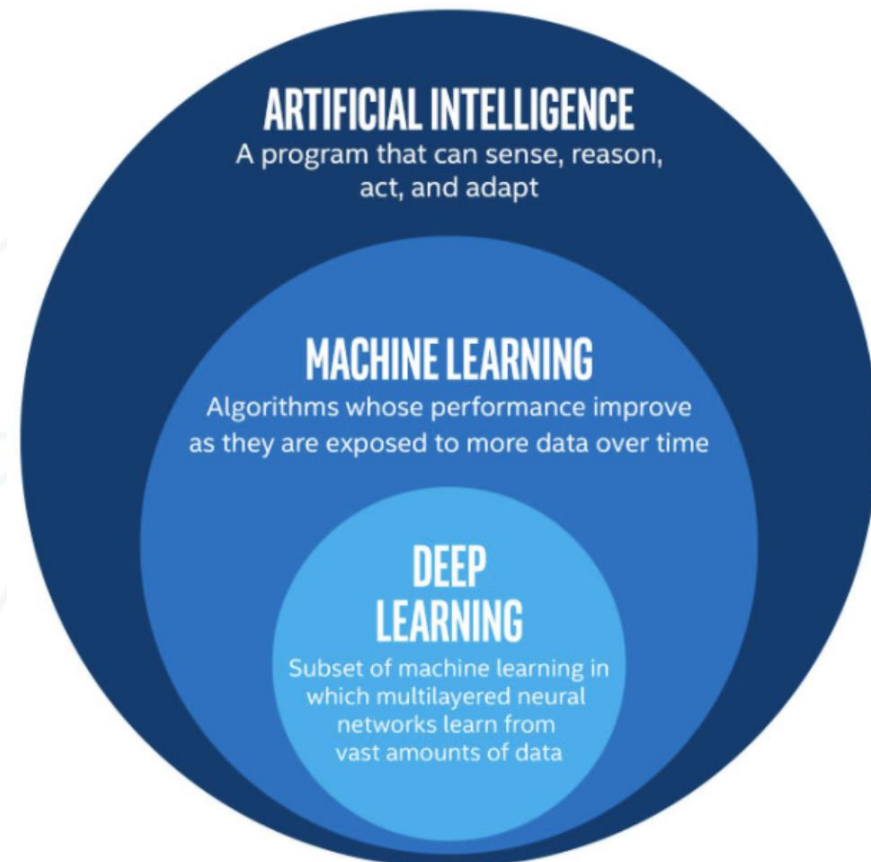# Next Generation of Artificial Intelligence: From Pattern Recognition Towards Conceptual Model Building

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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

[1]

ARTIFICIAL INTELLIGENCE
A program that can sense, reason, act, and adapt

MACHINE LEARNING
Algorithms whose performance improve as they are exposed to more data over time

