

1 Final Project Overview

The final project for CSE 4705 is to develop a player for the Hawaiian game of Kōnane which learns from its experience. At the end of the semester, you will join in a competition with other Kōnane players developed by your classmates.

While the overall goal of this project is to develop as effective a Kōnane player as possible (i.e., one that will perform well in the tournament), the specific goal is to develop a player that learns from its experience. To this end, your player will choose its moves based solely on a search of the game tree and evaluation of game states. Specifically, the encoding of openings, endings and other move sequences is expressly prohibited. More information about what is allowed is provided below

These projects will be done in teams of three to four students. Teams of other sizes must be approved by the instructor. The expectations are the same for all teams, regardless of team size.

Kōnane Game Overview

Kōnane is a native Hawaiian game played in preliterate Hawaii. Kōnane was popular among all classes and genders unlike some other games that were taboo to one class or gender. A game sometimes lasted an entire day and often matches consisted of a large number of games.

The Game Board

Kōnane is played on a rectangular game board divided into a grid of squares or indentations for game pieces. Boards of different sizes and dimensions existed. The number of rows ranged from 8 to 13, and the number of columns from 8 to 20. Each position on the game board had a hole or indentation for the game pieces. The center of the board was called piko (navel). The row along the borders of the board was termed kaka'i. Before starting play, the board positions were filled with alternating black and white stones. Local beaches provided basalt and coral pebbles for game pieces, whose preferred size was under an inch in diameter and slightly flattened rather than spherical.

Your version of Kōnane will be played on an 18×18 board. The board rows are numbered from 1 to 18 and columns denoted by the letters a through r .

Game Play

Initial Player Moves

Each game begins with a full game board as shown in Figure 1. One of the two players is selected uniformly at random to move first. The selected player removes one game piece from the board. The player may select either one of the four corner pieces or one of the four center pieces on the board as shown in Figure 1.

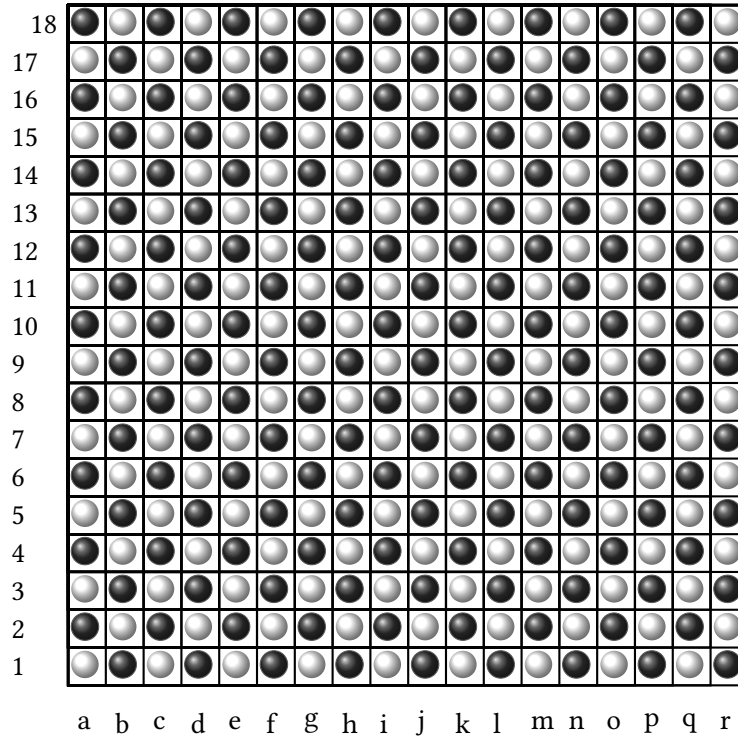


Figure 1: The starting Kōnane board.

With this selection the first player to move selects the color of the pieces they can move for the remainder of the game. The other player's first move is to select one of the pieces *horizontally or vertically adjacent to the piece removed by player 1*, to remove from the board. The piece selected must be of the alternate color from player 1 and will be the color of the pieces moved by player 2 for the remainder of the game.

Subsequent Player Moves

After the initial moves, Player 1 and Player 2 will alternate moves for the remainder of the game. Each player, in turn, will select one of their pieces to move. A move consists of jumping, and removing from play, a piece of the opponent player. Moves may only be made in the horizontal or vertical direction. That is, no diagonal moves (jumps) are allowed in Kōnane. A player's piece which jumps an opponent's piece must land in the space immediately beyond the opponent piece. This space must, of course, be vacant in order to be able to execute the jump. If a player's piece is able to jump another piece of their opponent *in the same direction*, then the player may jump the additional piece of their opponent at their discretion. There is no penalty for not executing multiple jumps even if the opportunity exists. Any and all opponent pieces which are "jumped" are captured and removed from the game board.

