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Machine Learning Techniques for 5G and Beyond Network Classification

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ABSTRACT

Wireless communication systems play a very crucial role in modern society for entertainment, business, commercial, health and safety applications. These systems keep evolving from one generation to next generation and currently we are seeing deployment of fifth generation (5G) wireless systems around the world. Academics and industries are already discussing beyond 5G wireless systems which will be sixth generation (6G) of the evolution. One of the main and key components of 6G systems will be the use of Artificial Intelligence (AI) and Machine Learning (ML) for such wireless networks. Every component and building block of a wireless system that we currently are familiar with from our knowledge of wireless technologies up to 5G, such as physical, network and application layers, will involve one or another AI/ML techniques. Here we try to use several ML algorithms to identify the suitable aspects related to the deployment of 5g and above networks by taking several features and ml algorithms into account. By comparing several algorithms we finally conclude which algorithm is best among several algorithms.

KEY WORDS:

Wireless Communication System, Artificial Intelligence, Machine Learning, Sixth Generation, Health Systems.

1. INTRODUCTION

Sixth Generation (6G) wireless technology is a fresh field of study for many academics and researchers. The key benefits of 6G are that they will be made available to consumers and wireless networks alike. Using AI and ML approaches, 6G will also offer improvements in technical metrics including fast throughput, enabling brand-new, high-demand apps, enhanced radio frequency band use, and many more. DL, one of the main ML

technologies, is one of the important technologies for 6G due to its significant applicability in learning from more human-like scenarios. For instance, DL can select the 6G access point to connect to and the resource controller with the most resources. It's intriguing to consider that. Zhenyu Zhou served as the assistant editor who oversaw the assessment of this submission and gave final approval for publication. Although it has been successfully used to classification issues and has produced positive results, its applicability in wireless networks is yet investigated. But in this article, we give a wide review of ML methods, including DL, and discuss how they could be used in upcoming 6G communication systems.

Wireless technology is constantly developing and improving to help consumers with more sophisticated demands with more and more useful applications [4]. In the 5G mobile communication system, there is an increase in data speeds, a decrease in energy consumption of devices linked with latency and energy, coupled with more precise localization [2], [5] [8].Many academics believe that greater attention should be paid to achieving latency and energy goals by strengthening the current wireless system from many angles due to the current rise in data quantity and use. This inspired me to create an application that uses machine learning methods to classify 5G services

In this research, we review various works that employed one or more data mining methods to anticipate the availability of 5 G services based on network and bandwidth. Numerous findings demonstrate that identifying 5G services manually is highly challenging, hence we aim to categorise 5G networks using ML algorithms. Based on the signals that are present in that network region, we aim to employ certain ML algorithms in this system to determine whether 5g service is available in a particular location. Here, we attempt to categorise the number of places that are prohibited from using 5G services and the number of regions that allow connections. Here, we apply a variety of machine learning (ML) algorithms, including SVM, KNN, Random Forest, and XGBoost Algorithms, to determine which one is best for identifying potential 5G services[9].

2. LITERATURE SURVEY

In this section we will mainly discuss about the background work that is carried out in order to prove the performance of our proposed Method. Literature survey is the most important step in software development process. For any software or application development, this step plays a very crucial role by determining the several factors like time, money, effort, lines of code and company strength. Once all these several factors are satisfied, then we need to determine which operating system and language used for developing the application. Once the programmers start building the application, they will first observe what are the pre-defined inventions that are done on same concept and then they will try to design the task in some innovated manner.

MOTIVATION

[1]."A vision of 6G wireless systems: Applications, trends, technologies, and open research challenges," by W. Saad, M. Bennis, and M. Chen. IEEENetw., May 2020, pp. 134_142, vol. 34, no. 3.

In contrast to its original assumption as a facilitator for Internet of Everything applications, the continued deployment of 5G cellular infrastructure is continually revealing the system's fundamental limits[10]. These 5G limitations are driving global efforts to define the next-generation 6G wireless infrastructure, which will be able to incorporate really far-reaching applications like extended reality and autonomous systems. The core architectural and performance elements of 6G remain largely unclear despite recent 6G projects (the 6Genesis project in Finland is one example). In this essay, we give a comprehensive, futuristic perspective that outlines the fundamental principles of a 6G system. We believe that 6G will be a confluence of emerging technology advances driven by fascinating, underlying services rather than just the discovery of additional high-frequency spectrum. In this context, we start by identifying the main applications and supporting technology advances for 6G systems. Then, we suggest a fresh set of service classes and lay bare their intended 6G performance specifications. We then provide a thorough research plan that makes use of the technologies we identified as the enabling ones for the newly supplied 6G services. We finish by offering specific suggestions for the route toward 6G. The ultimate goal of this essay is to provide as a springboard for more innovative research into 6G.