DEEP LEARNING
Subset of machine learning in which multilayered neural networks learn from vast amounts of data
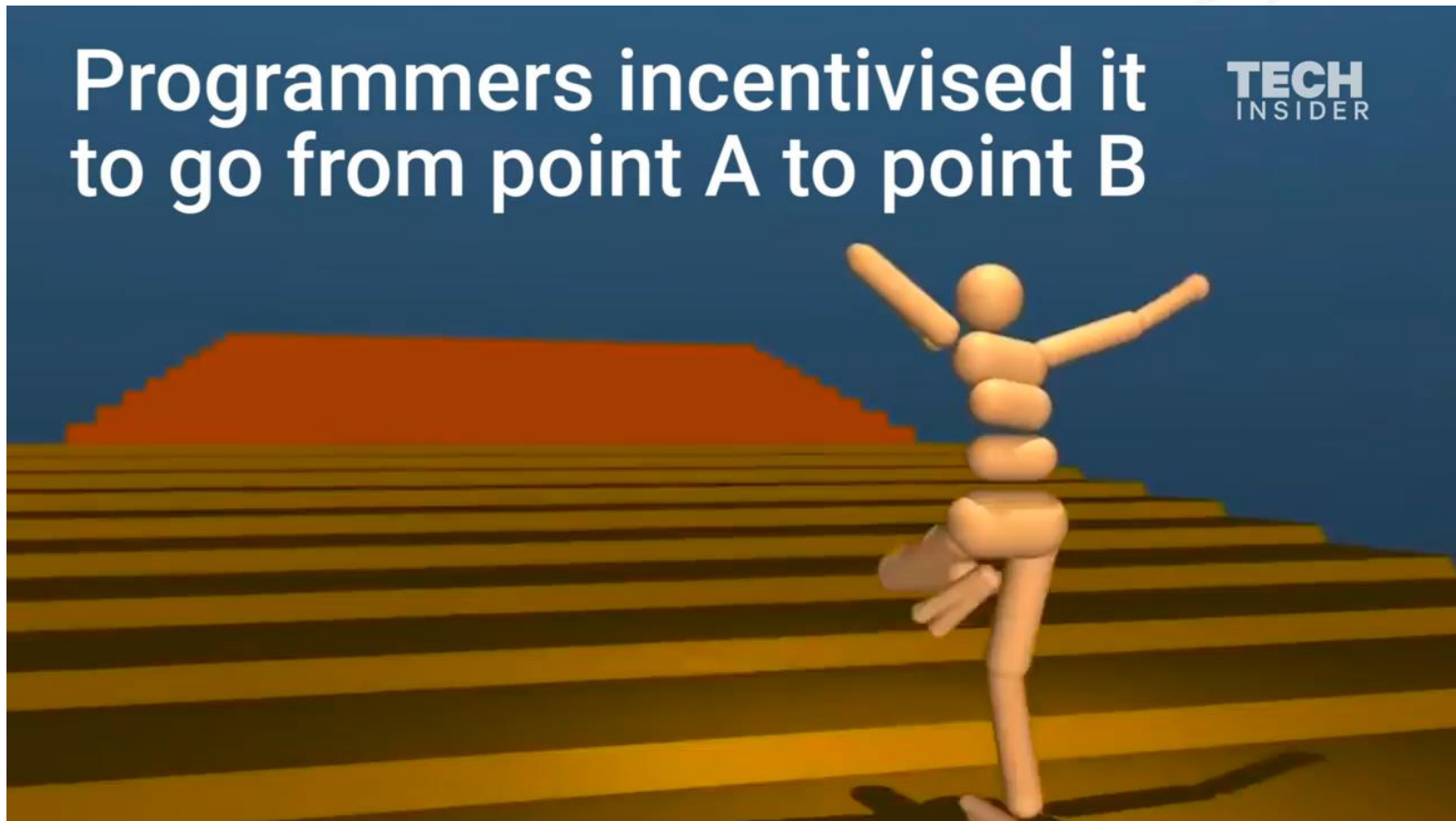
Where are we now?

