ANSWER OF EXAM IN SIF8072 DISTRIBUTED ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS

WEDNESDAY 18 DECEMBER 2000, 9AM - 1PM

1 Problem I. What is an agent? (10%)

1. If traffic lights (togather with their control systems) are to be considered as intelligent agents, which of agent's properties should they employ? Illustrate your answer by examples.

   ANSWER:

   Autonomous The traffic light can switch without intervention of human's.

   pro-active The traffic light will switch from red to green if many cars are waiting.

   reactive When a person presses the botton, the traffic light will switch green soon to let the person cross.

   social-ability Traffic light can interact with human through the button.

   varacity The traffic light will not give false information.

   benevolent The goal of traffic lights is to control the traffic.

   rationality The traffic lights wouldn't make the traffic condition worse.

2 Problem II. Theory (10% + 10%)

1. Are Modal Logics more suitable than Classical Logic for modeling intelligent agents? Explain your answer.

   ANSWER:

   Yes. In Classical Logic, formulas are either true or false in any model, which is not suitable for intentional notions. However, agent system is an intentional system. Modal logic can be considered as the logical theory of necessity and possibility. In the study of agents it is used to give meaning to concepts such as belief and knowledge.

2. Formalize in the logic of knowledge the following problem:

   "Agent A wants to find out cost of football tickets. Agent A doesn't know the cost but Agent A knows that Agent B exists. Agent B doesn't know the cost either but Agent B knows that Agent C exists. Agent C knows the cost".

   ANSWER:

$$\neg(K_A P_1) \wedge (K_A P_2) \wedge \neg(K_B P_1) \wedge (K_B P_3) \wedge (K_C P_1)$$

   Where P_1 the cost of ticket.
   P_2 agent B exists.
   P_3 agent C exists.

3 Problem III. Negotiation (5% + 5%)

1. What are the basic differences in applying negotiation strategies for cooperative and self-interested Multi-Agent Systems?

   ANSWER:

   For a cooperative Multi-Agent system, the goal of negotiation is to get the maxium social walfare. For a self-interested negotiation, each agent wants to fullfil maxium benefit of its own.

2. Insincerity of the auctioneer (even if s/he doesn't disclose bids to others) may be a problem in the Vickrey auction. Illustrate this by an example.

   ANSWER:

   If an auctioneer is eager to get the offer, he may give a bid much higher than the real price. The result is he can get the offer without paying so much in that he pays the bid by the second higher price. However, if there are more than one insincere auctioneers, the auctioneer may also pay a high price.

4 Problem IV. Communication (5% + 10%)

1. Give basic ideas of the agent communication languages KQML and FIPA. What do they have in common and what are basic differences between them?

   ANSWER:

   Both KQML/ FIPA:

   - have similar format that includes the fields, such as sender, receiver, content language, ontology, etc.

- provide a means for agent to communicate their intentions to other agents. In KQML, it's called performative while in FIPA, it's called
- are independent of the context syntax and ontology used to describe the actual content of the message.

The difference:

- FIPA includes a description of the pragmatics. The set of communicative acts it provides are provided in both a narrative form or with formal semantics. But KQML doesn't give an explicit explanation on the performative.
- The FIPA does not provide for facilitator agents while KQML provides a class of agents that serve or facilitate other agents, such as broker, translator or matchmaker.

2. List the sequence of KQML or FIPA(it is your choice) performatives that must be generated by Agent A, Agent B and Agent C for solving the problem described in the problem II, item 2.

   ANSWER:

   KQML: ask, tell, untell

   FIPA: inform-if, confirm, disconfirm

5 Problem V. Architectures for agents and Multi-Agent ystem (25%)

1. Propose a general architecture for a Multi-Agent System which implements a simple virtual shop on the Internet. In particular, give the basic types of agents and possible types of coordination, communication and negotiation in such a system.

   ANSWER:

   The virtual shop has a number of buyers and sellers which connect to a shop and communicate through the shop.

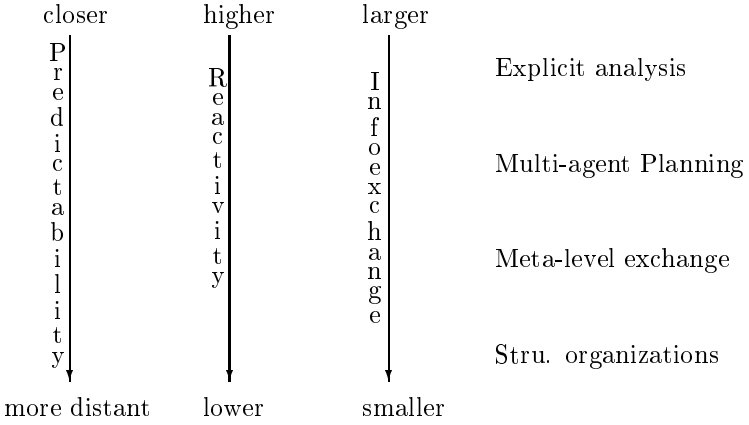
   - Multi-Agent Architecture.
     The shop is implemented by blackboard architecture which is goal directed. The agents post message about what they want/offer. The messages can be read and evaluated by all agents.
   - Agent Architecture
     The buyer and seller agents can be implemented in hybrid architecture where the reactive layer is on the bottom and the delibrative layer is on top. Some decisions, such as advertise, matchmaking can be made by reactive layer, while the other complex decisions, such as negotiation are made by delibrate layer.

6 Problem VI. Coordination (10%)

1. Describe the basic coordination techniques. Compare these techniques and give examples of situations where each of the techniques can work better than others.

   ANSWER:

   The common coordination techniques are explicit analysis, multi-aent planning, meta-level exchange and organizational structures. (no explicit analysis in Amund's lecture notes)



7 Problem VII. Mobile agents (10%)

1. What are the main security issues for mobile agent system?

   ANSWER:

   Authentication Both the agent and the host should be trusted.

   Secrecy Your agents should maintian your privacy.

   Security The mobile agent can't be infected by virus or cosume so much resource on the host.