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Resource Allocation Priority for Water Flow Monitoring in Reservoirs using Data Analytics

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Abstract: With the Progress of Science and Technology, as an infrastructure project, dam's construction scale is more and more big; its cost is higher and higher.
The Large dams play an important role in the national economy and social life. The multiple-reservoir operation problem is a complex, non-linear, non-convex and multi-objective optimization problem which cannot be easily handled by the classical approaches. This system composed of: (1) A database integrates dynamic values of different dam conditions data. (2) Combining Naïve Bayes classifier and β-Hill Climbing Algorithm for calculating and analyzing data from the database for improved recommendations. (3) At last the Web Application provide the recommended water level analysis to the dams. This system can analyze and monitor in real time conditions of dam and its environment, including the water levels, water velocity, climatic conditions and other safety conditions.
The system developed in this study can help promote the advancement of dam safety management and control by providing the water level analysis to the recommended dams.
In this paper, the Dam resource Scheduling problem is tackled using Naive Bayes. In order to validate the proposed method, Three-Dam systems used in the literature to evaluate the algorithm are utilized. A comparative evaluation is conducted to evaluate the proposed method against other methods found in the literature.

I. INTRODUCTION

A recent survey evaluating the scheduling Features of dams have increased amidst wide concerns about the global water resource crisis. Most of the existing algorithms are therefore restricted to considering some simplified form the problem suitable to the characteristics of the search algorithm used.

Reservoir operation is a nonlinear non-convex problem while some of the researchers have used a linear form of the problem to suit the Linear programming method proposed for their solution. Optimization of reservoir operation is an area that has attracted extensive research over the years. Optimization in design, planning, and implementation of water resources systems have always been an intensive research area.

Optimization of water resources systems is related not only to the physical structures and their functional characteristics but also to the criteria by which the system is operated. A reservoir operation problem can be considered as a decision-making problem having many constraints. Formerly, the techniques that were popularly used in water resources system analysis were linear programming (LP), dynamic programming (DP), and nonlinear programming (NLP) methods. Recently, however, the evolutionary computation (EC) and swarm intelligence (SI) techniques have shown capabilities of approximating optimal solutions to complex real-world problems within reasonable computational time.

Nonlinearities and non convex interactions among design and operation variables create a search space with multiple optimal solutions in engineering problems. In this paper, the β-hill climbing algorithm is used to model the MROPs and Naive Bayes algorithm to provide a solution to effectively improve NB-based traffic classifier with a small set of training samples. The idea is to seamlessly incorporate flow correlation into the NB-based classification process with feature discretization. As an MROP is a multidimensional, non-convex, and non-linear constrained problem, the feasibility of the solution is preserved during the search through a repair process.

Planned or scheduled maintenance is a list of predetermined maintenance actions caerried out at regular time intervals that are aimed at the prevention of breakdowns. It has been proven repeatedly that sporadic ongoing repair leads to asset deterioration, a shorter asset lifetime and increased long-term capital cost. The primary goal of scheduled maintenance is to prevent equipment failure before it actually occurs. The proposed method is evaluated using a three-reservoir system used to evaluate the performance of the previous methods.

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II. LITERATURE SURVEY

A. *Evaluation Model*

The CIPP model is an endeavour to make assessment specifically significant to the necessities of chiefs amid the stages and exercises of a program. Stufflebeam's specific situation, information, procedure, and item (CIPP) assessment show is prescribed as a structure to efficiently control the origination, plan, usage, and evaluation of administration learning ventures, and give criticism and judgment of the undertaking's adequacy for consistent improvement. These angles are setting, information sources, procedure, and item. The CIPP demonstrate is one of a kind as an assessment direct as it enables evaluators to assess the program at various stages, to be specific: before the program starts by helping evaluators to survey the need and toward the finish of the program to evaluate regardless of whether the program had an impact. CIPP display enables you to make developmental inquiries toward the start of the program, at that point later gives you a guide of how to assess the program's effect by enabling you to make summative inquiries on all parts of the program.[1] Context: What should be finished? Versus Were critical necessities tended to? [2] Input: How would it be advisable for it to be finished? Versus Was a solid plan utilized? [3] Process: Is it being finished? Versus Was the structure professional? [4] Product: Is it succeeding? Versus Did the exertion succeed? There are many learning assessment models right now by and by. Usually,the controlling component is accomplished either by compelling or by randomizing the arrangement of nearby neighbor answers for consider in nearby hunt just like the instance of reproduced strengthening (Kirkpatrick et al.1983) or tabu inquiry (Glover, 1989), or by consolidating components taken by various arrangements (swarm-based) similar to the instance of advancement methodologies (Ba¨ck and Schwefel, 1993) and hereditary (Holland, 1975) or bionomic (Maniezzo et al., 1998) calculations. Kirkpatrick et al. (1983) created reenacted toughening (SA) to manage exceedingly non-direct issues. They connected the field of factual mechanics to the field of combinatorial streamlining.