Yes

- ✓ Object recognition in images

- ✓ Translation between languages

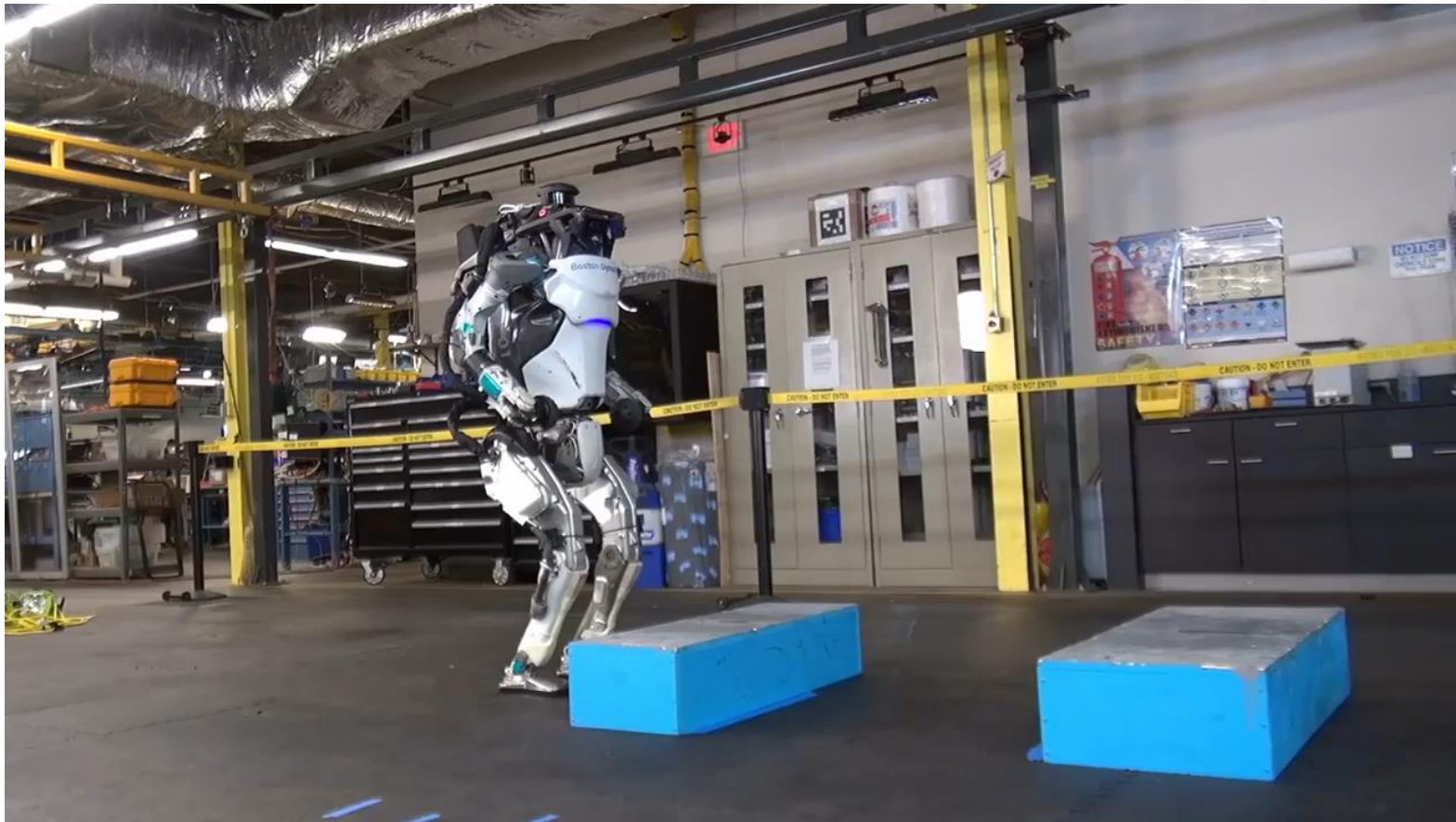- ✓ Play some games (Atari, Chess, Go)

