Artificial Intelligence
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Lecture - 11
Knowledge Representation and Logic

In the earlier lectures you have learnt about different search techniques, game theory and other aspects of artificial intelligence. Now one of the most important aspects of any artificial intelligence activity is how to represent knowledge that is knowledge representation. And one of the major techniques of knowledge representation is logic. So in this lecture we will be discussing about the different knowledge representation schemes. In fact this discussion will be divided into number of lectures and that will together constitute a particular module which you are naming as module four of this lecture series.

The first technique we will be looking into is propositional logic. In the course of this lecture we will gradually come to know about what is propositional logic and how it can help us in representing knowledge. But even before coming to the aspect of knowledge representation let me first enumerate the objective of this lecture. This lecture will enable you to represent simple facts that we use in our day to day life in the language of propositional logic.

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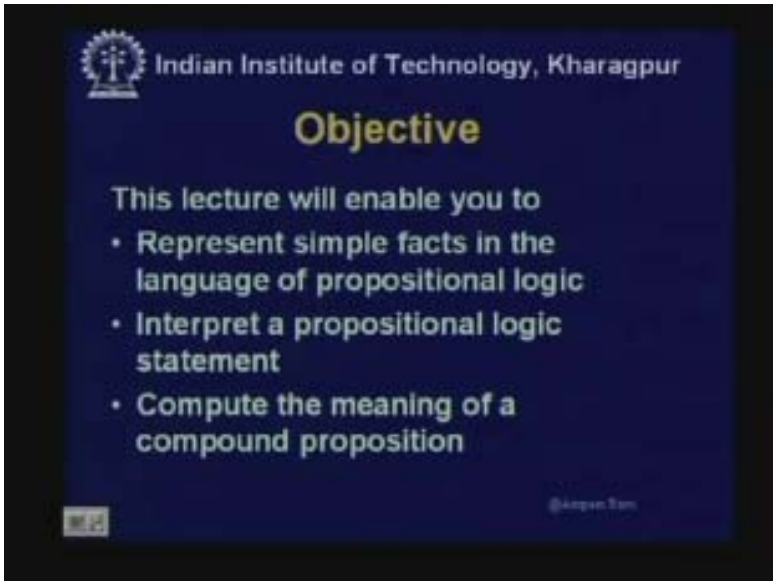

In order to express anything we need to take the help of some language and in general logic is one such language. We will see how we can represent simple facts using propositional logic and we will see how we can interpret a propositional logic statement. That means, whenever a propositional logic statement is made we have to understand

what it means. And there is a mechanism that helps us in understanding the meaning of a propositional logic statement. Unless we understand what it means we will not be able to work with it.

For example, if somebody tells you something in a language that you do not know you will not be able to understand it and unless you understand it you will not be able to act according to it. Hence it is essential to interpret a propositional logic statement that is the second objective of the lecture. And thirdly we will be able to compute the meaning of a compound proposition. A compound proposition is essentially a collection, a particular way of collecting a number of single propositions and joining them together which forms a compound proposition. So, in order to understand meaning of a compound proposition first of all we have to understand the meaning of the individual propositions we should be able to interpret a proposition and we should also learn as to how we can integrate the meanings of the individual propositions to understand the whole.

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Before delving into the details of knowledge representation first let us look at what is meant by intelligence and how is knowledge related to intelligence. There are different ways of interpreting knowledge philosophers, scientists, logicians psychologists etc have give some meaning to intelligence. Now, what is the role that knowledge plays in an intelligent behavior? Let us try to first look at it.

Let us first try to address the question does knowledge have any role at all in demonstrating intelligent behavior?
This is a debatable issue. For example, you may ask that, well this boy is very intelligent but he has never gone to school and he does not have enough knowledge but still all of us accept that he is intelligent. But the debate remains that what is really meant by knowledge? Is it the knowledge that we derive from formal education only?

