## Homework 1

## CSCE631 Intelligent Agents

## September 9, 2024 due: September 19, 2024. 11:10am. May be submitted in class or via email.

- 1. (a) Consider the matching pennies game in Fig 1. Determine a mixed strategy Nash equilibrium following the method shown in class (by guessing that both players mix and calculating the probabilities).
  - (b) Explain why the players cannot shift to a pure strategy despite it receiving the same expected reward.
- 2. Prove that every game must have at least one Pareto optimum with pure strategies.
- 3. Prove that every strategy is Pareto optimal in a zero-sum, two-player game.
- 4. Finish the proof of the Minimax theorem; that is, show that in any Nash equilibrium each player receives a payoff equal to her minmax value.
- 5. Consider the matching pennies game in Fig 1.

Determine a mixed strategy Nash equilibrium by executing the Lemke-Howson algorithm. Graphically construct the strategy simplicies, and label each vertex. Then, show the path the algorithm takes.

- 6. Show that in two-player games the maxmin value of a player is equal to the player's minmax value.
- 7. Show that in *n*-player games the maxmin value of a player is at most the player's minmax value.

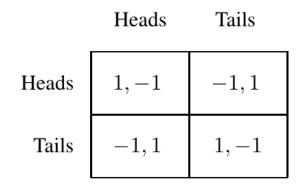


Figure 3.6: Matching Pennies game.

Figure 1: