Student name: ______________________________ Student number:

Faculteit der Exacte Wetenschappen	
Exam Design of Multi-Agent Systems	
Vrije Universiteit Amsterdam	**13 January 2011**

Exercise	**1**	**2**	**3**	**4**	**bonus**
points	25	30	20	15	10

Norm:
The exam mark **T** equals (the sum of the points scored for the exercises plus 10 bonus points) divided by 10.
The end mark **E** for the course Design of Multi-Agent Systems is calculated as follows: **E = (T + H + P) / 3** , note that the grade for the exam should be sufficient (≥ 5.5) in order to receive a grade.
Where : T = exam mark H = mark for the home work exercises P = mark for the small practicum

You find:

4 exercises
5 appendices (1A, 1B, 2, 3, 4)
You can answer in Dutch as well as English

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Exercise 1 (25 points):

Relevant Appendices: Appendix 1A and Appendix 1B.

This exercise consists of two parts. Motivate your answers.

Exercise 1a (15 points)

In chapter 1 of the syllabus a number of primitive agent concepts have been introduced (see Appendix 1B of the answer sheets). In Appendix 1A, you can find some information on an intelligent depression support system.
Analyse this information according to the primitive agent concepts and fill out Appendix 1B (3 answer sheets) indicating which agent concepts are relevant for the intelligent depression support system. Remember to motivate your answers clearly.

Exercise 1b (10 points)

Would you call this system an agent? Motivate your answer, and hereby involve the agent definitions as explained during the course.

Exercise 2 (30 points)

Relevant Appendix: Appendix 2.

This exercise concerns the building of an eleven cities tour agent, and is explained in Appendix 2.

Exercise 2a (15 points)

Give a graphical representation of the information types that you would use in the eleven cities tour agent.

Exercise 2b (15 points)

Use the information types you have identified above to specify rules of the knowledge base needed for the eleven cities tour agent.

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Exercise 3 (20 points)

Read Appendix 3 (about an energy management agent) and answer the following questions.

Exercise 3a (10 points)

The generic agent model of Chapter 7 consists of 6 components: agent_interaction_management, world_interaction_management, maintenance_of_agent_information, maintenance_of_world_information, own_process_control, and agent_specific_task. Which of these components do you need and which do you not need to model the energy management agent? Motivate your answer and make explicit references to the text of Appendix 3.

Exercise 3b (10 points)

The process of interaction that the agent needs is rather complicated. The type of communication that it needs with the households is rather different from that with the weather institute and the electricity company. Furthermore, for communication with the households it has different channels. Suppose that component comp_c of the agent is responsible for all this (note that this might be one of the components of the GAM but this is not important for this part). Then component comp_c should be composed. Provide a process composition of comp_c and the links needed within comp_c to model these processes. Motivate your answers in a rationale.

Exercise 4 (15 points)

Relevant Appendix: Appendix 4.

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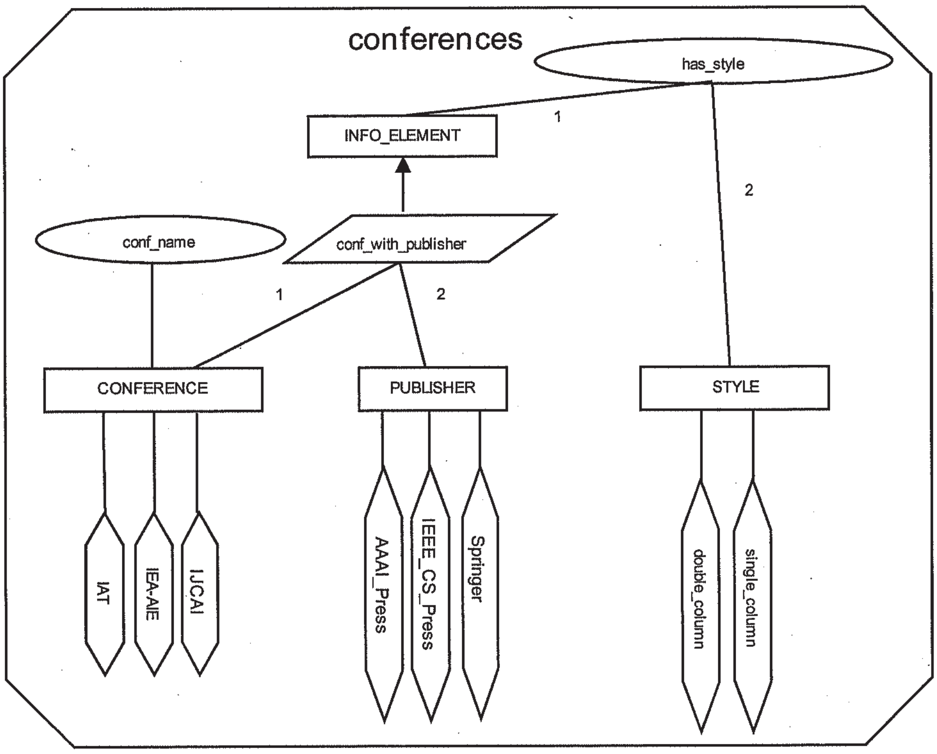

