

"BEYOND TURING EQUIVALENCE"
SEMINAR PAPER
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In "Beyond Turing Equivalence" Aaron Sloman argues against computation being the only key concept for explaining intelligence in Cognitive Science and AI. Instead, he proposes a taxonomy approach of intelligent 'architectures' and the mechanisms and processes governed by such architectures in which computational and non-computational processes are properly classified alike. Such an architecture will be suitable for explaining various types of control, causality, semantics and states such as beliefs and desires semantics, all of which are found in intelligent agents.

His reason for taking issue with computation, is that the the only well-understood concept of computation is the formal one, put forth by Turing and captured by what a Turing Machine can do. As a formal notion, it is limited to manipulation of structures. Therefore it doesn't require implementation of any sort and therefore lacks causality/control. The lack of account for causality in the formal notion of computation makes it a candidate unsuited for explaining intelligence, which requires causality.

Past attempts to remedy this shortcoming have included an extension of formal notion to include processes involved in intelligence. This, Sloman argues, leads to either circular and trivial definition of computation. An example of a circular definition is one which includes processes like 'meaning' in the definition,

which computation is meant to explain. An example of a trivial definition is one which includes *all* processes involved in intelligence. If computation includes all processes, its special status in intelligence will vanish.

Sloman concludes that this dilemma of defining computation is a misconception about the range of processes involved in intelligence, some of which may be computational and other that are clearly non-computational. Chemical processes, continuous and independently variable states, for example, do not map onto a single Universal Turing Machine, but they must also be accounted for.

Thus, computation as a key notion is at once too general (since it includes non-causal, formal processes which are not found in intelligent agents) and too restrictive (since it excludes the continuous processes required for intelligence). Therefore a "new set of concepts" is required for explaining intelligence.

A suitable alternative framework for describing, explaining and modeling intelligence, Sloman suggests, is a taxonomy of the entire range of processes, sub-states and mechanisms involved in intelligence, computational or otherwise. These processes and sub-states comprise the overall architecture of the intelligent agent. Sub-states and mechanisms within the architecture are

causally related, independently-variable and share control (which in turn can be classified in a number of ways.)

Unlike other complex systems, intelligent agents have substates which differ not only in complexity, but in type (compare a human to a storm-cloud). Once the theoretical framework of a taxonomy of intelligence is established, different descriptions of the parameters of types of sub-states, control and mechanisms will yield descriptions of different intelligent agents.

Sloman uses this to suggest a theory of attitudes and semantics. Attitudes such as beliefs and desires are explicable in terms of substates which are belief-like and desire-like. In this regard, a thermostat's have belief-like states about room temperature, which differs from a human's belief-like state in its role in their overall architecture and the complexity of that architecture.

In Sloman's account for semantics, such sub-states can be semantically interpreted by other mechanisms or architectures. His theory of meaning as relations between sub-states is closely tied to Taskian semantics, allowing for indeterminacy of meaning (even if it is unique) and ruling out isomorphism underlying representation. Systematic correspondence between the world and a sub-state within an intelligent architecture is all that is

needed for a sub-state to represent a state of affairs.