Course 03-05-H-711.01

Cognitive Systems I

Christian Freksa, Thomas Barkowsky, Thora Tenbrink, Jan Frederik Sima

Summer 2009

Exercise 2: Extension of the cognitive architecture: perception vs. memory, addition, visual routines

(to be done in groups of 3-4 students, return per email by 10 May 2009 to cosy-exercises@informatik.uni-bremen.de)

In the last exercise you developed and implemented a simple cognitive architecture. Aim of this exercise is to add further functionality to this architecture without compromising the functionality you already realized in the last exercise. The visual stimuli employed are the same as in the last exercise (see Fig. 1)

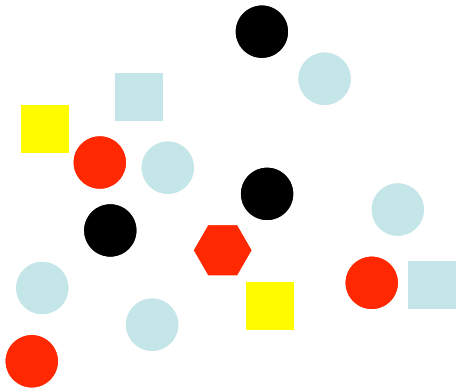

Fig. 1. Colored geometric objects as input of the cognitive architecture

1) We can assume that perception results are stored in memory (at the moment we leave open the question *how long* results are stored in memory). Thus, once the number of a particular type of objects (e.g., blue circles) has been determined, it can successively be reported regardless of the presence of the visual stimulus. Now the cognitive architecture ought to be extended such that separate results (from perception or memory) can be added up.

Example:
Question: “How many blue circles are contained in this picture?”
(visual stimulus)
Answer: “5”
Question: “How many blue circles are contained in this picture?”
(no visual stimulus)
Answer: “5”
Question: “How many black circles and blue circles (sum) are contained in the picture?”
Answer: “8” (Number of black circles determined from visual input, number of blue circles determined from memory, addition)
Question: “How many red circles and blue circles (sum) are contained in the picture?”
(no visual stimulus)
Answer: “number unknown” (number of red circles is unknown)

Remark: It is to be assumed that that operation will be executed which is most economic in cognitive terms: if the information asked for is already stored in memory, it is easier to retrieve it than to process the visual input (you can assume that always the same picture will be shown).

2) Grouping of uniform visual stimuli usually eases processing of these stimuli and thus allows processing to be faster. If, for instance, uniform objects like blue circles are arranged as in the following, it is immediately obvious that there are nine single objects even without counting them:

This ability to recognize and exploit spatial groupings is based on *visual routines*. Visual routines allow integrating several objects into a single complex one which, then, is utilized in the overall analysis (e.g., determining the number of blue circles). Extend your architecture by adding several (3-4) visual routines of your choice (for different kinds of groupings), such that these routines are employed for analyzing the visual input.

Example:
Analyzing the following input should result in correctly recognizing that there are 5 objects present without individually counting the four grouped objects.

The problem in more detail:

a) Describe your concept of the extensions: which additional components are necessary for solving the task(s)? How is the interplay between these components realized?

b) Implementation of the cognitive architecture: implement the components such that the above described tasks can be accomplished by the system and that the interplay of the components can be observed.

c) Exemplify how your system reacts to different requests.