Artificial Intelligence
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Lecture - 1
Introduction: What to Expect from AI, Part – 1

Alright, so, welcome to the AI course, from today we are going to talk about the technical aspects of AI. And before I start I want to mention that while I am going to be presenting the course, I have I am really standing on the shoulders of giants in other words, there are a lot of lot of people who have taught AI really well taught AI probably much better than me, taught AI I have learned AI lot from them and so on so forth.

And I have learned from many such people and the slides that I will be using will be stolen from different places of course with you know, some permission, I would say. And so, because of that, you know, we will be sort of taking interesting bits from wherever I found and combining them in the course, I should also point out that I am going to credit all the people that have taken slides from in the first slide, not on individual slides, but you know, I really, really thank them for developing this course for me and for themselves.

And for the field further, okay. Now, AI course has been is being taught in pretty much every department in the world, every top department in the world at least. And if you look at the AI courses in different institutions, you may find sometimes the overlap between topics is limited. There are many ways to look at a broad field like AI you know, I remember that when I would go to triple AI conferences as a student.

There will be 8 or 9 parallel tracks running and sometimes as a young student, even though I was a researcher in AI, I may only understand things about one track and not understand anything about the other 7 tracks. It is a really broad field. And the reason it is a broad field is that AI is not just a technical subject, and we will understand it more than more over time.

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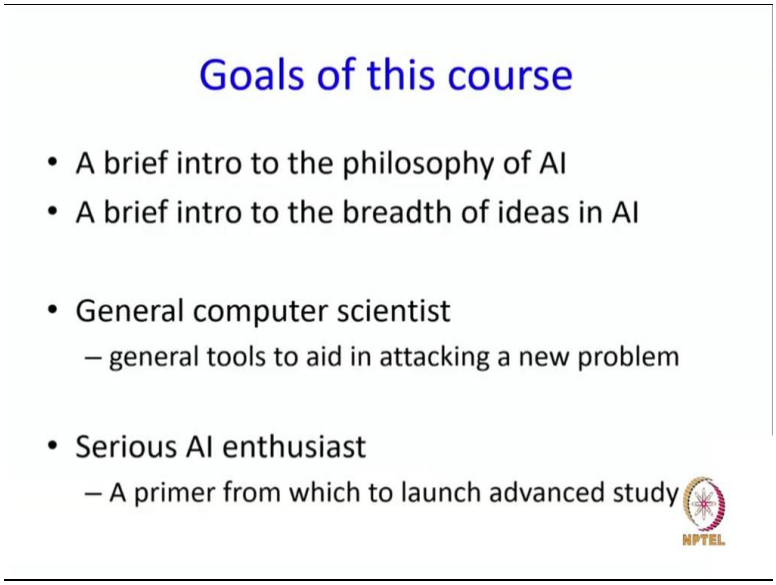

But it comes from a philosophy. AI is not a problem, which has 1 solution or 2 solutions. AI that is a general problem, philosophical problem, which has many, many, many frustrations into concrete problems, which have many, many, many different solutions. So triple AI conference, or an AI conference often thinks of itself as an umbrella conference, which brings all these people together. Because AI has so many diverse sub fields, any course cannot do justice to all of them any limited time course.

And therefore, if you look at the book, which is the Russell and Norvig book, by the way, how many of you now have access to the book? Very good, I am very happy to see that at least 20% of you have access to the book. This is only the second class by next week, I hope all of you will have a copy of the book with you, you as you must have seen for the people who have had looked who have looked at the book, it is a big fat book and there is no way we are going to cover the big fat book in the class.

So, any instructor has to make some calls on what it is that they want to cover in the course. Now, I think of it as a breadth course A breadth course, therefore, may not be deep. So usually the trade off is between broad and shallow versus deep and narrow. If you are one person who is broad and deep, you know all the power to you, I respect you. But most people are not such people. Most people are either on this side of the coin or that sort of thing.

