

Why LEARN Cognitive Science and Artificial Intelligence?

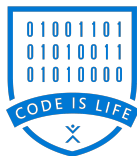
A Freshman's and Metaphysical Perspective

Yu-Zhe Shi^{1 2}

¹Learners' Engineering And Research Network
& Microsoft Student Club Joint Lab (LEARN & MSC Joint Lab)

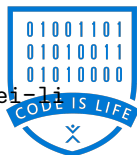
²Microsoft Student Partner

June 2nd, 2020



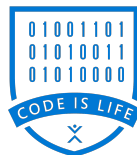
Before we start...

- ▶ Just a freshman's perspective.
- ▶ To Learn from a industrial perspective: visit MS Learn
<https://docs.microsoft.com/zh-cn/learn/>.
- ▶ To Learn from an engineering perspective: visit
<https://deeplearning-ai.github.io/machine-learning-yearning-cn/docs/home/>
- ▶ To learn from an academic perspective: search for the talks by
 - ▶ Yoshua Bengio: <https://yoshuabengio.org/>
 - ▶ Geoffery Hinton: <http://www.cs.toronto.edu/~hinton/>
 - ▶ Yann LeCun: <http://yann.lecun.com/>
 - ▶ Zhi-Hua Zhou: <https://cs.nju.edu.cn/zhoush/>
 - ▶ Joshua B. Tenenbaum:
<http://web.mit.edu/cocosci/josh.html>
 - ▶ Fei-Fei Li: <https://profiles.stanford.edu/fei-fei-li>



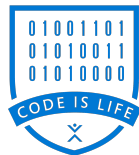
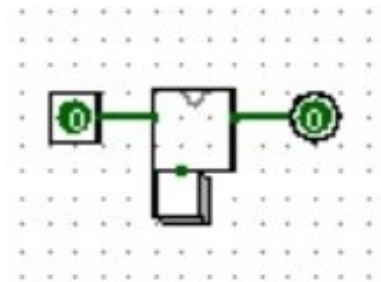
Overview

- ▶ Must I LEARN Cognitive Science and Artificial Intelligence?
- ▶ What is the relation between Cognitive Science and Artificial Intelligence?
- ▶ The way from Artificial Intelligence to Artificial General Intelligence?
- ▶ How helpless are we?
- ▶ What is LEARN & MSC Joint Lab?
- ▶ How to become a LEARNer?



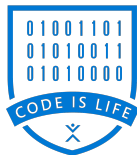
Know Yourself!

- ▶ A Software-level Perspective VS. A Hardware-level Perspective.
- ▶ Extention VS. Intention.
- ▶ Abduction VS. Deduction.
- ▶ Metaphysical VS. Metaphysical.



Metaphysical?

	Software-level Perspective	Hardware-level Perspective
Cognitive Science	Computational Cognitive Science	Artificial Intelligence
Cognitive Science	Cognitive Psychology	Neuroscience
Artificial General Intelligence	Cognitive Science	Artificial Intelligence
Artificial Intelligence	Cognitive Science	Machine Learning
Machine Learning	Statistical/Information Theory/Logic	Optimization/Programming



An Example

Learning representations by back-propagating errors

David E. Rumelhart*, **Geoffrey E. Hinton†**
& **Ronald J. Williams***

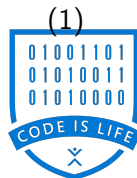
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† Department of Computer Science, Carnegie-Mellon University,
Pittsburgh, Philadelphia 15213, USA

Feedback \leftarrow *Psychology Phenomenen*

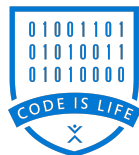
Feedback \rightarrow *Error Backpropagation*

Error Backpropagation? \leftarrow *Feedback*



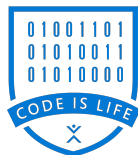
Computational Representation Understanding of Mind

- ▶ Logic.
- ▶ Rules.
- ▶ Concepts.
- ▶ Analogies.
- ▶ Images.
- ▶ Connections.



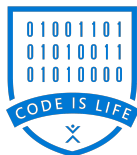
Logic Representation

- ▶ Y-Z Shi is a CS HUSTer.
CS HUSTer must learn Analog Electronic.
Y-Z Shi must learn Analog Electronic.
- ▶ `learn_Analog_Electronic(A):-CS(A), HUSTer(A).`
`CS(Y-Z Shi).`
`HUSTer(Y-Z Shi).`
`learn_Analog_Electronic(Y-Z Shi).`



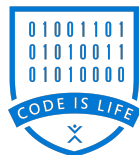
Rules

- ▶ IF X is a CS HUSTer, THEN X must learn Analog Electronic.
- ▶ More flexible than First-Order Logic. IF X is a CS HUSTer and he dropped before the 4th semester, THEN X needn't learn Analog Electronic.



