Conceivable!
Signaling with Inigo Montoya and The Dread Pirate Roberts

JET SET 2026

Introduction

Introduction

- Very few undergraduates get to take a full course on game theory.
  - Even fewer get exposed to games of incomplete information during a single semester.
- These games can be challenging.
  - But they are also the most real-world applicable games that undergraduates are exposed to.
    - Especially signaling games!
- Maybe we can turn to the greatest movie ever about game theory for help.

Signaling Games

- In *The Princess Bride*, the Dread Pirate Roberts is climbing up the Cliffs of Insanity in pursuit of Princess Buttercup.
  - At the top of the cliff awaits Inigo Montoya, who has been ordered to duel Roberts to the death once he ascends the cliff.
    - Montoya is impatient. He has offered to throw down a rope to assist with Roberts' climb.
    - Roberts, however, does not know if he can trust Montoya, and must decide whether to accept or reject Montoya's help.
      - Accepting help from an untrustworthy Montoya would likely injure Roberts, since he will likely fall.
      - A trustworthy Montoya, however, would never sabotage Roberts' climb.
  - Can Montoya effectively communicate his trustworthiness?

Signaling Games

- At their core, signaling games are about transmitting information.
  - A separating strategy gives the receiver perfect information.
    - Example: Going to college.
  - A pooling strategy gives the receiver no information.
    - Example: Playing poker.
- The key to a good signaling game is to understand whether the signaler can transmit information to the receiver.
  - Or if they even *want* to transmit the information.

