STRUCTURAL, FUNCTIONAL, AND ORGANIZATIONAL CONDITIONS IN ARTIFICIAL INTELLIGENCE

Turing in Context II

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Can a Machine Think?

The Commonsensical Answer:

Yes, but you will never get a machine to do X

The frame problem

Pattern recognition

Creativity

Free will

Autonomy

Systematicity

Understanding

Natural language [Linguistic capability]

Evolution

Learning

Telling lies

Can a Machine Think? / NO!

Structural Challenges:

-- The human mind possesses a form of cognition that cannot be possessed by a machine.

-- Even if AI succeeds in developing some models of our basic cognitive skills, it will never be able to construct a mental model of our experience (first-person level), free will and creativity, which are considered to be the distinctive features of human beings.

-- It is not possible to find and implement general rules for an everyday experience of the world.

-- The problem is not concerned with the *instrumental* adequacy of representation but, rather, concerns the *form* and the *internal working* of the representation.

Functional and Organizational Challenges:

-- Dynamic Process; complexity; contextuality, heuristic problems

Can a Machine Think? / YES!

Two types of Affirmative Answers

- Structural Theories: Discovery

  The Representational Form

  The mind is considered as a mechanistic device that can be represented in an algorithm.

- Functional Theories: Invention

  The Cartesian Form [AI's central paradigm]

  "cognition as computation", refers to two independent entities such as "brain as hardware" and "mind as software (program)". Therefore, modern AI considers that internal brain processes can be functionalized and embodied in a separated and self-governing computational algorithm

Can a Machine Think? / YES!

Structural Theories

- mind as a material process
- reasoning is reckoning
- thinking consists of *symbolic operations*
- thinking is at its clearest and most rational when it follows methodical rules
- The brain follows a set of mechanistic rules, which can be represented in an algorithm and which can be computed by a machine.
- On some level of operation –usually supposed to be that of the neurons- the brain processes information in discrete operations by way of some biological equivalent of on/off switches.

Can a Machine Think? / YES!

Functional and Organizational Theories

- Mind as Machine: The mind can be viewed as a device operating on bits of information according to formal rules.
- All cognition can be formalized, that is, that whatever can be understood can be expressed in terms of logical relations.
- There is a causal concatenation of mental states and the relationship between them can be modeled.
- In order to understand mind, the organizational structure (in a functionalist sense) of the brain is more essential than the physical structure and behavioral dispositions of a person.
- Semantic properties can be occupied by the rules which govern the compound of specified syntactical symbols.

Main Arguments

- In AI, the essential tension between machines and minds depends on the organization (function)-structure opposition.
- Structures are considered to be immanent and this calls for a morphological analysis.
- By contrast, organization is considered to be an arbitrary function of a mechanistical procedure.
- Such a polarized distinction is not suitable.
- Organization and structure are related because together they characterize cognitive acts.

Argument

Machine intelligence does not necessarily process information in the way humans do.

How *does the mind work?*
How *are problems solved?*
How are decisions made?
How are patterns detected?
How is memory structured?
How is knowledge organized?
How are statements presented via language?

- Machines and humans are not species of the same cognitive structure, but they can be the subject of the same questions about cognition, information, cognitive skills, mental states, and so on.

-- HOW ?

- Agency
- Models and Simulations

Agency [*Agentification*]

-- Agency is an ability to interact within different surroundings, adapt to changing tasks, and integrate a wide range of data.

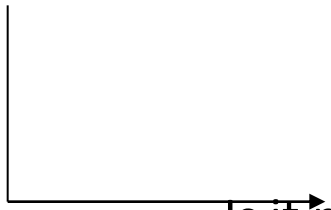
-- Agency is the ontological and epistemological constituent of reality and cognition. Reality is characterized by agentive activity.

-- Agency must be the essential criterion for the success of machine intelligence instead of linguistic-behavioral-based criteria (for instance, the Turing Test)

-- *Agentification* means to *characterize* a set of human cognitive skills and structures (such as reasoning, understanding, memory, perception, communication etc.) in an agent-based-model.

Models and Simulations

- **Can a machine think?**



Is it possible to design formal systems that can imitate the very complex structure of the human mind?

YES

Mental, linguistic and logical models should be developed under a unified methodological framework.

HOW

-- There is a necessity to consider the principles of simulation and modeling in AI distinct from the classical notions of simulation and modeling in science and in engineering.

-- We need to construct a new type of a model peculiar to AI.

Models and Simulations

General Characteristics of Models

- Many discussions on the status and the role of a model in the philosophy of science.
- How to consider the term “model” in relation to the target system and how to define associated terms, such as formal, simulation, representation, validation, accuracy, realism, in this relation.
- There are different types of models in terms of their application fields: Logical, scale, mathematical, analogue, functional, theoretical, physical, formal, material, archaic, auxiliary, main, *post hoc*, complementary, phenomenological, simplifying, abstract and structural.
- Three main stages: *target system*, *source* and *simulation*.
- In the first place, we make some observations on the *target system*.
- Following that, these observations provide *sources* which help us build a theory on the structure and on the mechanism of the target system.
- And finally, if this theory has a systematized body of law, i.e. codes, formulas, algorithms, hypothetical mechanism etc., then we look for the possibility of the *simulation* of this system.

Models and Simulations

Models and Simulations Peculiar to Artificial Intelligence

- The general characteristics of a model and the classical process of modeling cannot be used in AI.
- The aim and the structure of models should be re-formulated in terms of AI.
- A new type of a model and a simulation should be constructed.

WHY?

- There is not a single phenomenon or a single process in human intelligence that can be seen as a target system.
- Human mind and intelligence should be considered as open systems, which cannot be simulated and modeled by classical types of modeling.
- Intelligence is not the assemblage of cognitive skills and locations of the brain functioning independently of one another, but is its interacting and integrated structures.
- Modeling the mind is not an “availability of data” problem.

Models and Simulations

The Principles of a New Type of Modeling Strategy in AI

In order to achieve a successful modeling on human intelligence, AI should initially focus on the "*conditions* of/for intelligence" instead of looking for the prerequisites (brain/cognitive skills) and actual criteria (the Turing Test) for intelligence. [Zambak & Vergauwen 2007]

conditions of/for intelligence

-- self-organization: Structural-based-organization *versus* organization-based-structure

-- organism: part-whole, *Umwelt,* analog-digital, systematic whole

-- autonomy:

"*machines act according to plans* (their human designers'), whereas *living organisms are acting plans*." (Ziemke 2001: 170).

-- evolution: Adaptation and de-centralization of representation

-- interaction: The *Umwelt* is seen from the position of the agent instead of from the designer's position.

THANK YOU