Cognitive Systems

T5

2020 edition

Marcio Lobo Netto

João E. Kogler Jr.

cognitio

PSI 3560 – COGNITIVE SYSTEMS

class T5

Marcio Lobo Netto
João Eduardo Kogler Junior

Polytechnic School of the University of São Paulo
Department of Electronic Systems Engineering

ARTIFICIAL INTELLIGENCE AND COGNITIVISM

Symbolic Approach, Symbol Systems, Classical Artificial Intelligence

cognitio

Summary

– First session (7:30 – 9:10)

- Cognitivism
- Symbolic Processing
- Strong & Weak AI
- Wide and Narrow AI
- Turing Test
- Chinese Room

  - Coffee break

– Second session (9:20 – 11:00)

– We will have 4 sections with 5 to 7 slides each

Section 1

- Cognitivism & Symbolic Processing

Cognitivism

- A proposition oriented towards classical Artificial Intelligence principles
  - Symbolic AI
    - Handling symbols
- Algorithmic Reasoning
  - Recipe
    - A good way to express logic reasoning
    - Our own observation of reasoning abilities (process)
    - Hard to get how it emerge from our neural tissue (processor)

Cognitivism

- Brain Mind (HW SW) issue
  - Complex systems can be observed in different scales or levels
    - A cognitive process can emerge on a neural substrate
  - Even without being able, so far, to express how logic processes (mental) run on a neural tissue (brain), we recognize that it happens
    - Our perception of things

Cognitivism

- Computational Mind
  - Computational Theory of Mind
    - Which cognitive processes can be expressed by cognitivism?
    - Is cognitivism approach enough to express or to handle all cognitive features? And all mental ones?
    - Is it possible to express with symbols support any cognitive processes?
      - Probably not all, but some / many?
      - So, there is a computational side of the mind
    - Could a machine able to handle symbols be considered cognitive?
      - Are computers cognitive? Perhaps some will be!

Symbolic Processing

- Deductive Logic
  - Performing reasoning by using deductive logic

- Intelligent actions (algorithms)
  - If they are considered intelligent when performed by humans
  - They might be considered intelligent as well if performed by machines
    - Classical Artificial Intelligence

Symbolic Processing

- Algorithm
  - In computer science an algorithm is a finite sequence of executable actions (recipe) leading to the solution of a specific problem
    - Sorting, routing are are among typical examples
  - Algorithms tend to be precious procedures, without ambiguity, performing mechanical actions, correctly and efficiently
  - Conceived by the human “genius”
    - The computer algorithm is a transcription of the one conceived by a human

Section 2

- Strong and Weak AI
- Narrow & Wide AI

Strong & Weak Artificial Intelligence

- Strong AI
  - Human like
- Weak AI
  - On machines

- A way to accommodate things, avoiding hard questions
  - as proposed by John Searle

Narrow & Wide Artificial Intelligence

- Narrow AI
  - Focused on one subject
  - May be very powerful
    - Deep Blue (beating a Chess Master)
    - But requests another approach to beat AlphaGo Master
- Wide AI
  - General AI for any subject
  - So far, still in its infancy
    - Watson ? (Jeopardy)
    - Wider sense of logic reasoning
      - Domain transposition

Narrow & Wide Artificial Intelligence

- Narrow AI
  - May combine
    - 1: Preprogramed approaches (taught by humans)
    - 2: Embedded learning abilities (learning from self observation)
    - Exploiting advantages from both approaches
    - First attempts to bet chess masters used the first one
      - Exploiting sequences analysis (logic)
      - Exploiting scenario analysis (pattern)
    - Recent approaches to beat go masters used the second one

Artificial Intelligence

- Pre-Programed (designed by humans)
  - Reproducing human intelligent recipes
  - Teaching the machine how to behave
  - Cognitivist approach

- Evolutive (emergent – designed conditions)
  - Self growing/improving abilities
  - Learning by self experience
  - Connectionist approach (further classes)

Artificial Humans – Human like Robots

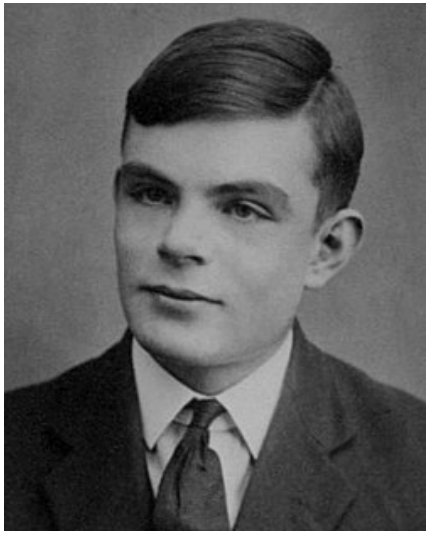
- West World – HBO series
  - What makes robots different from humans
  - The quest of building human like robots
    - Not just physically
    - But also mentally

copyright HBO

Section 3

- Allan Turing – Turing Machine & Test

Alan Turing (1912 – 1954)



- Alan Turing
  - British mathematician, logician
  - Cambridge
  - Computer science

  - Developer of *bombe,* a machine to break the codes from *enigma (second world war)*
  - Proposition of universal computation concept, the Turing Machine
  - Proposition of intriguing questions about computing abilities, the Turing Test