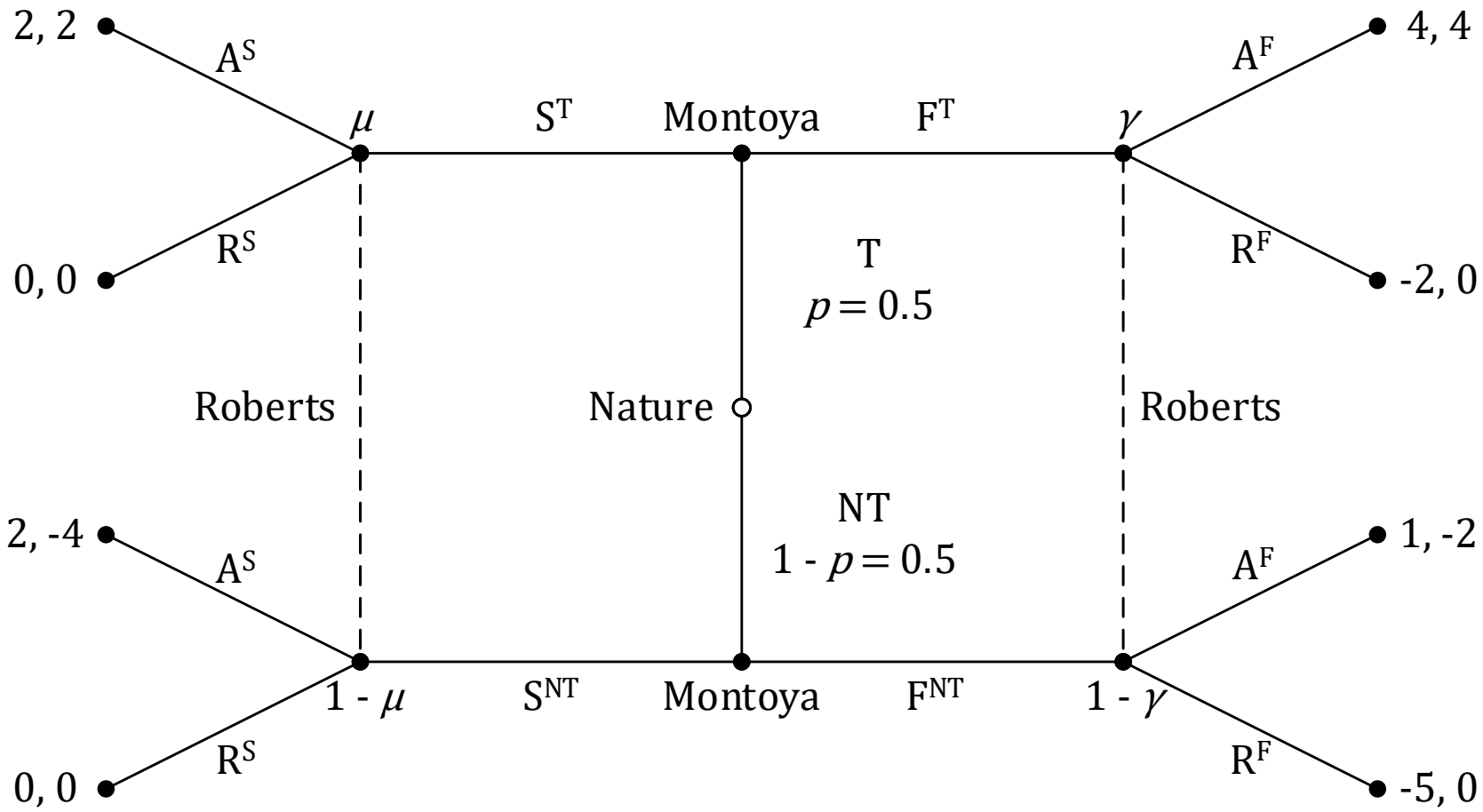
Signaling Games

- The game proceeds as follows:
  - First, Nature determines whether Montoya is trustworthy (T) or not (NT) with equal probability ($p = 0.5$).
    - Naturally, Montoya observes this information.
  - Second, Montoya can send one of two signals to Roberts.
    - "I could give you my word as a Spaniard" (S).
    - "I swear on the soul of my father, Domingo Montoya, you will reach the top alive" (F).
  - Finally, Roberts chooses whether to accept (A) or reject (R) the help from Montoya.
    - Of note, Roberts cannot observe Montoya's type, i.e., whether he is trustworthy or not.

Signaling Games

- Lastly, we need payoffs for our game.
  - Montoya (Player 1):
    - He receives 2 if his help is accepted.
      - A trustworthy Montoya's payoff is increased by 2 if he invokes his father's soul (great pride).
      - An untrustworthy Montoya's payoff is decreased by 1 if he invokes his father's soul (great shame).
      - Either way, rejecting Montoya's aid after he invokes his father soul decreases Montoya's payoff by 2 (offended).
  - Roberts (Player 2):
    - He receives 2 from accepting help from a trustworthy Montoya, or -4 from accepting help from an untrustworthy Montoya.
      - 0 from rejecting.
    - His payoff increases by 2 from hearing the story of Montoya's father, then accepting help (moving).

