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Pattern recognition : indistinguishability of the word objects

M Michel Troublé

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1 **Pattern recognition : indistinguishability of the word objects**

2 M. Michel Troublé :

3 * Nuclear industry : AREVA (Department of Advanced Researches : AI and Robotics)

4 * Orsay University - Institute of Nuclear Physics (PhD)

5 **1. Summary :**

6 The question is the following : can the numerical mechanisms of the ‘pattern recognition’
7 lead to the creation of sensory-motor structures that would be *self-organized* as are the
8 *living beings* that ensure in any circumstances the perennality of their structure confronted
9 to a multiform environment that can only degrade them.

10 We demonstrate that the objects of the world that are perceived through measurements are
11 physically *indistinguishable* from the point of view of any other system that may produce actions
12 and this regardless of the properties that can be attributed to these objects. This is what we call the
13 ‘indistinguishability theorem’.

14 By virtue of the ‘indistinguishability theorem’, an *autonomous* robot that should, in our
15 image, always ensure the durability of its structure in the face of an environment that could
16 only dissociate it, given the entropic degradation of the universe that affects all inert
17 structures, is physically unfeasible.

18 **2. Introduction**

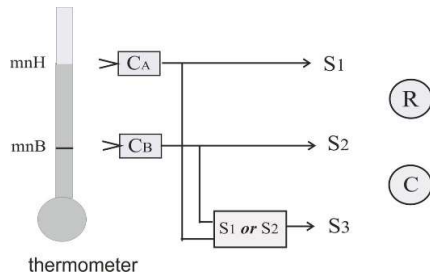
19 ‘Pattern recognition’ is a set of techniques that aim to identify the forms of objects from their
20 characteristic parameters in order to make decisions depending on the categories attributed to
21 these forms. ‘Pattern recognition’ is consequently a central issue in Artificial Intelligence and
22 Robotics which are essentially *sensory-motor* systems composed of *sensors* and *actuators*
23 (locomotion or gripper systems, displays) which are connected to each other in such a way that the
24 actions resulting from perception of the objects with which they interact, respond adequately to the
25 functions assigned to them.

26 In order to evaluate the relevance of the *categorizations* made by a ‘pattern recognition’
27 mechanism applied to *sensory-motor* structures provided with an Artificial Intelligence, we carry
28 out the ‘functional analysis’ of a thermometric measuring device of familiar use, a thermostat.

29 The functional analysis that allows to determine the solutions of connections between the
30 thermometric *sensor* and the *actuators* of a thermostat, is an analysis that must necessarily
31 be « out of subject ». This analysis has to determine the natural solutions of connections
32 between *sensors* and *actuators* which, « in the absence of any living being », could be
33 established spontaneously in view of the physical laws.

34 **Experimental device**

35 A thermostat (see Fig. 1) is made up of the following elements : a *sensor* (a thermometer),
36 *actuators* that turn on a ‘radiator **R**’ and an ‘air conditioner **C**’. The environment of the
37 thermostat is assumed to be only ‘hot’ or ‘cold’.



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39 Fig. 1. Thermometric device

40 Two photocells **CA** and **CB** – only sensitive to the specific shape of the mercury meniscus in the
 41 capillary tube – are positioned at two points **mnH** and **mnB** of the capillary which correspond to the
 42 two possible extreme positions reached by the meniscus depending on whether the thermostat
 43 environment is ‘hot’ or ‘cold’.

44 When the thermostat environment is ‘hot’ and the measurement is complete (the mercury column
 45 is stabilized) only the **CA** photocell is activated because the mercury column is in the high
 46 position **mnH**, i.e. an output signal **S1 = 1**, with **S2 = 0** (the **CB** photocell is not activated). For a
 47 ‘cold’ environment, only the **CB** cell is activated because the mercury column is in the low
 48 position **mnB**, i.e. an output signal **S2 = 1**, with **S1 = 0** (the **CA** photocell is not activated).

49 The states of the outputs **S1** and **S2** (**0** or **1**) of the **CA** and **CB** photocells are therefore the images
 50 of the thermal states in which the so-called ‘hot’ and ‘cold’ environments are found.

51 In all generality, there are logically two ways - and not only one - to take into account the totality
 52 of the information available at the two outputs **S1** and **S2** of the thermometer so that this
 53 information is transmitted for actions to the two actuators (**Radiator**, **Conditioner**) :

- 54 • Consider each of the two outputs **S1** and **S2** individually.
- 55 • Take into account both outputs **S1** and **S2** simultaneously, i.e. two possibilities :
 56 - the logical combination {**or**} between the two outputs, i.e. **S3 = [S1 or S2]**.
 57 - the logical combination {**and**} i.e. **S3 = [S1 and S2]**. However, since the mercury
 58 meniscus cannot objectively be simultaneously in the upper (hot object) and lower (cold
 59 object) positions, the combination **S3 = [S1 and S2]** is always identically null and therefore
 60 only the combination **S3 = [S1 or S2]** remains.

