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# Review on Genetic Algorithm and Machine Learning

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**Abstract—**Genetic Algorithms (GAs) are a type of optimization algorithms which combine survival of the fittest and a simplified version of Genetic Process. Machine Learning provides ability to automatically learn and improve from experience without being explicitly programmed. It uses the data set to train the machine. Genetic Algorithms are used in various fields where Machine Learning algorithm also used. This study shows some examples where this both Genetic Algorithm and Machine learning Algorithms are used to get the best accuracy for model. Literature survey briefly provides the applications of Genetic Algorithm and Machine learning Algorithms in various fields. This study is fruitful for new researchers to get the basic background about the Genetic Algorithm and Machine learning with its recent application that are currently used in various fields like robotics, wireless network, agriculture, medical, banking, gaming, finding shortest path on map, environment resources etc..
**Keywords—**Genetic Algorithm, Machine learning, Support Vector Machine, Extreme Learning Machine

## I. INTRODUCTION

Genetic algorithms (GAs) are based on the principles of natural genetic systems which use stochastic search methods. For any optimization problem Genetic Algorithms perform a search in providing an optimal solution using fitness function. It uses only the fitness function values to deal simultaneously with multiple solutions. While solving an optimization problem using GAs, each solution is coded as a string (called "chromosome") of finite length over a finite alphabet A. Each and every chromosome or string is considered as an individual as input to GAs. A collection of X ( X is finite) such individuals is called a population. The GAs starts with a randomly generated population of size M. A new population of same size is generated in each iteration from the current population. This is done by using three basic operations on the each of the population. Genetic Algorithms contains three operators are Selection, Reproduction/Crossover and Mutation. Author [1] Genetic algorithms can solve complex problems, including the problems of cryptography. Genetic algorithms can help the working time. It minimizes the cost of time from being calculating the correct fitness.

After applying three operations of GAs i.e selection, crossover and mutation; new population is obtained then it is used to generate another population. Here the number of possible populations is always finite since A is a finite set and M is finite. Best string knowledge is stored either within the population or in a separate location outside the population. Then among all possible coded solutions algorithm report the best value found from all iterations. Directed search algorithms provides optimization and machine learning applications based on the mechanics of biological evolution which provide efficient, effective techniques. It is widely-used today in business, scientific and engineering circles. Concept is easy to understand to new researchers for their innovations. It is supports multi-objective optimization, modular, separate from application, inherently parallel and easily distributed. To speed up and improve a GA-based application in various way as knowledge about problem domain is gained

- Easy to exploit previous or alternate solutions
- Flexible building blocks for hybrid applications
- Substantial history and range of use

Every research are faces a problem that when to use a GA. When we need an alternate solutions are too slow or overly complicated, an exploratory tool to examine new approaches, problem is similar to one that has already been successfully solved by using a GA, want to hybridize with an existing solution and the benefits of the GA technology meet key problem requirements. Machine Learning provides ability to automatically learn and improve from experience without being explicitly programmed. Machine learning applied on empirical data to learn computer for accuracy. In machine learning the computer learns. A learner can take advantage of examples to incarcerate characteristics of importance of their unfamiliar basic probability distribution. The examples illustrate the relation between the input and desired result. A major task of machine learning research is to automatically learn to identify multifaceted patterns and make intelligent decisions based on examples.

## II. LITERATURE REVIEW

A number of research challenges have been identified, which are expected to become major research trends in the next years. Genetic Algorithm and Machine learning are currently used in various fields like robotics, wireless network, agriculture, medical, banking, gaming, finding shortest path on map, environment resources etc. Author [2] proposed a hybrid model for epileptic seizure detection with genetic algorithm (GA) and particle swarm optimization (PSO) to determine the optimum parameters of support vector machines (SVMs) for classification of EEG data. SVMs are one of the robust machine learning techniques and have been extensively used in many application areas. The performance of SVM can be improved by GA's and PSO's parameter optimization. Author [3] focuses the ever increasing issue of water scarcity in different countries, the current study plans to apply support vector machine (SVM), random forest (RF), and genetic algorithm optimized random forest (RFGA) methods to assess groundwater potential by spring locations. The different kernels of the SVM were used for producing GPMs with acceptable performances. GPMs (groundwater potential maps) could significantly help water resources managers and planners for better understanding of water resources conditions, exploitation, and conservation plans.

