Next Generation of Artificial Intelligence: From Pattern Recognition Towards Conceptual Model Building

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What is Artificial Intelligence (AI)?

A. Strong AI: Systems that think exactly like humans do

B. Weak AI: Systems work without figuring out how human reasoning works

C. Human reasoning as a model but not necessarily the end goal
Where are we now?

**Yes**
- Object recognition in images
- Translation between languages
- Play some games (Atari, Chess, Go)
- Autonomous driving

**No**
- Learn a task with only a few examples
- Carry background knowledge across domains and tasks
- Learn complex relationships (Causal, transitive)
AI in all its glory

Programmers incentivised it to go from point A to point B
AI in action
A.I. TIMELINE

1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence.

1955
A.I. BORN
Term 'artificial intelligence' is coined by computer scientist John McCarthy to describe "the science and engineering of making intelligent machines".

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line.

1964
ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans.

1966
SHAKEY
The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions.

A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold.

1997
DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov.

1998
KISMET
Cynthia Breazeal at MIT introduces Kismet, an emotionally intelligent robot insofar as it detects and responds to people's feelings.

1999
AIBO
Sony launches first consumer robot pet dog AIBO (AI robot) with skills and personality that develop over time.

2002
ROOMBA
First mass-produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes.

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S.

2011
WATSON
IBM's question answering computer Watson wins first place on popular $1M prize television quiz show Jeopardy.

2014
EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human.

2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks.

2014
TAY
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments.

2017
ALPHAGO
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions.
Image Recognition
Image Recognition

Layer 1
Gabor +
color blobs
Image Recognition

Layer 1
Gabor +
color blobs

Layer 2

Layer 5

[3]
Image Recognition

Layer 1
Gabor + color blobs

Layer 2

Layer 5

Last Layer

[3]
## Learning a New Task

<table>
<thead>
<tr>
<th>AI</th>
<th>Humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crunching numbers</td>
<td>Background knowledge</td>
</tr>
<tr>
<td>Needs thousands of examples</td>
<td>One shot learning</td>
</tr>
<tr>
<td>Only inputs &amp; outputs</td>
<td>Complex relations</td>
</tr>
</tbody>
</table>
Why Pattern Recognition Is Not Enough

Guitar
98.90%

Penguin
99.99%

Guitar
99.99%

Penguin
99.99%
Conceptual Model Building
Bridging The Gap: A Neural-Symbolic Architecture

Neural back end + Symbolic front end
Conceptual Model Building In AI: A Neural-Symbolic Experiment

Fixed

Neural Network: 95%
Neural-Symbolic System: 70%

Random

Neural Network: 55%
Neural-Symbolic System: 70%
Neural combinations may hold the key

The next generation of AI may result from the combination of neural networks with better reasoning models such as symbolic logic.

Ask me in 3 years!
References


Thank you!

Questions?