

This document provides the problem statement, and a description of the game of Backgammon. The web-page

provides <https://web.unbc.ca/~casper/Semesters/2022-01W/101-project.php>.

1. A detailed list of tasks and deadlines,
2. a document describing the design process,
3. a document on what is generally required of formal reports, and
4. a sample design document.

1 Problem statement

The goal of this project is to write programs to play backgammon. The backgammon game itself is described in Appendix A.

1.1 Program specifications

Your team needs to create

- for distribution to other students, an executable `.jar`-file (see below),
- for submission to the instructor, a `.tar` (or `.jar`) file containing
 - your source code (`.java` files),
 - javadoc documentation for your program(s),
 - an executable `.jar`-file (see below),
- A brief guide that explains how to run your program as a game.

The executable jar file

One submitted version of the project must be an executable `.jar`-file. It need not contain `.java` files, but should be self-contained and easy to run.

Coding Requirements

Your team's program(s) must be written in `JAVA`, and must run on a standard `JAVA` installation. If you intend to use downloaded additional graphics libraries, or advanced `JAVA` features, consult with the instructor first.

Code must generally conform to the coding style specifications in Appendix E of the textbook. Additional coding style requirements will be specified in a future document.

Code must contain javadoc-style comments for packages, classes, `public`-, `protected`-, and package-level methods. All member variables must be `private`.

All code lines must be at most 100 characters long, and **MUST NOT** contain tabs.

Interactive mode Your program must supply an interactive mode where a human can play against the program's AI. There will be additional future requirements for the AI.

General comments

For the computer opponent program, correctness is far more important than cleverness. Intelligent play by the computer opponent is not necessary, and should not be a priority when completing the project.

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2022-01-15

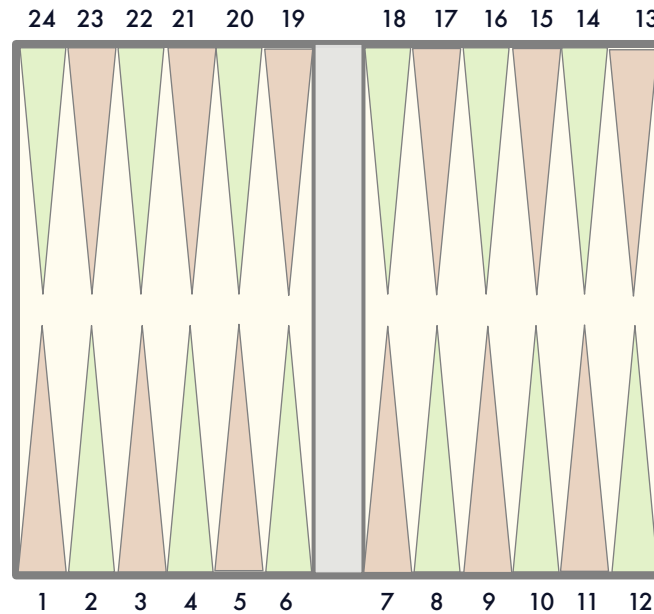


Figure 1: An empty board

A The Rules of Backgammon

These rules are loosely based on those found at <https://www.mastersofgames.com/rules/backgammon-rules.htm> They have been rewritten slightly with the goal of making OOD class extraction easier.

A.1 Equipment and Terminology

Backgammon is played on a specially designed board (see Figure 1) consisting of four *tables*, each containing six thing triangles (called **points**) of alternating colours. Traditionally, the numbering and initial board configuration is chosen so that the 1 and 24 points are closest the good light.

There are fifteen white pieces and fifteen black pieces (circular disks), two **dice**, and a **doubling cube**. Backgammon is a two player game, and we will refer to the players as black and white.

The doubling cube is an essential part of serious backgammon, but may be ignored for this project. The doubling cube is described further in Section A.7.

Figure 2 shows the **initial game configuration** from black’s perspective. The two tables with points numbered 24–19 and 18–13 are

black’s **outer tables** or **outer boards**. Conversely, the two tables with points numbered 12–7 and 6–1 are black’s **inner tables** or **inner boards**. In particular the lowest numbered table is black’s **home board**.

During a game, all of black’s pieces are either

- on one of the the 24 numbered points,
- on the **bar** — the vertical strip that divides the board in half, or
- have been successfully “born off” and are no longer in the game.

Typically pieces that are born off are placed in the storage compartments where the pieces lie when the game board is not in use.

A.2 Objective

Black’s objective is to move her pieces around the board lower numbered points and eventually to her home board and then off the board

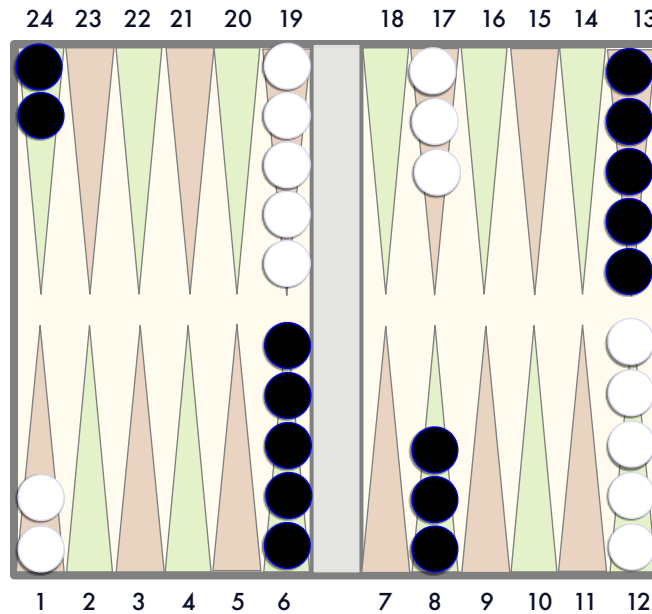


Figure 2: The initial configuration from black's perspective

before white.

