Artificial Intelligence: Search Methods for Problem Solving
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Lecture - 11
Introduction (2013) Concepts and Categories

So, that is a fundamental question one has to answer which say that if you are in modern day world, going to write programs which will operate according to the algorithms that you are putting into those programs, how can they be doing meaningful things?

Essentially, so its roughly equivalent that essentially or I might say that if I have to implement a neural network, which is I know that the structure of a neuron, how it operates and so on and so forth and I am just connecting together hundreds of thousands of neurons; how can that ever do meaningful things like character recognition? Of course, we know that it can be done character recognition can be done.

But the fundamental question is that intelligent or is it some doing something that we have asked it to do? In fact, Ada Lovelace had said that the computer can only do what it is instructed to do and nothing more than that which is of course true at a very fundamental level.

So, some recent thoughts on who is doing this manipulation; of thinking, there are some very interesting books and for those of you are interested, I would recommend them, all of them have a common author called Douglas Hofstadter, who is in the Indiana university. His famous book called Godel Escher Bach and he and Dennett wrote a series of, collected a series of articles called 'The Mind's I' and more recently, he is written a book called 'I am a Strange Loop' essentially.

So, he is trying to Hofstadter is trying to answer this question, I mean instead of saying who; he is saying what is this notion of I that I have as a human being that I have essentially. I or you essentially. So, if I talk of you as a person, what do I really mean? What is that you essentially? So, I say that my body, my mind, my hands, my eyes, my feet, my whatever; what is this I which is saying my essentially?.

That is the question with which Hofstadter is trying to answer and he sort of uses a combination of emergent behavior and self referential loops which we do not have time to get into here essentially. But I would recommend one of these books, they are quite easy to read, quite engrossing ok.

(Refer Slide Time: 02:37)

So, let us move on from Descartes. So, John Locke known as Father of Classical Liberalism. His theory of mind is often cited as the origin of modern concept of identity and the self

essentially and influenced other philosophers like Hume that we will see and Kant that we will see in a moment. He postulated that mind was a blank slate as opposed to what Chomsky says that we are born with a inbuilt grammar, called the universal grammar in our heads.

Locke said that the mind was a blank slate of tabula rasa as he called it and that we are born without innate ideas and as you can see in the last two lines, that knowledge is determined by experience derived from sense perception. That whatever we know in our heads is the result of whatever we have experience in the world and experience leads to knowledge essentially.

(Refer Slide Time: 03:39)

So, one of his collaborators followers David Hume's, Scottish philosopher whom rangeland calls as a mental mechanic and by this, we mean a mechanic whose operating in the mental domain.

He was an empiricist and in his book called the Treaties of Human Nature, he strove to create what he called as a "science of man" that examine the psychological basis of human nature. He said that everything is tied up to human nature. You can understand human nature, you can understand how human beings behave and what else is there essentially. So, science and everything derives from there.

He follows this idea of experience and observation as a foundation of logical argument and he was an admirer of Newton and he says in the manner in which Newton explains the movement of heavenly bodies, our planets and so on, he says that impressions and ideas are like basic particles to which mental forces and operations are applied.

Just as Newton is giving the laws of physics, Hume is saying that there is a law of mental activity, law of associations as he called it, that they were mental ideas were like particles. He is not saying that they were particles, he is says they are like particles to which mental forces and operations are applied.

Further like Newton, he does not care as to how that is happening. So, Newton never explains how gravity happens or you know why gravity happens; you know there is no explanation behind there. He just gives a Laws of Gravity and says that this is how planets are moving around the earth and it is explained by gravity. So, Hume does the same thing; he does not try to explain how it is happening. He says this is what is happening and it can be explained by this laws, do not ask me why it is happening like that essentially.

But he could not explain however, what made ideas now. No, its like that once you say these are particles which are obeying these laws, then why are they ideas essentially and what makes their interaction between different areas count as thinking essentially. So, he is done away with meaning all together.