Concepts

- ▶ Frame, Schema, Script.
- ▶ HUSTAnalogElectronic
A kind of: University Curriculum.
Kinds: Can't Capture, Can't Learn, etc.
Feeling: Awesome, etc.
Sequence: Learn→ Fail→ Learn Again.



Analogies

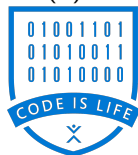
- ▶ 1. Sissifuss wanted to roll the huge stone to the peak.
- ▶ 2. Sissifuss always failed.
- ▶ 3. Sissifuss never gave up.
- ▶ 4. ...

$\text{cause}(1 \& 2 \& 3, 4) \Rightarrow (4 | 1 \wedge 2 \wedge 3)$

- ▶ You have the same causes as learning Analog Electronic, so...
- ▶ Very close to Training-Inference Schema of Statistical Learning!
- ▶

$$P(c|\mathbf{x}) = \frac{P(c)P(\mathbf{x}|c)}{P(\mathbf{x})}$$

(2)



Images

The relation between global and local? What about attention?

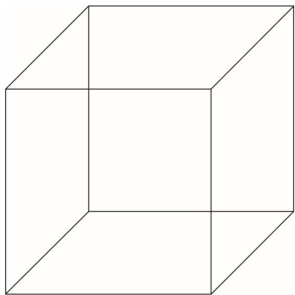
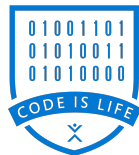


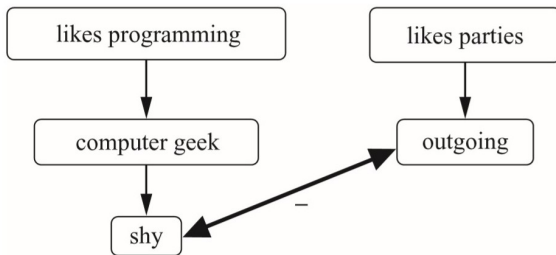
Figure 6.1

The Necker cube. The top edge can be seen either as being at the front or at the back of the cube. Try to make it flip back and forth by concentrating on different edges.

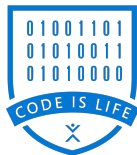


Connections

Distributed Representations.



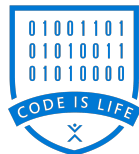
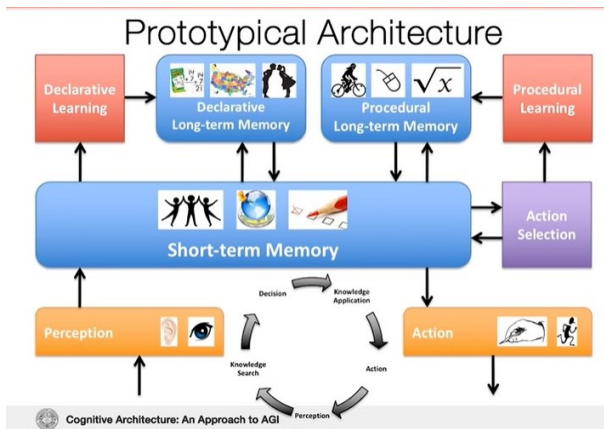
However, what about hidden layers?



AI2AGI?

- ▶ Artificial General Intelligence: Human-level Intelligence.

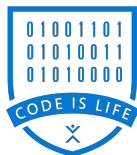
Pattern Recognition → Planning, Decision, Explanation. (3)



AI2AGI?

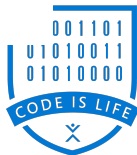
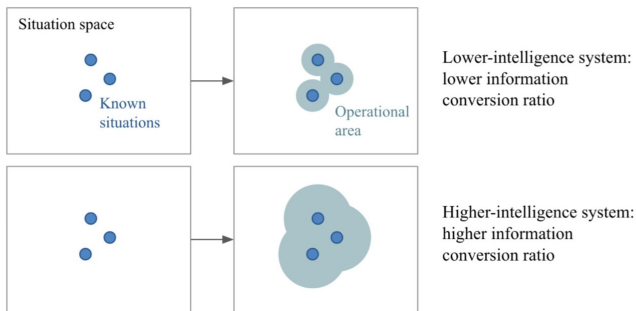
- ▶ Manage commonsense. (Are GPT-2/GPT-3 AGI?)
- ▶ Obtain reliable result \Leftrightarrow Comprehensibility.
- ▶ Weak AI? Strong AI? Ultra-Strong AI?

- *Yesterday I dropped my clothes off at the dry cleaners and have yet to pick them up.
Where are my clothes? at my mom's house.*
- *There are six frogs on a log. Two leave, but three join. The number of frogs on the log is
now seventeen*



AI2AGI?