White's situation mirrors black, and white's pieces move in the opposite direction.

In the setup shown in Figure 2 black's pieces move clockwise and white's pieces move count-clockwise. It is also possible to set up the board mirror-reflected around the bar. Traditionally, the players' home boards are closest to the better light.

A.3 Starting

To start the game, each player places her pieces as shown in Figure 2, that is

- two pieces on her 24 point,
- five pieces on her 13 point,
- three pieces on her 8 point, and
- five pieces on her 6 point.

Each player then rolls one die, and the player with the higher die value then plays first using the values on the dice. If the two players roll the same value, they roll again. Note that this means that the first player never starts with doubles.

A.4 Basic Play

During the game each of the 24 numbered points can either be empty, have white pieces on, or have black pieces on it, but there are never both white and black pieces on the same point.

There is no limit (other than 15) to the total number of pieces that can be on one point. Usually a point is about 5 pieces long; if there are more pieces than that on a point, they are just stacked up.

A point with two or more pieces on it is *safe*, and the opponent cannot land a piece there. A single piece on a point is called a **blot**, and the opponent can land a piece on the blot which removes the blot from the numbered board and places it on the bar.

Captured pieces re-enter from the bar as if they were on point 25. If black had a piece on the bar, and rolled a 4, she could move it to the 21 point (assuming that white had less than two stones there).

Players must re-enter their captured stones before they can make any other moves.

A.4.1 Playing Dice rolls

A normal (non-double) dice roll represents two separate plays that can be made in either order; so, for instance, if white were to roll 3–1 at the beginning of the game, she could move one piece from her 8 point to her 5 point, and another piece from her 6 point to her 5 point, thereby making her 5 point safe.

Alternatively, she could use the 3 to move a piece from her 13 point to her 10 point, and then move that piece again to her 9 point. (Here, the order matters, as she cannot use the 1 to move from the 13 point because black has more than one piece there.)

Doubles represent four individual plays of the value on one of the dice.

A player **must** play all of her roll if possible (even if this means leaving blots). In the case where a player can play either roll, but not both, she must make a play with the higher die value.

A.5 Bearing Off

Removing pieces from the board is called **bearing off**. A player may begin (or resume) bearing off whenever all of her pieces are in her home board.

In bearing off, the target is “0”. That is, a 3 allows you to bear off a piece on your 3 point, and so on. (If a player rolls a number higher than the highest point on which the player has a piece, the player is allowed to bear off from that highest point instead.)

Should a player have a piece captured while bearing off, they need to stop bearing off until all of their remaining pieces are back in their inner board.

A.6 Winning

A player who removes all of her pieces before her opponent does wins. A player who removes all of her pieces before her opponent removes a single piece wins a **gammon** which is worth twice as much. A player who removes

all of her pieces before her opponent removes a single piece and while her opponent still has a piece on the bar, or in her home board wins a **backgammon** which is worth three times as much.

A.7 The Doubling Cube

- optional
- doubling and redoubling
- refusing a double
- accepting a double

Playing with a **doubling cube** is optional, but is a standard part of the game when playing a multi-game match or when playing for stakes.

The doubling cube is like a die, but has the number 2, 4, 8, 16, 32, and 64 on its faces. At the beginning of the game the doubling cube is set half way between the players with the 64 face upmost (the 64 represents 1 in this circumstance).

Whenever the doubling cube is in the middle or on their side of the table, a player may double before rolling the dice.

To double, a player takes the doubling cube, rotates it so that the next highest number is showing, places it on the opponent’s side of the board and says “I double”.

The opponent then has a choice. The opponent can say “I refuse”, conceding the *current* (pre-double) stakes, or the opponent can say “I accept”, in which case the game continues for the new doubled stakes.

When a player refuses a double, they lose a simple game at the current stakes. However, if a double is accepted and a player then wins by a gammon or a backgammon, the multiplying effect of both the doubling cube and the gammon or backgammon both come into effect. For example if a player loses a backgammon after the game has been double three times, they lose 24 times the original stakes.

B Glossary

- B** **Backgammon** A win where a player removes all of their pieces before the opponent removes a single piece *and* the opponent still has pieces on the bar or in the winner's home board. A backgammon counts three times as much as a normal when.
- bar** The vertical section down the middle of the board. Pieces that are captured are placed on the bar, on the side closer to their opponent.
- blot** A single piece on a point. A blot is vulnerable to capture.
- G** **Gammon** A win where a player removes all of their pieces before the opponent removes a single piece. A gammon counts twice as much as a normal when.