the concept of **ensemble learning.** It builds decision trees on different samples and takes the majority vote for classification and average in case of regression.

APPLICATIONS:

1. Banking: Banking sector mostly uses this algorithm for the identification of loan risk.
2. Medicine: With the help of this algorithm, disease trends and risks of the disease can be identified.
3. Land Use: We can identify the areas of similar land use by this algorithm.
4. Marketing: Marketing trends can be identified using this algorithm.

ADVANTAGES:

1.Random Forest is capable of performing both Classification and Regression tasks.

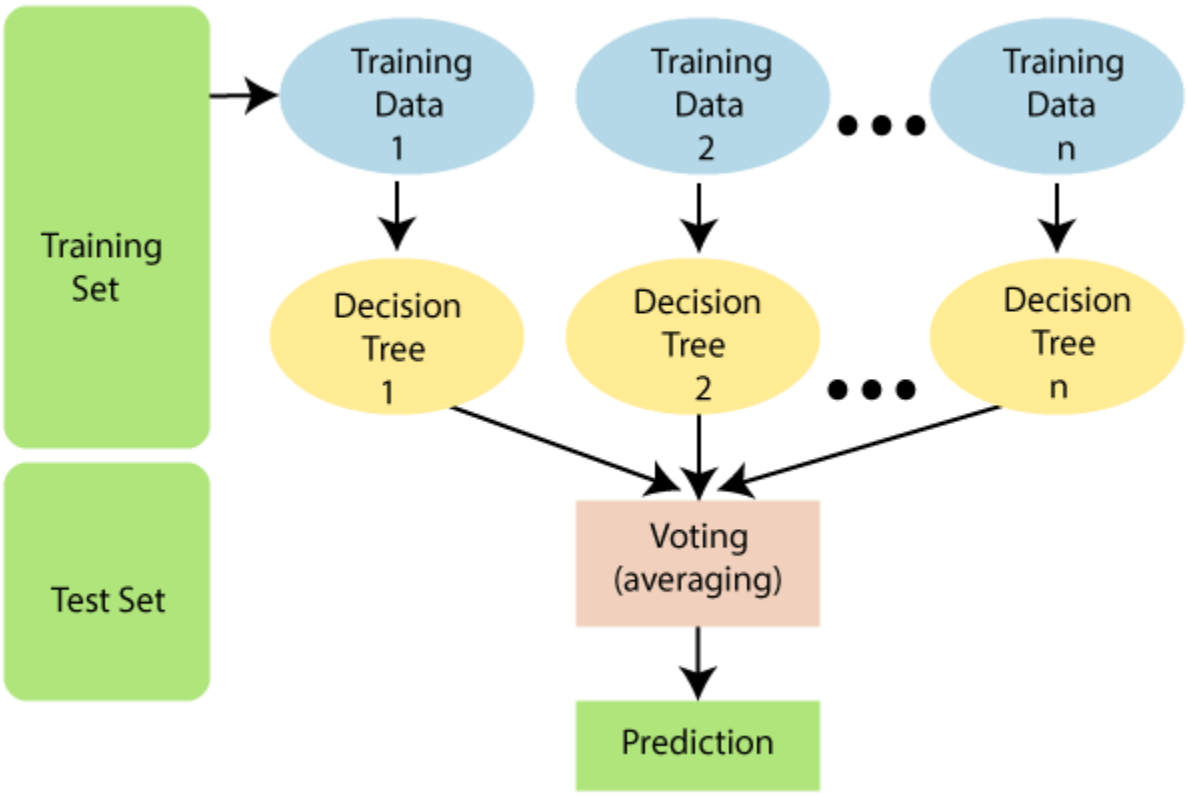
2.It is capable of handling large datasets with high dimensionality.

3.It is capable of handling large datasets with high dimensionality.

DISADVANTAGES:

Although random forest can be used for both classification and regression tasks, it is not more suitable for Regression tasks.