- ▶ Learn from very little data, generalize to very wide-domain knowledge.

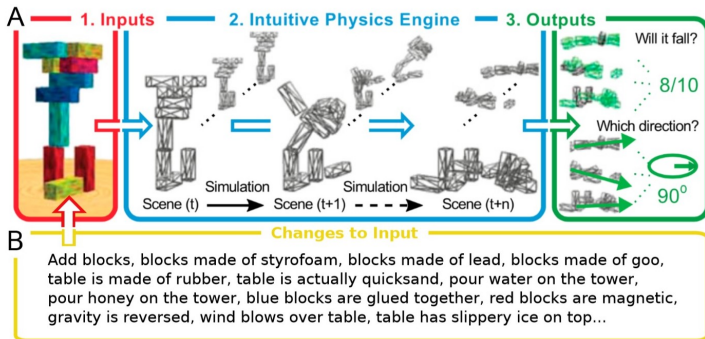


AI2AGI

- ▶ No free lunch?
- ▶ Bayes? Belief?

$$P(c|\mathbf{x}) = \frac{P(c)P(\mathbf{x}|c)}{P(\mathbf{x})} \quad (4)$$

- ▶ Infant Psychology!



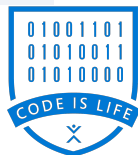
Human are helpless!

近期聊天 ∨






















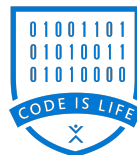
人类好无助

📞 通话已结束 - 2 小时 8...

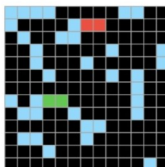
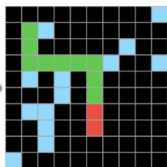
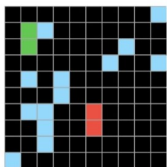
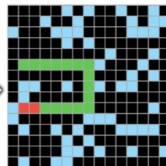
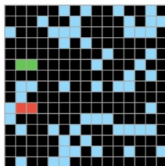
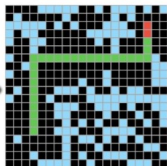
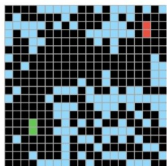


Abstract and Reasoning Challenge

1	—	icecuber		0.794	74	9d
2	—	Alejandro & Roderic & Yuji	  	0.813	441	5d
3	—	Vlad & Iliia	 	0.813	306	5d
4	—	After all, probing is...?		0.813	462	5d
5	—	alijs		0.823	309	5d
6	—	Zoltan		0.823	371	5d
7	—	Alvor		0.833	344	6d
8	—	-	    	0.862	370	5d
9	—	Deep magicians	    	0.862	307	5d



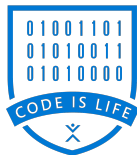
???



?

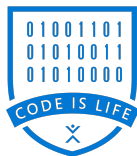
Why Cognitive Science?

- ▶ Study the mind and human cognition to create AI.
- ▶ Create AI to help human comprehend knowledge and improve their performance.
- ▶ Human-level intelligence & Ultra-strong intelligence!



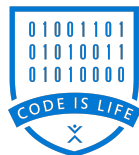
What we want?

- ▶ Interpretability/Comprehensibility.
- ▶ Learn from easy data, obtain easy knowledge, help human easily.



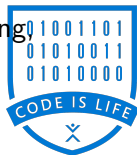
What can we do?

- ▶ LEARN & MSC Joint Lab!
- ▶ Combining Engineering and Research!
- ▶ An inter-discipline research group.
- ▶ Chances for one2one mentor!
- ▶ Chances for internship at MSRA!



Research Projects: Some New Settings

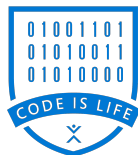
- ▶ Predicate Invention from Raw Data for Open World Recognition.
Key Words: Open World Recognition, Abduction, Predicate Invention, Hybrid Model.
- ▶ Self-Supervised Learning from Concepts or Rules.
Key Words: Self-Supervised Learning, Domain Specific Language, Hybrid Model.
- ▶ Research and Engineering in "A Feynman Machine": Can we evaluate all kinds of mind representations both qualitative and quantitative? Can we build a machine that tries to measure its comprehensibility during interaction with human?
Key Words: Cognitive Psychology, Reciprocal Learning, Human-Computer Interaction.



How to become a LEARNer?

1. Send a self-recommendation (Chinese or English)(> 600 words) to `l-ear-n@outlook.com`
2. DDL: 30th June, 24:00.
3. Become a Junior LEARNer.
4. Think.
5. Finish the learning path for you.
6. Become a Senior LEARNer.
7. Think.
8. Get enrolled in Research or Engineering Projects you like.

Feel free to contact me!



Thanks!
We still have a long way to go.