Yes that is certainly a part. but besides that there are different other aspects that come from day to day experience as we evolve as any human being or animal evolves. They acquire from nature some intelligence, some knowledge and that is somehow incorporated inside the being and that plays a major role in displaying intelligent behavior. Sometimes that is too succinct too intuitive that we do not understand the fact that knowledge exists but still that is evident from the behavior. Common sense knowledge for example, even without any formal education people can act according to their common sense. Instead of going to the details or debate on what is knowledge and how far we will say that this is knowledge, this is intuition etc.

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Let us first look at how this knowledge can help in displaying intelligent behavior in whatever form it might be. Here you can see that we are trying to sense something from the world, we are sensing. And we have to sense the environment. As soon as we sense we accept that and work according to it. We make some decisions and those decisions force us to take some actions so that is the action part. So this is the loop that is executed all the time in our day to day life.

Now, when this decision maker senses from the environment some event, may be the temperature has gone up very high and we have to act accordingly. The decision maker takes the help of knowledge to decide on what to do given the environment that it has sensed, given the fact that observed. Based on that it makes the decision and while making the decision the background knowledge that is either explicitly there or it is in the background either we can recognize that, yes he is a knowledgeable man so he can do that or even for a common person that in-built knowledge that has come with him with evolution in whatever form might be that plays a role and tells the decision maker what to do that may be in the biological system as such and based on that the action is taken. So we can see from here that knowledge certainly have a role in demonstrating intelligent

behavior because if we cut this part off then we will be able to sense but we will not be able to say what to do, we will not be able to act properly.

The fact that we act properly tells us we have knowledge in some form which tells us how to act given a particular scenario in the environment. That is the basic background of knowledge and intelligence. Therefore here you see that this knowledge certainly plays a very important part. But the question is our decision maker when we are starting Artificial Intelligence our objective is to build machine that will be able to behave like a human being or at least demonstrate some intelligent behavior.

Therefore, it is necessary for human beings we may or may not know exactly how knowledge has been incorporated in the brain. But in order to build a machine that will act intelligently it is mandatory that we must have a means of representing knowledge. How to represent knowledge? How to represent knowledge in a way that a machine can understand is all that we are going to learn in this lecture and the subsequent lectures in this module.

Knowledge representation:
How can we represent knowledge in a machine?
Now, in order to represent express anything that we want to talk about we need a language. So, just for expressing the knowledge we also need to have a language that will be able to represent the domain knowledge. The word domain is underlined because knowledge is not a small thing; it is very difficult to have a complete knowledge of everything. Even for a small problem solving activity, for example geometry, the amount of knowledge besides the theorems the intuition that this theorem can be applied at this point of time is also a part of knowledge. Now all these are really vast. Hence we should try to first capture or first focus on a particular domain and try to represent the knowledge about that domain.

We can only expect a machine to demonstrate an intelligent behavior when that machine is left to work in a particular environment in a particular domain provided we empower the machine with the relevant knowledge of that domain. Let us take the example of the theorems in the case of geometry, a theorem is just an expression and that takes help of the language English as well as the basic definitions, names, vocabulary of the domain geometry. So we always need a language. Algebra for example is a language of expression. We can very succinctly express many things in algebraic equation.

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Similarly, for representing knowledge we need to take the help of some language. Suppose there is some language that has represented some knowledge, now what is the use of that knowledge? Unless there is somebody who can take the help of this knowledge who can understand the language in which the knowledge has been expressed and therefore can use it the knowledge is of no significance. Hence we must first have a language no doubt about it but also there must be a method that will be able to use this knowledge.

If we think of knowledge representation we must think about the things, one is the language another is a viable method that can be executed in a machine so that it can read the language, understand the language and act according to the knowledge that is expressed in that language. This method is used to interpret knowledge in response to an environmental fact that has been sensed.

