

Foundations of AI

18. IJCAI or What is the Chinese Room?

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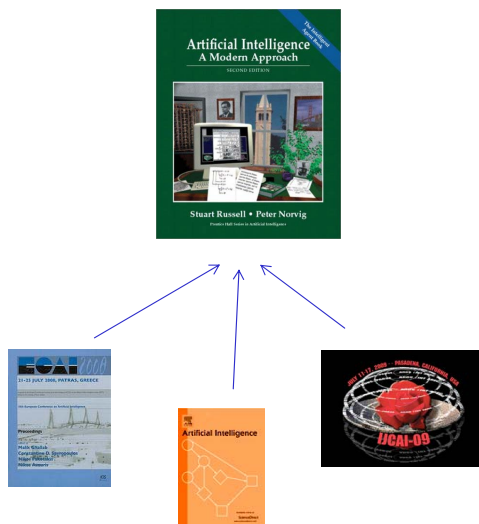
Contents

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- IJCAI and other outlets
- IJCAI 2009
 - How hard is it to manipulate an Election?
 - How convincing is Searl's *Chinese Room* argument?

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Where do text books come from?

- Text book such as "AI: A Modern Approach" are not the product of the ingenuity of the authors alone
- They compile and structure a lot of individual research results



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The publication food chain

- *Before*: Idea & solution & results
- Pre-Publication: Technical Report
 - no review
- First discussion: Workshop
 - review for plausibility (acceptance rate 95%)
- Presentation to peers: Scientific Conferences
 - strict but fast review (acc. 15-30%)
- Archival publication: Scientific Journal
 - strict review with multiple rounds (acc. 30%)

Note: not all stages necessary

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Publication Outlets: AI Conferences

- International Joint Conference on Artificial Intelligence *IJCAI* (bi-annual, odd years)
- European Conference on Artificial Intelligence *ECAI* (bi-annual, even years)
- American National AI Conference *AAAI* (annual, except when IJCAI is in the US)
- German AI Conference

- ... other conferences (e.g. application oriented)
- ... specialized conferences (planning, learning, robotics, etc)

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Publication Outlets: AI Journals

- *Artificial Intelligence Journal*
 - The most prestigious AI journal (focusing on formal approaches)
- Journal of Artificial Intelligence Research
 - Free online journal with high reputation and short turn-around times
- AI Communication
 - Journal by ECCAI
- ... other (usually) specialized AI journals

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International Joint Conference on Artificial Intelligence

- Takes place in different locations (e.g., 2009: Pasadena, 2011: Barcelona, 2013: Beijing)
- Approx. 1000 attendees
- Approx. 1200 submitted papers, 300 accepted
- Proceedings as hardcopy, CD, and online (back to 1969)
- 6 day conference
- including workshops (20-30) and tutorials (10-20)
- costs around 600-700k US-\$ each time
- 100k US-\$ spent on travel grants for students

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IJCAI 2009 - Talks

- 4 invited talks, 1 keynote
- 3 award talks (Computer & Thought, Research Excellence)
- Technical papers (332):
 - Agent-based & multiagent systems 55
 - Constraints, satisfiability, search 43
 - Knowledge representation, reasoning, logic 51
 - Machine learning 66
 - Multidisciplinary & applications 20
 - Natural language processing 20
 - Planning & Scheduling 30
 - Robotics & Vision 11
 - Uncertainty in AI 18
 - Web & knowledge-based information systems 16

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IJCAI 2009 – Freiburg

- 5 technical papers (1.5%)
 - *Qualitative CSP, Finite CSP, and SAT: Comparing Methods for Qualitative Constraint-based Reasoning* (Matthias Westphal, Stefan Wöfl)
 - *On Combinations of Binary Qualitative Constraint Calculi* (Stefan Wöfl, Matthias Westphal)
 - *A Fixed-Parameter Tractable Algorithm for Spatio-Temporal Calendar Management* (Bernhard Nebel, Jochen Renz)
 - *Eliciting Honest Reputation Feedback in a Markov Setting* (Jens Witkowski)
 - *Learning Kinematic Models for Articulated Objects* (Jürgen Sturm, Vijay Pradeep, Cyrill Stachniss, Christian Plagemann, Kurt Konolige, Wolfram Burgard)
- 1 Award
 - IJCAI/JAIR Best Paper / Honorable Mention: Malte Helmert

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2 selected papers

- *Where Are the Really Hard Manipulation Problems? The Phase Transition in Manipulating the Veto Rule* (Toby Walsh)
 - Analyzing the claim that NP-hardness is a tool to prevent strategic manipulation in elections from an empirical point of view.
- *Is It Enough to Get the Behavior Right?* (Hector J. Levesque)
 - The Chinese Room argument, which says that *strong AI* is impossible because AI systems can only fake intelligent behavior, is challenged. The only paper with a philosophical touch at IJCAI 2009.

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Elections and Social Choice

- Social Choice Theory:
 - Given a set of candidates, and a set of voters with preferences over the candidates, a social choice function (election rule) should return the most preferred candidate
- Subarea of Game Theory
- Interesting for preference aggregation (e.g. in CSPs), in coordination (e.g. in MAS), and in electronic communities and markets

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Example: Choosing a lecturer for next semester

- Voting:
 - 10 students: Karwarth > Nebel > Burgard
 - 7 students: Nebel > Burgard > Karwarth
 - 15 students: Burgard > Nebel > Karwarth
 - 6 students: Nebel > Karwarth > Burgard
- Which one should do it?
- Many possibilities (sometimes ignoring parts of the preferences):
 - Plurality
 - Veto
 - Borda count
 - ...