- ✓ 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 it's glory

AI in action

A.I. TIMELINE

SYZYGY

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

2016

TAY
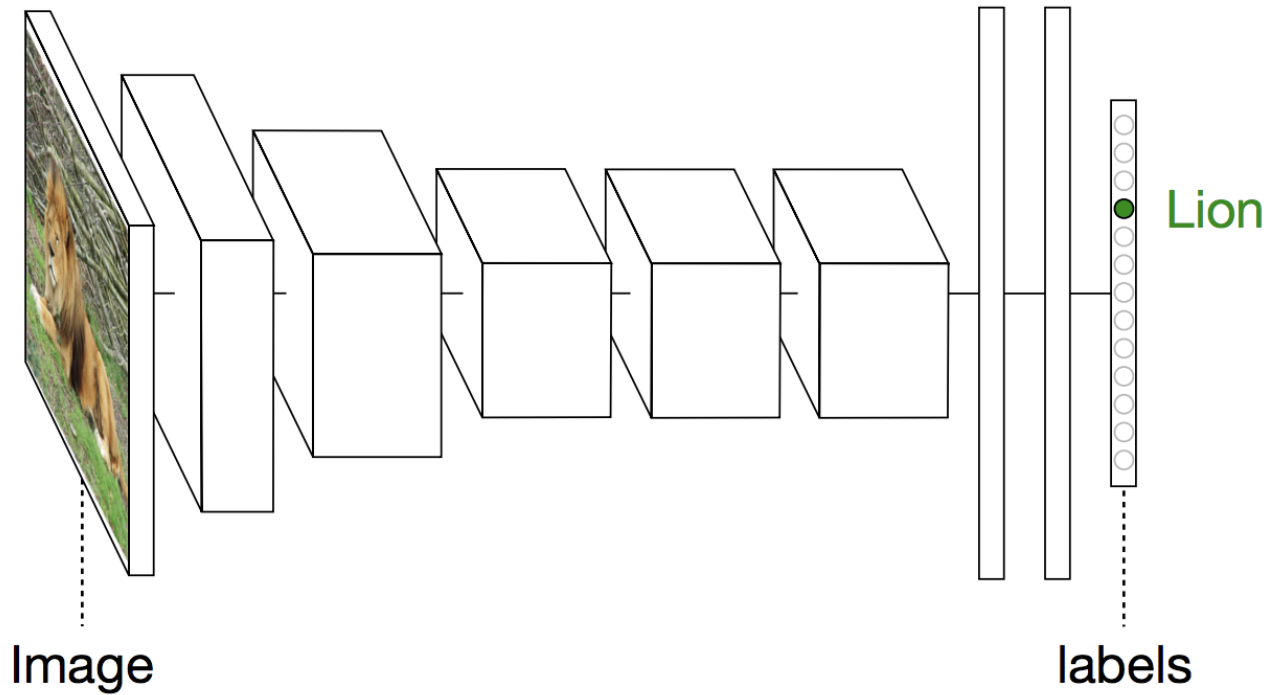Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments
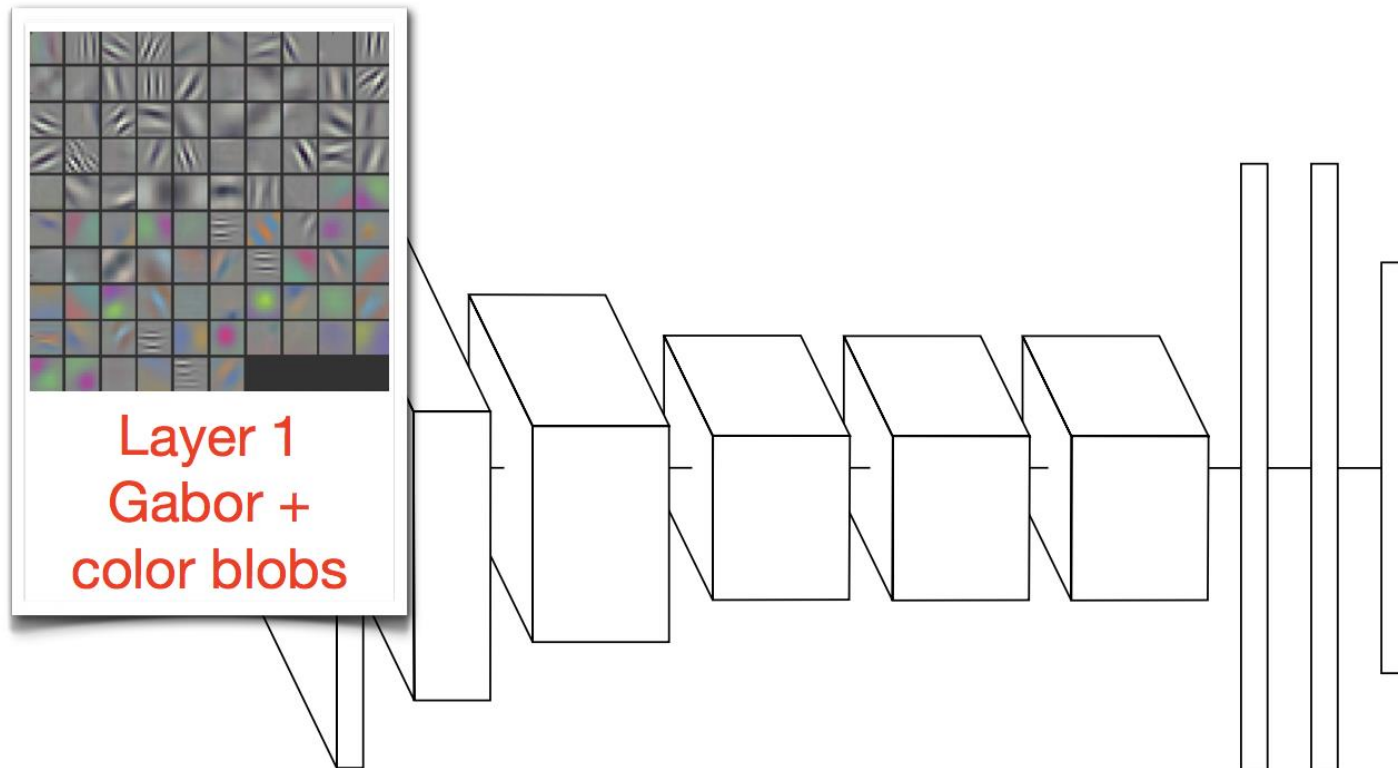
2017

