Introduction to Intelligent Systems: Homework 4

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Problem 1

It's February 1943, the Island of New Guinea during World War II. The Allies control the southern coast of the island, the Japanese control the northern coast. The Japanese are bringing in reinforcements - lost of them - from China and Japan. They've already reached the city of Rabaul. Rabaul is on the eastern tip of an island called New Britain. The troops massed in Rabaul tended for the city of Lae in New Guinea. They'll be convoyed by ship, and everybody knows it. What's not clear is what route they'll take. New Britain runs east-west, so the trip will be either along the north coast of New Britain or the southern coast. Either way, it's a three-day trip. The significant difference is the expected weather. To the south, the weather is clear; to the north, the weather is stormy. The Japanese fleet is fine with either kind of weather.

It's the Allies who care about the weather. They're going to send recon planes to find the fleet, then bombers to bomb it. In clear weather, both of these things can be done on the same day. In bad weather, the bombers go out a day after the enemy is sighted. That cuts down on bombing days, and of course, if you don't find the fleet, you can't bomb it at all. The recon planes can't search both routes on the same day. All of this information is known to both sides. Which route (north or south) should the Japanese commanders sail, and which route (north or south) should the Allied Forces commanders search?

	Allies search north (stormy)	Allies search south (clear)
Japanese sail north (stormy)	Japanese fleet found on first day and bombed on second and third days	Japanese fleet not found on the first day, found on second day, and bombed on the third day
Japanese sail south (clear)	Japanese fleet found on second day and bombed on the second and third days	Japanese fleet found on first day and bombed all three days

In terms of days of safety/bombing:

	Allies search north (stormy)	Allies search south (clear)
Japanese sail north (stormy)	Japanese = 1, Allies = 2	Japanese = 2, Allies = 1
Japanese sail south (clear)	Japanese = 1, Allies = 2	Japanese = 0, Allies = 3

The Japanese should sail to the north, and the Allied commanders should search the northern route as well.

Problem 2

A dominant strategy is a Nash equilibrium. Is a Nash equilibrium necessarily a dominant strategy? (If your answer is "yes", prove this. If your answer is "no" provide a counter-example.)

Yes. It is irrational for a dominated strategy to be played and thus they cannot be part of Nash equilibrium. A Nash equilibrium will always consist of both player's dominant strategy (strong or weak).

Problem 3

Two vendors are selling breakfast items. The price depends on demand. The fixed cost for making breakfast sandwiches is \$2; the fixed cost for a danish is \$1. Payoffs are repesented as profits for danish and sandwich sellers respectively.

	Sandwich: \$3	Sandwich: \$4	Sandwich: \$5	Sandwich: \$6
Danish: \$3	$D = 40, S = 12$	$D = 44, S = 22$	$D = 48, S = 28$	$D = 39, S = 18$
Danish: \$4	$D = 36, S = 14$	$D = 42, S = 24$	$D = 46, S = 32$	$D = 38, S = 24$
Danish: \$5	$D = 16, S = 17$	$D = 24, S = 26$	$D = 32, S = 36$	$D = 40, S = 16$
Danish: \$6	$D = 32, S = 18$	$D = 48, S = 25$	$D = 50, S = 29$	$D = 41, S = 32$
Danish: \$7	$D = 42, S = 19$	$D = 36, S = 18$	$D = 49, S = 17$	$D = 42, S = 28$

(a) Find the Nash Equilibrium using Iterated Elimination of Dominated Strategies (IEDS). Show your work with each iteration by specifying which row/column is dominated and eliminated.
Sandwich: \$3 and Sandwich: \$4 are eliminated first because they are dominated by either Sandwich: \$5 or Sandwich: \$6.

	Sandwich: \$5	Sandwich: \$6
Danish: \$3	$D = 48, S = 28$	$D = 39, S = 18$
Danish: \$4	$D = 46, S = 32$	$D = 38, S = 24$
Danish: \$5	$D = 32, S = 36$	$D = 40, S = 16$
Danish: \$6	$D = 50, S = 29$	$D = 41, S = 32$
Danish: \$7	$D = 49, S = 17$	$D = 42, S = 28$

Given this choice, Danish: \$3, \$5, and \$5 are eliminated because they are dominated by Danish: \$6 and Danish: \$7.

	Sandwich: \$5	Sandwich: \$6
Danish: \$6	$D = 50, S = 29$	$D = 41, S = 32$
Danish: \$7	$D = 49, S = 17$	$D = 42, S = 28$

Sandwich \$6 is a strongly dominant strategy at this point.

	Sandwich: \$6
Danish: \$6	$D = 41, S = 32$
Danish: \$7	$D = 42, S = 28$

The best choice for the Danish seller is Danish: \$7, making (Sandwich: \$6, Danish: \$7) the Nash equilibrium value.

	Sandwich: \$6
Danish: \$7	$D = 42, S = 28$

(b) Show any/all cells that strongly Pareto Dominate the Nash Equilibrium value.

(Sandwich: \$5, Danish: \$4) and (Sandwich: \$5, Danish:) strongly dominate the Nash Equilibrium value. (Sandwich: \$5, Danish: \$3) will result in a higher payoff for Danish and an equal payoff for Sandwich.

Problem 4

The game "Rock-Paper-Scissors-Lizard-Spock" is an extension of the popular "Rock-Paper-Scissors". In addition to the usual rules of Rock smashes Scissors, Scissors cuts Paper, and Paper covers Rock, we also have:

- Rock crushes Lizard
- Lizard poisons Spock
- Spock smashes Scissors
- Scissors decapitates Lizard
- Lizard eats Paper
- Paper disproves Spock
- Spock vaporizes Rock

(a) Fill in the payoff matrix for this game using values of 0 for a tie, -1 for a loss, and +1 for a win.

		Player A				
		Rock	Paper	Scissors	Lizard	Spock
Player B	Rock	0,0	-1,1	1,-1	1,-1	-1,1
	Paper	1,-1	0,0	-1,1	-1,1	1,-1
	Scissors	-1,1	1,-1	0,0	1,-1	-1,1
	Lizard	-1,1	1,-1	-1,1	0,0	1,-1
	Spock	1,-1	-1,1	1,-1	-1,1	0,0

(b) If Player A is utilizing the following mixed strategy:
Lizard = 22%
Spock = 25%
Rock = 20%
Paper = 15%
Scissors = 18%
What are the expected Payoff values for each option for Player B?

		Player A				
		Rock (0.20)	Paper (0.15)	Scissors (0.18)	Lizard (0.22)	Spock (0.25)
Player B	Rock	0,0	-1,1	1,-1	1,-1	-1,1
	Paper	1,-1	0,0	-1,1	-1,1	1,-1
	Scissors	-1,1	1,-1	0,0	1,-1	-1,1
	Lizard	-1,1	1,-1	-1,1	0,0	1,-1
	Spock	1,-1	-1,1	1,-1	-1,1	0,0

Player B	Rock	0-0.15+0.18+0.22-0.25 = 0
	Paper	0.2+0-0.18-0.22+0.25 = 0.05
	Scissors	-0.2+0.15+0+0.22-0.25 = -0.08
	Lizard	-0.2+0.15-0.18+0+0.25 = 0.02
	Spock	0.2-0.15+0.18-0.22+0 = 0.01

(c) Based on the expected Payoff values for Player B, what is the best mixed strategy for Player B?

Given these values, Player B should expect to lose more when playing scissors and win slightly more when playing paper. The best mixed strategy for Player B would be to favor playing Paper, Lizard, Spock while playing Scissors less.

If you have any questions, comments, or concerns, please contact me at alvin@omgimanerd.tech