

SET10107 Computational Intelligence

Tutorial 1

ANYTHING NOT COMPLETED IN THE TUTORIAL MUST BE COMPLETED BEFORE NEXT WEEK'S CLASS

AIM:

- To understand how deterministic “intelligent” strategies can be implemented in a simple card game
- To understand the limitations of such approaches

RESOURCES REQUIRED

- Goospiel C# Source Code from Moodle

BACKGROUND

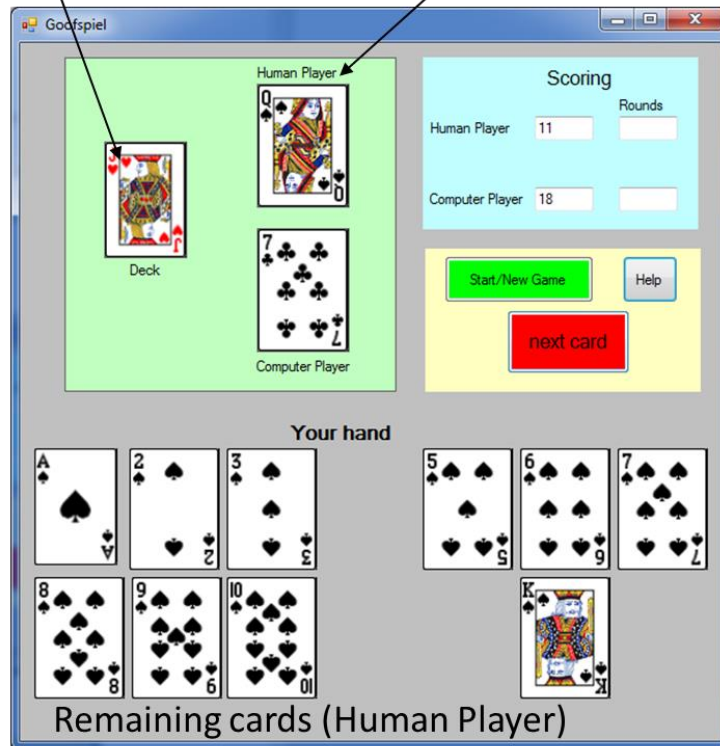
Goofspiel, also known as **The Game of Pure Strategy** or **GOPS**, is a [card game](#) for two or more players. It was invented by [Merrill Flood](#) while at [Princeton University](#). It is simple to learn and play, but has a large degree of tactical depth. It is popular with [game theorists](#) because, as a game of [pure strategy](#), it is susceptible to analysis. It is interesting as a card game as atypically, each player knows exactly what is in the hand of his or her opponent.

Goofspiel is played using cards from a standard deck of cards, and is typically a two-player game, although more players are possible. Each suit is ranked A (low), 2, ..., 10, J, Q, K (high).

1. One [suit](#) is singled out as the "competition suit" (we use the Hearts suit); each of the remaining suits becomes a hand for one player, with one suit discarded if there are only two players, or taken from additional decks if there are four or more. The Hearts are shuffled and placed between the players with one card turned up.
2. Play proceeds in a series of rounds. The players make "closed bids" for the top (face up) Heart by selecting a card from their hand (keeping their choice secret from their opponent). Once these cards are selected, they are simultaneously revealed, and the player making the highest bid takes the competition card. Rules for ties in the bidding vary, possibilities including the competition card being discarded, or its value split between the tied players (possibly resulting in fractional scores). Some play that the current Heart may "roll over" to the next round, so that two or more cards are competed for at once with a single bid card.

Competition Card

The Human Player wins
the Jack of Hearts worth
11 points as their bid
(Queen) was the largest



3. The cards used for bidding are discarded, and play continues with a new upturned Heart card.
4. After 13 rounds, there are no remaining cards and the game ends. Typically, players earn points equal to sum of the ranks of cards won (i.e. Ace is worth one point, 2 is two points, etc, Jack being worth 11, Queen 12, and King worth 13 points). Players may agree upon other scoring schemes.

INSTRUCTIONS

- Download the zip file Goofspiel from Moodle
- Save onto your D drive (Not H) and unzip the program

TUTORIAL EXERCISES

Part A: Strategy identification

1. Make sure you have read the description of the game above and understand how to play
2. Navigate to Goofspiel->Goofspiel->Bin->Debug and double click the executable file Goofspiel to start the program
3. Play 10 rounds of the game against the computer: how many of the games did you win?
4. What strategy do you think the computer player uses?
5. Identify 1-3 strategies that you think would be useful for playing this game – test them against the computer to see if they work. Check your results by completing the following table with your results

	Strategy 1		Strategy 2		Strategy 3	
	Human	Computer	Human	Computer	Human	Computer
Game 1						
Game 2						
Game 3						
Game 4						
Game 5						
Game 6						
Game 7						
Game 8						
Game 9						
Game 10						

Part B: Implementing a strategy

Now you are going to try and implement one of your strategies. In the top level of the Goofspiel folder, click Goofspiel Microsoft Visual Studio Solution to open Visual Studio.

1. Double click the File Form1.cs in the Solution Explorer Window to open the code
2. Scroll to the first method, `computerPlayerMove()` **You should not need to alter any other methods in the code except this one**
3. Look at the strategy currently implemented by the program – try and alter the code so that the computer used a different strategy. Some things to think about:
 - what card did the player play last time (in relation to the heart shown on the deck)
 - what cards does the player have left
 - what is the value of the card on the deck ?

Share your program with your fellow students – can it be beaten ?

Part C:

- Compare your strategy with those of your friends. How different are the approaches taken?
- Consider (or discuss with friends) the limitations of the computer player adopting a *single strategy* when playing against a human player. Think of simple methods of overcoming these limitations
- Implement a multiple strategy approach to playing the game where the computer can choose between multiple strategies. Consider how the computer chooses which strategy – at random ? based on the player's actions ?
- Evaluate whether the multiple strategy approach is better than the single strategy you currently implemented

FURTHER RESOURCES / READING

<http://en.wikipedia.org/wiki/Goofspiel>

<http://www.pagat.com/misc/gops.html>

Section 5 of the following research paper describes different strategies used by entries of a competition.

M. Dror and G. Kendall, "Repeated Goofspiel: A Game of Pure Strategy," in *IEEE Transactions on Computational Intelligence and AI in Games*, vol. 5, no. 4, pp. 312-324, Dec. 2013.

<http://ieeexplore.ieee.org/document/6497554/>