Endgame and Winning

The first player who is not able to make a move during their appointed turn loses the game. The number of captured pieces is irrelevant. Players may be unable to move due to either all of their pieces being

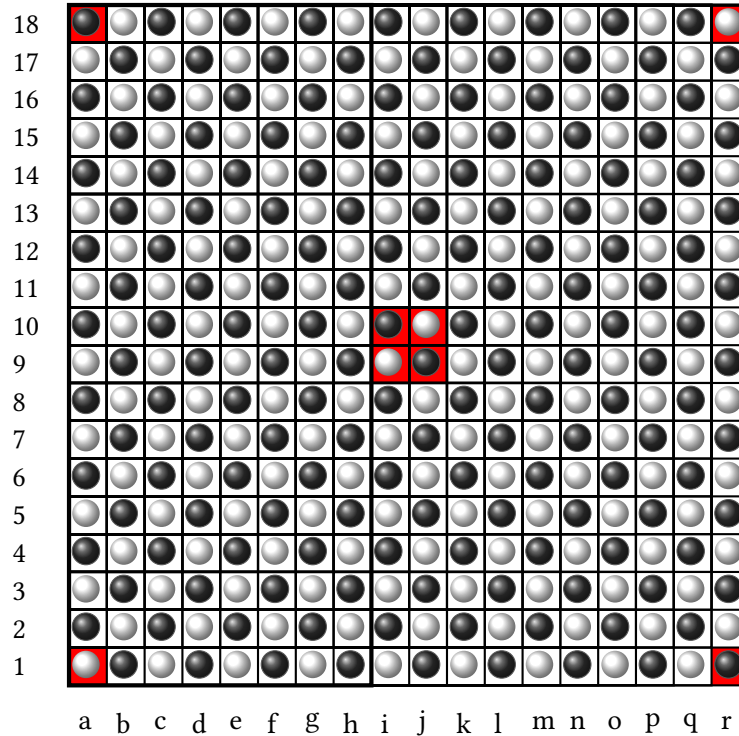


Figure 2: Selecting a piece for removal from the Kōnane board.

captured or having a board configuration which does not offer them any moves from which to choose. The last player to move is deemed the winner.

Client Players and Competition

Language and Environment

You are free to use any programming language (or languages) you choose to develop your player. However, it must be able to compete as a client using the Artemis Kōnane server. See the document “The Artemis Server Protocol” for more information on the server. A player who attempts to make an illegal move loses immediately and without warning. We will play using a game clock. If your player exhausts its allotted time, your player loses the game.

You may choose to represent the game state however you like. But, you must communicate with the server using its representation.

Wherever you are running your client, it will need to be available at the final competition, which will be in the location selected by the University for your final examination. Make sure it is feasible to run your client player with the server well before the competition.

Project Debrief

Each team will meet with the instructor (scheduled during class time as much as possible) during the final week of the semester. Each debrief will last approximately ten minutes and will involve discussion of your

program design, how your program updates its evaluation function, and how you trained it.

1.1 The Tournament

The tournament will be held during final exams. We will have a round-robin tournament (where each client plays each other client), followed by a two-game final round for the two top programs (best of three wins including the earlier match). For this to be feasible, we will allow three minutes per player in each match.

Documentation and Deliverables

Each team will submit a report that includes appropriate design documentation for your client, a description of the factors used by your evaluation function and a description of how your program was trained and evaluated. It should also include documented code for all of your programs. This report should document how your program progressed over time. It should show how the evaluation function changed as a function of the games it played.

What is Allowed?

Your program will choose moves based on limited lookahead, using a board evaluation function at the leaves. Your board evaluations should be a function of observable board features that estimates the Minimax value of the state. Samuel used a set of 25 board features for his Checkers player plus 12 “binary connective” terms, as his parameters. These may serve as a guide for parameters in your evaluation function.

Starting from an evaluation function with arbitrary coefficients, your client should learn a better evaluation function by playing games. We will look at a number of possible techniques for doing so (Chapter 21 in particular; Samuel also provides information on what he did for Checkers). However, feel free to apply other techniques.

Bottom line: Your program can learn to evaluate boards by playing with any other players, but it must always make its own moves. So, Samuels method of playing book games is not allowed and the use of opening or endgame databases is prohibited.

1.1.1 Endgame Variations

Experience shows that endgames are difficult to do with the same evaluation function that was used in earlier game play. There are fewer pieces, hence fewer features. Also, different features may have greater value when trying to end the game, etc. We will, therefore, allow programs to change behavior *once* during the game. From then on, it can use a different board evaluation function and search depth. As with any board evaluation, it must be based on learned feature weights, not encoded endgame knowledge. If you choose to use this feature, your client can only change to endgame mode once in a game and must remain there until the end of the game.

Grading

Grades will be assigned based on a linear function of the quality of your report, the debrief, and how well your client does in the tournament with weights approximately 0.4, 0.3, and 0.3 respectively. However,

winning the tournament will be given extra weight, so the winner is virtually guaranteed an A unless the team neglects to produce a report or participate in a debrief.