Author [4] propose a methodology to speed up the sampling of amorphous and disordered materials using a combination of a genetic algorithm and a specialized machine-learning potential based on artificial neural networks (ANNs). This methodology is based on a combination of a genetic algorithm (GA) with an artificial neural network (ANN) potential. Authors demonstrated that this ANN-assisted sampling is successful in determining low-energy amorphous structures and is computationally more efficient than the construction of a converged general ANN potential. Author [5] proposes an expert disease diagnosis system for Parkinson disease based on genetic algorithm (GA) wavelet kernel- (WK-) Extreme Learning Machines (ELM). In this study, the optimum values of these parameters and the numbers of hidden neurons of ELM were obtained by using a genetic algorithm (GA). The performance of the proposed GA-WK-ELM method is evaluated using statical methods such as classification accuracy, sensitivity and specificity analysis, and ROC curves. The proposed system is an integration of other disciplines and other technology with ELM by authors [6]. In recent years, many researchers in view of ELM problems try to combine other kinds of disciplines algorithm with the ELM, presented better training model. Authors also focuses on future study, how to make the online learning, genetic algorithm, SVM and ELM together will be a very worthwhile to explore direction.

According to the authors [7], the Machine learning techniques have been widely applied in the field of chemoinformatics to discover and design new drugs with superior biological activities. Machine learning techniques such as increased data interpretability to prove mechanistic hypothesis as well as methods preventing over-fitting are also important topics that warrant further development in the field of machine-learning-based drug discovery. Authors [8] are stated that in previous work, our learner uses a Gaussian process to develop a statistical model of the relationship between the parameters it controls and the quality of the BEC produced. The proposed Gaussian process machine learner is able to discover a ramp that produces high quality BECs in 10 times less iteration than a previously used online optimization technique.

Author [9] proposed novel method, Jaya algorithm for Pathological brain detection. Pathological brain detection is an automated computer-aided diagnosis for brain images. To balance the dataset authors are used synthetic minority oversampling. According to authors Jaya algorithm, as a training method, is superior to genetic algorithm, particle swarm optimization, and bat algorithm. According to authors [10] the hybrid GA is even more popular than the pure GA. Due to the known phenomena of local minima trap in GA routine, local search techniques have mostly been integrated with the GA. They also stated that there is a need to explore options for integration of more advanced artificial intelligence based algorithms with GA. Authors [11] are compared with Genetic Programming and Artificial Neural Network models for accuracy of ELM model for the estimation and prediction. The simulation results indicate that an improvement in predictive accuracy is achievable with the ELM approach in comparison with GP and ANN.

Author [12] stated that the convolutional neural network and genetic algorithm used to solve the problem of precision agriculture and agroindustry by satellite imagery. Due to the dynamic, operating conditions, modern wireless networking standards increasingly rely on machine learning and artificial intelligence algorithms. Authors [13] are stated that the Genetic algorithms (GAs) provide a well-established framework for implementing artificial intelligence tasks such as classification, learning, and optimization. Genetic algorithms are well known for their remarkable generality and versatility and have been applied in a wide variety of settings in wireless networks. According to authors [14], the Genetic Algorithm has promising implications in various medical specialties including radiology, radiotherapy, oncology, pediatrics, cardiology, endocrinology, surgery, obstetrics and gynecology, pulmonology, infectious diseases, orthopedics, rehabilitation medicine, neurology, pharmacotherapy, and health care management.

Author [15] proposed an intelligent model based on the Genetic Algorithm (GA) to organize bank lending decisions in a highly competitive environment with a credit crunch constraint (GAMCC). GAMCC provides a framework to optimize bank objectives when constructing the loan portfolio, by maximizing the bank

profit and minimizing the probability of bank default in a search for a dynamic lending decision. GAMCC facilitates how banks would make an efficient decision in case of a cut back on lending supply when faced with a negative liquidity shock, while staying focus on the main objective of bank profit maximization.

Author [16] focuses on the problem of selecting those sound-describing features that make the vehicle classifier work properly. They evaluate the feasibility of a novel feature selection method based on a special class of Genetic Algorithm with restricted search which hybridized with a Extreme Learning Machine. Because of its great generalization performance at a very fast learning speed, the Extreme Learning Machine plays the key role of providing the fitness of candidate solutions in each generation of the Genetic Algorithm. Both the Extreme Learning Machine and the Multi-Class Extreme Learning Machine classifiers exhibit the best results, even when using a short number of selected features. Authors [17] are proposed an algorithm for image segmentation technique used for automatic detection as well as classification of plant leaf diseases and survey on different diseases classification techniques that can be used for plant leaf disease detection. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done by using Genetic Algorithm.

