iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** III **Month of publication:** March 2020

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue III Mar 2020- Available at www.ijraset.com

Studying the Techniques for Water Resource Management using Machine Learning

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Abstract: ***Artificial Intelligence (AI) is one of the fastest growing area of the computer science . Machine Language (ML) is the part of AI. ML is an application of AI that enable system to automatically learn and improve from experience without being explicitly programmed.ML focuses on the study of computing with the goal learning, reasoning and perception. In simple word, ML is the process of synthesizing the useful concept from historical data. The value of ML technologies has been recognized in all fields that deal with huge volume of data. Some sectors are viz. Oil and gas, Financial, Transportations, Health care, Marketing and Sales etc. Water is the most essential and basic needs of live being to survive. The inability of water resource system to meet the diverse needs for water often reflects failure in planning, developing and management and decision making. Water Resource Management is an activity of planning, developing, distributing and managing the optimum use of water resources. In this literature survey , we tried to study some research activities which already been carried-out by the researcher for Water Resource Management using Machine Language.***
Keywords: Machine Learning, Water Resource Management, Artificial Intelligence, ANN

I. INTRODUCTION

Machine Learning is a sub-set of the broad field of Artificial Intelligence,which aims to mimic intelligent abilities of humans by machines. ML focuses on how to make a machine 'learn'[1]. It is a computational science where a large amount of data is fed to a computer algorithm and the algorithm analyzes the data, finds patterns in the data or makes some decisions based on the data. Systems are provided with the ability to automatically learn without being explicitly programmed.The name machine learning was coined in 1959 by Arthur Samuel.

Tom M. Mitchell provided a widely quoted, more formal definition of the algorithms studied in the machine learning field: "A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E." Water is an essential resource for all life on the planet. General objectives of water resources management models are to optimize the utilization of available water resources to meet the demand of as many users as possible. So water resources management involves the identification and development of water resources project investments that maximize the net benefit or minimize the total cost [2].

II. TYPES OF MACHINE LEARNING

There are three main classes of machine learning techniques[3](as shown in Fig. 1) :

1) *Supervised Learning:* In supervised learning, the training set consists of pairs of input and desired output, and the goal is that of learning a mapping between input and output spaces. Applications include the channel decoder discussed above, as well as email spam classification on the basis of examples of spam/ non-spam emails.
2) *Unsupervised Learning:* In unsupervised learning, the training set consists of unlabeled inputs, that is, of inputs without any assigned desired output. Applications include clustering of documents with similar topics. It is emphasized that clustering is only one of the learning tasks that fall under the category of unsupervised learning.
3) *Reinforcement Learning:* Reinforcement learning lies, in a sense, between supervised and unsupervised learning. Unlike unsupervised learning, some form of supervision exists, but this does not come in the form of the specification of a desired output for every input in the data.

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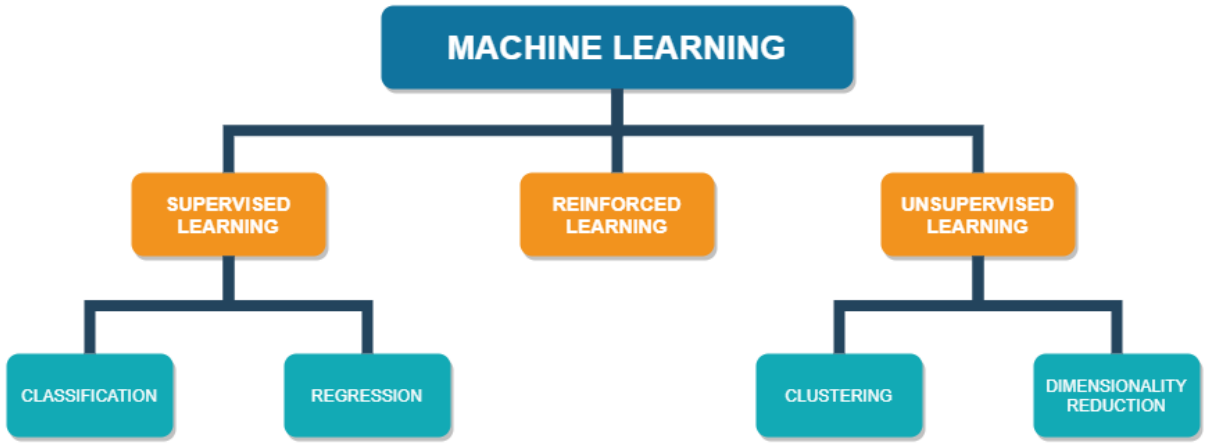