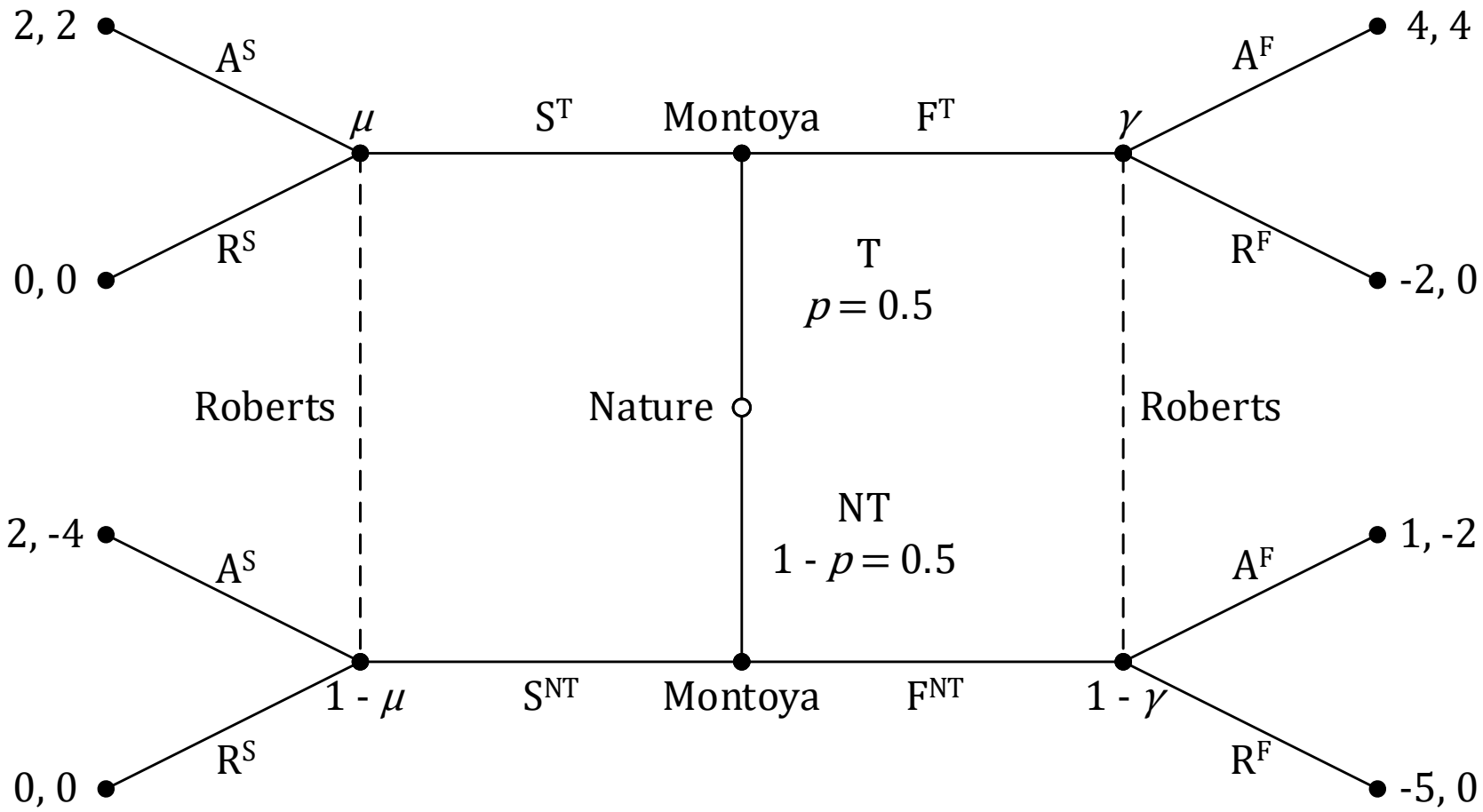
Signaling Games



Signaling Games

- Normally, we would use forward induction to solve this game.
  - Using each of Montoya's four strategy profiles:
    - Step 1: We calculate Roberts' posterior beliefs.
    - Step 2: We determine Roberts' best responses.
    - Step 3: We return to Montoya to look for a profitable deviation.
- I teach my students to insert a step at the start to make the analysis easier: predetermine Roberts' best-response function.

Signaling Games



Signaling Games

- If Roberts observes a signal of "Spaniard," he believes Montoya is trustworthy with probability μ.
  - So naturally, his best response will be a function of μ.
- We can derive his best-response function by looking at his expected values.
- Roberts prefers accept to reject if:

