Behavioural Dynamics - Exam

Wednesday December 22, 2004, 9:30-12:30.

This exam consists of three assignments, which count with equal weight. Hand in your answers to each exercise on a separate sheet. Always motivate your answers.

Good luck!

Assignment 1

A big company decided to employ several students for a certain job. In this assignment, you are going to model the behavior of a student (an agent), who is involved in the selection process. First, the list of possible candidates is published by the company and the agent observes his name among others. Then, the agent becomes more interested in the job, offered by the company, and definitely wants to get it. After some time, the company makes its final decision and publishes the names of the students, who will be employed. The agent observes his name on the list and believes that is proposed to be an employee of the company. Therefore, the agent intends to start performing his job soon. After some time the agent is given his job prescription. Finally, knowing his tasks, the agent begins to perform his job.

Assume the following relevant state properties for the example:

External state properties

list_pos_cand	the list of possible candidates for a job is available
list_future_emp	the list of future employees of the company is available
job_prescr	the job prescription is accessible

Input state properties

obs(list_pos_cand)	the agent observes the list of possible candidates for a job
obs(list_future_emp)	the agent observes the list of future employees of the company
obs(job_prescr)	the agent observes his job prescription

Output state properties

perform_job	the agent performs the job

Internal state properties

bel(employee)	the agent believes that he is proposed a future employee of the company
bel(job_prescr)	the agent has knowledge about his job prescription
des(perform_job)	the agent has a desire to perform a job
int(perform_job)	the agent has an intention to perform a job

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a) Give an example trace (showing external, input, output and internal state properties), characterizing the behaviour of the agent.

b) Show the dynamics of the example in a graphical form. Do not forget to indicate, which state properties are persistent.

c) Write down a list of executable dynamic properties, which characterize these dynamics. Which ones are step properties and which ones are persistence properties?

d) For one of the internal state properties, indicate by which of the dynamic properties in c) its functional role is defined.

e) Give a set of dynamic properties that specifies the input-output correlation from an **external** perspective.

f) Is it possible to attribute representational content to the desire to perform a job, according to the *causal/correlational approach* (address both forward and backward)?
If so, show how. If not, explain why not.

g) What are the {disjunction, conjunction, dynamics} problems? Do they occur in f)?

h) Give the representational content to the desire to perform a job, according to the *relational specification approach* (both forward and backward)?

i) Suppose the agent indeed performs a job. Give an (iterated) explanation from a functionalist perspective of the following form.

> Why does the agent perform the job?
>> The agent performs the job, because ....
>
> Why .....?
>> ...., because ...
>
> et cetera.

Assignment 2

Consider adaptive behaviour of a sea hare Aplysia.

Behaviour before learning phase

Initially the following behaviour is shown:

- a tail shock leads to a response (contraction)
- a light touch on its siphon is insufficient to trigger such a response

Learning phase

Now suppose the following experimental protocol is undertaken. In each trial the subject is touched lightly on its siphon and then, shocked on its tail (as a consequence it responds).

Behaviour after a learning phase

It turns out that after a number of trials (three in the current example) the behaviour has changed:
- the animal also responds (contracts) on a siphon touch.

a) A description from an **external** viewpoint of the behaviour **before** the learning period is given by dynamic property EP1

EP1   Contraction Upon Tail Shock

At any point in time t,

if   a tail shock occurs

then   it will contract

Is this an executable dynamic property? Why? If possible, give the property in graphical form. What type of behaviour is this (e.g., stimulus-response, rigid delayed response, updating delayed response, motivation-based, adaptive)?

b) A description from an **external** viewpoint of the behaviour **after** the learning period is given by dynamic properties EP1 and EP2 together.

EP2   Contraction Upon Siphon Touch

At any point in time t,

if   a siphon touch occurs

then   it will contract

Is EP2 an executable dynamic property? Why? If possible, give the property in graphical form. What type of behaviour is this (e.g., stimulus-response, rigid delayed response, updating delayed response, motivation-based, adaptive)?

c) A description from an **external** viewpoint of the behaviour **during** the learning period is given by dynamic property EP3.

