Interim project report

• *Name: Shikhaliyev Anar*

Project Title:

Design and development of a board game that incorporates elements of tactical decision-making and strategic planning
What are you going to do?
I am going to design and develop a board game that enables players to play against one another and most importantly play against AI. I want to analyze different AI approaches such as heuristics, tree- traversal algorithms - minimax, alpha-beta pruning, adversarial search algorithms, and other techniques to improve performance such as memorization.

Report:

The goal of this interim project report is to give an update on the progress achieved so far in the design and development of the board game that incorporates aspects of tactical decision-making and strategic planning. This report summaries the study that was conducted, the game mechanics that were developed, the artificial intelligence algorithms that were investigated, and the preliminary results.

The current state of research is that a significant amount of investigation has been carried out on pre-existing board games, AI systems, and decision-making strategies. The examination of the relevant literature has yielded new understanding of the fundamentals of game design, heuristic algorithms, minimax, alpha-beta pruning, Monte Carlo Tree Search, and the possible applications of deep reinforcement learning. The findings of this study have contributed to the conception of original game mechanics as well as the selection of AI strategies to be put into action.

Game Development prototype for the board game has been successfully planned and constructed, and it includes the strategic and tactical features that were specified in the project description. Players are given the opportunity to make choices that will have an effect on the next action taken by their opponent, making for a dynamic and demanding gaming experience. The graphical user interface and interactive aspects have not been included into the game's development yet.

AI Implementation: In order to provide human players with challenging competition, a number of different AI algorithms have been included into the game. Heuristics, minimax, and alpha-beta pruning are all examples of these kinds of algorithms. When analysing the current state of the game and determining how best to proceed, the various AI opponents use a variety of decision-making strategies. The installation of these AI algorithms has made it possible to do preliminary testing and analysis of the game.

A number of different artificial intelligence algorithms have been programmed into the game based on the results of the study so that they may compete against human players. These algorithms have been modified so that they are compatible with the particular mechanisms and guidelines of the board game. The following AI algorithms were developed and implemented into the game:

Heuristics-based Algorithm: This algorithm evaluates the game situation and chooses the best possible next move based on a combination of specified rules and heuristics. It takes into account a variety of aspects, including the present state of the board, the opponent's most recent move, and the probable repercussions of each play. The heuristics are constructed to give priority to strategic places and thwart the movements of the opponent.

The Minimax Algorithm The Minimax algorithm is a time-tested strategy for making decisions that is often used in board games. It does this by using a recursive method to investigate the game tree and figure out the best move to make. The program analyses the game state and determines a score based on the many possible consequences of each action that might be taken. Because it takes into account the player's as well as the opponent's movements, it improves the player's odds of winning while simultaneously reducing the chances of the opponent.

Alpha-Beta Pruning: The alpha-beta pruning technique has been devised in order to improve the overall performance of the minimax algorithm. The examination of some game states that have been decided to be unimportant based on their alpha and beta values is removed from the scope of this method thanks to its use. It cuts down on the amount of nodes that have to be investigated, which ultimately results in more effective decision-making and quicker AI reaction times.

Results of Preliminary Play-testing: A number of preliminary play-testing sessions have been run in order to collect comments and evaluate the effectiveness of the computer-controlled opponents. The findings suggest that the AI algorithms that were deployed are able to provide gameplay that is both interesting and demanding. The victory rates as well as the game durations have been gathered and analysed, which demonstrates the level of competition that the AI opponents provide to the human players.

Next Steps: As we go ahead, we will be concentrating on further enhancing the AI opponents by investigating more AI approaches such as adversarial search algorithms and memory-based techniques. This will be the primary emphasis as we move forward. The study will also take into account the possibility of using machine learning methods or neural networks with the goal of improving the AI's flexibility and competitiveness. In addition, comprehensive play-testing and data collecting will be carried out in order to confirm the performance of the AI and evaluate its scalability. Moreover, providing user interface for it.

The purpose of this interim report on the project is to present an overview of the work that has been done in the design and development of the board game with integrated AI opponents. The research, development of the game, and implementation of the AI have all contributed to the creation of a solid basis for the success of the project. The early findings point to some encouraging outcomes and emphasise the possibility for the development of a gaming experience that is both hard and entertaining. As the work on the project moves forward, further enhancements and iterations will be implemented in order to hone the gameplay mechanics, increase the performance of the AI, and amass a wider variety of data for subsequent study.