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Solving N-queens Problem By Genetic Algorithm

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ABSTRACT

Here we have discussed about the N-Queen problem and how to get a solution by using the concept of Genetic Algorithm. N-Queens problem refers to the problem in which one has to place N-Queens on an n×n chessboard such that no queen is attacking the other, i.e. no two queens occupy the same row, column or diagonal. Here we use Genetic Algorithm to obtain a new breed by crossing of their predecessor.

N-queens problem is a complicated problem to solve using Backtracking and any Heuristic Search. Here we have used Genetic Algorithm to solve the problem very simply and efficiently. The assumption of our work is that if the child solution resembles major part of the chromosomal structure of the parent 1 solution then we shall preserve the structure of parent 1 solution in child, and only modify the chromosomal structure of parent 2 solution in child, that is too restricted to a fixed number of deterministic move.

Keywords: Genetic Algorithm, n-queens problem.

1. INTRODUCTION

The *n*-queens problem [2] [4], originally introduced in 1850 by Carl Gauss, may be stated as follows: find a placement of n queens on an *n*×*n* chessboard, such that no queen can be taken by any other. While it has been well known that the solution to the n-queens problem is *n.* Many of these solutions rely on providing a specific formula for placing queens or transposing smaller solutions sets to provide solutions for larger values of n (Bernhardsson, 1991 and Hoffman *et al.*, 1969).Empirical observations of smaller-size problems show that the number of solutions increases exponentially with increasing *n.* Alternatively, search based algorithms have been developed.

Several researchers and scientists offered various Heuristic algorithms [1] for optimization by modelling from physical and biological processes in nature, which often operate collectively to overcome this problem. But here we have used Genetic Algorithm [6] to solve this problem. According to the theory of Darwin, there are three stages of genetic model like-

(1) Natural Selection
(2)Crossing
(3)Mutation

First to stages are obvious for every new breed, but the last is done if and only the breed fails two survive or violates the rules of N-Queens [2] [3] [4]. Then Mutation is done to make it fit to survive.

2. OBJECTIVE

GAs are search algorithms that follow the concept of natural selection and genetics [2]. GA are powerful and very efficient search and optimization techniques motivated by the natural selection theory of Darwin [5].

Suppose that we are given an n × n chessboard, where n is a selective positive integer. A queen can attack in horizontal, vertical, and the two diagonal directions. The n queens problem asks to find a configuration of n queens on an n × n chessboard such that no two queens attack one another. There are no solutions to this problem for n = 2 or 3, but it can be shown that a solution exists for some particular values of 'n' such as- n = 4, n = 8.

Hence, our main objective is to produce a new solution from given population, we assume all the parent solutions are allowed to reproduce and after the mutation and crossover 8- solution from parent and child is being selected randomly.

3. ALGORITHM

Step 1: Select 2 N-Queens solutions randomly from the given set of solutions.

Step 2 Cross over between them at any arbitrary position.

Step 3 After crossing if we find that any two queens is eliminating each other at any position, then that breed solution is violating the rules of N-Queens then we will perform the process of mutation to make it fit to survive.

Step 4: After mutation we will find that if the breed solution gets maximum percentage of genetic quality from one of the two solution then it will definitely resembles to that particular solution

4. ILLUSTRATION

- In Fig3 (below) we can see that the queen at pos. F5 is crossing chromosome at pos. F8 and G6. So, as per the rules of Survival of the Fittest by Darwin, this new child cannot survive and it also violating the rules of N queens.
- So, as we know that if any person get 70% of genetic quality from his/her mother/father, he/she will resemble his/her mother/father. In that case 30% of the chromosome of mother/father remains dominant.
- So to make it to survive and fit for survival the changes have to be made on the dominant part of the chromosome, then the child surely resembles that individual from where he/she has got the most part of the chromosome.
- The changes made in Fig3 to Fig4, by shifting the genes to the empty chromosomal row, by the process of mutation. Then it would be like –

  D7 – B7

  F8 – D8

  Q6 – H6

- So the child Fig4 now resembles like the Fig1 as it got the 70% of the Fig1 at the time of crossing.

The size of each chromosome is 8. Each row like A,B,C……G,H is taken as chromosome and each small block or cell is considered as a gene.

GRAPHICAL REPRESENTATION

	1	2	3	4	5	6	7	8
A					Q1			
B							Q4	
C			Q3					
D								Q6
E		Q5						
F					Q6			
G	Q7							
H						Q7		

Fig-1: General Solution 1

	1	2	3	4	5	6	7	8
A					Q1			
B		Q2						
C				Q3				
D							Q4	
E			Q5					
F								Q6
G						Q7		
H	Q8							

Fig-2: General Solution 2

1 2 3 4 5 6 7 8

Fig-3: After crossing Fig 1 & Fig 2

1 2 3 4 5 6 7 8

Fig4:Result after mutation.

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CONCLUSION

In this paper we have discussed about the N-queens problem and proposed a way to get a new solution. At first we selected two solutions and then by crossing over two solutions of N-queens by Genetic Algorithm we found a new breed solution which may violate the rules of n-queens, to overcome that, we performed the process of mutation.

A				Q1				
B								
C			Q3					
D							Q4	
E		Q5						
F					~~Q6~~			~~Q6~~
G	~~Q7~~					~~Q7~~		
H								

A				Q1				
B							Q2	
C			Q3					
D								Q4
E		Q5						
F					Q6			
G	Q7							
H						Q8		

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