



Analytical Approach Towards Evolutionary Computations

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Abstract

The evolutionary principle is the vital unifying principle of biology, linking every microbe together in the historical chain of occasions. Every creature in the chain is the item of a series of "mishaps" that have been ironed out thoroughly under discerning stress from the environment. Over several generations, arbitrary variants along with natural selection shapes the habits of people in addition to kinds to fit the requirements of their settings. This fit can be phenomenal and engaging. It could provide a method for resolving complicated engineering troubles- ones involving chaotic disruptions, randomness, and facility nonlinear dynamics-that our conventional algorithms have been unable to overcome. In the design as well as execution of computer-based trouble-solving systems, evolutionary computation uses models of transformative procedures. A subfield of artificial intelligence and a soft computer system that is motivated by biological evolution and produces algorithms for around the world optimization. It is inspired by Darwin's Theory of Natural Selection as well as Mendel's current genetics. Transformative algorithms are simply a subcategory of transformative calculation given that they just use methods to execute biological evolution-inspired systems consisting of recreation, mutation, recombination, natural selection, and survival of the fittest. This paper provides an overview of evolutionary calculations and describes some of the most often used evolutionary formulae. It also talks about countless applications of transformative algorithms in the different other fields, as an example, to fix feature option troubles which is an important job in information mining as well as artificial intelligence. It can be utilized in various markets like health care as an example of the identification of lumps.

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1 Introduction

Evolutionary computations are founded on the fundamental concept of "survival of the fittest," and they simulate some natural phenomena such as genetic inheritance and Darwinian survival struggle; they are also a fascinating area of current heuristic search. Presently there is so much to operate in this field, it is a nature-influenced approach of optimization. More than thirty years ago, a team of forward-thinking scholars in the United States, as well as Europe, independently proposed the idea of replicating biological evolution principles to establish reliable formulas for adaptation and optimization problems. A check out responses for challenging real-world situations with simulated evolution.

Computational Intelligence is a subfield of Machine Learning and Artificial Intelligence that includes Evolutionary Computation. Individuals in nature should adjust to their surroundings to live; this is called development. Traditional algorithms can't tackle issues with too many variables, thus evolutionary computation is utilized. Presently of recreation, the attributes that make a person extra competitive are kept, while the qualities that make an individual less competitive are eliminated. Genetics are the devices that manage these features, and also chromosomes are composed of a collection of these genetics. Just the fittest individuals endure in succeeding generations, as well as additionally their fittest

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genetics are given through the generations by means of recombination. Crossover is the term for it. The development of "transformative formulas" is a result of this all-natural option and optimization process. Alternative plans and likewise various other motorists like recombination as well as likewise mutation is made use of by transformative solutions to maintain a population of frameworks that establish gradually. Every person in the population is offered a rating based on their environmental fitness. Choice concentrates attention on people that are physically fit, permitting them to benefit from readily available health and fitness information. Mutation and recombination cause these to be disrupted. Because of expansion and possible refinement, EA accomplishes remarkable focus from lots of scientists nowadays [1]. Although domain name particular knowledge can be utilized to influence the search, a transformative algorithm's populace is usually initialized randomly. Each person's health and fitness is determined in terms of its value in a provided atmosphere. Generally, the transformative formula approach is motivated by organic evolution to produce options, individuals are not adjusted to the environment rather only the fittest survive. The mistake was made by older theorists was the atmosphere had a result on a person. The delayed convergence of evolutionary computing to an optimal solution is one of its drawbacks [2]. This study examines multiple literature reviews of various publications, research, and arguments that have been evolved. Not only does it contain the obtained conclusions and analysis but also diverse approaches that have emerged over the last decade.

