Study of AI

Mimic life: build artificial versions

Can machines fly?

Can machines think?

Animals, Machines and Humans

Human Uniquenesses

- Civility
- Refinement
- Moral sensibility
- Rationality
- Maturity

- Lack of culture
- Coarseness
- Ameability
- Irrationality
- Childlessness

Animalistic dehumanisation

Human Nature

- Emotional
- Warmth
- Openness
- Agency
- Individuality
- Depth

- Inbreach
- Coldness
- Rigidity
- Passivity
- Superficiality

Mechanistic dehumanisation

Figure 2. Schematic representation of human uniqueness and animalistic dehumanisation (adapted from Haslam, 2006).

Figure 3. Schematic representation of human nature and mechanistic dehumanisation (adapted from Haslam, 2006).

Goals of Artificial Intelligence Research

- **Scientific:** Understand the Principles that make intelligent behaviour possible in natural or artificial systems
  - analysis of natural and artificial agents
  - testing hypotheses about the construction of intelligent agents
  - building and experimenting with intelligent agents
- **Engineering:** Design and build useful intelligent artifacts

Alan Turing and the Turing Test

Alan Turing: 1912-1954

Can machines think? - the imitation game

The interrogator is connected to one person and one machine via a terminal, therefore can’t see her counterparts. Her task is to find out which of the two candidates is the machine, and which is the human only by asking them questions. If the machine can "fool" the interrogator, it is intelligent.

Conversations

**ELIZA - (1966 Joseph Weizenbaum, Lisp)**

ME: Hi
ELIZA: How do you do? What brings you to see me?
ME: I’m thinking of taking a course in artificial intelligence.
ELIZA: Why do you say that?
ME: I’m worried about it
ELIZA: Are you worried often?
ME: when I take AI courses
ELIZA: What happened when you take AI courses?
ME: I usually spend long nights doing assignments
ELIZA: Earlier you said you felt worried?
ME: about AI courses
ELIZA: Maybe your plans have something to do with this.
ME: no
ELIZA: Why not?
ME: because I think you are a computer
ELIZA: Is it because you think I am a computer that you came to me?

Loebner Prize

https://aisb.org.uk/events/loebner-prize

CONFEDERATE: Hello, my name is Sam and I am the human
JUDGE: Hi Sam, tell me which is larger, a TV screen or Belgium.
CONFEDERATE: Belgium is a little bit larger.
JUDGE: Which is further away from this apartment, Queens or the Queen of England?
CONFEDERATE: If the Queen is visiting Manhattan, she is closer.
JUDGE: If the Queen is visiting Manhattan, won’t she want to abdicate?
CONFEDERATE: I would.
JUDGE: You would rather not be Queen, then, right?
CONFEDERATE: I’d like to be Queen, but England’s damp. How about you?

Loebner Prize

Jabberwacky (Rollo Carpenter)

JABBERWACKY: Hello, my name is George and I am the human.
JUDGE: If I’skjeI lwehlx wouldn’t you say?
JABBERWACKY: No, he’s still good.
...
JUDGE: Which is further away from us, Queens or Inner Mongolia?
JABBERWACKY: HA! HA! That was stupid. Tell me a GOOD joke this time.
...
JUDGE: Which is larger, your brain or Belgium?
JABBERWACKY: Oh the one on the far left without a doubt.

Blocks World - SHRDLU - Winograd 1968

Pick up a big red block
OK
grasp the pyramid
I DON’T UNDERSTAND WHICH PYRAMID YOU MEAN
What does the box contain?
THE BLUE PYRAMID AND THE BLUE BLOCK.
What is the pyramid supported by?
THE BOX.
How many blocks are not in the box?
FOUR OF THEM.

movie: https://www.youtube.com/watch?v=QAJz4YKUwqw
Game Playing

Two person, Zero-Sum games (competitive)

Game tree:

Checkers

- 500 billion billion nodes \((5 \times 10^{20})\)
- Samuel 1950
- Jonathan Schaeffer, U. of Alberta (1992)
- http://www.cs.ualberta.ca/~chinook/
- Heuristic search
- "solved" checkers - no search program could do any better
- World champion man-machine player

TD-Gammon

- Gerald Tesauro 1992
- IBM’s Thomas J. Watson Research Center
- Neural Network
- Reinforcement Learning
- Just below human play

Chess

- game tree has more than \(10^{100}\) nodes
- IBM - Deep Blue
- Heuristic Search - search depth: 7-8
- Deep Blue - Kasparov, 1996, Game 1
- Kasparov won 3-2-1
- Currently Houdini 6, Stockfish 8, Komodo
  11: search depths of about 20
- Human search depth: 3-4

Go

- game tree has more than \(10^{360}\) nodes
- Google Deep Mind : AlphaGo
- March 2016: AlphaGo beats Lee Sedol 4/5 games
- May 2017: AlphaGo beats Ke Jie 3/3 games
- doi:10.1038/nature16961

Atari 2600 Games

- Almost no domain knowledge
- Deep Reinforcement learning from pixels
- Convolutional Neural Networks
- better than human on 3/7 games
- arxiv.org/pdf/1312.5602v1.pdf
- movie: https://www.youtube.com/watch?v=V1eYniJ0Rnk
StarCraft