61 – Provided with an « out of subject » thermostat which is thus made up of the 3 outputs **S1**, **S2**,
 62 **S3** of its *sensor*, a technician then carries out the experiment described below which consists in
 63 connecting the 3 outputs **S1**, **S2**, **S3** of the *sensor* to the two *actuators* (**Radiator** and **Conditioner**).

64 The ‘rule of thumb’ followed by the technician is then the following : the **Radiator** and the
 65 **Conditioner** must be switched on when the room temperature is low (object ‘cold’) or high (object
 66 ‘hot’) respectively, in order to meet the functioning that is expected from a thermostat.

67 To carry out this operation in an exhaustive way - as Nature would spontaneously do in the absence
 68 of any human being - the technician, following a probabilistic approach, then constructs the
 69 Universe of all possible events (as in ‘game theory’), i.e. the implementation of 4 ‘natural’
 70 thermostats which are equally probable, by connecting the outputs **S1**, **S2**, **S3** to the actuators.

71 **thermostat n°1** consisting of the following two connections :

- 72 - connection between the **S1** output and the ‘Conditioner’.
- 73 - connection between the **S2** output and the ‘Radiator’.

74 **thermostat n°2** consisting of the following connections :

- 75 - connection between the **S1** output and the ‘Conditioner’.
- 76 - connection between the **S3** output and the ‘Radiator’.

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thermostat n°3 consisting of the following two connections :
- connection between the **S3** output and the 'Conditioner'.
- connection between the **S2** output and the 'Radiator'.

thermostat n°4 consisting of the following two connections :
- connection between the **S3** output and the 'Conditioner'.
- connection between the **S3** output and the 'Radiator'.

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The technician then checks whether the experiment he has implemented from the four equally probable 'natural' thermostats, in order to eliminate any arbitrary choice of connections, meets the objective that has been set : (1) the 'Radiator' should be switched on when the thermostat environment is 'cold', (2) the 'Conditioner' should be switched on when the environment is 'hot'. To this end, the technician successively presents a 'hot' object and then a 'cold' object to these 4 different thermostats and notes their different responses :

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- 'hot' object, hence the activation (e.g. at 1) of outputs **S1 and S3** (I. 56) :

thermostat n°1 → Conditioner on
(due to the **S1-Conditioner** link - I. 72)

thermostat n°2 → Radiator and Conditioner simultaneously in operation
(due to the **S1-Conditioner** and **S3 Radiator** link - I. 75 and 76)

thermostat n°3 → Conditioner on
(dû au lien **S3-Climatiseur** - I. 79)

thermostat n°4 → Radiator and Conditioner simultaneously in operation
(due to the **S3-Conditioner** and **S3 Radiator** link - I. 82 and 83)

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- 'cold' object, hence the activation (e.g. at 1) of outputs **S2 and S3** (I. 56)

thermostat n°1 → Radiator on
(due to the **S2-Radiator** link - I. 73)

thermostat n°2 → Radiator on
(due to the **S3 Radiator** link - I. 76)

thermostat n°3 → Radiator and Conditioner simultaneously in operation
(due to the **S3-Conditioner** and **S2 Radiator** link - I. 79 and 80)

thermostat n°4 → Radiator and Conditioner simultaneously in operation
(due to the **S3-Conditioner** and **S3 Radiator** link - I. 82 and 83)

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Summary of responses from the 4 thermostats :

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- With the presentation of the 'hot' object :

thermostats 1 et 3 : Conditioner on 2 times (I. 91 and 95)

thermostats 2 et 4 : Radiator and Conditioner on 2 times (I. 93 and 97)

- With the presentation of the 'cold' object :

thermostats 1 et 2 : Radiator on 2 times (I. 100 and 102)

thermostats 3 et 4 : Radiator and Conditioner on 2 times (I. 104 and 106)

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Objects which are qualified as 'hot' and 'cold' by the technician, are therefore both *different* by the fact that the 'Air conditioner' as well as the 'Radiator' are **switched on separately twice** on the 4 thermostats, but also *identical* because the 'Air conditioner' and the 'Radiator' are **switched on simultaneously also twice** on the 4 thermostats.

119 Consequently, the ‘hot’ and ‘cold’ objects that interact with the thermostat are therefore
120 statistically *indistinguishable* as regards the actions they can entail on the two *actuators* whatever
121 the properties attributed to these deux objects, since the thermometric *sensor* of the thermostat is
122 physically *unrelated* of any other possible *sensor* (the gravitational attraction between the elements
123 being totally negligible at our scale).

124 What is noteworthy, the fundamental *indistinguishability* of the macroscopic objects of the world
125 revealed by an experimental demonstration performed on a thermostatic device, is the logical
126 extension of the *indistinguishability* of particles in ‘quantum mechanics’, which microscopic
127 particles are at the origin of the existence of all macroscopic objects whose properties we measure.