CPSC 532L: Models of Strategic Behaviour **Spring 2023**

Assignment #4

Due: February 14th, 2023, 1:00pm

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TA: Narun Raman

1 Perfect Information Games

Problem 1.1. [10 points] Consider the centipede game in Figure 1. It differs from the one appearing in the course reader only in that the payoff pair $(4, 3)$ has been changed to $(5, 3)$.

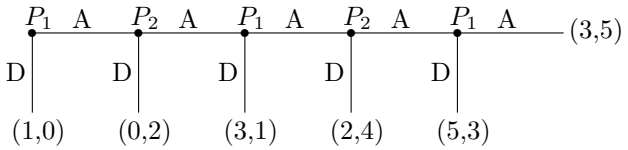

Figure 1: A centipede game.

Player 2 is one of two types: (i) With probability p player 2 is a rational player who follows the unique subgame perfect equilibrium strategy. (ii) With probability $1 - p$ player 2 is "irrational" and simply flips a fair coin at each of his choice points. For every possible value of p, find a best response (possibly mixed) strategy for player 1 to this player 2. (Obviously there will be ranges of p for which a strategy is always a best response.) Show your work.

2 Imperfect Information Games

Problem 2.1. [17 points] One nation (Facebookia) fears an attack by a second nation (Twittopia), and considers building a doomsday machine as a deterrent. If Twittopia attacks Facebookia, the machine will destroy both nations, automatically. In the words of Dr. Strangelove, "because of the automated and irrevocable decision making process which rules out human meddling, the doomsday machine is terrifying, simple to understand, and completely credible." Facebookia must decide whether or not to build the machine (B, N) and whether to carry out its action covertly or overtly (C, O). A doomsday machine is cheaper than Facebookia's conventional defenses, but Facebookia will face economic sanctions if the rest of the world observes that it has built one. Twittopia must decide whether to attack or to pursue peace (A, P), conditional on what it has observed.

This can be represented by the following extensive form game, where Facebookia is P_1 and Twittopia is P_2.

(a) **[3pts]** Which strategies can be removed by iterative removal of weakly dominated strategies?

(b) **[3pts]** What is the induced normal form of the game, after removing these strategies?

(c) **[2pts]** What are the pure-strategy Nash equilibria of this reduced game?

(d) **[5pts]** *Strangelove:* "My conclusion was that this idea was not a practical deterrent, for reasons which, at this moment, must be all too obvious." Find a Nash equilibrium of this game where the worst-case $(-10, -10)$ outcome happens with non-zero probability.

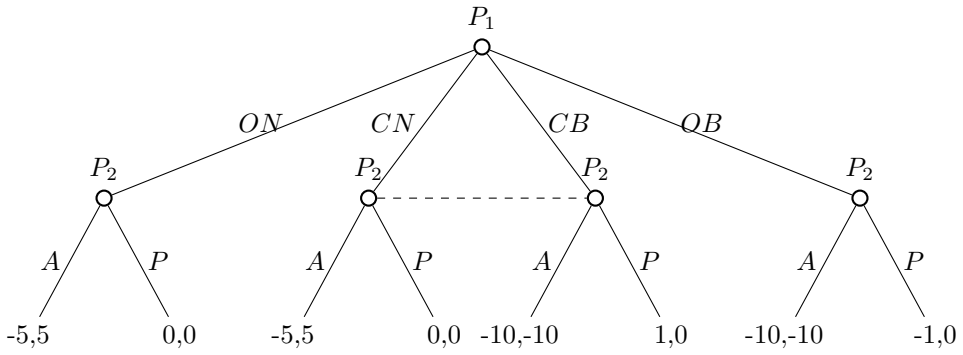

Figure 2: Extensive form representation of the "Strangelove game"

(e) **[3pts]** Now consider a game that is identical except that Twittopia can distinguish between CN and CB (that is, a game like Figure 2 but without the dashed line). What are the subgame perfect Nash equilibria of this game?

Academic Honesty Form

For this assignment, it is acceptable to collaborate with other students provided that you write up your solutions independently. The only reference materials that you can use are the course notes and textbook, and the reference textbooks listed on the course web page. In particular, getting help from students or course materials from previous years is not acceptable.

List any people you collaborated with:

1.

2.

3.

List any non-course materials you refered to:

1.

2.

3.

Fill in this page and include it with your assignment submission.