

# Bagh Chal - Game of Goats and Tigers

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## Description:

Bagh Chal is a strategic two-player board game. The game is asymmetric in that one player controls four tigers while the other controls up to twenty goats. The tigers 'hunt' the goats while the goats attempt to block the tigers' movements. The game is played on a 5x5 board. Pieces are positioned at the intersection of the lines and not inside the areas delimited by them. Lines connect directions of valid movement between these points.

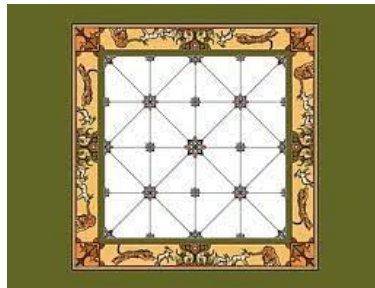


Figure 1: Board of Bagh Chal. [Source: Wikipedia]

## Rules for tigers:

- They can move to an adjacent free position along the lines.
- They can capture goats during any move and do not need to wait until all goats are placed.
- They can capture only one goat at a time.
- They can jump over a goat in any direction, as long as there is an open space for the tiger to complete its turn.
- A tiger cannot jump over another tiger.

The goats must move according to these rules:

- Goats cannot move until all goats have been positioned on the board.
- They must leave the board when captured.
- They cannot jump over tigers or other goats.

The game is over when either the tigers capture five goats, or the goats have blocked the tigers from being able to move.

Sometimes the game can fall into a repetitive cycle of positions. Goats especially may use this resort to defend themselves against being captured. To avoid this situation, an additional rule has been established: when all the goats have been placed, no move may return the board to a situation that has already occurred during the game. For instance, in the following position, the goat player cannot move forever in the upper right edge while the tiger player may continuously play the middle bottom edge tiger waiting for a goat to sacrifice itself.

## Objective:

To develop an AI agent to compete with a human player in this game.

## Planned Approach:

- Develop heuristics to evaluate the state of the board.
- Possible heuristics: Number of goats captured, number of goats that cannot be captured, number of tigers hemmed, number of vulnerable goats.
- Evaluate heuristics by playing against a random player agent.
- Develop an AI agent that uses these heuristics along with alpha-beta search.
- Implement dynamic depths for alpha-beta search to allow it to search deeper for more critical lines of the game.
- Compare performance against agents that used deep reinforcement learning to learn the game.

## Development Environment:

Python

## Evaluation Methods:

- Number of games won against random agent.
- Number of games won against different human players.
- Number of games won against deep reinforcement learning agents available online.

## Time Frame:

- 15 -Nov: Implementation of the game with a random agent and human player
- 22 - Nov: Implementation of alpha-beta pruning with basic heuristic
- 28 - Nov: Develop better heuristics and implement dynamic depth
- 6 - Dec: Test heuristics and improvise
- 14 - Dec: Prepare statistics with human and online agents
- 18 – Dec: Prepare report

## Bibliography:

- Lim Yew Jin and J. Nievergelt, "Computing Tigers and Goats", ICGA Journal, Sept 2004
- Sakshi Agarwal and Hiroyuki Iida, "Analyzing Thousand-Year-Old Game: Tigers and Goat is Still Alive", Article in Information Technology and Tourism, Oct 2018