2 Methodology

A secondary research study is a collection of well-organized literary works reviews. It is a method used for finding as well as assessing various research study work performed by numerous authors relevant for a particular location of rate of interest. Throughout the research study, different questions were encountered, some of the queries that were

considered while examining many documents for example substantial concerns and also challenges, future patterns, how hybrid formulas are far better than standard evolutionary formulas. The authors for the research were picked from IEEE Xplore, Springer virtual libraries, and well-known seminars. The research was limited to online papers. To include data from the papers, notes were made from each research paper after the segregation and removal of duplicate content. The notes were divided into three sections: the first section included the paper's strengths, the second section included the paper's flaws and difficulties, and the third section included the paper's important points and summary. After that, the three portions of the notes were integrated to produce the whole Paper.

3 Literature Review

A study has been done on google scholar, IEEE, and springer for recognition of documents connected to evolutionary computations. The crucial research study functions discovered throughout the hand-operated search were likewise added in this paper. During search essential crucial jobs such as "Evolutionary Computations", "Application of evolutionary calculations", "Kinds of transformative computations (Hereditary Algorithms, Flock Fragment optimization, Evolutionary Programming, Genetic programs)" were utilized. A total of 55 documents and a few blogs were discovered. Throughout the screening of all the products, much less relevant as well as replicate material was eliminated. Only 34 of them have been selected based on the study's high quality and importance. A secondary research study is an organized review of literary works. It is a method used for finding as well as assessing various research study work performed by numerous authors relevant for a particular location of rate of interest. The current review technique is linked to the literary works testimonial target different study questions to find, review, choose, and incorporate all of the high-quality research study evidence required for the study.



TABLE 1: Analysis of Literature Review

Ref	Advantages	Disadvantages	Summary
[1]	Includes references to other papers where one can study in-depth a particular topic.	Discusses only 3 types of techniques moreover it does not elaborate the difference between evolutionary techniques and algorithms.	It presents an overview of the basics of evolutionary computations by giving various examples.
[2]	Experiments to show incorporation of domain knowledge	Work done with CERICIA not included	The ultimate objective of evolutionary computations is to tackle more complicated real-world issues, and It's a big field with a lot of different applications.
[3]	It analyzes various types of algorithms for instance greedy algorithm, no free lunch algorithm.	The study makes no claims about whether combining feature selection and design enhances classroom performance or efficiency.	Feature option is a crucial job in data mining and also artificial intelligence to minimize the dimensionality of the information as well as increase the performance of an algorithm, such as a category algorithm.
[4]	Variation of the temperature field caused by the tumor helps in the identification of its shape and position. Using inverse problems.	Table no 3 is not accurate because of non unique problems.	The practical is considered as the physical fitness function and also the reduction is done by an evolutionary formula with the drifting factor representation of chromosomes. Geometric parameters of form and placement of the tumor play the duty of genes. The examination of the fitness feature is preceded by the solution of the direct issue for the bioheat transfer.
[5]	Computational models of natural evolutionary processes are used as important elements in the design and implementation of computer-based problem-solving systems in the evolutionary computation method.	Assuming non-linear static part of wiener model is invertible	For Wiener models, which are composed of a linear dynamic system followed by a nonlinear static element, a new technique for nonlinear dynamic system identification is addressed.
[6]	Reviews the basics of evolutionary computations and necessary steps.	Does not provide the conclusion and analysis of the provided theory.	The relationship between evolutionary algorithm and device knowledge is checked out.
[7]	Explains the significance of both problem-solving and natural evolution modeling.	It is assumed that the population size has to scale with the number of strategy parameters.	The principles of strategy parameter self-adaptation used by the first two algorithms to learn their own strategy parameters like mutation variances and covariances are summarized
[8]	Both classical and experimental genetic algorithms are covered. The schema theorem is included, as well as constructed models of canonical GA.	Experimental proof required	A set of computing models inspired by evolution is known as genetic algorithms. These methods encode a suggested solution to a given issue on a simple chromosome-like data structure using recombination operators to keep critical information intact.
[9]	Maximization and minimization problems, GA operators are elaborated.	Discusses only binary-coded strings, The discussion of uncertainties about whether computer-generated life could exist is far from conclusive.	Genetic Algorithms are a group of computing models that are based on evolutionary principles. These algorithms employ recombination operators to maintain vital information while storing a proposed solution to a problem on a simple chromosome-like data structure.
[10]	Focuses on mutation rate and crossover ratios, Elitism operator used.	Interval chosen for mutation was in between 0,1, P-values obtained after conducting Wilcoxon rank-sum test are at 5% significance level for algorithms.	One of the first population-based stochastic algorithms proposed in history is the Genetic Algorithm (GA). GA's key operators, like those of other EAs, are selection, crossover, and mutation.
[11]	It includes different theoretical discussions.	It is assumed: Mapping from objective space to decision space is one to one. Decision variable are independent	The optimization issues in different fields are growing increasingly difficult as contemporary science and engineering progress.
[12]	Keels makes it easier to analyze the behavior of evolutionary algorithms.	The weak duality theorem is a free tool for solving optimization problems with great efficiency.	Includes evolutionary learning algorithms based on a variety of approaches, including Pittsburgh, Michigan, and IRL, as well as the integration of evolutionary learning techniques with a variety of pre-processing techniques, allowing it to perform a thorough analysis of any learning model in comparison to existing software tools.
[13]	It includes 46 algorithms from the whole family of GA, GP, DE Taxonomy of nature-inspired methods.	Disadvantages of 1+1 rule and $\mu+\lambda$ rule not discussed.	The focus of this research is on the transformational algorithm family as well as real-world applications. Paper provides the complying with algorithms: genetic formulas,



