Critique of Neuroscience – Inspired Artificial Intelligence

Demis Hassabis presents the importance and the relevance neuroscience research plays in the development of AI. He presents a number of cases where there has been research intertwined with each other that I would like to put forth here.

The first and most prominent work that can be correlated are the Artificial Neural Networks and the Biological one. The fact that the current structure has been fully inspired by the biological neuron with relevant work first presented by McCulloch & Pitts etc. Moving forward, the back-propagation algorithm that allows curve fitting in high dimensions and recognizes patterns, and very costly in terms of computation, is not a mechanism in the brain and hence a better algorithm that is much more cost efficient must be realized with research in neuroscience.

The visual attention on the object of visualization slightly ignoring the surroundings expressed in animals and humans has inspired RNNs and CNNs to accommodate a similar structure resulting in greater scene understanding and better machine translation.

The fact that all beings are driven by attaining dopamine sets an agenda to perform steps that lead to a goal. The famous rat maze experiment is an illustration of the same. Reinforcement Learning is solely inspired by this work. Moreover, the Temporal Difference Learning bears a striking resemblance to similar such mechanisms in the brain for conditioning paradigms.

An astonishing but very prevalent mechanism that can be observed in the brain is the replay of the memory in the hippocampus and the consolidation of those memories in the neocortex. The brain obviously favours the most important events of the day. This mechanism is very similar to the DQN where it replays offline the most important features or states.

Further Imagination and planning that is exhibited by most beings can be attributed to the Monte Carlo Tree Search in DQN mechanisms where in a number of plausible situations that might imagined so as to plan for the best step anticipating the future is also a great correlation between the two fields.

The ability of the human cognition to rapidly learn new concepts is an active area of research. Deep generative and probabilistic models have been experimented with trying to achieve inference with low amounts of data. The attempt at One-shot learning is also inspired by the same fact.

We are also very quick at inferring solutions or understanding concepts based on the knowledge in similar or relevant fields. This concept in AI can be attributed to transfer learning. For example, a person with the knowledge of one programming language can easily adapt, understand and code in other programming languages as well. Much work has to be done in this perspective to achieve similar results.

Lastly, the ability of the human mind to comprehend the physical world/ecosystem in their mind gives huge insights into our ability to localize, have intuition of space and numbers. Some research work has begun in this regard and an experimentation with deep generative models has been carried out to address the same issue.

However, much research has to be done in the above 4 to 5 cases presented here to achieve the goal of AI. It clearly seems to be a far way off from where we are currently positioned. The fact that we must continuously draw inspiration from our own experiences of the mechanism of the brain cannot and must not be neglected. The way forward is surely to collaborate research work from the fields of AI and neuroscience although these fields have vastly grown in size.