$$E\pi^A \geq E\pi^R$$

$$-4 + 6\mu \geq 0$$

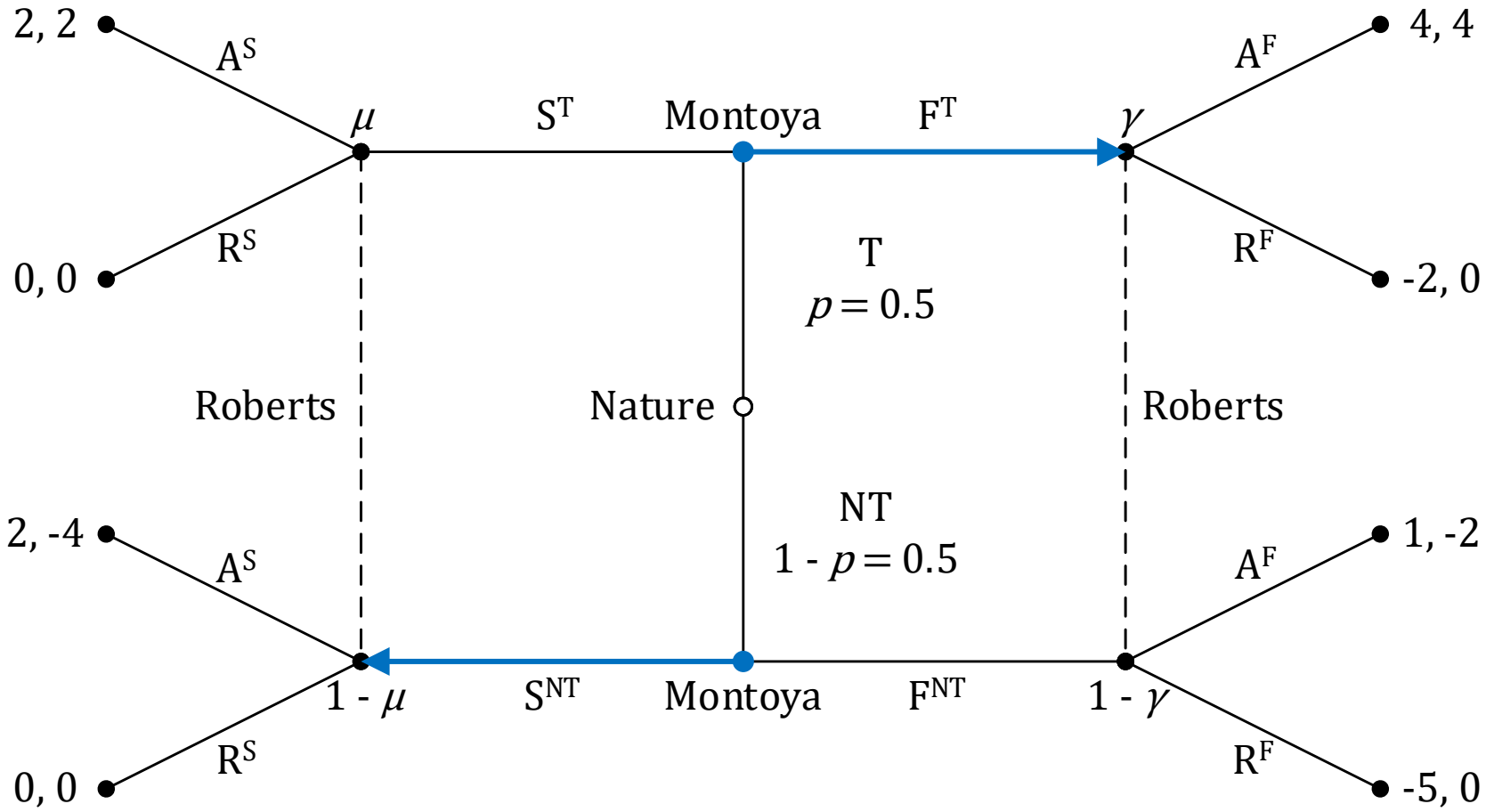
$$6\mu \geq 4$$

$$\mu \geq \frac{2}{3}$$

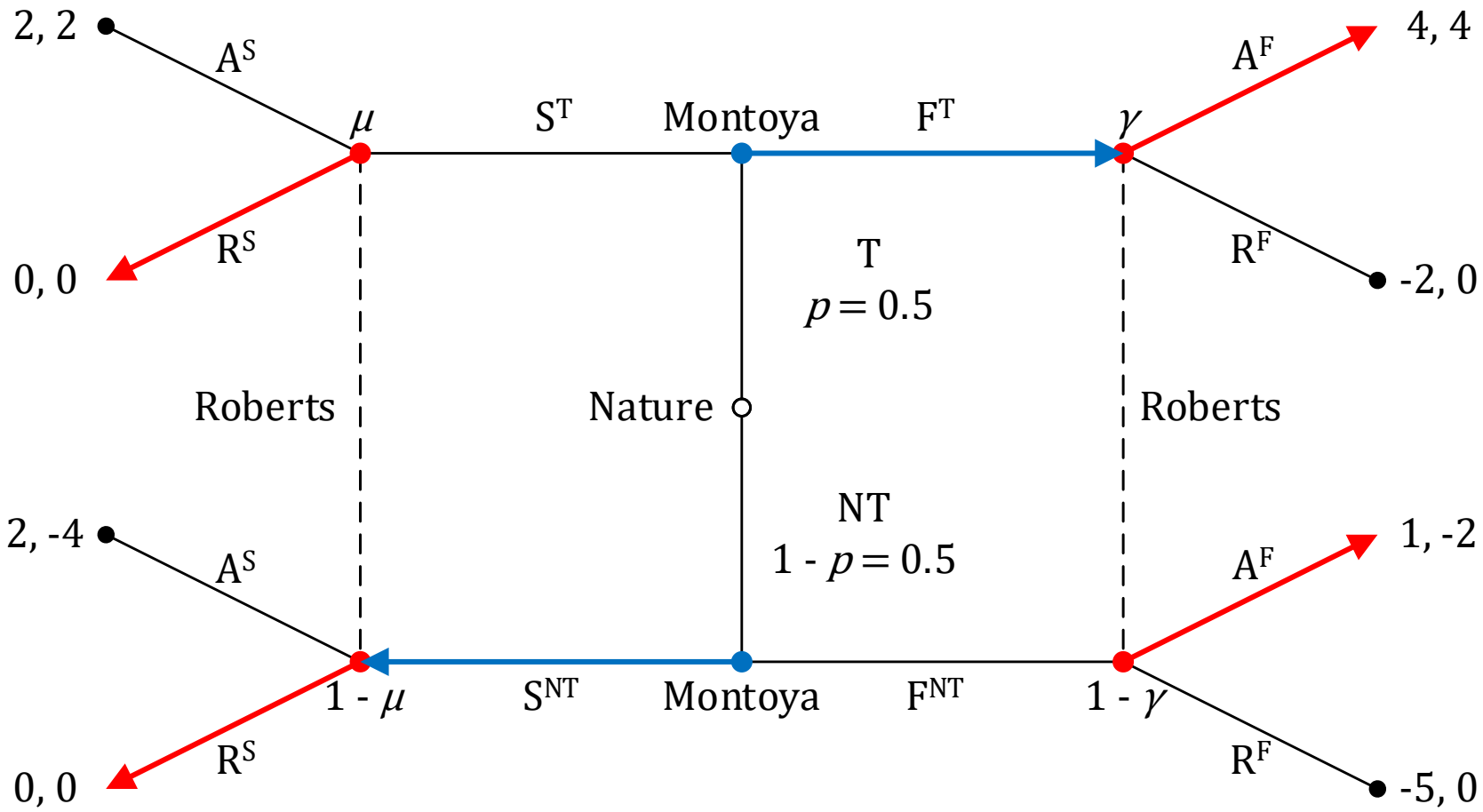
Signaling Games

- By similar calculations, if Roberts observes a signal of "Father," he believes Montoya is trustworthy with probability γ, and prefers to accept if $\gamma \geq \frac{1}{3}$.
  - Thus, we accept when either $\mu \geq \frac{2}{3}$ or $\gamma \geq \frac{1}{3}$ depending on which signal we receive.
- From here, it's straightforward to determine Roberts' best responses regardless of whether a separating or pooling strategy is used.
  - Let me show you two of the four.
    - Note: I spend two whole class periods on this single problem.

