- **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.
  - Game description:

    It is a board game I used to play at school, It is a more tactical and strategical version of a normal tic-tac-toe game. Such as, in this game when you put your mark on the board, you decide the area where your opponent will play next. Let's imagine our board as a matrix. If Player-X decides to start from the down-left corner of a "big table" and puts his/her mark in one of 9 places(for example up-left corner) in the little table, next Player-O will only be able to play on the chosen area where his opponent marked earlier(Player-O can play only on table in the up-left corner). This sequence continues till the end of the game. If a player's little table is full, they can put their mark on one of the empty slots of other little tables they choose, making the decision process difficult as the game progresses.

    I apologize :D and attach the eye-hurting demo to this game I developed to practice my JS skills in the first year of my bachelor's degree. It is full of bugs and only allows player vs player but, it can be useful to show the visual implementation of how the game rules basically work.

    Link to the game: https://anar-sixeliyev.github.io/TTT/

- 2. How is it done today? Current Limitations?

  Generally, board games are designed and developed using various techniques, such as game theory, heuristic algorithms, and machine learning. AI opponents in board games often rely on algorithms like minimax, alpha-beta pruning, or Monte Carlo Tree Search. However, the specific techniques used can vary based on the game(mechanics) and desired AI behavior.
- 3. What is your idea to do something better?

  My idea is to conduct research on innovative game mechanics and AI algorithms. By combining insights from game design, AI, and decision-making algorithms, I would aim to create a board game and develop an AI opponent that can provide a challenging and dynamic gameplay experience for players. For this specific game, I want to explore

advanced AI techniques such as machine learning algorithms or neural networks which can enhance the AI opponent's adaptability and competitiveness while playing the game.

- 4. Who will benefit from your work? Why?
  Both board game enthusiasts and researchers interested in AI could benefit from this work.
- 5. What risks do you anticipate?
  Technical risks may arise from issues such as algorithmic complexity, scalability, and potential biases in AI decision-making.
- 6. Out-of-pocket costs? Complete within 11 weeks?
  I believe it is a doable project to be completed in 11 weeks(at least to some degree, being able to handle a few major caching algorithms), considering possible hardware limitations, available tools, and collecting datasets.
- 7. Midterm results?
  Midterm results would likely involve significant progress in research, game design, and AI implementation. It would include the development of core game mechanics, initial AI prototypes, and conducting preliminary playtesting sessions to gather feedback and make necessary adjustments.
- 8. Final Demonstration?
  In the final demonstration, The final demonstration would showcase the fully developed board game, the AI opponent, and the player experience. It would highlight the innovative mechanics, the AI's ability to provide a competitive challenge, and the overall enjoyment and engagement provided by the game.

#Answers to Prof. Jamaladdin’s questions:

- Dataset:
  Since there is no data available for this game on the internet, I want to collect data by letting AI play the game against itself or using human gameplay data.

- Approaches:
  Investigate and implement various AI approaches, including heuristic-based algorithms, minimax, alpha-beta pruning, Monte Carlo Tree Search, and potentially deep reinforcement learning. Experiment with different search depths, evaluation functions, and AI architectures to find the best combination for the game. Consider techniques like adversarial search algorithms or memory-based techniques to enhance the AI's decision-making capabilities.

- Experiments:
  Evaluating the AI's performance by playing against human players with varying skill levels. Additionally, gathering metrics such as win rate and average game duration to establish a performance baseline.