B. *Heuristic Model*

Heuristic Model uses judgmental standards known as information structures that are found out and put away in memory. The heuristic methodology offers a financial preferred standpoint by requiring insignificant intellectual exertion with respect to the beneficiary. Heuristic handling is administered by accessibility, openness, and appropriateness. Accessibility alludes to the information structure, or heuristic, being put away in memory for sometime later.

1) *Ant Colony Optimization:* Intriguing and vital conduct of subterranean insect states is their scavenging conduct, and specifically, their capacity to locate the most limited course between their home and a nourishment source, understanding that they are practically visually impaired. The way taken by individual ants from the home to the nourishment source is basically arbitrary. Nonetheless, when they are voyaging, ants store a substance called pheromone, shaping a pheromone trail as a circuitous method for correspondence. As more ants pick a way to pursue, the pheromone on the way develops, making it increasingly alluring for different ants to pursue. In the ACO calculation, fake ants are allowed to discharge pheromone while building up an answer or after an answer has been completely created, or both.
2) *Bat Optimization:* The bat-optimized calculation is a metaheuristic streamlining calculation created by Xin-She Yang in 2010. This bat calculation depends on the echolocation conduct of microbats with fluctuating heartbeat rates of discharge and tumult. The romanticizing of the echolocation of microbats can be outlined as pursues: Each virtual bat flies haphazardly with a speed vi at position (arrangement) xi with a fluctuating recurrence or wavelength and uproar. As it hunts and discovers its prey, it changes recurrence, tumult and heartbeat outflow rater. Pursuit is strengthened by a neighbourhood arbitrary walk. Determination of the best proceeds until certain stop criteria are met. This basically utilizes a recurrence tuning procedure to control the dynamic conduct of a swarm of bats, and the harmony among investigation and abuse can be constrained by tuning calculation subordinate parameters in bat calculation.

3) *Harmony Search Optimization:* To clarify the Harmony Search in more detail, let us initially glorify the act of spontaneity process by a gifted artist. At the point when a performer is extemporizing, the person in question has three conceivable options: (1) play any celebrated bit of music (a progression of contributes agreement) precisely from his or her memory; (2) play something like a known piece (hence modifying the pitch somewhat); or (3) form new or arbitrary notes. Zong Woo Geem et al. formalized these three choices into quantitative improvement process in 2001, and the three comparing segments progress toward becoming utilization of congruity memory, pitch modifying, and randomization [1]. The use of agreement memory is critical, as it is like the decision of the best-fit people in hereditary calculations (GA). This will guarantee that the best harmonies will be continued to the new congruity memory. So as to utilize this memory all the more adequately, it is commonly doled out as a parameter acknowledge $\in[0,1]$, called concordance memory tolerating or thinking about rate. On the off chance that this rate is excessively low, just a couple of best harmonies are chosen and it might merge too gradually. On the off chance that this rate is incredibly high (close to 1), practically every one of the harmonies are utilized in the concordance memory, at that point different harmonies are not investigated well, prompting possibly wrong arrangements.
4) *Particle Swarm Optimization:* PSO shares numerous similitudes with developmental calculation strategies, for example, Genetic Algorithms (GA). The framework is introduced with a populace of irregular arrangements and scans for optima by refreshing ages. In any case, in contrast to GA, PSO has no advancement administrators, for example, hybrid and change In PSO, the potential arrangements, called particles, fly through the issue space by following the present ideal particles. Every molecule monitors its directions in the issue space which is related to the best arrangement (wellness) it has accomplished up until this point. (The wellness esteem is additionally put away.) This esteem is called pbest. Another "best" esteem that is followed by the molecule swarm enhancer is the best esteem, got so far by any molecule in the neighbors of the molecule. This area is called lbest. At the point when a molecule accepts all the populace as its topological neighbors, the best esteem is a worldwide best and is called gbest. In the previous quite a long while, PSO has been effectively connected in many research and application zones. It is exhibited that PSO improves results in a quicker, less expensive path contrasted and different strategies.

