**NILE UNIVERSITY**



**Matrix Applications in Chess**

A Math301i Project Report

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# **ABSTRACT**

Matrices have different applications in mathematics and in real-life as well. As matrix different applications in real life proved the efficiency of using matrix in understanding and visualizing data. As a result, matrix applications became common in different majors as Cryptography, Wireless Communication, Computer Graphics, and chess game. In this paper we are trying to solve the chess game using the matrix applications and rules. We will try to make a digital software to visualize well the available moves in each row for the player, then using the matrix to choose the best move for the row.

# **SECTION I. INTRODUCTION**

We live in a complicated environment with limited resources, competing needs, and information streams that must be examined before resources can be allocated appropriately to those demands. Thus, any suspicious mechanism that can be valued has to be recognized. The matrix has a long history of use in the solution of linear equations. It is a rectangle with rows and columns of integers, symbols, or expressions. It can be used to write and work with several linear equations in a compact manner, referred to as a system of linear equations.

Technology advances, but the history of matrices and their applications remains the foundation. To trace the history of matrices and their applications, consider how essential matrices are in the mathematical world because they serve as a foundation for many ideas and practices. We decided to trace it in the chess game. Chess is one of the most popular board games and has a long history. It is a game which concludes a two-player strategy and tactics game played on an 8x8 chequered board.

This project aims to provide an overview of the history of matrices as well as their practical uses, with a focus on the topic utilized in conjunction with it. Furthermore, we intend to construct classifiers that can accurately predict chess game results based on certain characteristics.

# **SECTION II. LITERATURE REVIEW**

1. **Chess in matrix:**

The ability level of the contending players can be useful in predicting game results, as better skilled players are more likely to win games. Moreover, The total number of turns taken during a chess game may be a useful predictor of outcome. In a two-player sequential game like chess, each player's turns are frequently referred to as half moves. Thus, we intended to use matrices to forecast the game results in the chess game. We hope to be able to generate classifiers that can predict the outcome of a chess game based on the information we have. We intended to use different types of matrices for example the gauss elimination, Jordon method, multiplication, and addition matrices as they are used to solve simultaneous linear equations. Finally, chess databases offer algebraic notation for the chess moves made during a game. It can be read by chess engines that can assess the power of moves. These assessments can be a useful element for forecasting. However, game analysis takes time and is difficult to automate. Furthermore, just using chess engine analysis results as a basis for cheating detection is restrictive [1].

1. **Linear Algebra in chess:**

The study of linear combinations is known as linear algebra. It is the study of vector spaces, lines, and planes, as well as some mappings needed to conduct linear transformations. Vectors, matrices, and linear functions are all part of it. It is the study of linear equation sets and their transformation features [2]. When we look attentively at the chess game, we can see that it is essentially a matrices game. Because it is about a matrix board. As a result, it is included in liner algebra, which is a branch of mathematics. Later in this chapter and others, we will learn how to solve this game with linear algebra and achieve our major goal from this research.

1. **Electronic chess game:**

Chess game is old game it is a board game played by two players. The board is divided in to two colors white and black. The player moves the elements of the color he choose in a set of rules of movement for every element. The objective is to put the opponent's king under a direct attack from which escape is impossible. Chess game can be made by a machine. Computer chess is extremely popular and in certain situations it surpasses the original game [3].

1. **Applications on matrices:**

A matrix is a rectangular or square array of numbers or variables arranged in rows and columns in mathematics. Elements or entries are the individual items in a matrix. Matrix applications are widely used in mathematics as well as other subjects. It aids in the solution of linear equations. Matrices are incredibly important things that can be used in a variety of situations. The usage of matrices in mathematics can be found in a wide range of scientific and mathematical subjects. It can be used in various fields as cryptography The “golden” matrices can be used for creation of a new kind of cryptography called the “golden” cryptography. The method is very fast and simple for technical realization and can be used for cryptographic protection of digital signals (telecommunication and measurement systems) [4]. Matrices are also used in Wireless Communication. Random matrix theory has found many applications in physics, statistics, and engineering since its inception [5]. As a result, matrices applications are common and important.