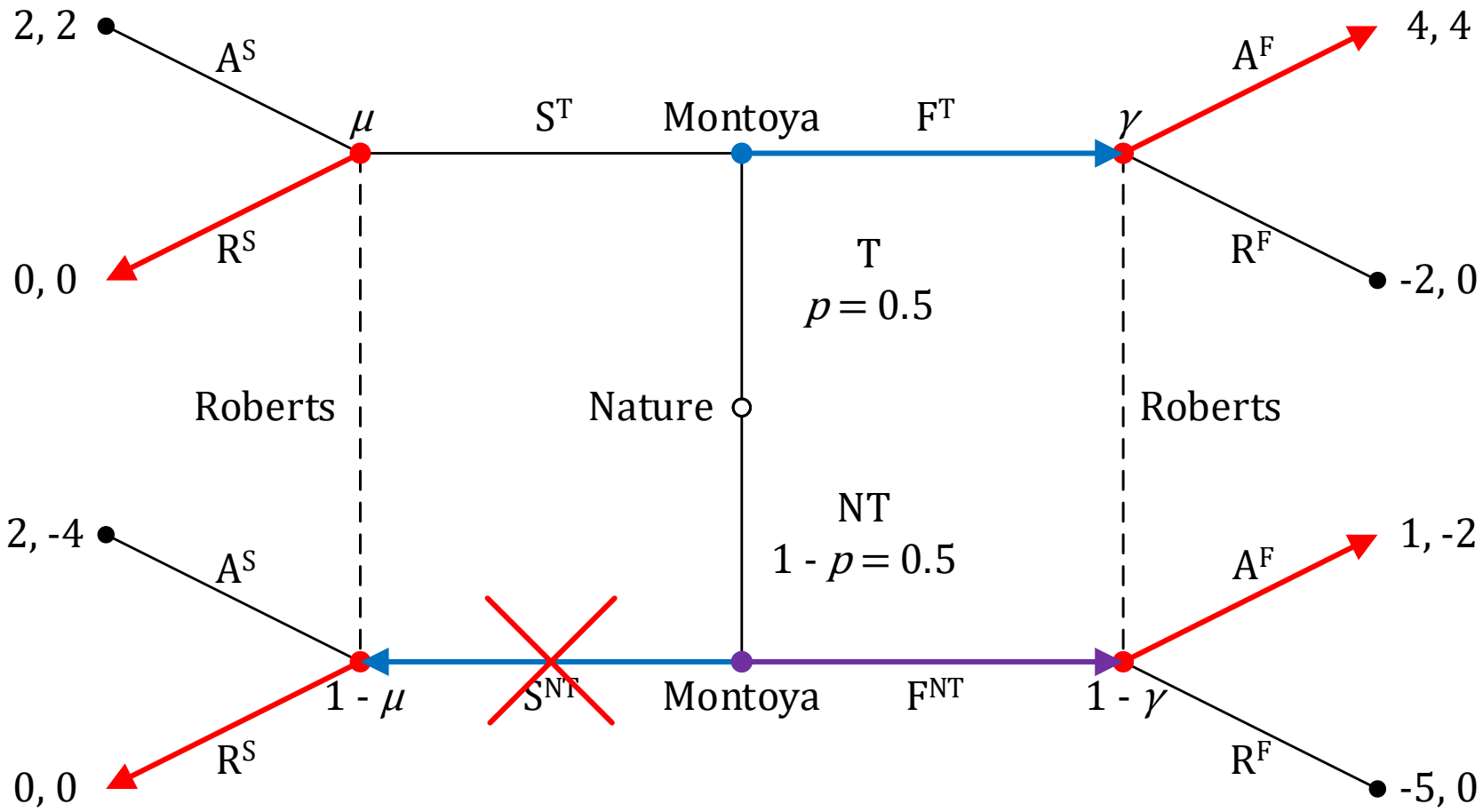
Signaling Games



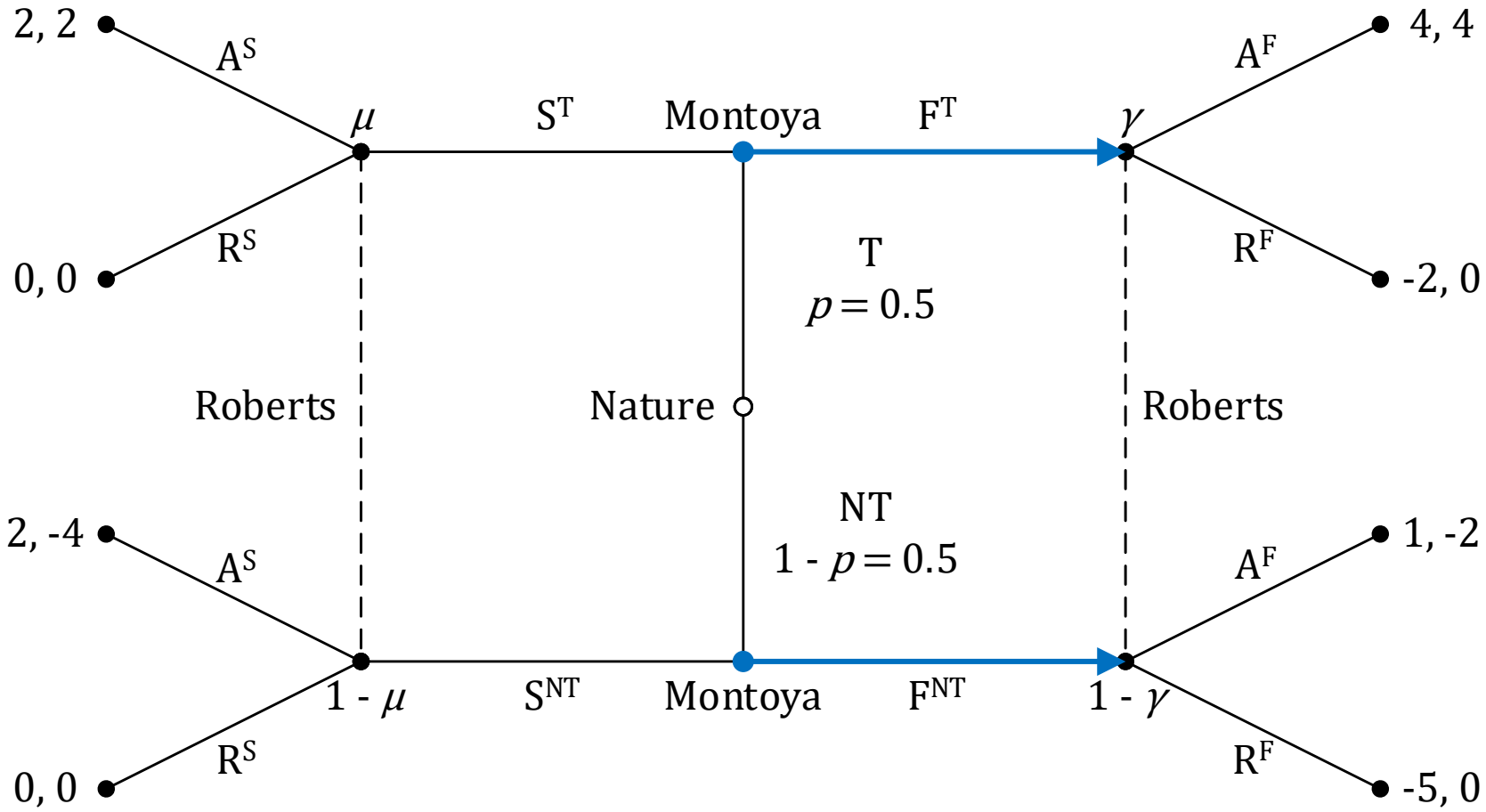
Signaling Games



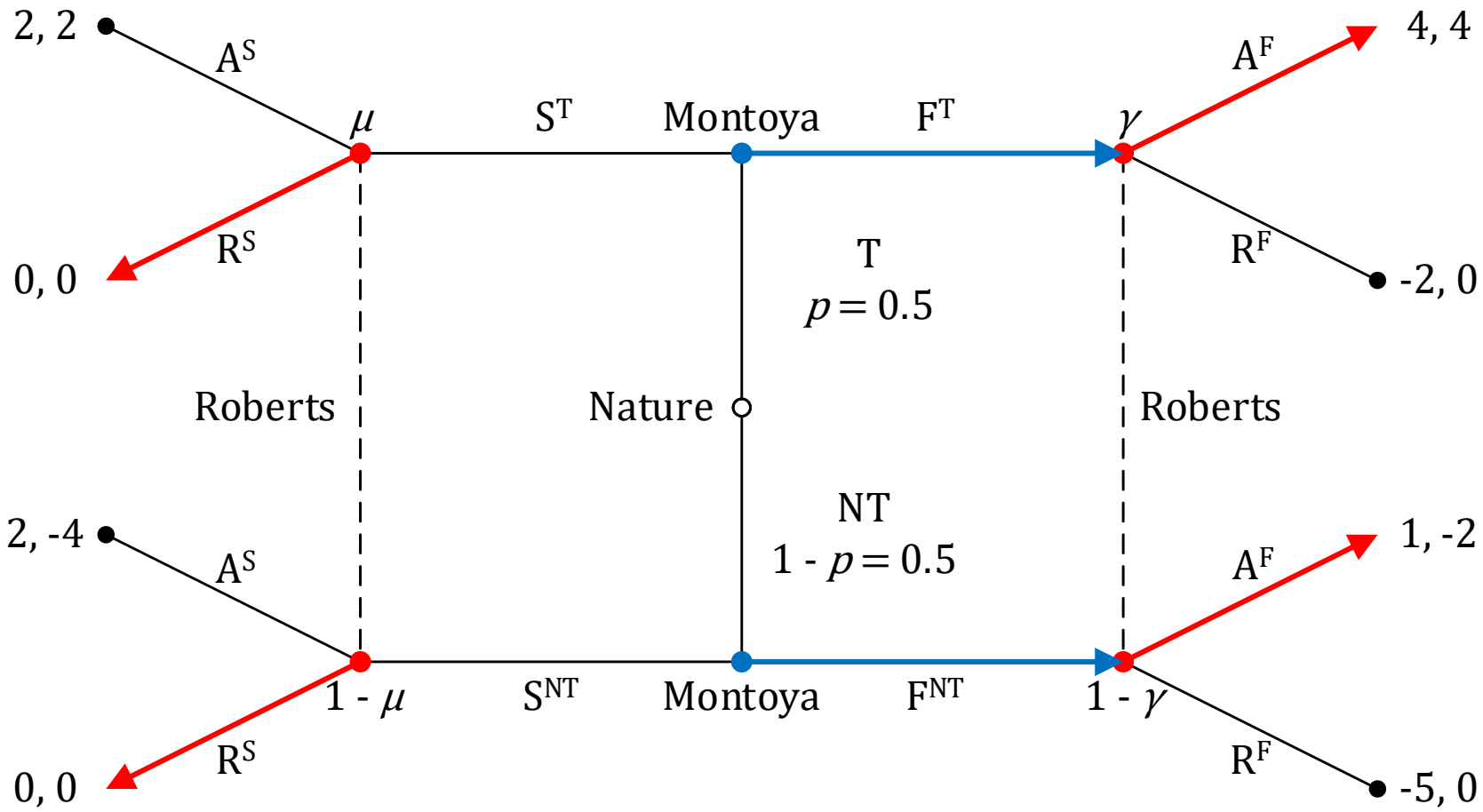
Signaling Games



Signaling Games



Signaling Games



Summary

- Signaling games don't have to be torture!
- Fun examples can help students learn how to apply signaling games.
  - Usually after this game, we work through the Spence Education model.

Thank You

Thanks for being here!

For all materials:

https://github.com/drdenarii/Claude-Skills