Working of the Random Forest algorithm:



Random Forest works in two-phase first is to create the random forest by combining N decision tree, and second is to make predictions for each tree created in the first phase.

The greater number of trees in the forest leads to higher accuracy and prevents the problem of over fitting. It takes less training time as compared to other algorithms.

~G.Jaswanth(1861A0412)

5. Boosting Algorithms in machine learning

Introduction:

Boosting grants power to machine learning models to improve their accuracy of prediction. Boosting algorithms are one of the most widely used algorithm in data science competitions.

Definition*:* The term 'Boosting' refers to a family of algorithms which converts weak learner to strong learners.

Classification of mails as SPAM:

1. Email has only one image file (promotional image), It's a SPAM
2. Email has only link(s), It's a SPAM
3. Email body consist of sentence like "You won a prize money of $ xxxxxx", It's a SPAM
4. Email from our official domain "Analyticsvidhya.com" , Not a SPAM
5. Email from known source, Not a SPAM

Above, we've defined multiple rules to classify an email into 'spam' or 'not spam'. But, do you think these rules individually are strong enough to successfully classify an email? No.

Individually, these rules are not powerful enough to classify an email into 'spam' or 'not spam'. Therefore, these rules are called as **weak learner**.

To convert weak learner to strong learner, we'll combine the prediction of each weak learner by using different methods. For example: Above, we have defined 5 weak learners. Out of these 5, 3 are voted as 'SPAM' and 2 are voted as 'Not a SPAM'. In this case, by default, we'll consider an email as SPAM because we have higher (3) vote for 'SPAM'.

Working of Boosting Algorithms:

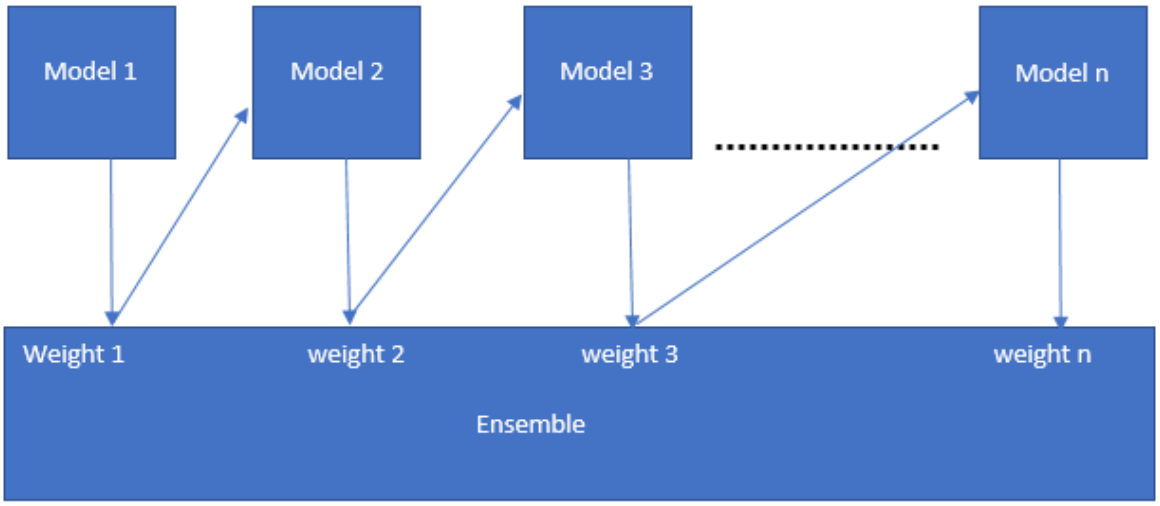
Boosting combines weak learner i.e base learner to form a strong rule. To find weak rule, we apply base learning (ML) algorithms with a different distribution. Each time base learning algorithm is applied, it generates a new weak prediction rule. This is an iterative process. After many iterations, the boosting algorithm combines these weak rules into a single strong prediction rule.

For choosing the right distribution, here are the following steps:

Step 1: The base learner takes all the distributions and assigns equal weight or attention to each observation.