III. ITERATIVE MODEL

The Iterative strategies used to take care of issues of non-straight Programming as indicated by whether they assess Hessians, slopes, or just capacity esteems. While assessing Hessians (H) and slopes (G) improves the rate of combination, for capacities for which these amounts exist and in all respects adequately easily, such assessments increment the Computational multifaceted nature (or computational expense) of every cycle. At times, the computational intricacy might be too much high. One noteworthy basis for streamlining agents is only the quantity of required capacity assessments as this frequently is as of now a vast computational exertion, typically substantially more exertion than inside the analyzer itself, which for the most part needs to work over the N factors. The subsidiaries give nitty-gritty data to such enhancers, however, are significantly harder to ascertain, for example, approximating the inclination takes at any rate N+1 work assessments. For approximations of the second subordinates (gathered in the Hessian grid), the quantity of capacity assessments is in the request of N^2. Newton's technique requires the second request derivate, so for every emphasis, the quantity of capacity calls is in the request of N^2, however for a less difficult unadulterated inclination streamlining agent it is just N. Be that as it may, slope streamlining agents need generally a greater number of cycles than Newton's calculation. Which one is best regarding the quantity of capacity calls relies upon the issue itself.

A. Ellipsoid Method

In scientific improvement, the ellipsoid strategy is an iterative technique for limiting arched capacities. At the point when specific to taking care of plausible straight improvement issues with discerning information, the ellipsoid technique is a calculation which finds an ideal arrangement in a limited number of steps.

The ellipsoid technique produces a grouping of ellipsoids whose volume consistently diminishes at each progression, along these lines encasing a minimizer of an arched capacity. Imbalance obliged minimization of a capacity that is zero wherever relates to the issue of basically recognizing any attainable point.

For reasons unknown, any straight programming issue can be diminished to a direct achievability issue (for example limit the zero capacity subject to some direct imbalance and balance requirements). One approach to do this is by consolidating the basic and double direct projects together into one program and including the extra (straight) imperative that the estimation of the base arrangement is no more terrible than the estimation of the double arrangement. Another route is to treat the objects of the direct program as an extra requirement and utilize paired hunt to locate the ideal esteem.

B. Frank-Wolfe

The Frank Wolfe calculation is an iterative first-request advancement calculation for obliged curved enhancement. Otherwise called the contingent angle technique, diminished inclination calculation and the arched blend calculation, the strategy was initially proposed by Marguerite Frank and Philip Wolfe in 1956. In every cycle, the Frank– Wolfe calculation considers a direct estimate of the target capacity and moves towards a minimizer of this straight capacity (assumed control over a similar area). While contending strategies, for example, inclination plunge for compelled advancement require a projection venture back to the achievable set in every emphasis, the Frank– Wolfe calculation just needs the arrangement of a direct issue over a similar set in every cycle, and naturally remains in the practical set. The intermingling of the Frank– Wolfe calculation is sublinear when all is said in done: the blunder in the target capacity to the ideal is {\display style O(1/k)} O(1/k) after k emphases, inasmuch as the inclination is Lipschitz nonstop concerning some standard. A similar union rate can likewise be appeared if the sub-issues are just comprehended roughly. The repeats of the calculation can generally be spoken to as a meager arched mix of the extraordinary purposes of the possible set, which has served to the fame of the calculation for scanty voracious enhancement in AI and flag preparing problems, just as for instance the streamlining of minimum– cost streams in transportation systems. On the off chance that the achievable set is given by a lot of direct imperatives, at that point the sub problem to be understood in every cycle turns into a straight program. While the most pessimistic scenario union rate with {\display style O(1/k)} O(1/k) can't be improved when all is said in done, quicker intermingling can be acquired for extraordinary issue classes, for example, some firmly raised issues.

