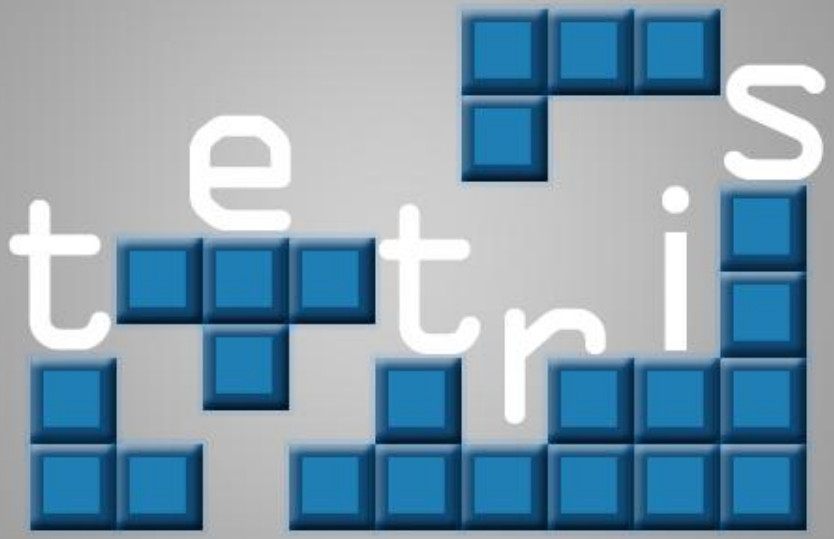
Development of a



playing agent in Java

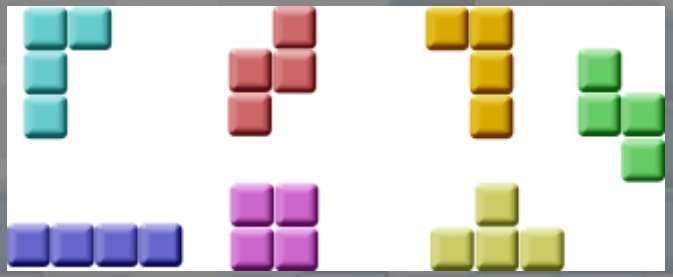
Ömer Nebil YAVEROĞLU
Computer Engineering Department , METU

The Questions To Be Answered

- What is Tetris?
- Why not another game but Tetris?
- How do the agent play the game?
- What is the used performance measure in this study?
- What have been conducted by other researchers?
- What are current performance results of the developed agent?

What is Tetris?

- Tetris is a falling blocks game in which the player aims to prevent filling the game play area.
- Pieces of 7 different shapes appear randomly.

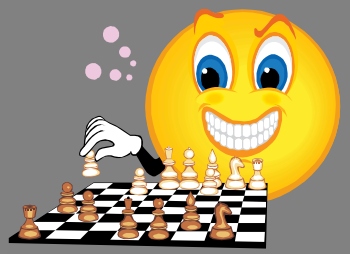


- The player should place these pieces filling the rows of the game play area as much as possible.
- A row of blocks is removed when the row is filled. The blocks above the removed row fall one level down.

Why not another game but Tetris?

- A well-known game since 1980’s.
- There are many competitions and studies on this game because of its simple nature and no limit of improvement.
- RL-Competition is one of these competitions which aims development of agents which uses reinforcement learning techniques.
- Their framework named RL-Viz is used for the visualization and game logic purposes of the project.

How do the agent play the game?



- The algorithm of the agent is based on a search between the scores of all the possible placements of a falling piece.

- The possible placements are computed by looking at all the possible movements in an ***order***. The considered order is:

Rotations → Moving left and right → Dropping the piece to bottom

How do the agent play the game?

- The scoring mechanism is a linear function consisting of parameters representing different aspects of the board situation:

$$f(\text{Score}) = a_1 * n_1 + a_2 * n_2 + \ldots + a_8 * n_8$$

a_i values : the constants that define the weight of the parameter

n_i values : the normalized parameter values

How do the agent play the game?

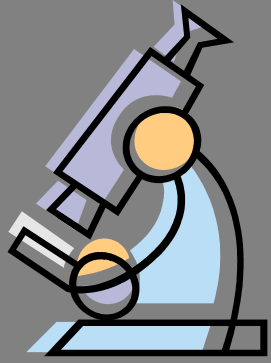
- The parameters used for the scoring mechanism are:
  - Pile Height
  - Hole Count
  - Removed Lines
  - Altitude Difference
  - Blocks
  - Weighted Blocks
  - Surface Length
  - Number Of Transitions

What is the used performance measure in this study?

- The number of blocks entering the game area without losing the game is used as a performance measure.

- More detail and calculation of this performance measure will be described during the demonstration of the project.

What have been conducted by other researchers?



- Breukelaar *et al.*'s study[1] proves the NP-Completeness of Tetris goals and NP-Hardness of making approximations about the goals in Tetris
- In Hoogeboom *et al.*'s study[2], some decidability questions related to Tetris is tried to be answered.
- Böhn *et al.*'s study[3] proposes a solution to where and how to place a falling piece by using a genetic algorithm.
- Szita *et al.* [4] apply their noisy cross entropy method that they have developed for using with reinforcement learning on Tetris.
- In Farias *et al*'s study [5], an approximate dynamic programming algorithm is proposed for playing Tetris.

What are the current performance results of the developed agent?

- According to the scoring mechanism mentioned, an average of 4471.33 blocks can be placed during the game without filling the game play area.
- The most important parameters are the hole count and the number of transitions. These parameters determine the compactness of the solution.