Consider the information type conferences as shown in the figure above. In Appendix 4 you can find a table consisting of a number of strings. Which of these strings are terms considering the information type conferences? Which are atoms? And which are ground atoms? Which of the terms are well formed? Which of the atoms are well formed? Fill in your answer in the table in Appendix 4.

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Appendix 1A: Intelligent depression support

In modern society, depression is a mental illness with a significant impact on the patient suffering from a depression, the direct environment of the patient, but also the society in general. A problem with treating people suffering from a depression is that it is quite a step for a person suffering from a depression to go to a general practitioner, or a psychologist, explain his/her problems, and receive appropriate treatment. As a consequence, too few people receive treatment, and remain in their depression for an unnecessary amount of time. In order to improve these matters, it is envisioned to develop an intelligent support system for people suffering from a depression. This system is briefly described below.

The intelligent support system is meant to monitor the patient, provide therapy, and give dedicated feedback to the patient. In order to do so, the system continuously monitors the behavior of the patient. It hereby monitors the activity of the patients via sensors (e.g. motion sensors, heart rate sensors, but also by looking at GPS locations), but also actively asks the patient questions what the patient is currently doing. Next to the activities, the system also monitors the mood (i.e. how the patient is feeling), this is done by asking the patient how he is currently feeling. The providing of therapy consists of giving homework assignments to the patient (e.g. to schedule certain nice activities), and showing relevant information to the patient (e.g. general information about negative thoughts people might have). All of this is done in a joint effort between patient and system to come to a rapid recovery. The final element is to provide feedback to the patient, which is simply done by sending text messages, or displaying some graphical information (e.g. the mood over the past week).

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Appendix 1B: Answersheet (1 out of 3)

I. External primitive concepts	
A. Interaction with the world	
passive observations	
active observations	
performing actions	
B. Communication with other agents	
incoming	
outgoing	

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Appendix 1B Answersheet (2 out of 3)

II. Internal primitive concepts	
A. World Model	
B. Agent Models	
C. Self Model	
D. History	
E. Goals	
F. Plans	
G. Group Concepts	
Joint goals	
Joint plans	
Commitments	
Negotiation strategies	

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Appendix 1B Answersheet (3 out of 3)

III. Types of behaviour	
Autonomy	
Responsiveness	
Pro-activeness	
Social behaviour	
Own adaptation and learning	

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Appendix 2: Eleven cities tour agent

Probably one of the most discussed topics in the Netherlands when there is a substantial period of very cold weather is whether an eleven cities tour (a large outdoor skating tour) will be organized. As a consequence of all these discussions and speculations, the job of determining whether it is safe to organize such a tour should be specified in a very precise way (to not give into the pressure of a lot of people wanting to have an eleven cities tour). Therefore, an agent will be developed which is able to do exactly this job: observe the ice conditions, and derive if and when an eleven cities tour can indeed be organized.