C. Simultaneous Perturbation Stochastic Approximation

Simultaneous perturbation stochastic approximation (SPSA) is an algorithmic strategy for improving frameworks with different obscure parameters. It is a kind of stochastic guess calculation. As a streamlining technique, it is properly fit to expansive scale populace models, versatile displaying, recreation improvement, and environmental demonstrating. A thorough ongoing book regarding the matter is Bhatnagar et al. An early paper regarding the matter is Spall (1987) and the basic paper giving the key hypothesis and legitimization is Spall (1992).SPSA is a nice technique fit for finding worldwide minima, offering this property to different strategies as reenacted strengthening. Its principle include is the slope estimate that requires just two estimations of the goal work, paying little respect to the component of the advancement issue.

D. Gradient Descent

Gradient descent is a first-request iterative advancement calculation for finding the base of a capacity. To locate a neighborhood least of a capacity utilizing slope drop, one makes strides corresponding to the negative of the inclination (or rough angle) of the capacity at the present point. On the off chance that rather, one makes strides corresponding to the positive of the slope, one methodology a neighborhood limit of that work; the technique is then known as inclination rising. Angle plummet is otherwise called steepest plunge. Be that as it may, Gradient descent ought not to be mistaken for the strategy for steepest plummet for approximating integrals. This procedure is shown in the nearby picture. Here (show style F) F is thought to be characterized on the plane, and that its chart has a bowl shape. The blue bends are the shape lines, that is, the areas on which the estimation of (show style F) F is consistent. A red bolt starting at a point demonstrates the bearing of the negative angle by then. Note that the (negative) angle at a point is symmetrical to the form line experiencing that point. We see that slope plummet drives us to the base of the bowl, that is, to the point where the estimation of the capacity (show style F) F is insignificant.

IV. MACHINE LEARNING METHODS

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from knowledge without being explicitly programmed. Machine learning focuses on the development of computer programs that can admit data and use it learn for themselves.

A. Support Vector Machine (SVM)

Although SVM can be introduced to various optimization problems such as regression, the typical problem is to classify the data. The data points are identified as being positive or negative, and the problem is to find a hyper-plane. This plane separates the points by a maximal margin. “Support Vector Machine” (SVM) falls under a category of supervised machine learning algorithms which can be used for both classification and regression challenges. However researchers mostly use it for classification problems. In this algorithm, we plot each data item as a point in n-dimensional space with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane that differentiates the two classes very well. The figure only

shows the 2-dimensional case where the data points are linearly separable. SVM approach to linear regression amounts to minimization of ε -insensitive loss and minimization of the norm of linear parameters [19]. This can be formally described by introducing slack variables, to measure the deviation of training samples outside ε -insensitive zone.

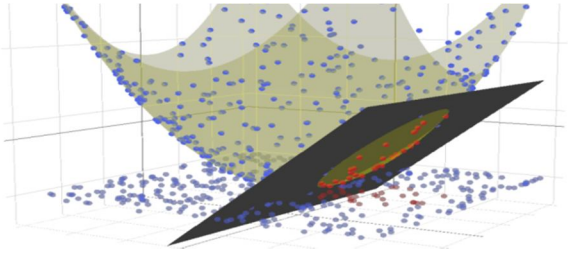

Fig 2: Support Vector Machine (SVM)

B. Hidden Markov Models (HMM)

Hidden Markov Model (HMM) is a finite state machine. This has some fixed number of states.

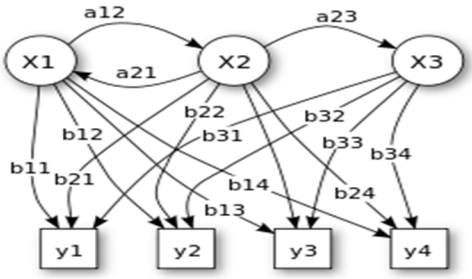

Fig 3: Hidden Markov Model (HMM)

It gives a probabilistic framework for modeling a time series of multivariate observations. Hidden Markov models were introduced in the beginning of the 1970's. It is used as an aid in speech recognition. This model which is based on statistical methods has become increasingly well-liked in the last several years due to its strong mathematical structure and theoretical basis as it is used a wide range of applications. Recently researchers proposed HMM [20] as a classifier or predictor for speech signal recognition, DNA sequence analysis, hand written characters recognition, natural language domains etc. It shows that HMM is a very influential tool for various applications.