## **Previous research on Matrix Applications in Chess:**

For background information, two previous papers will be discussed briefly with the technologies that have been used in chess using matrix application. Both papers have greatly inspired us to apprehend the variety of linear equation system approaches used in various chess application.

In the first paper A pairwise comparison approach to ranking in chess team championship. [6] The paper suggests that pairwise com-parison matrices perform in similar ranking problems. Some features of the proposed method are illustrated by the results of the 18th European Team Chess Championship. The research depended on LLSM method are robust with respect to the arbitrary scales for the transformation of match results. The research reached to good results in alternative method to determine the final ranking of a Swiss-system tournament based on incomplete pairwise comparison matrices.

In the second paper, The axiomatic design of Chessmate: a chess-playing robot. [7] This paper demonstrates the application of Axiomatic Design principles to shape and direct a multi-disciplinary project from initial conception to the final tested product. This product is Chessmate: a small robot which plays chess on a physical board. The research was based on ADT algorithm it proved its success in understanding the interaction between the elements of hard-

ware and software. The research reached to Functional Requirements enabled systematic impel-

mentation improving the chances of on-time completion of a project.

# **SECTION III. METHDOLOGY**

After learning more about our topic in previous sections, we want to utilize several types of matrix algorithms in this section to properly characterize all of the structures we meet and formulate all of these application problems using matrix multiplication, Gauss elimination, or Gauss Jorden elimination. Last but not least, generate code to generate all of these distinct matrices. We wanted to use vectors as well to achieve our goal. The basic goal of this work is to describe the application of matrices and how it connects algebraically with the chess game. The equations will then be shown, along with various possible solutions to the chess game, including the best play from the position required to win. This may be challenging, but we will do our best to work with it.

Using course’s concepts as gauss elimination we would solve our chess as a vector matrix. We are going to use vectors to find possible movements, pieces that can move and illegal/ restricted movements. By collecting all these data, we are going to solve these vectors and compare the movements until we find the best one. These steps should be repeated until the chess is solved with zero possible moves left. By the end of our methodology, chess would be solved by the optimum movements.

# **SECTION IV. RESULTS**

In chess, the use of linear algebra and vector matrices aids in the visualization of moves. As a result, visualizing it in this way aids the player in predicting opening moves and even upcoming movements. [8]

Chess can increase memory because of the complicated rules that players must recall while making a move, as well as the use of memory recall to prevent earlier mistakes or remember the enemy's playing style. In our software model we tried to reach the goal with less moves and by that the memory problem would be solved.

When playing chess, players must think quickly and have excellent problem-solving skills.

Chess activates the right side of the brain, which is responsible for innovation, and practicing intelligent games like chess can help you improve your IQ. [9]

At the end we made a software program that plays chess with the user and that software model tries to reach the possible solutions and play the optimum solutions according to Gauss elimination, Gauss Jordan, and matrix operations.

**SECTION V. CONCLUSION**

At the end of the paper, after all the previous chapters, we can finally say that we have reached the end of our paper. As so far, we have learned that this study studies many types of different application of the matrices and how that they can help solving different application such as the chess game that was our topic.

Our research intends to discover the relationship between various matrix applications, which will aid in the solving the chess game and the understanding of their repercussions. The importance of such research is to understand their connection because it may improve the outcomes and help us learn more about this study. for our outcome, We can see that the analysis, computation, and prediction processes are essentially straightforward. As a result of all the software we have tested, we have determined how to connect the matrix application and the chess game.

Several constraints prevented us from collecting more specific results and information on our challenges while we were working. At the same time, we discovered a helpful resource that let us understand more about our topic and its applications.

We are enthusiastic to learn more about this topic and foresee useful solutions that will be extremely valuable in the upcoming challenges.

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**APPENDIX**