Remember we discussed earlier, we sense from the environment, first you have to sense and then you have to use the knowledge to act accordingly. That entire thing is clubbed in the name inference machine. So an inference machine or inference mechanism what it does is, it reads the environment, can interpret the knowledge that has been represented in a suitable language and use that knowledge to act according to the need. Therefore it can generate proper actions which we often say that the machine or object is behaving intelligently.

So, in order to demonstrate intelligent behavior specifically two things are needed. One is the knowledge represented in some language and the method to use the language in all we must have a powerful inference machine that can understand the language in which knowledge has been represented. So a knowledge representation should include both; the language to represent knowledge and an inference mechanism that can use this knowledge. These two together when defined gives us a knowledge representation

scheme. Whenever we talk of any language we talk about grammar, some rules that the language must follow because unless the language is grammatically well formed, it is grammatically correct it will be difficult for others to understand it. We can take the example of our normal day to day English, if we say a wrong English statement then many people will not be able to understand it, some may be able to apply their own knowledge and still understand it.

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But for a computer or for a machine the scenario is little different because here a machine can play with the things that it knows it cannot as yet interpret in any particular way. So we must stick to the grammar the syntax of the language so that the inference machine which is nothing but a machine which is a program running in a computer will be able to understand what it says. So the syntax is the grammar of any language and semantics of a language is the meaning.

For example, I say pen cut road cut is a verb; pen is a noun and road is also a noun, but all these together do not really convey anything meaningful to you although everything was there. Here I have made a syntactic mistake, even if it is syntactically correct I should have said that the pen cuts the road. Now does it really mean anything? Can you really map this to a real world scenario? Have you ever seen a pen cutting the road? So the semantics is an issue, does it carry the meaning?
So two things are important; one is the syntax, one is the semantics. Both of them must be well defined in order to form a knowledge representation language. For example, if you write laughs tom. Now laughs then parenthesis tom. What does it mean? Does it mean tom laughs? Does it mean tom is laughed at? What does it mean? Assuming that this is the correct syntax in some language what is the meaning of that, what is the semantics of this? We must understand this. For example, likes (Sunita, Aditi) now what does it mean? Sunita likes Aditi or Aditi likes Sunita? There must be a specific

interpretation that should be given in order that this statement like (Sunita, Aditi) can qualify as a value knowledge representation language.

When we are talking of language we must search for a language and logic is one such formal language. Let us start with propositional logic because propositional logic is a relatively simpler form of logic. Anything that we use in our day to day world is a proposition. Now I make a statement Anil is intelligent. It is a statement, it is a proposition. Anil is hard working, it is another proposition. I am making a statement about Anil, Anil is hard working. So both these are propositions. So Anil is intelligent is a proposition, Anil is hardworking is a proposition. Again if I make a statement like, if Anil is intelligent and Anil is hard working then Anil scores high marks. This is also proposition because I am making another statement.

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But this statement is a combination of some other propositions. Anil is intelligent is a proposition and this one says, if Anil is intelligent and Anil is hardworking this Anil is hardworking is itself a proposition here, then Anil scores high marks, so all these white ones are also individual propositions. But when I am connecting all this together I am making another proposition. This one is called compound proposition. So briefly speaking whenever we speak in our day to day life, whatever statements we make consists of propositions. Now these propositions Anil is intelligent, Anil is hardworking are constituted of objects and relations or functions. Now, the statement, Anil is intelligent can be true or false. Anil is hardworking can be true or can be false.

