Australian Brain Alliance

CRACK THE BRAIN'S CODE

BRAIN INSPIRED COMPUTING ALGORITHMS THAT LEARN

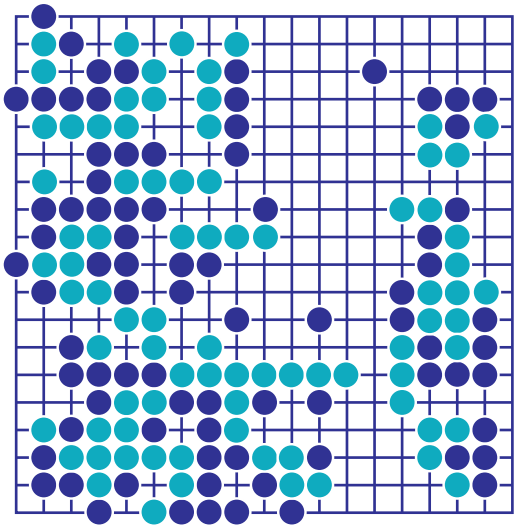
What are brain inspired algorithms?

The human brain is the ultimate model to revolutionise computing. Brain-inspired computing is already driving much of modern artificial intelligence research.

One approach is developing algorithms inspired by how the brain processes and uses information—in short, how we learn.

Deep learning involves layered 'neural networks' of connections that are strengthened through exposure to example datasets—as the system is 'fed' example data, it 'learns' how to identify or classify various examples. After sufficient exposure to 'correct' examples, neural networks can become astonishingly accurate at identifying unknown inputs.

Reinforcement learning involves algorithms that can learn sequences of actions that maximise a reward, mimicking the role dopamine plays in the brain. This type of computing is the brainpower behind DeepMind's powerful AlphaGo—the computer that managed to beat the human world champion player of the game Go.



In March 2016, AlphaGo, a computer developed by Google DeepMind, beat Lee Sedol, the reigning Go world champion—arguably the best Go player of the past decade—4 games to 1.

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The biggest successes for deep learning and reinforcement networks so far have been in closed, tightly-constrained environments such as games. Training deep learning systems to tackle new challenges has often meant a loss of their former abilities—very different from the human brain, which can learn an almost limitless number of new things, without having to 'forget' or 'delete' old information.

The ultimate goals for deep learning are systems that can process new information, learn from it and use it to make predictions and decide upon appropriate actions. This will require new neuroscience-inspired algorithmic advances.

Future applications include cyber-security, stepping forward from the current generation of systems that respond to security breaches, to those that predict future attempts and adjust systems to prevent breaches before they occur. We would see increasingly adaptive machines for manufacturing lines, novel uses for hand-held smart devices and improvements to weather and market forecasting.

The 'Internet-of-Things' – an extensive integration of sensors into our daily lives in the form of wearables, smartphones, integrated building management systems – provides valuable data that can predict health or environmental incidents. Combined with deep learning, these networks will drastically improve quality of life.

In the neuroscience and neurotechnology realm, applications include advances in neurostimulation devices that read and learn to recognise patterns in brain activity to pre-empt and derail seizures, or administer therapeutic treatments.

The Australian Brain Initiative will nurture the basic research required to take neural networks and deep learning to the next levels. It will also progress collaboration between research and industry to advance computing and neurotechnology applications that have the potential to transform society and strengthen Australia's economy.

In 2017, AlphaGo Zero used reinforcement learning to teach itself to play Go with no input from humans.

Simply playing games against itself, it took just 3 days to learn how to beat AlphaGo and 21 days to reach the level of AlphaGo Master, and beat the then world champion Ke Jie 3 games to nil.

AlphaGo Zero required fewer operations and much less power than its predecessor.

Facebook's facial recognition program, DeepFace, can ascertain whether different images are of the same person with the same accuracy as humans.