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
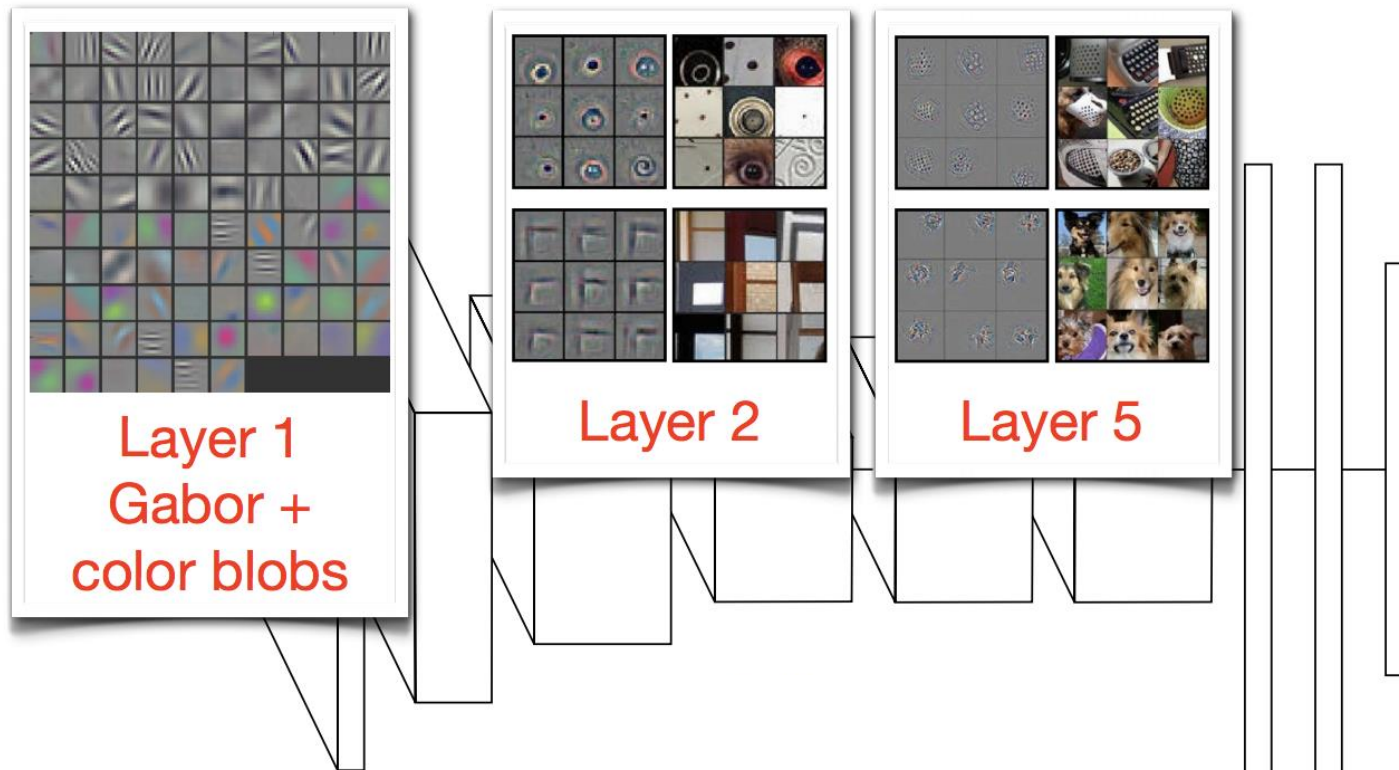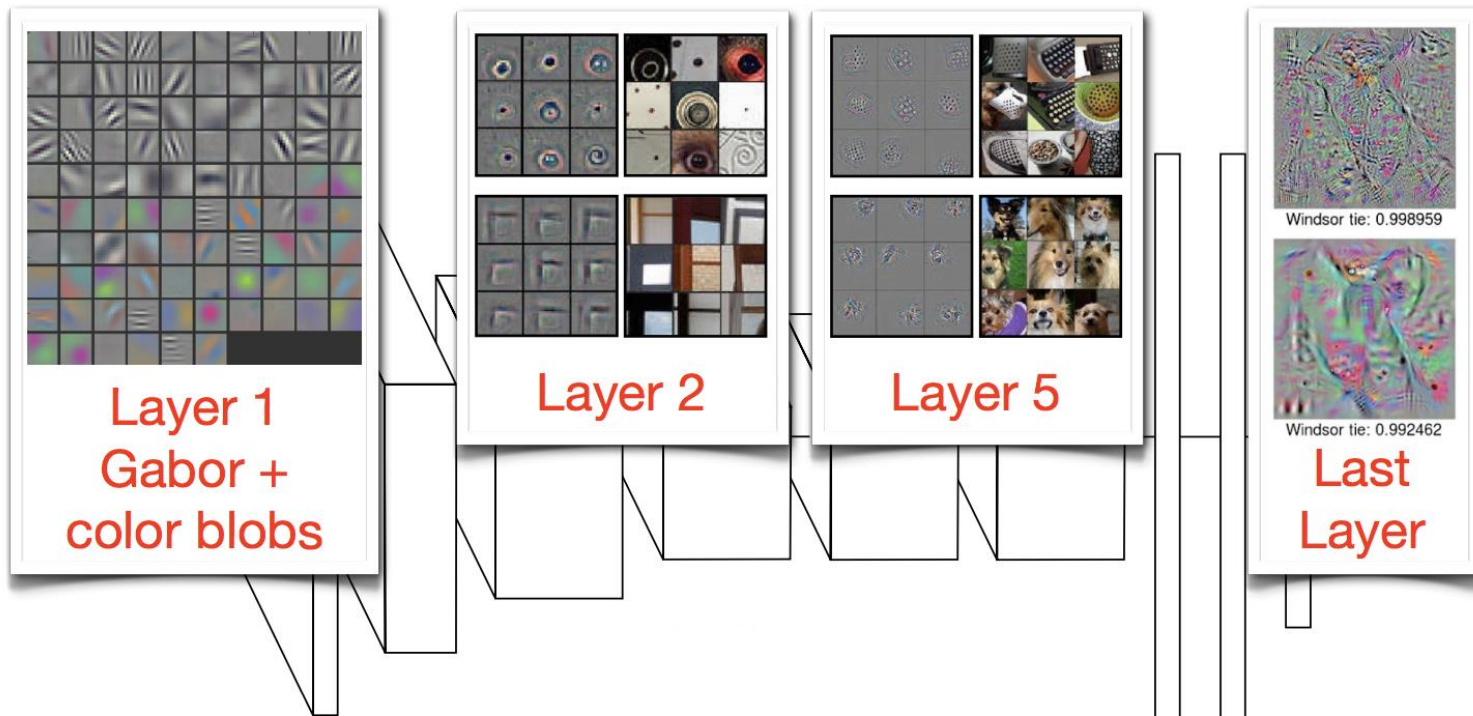
[2]