			hereditary programs, differential evolution, advancement methods, and transformative programs.
[14]	Included number of publications with assuring results.	Author examines the assumption that large populations are useful in the starting.	In the subject of local search, substantial advancements have been made, including techniques that adjust the parameters of search engines on the fly.
[15]	Includes extension of EAs.	Does not include experimental analysis.	Different EA approaches are combined, resulting in a variety of changes that may be used to solve a variety of real-world situations.
[16]	Examines the problem using different methods of AI, heuristic search, Genetic Evolutionary computation.	Difficult to discover solutions using Heuristic Method, all processors are of the same computational speed and all code blocks take exactly the same amount of computing time.	A deceptive problem is provided, along with a well-known analytical solution. It is arguable that the solution search environment is such that heuristic techniques will have a tough time finding the service.
[17]	Suggested ways in which performance might improve by incorporating features of one algorithm into another.	There is no experimental evidence that compound algorithms are superior.	The differences between the four key areas of evolutionary computing are now being sorted out, and the lines between them are becoming blurry. The development of new approaches is still ongoing. The new should be the focal point. Hybrid implementations are possible.
[18]	DE is successfully applied to the IEC framework due to pairwise comparison.	The proposed approach was not used to combine colors on a big scale.	Differential evolution is an evolutionary technique that uses a population-based stochastic search strategy to solve optimization problems in a continuous space.
[19]	Includes related work of study.	Use the synthetic data set.	Traditional clustering techniques can only handle low-dimensional data due to the dimensionality curse, and cannot handle high-dimensional data.
[21]	Talks about bottom-top approach	Experimental analysis required	Genetic programming 1, 2 and its offshoots will change program development in the long term.
[22]	The method can follow the drift of users' preferences.	The method will deduce the knowledge of the user's preference which will cost more time.	The distinction between interactive evolutionary computation and traditional evolutionary computation is that in IEC, the user subjectively assigns fitness to people, whereas in TEC, fitness is objectively determined by function or others.
[23]	Scalability feature	Early generation populations were not included in the experimental analysis.	Multiobjective evolutionary optimization techniques have been effectively applied in a variety of real-world situations.
[25]	Experiments were done out on a Drawing TC5000A, which included all associated research.	Experimental proof required	The HDEA is a considerably better choice than the DEA, according to the study and the experiment. If a DEA with numerous subpopulations cannot provide appropriate answers, an HDEA built on the same EA with the same number of subpopulations can provide superior results.
[27]	PRISMA guidelines were used to conduct the review of GA Comparative study of GA's variants in terms of pros and cons also covers future research directions.	The main attention was only on mixed media and wireless networks.	The genetic algorithms that have sparked the curiosity of the scientific community have been chosen for investigation. In order to aid novice researchers, the genetic operators and their applications are presented.
[29]	Includes proof to validate adaptation approach, which allows an ES to converge to the optimum with probability one in the elitist situation.	This paper is formulating EAs as finite state Markov chain but the disadvantage of Markov chain is, Markov models are problematic if the time period is too small since the individual displacements are not random, but rather deterministically coupled in time.	The ability of evolutionary programs to discover good solutions to challenging optimization issues has been demonstrated. The strategy parameters have often been held fixed in previous analyses of their convergence qualities.



