Use Of Genetic Algorithm To Calculate The Extinction Probability Of Urmia Lake Artemia Due To Over-Saltiness Of Water

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Abstract

In this paper, because of the importance of existence of Artemia in Urmia lake, this living gold, we decided to calculate the swings of Artemia reduction in statistical population in time period of t. Afterwards to implement the problem environment according to the existing parameters and using the existing techniques in genetic algorithms and examine various solutions to achieve the optimum result by the use of existing concepts such as chromosomes, mutation, inheritance, and combination of the existing solutions. Genetic algorithm is a searching technique in computer sciences to find the optimum solution and searching problems. This method is one of the evolutionary algorithms which have been derived from biology sciences such as heritance, and mutation (sudden selection).

Keywords: Artemia, genetic algorithm, mutation, crossover.

1 Introduction

Urmia Lake was famous as the red pearl of Azerbaijan. The redness of the lake was due to existence of Artemia, the first species which was destroyed and was not able to continue life because of Urmia Lake draining and too much salt in water. After that, flamingo, pelicans, winter birds, and fallow deer were hurt because of the lake drought, over-saltiness being the reason, which was called as white death. The second important habitat of Artemia in the world and an only habitat of Urmiana Artemia converted to death place for Artemia because of lack of water and over saltiness of lake water. Artemia is the feed for flamingo and migrating birds. The destruction of this first step of food chain, from birds to mammals faces this national park with danger. Therefore, we attempted to examine the general problem by using genetic algorithm.

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Genetic algorithm (GA) is a search technique based on optimizing algorithms and structure of genes and chromosomes which uses genetic evolution as a model to solve the problem. The problem which must be solved is the input and the solutions in search environment are coded according to a model which is called fitness function. Each solution evaluates the candidate which most of them are chosen randomly and afterwards, some of the chromosomes from the first population are chosen as father and finally produce children by crossover. Genetic algorithms are random search methods which are created in nature by evolution principle. These algorithms are implemented on a population of potential solutions, on the basis of survival principle, to generate better responses. In each generation by choosing some people on the basis of their desirability and then by implementing operators which are derived from nature, a set of new responses are created. This process leads to creation of population which is closer to goal. On the other hand, genetic algorithms act so fast in finding an acceptable answer or almost an optimum one with negligible error, for an optimizing problem. Although genetic algorithms do not guarantee finding a general optimum solution in a specific period of time, but by continuing the algorithm, it is possible to get responses which are closer to the optimum response. Considering the advantages of genetic algorithms over the traditional methods, this method also has problems such as not converging to the solution and getting caught in the trap of local minimums. The obtained results in comparison with those from classic genetic algorithms suggest the superiority of genetic cellular automata model.

2. The research problem

This problem has been taken from 500 samples, and from different parts of Urmia Lake water which are independent from each other. The possibility of lack of Artemia or the existing samples being death is 0.001. The existence or lack of Artemia in samples is easily observable in microscope. For ease of work of this possibility, the sample has taken in this statistical population (500 places). The positiveness probability of the experiment is at least one sample without Artemia or alive Artemia. As an example the probability of lack of at least one Artemia or probability of dead Artemia among the statistical population is explained by genetic algorithms.

The probability functions of the problem. Each of the 500 samples is without Artemia with probability of 0.001. Therefore, they have Artemia with probability of 1- 0.001 and as we have 500 independent samples, as a result, we have 500(1-0.001):  
\[ P(E) = 1 - P(Ec) = 1 - (1 - 0.001)500 \]  
(2.1)  
And the result of this equation is as follows:  
\[ P(E) = 1 - 0.999 = 0.3935 \]  
(2.2)  
Therefore, any randomly chosen sample from this population, if placed in neighborhood of this probability, is optimum.

3. Solving the problem by genetic algorithm

1. The chromosomes of this problem are a number or numbers with specific length and therefore binary chromosomes must be used. Any number is chosen randomly in a way that: 0 ≤ xi ≤ 1 and that each xi is considered a binary.

2. The encoding of the problem is 500 random numbers with determined condition which are coded in a binary manner. In fact, the environment of the problem is an array with 500 rows and 32 columns (each number is considered as a 32-bit code). This array is the first population of the problem.
3. The assessment criteria of the function or the fitness is considered as follows in order to achieve the best result:

\[ |x_i - 0.3935| \leq 0 \]

Each random \( x_i \) from among 500 population of the problem is in zero neighborhood according to the above condition, which its fitness as single-bit can be intended as the optimum answer. While ring continues till \( n=500 \) and whole state space is checked, then the state space is checked and then its fitness column is considered as the optimum answer.

4. Now, we have a set of answers in state space and must produce the best answer with merger operator (crossover). Two strings are randomly chosen from among bit strings and then we create a new string by crossover. Crossover is a combined operator which consists of three actions. First the operator chooses the production of a string randomly. Second randomly selects a place for merging along the string and finally in third stage moves the amount of two strings considering the merging place. The merging operators differ on the basis of number of selected points and two-point crossover is used in this problem. For example we assume that two points are selected as follows; the value of new string after merging will be:

<table>
<thead>
<tr>
<th>Before Crossing</th>
<th>Father</th>
<th>011110010011 01010110001110110 01001101</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mother</td>
<td>010100111110 00101101100011101010010010</td>
</tr>
<tr>
<td>After Crossing</td>
<td>Child1</td>
<td>011110010011 010101111101000100010010</td>
</tr>
<tr>
<td></td>
<td>Child2</td>
<td>010100111110 00101101100011101010010000</td>
</tr>
</tbody>
</table>

Two-point crossover was utilized in this merging action. If these two points are suitable places, it will lead to production of suitable children, but if not, it will lead to destruction of string quality and elimination of the string in next generations.

5. After merging action, it is time for mutation that is conversion of bit from zero to one and vice versa. Mutation is an action that an output between zero and one with a little probability is considered for each bit and if the random number is less than this probability, the output value is true and the related bit changes and if it is bigger, the output value is false and the related bit remains unchanged. Considering this probability and bit changes in this problem, many responses can be obtained and finally from among these responses, we can get more responses and at last, the optimum response can be selected from among the obtained responses. Selection is competitive and after sorting set of answers, the best answer is determined from among set of answers.

4 Conclusion

Genetic algorithms are algorithms with high ability in finding answers to problems, however, it must be noted that the main application of these algorithms must considered in problems that have a very large state space and investigation of all statues is not practically possible for human in normal time periods (human life). On the other hand, it must be considered that, there is a need for suitable and logical between different states of the problems. Finally genetic algorithms provide us with a chance to achieve the objectives in problem space rapidly. It is such that we can imagine flying toward the answer in problem states space. In this algorithm, the must be converted to genetic space and the variables must be coded. The advantage of working with coded variables is converting the continuous state in to a discrete one. In this paper, also the optimum answer was obtained by converting the problem space in to a continuous state from the statistical population.
References

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