TEK5010 MAS

Lecture 2: Agents, com & coop

Exercise: Decision theory

Question 1

a) Is this a decision-making problem or a problem of strategic interaction? Explain the variables used. What are the requirements for maximazing expected utility?

This is a decision-making problem since:

1) optimization does not take other agents action into account
2) Environment is static
3) One shot/round

Definition of expected utility

$$\hat{u}(Ag, Env) = \sum_{r \in R(Ag, Env)} u(r) P(r | Ag, Env)$$

where $\sum P(r) = 1$ makes it a proper density function

We must decide stakeholders, agents Ag_1 and Ag_2, and their corresponding available states e, with outcomes u and probabilities p of ending up in u from different runs r.

$Env = \langle E, e_0, T \rangle$ is the environment

where $E = \{e_0, e_1, \ldots, e_6\}$ is the set of possible states, e_0 is the initial state

$\tau(e_0 \xrightarrow{\alpha_0}) = \{e_1, e_2, e_3\}$ is state transform function for action α_0.

$\tau(e_0 \xrightarrow{\alpha_1}) = \{e_4, e_5, e_6\}$ is state transform function for action α_1.

So, we have two agents;
Ag_1 uses action α_0 and
Ag_2 uses action α_1

By example, we have probability of ending up in another state

$$P(e_0 \xrightarrow{\alpha_0} e_1 \mid Ag_1, Env) = 0.3$$

The corresponding utility of ending up in that state is, by example

$$u(e_0 \xrightarrow{\alpha_0} e_1) = 4$$

Lets calculate if $\Sigma p(x) = 1$

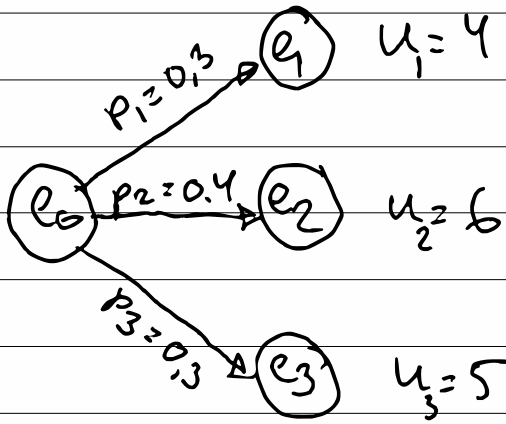
$$\left.\begin{array}{l} p(e_0 \xrightarrow{\alpha_0} e_1 \mid Ag_1, Env) = 0,3 \\ p(e_0 \xrightarrow{\alpha_0} e_2 \mid Ag_1, Env) = 0,4 \\ p(e_0 \xrightarrow{\alpha_0} e_3 \mid Ag_1, Env) = 0,3 \end{array}\right\} = 1$$

$$\left.\begin{array}{l} p(e_0 \xrightarrow{\alpha_1} e_4 \mid Ag_2, Env) = 0,8 \\ p(e_0 \xrightarrow{\alpha_1} e_5 \mid Ag_2, Env) = 0.1 \\ p(e_0 \xrightarrow{\alpha_1} e_6 \mid Ag_3, Env) = 0.1 \end{array}\right\} = 1$$

b) Given these definitions, determine the expected utility of agent Ag_1 and Ag_2 with respect to Env and u, and explain wich agent is optimal with respect to Env and u.

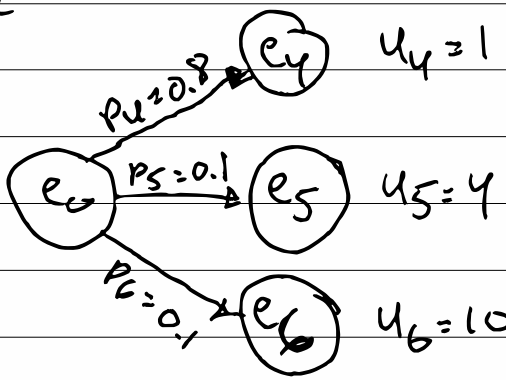
We need to calculate the expected utility of both agents using their actions.

A_{S1}:



$$\hat{u}_{A_{S1}} = E(u) = p_1 u_1 + p_2 u_2 + p_3 u_3$$
$$= 0.3 \cdot 4 + 0.4 \cdot 6 + 0.3 \cdot 5 = \underline{\underline{5.1}}$$

A_{S2}:



$$\hat{u}_{A_{S2}} = E(u) = p_4 \cdot u_4 + p_5 \cdot u_5 + p_6 \cdot u_6$$
$$= 0.8 \cdot 1 + 0.1 \cdot 4 + 0.1 \cdot 10 = \underline{\underline{2,2}}$$

$\Rightarrow$ Ag_1 using action a_0 is optimal in this environment

$$\hat{u}(Ag_1, Env) > \hat{u}(Ag_2, Env)$$