[30]	Through experimental results, it was seen that it's not adequate to inspect the mutation bit for positiveness and the option kernel for elitism to satisfy the preconditions of Lemma 1 and Thesis 1 generally search rooms. But it appears possible to obtain conditions for further genetic operators and trouble courses bring about more effective outcomes.	It is assumed that to minimize a real-valued objective function $f: M \rightarrow \mathbb{R}$ that is bounded from below, that is, $f(x) > \epsilon$ for all $x \in M$, some EA is employed.	This paper provides conditions under which transformative algorithms with an elitist choice regulation will assemble to the global optimum of some feature whose domain may be an arbitrary space. These outcomes generalize the previously created convergence concept for binary and Euclidean search rooms to basic search rooms.
[31]	Cryptographic applications and real-life scenarios.	Experimental analysis required	Evolutionary computation algorithms stand for a variety of analytical strategies based upon concepts of biological evolution, like natural selection and hereditary inheritance. These formulas may be used for a wide range of complicated problems, including those in cryptography.
[32]	Includes the challenges and the models used.	Except for a little quantity of data collected prior to optimization, it is believed that the true objective function is unavailable during optimization.	Data-driven evolutionary algorithms (DDEAs) can be highly useful in addressing expensive and computationally heavy issues by effectively creating and utilizing surrogates.
[33]	Aspects of biology and computer science are also addressed.	Invariant dynamical structure not included	Modeling of GRN layout, or 'electrical wiring,' has been even more preferred in developmental and medical biology as a way of measuring gene-gene communications, perturbation responses, and also general dynamic patterns of networks.

4 Varieties and Working

This paper discusses the many types and functions of numerous algorithms and methodologies that have arisen in recent decades. Evolutionary Computation goes through many phases. Fig 1 describes Each of these phases approximately corresponds to a different aspect of natural selection, and thus makes it simple to modularize implementations of this algorithm category.

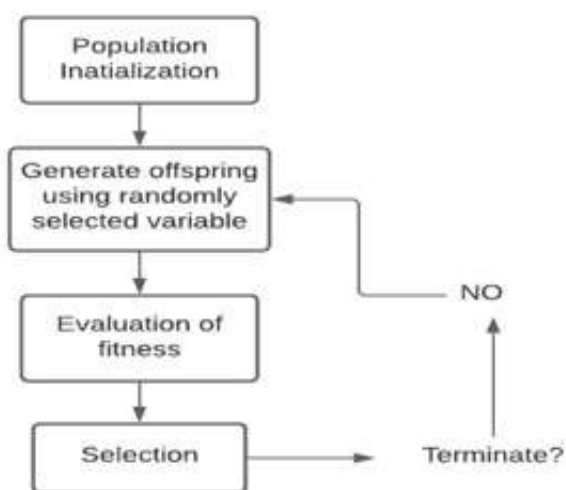


Figure 1: The Stages That An Evolutionary Algorithm Goes Through

Phase 1: This activity defines the original issue area. It's called representation.

Phase 2: Entails determining the evaluation feature (Fitness Function). This feature works

as the framework for the selection treatment and likewise enables renovations.

Phase 3: You'll be able to find a service once you've defined your sample population. It is a multistep genotype that composes the transformative system.