[2] "A speculative research on 6G," IEEE Wireless Commun., vol. 27, no. 4, pp. 118_125, August 2020. F. Tariq, M. R. A. Khandaker, K.-K. Wong, M. A. Imran, M. Bennis, and M. Debbah.

Researchers are starting to look on what 6G may be in 10+ years, and there are currently programmes in many nations focused on the development of potential 6G technologies, while 5G is being tested globally and is expected to be progressively pushed out in 2019. This article speculates on the futuristic technologies that could bring about the step changes required to enable 6G in order to expand the vision of 5G to more ambitious scenarios in a more distant future[11].

[3] "6G wireless communication systems: Applications, needs, technologies, problems, and research directions," IEEE Open J. Commun. Soc., vol. 1, pp. 957–975, 2020; M. Z. Chowdhury, M. Shahjalal, S. Ahmed, and Y. M. Jang.

Over the past several decades, the need for wireless communication has increased dramatically. Worldwide deployment of fifth-generation (5G) communications, which has many more capabilities than fourth-generation communications, is likely to begin. The sixth-generation (6G) system, a new wireless communication paradigm with full AI support, is anticipated to be put into use between 2027 and 2030. Faster system capacity, higher data rate, lower latency, higher security, and enhanced quality of service (QoS) compared to the 5G system are some basic concerns that need to be solved beyond 5G[12]. This article outlines the network architecture and

future of 6G wireless communication. The developing technologies discussed in this article include artificial intelligence, terahertz communications, wireless optical technology, free-space optical networks, blockchain, three-dimensional networking, and quantum communications, Unmanned aircraft, cell-free communication, wireless information and energy transfer integration, integrated sensing and communication, integrated access-backhaul networks, dynamic network slicing, holographic beamforming, backscatter communication, intelligent reflecting surface, proactive caching, and big data analytics are all technologies that can help the development of the 6G architecture in ensuring the QoS. In addition, potential technologies and anticipated applications with 6G communication needs are outlined. We also discuss potential obstacles and future possibilities for research to accomplish this aim[13].

3. EXISTING METHODOLOGY

There was no appropriate way to extract the important features of 5g and above networks from the given region. In the existing system there was no proper method to identify the prediction of 5g services in appropriate area by using data mining algorithms. The following are the main limitations in the existing system.

LIMITATION OF EXISTING SYSTEM

1. More Time Delay in finding the prediction of 5g services in appropriate area.
2. There is no accurate prediction.
3. This is not efficient method to predict the 5g services in appropriate area
4. All the primitive methods use manual approach for predicting 5g services in appropriate area.

4. PROPOSED SYSTEM & ITS ADVANTAGES

The proposed system tries to discuss an up-to-date review of future wireless system concepts such as 6G and role of ML techniques in these future wireless systems. Hence we try to use some algorithms which can predict the restricted areas as well as possibility of finding access locations based on network and other parameters which are present in that region. By using the proposed system we can easily classify the restricted and normal regions accurately.

ADVANTAGES OF PROPOSED SYSTEM:

The following are the benefits of the proposed system. They are:

1) By using data mining techniques it takes less time for the prediction of 5g services in appropriate area.

2) In this paper we survey different papers in which one or more algorithms of data mining used for the prediction of 5g available services.

3) Result from analysis clearly state that the Random forest gives best result in very less time.

4) The proposed system can easily identify the prediction of 5g services in an area based on some important features.

5. PROPOSED ALGORITHMS

The following are the set of models or algorithms which are deployed in this current application. They are as follows:

MACHINE LEARNING

A branch of artificial intelligence is called machine learning (AI). The main aim of machine learning is to comprehend the structure of data and fit it into models that people can comprehend and use. Despite being a branch of computer science, machine learning is distinct from conventional computational methods. Algorithms are collections of deliberately coded instructions that computers employ to do calculations or solve problems in conventional computing. Instead, machine learning techniques enable computers to train on data inputs and make use of statistical analysis to produce results that fall inside a particular range..

The scientific discipline focusing on how machines learn from experience is known as machine learning. Given that the ability to learn is the primary quality of an entity referred to be intelligent in the broadest meaning of the word, for many scientists, the terms "machine learning" and "artificial intelligence" are interchangeable. Building computer systems that can adapt and learn from their experiences is the goal of machine learning. There are two varieties.

