Behavioral Psychology

Mallot [MALLOT97], among others, describes the interactions between a behavioural entity and its environment (see Figure 1). The overview of the system is a perception-decision-action loop. The first arrow from sensors to actuators is called homeostasy (i.e. the internal regulation feedback) whereas the second arrow stands for the actions required for perception (e.g. turning the head to see something which should be on the left).

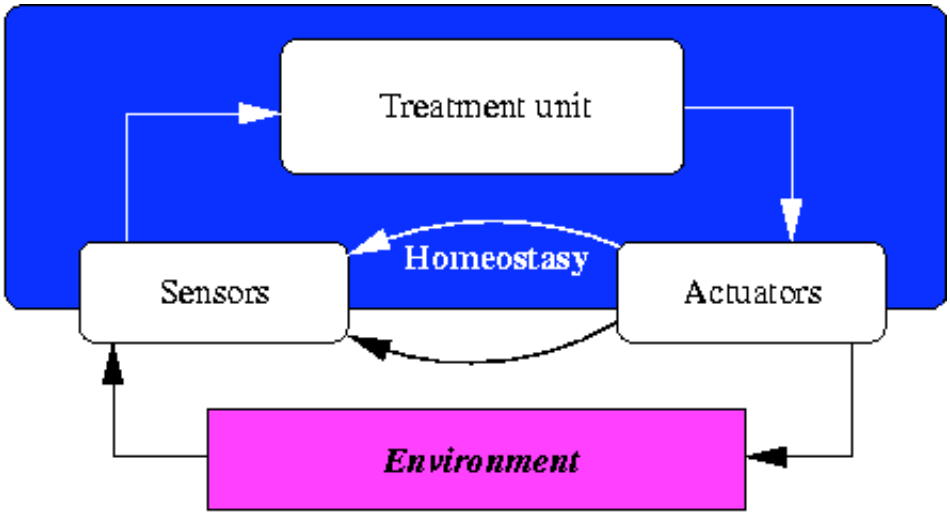

Figure 1: The human organism and its environment.

Information needed to describe the behaviour of an entity depends on the nature of this entity. No theory exists for determining either the necessary or sufficient structures needed to support particular capabilities and certainly not to support general intelligence. As direction and inspiration towards the development of such a theory, Newell [NEWELL90] posits that one way to approach sufficiency is by modelling human cognition in computational layers or bands. He suggests that these computational layers emerge from the natural hierarchy of information processing.

Lord [LORD94] introduces several paradigms about the way the brain works and controls the remainder of the human body. He explains that human behaviour is naturally hierarchical, that cognitive functions of the brain are run in parallel. Moreover cognitive functions are different in nature: some are purely reactive, while others require more time. Execution times and frequencies of the different activities are provided. Newell asserts that these levels are linked by transferring information across hierarchical levels, and that each of them operates without having any detailed knowledge of the inner workings of processes at other levels. All that is required is a transfer function to transform the information produced by one level into a form that can be used by another. Particularly important is the notion that symbolic activities occur when they are locally based on problem spaces constructed on a moment-to-moment basis. According to Newell [NEWELL90], the constraints of a computer behavioural model are the following:

- adaptative and flexible behaviour;
- real-time interaction with the environment;
- complex and rich environment, i.e., a behavioural entity should be able to perceive its environment, should have a knowledge database and several degrees of freedom of action on the environment;
- use of symbols and abstraction;
- autonomy in a social background (ie. possible social interactions with other entities);
- self-consciousness and perception;
- ability to learn;
- constructable as a neural network by an embryological growth process, and having arisen through evolution.

The last three constraints expressed in the last item will not be adressed in this paper. In fact we essentially focus on the first six constraints. Therefore, our goal is to build a model which will allow some adaptative and flexible behaviour to any entity evolving in a complex environment and interacting with other entities. Interactive execution is also fundamental. This has led us to state that paradigms required for programming a *realistic* behavioural model are the following:

- reactivity, which encompasses sporadic or asynchronous events and exceptions;
- modularity in the behaviour description, which allows parallelism and concurrency of sub-behaviours;
- data-flow, for the specification of the communication between different modules;
- hierarchical structuring of the behaviour, which means the possibility of preempting sub-behaviours on transitions in the meta-behaviour as a kind of exception or interruption. It means also that sub-behaviours can notify the meta-behaviour of their activity;
- frequency handling for execution of sub-behaviours. This provides the ability to model reaction times in perception activities.