Fig. 1 Types of ML

III. WHY MACHINE LEARNING

A given problem can opt for machine learning depending on two factors[4]:

A. Tasks That Are Too Complex to Program

1) Tasks Performed by Animals/Humans: Machine learning programs, programs that "learn from their experience," achieve quite satisfactory results, once exposed to sufficiently many training examples. For example driving, speech recognition, and image understanding.

2) Tasks beyond Human Capabilities: Another wide family of tasks that benefit from machine learning techniques are related to the analysis of very large and complex data sets: astronomical data, turning medical archives into medical knowledge, weather prediction, analysis of gnomic data, Web search engines, and electronic commerce.

B. Adaptability

One limiting feature of programmed tools is their rigidity – once the program has been written down and installed, it stays unchanged. Machine learning tools are programs whose behavior adapts to their input data.

IV. PROS AND CONS

A. Pros

1) Trends and Patterns: Machine learning involves reviewing large volumes of data to discover specific trends and patterns that would most often not be apparent to humans.

2) Human interaction is minimal:Machine learning does not require human intervention. It gives machines the ability to learn. It helps machines make predictions and improve the algorithms by themselves.

3) The model improves over time: Machine learning algorithms improve in accuracy and efficiency as they gain experience. This helps them take better decisions.

4) It can handle multidimensional data

5) ML has a wide range of real-life applications

B. Cons

1) *Data Acquisition:* ML needs a huge amount of data to be processed. Sometimes this vast amount of data is not available and new data is to be created.

2) *High error Susceptibility:* False data, biased data, missing values, defective sensors sending incorrect data cause errors in the output of the model. A slight mistake can change the outputs drastically.

3) Time and resources are taken by ML for learning from the data and producing accurate and reliable data. This increases the cost of developing the model.

ML works great when it is used when a huge training data set is present. It provides a huge benefit to businesses if used properly. But it is not suitable for all companies or applications.

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V. APPLICATIONS OF MACHINE LEARNING

Machine learning has proven itself to be the answer to many real-world challenges, but there are still a number of problems for which machine learning breakthrough is required[14].Following are some of the applications given and also shown in Fig. 2 :

1) *Web Search Engine:* One of the reasons why search engines like google, bing etc work so well is because the system has learnt how to rank pages through a complex learning algorithm
2) *Spam Detector*: Our mail agent like Gmail or Hotmail does a lot of hard work for us in classifying the mails and moving the spam mails to spam folder. This is again achieved by a spam classifier running in the back end of mail application.
3) *Image and speech Recognition:* One of the most common uses of machine learning is image recognition. There are many situations where you can classify the object as a digital image. For digital images, the measurements describe the outputs of each pixel in the image.In speech recognition, a software application recognizes spoken words. The measurements in this application might be a set of numbers that represent the speech signal. In each segment, we can represent the speech signal by the intensities or energy in different time-frequency bands.
4) *Medical Diagnosis:* Medical diagnostics are a category of medical tests designed to detect infections, conditions and diseases. Machine vision and other machine learning technologies can enhance the efforts traditionally left only to pathologists with microscopes. Patient photos are analyzed using facial analysis and deep learning to detect phenotypes that correlate with rare genetic diseases.