Image Recognition

Image   labels

[3]

Image Recognition

Layer 1
Gabor +
color blobs

[3]

Image Recognition

Layer 1
Gabor +
color blobs

Layer 2

Layer 5

[3]

Image Recognition

[3]

Learning a New Task

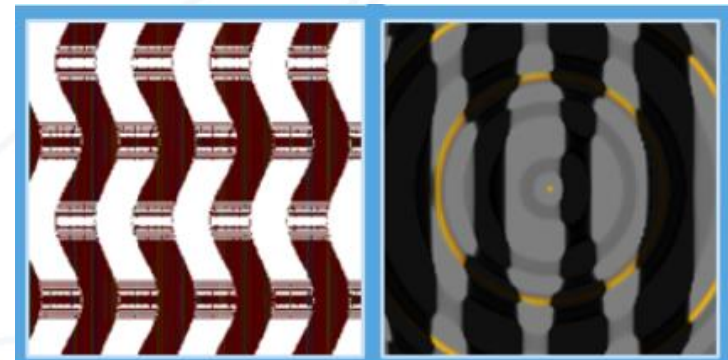| AI	Humans
Crunching numbers	Background knowledge
Needs thousands of examples	One shot learning
Only inputs & outputs	Complex relations

Why Pattern Recognition Is Not Enough

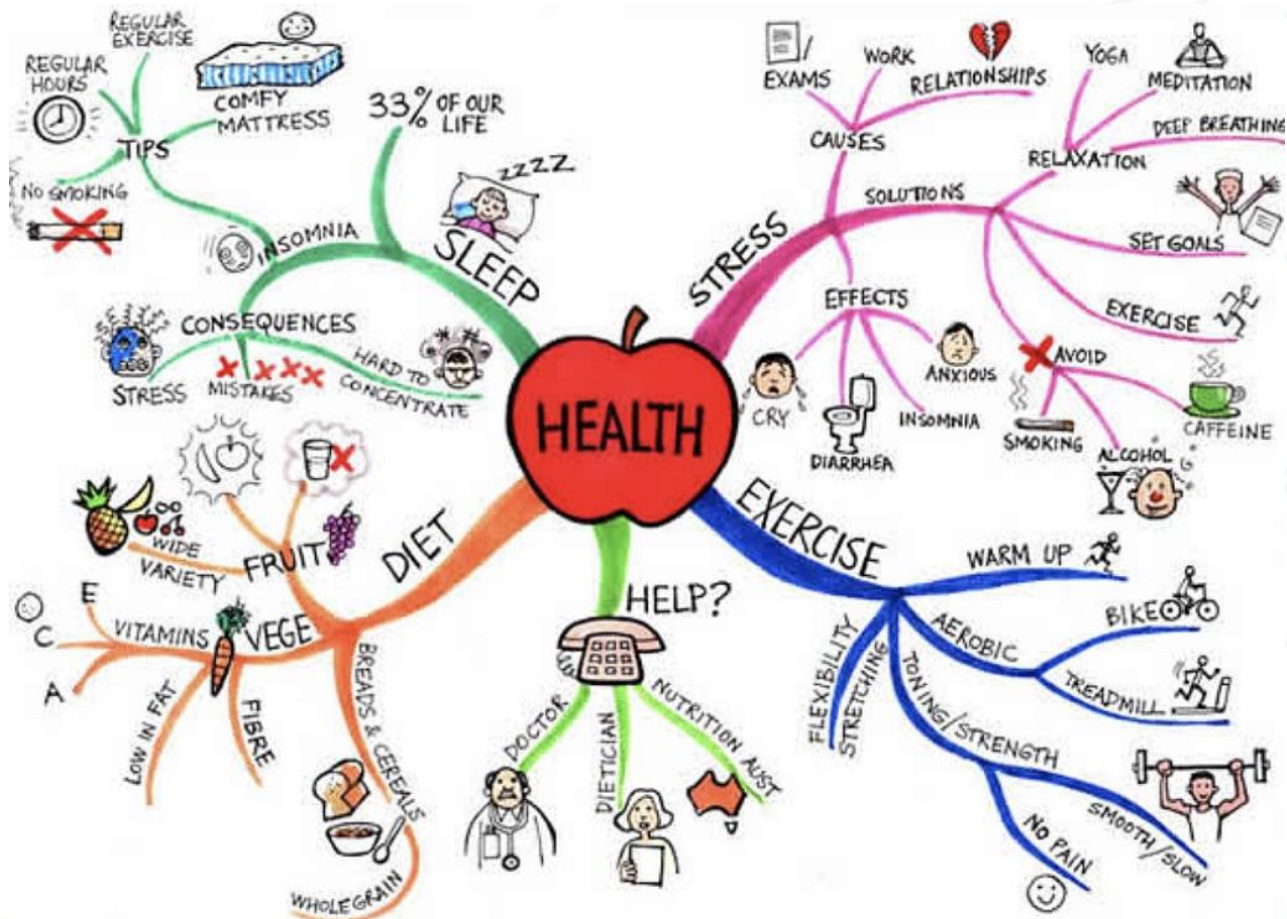| Guitar	Penguin
98.90%	99.99%

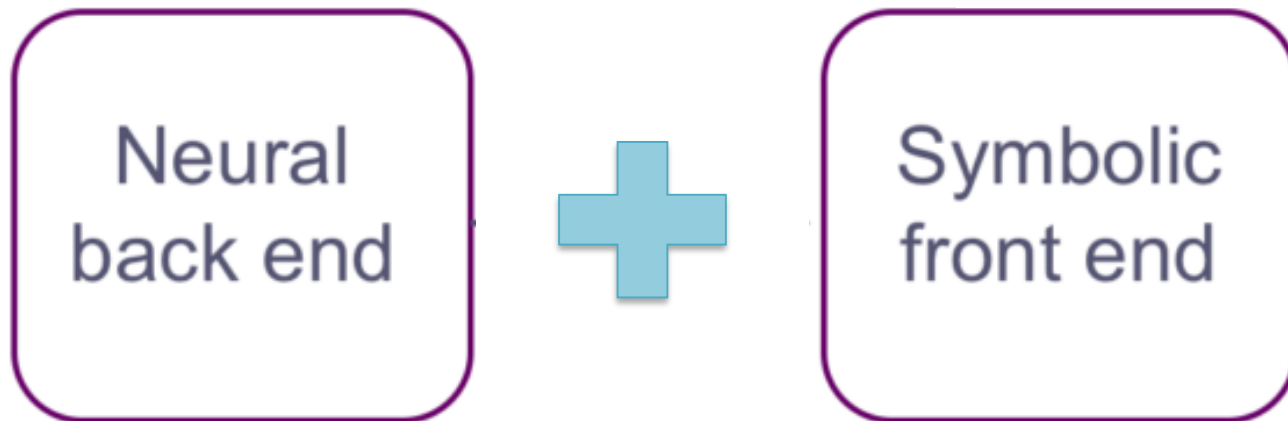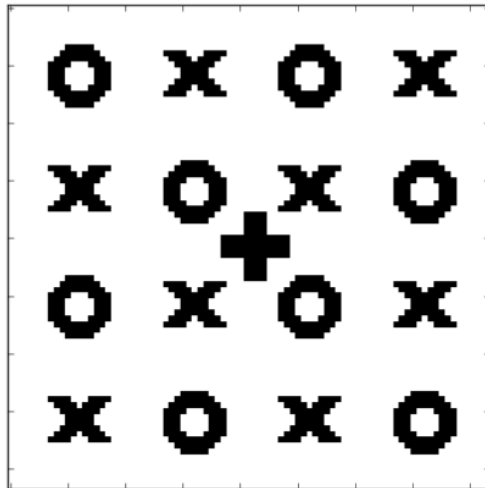| Guitar	Penguin
99.99%	99.99%

[4]

Conceptual Model Building

[5]

Bridging The Gap: A Neural-Symbolic Architecture

[6]

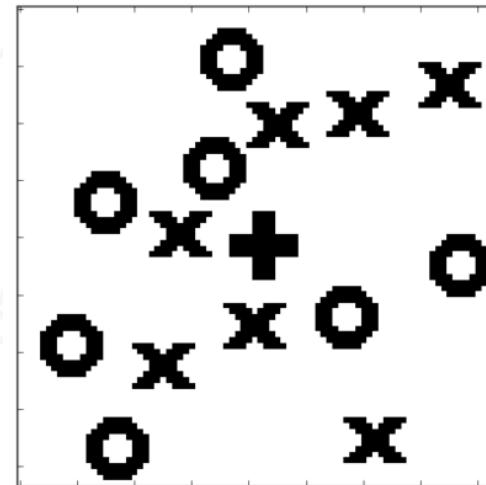# Conceptual Model Building In AI: A Neural-Symbolic Experiment

Fixed

Random

Neural Network: **95%**

Neural-Symbolic System: **70%**

Neural Network: **55%**

Neural-Symbolic System:
70%

[6]

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

[1] B. Marr, "The Key Definitions Of Artificial Intelligence (AI) That Explain Its Importance", *Forbes*, 2018. [Online]. Available: https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/2/#6f2115655284. [Accessed: 22-May- 2018].

[2] P. Marsden, "Artificial Intelligence Timeline Infographic – From Eliza to Tay and beyond", *digitalintelligencetoday*, 2017. [Online]. Available: https://digitalintelligencetoday.com/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/. [Accessed: 22- May- 2018].

[3] J. Yosinski, "How transferable are features in deep neural networks?", NIPS 2014, Palais des Congrès de Montréal, Montréal, Canada, 2014.

[4] J. Yosinski, J. Clune, A. Nguyen, J. Yosinski, and J. Clune, "Deep Neural Networks are Easily Fooled: High Confidence Predictions for Unrecognizable Images" 2014.

[5] J. Genovese and S. Genovese, "The Health Mind Map", 2011. [Online]. Available: http://www.mindmapart.com/health-mind-map-jane-genovese/. [Accessed: 22- May- 2018].

[6] M. Garnelo, K. Arulkumaran, and M. Shanahan, "Towards Deep Symbolic Reinforcement Learning" 2016.

Thank you!

Questions?