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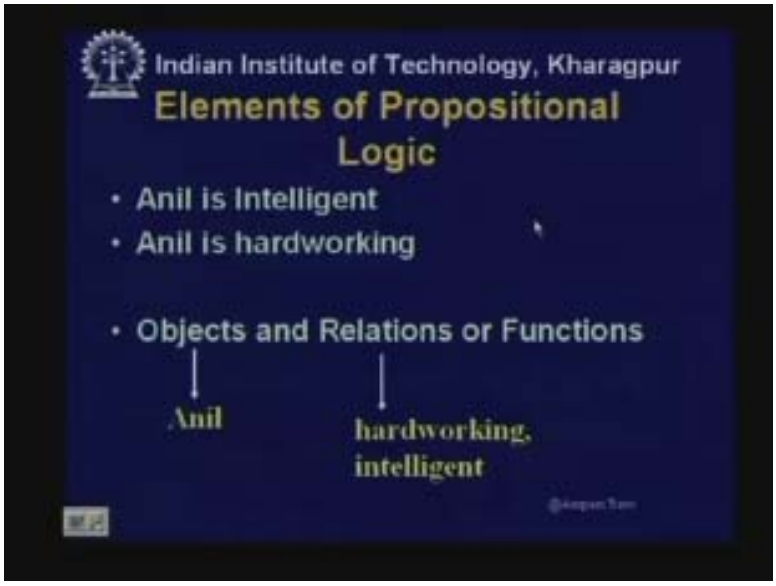

Therefore any proposition in propositional logic can have either of two values true or false. And it is constituted of objects and relations or functions. So Anil is an object, hardworking, intelligent are some functions or relations depending on the usage. So, when we write intelligent on Anil I am putting in some function on Anil and that means Anil is intelligent and this entire thing can be true if the Anil that I am taking about is true, is intelligent if that Anil is intelligent then this statement is true. Hardworking Anil again means Anil is hardworking. So again these are propositions. Now, propositions can be written either in this way or intelligent Anil I could have also written in that way provided my language the syntax of the language are allowed. A proposition can be true or false. Now let us look at it a little more formally.

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Can I write it in any particular way or the way I like?
For example, intelligent Anil or intelligent Anil within parenthesis or what should I write? We must come to the syntax in order to know that. And syntax basically talks about the grammar of the sentence. Now, let P stand for this proposition that I was using intelligent Anil. Let Q stand for hardworking Anil. Now look at this symbol this is a logical n.

What does P AND Q mean?
P AND Q is a new proposition. Now P AND Q is true when P is true and Q is true that is when both of them are true. If either of them is false then P AND Q is not true. But P AND Q is another proposition, although P is true Q is false, P AND Q both will be false. Or when P is true and Q is true I will have to separately evaluate P AND Q and see that P AND Q is true. This symbol means P OR Q.

What does P OR Q mean?
This is again another proposition P OR Q. this means that when either P is true or Q is true any one of them is true then this proposition P OR Q will be true. So P OR Q are examples of compound propositions because P is a proposition statement, Q is a statement. I have formed a new statement by applying some connection operators like AND OR etc. There are other operators also which you can use to make more compound statements. Now let us look at it in a more formal manner.

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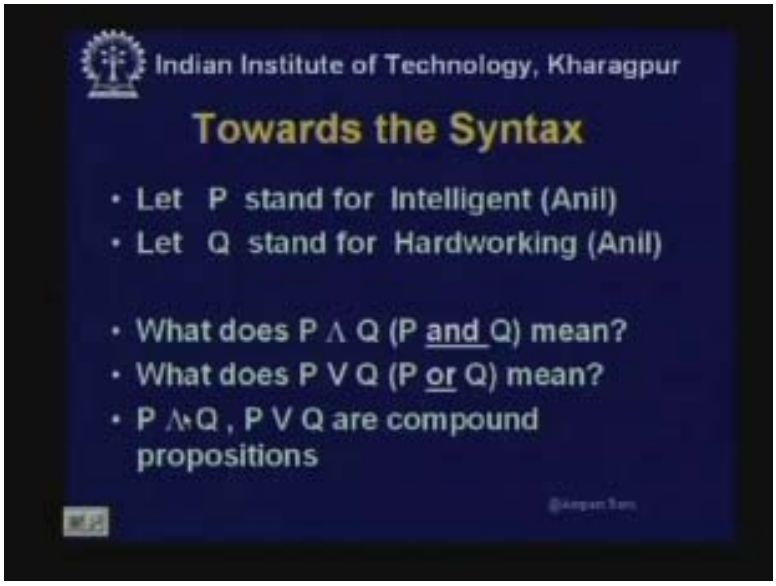

Syntactic Elements of Propositional Logic:
Any language will have some vocabulary. For example, the language English for that we have got the vowels, consonants, some numbers etc. Similarly, for propositional logic also the vocabulary is a set of propositional symbols. Now whether Anil is intelligent or Anil is hardworking, Geetha is beautiful, Sita is smart etc we can symbolically represent each of these propositions as P, Q, R etc. So let us symbolically represent P, Q, R which is a set of propositional symbols.