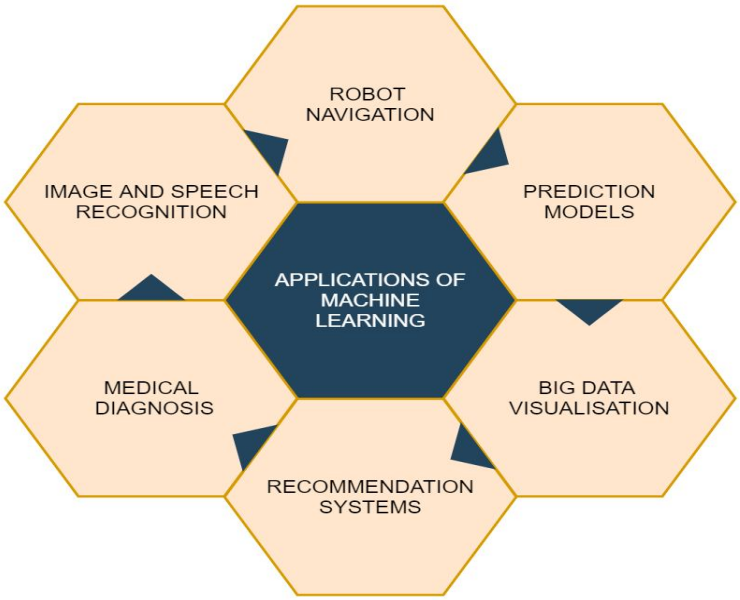


Fig. 2 Applications of ML

VI. LITERATURE SURVEY

In this literature survey , we studied various research experiments, Case Studies, Articles etc. related to Water Resource Management using Machine Learning Techniques.

Ping Liu et al[5] This paper focuses on building a prediction model for testing the water quality of Guazhou Water Source of the Yangtze River in Yangzhou. The model requires high quality data which is collected using automated water quality monitoring systems based on Internet of Things (IoT).The annual trend of water quality parameters - Water Temperature, pH, Dissolved Oxygen, Conductivity, Turbidity, CODMn, NH3-N are studied. A relationship between the the data collected and the changes in parameters is formed which helps to predict the status of water quality in future. The dataset of of water quality monitored can be regarded as time series. It is an ordered collection composed of water quality measurement values and measuring times. Long Short term Memory(LSTM) neural networks is then used to realize the time series and accordingly predict the future series.The results of the study indicate that the predicted values of the model and the actual values were in good agreement and accurately revealed the future developing trend of water quality, showing the feasibility and effectiveness of using LSTM deep neural networks to predict the quality of drinking water.

H. Afsarmanesh et al[11] talks about the two year RTD project named as 'WATERNET', an evolutionary idea for advanced supervision of water distribution network.This system aims for assisting the control of distributed water Management to minimize the costs of exploitation, guarantee the continuous supply of water with a better quality monitoring, save energy consumption and minimize natural resources waste.This paper focuses mainly on two subsystems: distributed information management and the machine learning subsystems, from various other subsystems that are in the project. The data collected in WATERNET is based on both traditional approach and continuous learning approach. In traditional approach historical data is given to the supervision system while in the continuous approach data is continuously provided by the sensors and actuators. The learning aspects described are Consumer trends models, diagnosis models to locate problematic areas, models describing the behaviour of specific nodes and models for daily forecast of water demands. Thus the next generation water distribution networks were described in the paper.

Swapnali D. Mahadik et al[6] proposes a model for classification of packaged drinking water on the basis of 5 parameters - . pH, turbidity, Total Dissolved Solid, Color and Toxic / Heavy Metals. Three main brands are considered are RailNeer, McDowells and Bisleri. Initial steps were data preprocessing which involves handling missing data and categorical data. The drinking water is classified in two classes i.e. safe or risky. The model predicts categorical class labels. The algorithm used for building the model is Decision Tree Classifier and it can further be improved by using K Nearest Neighbors(KNN). Here in Packaged drinking water the range of value is fixed for every brand with respect to every parameter. But after the expiry of a bottle or old water samples can give variations in range of specific values. Therefore, this model does not consider these factors in its classification model.