And in fact, you are undergrad students. So it is your time to learn something about everything. It is your time to be broad. Once you start doing a research project. Once you go deeper into a particular assignment. Once you go into a specific, you know, course project or what is not, that would be the time for you to go deeper into something. And you can only go deeper into a few things not too many? So I am taking a view that we this would be an introduction to the breadth of ideas in AI. So I am going to introduce an idea and that idea if you are able to capture it.

The core of it and have it with you, it is going to help you in wide variety of settings, not just in this specific topic in which we learned that particular idea. So if you are a general computer scientist, not interested in AI in the long run, you will still get a point of view and a set of general tools that will help you in attacking a new problem and I am assuming that almost all of you will go into the industry or somewhere there you will be solving problems and not saying that you will be solving computer science problems also.

You will be solving problems technical problems at some level and this AI way of thinking is going to help you and that particular way of thinking will in introducing the Next week, For now, we are just motivating them and talking about what is AI and the history of it. And if you are a serious AI enthusiast if you want to make AI career either in research or in further study and you know a job and so on so forth. This would give you an introduction to a lot of topics. This will teach you about search then you can go and take a heuristic search course.

This will teach you about some basic networks, probabilistic graphical models and you can take Ferro zinc law in probabilistic graphical models or Daphne Koller. You know about Daphne Koller. Daphne Koller was one of the founders of Coursera. She was a professor at Stanford. How probabilistic graphical models book and her courses are the most famous course in this particular area. You will learn a little bit about planning and decision making from there you can take a full blown course on reinforcement learning.

For example, Ferro zinc laws teaching a reinforcement learning 800 level course in our department this semester. Now you are not ready to take that course without doing the AI which gives you the introduction. I mean, you can always pick it up, but eventually this course prepares

you to take that advanced course, if you are interested in and so on so for. So, there are many, many sub topics of AI and this particular course is going to introduce all of our many of them to you get.

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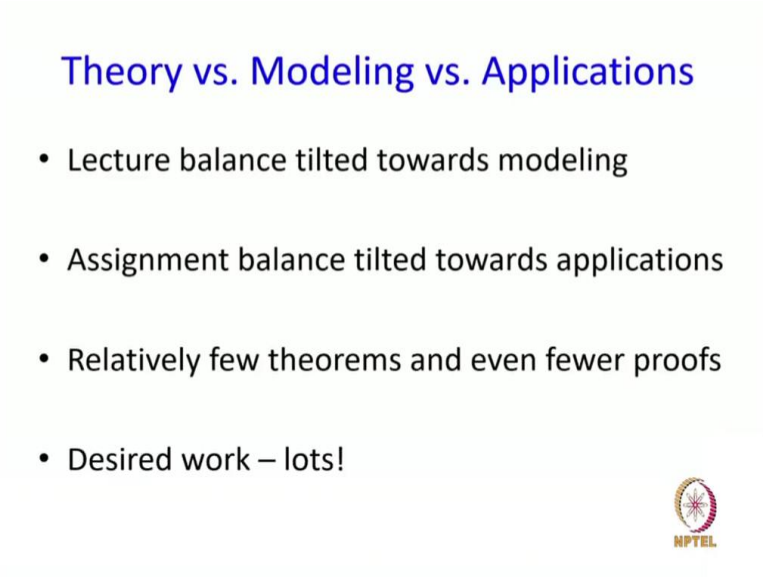

The other decision as an instructor we have to make is, what do we focus on even within the topics that we are going to explain. And here, you all know about theory and practice, theory and applications those are the 2 extremes of any scenario. But there are 2 more steps in the middle the way I think about it, there is the theory, there is the modeling, there is the algorithm and then there is the application in my view.

And let us think about this from an example. And this is very important, this broad understanding of any problem is very important. So, let us say I am in 2004 or 2003 and I am trying to create a MapQuest or a Google Maps. And there I need to decide that I have the whole map of the world, I need to figure out that I want to go from location A to location B, what is the best way to reach location B from location A? Now, this is a real problem, this is a real application.