SUPERVISED LEARNING

In supervised learning, a function called target function, which is an expression of a model explaining the data, must be "learned" by the system inductively. A set of variables, known as independent variables, input variables, characteristics, or features, are used to predict the value of a variable, known as the dependent variable or output variable. Instances refer to the collection of potential input values for the function, or its domain. A set of traits is used to characterise each situation (attributes or features). Training data or examples are a subset of all situations for which the output variable value is known. Given a training set, the learning system considers other functions, referred to as hypothesis and alternative functions, to infer the optimum target function takes into consideration alternative functions, called hypothesis and denoted by h. In supervised learning, there are two kinds of learning tasks: classification and regression.

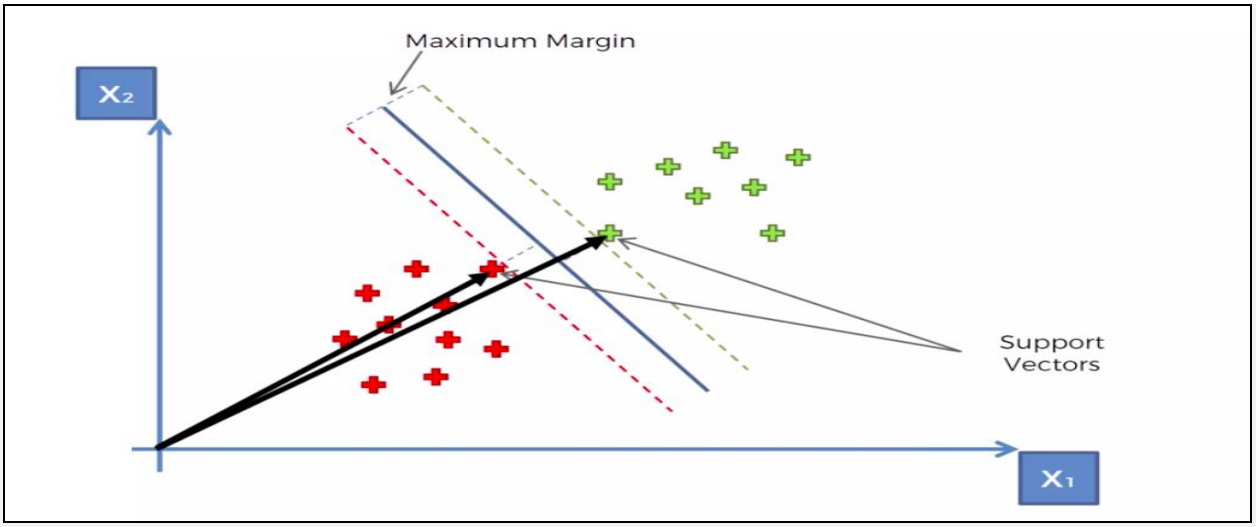
UNSUPERVISED LEARNING

In unsupervised learning, the system looks for correlations between variables or data's underlying structure. The training data in that situation comprises of examples without any associated labels. Rule of Association Machine learning first developed considerably later than mining, and mining is more influenced by database research..

SUPPORT VECTOR MACHINE

A supervised machine learning technique called the Support Vector Machine (SVM) may carry out classification, regression, and even outlier identification. The linear SVM classifier functions by connecting two classes using a straight line. All of the data points that fall on one side of the line will be given a single class label, and all of the points that fall on the other side will be given a second class label. Although it seems straightforward, there are an endless number of lines to pick from. How can we determine which line will classify the data the most accurately? The LSVM method is useful in this situation. The LSVM algorithm will choose a line that keeps a

minimum distance from the nearest samples while also dividing the two classes into them. In actuality, the term "support vector" in the phrase "support vector machine" refers to two position vectors drawn from the origin to the points that determine the decision boundary.



K NEAREST NEIGHBOR ALGORITHM

One of the simplest machine learning algorithms, K-Nearest Neighbors, or KNN for short, is utilised in a variety of organizations. KNN is a lazily learning method that is non-parametric. A approach is said to be non-parametric if it makes no assumptions about the underlying data. In other words, regardless of the characteristic the numerical values denote, it chooses depending on the selection's closeness to other data points. A lazy learning algorithm has little or no training phase, according to this definition. Therefore, as soon as a new data point appears, we may quickly classify it.