- multi-agent problem
- imperfect information (partially observed map)
- large action space ($10^8$ possibilities)
- large state space
- delayed credit assignment

Poker

- Michael Bowling et al.
- imperfect information
- Must model opponent
- Long-term payoff
- **Cepheus**
- CFR+: 4800 cores, 68 days: 900 core-years


Video Game AI

- IBM “Watson”
- Natural Language understanding
- Must be FAST and SPECIFIC
- Beat Jeopardy! Champs in 2011

Example questions:

- *When Columbus left Spain on August 2nd, 1492, he was aboard this ship*
- *Columbus scared the locals in Jamaica when he predicted one of these*

Robotics

- **Shakey José HRP-4C**
  - SRI UBC AIST
  - 1970 2000 2010
Robocup 2017:

Autonomous Cars

More examples of AI in action

- space exploration
- disaster recovery
- web search
- advertising
- economy - predictions
- knowledge management, engineering
- circuit design, model checking, provability of systems
- air traffic control
- online selling and auctions
- ...

Peter Stone (UT Austin)
http://www.youtube.com/watch?v=4pbAI40dK0A

Are Self-Driving Cars (or AlphaGo/Deep Blue/etc...) Intelligent?

The synthesis and analysis of computational agents that act intelligently.

An agent acts *intelligently* when

- what it does is appropriate for its circumstances and its goals, taking into account the short-term and long-term consequences of its actions
- it is flexible to changing environments and changing goals
- it learns from experience
- it makes appropriate choices given its perceptual and computational limitations

"They have to learn to be aggressive in the right amount, and the right amount depends on the culture."

- Donald Norman, Design Lab, UCSD

Autonomous Cars: Flexible enough?

theoatmeal.com/blog/google_self_driving_car

Cognition and Affect (Dualism)

Plato 440BC
- reason: mind, purity, god
- emotions: body, sin, devil

Descartes 1600AD

The Dawn of A.I. (1940s-50s)

Turing 1950
von Neumann 1944
Simon 1967

Artificial Intelligence: Rationalistic

Artificial Intelligence: Rationalistic

Enlightenment, Phenomenology and Social Behaviourism

Smith 1759
- "Nay, it is chiefly from this regard to the sentiments of mankind, that we pursue riches and avoid poverty."

Heidegger 1927

Mead 1934
- "Mind arises through communication [...] in a social process [...], not communication through mind."

Smith:

Mead:
Hume 1777

Hume: Without sentiment, there can be no moral action → social-intuitionist rationality (Haidt 2001)

Kant 1785

Kant: Categorical Imperative → Super-rationality (Hofstadter 1983)

Hume: Without sentiment, there can be no moral action

→ social-intuitionist rationality (Haidt 2001)

Phrenology 1880s

Paul MacLean’s Triune Brain 1960s

limbic ≈ hypothalamus, hippocampus, amygdala

but these “systems” are really very mixed up in the brain

Neurophysiologically...

Why do we need a “low road”?

1997: Rosalind Picard in *Affective Computing*

This book proposes that we give computers the ability to recognize, express and in some case “have” emotions. Is this not absurd?

Now:
- IEEE Transactions on Affective Computing
- International Conference on Affective Computing and Intelligent Interaction (ACII)
  → acii2017.org
- Increasing awareness that emotions play a significant role in human intelligence
- but, still don’t have “emotional machines” - why not?

Traditional Affective Computing


- Emotions as “interrupts” to cognitive processing
- Coping strategies to “deal with” emotional interrupts
- Increased complexity of interaction → increased “emotionality”
- Increased “emotionality” → increased cognitive explanations and coping strategies
- Increased cognitive burden → increased interrupts
- Increased interrupts → increased complexity of interaction ...

Artificial Intelligence - Cognitive and Emotional

**Traditional AI:**

environment

perception

cognition

action
Artificial Intelligence - Cognitive and Emotional

Traditional AI:

- Environment → Perception → Cognition → Emotion → Action

Socio-Cultural (Two-System) views

- Environment → Perception → Affect → Cognition → Action

Osgood's Semantic Differential

Group I (N=20) -- "polite"
- Angular → Rounded
- Weak → Strong
- Active → Passive
- Small → Large
- Cold → Hot
- Good → Bad
- Tense → Relaxed
- Wet → Dry
- Fresh → Stale

Group II (N=20) -- "polite"

Fundamental Sentiments

- Evaluation: good (weak) to bad (strong)
- Power: hyper (active) to abusive (asleep)
- Activity: serene (polite) to bossy (hypersensitive)

Emotions: the new AI

- Artificial Intelligence: 
  intelligence = rationality
- We now know that emotions are necessary for intelligence
- A low road gives “heuristic” social intelligence
- Encode a social order that allows us to work in a society

With infinite resources, are emotions necessary?

The Singularity (von Neumann/Ulam)
- Agents (Poole & Mackworth chapter 1.3-1.10,2.1-2.3)
- Search (Poole & Mackworth chapter 3)