Step 2: If there is any prediction error caused by first base learning algorithm, then we pay higher attention to observations having prediction error. Then, we apply the next base learning algorithm.

Step 3: Iterate Step 2 till the limit of base learning algorithm is reached or higher accuracy is achieved.



Finally, it combines the outputs from weak learner and creates a strong learner which eventually improves the prediction power of the model. Boosting pays higher focus on examples which are mis- classified or have higher errors by preceding weak rules.

Types of Boosting Algorithms

Underlying engine used for boosting algorithms can be anything. It can be decision stamp, margin-maximizing classification algorithm etc. There are many boosting algorithms which use other types of engine such as:

1. AdaBoost (**Ada**ptive **Boost**ing)
2. Gradient Tree Boosting

3. XGBoost

AdaBoost (Adaptive Boosting): It works on similar method as discussed above. It fits a sequence of weak learners on different weighted training data. It starts by predicting original data set and gives equal weight to each observation. If prediction is incorrect using the first learner, then it gives higher weight to observation which have been predicted incorrectly. Being an iterative process, it continues to add learners until a limit is reached in the number of models or accuracy.

Gradient Boosting

In gradient boosting, it trains many model sequentially. Each new model gradually minimizes the loss function (y = ax + b + e, e needs special attention as it is an error term) of the whole system using Gradient Descent method. The learning procedure consecutively fit new models to provide a more accurate estimate of the response variable.

The principle idea behind this algorithm is to construct new base learners which can be maximally correlated with negative gradient of the loss function, associated with the whole ensemble.

In Python Sklearn library, we use Gradient Tree Boosting or GBRT. It is a generalization of boosting to arbitrary differentiable loss functions. It can be used for both regression and classification problems.

XGBoost:

XGBoost is an algorithm that has recently been dominating applied machine learning and Kaggle competitions for structured or tabular data. XGBoost is an implementation of gradient boosted decision trees designed for speed and performance