The agent will be able to perform a number of observations. First of all, it will be able to observe the thickness of the ice at two locations of the tour (assuming they are representative): Sneek and Dokkum. The thickness of the ice can be observed as *too thin*, *almost thick enough*, and *thick enough*. In addition to the observations of the ice itself, the agent is also able to observe the weather forecast for the coming week. This forecast can be *very cold*, *cold*, and *warm*. Finally, the agent is able to observe whether the tour has already been organized this season.

Of course, the agent not only simple observes, but also derives particular actions. In this case, the agent can decide to take the action of organizing the tour. This action incorporates when the tour needs to be organized: either in *one week time*, or in *two weeks time*. The agent can also perform the action to start transplanting ice at one of the two locations. This essentially will result in a quicker growth of the ice mass.

The agent now has the following knowledge rules: If the agent observes that the ice is thick enough in both Sneek and Dokkum, and the forecast is either cold or very cold, and the tour has not been organized yet, the agent will perform the action to organize the tour one week from now. In case the ice is almost thick enough in either Sneek or Dokkum, whereas it is already thick enough in the other (i.e. thick enough in Sneek and almost thick enough in Dokkum, or thick enough in Dokkum and almost thick enough in Sneek), a cold period is forecasted, and the tour has not been organized yet, the agent will perform the action to transplant ice at the location where the ice is almost thick enough. Finally, in case of the same situation (almost thick enough at one location, and thick enough at another), a very cold period is forecasted, and the tour has not been organized yet, the agent will perform the action to organize the tour in two weeks.

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Appendix 3: Energy management agent

As a consequence of the trend towards renewable sources of energy, and due to the nature of such energy sources, the structure of the energy market is rapidly changing. Traditionally, the energy market was set up in such a way that you had a small number of large producers (i.e. large power plants) that sold electricity, and a large set of smaller consumers that would buy this energy. With renewable energy however, households are even producing their own electricity (e.g. solar panels on the roof) and sometimes even produce more energy than they need themselves, hence, they even become willing to sell energy. A problem with this trend is that the production of energy is becoming less predictable. If there is no sun, the households will not be able to sell power to the network (and might even need to buy additional energy), and windmills for example, only produce energy when there is wind.

In order to make the transition sketched above possible, it is envisioned to create intelligent support agents for each household that make predictions on the amount of electricity they expect to consume or produce during the coming week. Such an agent can be very helpful to determine the gap between supply and demand which could potentially be used to act as a trigger to create buffers of energy in case there is an expected excess of energy production, or utilize buffers of energy in case there is a shortage. Such a buffer could for example be a water basin.

To create a prediction, this agent will truly need a lot of intelligence. Essentially, the agent has the following tasks:

1. It builds up a profile of the household, this should at least contain:
    a. The number of persons in the household.
    b. The weekly routines of each household member (limited to those routines which influence the electricity consumption).
2. It has knowledge about the energy production capabilities of the house:
    a. The type of energy producer (e.g. solar panel, wind turbine)
    b. The characteristics of the energy producer (e.g. in case of wind power 5, the wind turbine produces x kilowatt of power).
3. The agent is capable of interacting with the weather institute concerning weekly predictions about the expected solar power, temperatures, and wind power.
4. The agent is capable of interacting with electricity companies to know the prospected price of energy (i.e. the price at which energy can be bought, but also sold).
5. The agent will keep the household informed about their envisioned power consumption/production and the associated cost.
6. The agent will keep the electricity companies updated on the expected power production or consumption of the household.
7. In order to interact with the various external parties (the people part of the household, the weather institute, and the electricity companies), it can interact with the household through a web-based interface, or via voice (to satisfy potentially older customers). With the electricity company and the weather institute it communicates via a dedicated data connection.

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Appendix 4: Answersheet for Exercise 4.

	term	atom	ground atom	well-formed
single_column				
has_style(I:INFO_ELEMENT, S:STYLE)				
conf_with_publisher(IAT, X)				
conf_name(IJCAI)				
has_style(conf_with_publisher(IAT, Springer), single_column)				
conf_with_publisher(has_style, S:STYLE)				
conf_name(AAMAS)				
has_style(conf_name(IAT), double_column)				
P:PUBLISHER				