Game Theory – Lecture 2

AI for Economics – Module 3

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Pirate – Gold Coin Problem

- There are 5 pirates. They must decide how to distribute 100 gold coins among them.
- The pirates have seniority levels, the senior-most is A, then B, then C, then D, and finally the junior-most is E.

- Rules of distribution are:

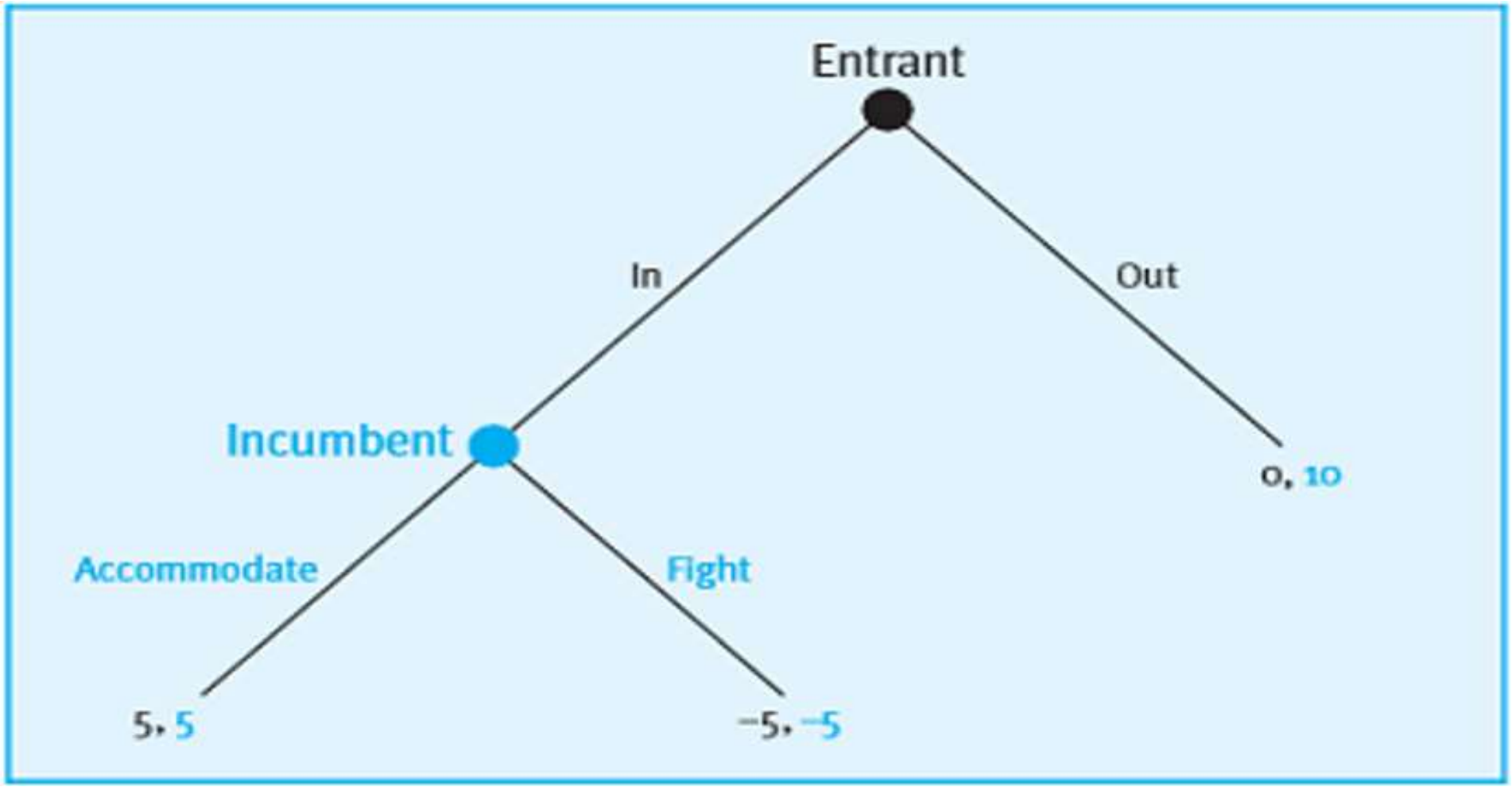
1. The most senior pirate proposes a distribution of coins.
2. All pirates vote on whether to accept the distribution.
3. The distribution is approved **if at least half of the pirates agree (including the proposer)**
4. If the distribution is accepted, the coins are disbursed and the game ends.
5. If not, the proposer is thrown and dies, and the next most senior pirate makes a new proposal to begin the system again.
6. In case of a tie vote, the proposer can have the casting vote

- Objective of every pirate:

1. **Every pirate wants to survive**
2. **Given survival, each pirate wants to maximize the number of gold coins he receives.**

SEQUENTIAL GAMES

Entrant – Incumbent Game



Sequential (Extensive Form) Game

- ***Set of Players***: {Entrant, Incumbent}

- ***History:*** *A history is a sequence of actions chosen by different players.*

e.g: (In) , (In, Fight), (Out)…. are histories of the game.

