# It's Cognitive Robotics, Stupid…

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Over the last decade we witness an unprecedented robot expansion into various fields of our life – from the traditional industrial and factory floor applications to much more smart and complex activities in homes, workplaces, hospitals, military and space missions, and so on. This new generation of robots is expected to co-habitat, interact and closely cooperate with humans. That, in turn, would require them to possess much more human-like features and capacities, which are usually designated by the umbrella terms "cognition" and "intelligence". This challenge for robotic intelligence has been readily met by the international research community – since 2002 DARPA and the European Commission are pushing ambitious programs under the label "Cognitive Robotics". However, the results of these enterprises are far from being satisfactory. The reason for this is that, first, the notions of cognition and intelligence (usually borrowed from human behavior studies) are notoriously blurred and ill-defined, and second, the basic concepts underpinning the whole discourse are by themselves either undefined or defined very vaguely [1]. That leads to improper and inadequate research goals determination, which I will illustrate with some examples drawn from recent documents issued by DARPA and the European Commission. On the other hand, I would like to propose some remedies that, I hope, would improve this embarrassing situation [2]. The main points of my proposition are as follows: Intelligence (cognitive capacity) is the system's ability to process information. Information is a description of structures observed in a data set. Two types of information thus must be discerned in any information description – "physical information" and "semantic information". Physical information deals with primary structures that emerge from similarity among neighboring elements within the data. For an external observer these primary (physical) structures may create patterns of different arrangements, thus producing secondary structures. The description of these secondary structures is "semantic information". An important, but often neglected feature of semantic information is that it does not pertain to the data set. It is entirely an observer's property. More precisely, it is a convention, a shared agreement between members of a particular viewers group that observe the data. And therefore, it can not be learned from the analysis of primary structures' interrelations. On the contrary, to facilitate system's ability to process physical information the system must be provided with some prior knowledge (semantic information) about the likelihood of such interrelations. Again, semantics can not be learned. It must be provided (from the outside). And that is usually neglected by research requirements issued by the leading research authorities. In [3], one of the main goals of Challenge 2 is defined as "the problem of extracting meaning and purpose from bursts of sensor data". Wrong, sensor data does not possess semantic information and therefore meaning can not be extracted from it. In [4], "DARPA is interested in new algorithms for learning from unlabeled data in an unsupervised manner to extract emergent symbolic representations from sensory input…" Again, the statement is wrong and misleading because extraction of semantics ("from sensory input") can not be learned in any way.

I am not the great Hillel and I do not intend to teach you the Bible of Robotic Intelligence while you are standing on your one foot. But, I hope, I would be allowed to make my point.

**References:**

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[4] DARPA RFI SN-08-42: Deep Learning, http://www.darpa.mil/ipto/solicit/baa/RFI-SN-08-42_PIP.pdf