**1.** Prepare **Genetic Algorithm in Machine Learning**

GENETIC ALGORITHM IN MACHINE LEARNING

In machine learning we are trying to create solutions to some problem by using data or examples. There are essentially two ways to do this (i) either the solution is designed from the data, (ii) or to find an effective one; some search method is used to search over a class of candidate solutions. Decision tree induction by ID3 and nearest-neighbour classification are examples of creation of a solution by construction. Use of a gradient-descent algorithm to search over a space of neural network weights to find those which affect a particular input-output mapping is an example of the use of search. Genetic algorithms are stochastic search algorithms which are often used in machine learning applications.

By three reasons the Genetic algorithms are important in machine learning are (i) they act on discrete spaces, where gradient-based methods cannot be used. They can be used to search rule sets, neural network architectures, cellular automata computers, and so forth. In this respect, they can be used where stochastic hill-climbing and simulated annealing might also be considered. (ii) they are essentially reinforcement learning algorithms. Fitness functions determined the performance of a learning system by a single number. This is unlike something like back-propagation, which gives different signals to different parts of a neural network based on its contribution to the error. Thus, they are widely used in situations where the only information is a measurement of performance. In that regard, its competitors are Q-learning, TD-learning and so forth. (iii) Genetic Algorithms involve a population and sometimes what one desires is not a single entity but a group. Learning in multi-agent systems is a prime example. In artificial intelligence, search is used in reasoning as well as learning, and genetic algorithms are used in this context as well. In chess-playing program, Machine learning could be used to acquire the competence of chess-playing. However, when the program plays the game it also uses search to find a good move. Other examples include searching over a set of rules to evaluate a predicate. Genetic algorithms have been used for problems which have been in the domain of artificial intelligence, such ascending an effective timetable or schedule within a set of constraints.

In machine learning, one of the uses of genetic algorithms is to pick up the right number of variables in order to create a predictive model. To pick up the right subset of variables is a problem of combinatory and optimization. The benefit of this technique over others technique is, it allows the best solution to emerge from the best of prior solutions. Improves the selection over time by an evolutionary algorithm,

The idea of GA is to combine the different solutions generation after generation to extract the best genes (variables) from each one. That way it creates new and more fitted individuals. The other uses of GA such as hyper-tunning parameter, find the maximum (or min) of a function or the search for a correct neural network arquitecture (Neuroevolution), or among other. Every possible solution of the GA, which are the selected variables, are considered as a whole, it will not rank variables individually against the target.

For the project the machine learning part is only the first step. Once the model is trained and saved, the genetic algorithm can be applied as next step. For the better solution, a population of candidate solutions of the genetic algorithm to an optimization problem is evolved, and each candidate solution has a set of properties which can be mutated and altered. When this model is use as a part of the genetic algorithm, what they start with is a random visit order for each point. Then, on the basis of the fitness function score being the shortest total time traveled. The predictions from the machine learning model, this algorithm attempts to find a better visit order.

This process repeats until we figure out a close to ideal solution.

Some researches vary Genetic Algorithms structure based on their purpose, but all of them contain some common components. Following figure shows the flow of Genetic algorithm. Genetic algorithms start with the initializing a population of individuals using default or random values. After initialization, it runs each member of that population through a fitness function.

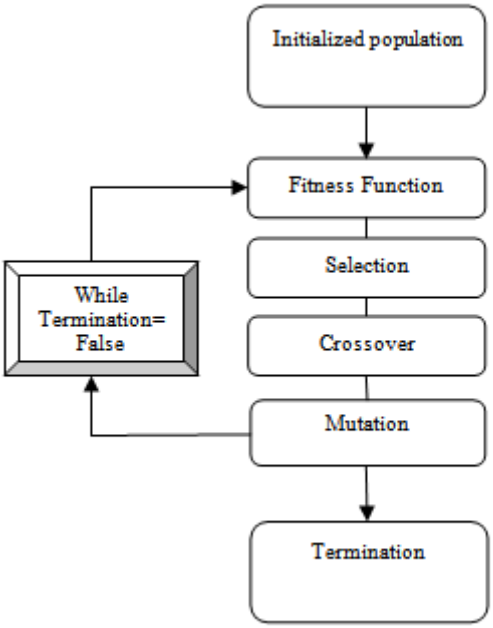


**Fig: Structure of Genetic Algorithm**

The method defined in the reproduction function selects the fittest members of the population to reproduce population. Then it repeats the evaluation and reproduction until a desired number of iterations have passed. At the end, the algorithm presents the best member or members of the population according to the fitness function.