- ***Terminal History***: *A terminal history is a sequence of actions such that it is NOT a sub-history of any other sequence.*

e.g: Set of terminal histories: {(In, Fight) , (In, Accommodate), (Out)}

- ***Player Function***: *It is a function which assigns a player to any non – terminal history.* P(start) = E, P(Start, In) = I, P(start, Out) = Ø

- ***Payoffs***: For each player there is a payoff associated with each terminal history.

Strategy

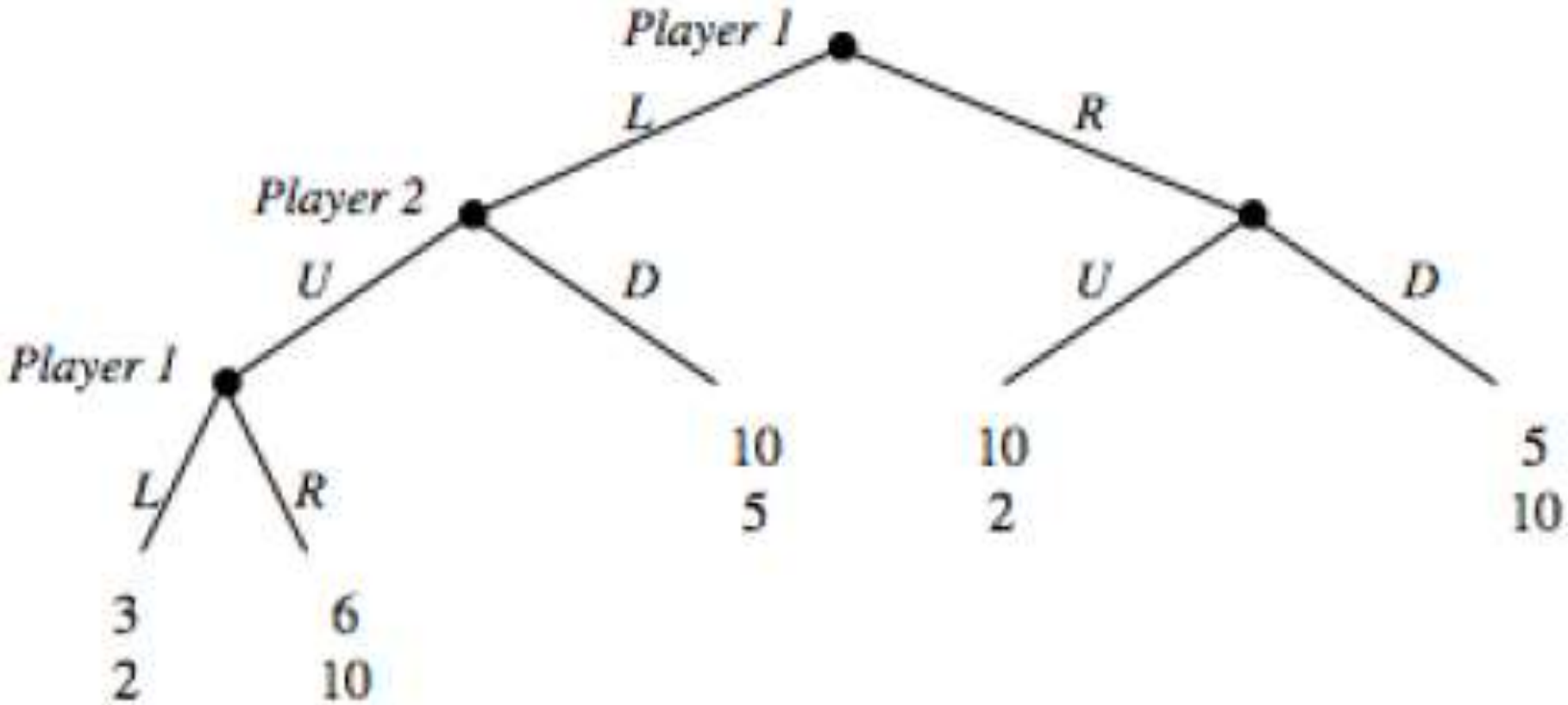
A strategy of player i in a sequential game is a function that assigns to each history 'h' after which it is player i's turn to move (i.e P(h) = i) an action in A(h), where A(h) is the set of possible actions available to player i after history 'h'

Strategies

Entrant	Action assigned to history: (Start)
Strategy 1	In
Strategy 2	Out

Incumbent	Action assigned to history: (Start, IN)
Strategy 1	Accommodate
Strategy 2	Fight

Consider the following sequential move game:



Strategies

Player1	Action assigned to history: (Start)	Action assigned to history: (Start, L, U)
Strategy 1	L	L
Strategy 2	L	R
Strategy 3	R	L
Strategy 4	R	R

Player2	Action assigned to history: (Start, L)	Action assigned to history: (Start, R)
Strategy 1	U	U
Strategy 2	U	D
Strategy 3	D	U
Strategy 4	D	D

Optimal Strategies: Backward Induction

Backward induction is the process of reasoning backwards in time, from the end of a problem or situation, to determine a sequence of optimal actions. It proceeds by examining the last point at which a decision is to be made and then identifying what action would be most optimal at that moment.