TU Clausthal

Department of Informatics

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Artificial Intelligence

– Sheet 1: Agents and Problem Formulation –

Date: 06. April 2011

Points:

_____ of 20

Group / Tutor:

Name(s) & Matr. no.:

Remarks:

- Exercises can be solved in **groups up to 2 students**.
- With **formal proofs** we do really mean **formal proofs**; i.e., not just text but mathematical methods (e.g. *proofs by induction*, proper formalizations, etc.).
- In order to be **permitted to the exam**, Clausthal students must have fulfilled the following requirement: In **average 50%** of each exercise sheet has to be solved successfully *and* on all but one exercise sheet at least **25%** of the points have to be reached.

Exercise 1 (2 Points, Performance vs. utility)

Both the performance measure and the utility function evaluate how well an agent is doing. Explain the **difference** with *a few* sentences.

Exercise 2 (6 Points, Expressiveness of standard agents)

Give **formal** proofs of the following claims.

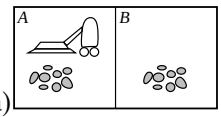
1. For every purely reactive agent, there is a behaviorally equivalent standard agent.
2. There are standard agents that have no behaviorally equivalent purely reactive agent.

Exercise 3 (4 Points, Equivalence of agents)

Formally prove Theorem 1.18: State-based agents are equivalent in expressive power to standard agents, i.e. that for every state-based agent there is a behaviorally equivalent standard agent *and* vice versa.

To be submitted:

20. April 2011
before class

(a) 

(b)

Percept sequence	Action
$[A, Clean]$	$Right$
$[A, Dirty]$	$Suck$
$[B, Clean]$	$Left$
$[B, Dirty]$	$Suck$
$[A, Clean], [A, Clean]$	$Right$
$[A, Clean], [A, Dirty]$	$Suck$
⋮	⋮

Figure 1: Vacuum-world

Exercise 4 (4 Points, Rational agents)

Consider the following definition of a *rational agent:*

> For each possible percept sequence per, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by per and whatever built-in knowledge the agent has.

Now consider the following scenario. There are two rooms A and B, each can be *dirty* or *clean* (cf. Figure 1(a)). A vacuum-cleaner agent can perform actions *left, right*, and *suck* (all actions have their obvious effects). Actions may fail with some low probability.
Does the the simple agent program in Figure 1(b) describe a rational agent? Show formal arguments for both possible answers.

Exercise 5 (4 Points, Problem formulation)

Suppose that `Successor-Fn`(s) consists of all tuples (a, s') such that s' is reachable by s if a is performed, `Legal-Action(s)` denotes the set of actions that are legal in state s, and `Result(a,s)` denotes the states that result from performing legal action a in state s.
Define each of these notions as **a function of the other two** (i.e, for instance, `Successor-Fn` in terms of `Legal-Actions` and `Result`).