Neuro4ML

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# Challenges for ML and neuroscience

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https://neural-reckoning.org

# Challenges for ML: power efficiency

AlphaGo
100 kW – 1 MW
5,000 – 50,000 human brains

Lee Sedol
20 W

AlphaGo Zero
Claimed 1-2 kW
50 – 100 human brains

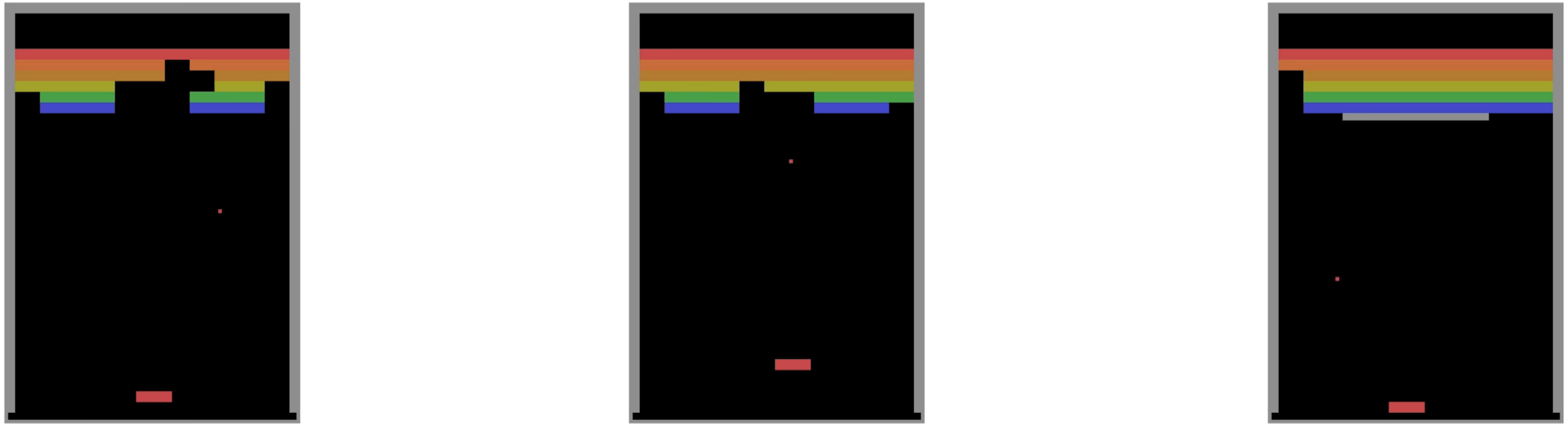
# Challenges for ML: sample efficiency

AlphaGo Zero
>5m games played

Lee Sedol
<50k games played

# Challenges for ML: generalisation and re-use

Vicarious (2016)



Normal | Higher paddle | Center wall

Tsividis et al. (2017)

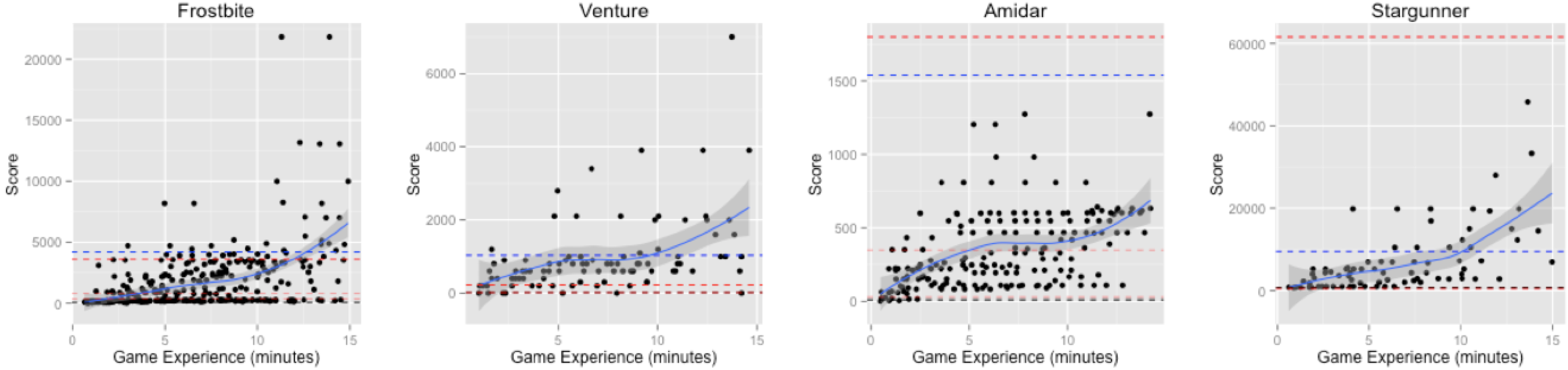



Figure 1: Human learning curves for four Atari games. Black horizontal line: random play. Blue horizontal line: 'expert' play. Red horizontal lines: DDQN after 10, 25, and 200 million frames of game-play experience (46, 115, and 920 hours, respectively).

