Intelligent Multi Agent Systems

TECHNISCHE UNIVERSITÄT DARMSTADT

Summer Semester 2016, Homework 2 (0 points)

G. Neumann, G. Gebhardt, R. Lioutikov

Due date: Wednesday 8th June, 2016, 23:59 CEST (that's 10:59 AM on the following day in Pago Pago!)

Intelligent Multi Agent Systems - Homework 2

Name, Vorname: _____ Matrikelnummer: ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

Problem 3 Problem 2.1 Theoretical Questions

a.1
A normal game has no stages. An extensive game consists of a sequential decisions.

a.2
Yes, but it's NP-hard.

a.3
The Pros and Cons to express a game in extensive form are:

a) Pros The subgames are easy to identify. And thus a NE might be easier to find. If the game is defined by a sequence of action, the game is easier to formulate.

b) Cons: Pareto-dominated actions are easier to see in a normal game form.

a.4
Yes.

a.5
A threat is a non-optimal choice of an agents openent in the next stage. This choice reduces both agents utility.

a.6
todo:inline answer

b.1
Let Γ be an extensive game with perfect information*, with player function P. For any nonterminal history* h of Γ, the subgame $\Gamma(h)$ following the history h is the following extensive game:

a) *Players* The players in Γ

b) *Terminal histories* The set of all sequences h' of actions such that (h, h') is a terminal history of Γ

c) *Player function* The player function $P(h, h')$ is assigned to each proper sub-history h' of a terminal history

d) *Preferences* Each player prefers h' to h'' if and only if she prefers (h, h') to (h, h'') in Γ

From 04-ExtensiveForm p.22.
*1: *Perfect information:* Every player has all the information from the given extensive-form tree (c.f. 04-ExtensiveForm p. 10). *2: *nonterminal history:* "Sequence of actions taken by the players up to some decision point[.]", that does not reach until a payoff distribution (c.f. 04-ExtensiveForm. p.5).

b.2
In a *sub-game perfect equilibrium* each player's strategy is required to be optimal, given the other players' strategies, not only at the start but at every possible history. From 04-ExtensiveForm p.21.

The strategy profile $s*$ in an extensive game with perfect information is a *sub-game perfect equilibrium (SPE)*, if for every player i and every history h after which it is player $i's$ turn to move, $u_i(O_h(s*)) \geq u_i(O_h(r_i, s_{-i}*))$ for every strategy r_i of player i, where u_i is a payoff function that represents the player $i's$ preferences and $O_h(s)$ is the terminal history consisting of h followed by the sequence of actions generated by s after h. From 04-ExtensiveForm p.26

b.3

Every SPE is a NE because, "$u_i(O_h(s*)) \geq u_i(O_h(r_i, s_{-i}*))$ for every strategy r_i of player i," is excatly the best response operator in a *normal game*.

b.4

It is possible for a an extensive form game to have a set $s*$ of SPE's (c.f. Problem 3). Example: $u_i(O_h(s*)) = u_i(O_h(r_i, s_{-i}*))$ for every strategy r_i of player i.

c.1

Baysian games deal with imperfect information. An agents perceives chances of an other agents utilities (Player twos has assigned chances to play different version of the game.) From 04-ExtensiveForm p. 61 ff.

c.2

"We can [...] convert a Bayesian game to a game in normal form over the set of pure strategies of the players." (from: 04-ExtensiveForm games p. 66) Meaning: Compute the expected utilies and compute the Nash Equilibria.

c.3

a) Ex-ante: the agent knows nothing about anyone's actual type

b) ex-interim: an agent knows his own type but not the types of the other agents

c) ex-post: the agent knows all agents' types

From 04-ExtensiveForm games p.66
Ex-ante is the sum of all possible strategy-type-expectations. *Ex-interim* is the sum over the oponents strategy-type-expectations given my preferences/types. *Ex-post* is the sum over all expected strategies