S. John Livingston et al[7] This model consists of various sensor using which the water level and the flow is calculated accordingly, there would be a valve, which can autonomously control the on/off operations.This particular device has a prominent use in the field of water distribution, farming, industrial usage etc., Since the whole system can be controlled through a mobile application we can remotely operate and conserve a lot of water.The prime feature of this model is to monitor and forecast the water usage of a particular house. Here ultrasonic and water flow sensors for water level and to calculate the rate of flow of water are used respectively. After getting the values from the sensors the prediction or forecasting is done using various algorithms like SVM (support vector machine), RFC (random forest classifier) and on this basis the monthly or yearly consumption is calculated.

Janusz A. Starzyk et al[8] This paper presented motivated learning approach and its potential use in water resource planning and management.A case study of machine learning water management decisions is presented in this paper to demonstrate the application of Emboided Intelligence in facilitating the humans with modeling and water related decision making process. Comparison of performances of the learning agents based on motivated learning and reinforcement learning principles in identical environments that has many dependencies between its resources is done. It is found out that ML based agent was able to converge to stable solution with low pain signals while RL based agent cannot do that in this kind of environments.

Savithri et al[9] carries out a research on flood prediction models for reducing the human losses, property losses after a flood. They attempt to forecast flood by modelling the following parameters - water level, temperature and rainfall data in the region of Korattur lake, Chennai, India. Ultrasonic sensors are used to capture the measurement of water level to predict from ultrasonic waves. The data collected from this is feeded the models which use the Machine Learning (ML) techniques - Artificial Neural Network (ANN) and Support Vector Machine (SVM) to predict the flood forecasting for higher accuracy. The performance evaluation is done by the measurement of Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Coefficient of Determination (R2). This prediction is compared with ANN and SVM model for better accuracy.

Haytham Assem et al[10] The main objectives of this research is to build a prediction model for the water flow and water level parameters of the Shannon river in Ireland over a 30-year period. The datasets stored in the data storage comprised of five parameters which are max-temp, min-temp, run-off, water flow and water level. A deep convolutional network architecture to exploit the time-series nature of the data. Two baseline models were prepared to asses the performance of deep CNN. Two basic machine learning algorithms that are SVM(Support Vector Machine) and ANN(Artificial Neural Network) are used for this purpose. Based on the proposed deep convolutional network model the prediction is made for next 67 years. The proposed solution may prove very useful for water authorities in the allocation of water resources among competing users such as agriculture, demotic and power stations.

Dimitri P. Solomatine et al[12] presented a model for estimating uncertainty using machine learning techniques which is used fr rainfall runoff modeling of the Bagmati catchment in Nepal.The method used to achieve this is ''uncertainty estimation based on local errors and clustering'' (UNEEC). It consists of three main parts: (1) clustering; (2) estimation of the error probability distribution for clusters; and (3) building the overall model of the error probability distribution.Clustering is the task of dividing the population or data points into a number of groups such that data points in the same groups are more similar to other data points in the same group than those in other groups. The probability distribution of the model error is estimated separately for different

hydrological situations. The parameters characterizing this distribution are aggregated and used as output target values for building the training sets for the machine learning model. The nonlinear regression method is used for this .UNEEC method proves effective for predicting the uncertainty values and can also be used for other prediction models

The applications show that (a)Big Data will fundamentally change the way that EWM researchers are conceiving, conducting,and analyzing experiments;(b)the benefits of Big Data can only be maximized when appropriate automated data wrangling and cleansing area accessible with relatively low cost[13]. Deep Learning can be water scientists' operational approach to modeling interdisciplinary processes for which mathematical formulations are not well defined but sufficient data exist,especially those related to human dynamics.Some potential applications include modeling land management decisions in response to water constraint or flooding risks, irrigation and consumptive water demands, water saving strategies, ecosystem responses and interactions with landscapes, and urban water flows. DL can automatically turn raw data into readily useful information, alleviating the stress from the deluge of data[15].