So, the last person, we will visit today is Immanuel Kant, German philosopher widely considered to be central to modern philosophy. In fact, when I was an undergraduate, we had a whole course which did a comparative analysis of Kant and Mill's philosophy essentially. He says and this is very interesting.

So, we have come a long way in this short period of time, from this notion that the world is out there and we are simply seeing the world? No, the correspondence theory of knowledge and then, mind body dualism and then so.

Kant has come to the other extreme, he says the mind has a priori principles which makes things outside conform to those principles and these are some very consistent with some very modern ideas essentially.

So, for example, some very recent research in computer vision, so the simple view of computer vision would be like the correspondence theory of knowledge that you get the image of things and you do image processing, pattern recognition, feature extraction, all this kind of stuff and then, you understand what is happening. It is a forward process from the world to the mind.

Modern theory says that we have preconceived notions of what we are trying to see and what we see is already there in our minds to some extent. This is what Kant has said, the mind has a priori principles which make things outside conform to those principles. Then, he says the mind shapes and structures experience, it is a mind which shapes structures and experience so that on a abstract level all human experience shares essential structural features.

So, all of our minds operates in the same way that is why we are able to communicate, you know that is a question that one could have asked how can you know one human being communicate ideas to another human being essentially. So, he says that fundamentally the mind has a similar structure.

Then, he of course, goes to goes on to explain that the concept of space and time are integral to human experience that you cannot operate without them, as are the notions of cause and effect essentially. So, how what causes what? Causal theory is basically a mental theory, I mean in the real world, I mean we have this cause and effect kind of a notion that if I turn a switch on the light will come on.

But the physics does not recognize any cause causal theory, the physics only recognizes equations. So, it goes on once equilibrium state to another equilibrium state; there is no causal things, but they these are fundamental to our thinking essentially.

So, the second last paragraph is very interesting, he says that we do not have direct experience of things and we will visit this in the next class which we have it on Wednesday, we will come back to this question of the as he called is there the nominal world or the real world outside

there. We do not have direct experience access to the real world, but what we do experience is a phenomenal world as conveyed by our senses.

So, we cannot now this is a very philosophical question and if you look at some Indian philosophies like Buddhism, they asked the same question against the (Refer Time: 09:21) that what is there in the mind is what we think is out there essentially, that is what Kant is saying essentially and he says that human concepts and categories structure the view of the world as we see it essentially.

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So, the world is not as it is out there, but as we see it essentially. So, the world as we know it essentially. So, this is known as a subject-object problem essentially; a long standing philosophical issue is concerned with analysis of human experience. So, the question is that the

world consists of objects and entities which are perceived or otherwise presumed to exist as entities by subjects observers (Refer Time: 10:00).

So, there is a subject. So, we think that the world has this objects out there and how does that happen essentially? Ok. So, some technical terms which we should be familiar with. So, the subject object problem has through two primary aspects; first is what is known what can exist out there and this is something that we call as ontology, it become very popular in current day computer science.

So, the field of ontology deals with questions concerning what exists or what can be can said to be exist essentially and how such entities are grouped together essentially, related within a hierarchy and that kind of a thing.

So, nowadays computer scientists talk a lot about ontologies and in the concept of the semantic webs. So, we have wants computers, talk to another one computer sitting here to meaningfully talk to another computer and we have this notion of Ontologies and taxonomies which we may not have time to go through in this course.

The second standpoint is how does one know what we know essentially and this concerns epistemology. Questions as to how knowledge is acquired?. So, ontology says what can exist and epistemology is concerned with how do we get the real facts of for example, why was Durga suspended (Refer Time: 11:35), epistemic question how do we say that this is what is really happened out there essentially. So, that is the question of knowledge acquisition or epistemology and the bounds of our own mind.

(Refer Slide Time: 11:43)

..the bounds of our own mind

Kant claimed to have created a "Copernican revolution" in philosophy. This involved two interconnected foundations of his "critical philosophy":

- the epistemology of *Transcendental Idealism* (we are not able to transcend the bounds of our own mind), and
- the moral philosophy of the autonomy of practical reason.

