TEK5010 Multiagent systems

Lecture 2: Agents, communication and cooperation

Exercise: Decision theory

**Question 1**

Consider the environment $Env = \langle E, e_0, \tau \rangle$ defined as follows:

$$E = \{e_0, e_1, e_2, e_3, e_4, e_5, e_6\},\ \tau\left(e_0 \xrightarrow{\alpha_0}\right) = \{e_1, e_2, e_3\} \text{ and } \tau\left(e_0 \xrightarrow{\alpha_1}\right) = \{e_4, e_5, e_6\}$$

There are two agents possible with respect to this environment, which we shall refer to as $Ag_1$and $Ag_2$:

$$Ag_1(e_0) = \alpha_0 \text{ and } Ag_2(e_0) = \alpha_1$$

Assume the probabilities of the various runs are as follows:

$$P\left(e_0 \xrightarrow{\alpha_0} e_1 \middle| Ag_1, Env\right) = 0.3$$
$$P\left(e_0 \xrightarrow{\alpha_0} e_2 \middle| Ag_1, Env\right) = 0.4$$
$$P\left(e_0 \xrightarrow{\alpha_0} e_3 \middle| Ag_1, Env\right) = 0.3$$
$$P\left(e_0 \xrightarrow{\alpha_1} e_4 \middle| Ag_2, Env\right) = 0.8$$
$$P\left(e_0 \xrightarrow{\alpha_1} e_5 \middle| Ag_2, Env\right) = 0.1$$
$$P\left(e_0 \xrightarrow{\alpha_1} e_6 \middle| Ag_2, Env\right) = 0.1$$

Finally, assume the utility function $u$ is defined as follows:

$$u\left(e_0 \xrightarrow{\alpha_0} e_1\right) = 4$$
$$u\left(e_0 \xrightarrow{\alpha_0} e_2\right) = 6$$
$$u\left(e_0 \xrightarrow{\alpha_0} e_3\right) = 5$$
$$u\left(e_0 \xrightarrow{\alpha_1} e_4\right) = 1$$
$$u\left(e_0 \xrightarrow{\alpha_1} e_5\right) = 4$$
$$u\left(e_0 \xrightarrow{\alpha_1} e_6\right) = 10$$

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

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