Group 4: Briscola

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Course Modelling Project

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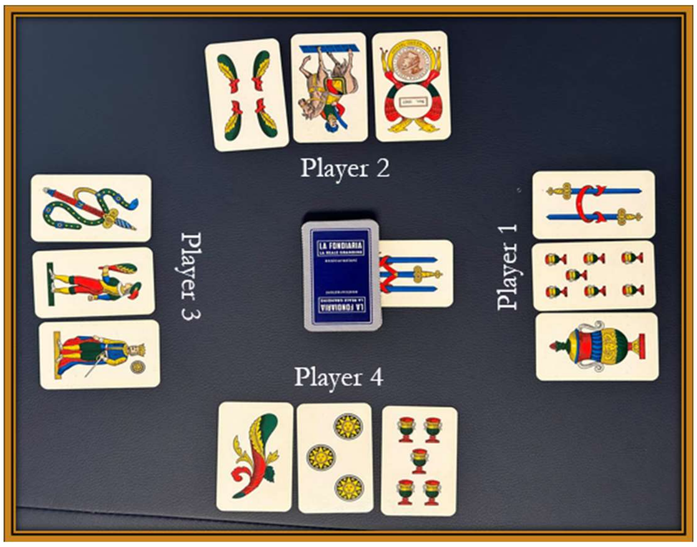
Project Summary

The game **Briscola** has players play a card from their hand each round. Based on the suit of the card and the value of each card (Ace, King, etc.), a player wins a round if the card they played had the highest value and was the same suit as the first card played. In addition, at the start of the game a suit is chosen to be the "Briscola", which ignores the requirement of the highest card needing to be the same suit as the first card played in order to win the round, but still follows the rules regarding value. The game continues until all cards have been played, with each player drawing one card at the end of each round. In a regular game of Briscola, the player with the most points at the end of all the rounds wins – based on the card values. For this project, the player who wins the most rounds wins the game instead.

We will model if it is possible for Player-1 to win 4 of the 10 possible rounds in a game of four players. The model will be using the game configuration seen below, which shows the players' starting hands and the Briscola suit (swords). The rest of the deck is not predetermined.



Propositions

The propositions will make use of the following variables:

Variable	Description
(p)	A specified player. Can have a value of (1-4) to represent Player-1, Player-2, and so on. Also acts as a dictionary to count the player wins for each player.
(t)	The current trick/round of the game. Can have a value of (1-10) to represent Trick-1, Trick-2, and so on.
(c)	The specified card out of the available 40 cards. Can have a value of (1-40) to represent Card-1, Card-2, and so on. Each card has its own Suit (ranging from "Swords", "Coins", "Cups", and "Clubs") and Value (ranging from 1-7, then J, H, and K) and is stored in a dictionary.
(b)	The Briscola suit of the game. Can have a string value of ("Swords", "Coins", "Cups", or "Clubs")

Proposition	Description
starting_player(p)	Returns True if player (p) is starting the trick.
val_is_greater(c_1, c_2)	Returns True if (c_1)'s value is greater than (c_2)'s value.
card_is_bris(c, b)	Returns True if (c) is the same suit as (b).
card_is_same_suit(c_1, c_2)	Returns True if (c_1) is the same suit as (c_2).
card_beats_card(c_1, c_2)	Returns True if (c_1) beats (c_2) in terms of value and suit. Uses the above propositions to check this.
player_win_trick(p, t, [c_1, c_2, c_3, c_4])	Returns True if the player (p) wins the trick (t) based on the cards [c_1, c_2, c_3, c_4].
can_draw_card(p)	Returns True if player (p) can draw one card.

Constraints

Constraint	Description
player_win_trick(p_1, t, [c_1, c_2, c_3, c_4]) ∧ starting_player(p_2)	When checking if player (p_1) won the trick (t), we also check if (p_2) is the starting player (where it is possible for $p_1 = p_2$) to determine the order the cards were played.
¬ ($c_1 \Leftrightarrow c_2$)	Two cards (c_1) and (c_2) cannot be the same (they must be unique). (And by proxy, they can't have the same suit ***and*** the same value).
(val_is_greater(c_1, c_2) ∧ val_is_greater(c_2, c_3)) → val_is_greater(c_1, c_3)	If a card's value (c_1) is greater than another card's value (c_2). Then, if (c_2)'s value is greater than another card's value (c_3), then (c_1)'s value is greater than (c_3)'s value.
(player_win_trick(p_1, t, [c_1, c_2, c_3, c_4]) ∨ player_win_trick(p_2, t, [c_1, c_2, c_3, c_4]) ∨ player_win_trick(p_3, t, [c_1, c_2, c_3, c_4]) ∨ player_win_trick(p_4, t, [c_1, c_2, c_3, c_4])) → (can_draw_card(p_1) ∧ can_draw_card(p_2) ∧ can_draw_card(p_3) ∧ can_draw_card(p_4))	If any of the four players have won a trick, this means a trick has concluded, and thus all for players draw one card.

Model Exploration

List all the ways that you have explored your model – not only the final version, but intermediate versions as well. See (C3) in the project description for ideas.

[Haven't started on Model Explorations yet].

Jape Proof Ideas

We haven't started on fully implementing the JAPE proofs yet but below are some potential ideas we can look into solving:

1. For a single trick, if player-1 wins the trick, then player-2, player-3, and player-4 could not have won.
2. If player-(x) wins the previous trick and the trick number is less than 11 and player-(1) has less than 4 wins, then player-(x) starts the current trick.
3. [More-To-Be-Added]

Requested Feedback

Provide 2-3 questions you'd like the TA's and other students to comment on.

[Will be filled in at a later date before draft submission].

First-Order Extension

Describe how you might extend your model to a predicate logic setting, including how both the propositions and constraints would be updated. ***There is no need to implement this extension!***

[Haven't started on Predicate Logic yet].

Useful Notation

$\wedge \quad \vee \quad \neg \quad \rightarrow \quad \forall \quad \exists$