# Challenges for ML: robustness

[Goodfellow et al. (2014)](#)

(a) Texture image

| | |
|---|---|
| 81.4% | **Indian elephant** |
| 10.3% | indri |
| 8.2% | black swan |

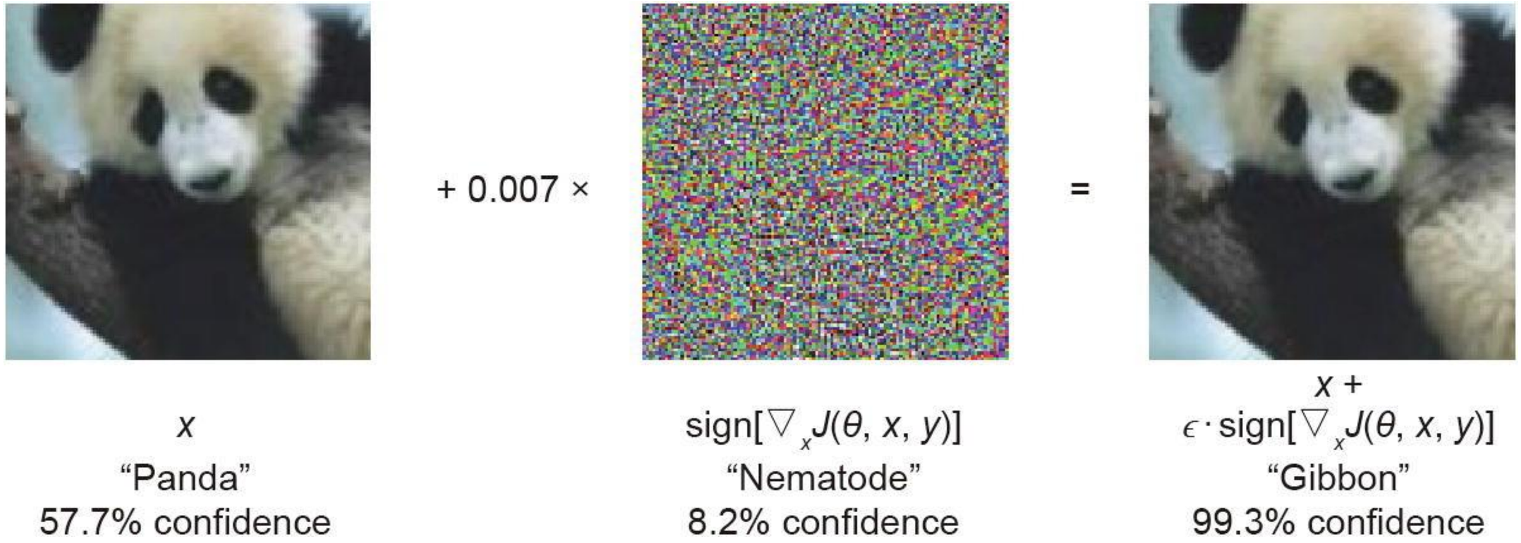
(b) Content image

| | |
|---|---|
| 71.1% | **tabby cat** |
| 17.3% | grey fox |
| 3.3% | Siamese cat |

(c) Texture-shape cue conflict

| | |
|---|---|
| 63.9% | **Indian elephant** |
| 26.4% | indri |
| 9.6% | black swan |

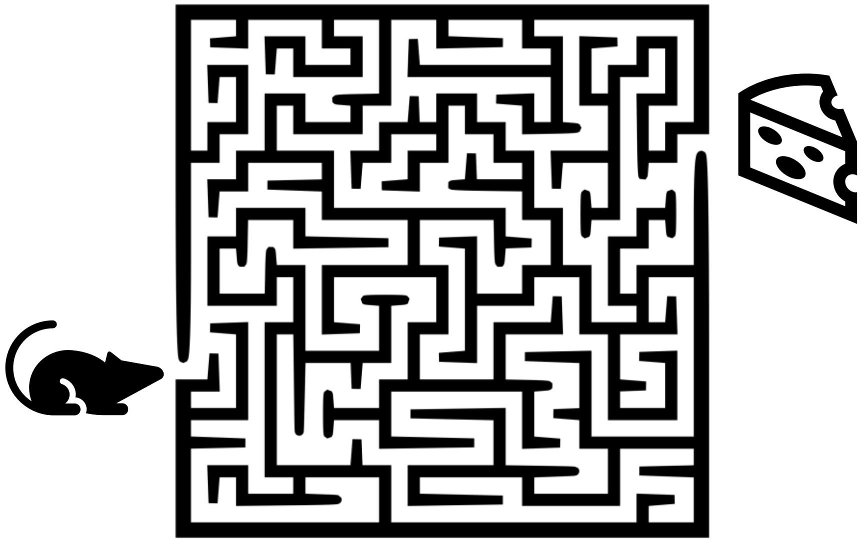
Geirhos et al. (2019)

