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An approach to solve the N-Queens Problem using Artificial Intelligence algorithm

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Abstract—*The N-Queens problem is a delicate problem of placing N queens on an NxN chessboard in a fashion such that no queens attack each other. This paper deals with a very simple and not much talked about AI algorithm to solve this problem in polynomial time. The algorithm used in this paper is Min-conflict-algorithm. Min-conflicts will choose a queen at random and relocate it to a location on the board with fewer conflicting queens than there are now. If no such spot exists, it will choose a new queen at random and repeat the process. The paper explains the same with both mathematical and technical perspectives.*

Key Words—n-queens, AI, algorithm, min-conflict, Artificial intelligence

1. INTRODUCTION

In 1850, Carl Gauss proposed the n-queens problem for the first time. The objective is to arrange n queens on an nxn chessboard so that no two queens attack one other. This problem belongs to the NP-complete problem category, which means it has no polynomial-time solution. Because all of the solutions are more complex, there are no deterministic ways. Certain solutions are identical and can be discovered by applying rotations or symmetry to each other. The n-queen problem is an expanded variant of the same old 8-queen issue with N queens and an nxn chessboard.

The N-Queens problem, which is a kind of combinatorial optimization problem, is a very important problem, the solution of which can actually solve real-life challenges. Combinatorial optimization issues are a type of mathematical problem that has a wide range of applications in the real world, including VLSI design automation, communication network design and control, job scheduling, and many more. There are frequently a lot of variables to solve in these issues. VLSI design automation, for example, necessitates a million or more variables. Furthermore, due to NP-hardness, their computational complexity is frequently insurmountable. Because of their intrinsic parallelism and affinity for hardware realization, neural networks have provided elegant solutions as approximation algorithms to many difficult challenges.

1.1 RELATED WORKS

The authors in paper[2], deal with a very unique solution to the same problem we are approaching, but limited themselves to only the mathematical side of it. Paper [4], deals with a very generic but powerful approach in addressing the N-Queens problem, where they used Backtracking to find the solution.

Paper[12], deals with generic approaches like Depth-First Search and Breadth-First Search to find the solutions to the n-queens problem. The algorithms are fast and provide near accurate results of the unique solutions.

1.2 PROPOSED APPROACH

To solve the problem, there are various algorithms people have used from ancient times, some of them being, Backtracking and Genetic algorithms. This paper deals with a not-so-famous Artificial Intelligence algorithm that randomly selects a column from the nxn chessboard for queen reassignment. The algorithm finds out the possible unique positions of the queens on the chessboard. For example: If we are considering a 4x4 chessboard, there would be present only "one" Unique Solution. The min-conflicts algorithm finds this out with the utmost accuracy. It is a kind of slow and steady algorithm, as the time taken by the algorithm to find the solution increases considerably when the value of n increases.

2. Min-conflicts Algorithm-

The minimum conflict algorithm is a heuristic method for solving constraint satisfaction problems.

Min-Conflicts solves the N-Queens Problem by reassigning queens to a column on the Chessboard at random. The method looks for the number of conflicts in each square in each possible move. The program sends the queen to the square with the fewest disputes, randomly breaking ties. It's worth noting that each new direction from which a queen can assault increases the number of conflicts. The fight is only counted once if two queens assault from the same direction. It's worth noting that if a queen is in a situation where a move will place her in more conflict than she is now, she won't move. As a result, if a queen is in a low-conflict situation, she does not need to move. The time it takes this algorithm to solve N-Queens is independent of the size of the problem. Fig. 1 shows the detailed flowchart of the algorithm.