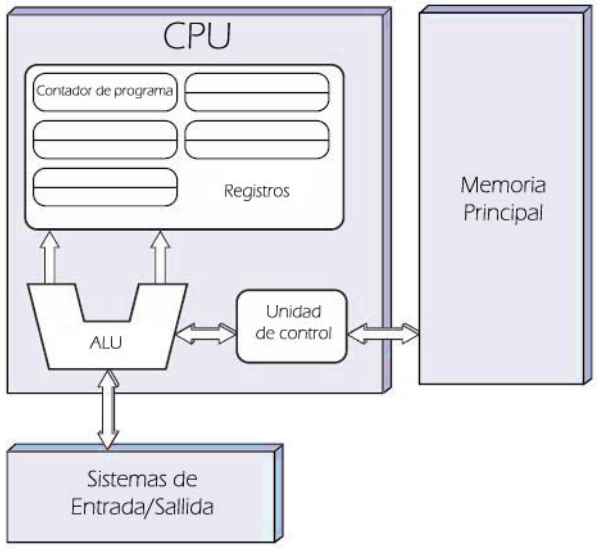
Turing Machine

- The Turing Machine
  - A symbols handling machine
  - Any computational action may be expressed by the Turing Machine
  - A concept

  - Is the mind just computational?
  - Is the cognitive mind its computational side?
  - Can be the cognitive mind reduced to (described by) a Turing Machine?

Turing Machine

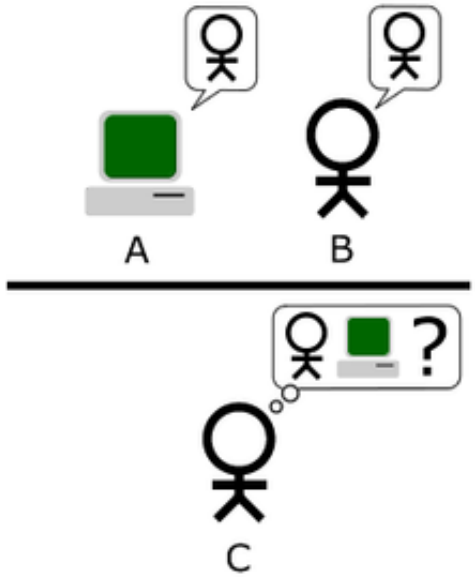
- Universal machine (a concept)
  - Tuple M = (…….)
    - Finite set of states, and an initial state
    - Alphabet of symbols
    - Recording tape
    - A controller able to read and write symbols to the tape following instructions from a controller embedded function
  - The evolution of the algorithm depends on the tape symbols and on the control function
  - Any computational algorithm can be described / performed by the TM
    - Theoretical – not feasible for real implementations
    - Real propositions follow, for instance, the Von Neumann architecture



Turing Test

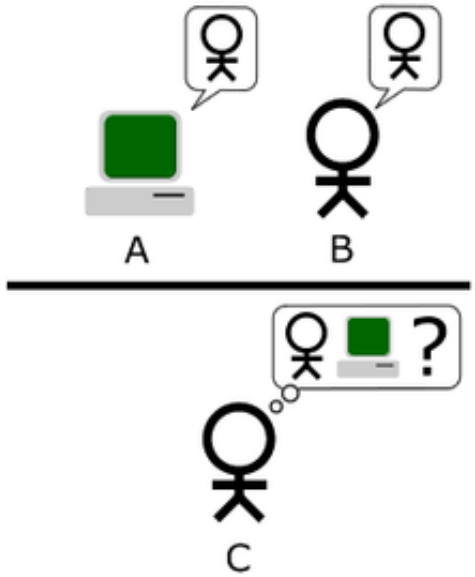
– The Turing Test

- How to recognize if computational tasks have been performed by an human or a machine
- Interviewer needs to guess if answers come from a human or a machine,
- If he can not identify, then both are considered to be equivalent in this task
  - performing computational acts
  - handling symbols



Modern version of the Turing Test

- The Turing Test
  - Does it look like human while performing computational tasks?



- The modern quests
  - Ok, at least on some tasks, the machine performs as well as humans
  - But, can we say that it is as cognitive as humans?
  - The questions now are deeper. It is not just about looking alike, but being equivalent

Modern version of the Turing Test

- The modern quests: Ex Machina movie
  - The machine taking the lead on a kind of Turing Test
  - Getting deeper insights about this quest, but inverting roles
    - Humans need to prove they are humans, not machines

Section 4

- John Searle – Chinese Room

John Searle (1932 –)

- John Searle
  - American philosopher
  - Berkeley
  - Philosophy of Mind
- Subjects of interest
  - Meaning
  - Intentionality
  - Consciousness

Strong & Weak AI

- Proposed by John Searle
  - Strong AI (human like)
  - Weak AI (on machines)
  - Consider that we accept full AI (as capacity)
    - But would it be possible to be Strong, or would it be kept Weak (as postulated above)?
  - As technology evolves (computing power, data accessibility, …) it is plausible to expect very sophisticated AI systems, some with cognitive abilities
  - But will they be accepted as humans, or just as high-performance machines

Chinese Room

- Questions in Chinese are given to someone through this room´s door, who do not understand the language
- This person has a set of rules and dictionaries allowing him to handle and answer the questions, even not understanding them
- Being able to provide proper answers

- Outsiders will have the impression the person is proficient in (comprehends) Chinese

Chinese Room

- This raises the question
  - Does a symbolic system, able to properly handle symbols providing right answers, understands what it is performing?
  - If not, how can we be sure if the system understands what it does, as outsiders?

Chinese Room

- Similarly, a machine programed to properly work on symbols (transforming them) may present these same skills
- Looking as an intelligent machine, even though it has no “idea” about what is going on!

- But we think we understand it! It is how we fell!
- Why? What might be the difference between us and these machines in such tasks?

Chinese Room

- Chinese Room
  - Symbol handling is enough to express our mind abilities?
    - What about meaning?
  - Translation of symbols (English – Chinese)
    - Set of rules and dictionaries
    - A translation machine can perform such task without understanding its meaning
    - And a cognitive system?

Coffee break

10 minutes