The first thing you will have to do is to make it into a computational problem. You are not going to talk about which car am I driving you are not going to talk about you know whether there is a gas station on this particular road not for now, I am going to abstract out all this information. I

am not going to talk about whether there is a path hole in the road I am not I have to abstract out all that information into a simplified approximated computational problem.

And what will be such a computational modeling can you think about it, it is very easy you have done this graphs, you will take the model the computational model of a graph now graph has node and edges. So, you will say for my problem what is the node? So, you could say that any intersection is the node see, we are talking about roads and locations, we are not modeling every coordinate in the location.

We are abstracting it out if we start modeling every coordinate then it will be impossible every little point we can model that we have different abstracted out. So, in our model, we will have graphs and node will be an intersection the edge will be a load segment that connects 2 intersections then, we can additionally have a weight on the edge and the weight could be in this case, length is one possibility some people will say time now you have to say oh in the morning the time is different in the evening the time is different in the daytime the time is different.

If there is an accident the time is different. If it is raining, the time is different, which time it is an abstraction. Initially, we will say I do not want to worry about morning evening raining, I will just take some average time. So I will keep my Google cars going all around the city at different points in time and in each road. However time it takes I am going to just average it out or take the not if not average, you know one deviation or whatever. Then now I have converted into a graph. Now notice this is called can you guess?

Modeling, this is modeling, taking a problem and converting it to a computational problem. This is modeling this you have to do in everything in the world. If you are a computer scientist, you will never get a computation problem almost never unless with a theoretical researcher which will start from model you will always in the world, you will get some real problem you do not even know how to start modeling it into a competition problem.

Often you would see that for a real application a lot of the magic is a modeling because once you model somebody some time has already solved that problem. Once you model this is a graph and

model on the graph as a shortest path problem. Now, the all the literature on shortest path problems becomes applicable here. You do not have to really be creative in solving this specific problem. You just not have to read up the read up and check what are the various shortest path algorithms?

You know, there is a there is a Bellman Ford algorithm there is a Dexter's algorithm there will be 20 others. You just quickly go look at which one is the right one for this fit. Bellman Ford is much better if it is if you have negative edges. We do not have negative edges. Nobody's gone a gain time. We were not time travelling here, so you do not need Bellman forward, let us do something simpler and so on. I am not getting into the specifics of how Google and Microsoft made their map engines.

That is called the algorithm. We model it is a problem, then we chose an algorithm for it, we may have to innovate there. But that is the algorithm, then we implement the algorithm. And when we implement the algorithm, we have to decide on, you know, what is the full graph. Now, when I am going from IIT Delhi to AIMS or hauz khas metro station, do I need to have in my graph the edge from, you know, the highway edge from Seattle to Portland? I do not the whole graph of the world is huge.

We do not need the whole graph for every problem. So how do we cut it slices dices, where does the map get stored, which part of the map do we put into memory etcetera. All of these parts would be parts of the application solution they also always interact with the algorithm obviously. And last but not least, what can I prove about them? can I prove that I will always get the shortest path under what conditions will I always get the shortest path etcetera that will be called the theory.

So, now, do you understand with an example, this is called you know explanation for example, application modeling algorithm theory you can I guess I do not know which what will be the right order the order is because you can prove theorems about the problem, what is the complexity class of the problem, you can prove theorems about the algorithm. So, therefore,

theory interacts with both the modeling as well as the algorithm itself. The algorithm is implemented in the actual application.

Now, in this course, we will tilt towards modeling and algorithms in your assignments you would do application and we will not very much bother about theory. And again, this is a choice once in a while I will introduce some theorems. Maybe I may prove one, but mostly we will the book has theorems and proofs, we will talk about the term but not talk about proof more often than not, we will mostly focus on how it gets applied, how a new problem can get modeled how a problem a model may have solutions, how what are the properties of each solution.

And so on so forth. This is part that we are going to focus on in this particular course. And of course, you can have any AI course where you go deep into the math and the theorems and the theory and that is not what we are going to do. Okay, any questions on this? All right.