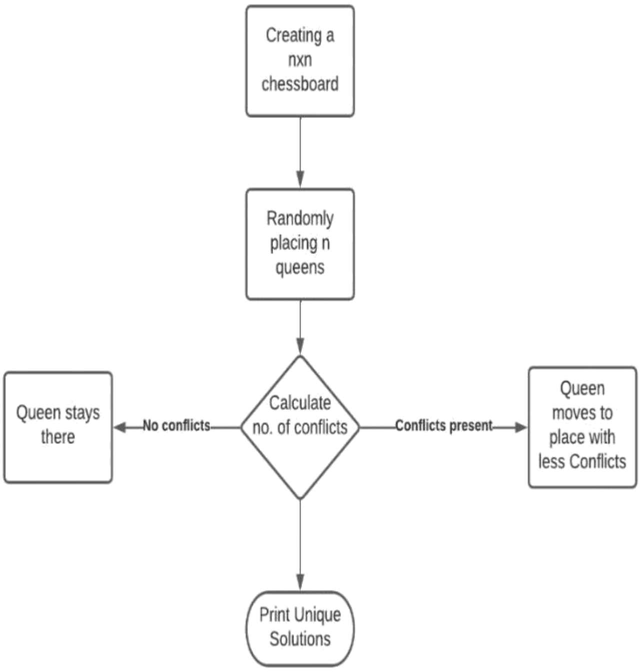

Fig. 1 Flowchart of the algorithm used

As solutions are densely scattered throughout the state space, local search in N-Queens is simple. It can also be used to solve difficult challenges.

After we coded the approach using Python, we checked with a considerable number of values of n, and the result was accurate as you can see in the figures below.