There should be a set of propositional symbols and as we have seen any proposition can be either true or false. Each of these P, Q, R can be true or false. Besides there will be a set of logical operations. Why do you say it is logical operator? It is because this operator can have either true value or false value. After I apply a logical operator on two variables P and Q I will get P AND Q that will return a value true or false. That is the significance of logical operator.

Now we can have AND OR NOT and implies these are the basic four logical operators that are used in propositional logic. Often parenthesis is also used for grouping. There are two special symbols true and false. Basically these are logical constants. Any proposition can have the value true or false. Therefore both these true or false are very important logical constants you will be using all through.

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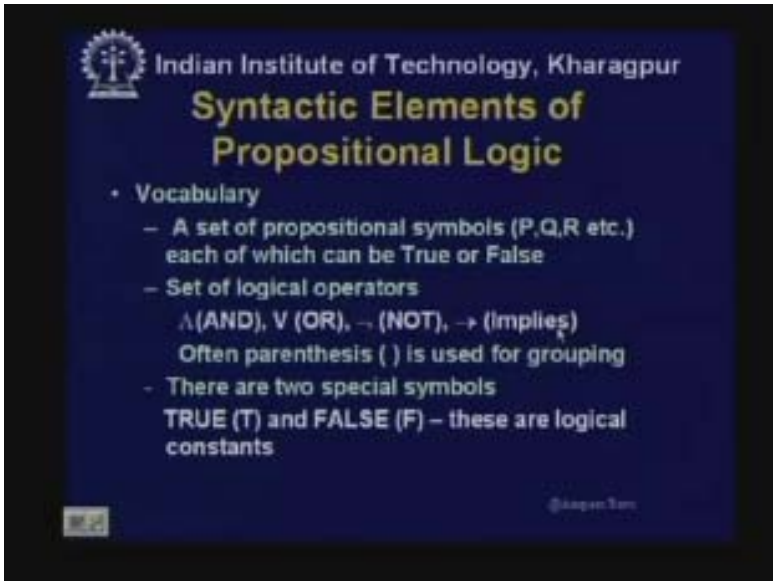

Basically we have seen that there are four basic operators besides parenthesis AND OR NOT and implies. Now we will see the meaning of those but before that we will see how to form propositional sentences. We have got the vocabulary which is set of propositional symbols, we have got the logical operators and we have got the logical constants like true or false. So let us see how we can form logical sentences using these. Each symbol whether it is a proposition or a constant is a sentence, it is always the sentence. If P is a sentence and Q is a sentence then if we block them in parenthesis, parenthesis P is a symbol. Since P is a sentence and Q is a sentence P AND Q is a sentence.

Similarly, P OR Q is a sentence. If P is a sentence NOT P is also a sentence. For example, if we say Anil is good which is P then NOT P is NOT Anil is good. Anil is good was true and NOT of Anil is good will be false. But NOT of Anil is good is also a valid sentence. It may evaluate to true or may evaluate to false. P implies Q is also a sentence, nothing else is a sentence. This is very important, that, in order to qualify as a valid propositional sentence each of these statements that are formed, where P is a sentence and Q is a sentence now I can comply with these only if these allowed are ways. Either I block them bracket them in the parenthesis then it is a valid sentence, P AND Q will be a sentence, P OR Q will also be a sentence, NOT P is a sentence, P implies Q is a sentence and nothing else is a sentence.