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Manipulation

- A social choice function (or election scheme) can be manipulated if by stating preferences insincerely, one can get a more favorable outcome (as an individual or group)
- Example:
 - For plurality, it can make more sense to state the second choice as the most preferably one, if one owns candidate would not get enough votes
- If a social choice function is immune to manipulation, one calls it “incentive compatible”

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The Gibbard-Satterthwaite impossibility result

- Gibbard and Satterthwaite proved that any social choice function that
 - handles more than 2 candidates,
 - is surjective (allows all candidates to win), and
 - is incentive compatiblewill also be
 - a dictatorial choice function (only one voter decides)!

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NP-hardness as a tool against manipulation

- All social choice function (election schemes) can be manipulated (Gibbard/Satterthwaite)
- However, it might be **computationally hard** to decide *whether* and *how* this could be done!
- For some election schemes, it can be proven that manipulation is **NP-hard** (for some, winner determination is actually NP-hard!)
- So here, NP-hardness is a **GOOD** thing!

- Since it is a worst-case notion, the question is, whether it appears in practice

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Manipulating elections according to the veto rule is NP-hard

- **Destructive** manipulation (avoiding a candidate) is actually easy (polynomial time)
- **Constructive** manipulation is NP-hard
- However, as shown in the paper, only for very few cases one gets a computationally hard **phase transition**
- Throwing in another random voter makes everything easy again
- For veto voting, the theoretical worst-case result seems to mostly **irrelevant**.
- What about other election schemes?

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Intelligence, Behavior, Philosophy ...

- Most papers at AI conference are about technical results (methods, algorithms, empirical results ...)
- This paper takes up an issue from the 80's voiced by the philosopher Searl, who states that **strong AI** is impossible

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What is Intelligence?

- Turing:
 - Hard to tell
 - Let's call a machine **intelligent** if it **behaves intelligently**
 - **Turing test**: If the (linguistic) behavior is **indistinguishable** from the human behavior over a long time, then a machine passes the test
 - Be careful with partial satisfaction of the test, which can very easily achieved by trickery!

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What is Intelligence?

- Searl:
 - Whatever intelligence is, it cannot be achieved by a machine!
 - Machines might be able to simulate (**fake**) intelligent behavior, but it is not acting because of (real) intelligence
 - So, AI is doomed to failure – if AI is understood in the **strong sense**, namely, if we want to make machines intelligent (as humans are)
 - In AI research we do not care much about Searl's argument ... nevertheless ...

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The *Chinese Room* argument

- Let's assume, AI has succeeded in creating a system that perfectly understands and generates Chinese sentences: `chinese.py`
- Instead of running this program, we could put Searl and `chinese.py` in a room, and Searl could process the inputs and generates outputs according to the rules of `chinese.py`
- It is obvious that Searl does not understand Chinese at all, while an outside observer would think the system understands Chinese (according to the Turing test)



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Chinese Room: The System Reply

- Of course, Searl does not understand Chinese
- But the system consisting of Searl and the book `chinese.py` (CPU+program) understands Chinese!
- Searl's reply:
 - Assume I read and memorize the book `chinese.py` and then throw it away.
 - After that, I process the inputs and generate outputs as before
 - I still do not understand Chinese!

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Type I and Type II books

- Implicit in Searl's reply is that there two types of books or programs:
 - **Type I**: You can memorize, but you do not understand Chinese afterwards
 - **Type II**: After you have memorized them, you understand Chinese (e.g., as a second language)



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Can there be Type I books?

- While understanding Chinese as a second language (using a Type II book) is not interesting from an AI point of view, there are probably also Type I books using programming languages
- The question is, if there can be Type I books for the Chinese room at all
- Hard to tell
- Let's simplify this and consider the Summation Room

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The Summation Room

- An input is a list of 20 ten-digit numbers
- The required output is the sum
- Assume a book/program `sum20.py`
- Could be a lookup table
 - Type I book
- But a lookup table is too large: 10^{200}
- There are only 10^{100} atoms in the universe

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Other books for the Summation Room

- One could write a program performing addition based on a 10x10 single digit addition table
 - This would be a Type II book!
 - Having memorized it, one really does summation and knows what one does (even when the name for the operation might be unknown)
- Even all other “small” books would implement *addition* as such (e.g. base 100 addition or parallel addition)
- There is no Type I book for the Summation Room

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Summary

- Searl's *Chinese Room* argument suggest that AI can only simulate intelligent behavior
- This is based on a thought experiment, where a human memorizes a rule body and executing it, without understanding it
- Difficult to make precise for Chinese language processing
- More obvious for the *Summation Room*
- However, here it is impossible to memorize a (small) rule set without doing (real) summation when executing the rules
- So Searl's answer to the *System reply* is not convincing

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Conclusion

- The interesting stuff is happening at [scientific conferences](#) (not in the text book)
- Try to read such papers (e.g. go to ijcai.org)
- For a Bachelor thesis in AI, you may want to aim to publish it at the German AI conference
- For a Master thesis, you may want to go for AAI, ECAI or IJCAI
- But for now, you may want to relax (in the next few weeks)

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