Artificial Intelligence
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Lecture-50
Uncertainty in AI: Motivation
Part- 1

So, what did we learn let us think about what is it that we learned in this whole half of course so far I would say is almost half of course at this point this is a midpoint for me. And the reason it is a midpoint for me is that now I am stopping with them traditional AI. And we will be moving into modern AI. So, let us take a few minutes and think about what is it that we have resolved so far in the field? So, we started by saying there is a hallmark of intelligence is to solve a new problem.

I give you a new puzzle I give you a new setting I put you in a different setting you will not train for it you should be able to solve it. You should be able to reason about it. We said that to solve a new problem let us come up with a very general algorithm that solves pretty much everything almost everything. And we said that we can do by search. So, we defined that the idea of search a general problem a meta problem where every problem can be converted or many problems at his deterministic single agent problems can be converted into a search problem.

And we said okay awesome, now let us come up with general purpose algorithms and we did a huge barrage of algorithms going from uninformed systematic search to heuristic function in form systematic search to local search and to backtracking search and DPLL then we also said that search is just equivalent to trying out things. But sometimes the problem has some characteristics which we can do the reason which to make some inferences.

So we said okay search and inference together is even better than search right. Every step if I can make some inferences and I can disprove something so I can prove something I can say those cases I should not be trying so that way I will only be trying the cases which still may lead to a solution that I cannot disprove that reduce my search size that will speed up my algorithm. Then we said that but in order to do inference I need to understand the structure of the problem.

How would a person or an agent communicate the structure of the problem to the machine I need to define a language? Earlier in search our language was just a program blackbox but now we said let us go inside the black box let us define the language. So, he said let us define a very simple language we define the language of constraint satisfaction problems. We said let us define a more interesting language we define the language of logic.

Language of logic is awesome because logic has had a long history we know that pretty much a lot of reasoning tasks can be put into logic logical inference tasks. So, we learned about some algorithms for inference and logic. We talked about the solution and forward chaining and then we said that; so, these are called knowledge representation languages and then finally we said that all of this for single agent problems but we often have multi agent problems.

And we looked at the case where multi agent or two agent problems were competing against each other they were fighting against each other they wanted to win each of them. And so we define that problem as a search problem and we talked about the minimax algorithm and after talking about the minimax algorithm. We said but minimax will not be able to go till the very end because the games can go take very long so we need to cut off.

Well if we need to cut off we need to figure out what is the value at this node what is the my probability of winning what is their probability of winning what is the likelihood right. And so I learned that machine learned that using some feature function representation and that is what I backed up this is what we have achieved so far. And there were some other insights that you know kept coming along the way of how intelligence works.

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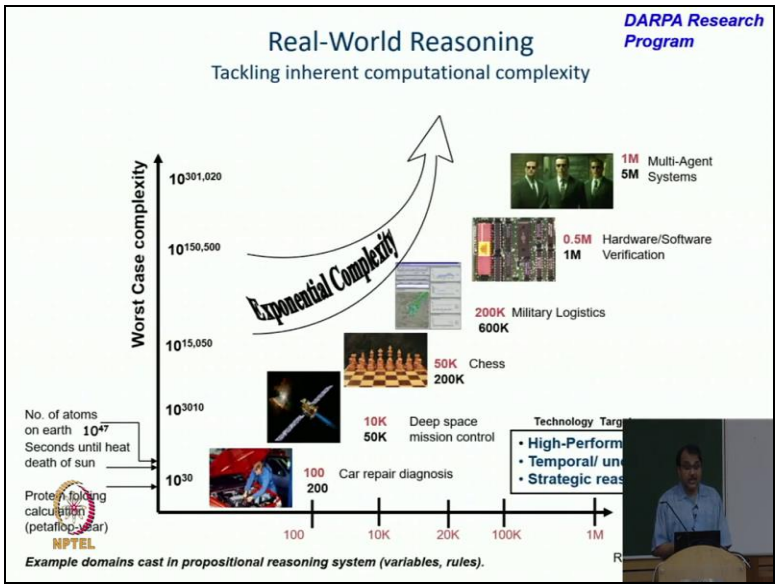

And in the context of sad we also said that this is one of the biggest successes in the field of AI because at least in the field of traditional AI because these days we can solve 1 million problems five million constraints which is has a search space of size to the power 300,000 but we are able to solve some of these problems today that is pretty amazing pretty exciting. And the way we are able we are not able to solve a random problem here just to clarify the only able to solve real-world problems that come about because they have hidden tractable structures which sometimes the model is able to hit on and there are many many bells and whistles that go into the best search service.

Now where are we going to go from here this one seems like a lot of the AI is solved well not quite and in fact all of this AI has gone slightly out of fashion today and the reason it has gone out of fashion and you will delve upon it a little bit more than the coming week is because it is modeling the world deterministically. It says that I have a specific Clause and this is a clause I always have to satisfy. There is no notion of randomness there is no notion of uncertainty think about a robot moving in a real physical environment.

It tries to pick up a cup with some probability it will be able to pick up the cup with some probability the cup will fall down with some probability it will miss with some probability thought it is a cup but it is actually a you know wallet. With some probability it is a cup but the

cup is immovable because it is a showpiece and it is stuck to the floor. With some probability the cup is too heavy that it starts to lift but the cup is not is not liftable etcetera.

There are many, many such possibilities that happen many, many such possibilities. Now unfortunately in logic we have to define a variable for each such possibility. And if the possibilities are infinite or uncountable or at least countable but infinite you just cannot define a problem with all such possibilities. I think of all the ways in which your car can break down you know you will find that there are large numbers of ways and with the car can break down right.

And you will not be able to enumerate all of them similarly if I give you a symptom like I have cuff and cold what is the disease I have. If these are the only symptoms I give you you will say I have what would you say common cold let us say. Why did not you say throat cancer other than that you were trying to be nice to me. It is less probable you have some intuition right it could be throat cancer you know this is what happens when you go to this online Google and start to be a doctor for yourself.

I am sure everybody has tried this every symptom has a million diseases or at least you know 1000 diseases. And some of those diseases are very scary and if you go eat these bulletin boards or no discussion groups you always find these random people with very little symptoms they died or their loved one died or they nearly died and you get really scared. Can logic deal with all of that? Can logic say that you could have throat cancer but the probability of throat cancer is ridiculously small and you probably have common cold because that is the most frequent.

Or you could even have dengue because you know you are in India and it is the monsoon season. You need to make inferences in life which are not logical which are probabilistic which have notion of likelihood highly likely and less likely. And unfortunately the world traditionally AI could not do this. And therefore at some point people realize that they are not able to get from AI what they want and they were interested in a different knowledge representation framework that leads to some of these kinds of reasoning's.

And therefore logic went out of fashion and what came into fashion at the time is probabilistic modeling which is what we are going to start with. AI the field of AI has seen many turing awards and the latest one is on deep learning you all aware. But do you know who was the turing awardees, in the field of AI before deep learning okay. So, this is your homework and this time I want more than two near hands to be raised which is a very low bar right.

But if you want an easier exam you have two more of you have to answer this question for yourself. So, the question is who was the Turing Award winner from the field of AI before the latest one this year on deep learning okay. And the answer to that will lead us to the topic that you will study which is Bayesian networks. I will stop here welcome to the world of modern AI starting in the next class.