VII. CONCLUSIONS

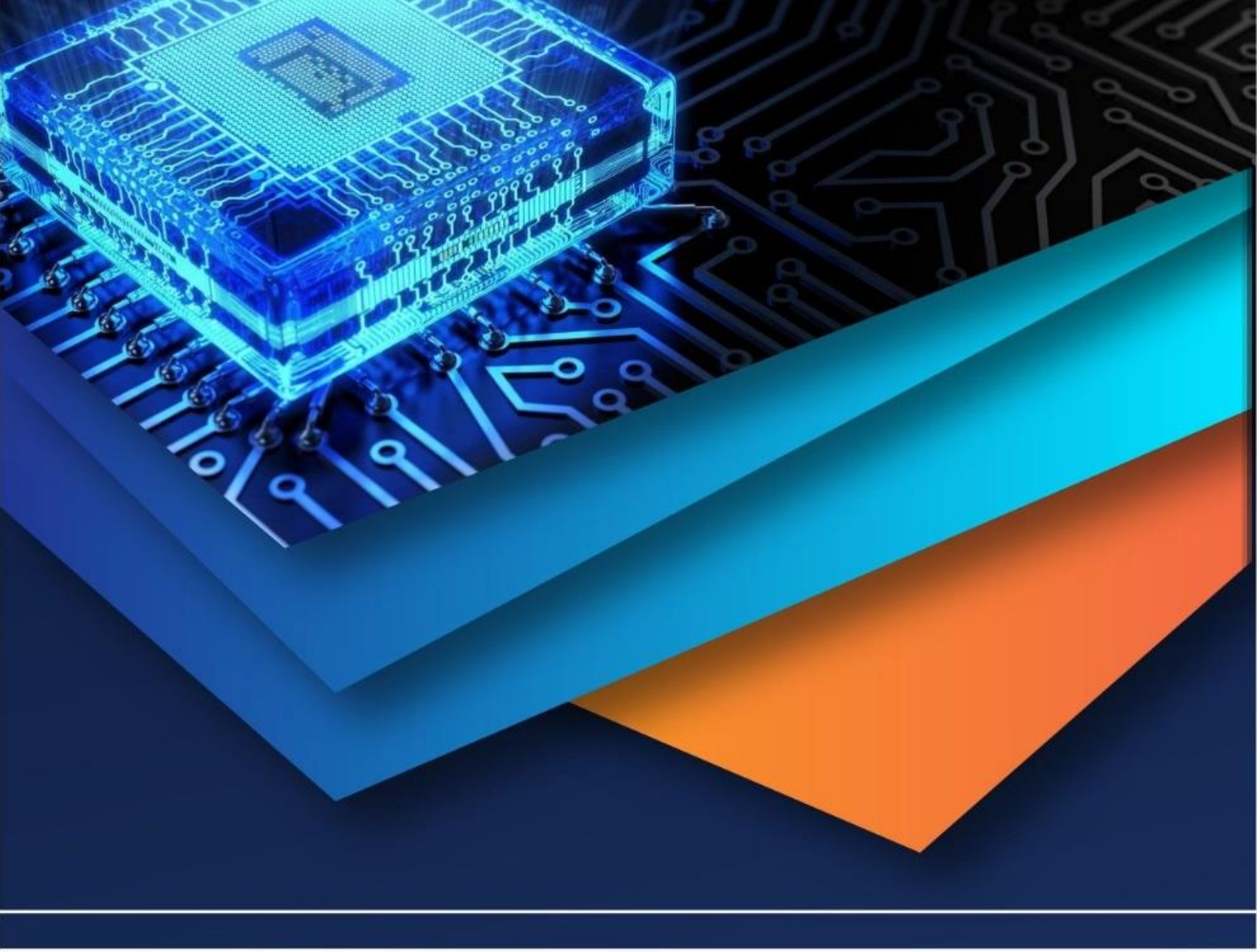
In this literature survey we found that in many experiments/activities, the ML prove it's important role for water resource management. The prediction model using Long Short Term Memory (LSTM) Neural Network for water quality study revealed the acceptable results. The algorithm Decision Tree Classifier and K Nearest Neighbors (NKN) used for classifying the packaged drinking water. The Support Vector Machine (SVM) and Random Forest Classifier (RFC) algorithm is used for calculating the Water Level and Water Flow for consumption of water. The ML techniques, Artificial Neural Network (ANN) and Support Vector Machine (SVM) used for prediction of flood forecasting for higher accuracy. These all studies prove the ML is capable to compute the large volume of data. We also observed that the Modeling using ML for computing/calculating/pattern matching various parameters pertaining to water resource management is acceptable.