Phase 4: The top quality of the individuals is affected by adult choice. Consequently, excellent top quality people end up being parents in the adhering to generation. When an individual is selected to be a parent, it undergoes a series of adjustments in order to generate youngsters

Phase 5: Variant operators take an existing driver and also turn it right into a new one. Anomaly and recombination are 2 different forms of variation drivers. The unary driver is utilized to indicate mutation. When it is put on one genotype, it generates a child of that genotype. Whereas recombination is a binary procedure. During the recombination procedure, the info from 2 or even more parent genotypes is combined, resulting in one or more kid genotypes.

Phase 6: In Survivor Selection, people are picked based on their outstanding characteristics. It's comparable to the process of selecting a parent. However, it takes place at different phases of evolution. Just if there are children of picked parents is this process triggered.

Phase 7: People are produced at random in the first population. To create the first populace, particular heuristics with much better health



and fitness are usually utilized. Because the problem recognizes its optimal health and fitness level, getting it might bring the process to a halt. [6].

4.1 Evolutionary Algorithms

With the advancement of ubiquitous computing, human-computer interaction is becoming increasingly powerful [34]. Dispersed evolutionary formulas: Here the single population is divided into numerous subpopulations [8]. In the majority of DEAs, movement happens after established consistent intervals. Ordered distributed transformative algorithms: The presence of both various sorts of movement is the crucial attribute of HDEAs considering that they develop the genuine pecking order in between standard DEAs and the HDEA [25].

4.2 Types of Evolutionary Computation Techniques

Evolutionary algorithms (EA) have been a prominent optimization and search method in the last decade. EA is a form of heuristic-based search engine that is a subset of EC. There are various types of evolutionary computation techniques such as Model-Based evolutionary algorithms. These EAs are a family of equations inspired by nature that are often employed to tackle complicated optimization issues. The study tries to shed light on the various inspirations of using designs in EAs: an estimate of circulation, Inverted modeling, and surrogate modeling[11], Evolutionary programming is the goal of transformational programming, which may be traced back to the 1960s, is to promote smart behavior through replacement development and it defines knowledge as the capability of a system to adjust its behavior to fulfill goals in a variety of environments, figuring out how to substitute development can be utilized as a starting point for this [16], Evolutionary multi-objective optimization (EMO) there are variety of EMO algorithms have been recommended and efficiently used in a wide variety of real-works application jobs. EMO algorithms usually work effectively on two objective troubles [23]. The beginnings of transformative algorithms can be mapped to at least the 1950s [1], Genetic Algorithms they are one of the first population-based stochastic algorithms proposed in the background was the

Hereditary Formula (GA) [28]. Usually, there are just 2 main elements of the majority of hereditary algorithms that are trouble reliant: the trouble inscribing and also the examination function [8]. Regardless of the application, GAs are known to use one or more of the following three operators: option, crossover, and anomaly [17]. The alphabet 0 1 is commonly used in GAs, Particle swarm optimization is a bit comparable to a populace member (chromosome) in a GA. Like a GA chromosome, a particle represents a candidate remedy to the trouble being attended to. An individual particle is treated as a point in the D-dimensional issue area. The i th fragment stands for as $X = (X_{i1}, X_{i2} \dots X_{io})$, Differential evolution is a type of evolutionary algorithm that was first suggested by Price and Storn for optimization problems in a continuous domain [14]. DE is a wonderful blend of ease of use, quickness, and durability. DE emphasizes the need of adjusting the search during the transformational process. In DE, the fittest of a spawn competes for a one-to-one with that of the equivalent parent which is different from various other transformative formulas [20], The complete range of literally determinable features is now within the scope of genetic programming, which is beginning to locate intriguing new programs that human beings had actually not formerly uncovered.[21]

5 Applications

Evolutionary computation methods can generate very maximized solutions in a variety of issue settings, making them prominent in computer technology [24] Evolutionary computation technique can additionally be made use of to Wiener Version Identification An unique method for nonlinear vibrant system recognition is addressed for Wiener variants have a linear dynamic system component followed by a nonlinear static component [5]. KEEL is a software application that evaluates evolutionary formulae for a variety of Information Mining challenges, such as regression, categorization, and not being watched comprehension, among others [12]. Computer technology concept approaches Computer science interdisciplinary applications, Automation control system, Computer science information systems, Operations research management science [13]. Evolutionary computations and



genetic algorithms can be used for image processing for instance images shot at night have a lower quality than those captured during the day. Because of weather and other constraints, pictures from security cameras exhibit poor brightness, low contrast, and significant noise [35]. The design and progression of gene and cell regulatory networks may be recognized using evolutionary calculations [33].