EP3   Learning Contraction Upon Siphon Touch

At any point in time t,

if a siphon touch occurs

  and   at three different earlier time points t1, t2, t3,

a siphon touch occurred, directly followed by a tail shock

then   it will contract

Is EP3 an executable dynamic property? Why? If possible, give the property in graphical form. What type of behaviour is this (e.g., stimulus-response, rigid delayed response, updating delayed response, motivation-based, adaptive)?

The rest of this exercise will focus in particular on the behaviour **during** the learning period. Assume the conditioning process takes place after a training period of three steps. In Table 1 below,

an example **external** interaction trace of this process (from behaviour before a successful learning phase via the learning phase to behaviour after the learning phase) is given.

Table 1

time	0	1	2	3	4a 4b	5	6a 6b	7
input	shock		touch		touch shock		touch shock	
internal								
output		contract				contract		contract

time	8a 8b	9	10	11
input	touch shock		touch	
internal				
output		contract		contract

d) Extend this table with an **internal** description of the overall behavioural trace. In other words, fill in the internal state properties **SN1, SN2, IN, MN, S1, S2, S3** and **S4** (see Figure 1) in the table. While doing this, make sure you add a new column for each new situation. Thus, the number of time points might become a lot more than 11! Furthermore, assume for the sake of simplicity that during a trial in the learning period, activations of IN and SN2 last sufficiently long so that they are activated at a same time point.
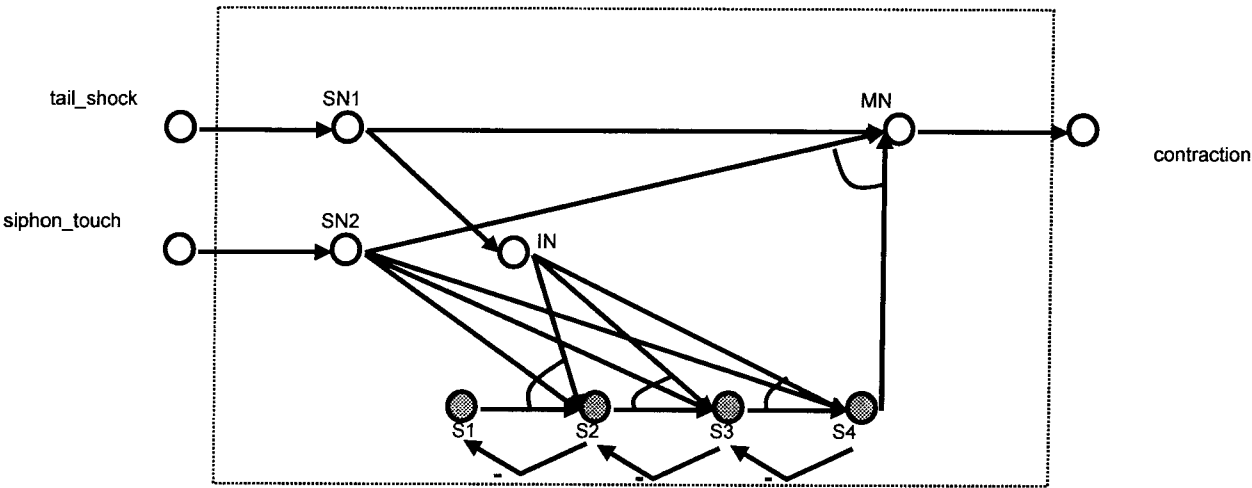
Figure 1 Dynamics of *Aplysia*'s Internal Adaptation Mechanisms

e) Consider the internal dynamics given in Figure 1. Describe the functional role of one of the nonpersistent and one of the persistent internal state properties.

Assignment 3

Answer the following questions

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a) Explain the difference between *behaviouralism* and *functionalism*

b) What is *compositional verification* of an Agent System?

c) Give an example of reasoning by assumption.

d) What does Damasio mean by *emotion, feeling,* and *feeling feeling*?

e) When is a certain theory T2 *Nagel-reducible* to another theory T1? Give an example.

f) What is an *extended mind*? Give an example.