VIII. ACKNOWLEDGMENT

We would like to thank Dr. V.V. Bhosekar (Mrs.), Director CWPRS Pune, for granting me permission for one month internship training. I would like to give my sincere thanks to Mr.P.S.Solanki, Scientist-B for their support and valuable guidance that has led this work to its completion. I also like to thanks Mr. P.R.Khatarkar, Scientist-D, In-charge IT Group for kind co-operation.

REFERENCES

[1] Gunnar R¨atsch ,"A Brief Introduction into Machine Learning",Friedrich Miescher Laboratory of the Max Planck Society, Spemannstraße 37, 72076 T¨ubingen, Germany
[2] Zahidul Islam,"A Review on Water Resources Management Modeling",DOI: 10.13140/2.1.3496.0168,Research Gate
[3] Osvaldo Simeone,"A Very Brief Introduction to Machine Learning With Applications to Communication Systems" , Fellow, IEEE
[4] Shai Shalev-Shwartz and Shai Ben-David,"Understanding Machine Learning: From Theory to Algorithms ", Published 2014 by Cambridge University Press.
[5] Ping Liu 1, Jin Wang 1,2,3,* , Arun Kumar Sangaiah 4 , Yang Xie 5 and Xinchun Yin 6,"Analysis and Prediction of Water Quality Using LSTM Deep Neural Networks in IoT Environment",MPDI,Published: 7 April 2019.
[6] Swapnali D. Mahadik, Anup Girdhar,"Packaged Drinking Water Analysis by Classification Technique of Data Mining" ,International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2S3, December 2019
[7] S. Livingston, M. Raj Sandeep Simeon, Bommi Vikas, P. Hari Chandan,"A Hybrid Approach for Water Utilization in Smart Cities Using Machine Learning Technique",International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6S, April 2019
[8] Janusz A. Starzyk,Ohio University,"Water resource planning and management using motivated machine learning", (2002) The IEEE website. [Online]. Available: http://www.ieee.org/
[9] Savithri,"Overwhelming Flow of Water using Machine Learning Techniques" ,Suganya.D,International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2S3, December 2019
[10] Haytham Assem1, Salem Ghariba2, Gabor Makrai3, Paul Johnston4, Laurence Gill4, and Francesco Pilla2,"Urban Water Flow and Water Level Prediction based on Deep Learning",http://www.met.ie.
[11] H. Afsarmanesh(1), L.M. Camarinha-Matos(2), F.J. Martinelli(2),"Federated Knowledge Integration and Machine Learning in Water Distribution Networks",Springer Science+Business Media Dordrecht 1997.
[12] Solomatine, D. P., and D. L. Shrestha (2009), "A novel method to estimate model uncertainty using machine learning techniques", Water Resour. Res., 45, W00B11, doi:10.1029/2008WR006839.
[13] Alexander Y Sun and Bridget R Scanlon,"How can Big Data and machine learning benefit environment and water management: a survey of methods, applications, and future directions", 2019 Environ. Res. Lett. 14 073001.
[14] Mohssen M. Z. E. Mohammed,"Machine Learning: Algorithms and Applications",Book · July 2016 DOI: 10.1201/9781315371658
[15] Chaopeng Shen,"A trans-disciplinary review of deep learning research for water resource scientists" Water Resources Research · December 2017 DOI: 10.1029/2018WR022643



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