Conceptual unification and integration is carried out by the mind through concepts or the "categories of the understanding" operating on the perceptual manifold within space and time. The latter are not concepts, but are forms of sensibility that are *a priori* necessary conditions for any possible experience. Thus the objective order of nature and the causal necessity that operates within it are dependent upon the mind's processes, the product of the rule-based activity that Kant called, "synthesis".

Source: http://en.wikipedia.org/wiki/Immanuel_Kant

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So, he create; so, Kant say that he is done something like a "Copernican revolution" in philosophy. So, what he calls as critical philosophy? So, he says there two things; one is the epistemology of transcendental idealism which says that we are not able to transcend the bounds of our own mind.

We can only perceive the world through the prism of our mind in some sense or through the spectacles or glasses of our mind and we cannot exceed that. So, we cannot access the real world out there, only what our mind allows us to see.

So, already the notion of mind has become so prominent essentially and the moral philosophy, the moral philosophy in those days was not quite what we talked about it as right now; but something to do with the mental world the modern philosophy of the autonomy of practical reasons. He says that you know practical reason can be automated. So, maybe this is the last

thing, I will leave you with. Conceptual unification and integration is carried out by the mind through concepts or the categories of understanding.
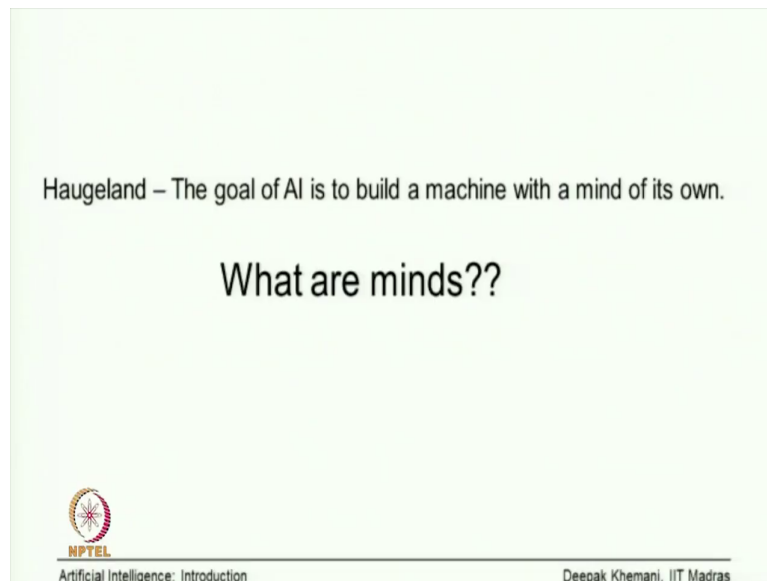
So, this is again those terms from ontology's are coming up. We have concepts about things we know we have categories of birds and you know flowers and apple and fruits and all these kind of categories or things. Operational on the perceptual manifold which is built within space and time, we say space and time is something fundamental to our minds. Our minds think in terms of space and time and everything that we think about is located within is in the notion our notions of space and time.

They are not concepts, but are forms as a that are a priori necessary conditions for any possible experience. He says that without this notion of say space and time we would not have been able to imagine the world and think about the world, that is the objective order of nature and the causal necessity that operates within it are dependent upon the minds processes ok, which he called by a product of a rule-based activity which he called as a synthesis.

So, the emphasis is totally shifted to the human mind, it is a human mind which shapes the way we see the world and we reason about the world and everything is dependent upon that essentially ok.

So, from a notion when we did not even have a notion of a mind and then, gradually we said thought and reality is different and then, mind body is different. Kant has come taken us to a point which says that our interaction with the world is controlled by our mind essentially.

(Refer Slide Time: 14:18)

Haugeland – The goal of AI is to build a machine with a mind of its own.

What are minds??

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So, this is what we will do in the next class, just to remind you of the goal that Haugeland that we have set the goal of AI is to build a machine with a mind of its own. So, in the next class, we will come back to this Kantian view of the mind and discuss a little bit more and maybe wind up with the introduction in the on next Wednesday essentially.