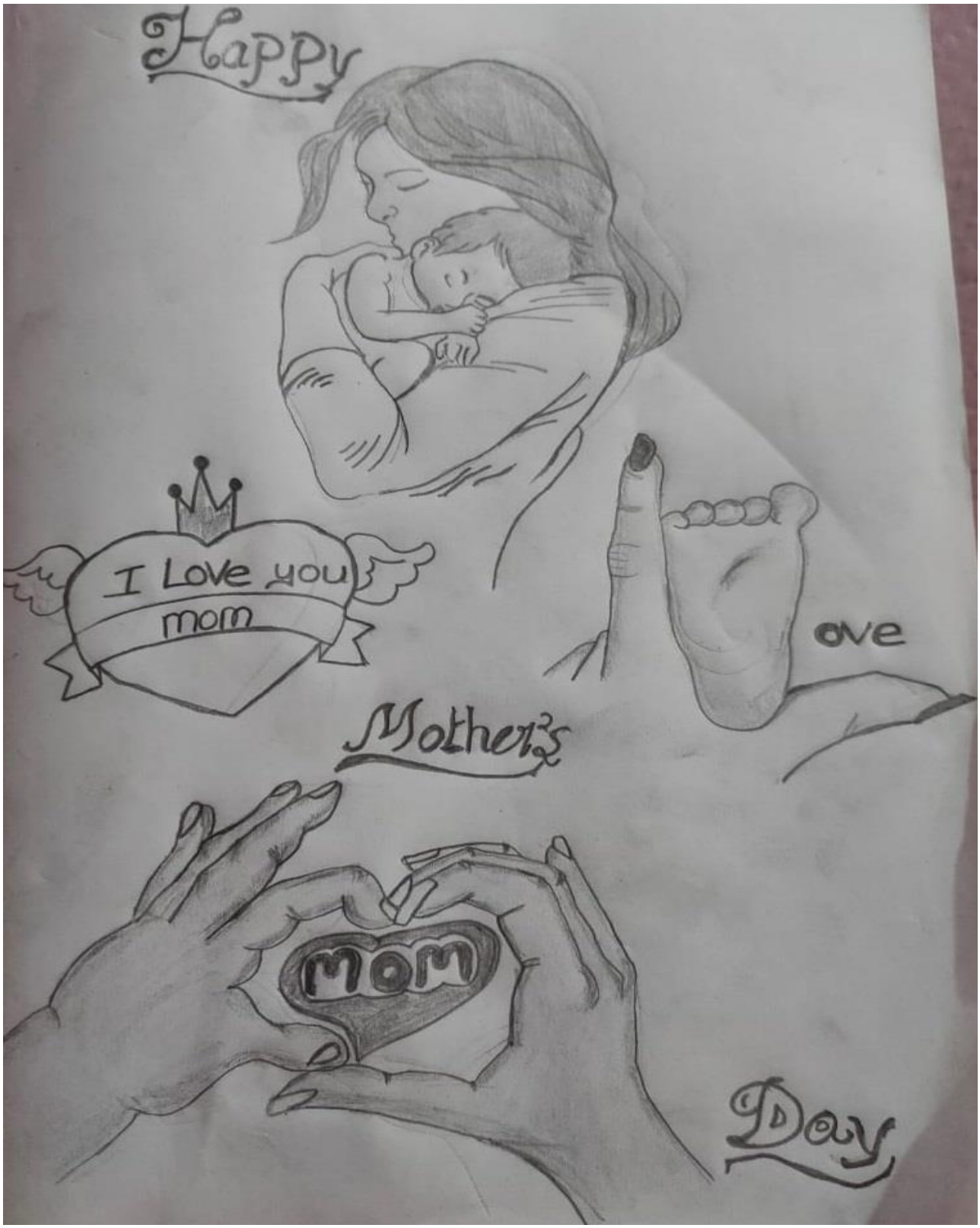
Pros and Cons of Boosting

As an ensemble model, boosting comes with an easy-to-read and interpret algorithm, making its prediction interpretations easy to handle. The prediction capability is efficient through the use of its clone methods, such as bagging or random forest and decision trees. Boosting is a resilient method that curbs over-fitting easily.

One disadvantage of boosting is that it is sensitive to outliers since every classifier is obliged to fix the errors in the predecessors. Thus, the method is too dependent on outliers. Another disadvantage is that the method is almost impossible to scale up. This is because every estimator bases its correctness on the previous predictors, thus making the procedure difficult to streamline.