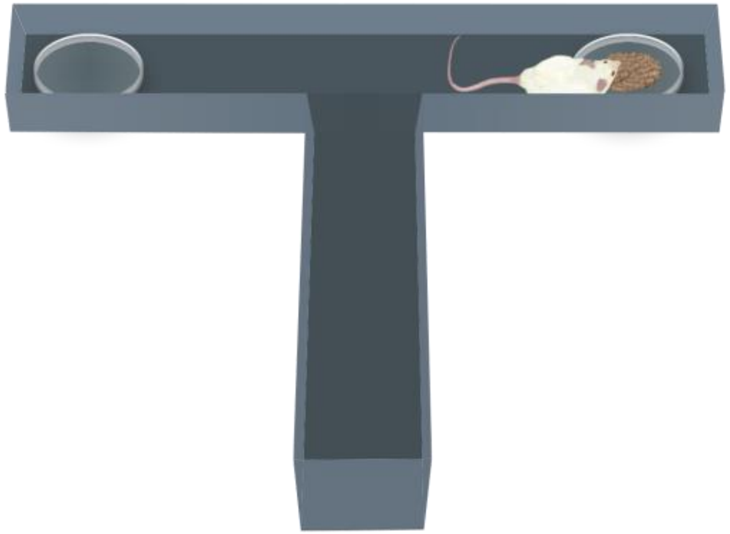


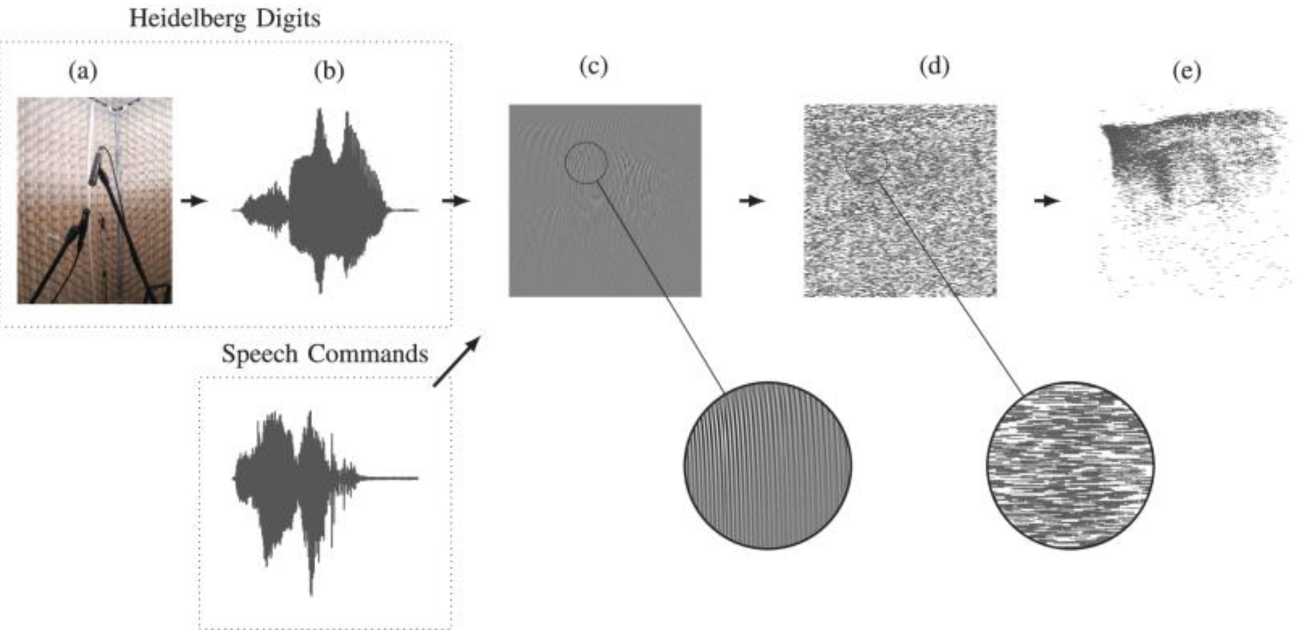


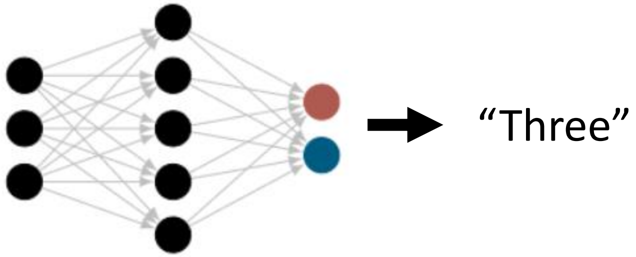
https://openai.com/research/multimodal-neurons

# Challenges for neuroscience








[Cramer et al. (2022)]

# Neuroscience ❤ ML
# A beautiful future?