C. Decision Trees

Decision tree builds classification or regression models in the form of a tree structure. It breaks down a dataset into small and smaller subsets while at the same time an associated decision tree is incrementally developed. The resultant is a tree with decision nodes and leaf nodes. A decision node will have two or more branches. Leaf node represents a classification or decision. The topmost decision node in a tree which corresponds to the best predictor called root node. Decision trees can handle both categorical and numerical data.

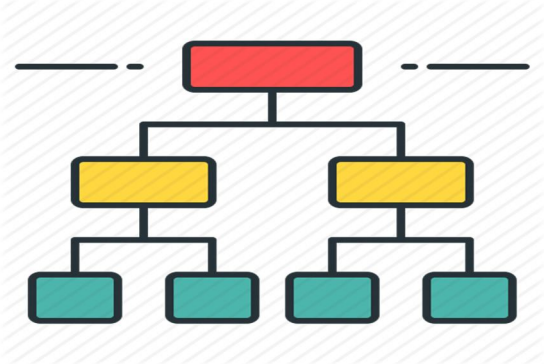

Fig 4: Decision Tree

A decision tree is built top-down from a root node and involves partitioning the data into subsets that contain instances with similar values (homogenous). ID3 algorithm uses entropy to compute the homogeneity of a sample [21]. If the sample is completely homogeneous the entropy is zero and if the sample is an equally divided it has entropy of one. The information gain is based on the decrease in entropy when a dataset is split on an attribute. Constructing a decision tree is all about finding attribute that returns the greatest information gain (i.e., the most homogeneous branches).

D. Artificial Neural Network (ANN)

An ANN has several advantages but one of the most recognized of these is the fact that it can actually learnt from observing data sets. In this way, Artificial Neural Network is known for as a random function approximation tool. These types of tools help estimate the most cost-effective and ideal methods for arriving at solutions while defining calculating functions or distributions. ANN use data samples in its place of complete data sets to arrive at solutions, which saves both time and money. ANNs are considered fairly simple mathematical models to improve effectiveness of the available the data analysis technologies.

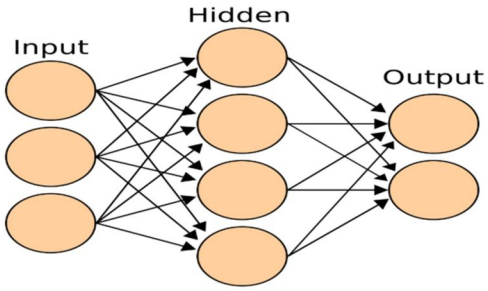

Fig 5: Artificial Neural Network (ANN)

ANNs includes three layers. These layers are connected to each other. The first layer consists of input neurons. Those neurons send data on to the second layer, which in turn sends the output neurons to the third layer. Training an artificial neural network involves choosing from allowed models for which there are several associated algorithms.

E. Feed Forward Neural Network (FFNN)

A feed forward neural network is an artificial neural network wherein associations between the nodes do *not* form a cycle. As such, it is a way different from recurrent neural network. The feed forward neural network was the first and simplest type of artificial neural network devised. In this network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes (if any) and to the output nodes. There are no cycles or loops in the network.