DECISION TREE CLASSIFICATION

How to construct and tune Decision Tree Classifiers using the Python Scikit-learn module, as well as attribute selection metrics. You want a group of clients who are most likely to buy your goods as a marketing manager. By identifying your audience, you may reduce your marketing expenditures. To reduce the rate of loan defaults, you must recognize hazardous loan applications as a loan manager. A classification difficulty occurs when clients are divided into groups of prospective and non-potential customers or safe or dangerous loan applications. The two steps of classification are learning and prediction. The model is created using provided training data in the learning phase. The model is applied to forecast in the prediction stage the response for given data. Decision Tree is one of the easiest and popular classification algorithms to understand and interpret. It may be applied to problems involving classification and regression.

RANDOM FOREST ALGORITHM

A supervised machine learning approach based on ensemble learning is known as random forest. In order to create a more effective prediction model, you can combine several kinds of algorithms or use the same technique more than once in ensemble learning. The term "Random Forest" comes from the fact that the random

forest method mixes several algorithms of the same type, or different decision trees, into a forest of trees. Both regression and classification tasks may be performed using the random forest approach.

XGBoost Algorithm:-

XGBoost is a distributed gradient boosting library that has been developed to be very effective, adaptable, and portable. It uses the Gradient Boosting framework to construct machine learning algorithms. XGBoost offers a parallel tree boosting (also known as GBDT, GBM) that quickly and accurately resolves a variety of data science issues.

6. IMPLEMENTATION PHASE

The step of implementation is when the theoretical design is translated into a programmatically-based approach. The application will be divided into a number of components at this point and then programmed for deployment. The front end of the application takes Google Collaboratory and as a Back-End Data base we took UCI Heart Patients Records as dataset. Python is being used in this instance to implement the present application. The following five modules make up the bulk of the application. They are listed below.:

1. Import Necessary Libraries
2. Load Dataset Module
3. Data Pre-Processing
4. Train the Model Using Several ML Algorithms
5. Find the Performance of ML Algorithms

1) IMPORT NECESSARY LIBRARIES

We must first import all the relevant libraries into this module in order to create the model. Here, we make an effort to employ every library available for converting data in a useful way. We try to import the numpy module since the data is separated into numerical values that the system can quickly identify, and we use the matplot library to plot the data in graphs and charts..

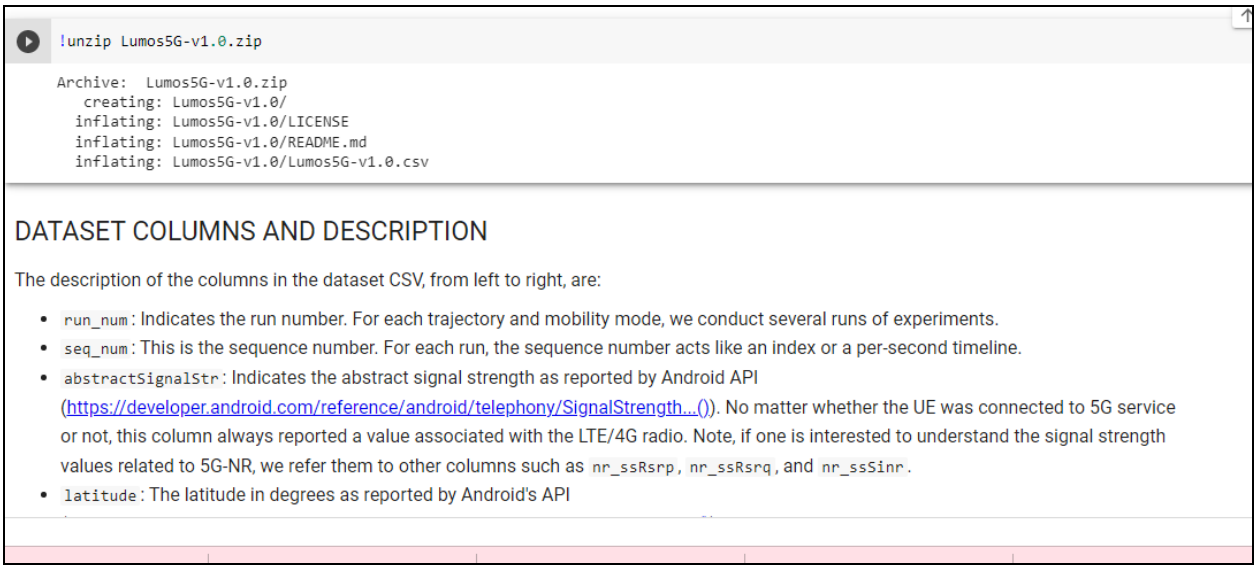
```
[ ] import pandas as pd
    import numpy as np
    import matplotlib.pyplot as plt
    import seaborn as sns
```

```
df=pd.read_csv('Lumos5G-v1.0/Lumos5G-v1.0.csv')
df.head()
```

