The Society of Mind **(MIT 6.868J, Fall 2011)**

Lecture 1: Introduction

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1 Introduction

This course is based on lecturer's books, namely the *The society of the mind* and *Emotion Machine*, although they have drawn much criticism in the recent years, specially from the neuroscience community. But then again, so has neuroscience from Minsky and the other pioneers of Artificial Intelligence.

2 Why do we need machines?

- Humans are clever beings, for species that have been here on earth for only a few thousand years. We do not know how long we will last, and we can go extinct anytime due to a wide variety of reasons that may or may not be clear. But we in general strive to make our lives easier and more productive and that brings us to the use of machines.
- Machines are objects that may be animate or inanimate and allow us to solve problems in our everyday lives

3 History of AI

AI is one of the most complex fields and has been worked in concert with a large number of other fields such as linguistics, philosophy, biology, evolution and phuysical sciences, mathematics and more recently Computer Science.

3.1 People

Aritificial intelligence has been strived by a large number of people, all of whom presented interesting ideas that iteratively helped us to solve the problems in AI. To name a few would be :

Aristotle	Augustine	Seymour Papert
Baruch Spinoza	David Hume [2]	George Miller
Emmanuel Kant	Wilhelm Wundt Freud	Bartlett
Wiener	Neumann	BF Skinner
Turing	Herbert Simon	Claude Shannon

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3.2 Features of AI theories

As usual, most theories of the intelligence and learning can be seen to be drawn from some of the ancient wisdom of Buddhists and Indians, but the real problem with any of them is that they never crossed the threshold into studying via experimentation and acutally backing up theories with understanding and insights.

It is valid to argue that if there is a theory that can not be really tested why should we even look at twice? It is not relevant to observe what could happen, but only what can be backed up by testing and experimentation. We can argue partial results that can not be backed up properly should not be considered, since they did not cross the threshold of understanding which we hold as our benchmark.

An eventual question is that why did science get extinguished due to the constructs of society, except once. It is not that difficult to say "Let us do an experiment" when you hear an interesting idea, so why is it science did not happen a million years before. Why did people not experimenting? Did religion intervene? The answers to the questions are the ones that have affected science and learning in ways that have changed the course of history.

Artificial Intelligence is the job of making machines smart. To make them do things that are quite general.

4 Course of AI

Recent history, specially starting from 1930s, we have seen a surge in results, research and work in Artificial Intelligence. With more mathematical ideas we have moved to more general forms of Artificial Intelligence, that work towards more complex and common sense problems.

- **Emil Post** at NYU who came up with rule based systems.
- **Godel** came up with the idea of unsolvable problems that exist in every proof system
- Following which came the star of the field, **Turing**, who came up with the idea of Turing Machines

We look at the problem of AI and know that every problem is one of which must be attacked from a lot of different sides. There are multiiple ways to do anything. So we try different modes to solve the problem and try different approaches when one of them fails, using some ideas or heurestics to decide which approach to use. We can try something, figure out what to do something first and get enabled to try another idea. But interestingly we can be sure that one of the systems may take the fall for another. This idea of redundancy explains most of the things we observe in everyday life.

4.1 Redundancy

- Aristotle argued to some sense that a theory's most important idea is inclusion of inherent redundancy but represented as an instance of minimalism.
- Feynman too agreed to this idea in 1965, by reinforcing this idea by discussing multiple redundancies in a single model

Brain too has many redundancies, and has over 400 models performing similar functions. But mostly we do not know how the brain works, apart from the knowledge of visual cortex that projects the relevant

gradients and shades. But that does not imply that we can understand explicitly using just this information which object is what. A classic question is what are the sub systems that can be c oncerted to perform larger and more complicated tasks.

4.2 Relation to neuroscience

By 1950s we understand the role of neurons, but we still dont understand how it is we really understand things and how that knowledge is really represented. There are multiple theories to them, one of them called Knowledge lines which further motivated neural networks.

But still these ideas have not reached neuroscience but they neuroscience community only believes things that can be proven and is therefore not looking for such things but focusing only on things that can be found. But in the end, it is only if we have an idea can we really try to look for something, so any argument that says there is no proof, also has the reverse argument that we have not really proved that it does not exist either.

It is not the chemical properties of the neurons matter, but it is what the brain can do with those. Therefore neuroscience is biased, because they started with too much knowledge of chemistry which is not the most important part of the brain. It is actually the least. It like saying that the transistor is important in the computer, while actually a flip flop basically negates the effect of any transistor and therefore ensures that it is irrelevant. What matters is the computer can do by combining all of them together in the said manner.

Neuroscience is ignorant of the real things. The revel in obscurity of things while not contributing something back.

5 General Techniques

- Reinforcement theory [1] : first observed in animals where we could force animal behaviour by reducing external noise and giving rewards for these kind of actions.
- Simulated evolution : learning larger problems from solving smaller problems and iteratively solving problems
- Logic based systems : we can make symbolic inferences in data to come up with hypothesis for interaction
- Rule based expert systems
- Statistic based, neural networks : if you have a lot of variables then thinking of higher order combinations will lead to a large number of cases to learn about probability
  - One belief is to overcome this using hierarchical combinations
  - But larger or deeper correlations would not be handled by consecutive approximations
  - But then again students who are starting out only focus on what is popular

6 Computers and common sense

It is not the mathematical problems that are difficult, because they have rules and procedures. It is the problems that have a lack of rules that must be solved in more robust mannerisms. Like the brain we have to

simaltaneously consider a lot of issues like physiccal, spatial and temporal ones, which are embedding into thought that spans the mental, social and physical context in a parallel manner.

We need to have 6 level understanding that must be perceived :

- Self conscious relations
- Self relfective relations
- reflective thinking
- Deliberative thinking
- Learned reactions
- Instinctive reactions

References

[1] V. Mnih, K. Kavukcuoglu, D. Silver, A. Graves, I. Antonoglou, D. Wierstra, and M. Riedmiller. Playing Atari with Deep Reinforcement Learning.

[2] Wikipedia. David hume, 2017.