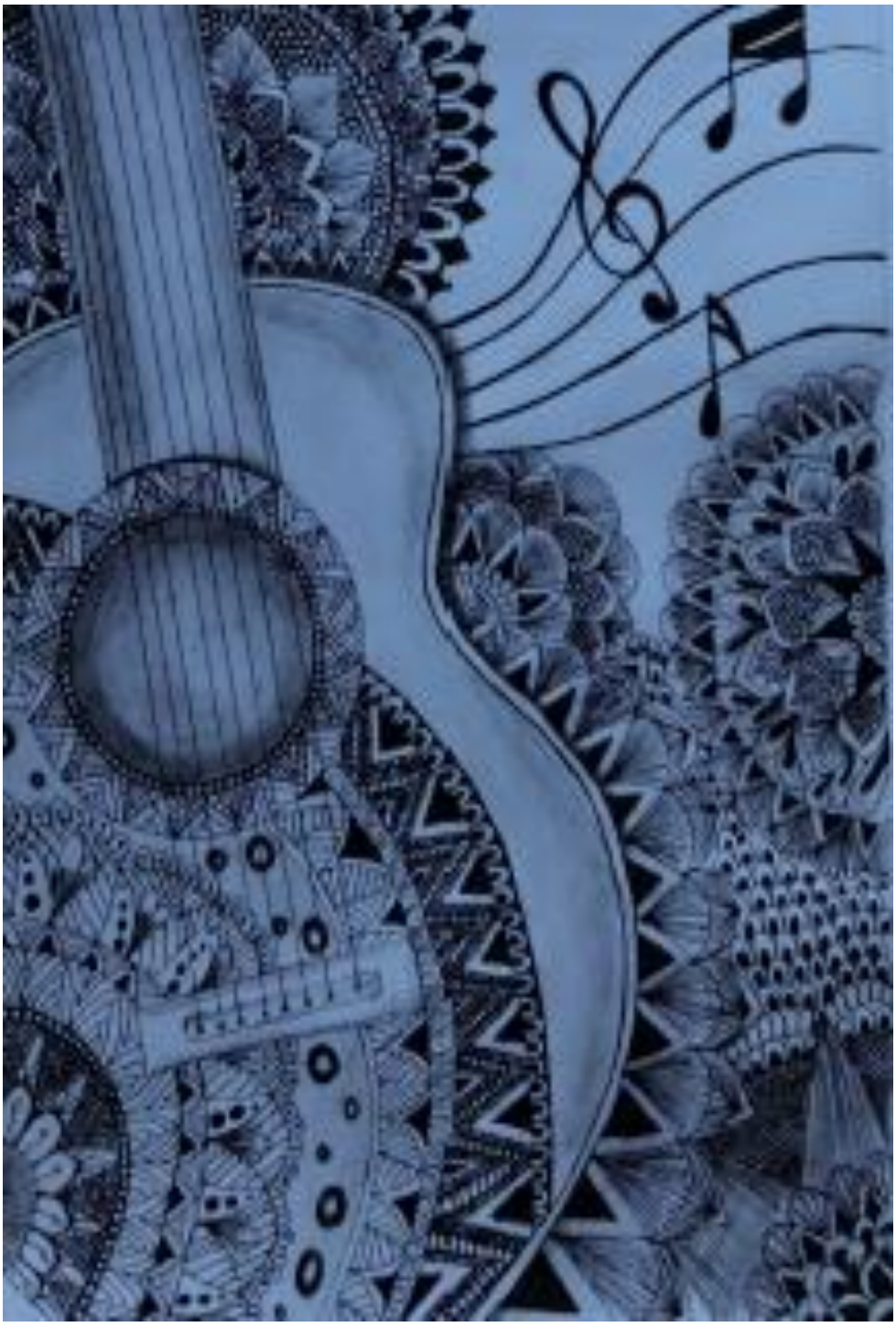
~ K.HemanthReddy(18761A0423)

5. Mother's Love



~V.Venkatesh(1971A04C5)

6. Art of Music



~G.Vasavi

7. James Web Telescope (JWST)

The James Webb Space Telescope (JWST) is a space telescope designed primarily to conduct infrared astronomy. The U.S. National Aeronautics and Space Administration (NASA) led development of the telescope in collaboration with the European Space Agency (ESA), and the Canadian Space Agency (CSA).The James Webb Space Telescope has a mass about half of Hubble Space Telescope's, but has a 6.5 m (21 ft)-diameter gold-coated beryllium primary mirror made of 18 hexagonal mirrors, giving it a total size over six times as large as Hubble's 2.4 m (7.9 ft). Of this, 0.9 m^2 (9.7 sq ft) is obscured by the secondary support struts, making its actual light collecting area about 6.25 times larger than Hubble's 4.0 m^2 (43 sq ft) collecting area. Beryllium is a very stiff, hard, lightweight metal often used in aerospace that is non-magnetic and keeps its shape accurately in an ultra-cold environment. The gold coating provides infrared reflectivity and durability.

JWST is designed primarily for near-infrared astronomy, but can also see orange and red visible light, as well as the mid-infrared region, depending on the instrument. It can detect objects up to 100 times fainter than Hubble, and objects much earlier in the history of the universe, back to redshift z≈20 (about 180 million years cosmic time after the Big Bang).[17] For comparison, the earliest stars are thought to have formed between z≈30 and z≈20 (100-180 million years cosmic time), the first galaxies may have formed around redshift z≈15 (about 270 million years cosmic time), and Hubble is unable to see further back than very early reionization at about z≈11.1 (galaxy GN-z11, 400 million years cosmic time).