6 Analysis of Different Publications

Evolutionary calculations are used to identify solutions that do not already exist. As a result, it's crucial to examine how evolutionary computations have been used over time. The graphs below illustrate research in the subject of evolutionary computing.

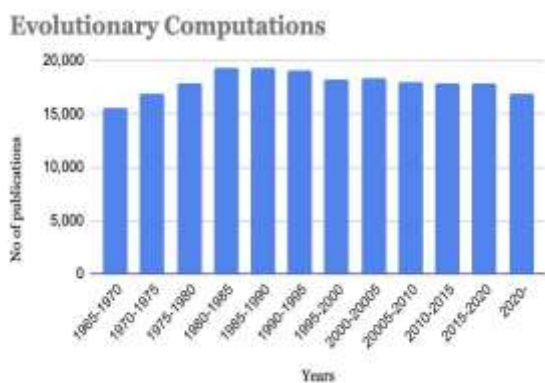


Fig 2: Frequency of research based publications on evolutionary computations

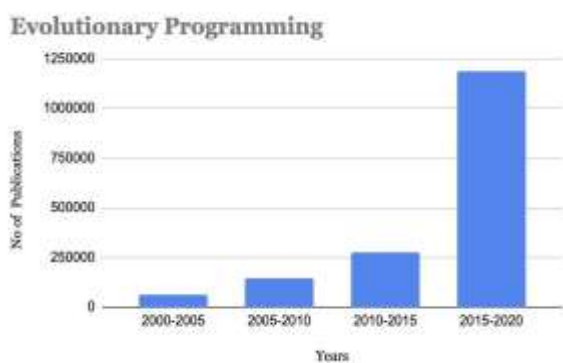


Fig 3: No of publications on evolutionary programming over the years

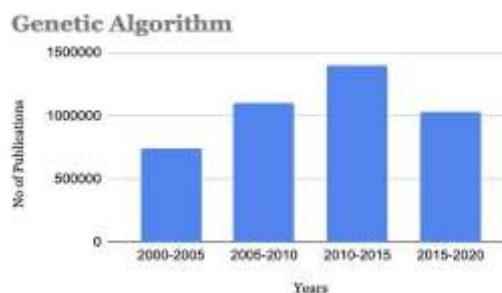


Fig 4: Research publications on genetic algorithms

It was discovered that while there was an increase in the number of publications of evolutionary calculations starting in the 1980s, there was a reduction in the number of publications starting in 2015. It also comprises other forms of calculations and study in their disciplines.

7 Conclusion and Future Scope

EC was first presented because traditional methods could not solve the problem. Though Evolutionary Algorithms are commonly appropriate to numerous domain names, it delivers just low performance. A present trend is to hybridize 2 or more algorithms or to improve the existing algorithms. It will undoubtedly give far better results than individuals. Different techniques of EAs are integrated which generates lots of refinements to solve a range of real-world applications. Due to expansion and also feasible refinement. As a result of simplicity, flexibility, and robustness, EA comes to be a preferred trouble fixing technique in finding out and also optimization. In this paper, it was attempted to offer a brief overview of the area of evolutionary computation by explaining its various methods which have actually offered to specify the area. A fairly short overview of existing formulas and institutions of a general idea to stimulate the process of all-natural evolution in order to resolve search, as well as optimization troubles in a selection of application areas, was provided. With the quick growth of the field, there is an especially pushing need required to extend existing and also establish brand-new analysis tools which allow us to better recognize and evaluate the arising ranges of EAs and their applications, this paper will certainly serve as a driver for such activities.



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