The heart of a genetic algorithm is the fitness function. Fitness function takes an individual and determines how well it fulfills whatever criteria the algorithm is optimizing for. The fitness function should be applied to each individual of the population separately to determine whether they should be allowed to reproduce. The function may return a fitness score or a boolean for whether the individual passes a set threshold for reproduction.

The population and the results of the fitness function are used by the selection function to determine who should reproduce. If the threshold is set by fitness function for reproduction of individuals and returned a Boolean. Then population filters by selection function based on that value. However, if the fitness function returned raw scores, the selection function calculates a threshold from those scores. For example, it may calculate the average score and only keep the top half of the population. It passes the selected population into the reproduction function and deletes the rejected individuals like Thanos snapping his fingers.

After the desired iterations have occurred, the termination function takes the ending population and returns the best members by fitness score. The role of the termination function depends entirely on the application. For a video game, the termination function might output optimal statistics for the final boss, for a mathematical optimization, it returns the best input values to the function. Example, there is 5 points on the map. We would like our delivery pizza to visit all these locations on the same day, and we want to know the best route. However, we don't know how long it will take the driver to go between each point because we don't have the data for all address combinations. Here the machine learning part comes in. Predictive model can find out how long it will take for a pizza boy to get from one point to another, and make predictions for each pair of points.

Genetic algorithms have many applications, some of them are- Compared to traditional artificial intelligence, a genetic algorithm provides many advantages. It is more robust and is susceptible to breakdowns due to slight changes in inputs or due to the presence of noise. While searching large multi-modal state spaces, large state spaces or n-dimensional surfaces, a genetic algorithm can provide better and more significant results with respect to other optimization methods like heuristic, praxis, first or breadth-first, linear programming.

Genetic algorithms are broadly used in various fields such as optimized telecommunications routing, robotics, wireless network, computer-aided molecular design, agriculture, medical, banking, gaming, automotive design and engineering design. Genetic algorithms are used for NP-hard problems but it is not suited for all problems, particularly problems which are simple and for which derivative information is available. For some problems, fitness value is calculated repeatedly which might be computationally expensive. Being stochastic, there are no guarantees on the optimality or the quality of the solution. If not implemented properly, the GA may not converge to the optimal solution.

Advantages of Genetic Algorithm

- there are multiple local optima
- the objective function is not smooth
- the number of parameters is very large
- the objective function is noisy or stochastic
- They usually perform better than traditional feature selection techniques.
- Genetic algorithms can manage data sets with many features.
- They don't need specific knowledge about the problem under study.
- These algorithms can be easily parallelized in computer clusters.

Disadvantages are:

- Genetic Algorithms might be very expensive in computational terms, since evaluation of each individual requires building a predictive model.
- These algorithms can take a long time to converge, since they have a stochastic nature.

## III. CONCLUSION

This study is fruitful for new researchers to get the basic background about the Genetic Algorithm and Machine learning with its recent application that are currently used in various fields. After trained the system with any type of machine learning algorithm, the Genetic Algorithm applied to get the accurate results. When applied to learning, genetic algorithms turn learning tasks into reinforcement learning problems. Researchers can research in optimized telecommunications routing, robotics, wireless network, computer-aided molecular design, agriculture, medical, banking, gaming, automotive design and engineering design with the combination of Genetic Algorithm and machine leaning which will help to get better accuracy and performance. Genetic algorithms combine quite successfully with local search algorithms or local machine learning methods.

## REFERENCES

[1]. Andysah Putera, Utama Siahaan and Robbi Rahim, "Dynamic Key Matrix of Hill Cipher Using Genetic Algorithm", International Journal of Security and Its Applications Vol. 10, No. 8, pp.173-180, http://dx.doi.org/10.14257/ijsia.2016.10.8.15, 2016.

[2]. Abdulhamit Subasi, Jasmin Kevric & M. Abdullah Canbaz, "Epileptic seizure detection using hybrid machine learning methods", Neural Comput & Applic, DOI 10.1007/s00521-017-3003-y, 2017.

[3]. Seyed Amir Naghibi, Kourosh Ahmadi & Alireza Daneshi, "Application of Support Vector Machine, Random Forest, and Genetic Algorithm Optimized Random Forest Models in Groundwater Potential Mapping", Water Resour Manage 31:2761–2775, DOI 10.1007/s11269-017-1660-3, 2017.