The design emphasizes the near to mid-infrared for three main reasons:

- High-redshift (very old and distant) objects have their visible emissions shifted into the infrared, and therefore their light can only be observed today via infrared astronomy;
- Colder objects such as debris disks and planets emit most strongly in the infrared;
- Infrared bands are difficult to study from the ground or by existing space telescopes such as Hubble.

Ground-based telescopes must look through Earth's atmosphere, which is opaque in many infrared bands (see figure of atmospheric absorption). Even where the atmosphere is transparent, many of the target chemical compounds, such as water, carbon dioxide, and methane, also exist in the Earth's atmosphere, vastly complicating analysis. Existing space telescopes such as Hubble cannot study these bands since their mirrors are insufficiently cool

(the Hubble mirror is maintained at about 15 °C (288 K; 59 °F)) thus the telescope itself radiates strongly in the infrared bands.

JWST can also observe nearby objects, including objects in the Solar System, having an apparent angular rate of motion of 0.030 arc seconds per second or less. This includes all planets and satellites, comets, and asteroids beyond Earth's orbit, and "virtually all" known Kuiper Belt Objects. In addition, it can observe opportunistic and unplanned targets within 48 hours of a decision to do so, such as supernovae and gamma ray bursts.

Location and orbit:

JWST operates in a halo orbit, circling around a point in space known as the Sun-Earth L_2 Lagrange point, approximately 1,500,000 km (930,000 mi) beyond Earth's orbit around the Sun. Its actual position varies between about 250,000 km (160,000 mi) and 832,000 km (517,000 mi) from L_2 as it orbits, keeping it out of both Earth and Moon's shadow. By way of comparison, Hubble orbits 550 km (340 mi) above Earth's surface, and the Moon is roughly 400,000 km (250,000 mi) from Earth. Objects near this Sun-Earth L_2 point can orbit the Sun in synchrony with the Earth, allowing the telescope to remain at a roughly constant distance with continuous orientation of its unique sunshield and equipment bus toward the Sun, Earth and Moon. Combined with its wide shadow-avoiding orbit, the telescope can simultaneously block incoming heat and light from all three of these bodies and avoid even the smallest changes of temperature from Earth and Moon shadows that would affect the structure, yet still maintain uninterrupted solar power and Earth communications on its sun-facing side. This arrangement keeps the temperature of the spacecraft constant and below the 50 K (−223 °C; −370 °F) necessary for faint infrared observations.

Sunshield protection:

Test unit of the sunshield stacked and expanded at the Northrop Grumman facility in California, 2014.To make observations in the infrared spectrum, JWST must be kept under 50 K (−223.2 °C; −369.7 °F); otherwise, infrared radiation from the telescope itself would overwhelm its instruments. It therefore uses a large sunshield to block light and heat from the Sun, Earth, and Moon, and its position near the Sun-Earth L_2 keeps all three bodies on the same side of the spacecraft at all times. Its halo orbit around the L_2 point avoids the shadow of the Earth and Moon, maintaining a constant environment for the sunshield and solar

arrays. The shielding maintains a stable temperature for the structures on the dark side, which is critical to maintaining precise alignment of the primary mirror segments in space.

The five-layer sunshield, each layer as thin as a human hair, is constructed from Kapton E, a commercially available polyimide film from DuPont, with membranes specially coated with Aluminium on both sides and a layer of doped silicon on the Sun-facing side of the two hottest layers to reflect the Sun's heat back into space. Accidental tears of the delicate film structure during testing in 2018 were among the factors delaying the project.

The sunshield was designed to be folded twelve times so that it fit within the Ariane 5 rocket's payload fairing, which is 4.57 m (15.0 ft) in diameter, and 16.19 m (53.1 ft) long. The shield's fully deployed dimensions were planned as 14.162 m × 21.197 m (46.46 ft × 69.54 ft). The sunshield was hand-assembled at ManTech (NeXolve) in Huntsville, Alabama, before it was delivered to Northrop Grumman in Redondo Beach, California, for testing.

