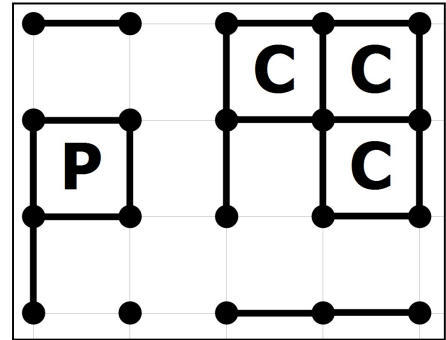


**Code / Project** : CME1251 / 2  
**Year / Semester** : 2024-2025 Fall Semester  
**Duration** : 7 weeks



## Project: Squares

The aim of the project is to develop a 2-player turn-based game in which players try to form squares.

## General Information

The game is played in a 19\*33 game field including outer walls. Game elements are dots, lines and squares. There are two players: Human (P) and Computer (C). The aim of the game is reaching the highest score by forming squares. Human player starts the game.

## Game Elements

+ : Dot

- All dots are given at the beginning of the game.

| or - : Line (vertical or horizontal)

- Lines are placed in between dots.
- Some of the lines are determined at the beginning of the game.
- Players place lines to form squares.

## Square / Square Ownership

- 4 lines are required to form a square.
- The owner of the square is the player who places/draws the last line of the square.
- Each square is 1 score point.
- There are 3 types of ownership:
  - Player (P)
  - Computer (C)
  - Ownerless (:)

<pre> +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                                +--+ +--+ +--+ +--+ +--+ +--+ +--+ +--+ +--+ +--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+                                             +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+ </pre>	<p><b>Round: 1</b>  <b>Turn : Human</b>  <b>Stage: 1</b></p> <p><b>H.Score : 0</b>  <b>C.Score : 0</b></p> <p><b>H.Squares : 0</b>  <b>C.Squares : 0</b>  <b>Ownerless : 5</b></p>
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## Game Initialization

- Enclose the outer game field with lines.
- Place random 90 lines into the inner game field.
- Determine the ownership of randomly formed squares as ownerless (:).

## Game Playing Information

- Human player starts the game. Human uses cursor keys to move on the board and space key to place a line.
- Each turn (Human or Computer) includes 3 stages (return key is used to move to the next stage):
  - Stage 1: Squaring. The player places a line to form a square. In this stage each new line must form a square. Each new formed square must be neighbor (in 4 directions) to the previous regular square. So, formed squares must be consecutive (regular square). If a new formed square cannot fulfill this condition (irregular square), the player's score is decreased by 5 points as a penalty. If a placed line causes extra non-neighbor irregular squares (in addition to 1 regular square), they are marked as ownerless. After forming a square, the player places another line to form another square. This process continues as long as the player achieves squaring.
  - Stage 2: Placing an extra line. The player places another line. If this line causes a square, this is not penalty but it is also an ownerless square.
  - Stage 3: Game system adds random lines to the board.
    - Game generates connected 3 lines in a 5\*5 board.
    - It shifts the figure to the upper-leftmost position.

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Shift:
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	+ + +				+ - + +
	+ + - +	- - - >			+ - + +
	+ + - +				+ + +

- It tries to place this figure into a random location (It tries max. 100 times).
- Game generates connected 2 lines in a 5\*5 board.  
It shifts the figure to the upper-leftmost position.  
It tries to place this figure into a random location (It tries max. 100 times).
- Game generates 1 line in a 5\*5 board.  
It shifts the figure to the upper-leftmost position.  
It tries to place this figure into a random location (It tries max. 100 times).
- Game determines random formed squares and marks them as ownerless.
- Last moves and ownerships are colored (Human:Blue, Computer:Red, Random/Ownerless:Green).

## Computer Player AI

- Computer player, tries every possible starts (x,y) which can be turn into score points.
- When squaring (stage 1), alternative branching may occur. Computer chooses its way/direction randomly (Directions --- 1:right, 2:up, 3:left, 4:down).
- Computer tries the same starting point n times because of alternative branching.
  - Easy game: 5 trials.
  - Moderate game: 50 trials.
  - Hard game: 500 trials.
- When placing an extra line (stage 2), computer chooses the places which cannot turn into an instant score point for human.

## End of the Game and High Score Table

When there is no possible place for a line, game is over. After the game finishes, High Score Table is displayed in descending order.

Default High Score Table for the game (in the following order in "highscore.txt" file):

- Eda Fırat 200
- Tarık Yolcu 325
- Sinem Okur 153
- Ali Okyanus 26
- Deniz Vadi 85

### Sample Game Playing Screens

<pre> +---+---+---+---+---+---+---+---+---+---+---+---+  P P                        +---+---+---+---+---+---+---+---+---+---+---+---+  P P                        +---+---+---+---+---+---+---+---+---+---+---+---+    P : :                    +---+---+---+---+---+---+---+---+---+---+---+---+    P                        +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+  : :     C C C   C          +---+---+---+---+---+---+---+---+---+---+---+---+          C   C              +---+---+---+---+---+---+---+---+---+---+---+---+  : :     C C C C          +---+---+---+---+---+---+---+---+---+---+---+---+ </pre>	<p>Round: 1 Turn : Computer Stage: 2</p> <p>H.Score : 6 C.Score : 10</p> <p>H.Squares : 6 C.Squares : 10 Ownerless : 7</p> <p>--- Computer AI --- BestPoint : 10 BestX : 15 BestY : 13 BestDirection : 4, 4, 3, 3, 3, 2, 2, 3, 3</p>
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<pre> +---+---+---+---+---+---+---+---+---+---+---+---+  P P                        +---+---+---+---+---+---+---+---+---+---+---+---+  P P                        +---+---+---+---+---+---+---+---+---+---+---+---+    P : :                    +---+---+---+---+---+---+---+---+---+---+---+---+    P                        +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+                             +---+---+---+---+---+---+---+---+---+---+---+---+  : :     C C C   C          +---+---+---+---+---+---+---+---+---+---+---+---+          C   C              +---+---+---+---+---+---+---+---+---+---+---+---+  : :     C C C C          +---+---+---+---+---+---+---+---+---+---+---+---+ </pre>	<p>Round: 1 Turn : Computer Stage: 3</p> <p>H.Score : 6 C.Score : 10</p> <p>H.Squares : 6 C.Squares : 10 Ownerless : 8</p> <p>Random Piece : 3 lines</p> <pre> +---+---+   + + + + + + </pre>
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### Suggested Weekly Program

1. Discussing and designing solution alternatives. Creating the necessary variables, structures. Screen. Determining the team leader (no previous projects' team leaders). Planning task distribution and scheduling.
2. Game initialization. Cursor movements.
3. Human line placing. Human move (stage 1 and stage 2).
4. Random piece generation (3 lines, 2 lines, 1 line). Human move (stage 3). (---First Evaluation Week---)
5. Computer move (stage 1) for one starting point and one trial.
6. Computer move (stage 1) for all starting points and n trials. Computer move (stage 2).
7. High score table. Remaining parts of the game. Testing/Debugging. (---Final Evaluation Week---)

<b>First Evaluation:</b> 20.12.2024 <b>Report:</b> 20.12.2024	<b>Final Evaluation:</b> 10.1.2025 (powerpoint presentation + poster) <b>Report:</b> 10.1.2025
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