	run_num	seq_num	abstractSignalStr	latitude	longitude	movingSpeed	compassDirection	nrStatus	lte_rssi	lte_rsrp	lte_rsrq	lte_rssn
0	1	1.0	2	44.975314	-93.259316	0.094889	150	NOT_RESTRICTED	-61.0	-94	-14.0	2.147484e+0
1	1	2.0	2	44.975311	-93.259311	0.876634	117	NOT_RESTRICTED	-61.0	-94	-14.0	2.147484e+0

2) LOAD DATASET MODULE

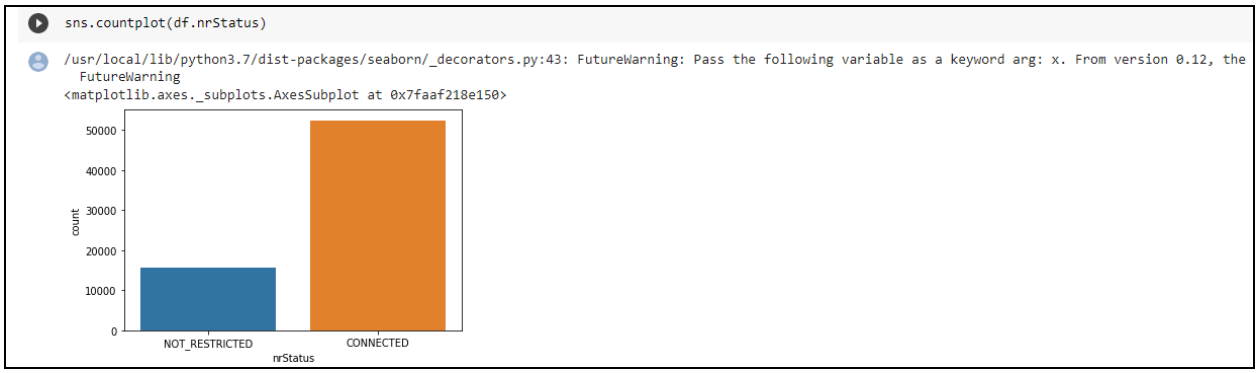
We attempt to load the dataset that has been downloaded or gathered from the Google repository in this module. The dataset is described as follows.:



Every property comprises data that has been evaluated and gathered from fifth generation networks..

3) DATA PRE-PROCESSING MODULE

In this part, we try to perform a pre-processing operation on the incoming dataset to identify any missing values or incomplete data. The programme will load only valid rows that have all the valid inputs if there are any such data present in the dataset.



4) TRAIN THE MODEL USING SEVERAL ML ALGORITHMS

Here, we attempt to train the present model on a particular dataset using a variety of ML classification methods in order to determine which algorithms work best for properly and effectively identifying and classifying the input dataset. Here, we try to apply the subsequent algorithms on the supplied dataset, including:

1. Support Vector Machine
2. K-Nearest Neighbors
3. Random Forest
4. XGBoost

5) PERFORMANCE ANALYSIS MODULE

On a given input dataset, we compare each classification method in this module in an effort to determine which one is most effective at producing correct results. Finally, we will choose the method that produces the most accurate results in the shortest amount of time. As we can see, Random Forest outperforms other machine learning algorithms in terms of accuracy.

7. CONCLUSION

We have covered a variety of ML approaches in this post and how they operate. We have also discussed the 6G communication system's acceptance, as well as its difficulties and potential. We have outlined how ML at the application and infrastructure levels may be more productive to tackle the upcoming 6G challenges after outlining the 6G future vision. The present need for 6G is contrasted and examined in terms of the state-of-the-art. In comparison to infrastructure level, it is determined that applications are more suited to fill in the gaps created by 6G problems. The case study-biometric application has been explored after best fit. The case study demonstrates the operation of smart biometric applications at the infrastructure and application levels. In order to do this, we have determined the future directions for applying ML to channel modeling, data reduction, and resource management. When paired with a 6G wireless communication network, several ML approaches may be used effectively. As a result, in order to improve smart applications for both present ML and future 6G, we need to provide a solution to address existing difficulties including latency, power allocation, privacy, security, and model interoperability.

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