S.NO	TECHNOLOGY		TITLE	AUTHORS	YEAR	MERITS	DEMERITS
1	Evaluation model		Application of Reservoir Logging Evaluation Technology in TPT Region of Yijianfang Group	1. Hongfei Yu 2. Rui Li1 3. Bei Yang1	2012	1.It can evaluate at each step. 2.It can measure for individual performance	1.Cannot determine position quickly 2.Too many assumptions and sources are used
2	Heuristic Model	Ant colony Optimization	Multi-reservoir operation by adaptive pheromone re-initiated ant colony optimization algorithm	1. M. R. Jalali1 2. A.Afshar2 3. M. A. Mariño	2007	1.can search among population in parallel. 2.Have guaranteed convergence	1.Have difficult theoretical view. 2. Uncertain to time convergence
3		Bat algorithm	Development and Application of the Bat Algorithm for Optimizing the Operation of Reservoir Systems	1. Omid Bozorg 2. Iman Karimirad 3. Samaneh eifollahi-	2014	1.simplicity and flexibility 2.easy to implement	1.Unclear in selecting time period of data 2.It is subject to regency bias
4		Harmony search algorithm	Application of the Harmony Search optimization algorithm for the solution of the multiple dam system scheduling	1. P. Kougias 2. P. Theodossiou	2011	1.simple concept model 2.less adjustable parameter	1.True reversal signals are rare and can be difficult to separate from false alarms 2.False positive and false negative is difficult to identify

5		Particle swarm optimization	Extension of the constrained particle swarm optimization algorithm to optimal operation of multi-reservoirs systemindicators signals	1.M.H.Afshar	2013	1.Signals can be quickly incorporated 2.Helps traders in short term direction	1.It can generate several transaction signals 2.Position changes before capturing a strong change in momentum
6	Iterative Model	Ellipsoid Method	Optimization of the cross-sectional shape of a ridge waveguide using the ellipsoid and the tabu search algorithms	1. R.R. Saldanha J.A. 2. Vasconcelos 3. A.N. Moreira	1996	1.It provides a more stable level indication 2.It is the most straight forward calculation	1.There are no loops 2.It does not contain any cycles
7		Frank Wolfe	Decentralized Frank-Wolfe Algorithm for Convex and Non-convex Problems	1. Hoi-To Wai	2017	1,It has strong tolerance to input noise 2.Easy design	1.It does not exhibit a linear relationship 2.Slower to respond to rapid changes
8		Simultaneous perturbation stochastic approximation	Convergence rate of moments in stochastic approximation with simultaneous perturbation gradient approximation and resetting	1. Laszl Gerencs	1999	1.It is easy to implement 2.It is efficient to train	1.Its hypothesis space is limited 2.space complexity is high
9		Gradient descent	A Normalized Gradient Descent Algorithm for Nonlinear Adaptive Filters Using a Gradient Adaptive Step Size	1. Danilo P. Mandic 2. Moe Razaz	2001	1.Great for learning about data analysis process 2.Oversimplifies problems	1.It does not exhibit a linear relationship 2.Slower to respond to rapid changes
10	Machine learning	Support Vector Machine (SVM)	A hybrid aroma and support vector machines model in stock price forecasting	1.P.F. Pai 2.C.-S. Lin	2005	1.Works well on smaller cleaner datasets 2.It can be more efficient because it uses a subset of training points	1.Is'nt suited to large datasets as the training time with SVMs can be high 2.less effective on noiser datasets with overlapping classes
11		Hidden Markov Models (HMM)	Predicting Trend in the Next-Day Market by Hierarchical Hidden Markov Model	1.Luigi Troiano, 2.PraveshKriplani,	2010	1.Signals can be quickly incorporated 2.Helps traders in short term direction	1.Unclear in selecting time period of data 2.It is subject to regency bias
12		Decision trees	A Genetic Algorithm Optimized Decision Tree-SVM based Stock Market Trend Prediction System	1.Binoy B. Nair 2.et. aI	2010	1.Creates a comprehensive analysis 2.It traces each path to conclusion	1.It is overfitting 2.It has high variance and low bias
13		Artificial Neural Network(ANN)	Stock market prediction by using Artificial Neural Network	1.Yunus yetis 2.Halid kaplan 3.Mo Jamshidi	2014	1.It is relatively simple learning algorithm 2.Scales well to larger datasets	1.Hard to interpret the model 2.Dont perform well on small datasets
14		Feed Forward Neural Network (FFNN)	Stock market forecasting by using Feedforward Neural Network	1.Adetya prastayo 2.Darang junaedi 3.Mahmud dwi sulistiyo	2017	1.It is a simple network 2.Information is moved in single direction	1.There are no loops 2.It does not contain any cycles

V. CONCLUSION

This paper demonstrates a survey on different algorithms and methods that were proposed by researchers earlier for better development in the multiple reservoir operations and explain about the prediction of resource sharing. The aim of our research study is to help the reservoir workers and surrounding people for predictions of resource sharing for irrigation purpose. The multiple algorithms discussed above will be of great use for developing a new improved technique for a reservoir operation, which is efficient and effective. In future, we will be developing an algorithm and method to predict the reservoir operation with weather predictions.