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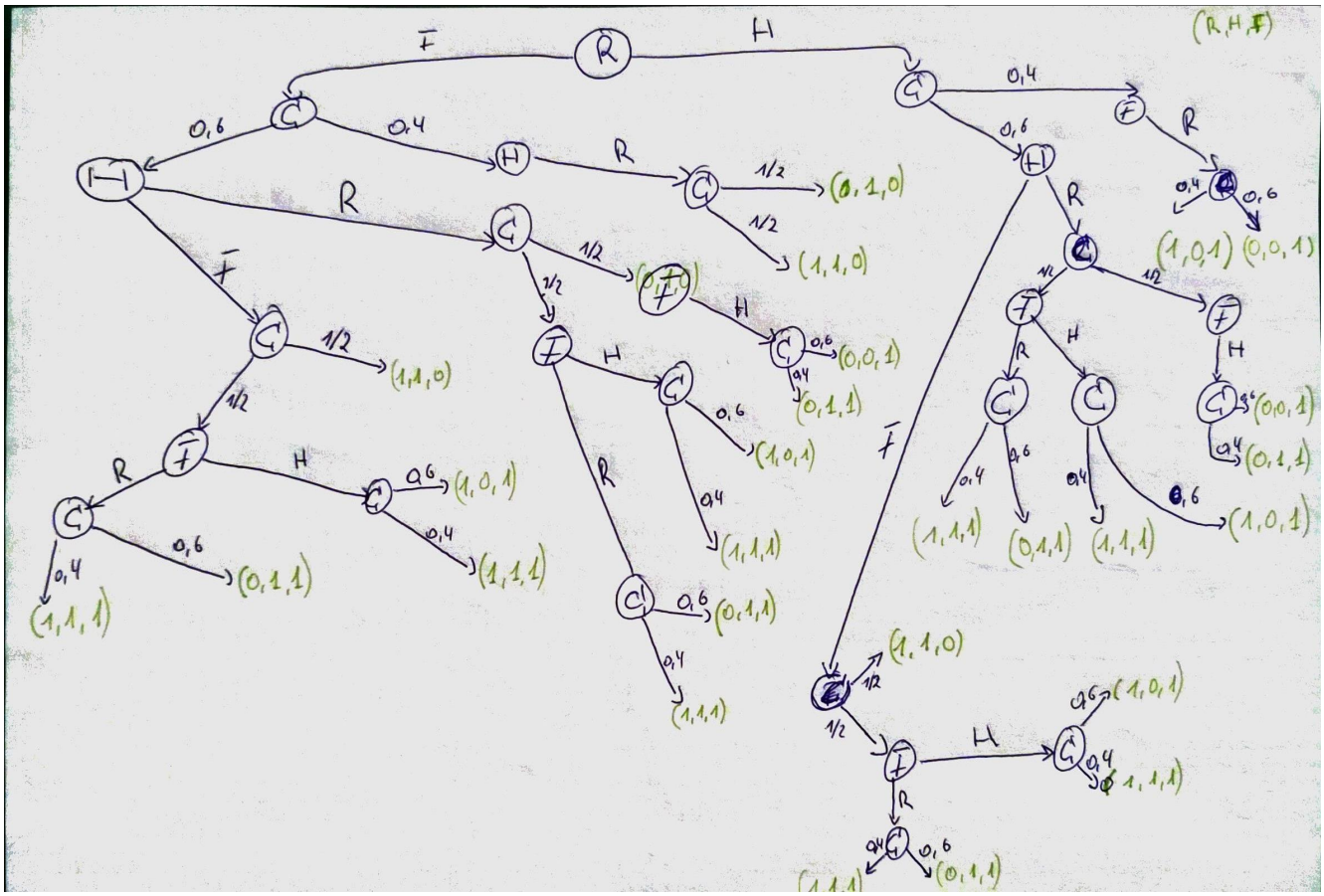
Figure 1: Problem 2.2.a)



The utility vector at the leafs encode the survivor in the order (Roberto, H as Jolly, Filipe) may be read as: $U\left(vector_{player_i}\right) = \sum_j^{player-i} v_i * p\left(hit_j\right)$

Problem 4 Problem 2.2

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Problem 5 Python Exercice

a.1

It is not necessary, because the result will always be the same. Therefore we can fix the action of the computer if it is the first player. This will allows to reduce the excution time.

a.2

If the computer is the first player, we can use heuristics such as

a) Play middle (action 4)

b) Play corner (actions 0,2,6 and 8)

To maximizes the fun, we randomize which of these actions is chosen.

a.3

a) Computer plays "corner" when the player has played middle

b) Computer plays "middle" when the player has played corner