**Assignment 2**

Agents Reasoning with Incomplete Information

3806ICT Robotics, Agents and Reasoning

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# Task 1: Knowledge representation and belief revision

Describe how to update the belief of a player in a game of Spanish Dominoes.

Illustrate the different cases and the application of Bayesian Belief revision.

# Task 2: Incorporating reasoning

Illustrate how the new method does better.

Propose a further improvement or at least another algorithm that benefits from the representation of gaining information about the history of the game.

What strategies can you imagine for collaboration?

# Experience

It was great using Python to interface with Prolog.

# Topics Covered

In this assignment we covered topics such as the following:

1. **Knowledge Representation**

One of the most useful ways of representing knowledge in a system is with logic. This can be done through a Programming language such as Prolog. Prolog’s robust knowledge base is made up of facts and relationships between facts. This allows knowledge to be accessed through queries.

1. **Incomplete Information**

In some cases, agents may not have complete information about there environment. For example, in a game like Dominoes, players do not know the tiles held by the other players. In contrast, within a game like chess, both players have complete information about the environment as all pieces are visible. Despite having incomplete information, it is possible to reduce uncertainty and make predictions about the environment with something like Bayes inference. Bayes inferences takes what we know about the environment and creates a probability that a given thing is true. E.g. perhaps you are dealt 7 tiles with a 1 on each. Since we know that there are only 7 tiles in the game with a 1, we can make the inference that nobody else has a 1.

1. **Agent Collaboration**

Agent collaboration is when we have multiple agents communicating and cooperating with one another. It is useful for solving problems too large for a single agent to solve by itself. An example of this could be in a system that collects global weather information. It would be impossible to have a single agent identify global weather by itself. However, a vast spread of agents collaborating across the globe each identifying a different section of weather to build a big picture would be much more efficient.

1. **Teams of Agents**

Agents that collaborate can also be in teams. This can look different depending on the type of the agents in the team. Firstly, there are benevolent agents. These are agents which we can fully control and thus can help each other. Secondly, there are self-interested agents. These are agents that come from a 3rd party and act in their own interest, potentially causing conflict with other agents in the system. An example of teams of agents can be seen in a dominoes game. We might have two benevolent agents on the same team who try to optimise which tiles they place down in order to help its team member. The opposition would be seen as self-interested agents who have their own goal and thus may intentionally or unintentionally make it more difficult for them to win.

1. **Belief**

When there is incomplete information about an environment, agents use a system of probabilistic belief to make decisions. This can be achieved by using probabilistic reasoning using Bayes inference. For example, in robot soccer the robot might be out on the field and have an unclear idea of its current position. It may then see it is next to the opposition goal post, and suddenly it has a very clear idea of its current position. The more information the robot has, the more clarity it has of its position.

1. **Intelligent Decision Making**

Agents can make intelligent decisions by applying game theory. Game theory is when we apply strategy in a situation. This is done usually to receive the greatest payoff. In a game payoff is determined by the decisions of all agents. Here, an agent can make intelligent decisions based off an action’s expected payoff and make an optimal decision. In some cases, this cannot function in a pure greedy approach where the agent choses payoffs that are the largest. Sometimes a Nash Equilibrium state will occur whereby, despite having a lower payoff, is the better choice, as it is more stable and can be made irrespective of an opponent’s action.

# Appendix

**[1] …**