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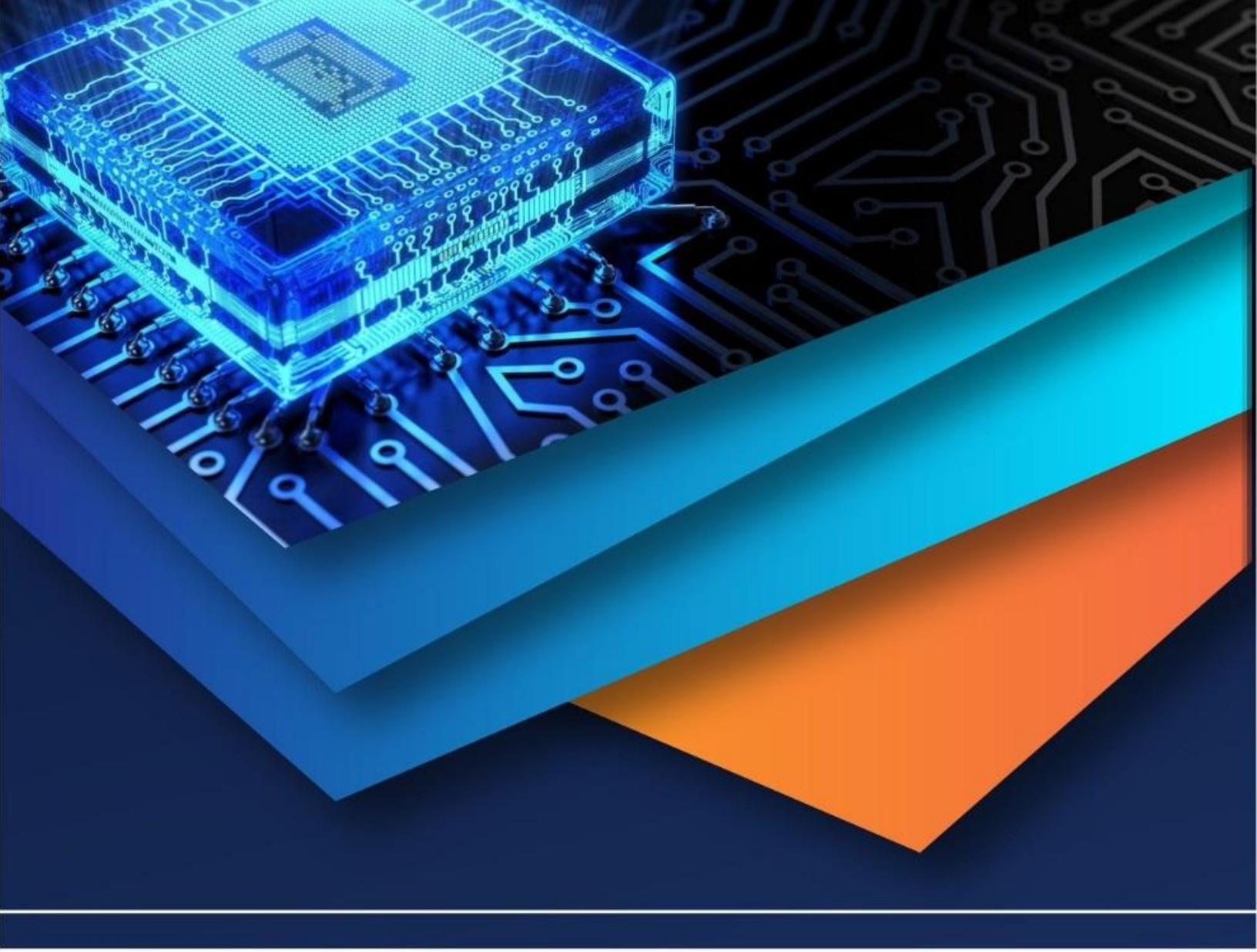

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