Because of the sunshield, JWST does not have an unlimited field of regard at any given time. The telescope can see 40 percent of the sky from one position and can see all of the sky over a period of six months, the amount of time it takes to complete half its orbit around the Sun.

Optics:

JWST's primary mirror is a 6.5 m (21 ft)-diameter gold-coated beryllium reflector with a collecting area of 25.4 m^2 (273 sq ft). If it were built as a single large mirror, this would have been too large for existing launch vehicles. The mirror is therefore composed of 18 hexagonal segments, which unfolded after the telescope was launched. Image plane wavefront sensing through phase retrieval is used to position the mirror segments in the correct location using very precise micro-motors. Subsequent to this initial configuration, they only need occasional updates every few days to retain optimal focus.[66] This is unlike terrestrial telescopes, for example the Keck telescopes, which continually adjust their mirror segments using active optics to overcome the effects of gravitational and wind loading.

The Webb telescope will use 132 small motors (called actuators) to position and occasionally adjust the optics as there are few environmental disturbances of a telescope in space.[67] Each of the 18 primary mirror segments is controlled by 6 positional actuators with a further ROC (radius of curvature) actuator at the center to adjust curvature (7 actuators per segment), for a total of 126 primary mirror actuators, and another 6 actuators for the

secondary mirror, giving a total of 132. The actuators can position the mirror with 10 nano meter (10 millionths of a milli meter) accuracy.

JWST's optical design is a three-mirror anastigmat, which makes use of curved secondary and tertiary mirrors to deliver images that are free from optical aberrations over a wide field. The secondary mirror is 0.74 m (2.4 ft) diameter. In addition, there is a fine steering mirror which can adjust its position many times per second to provide image stabilization. The primary mirror segments are hollowed at the rear in a honeycomb pattern, to reduce weight.

Reference:

[1*]. https://en.wikipedia.org/wiki/James_Webb_Space_Telescope*

~Dr.G.L.N.Murthy

8. Adaptive Neuro Fuzzy Interface System

An adaptive neuro-fuzzy inference system or adaptive network-based fuzzy inference system (ANFIS) is a kind of artificial neural network that is based on Takagi–Sugeno fuzzy inference system. The technique was developed in the early 1990s. Since it integrates both neural networks and fuzzy logic principles, it has potential to capture the benefits of both in a single framework. Its inference system corresponds to a set of fuzzy IF–THEN rules that have learning capability to approximate nonlinear functions. Hence, ANFIS is considered to be a universal estimator. For using the ANFIS in a more efficient and optimal way, one can use the best parameters obtained by genetic algorithm. It has uses in intelligent situational aware energy management system.

Architecture:

It is possible to identify two parts in the network structure, namely premise and consequence parts. In more details, the architecture is composed by five layers. The first layer takes the input values and determines the membership functions belonging to them. It is commonly called fuzzification layer. The membership degrees of each function are computed by using the premise parameter set, namely {a,b,c}. The second layer is responsible of generating the firing strengths for the rules. Due to its task, the second layer is denoted as "rule layer". The role of the third layer is to normalize the computed firing strengths, by dividing each value for the total firing strength. The fourth layer takes as input the normalized values and the consequence parameter set {p,q,r}. The values returned by this layer are the de-fuzzificated ones and those values are passed to the last layer to return the final output.

Fuzzfiication layer:

The first layer of an ANFIS network describes the difference to a vanilla neural network. Neural networks in general are operating with a data pre-processing step, in which the features are converted into normalized values between 0 and 1. An ANFIS neural network doesn't need a sigmoid function, but it's doing the pre-processing step by converting numeric values into fuzzy values.