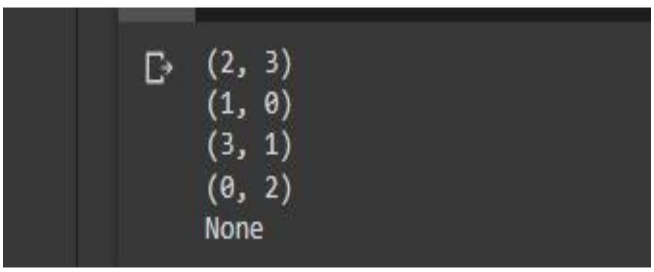

Fig. 2 4x4 chessboard queen positions

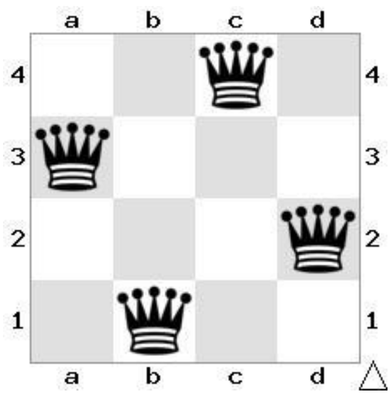

Fig. 3 Corresponding 4x4 chessboard image

```
(0, 4)
(4, 1)
(1, 2)
(2, 0)
(3, 3)
```

```
(3, 3)
(4, 1)
(2, 0)
(0, 4)
(1, 2)
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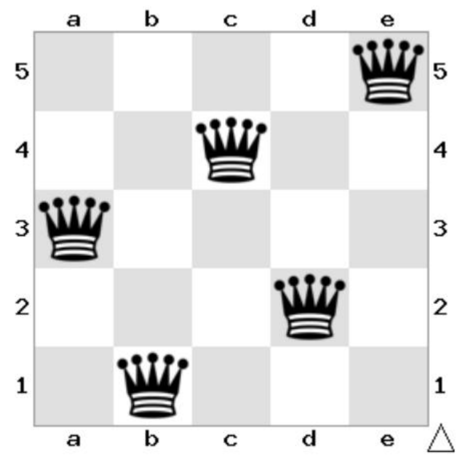
Fig. 4 5x5 chessboard queen positions



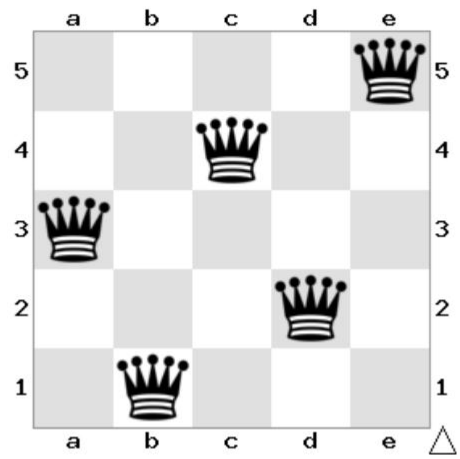


Fig. 5 Corresponding 5x5 chessboard images

3. CONCLUSION

The algorithm used in this paper is probably a very rarely used Artificial Intelligence algorithm capable of solving constraint satisfaction problems like the n-queens problem we are approaching. The reason we went for this approach is that it uses human-like thinking or simply speaking AI to find out the best possible solutions. The paper deals with a very simple and simple-to-understand approach to solve a very complex problem. The algorithm is a bit slower as compared to other algorithms normally used, but there is a major advantage while using this algorithm, which is it checks all possible outcomes and not only the unique outcomes as is done by other algorithms. We are using a filtered version of the algorithm to show us only the unique solutions, but it is very much possible to find out all possible solutions(e.g. 92 distinct possible solutions in the case of 8x8).

4. FUTURE WORKS

Min-conflicts algorithm can be effectively used to solve Scheduling Meeting problems that include people with a variety of interests and commitments. It can be done by combining a neural network with the min-conflicts algorithm. The algorithm and generic AI can also help in solving Very Large Scale Integration(VLSI) testing problems. Using AI and machine learning (ML) algorithms in VLSI design and production saves time and effort by automating the comprehension and processing of data inside and across multiple abstraction levels. VLSI technology is a very booming industry not only in India but also all around the globe, it being one of the industries to produce ample amount of jobs. Machine learning and VLSI design engineers can be highly benefited from the Machine Learning approach being applied to automate labor tasks which will eventually lead to cost cuts and economic leverage. Another generic use of AI algorithms used in our regular lives is an automated traffic control system.

REFERENCES

[1] Russell, S. and Norvig, P. "Artificial Intelligence A Modern Approach", Second Edition, pp 139-140.

[2] V. Kesri, Va. Kesri and P. Ku. Pattnaik. "An Unique Solution for N queen Problem". International Journal of Computer Applications.Vol:43 Issue:12 pp: 1-6, 2012.

[3] Letavec, C. and Ruggiero, J. 2002. "The n queen problem", Informs Transaction on Education, volume 2 number 3, May 2002.

[4] S.Ahmadi V. Kesri, and Va. Kesri. "Clustering in backtracking for solution of N-queen Problem". Third International Conference on Contemporary Issues in Computer and Information Sciences CICIS 2012

[5] Solving N Queen Problem Using Various Algorithms" –A Survey by S. Pothumani, Department of CSE, Bharath University, India. International Journal of Advanced Research in Computer Science and Software Engineering. pp. 247-250, 2013, ISSN: 2277 128X.

[6] E. Masehian, H. Akbaripour, and N. Mohabbati-Kalejahi."Landscape analysis and efficient metaheuristics for solving the n-queens problem". *Computational Optimization and Applications* 56(3):735–764, 2013.

[7] Homaifar. A. A., Tumer, I., and Ali. S. "The n-queens problem and genetic algorithms" Proceedings of the IEEE Southeast Conference, pp. 262-261, 1992.

[8] Gutiérrez-Naranjo, Miguel A., Martínez – del - Amor Miguel A. , Pérez-Hurtado Ignacio, and Pérez-Jiménez Mario J. February 02, 2009. "Solving the N-Queens Puzzle with P Systems", 7th Brainstorming Week on Membrane Computing, volume 1, pp 199-210.

[9] Lijo V. P. and Jasmin T. Jose, "Solving N-Queen Problem by Prediction", International Journal of Computer Science and Information Technologies (IJCSIT), Vol. 6 (4) , 2015, 3844-3848

[10] Jalal eddin Aghazadeh heris and Mohammadreza Asgari Oskoei, "Modified Genetic Algorithm for Solving n-Queens Problem", 978-1-4799-3351-8/14/$31.00 ©2014 IEEE

[11] Jordan B. and Brett S, "A survey of known results and research areas for n-queens", Discrete Mathematics 309, 2009.

[12] Farhad S., Bahareh S. and G. Feyzipour, "A New Solution for N-Queens Problem using Blind Approaches: DFS and BFS Algorithms", International Journal of Computer Applications (0975 – 8887) Volume 53– No.1, September 2012.

[13] de Souza, F. J. & de Mello, F. L. "N-Queens Problem Resolution Using the Quantum Computing Model." IEEE Latin Am. Tran. 15, 3 (2017).