# FINAL PROJECT PROPOSAL

CS 5100, Fall 2023

**PROJECT TITLE:**
TetrAIs

**TEAM MEMBERS:**
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## 1. PROBLEM DESCRIPTION:

Problem: The goal of the project is to create an AI agent that can play the popular and difficult puzzle game Tetris.

Formal Problem Definition: The following is a description of the computational problem: The task is to determine whether these Tetris pieces, supplied in the given order, can be placed on the game board such that the board is cleared, with the last piece of the sequence filling the final gap. The game board, a finite sequence of Tetris pieces, and a set of rules for piece placement (rotation and translation) are provided.

Inputs: The starting Tetris piece setup, the piece operation rules, and the Tetris piece order are the inputs.

Outputs: Choosing whether or not the provided pieces can be used to empty the game board is the main output. To do this, the AI agent should also generate sequences of actions or piece placements.

Data: Tetris piece configurations, the game board state, and past game data (if utilized for training reinforcement learning) make up the data used. The Tetris gameplay in this project is likewise based on pre-established rules and algorithms.

Interest: The problem is not just a computational challenge; it's a thrilling opportunity to fuse the realm of AI with the timeless joy of Tetris. Delving into this iconic puzzle game presents us with the chance to unravel the mysteries of optimal gameplay, tackle the NP-complete problem it poses, and ultimately outshine human performance. It's a quest that combines nostalgia, complexity, and innovation, making the Tetris AI project a captivating and exhilarating journey.

## 2. ALGORITHMS:

We are planning to leverage 3 algorithms primarily to solve our problem. We will talk about them in detail below:

*Search:* To investigate potential piece placement sequences, search algorithms including heuristic search and depth-first search will be applied.

*Reinforcement Learning:* To maximize gameplay, the AI agent will be trained using reinforcement learning algorithms, which will reward favorable movements and actions.

*Genetic Algorithm:* Through the evolution of sets of parameters that direct piece placement, genetic algorithms will be utilized to investigate and optimize solutions to the Tetris puzzle.

Usage: In AI for games, search and reinforcement learning techniques are frequently employed. Numerous disciplines have seen the application of genetic algorithms to optimization issues.

Appropriateness: These algorithms are appropriate because they tackle distinct parts of the issue: genetic algorithms provide an evolutionary path to improved answers, reinforcement learning allows learning from experience, and search methodically investigates possible solutions.

Previous Research: It has been done before to use comparable algorithms to Tetris. It appears from the proposal's sources (such as Szita's work on reinforcement learning in games) that comparable algorithms have been researched in this situation.

## 3. RESULTS:

Expected Results: In terms of overall scores, survival time, and computing efficiency, this project intends to show that the AI agent performs better than baseline tactics and possibly even human players.

Comparisons: Baseline tactics (such as always positioning blocks at the bottom-most place) and human gameplay (the "oracle") will be compared. Achieving outcomes superior to those of the oracle is the definition of the success criteria.

Risks: The possibility exists that the expected results may not be attained. As an illustration, the algorithms may not perform better than the oracle than anticipated. Under such circumstances, the project might look into different approaches, adjust parameters, or carry out an in-depth analysis of the factors preventing performance.

Mitigation: The project describes a plan to compare and enhance algorithms in the event that the results are not up to grade. For gaining significant insights, the project may also evaluate and modify the evaluation criteria or approach. If we cannot achieve the desired results after rigorous trials, we will consult with all the instructors and try to find approaches to tackle this problem or find a new problem statement.

## 4. REFERENCES:


[1] Tetris Game (https://tetris.com/about-us)
[2] Reinforcement Learning in Game Industry—Review, Prospects and Challenges (https://www.mdpi.com/2076-3417/13/4/2443)
[3] Tetris is hard, made easy (https://www.researchgate.net/publication/228997752_Tetris_is_hard_made_easy
[4] Using Reinforcement Learning for Games with Nondeterministic State Transitions (https://www.diva-portal.org/smash/get/diva2:1334684/FULLTEXT01.pdf)
[5] The Use of Reinforcement Learning in Gaming The Breakout Game Case Study (https://www.researchgate.net/publication/340440656_The_Use_of_Reinforcement_Learning_in_Gaming_The_Breakout_Game_Case_Studypdf)
[6] Techniques and Paradigms in Modern Game AI Systems (https://www.mdpi.com/1999-4893/15/8/282)
[7] Comparison of Searching Algorithms in AI Against Human Agent in Snake Game (https://bth.diva-portal.org/smash/get/diva2:1474900/FULLTEXT02.pdf)
[8] Playing Games with Genetic Algorithms (https://www.researchgate.net/publication/228697986_Playing_Games_with_Genetic_Algorithms)
[9] Game Theory Using Genetic Algorithms. (https://www.researchgate.net/publication/220977750_Game_Theory_Using_Genetic_Algorithms)
[10] Using genetic algorithms to evolve character behaviors in modern video games (https://www.csd.uwo.ca/~mkatchab/pubs/gameonna2008_unreal.pdf)
[11] A review on genetic algorithm: past, present, and future (https://link.springer.com/article/10.1007/s11042-020-10139-6)
[12] Genetic Algorithms in Repeated Matrix Games: The Effects of Algorithmic Modifications and Human Input with Various Associates (https://faculty.cs.byu.edu/~crandall/papers/HassanCrandall_2013.pdf)