Here is an example: Suppose, the network gets as input the distance between two points in the 2d space. The distance is measured in pixels, and it can have values from 0 up to 500 pixels. Converting the numerical values into Fuzzy numbers is done with the membership function which consists of semantic descriptions like near, middle and far. Each possible

linguistic value is given by an individual neuron. The neuron “near” fires with a value from 0 to 1, if the distance is located within the category "near". While the neuron “middle” fires, if the distance in that category. The input value “distance in pixels” is split into three different neurons for near, middle and far.

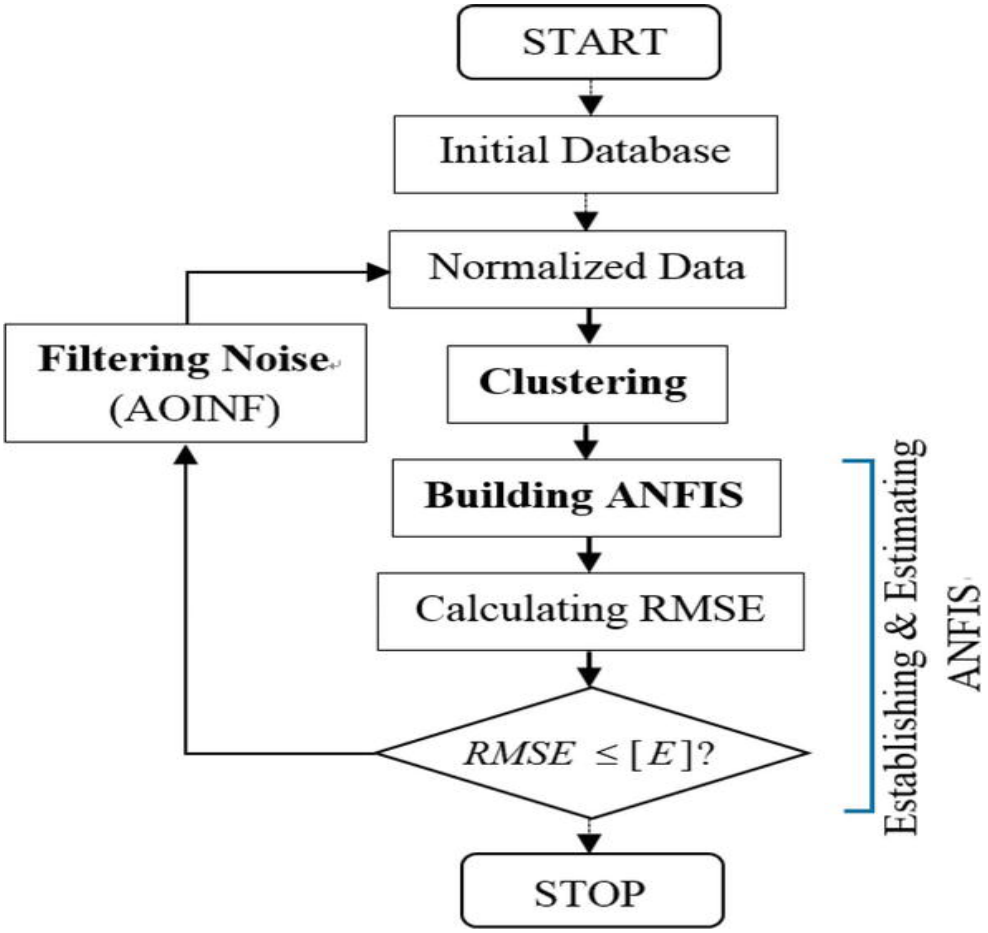


Fig.1.Block diagram of ANFIS

~V.SaiAnil(18761A04B5)

Editorial

Creativity and thrust towards innovating new things is origin for the technological development Small idea in the mind and working towards it for making it reality can do miracles but it needs dedication. Human is always curious regarding knowing about the space and in coming December one spectacular event in the current days is about to happen. James web telescope, the first of its kind in locating at around 15,00,000 Km is about to get launched. Designed for decades and costing lots of millions f dollars, the telescope is aimed at studying about the past and about other galaxies. One must be get inspired by such developments and try towards developing solutions to real time problems.

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