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MATH. - NATURWISS. FAKULTÄT
FACHBEREICH INFORMATIK
KOGNITIVE SYSTEME · PROF. A. ZELL

Artificial Intelligence

Assignment 1

Discussions and Assignment due on: 05.11.2021

<u>Notes</u>: Please always justify your answers, even for yes/no questions, unless the description explicitly states otherwise. Full grades can only be awarded when answers are justified. Use the template provided on ILIAS for your submissions and answer in English.

Question 1 Properties of Agents (5 points)

For each of the following statements, decide whether it is true or false and support your answer with examples or counterexamples where appropriate.

- A rational agent mastering chess cannot be rational in playing go at the same time.
- An agent which acts in a certain way may behave differently at a different time step, although the environmental state is exactly the same. Such an agent can still be rational.
- A rational agent is certainly deterministic.
- AlphaZero and Stockfish are both esteemed chess programs, able to beat today's best human chess grandmasters. Though, AlphaZero is considered to be superior over Stockfish. This indicates, that AlphaZero is at least slightly more rational than Stockfish.
- An agent deliberately choosing a losing move is not rational.

Question 2 Environments for agents (4 points)

For each of the following task environments identify its properties: observable, deterministic, static, discrete, and number of agents. Justify your answer.

- Solving this Assignment
- Playing Chess
- Playing Soccer
- Cooking hard-boiled Eggs

Question 3 Structure of Agents (2 + 2 + 1 = 5)

- Suppose we keep the agent program fixed but speed up the machine by a factor of two in a dynamic environment. Does that change the agent function and why?

- Consider a self-driving car equipped with all the sensors, which drives automatically from a source point A to a destination point B? Is this self-driving car an instance of a model-based reflex agent, a goal-based agent, or a utility based reflex agent? Justify your answer?

- Give an example of a useful model-based reflex agent which is not a goal-based agent. Justify your answer.

Question 4 Introduction to Python (2 + 4 = 6 Points)

In preparation for this assignment, you need to install an interpreter for python as discussed in the tutorial session. You are not allowed to use any packages. Make sure to use python ≥ 3.6. Implement the following tasks using the template provided in our Ilias course.

(a) Implement a function `binomial(n,k)` which returns the binomial coefficient $\binom{n}{k}$ for $n, k \in \mathbb{N}_0$ as an integer (`binomial(n,k).__class__` evaluates to `<class 'int'>`).

(b) Now implement a class `PascalsTriangle`. This class is meant to generate and hold the famous Pascal's triangle.

  − It will have the triangle as a list of lists in the attribute `self.data`. In the end, we will have, for example, `self.data[4][2] = binomial(4,2)`, i.e. `self.data[1]` is the first line of the triangle, and so on.

  − This class will have a static generator `binomial_generator` which yields the next line of Pascal's triangle one line at a time. The type of the returned object is a `list`. The first line is `[1]` $(= \binom{0}{0})$. Make sure to leverage the fact it's a generator by using the rule

$$\binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k} \quad \text{for } n, k \in \mathbb{N}.$$

  − Implement a method `update(num_rows)` for this class. This method uses the generator to calculate all rows until `num_rows` and updates `self.data`. If `num_rows` is smaller than what is there so far, no calculation should take place.

  − Implement `__str__()` (overrides this method from `Object`) for `PascalsTriangle` in a meaningful way, so that it prints Pascal's triangle nicely.