[4]. Nongnuch Artrith, Alexander Urban, and Gerbrand Ceder, "Constructing first-principles phase diagrams of amorphous LixSi using machinelearning-assisted sampling with an evolutionary algorithm", The Journal of Chemical Physics 148, 241711; doi: 10.1063/1.5017661, 2018.

[5]. Derya Avci and Akif Dogantekin, "An Expert Diagnosis System for Parkinson Disease Based on Genetic Algorithm-Wavelet Kernel-Extreme Learning Machine", Hindawi Publishing Corporation, Parkinson's Disease, Volume 2016, Article ID 5264743, 9 pages, doi: 10.1155/2016/5264743, 2016.

[6]. Shifei Ding, Han Zhao, Yanan Zhang, Xinzheng Xu, Ru Nie, "Extreme learning machine: algorithm, theory and applications", Artif Intell Rev (2015) 44:103–115, DOI 10.1007/s10462-013-9405-z, Science+Business Media Dordrecht 2013.

[7]. Lo, Y.C. et al. Machine learning in chemoinformatics and drug discovery, Drug Discov Today (2018), https://doi.org/10.1016/j.drudis.2018.05.010.

[8]. Wigley, P. B. et al. Fast machine-learning online optimization of ultra-cold-atom experiments. Sci. Rep. 6, 25890; doi: 10.1038/srep25890 (2016).

[9]. Yu-Dong Zhang, Guihu Zhao, Junding Sun, Xiaosheng Wu, Zhi-Heng Wang, Hong-Min Liu, Vishnu Varthanan Govindaraj, Tianmin Zhan & Jianwu Li , "Smart pathological brain detection by synthetic minority oversampling technique, extreme learning machine, and Jaya algorithm", Multimed Tools Appl, DOI 10.1007/s11042-017-5023-0, Science+Business Media, LLC 2017.

[10]. Muhammad Kamal Amjad , Shahid Ikramullah Butt , Rubeena Kousar, Riaz Ahmad, Mujtaba Hassan Agha, Zhang Faping , Naveed Anjum, and Umer Asgher, "Recent Research Trends in Genetic Algorithm Based Flexible Job Shop Scheduling Problems", Hindawi, Mathematical Problems in Engineering, Volume 2018, Article ID 9270802, 32 pages, https://doi.org/10.1155/2018/9270802, 2018.

[11]. "Estimating building energy consumption using extreme learning machine method", Sareh Naji , Afram Keivani , Shahaboddin Shamshirband, U. Johnson Alengaram, Mohd Zamin Jumaat, Zulkefli Mansor, Malrey Lee, Energy 97 (2016) 506-516, science direct, 2015.

[12]. Firdaus, Y Arkeman , A Buono and I Hermadi , "Satellite image processing for precision agriculture and agroindustry using convolutional neural network and genetic algorithm", IOP Conf. Series: Earth and Environmental Science 54 012102 doi:10.1088/1755-1315/54/1/012102, 2017.
[13]. Usama Mehboob, Junaid Qadir, Salman Ali, Athanasios Vasilakos, "Genetic algorithms in wireless networking: techniques, applications, and issues", Soft Comput, DOI 10.1007/s00500-016-2070-9, Springer-Verlag Berlin Heidelberg 2016.
[14]. Ali Ghaheri, Saeed Shoar, Mohammad Naderan and Sayed Shahabuddin Hoseini, "The Applications of Genetic Algorithms in Medicine", Oman Medical Journal, Vol. 30, No. 6: 406–416, 2015.
[15]. Noura Metawa, M.Kabir Hassan, Mohamed Elhoseny, Genetic Algorithm Based Model For Optimizing Bank Lending Decisions, Expert Systems With Applications (2017), doi:10.1016/j.eswa.2017.03.021., 2017.
[16]. E. Alexandre, L. Cuadra, S. Salcedo-Sanz, A. Pastor-Sánchez, C. Casanova-Mateo, Hybridizing Extreme Learning Machines and Genetic Algorithms to Select Acoustic Features in Vehicle Classification Applications, Neurocomputing, http://dx.doi.org/10.1016/j.neucom.2014.11.019 pp1-30.
[17]. Vijai Singh, Varsha, Prof. A K Misra, "Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm", International Conference on Advances in Computer Engineering and Applications (ICACEA), IMS Engineering College, Ghaziabad, India, Pp1028-1032, 2015.

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