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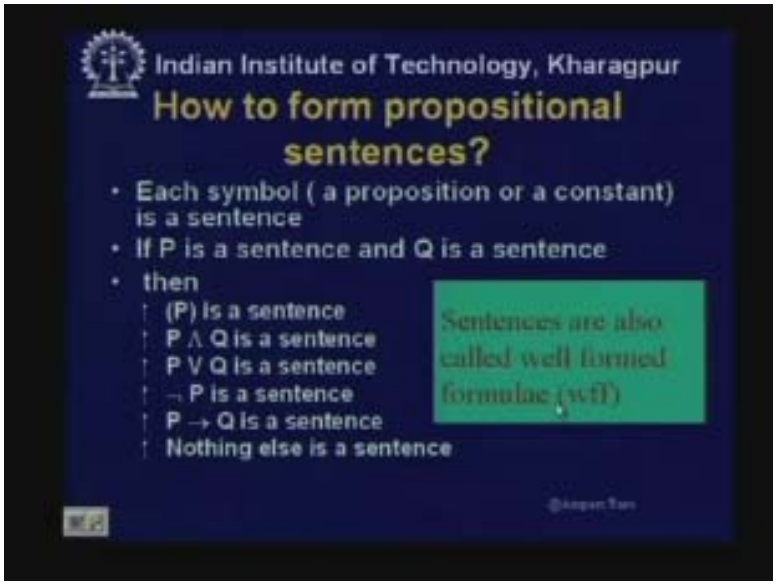

Often you will see that sentences are also called well formed formulae written in short wff. We will use the term sentence or well formed formulae interchangeably. Here are some examples of wff well formed formulae: P S is a well formed formulae, true is a logical constant so it is a well formed formulae, P AND Q uses allowed operator so it is a well formed formulae.

Now let us look at P OR Q implies R so P OR Q is a valid proposition and any valid proposition P implies R is a valid proposition so this whole thing implies R is a valid proposition so this is a valid sentence. P AND Q OR R implies S is a valid sentence. Now, NOT of P OR Q here I see that P is a proposition or a sentence, Q is a proposition or sentence, if P is a valid sentence, Q is a valid sentence therefore P OR Q is also valid sentence. Since this is a valid sentence if I apply the NOT operator over there that is also a valid sentence. Similarly here you see that NOT of P OR Q implies R AND S is also valid sentence.

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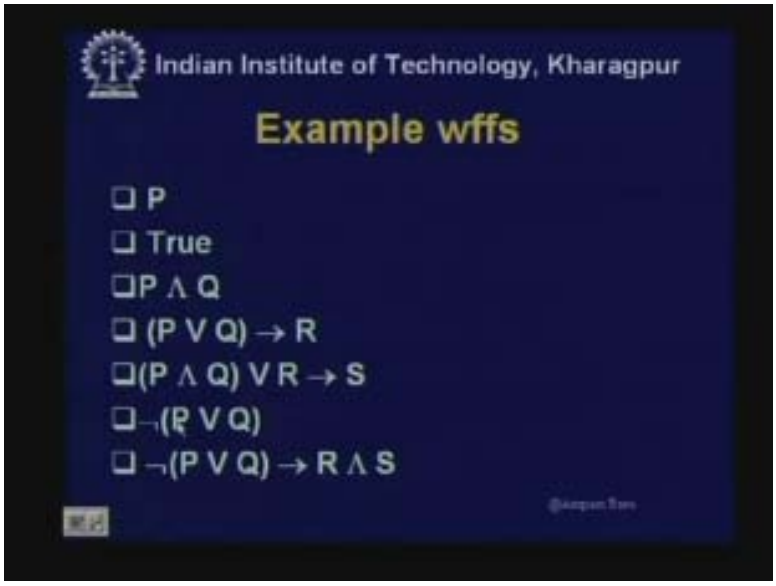

There is a special meaning of this implication statement we are talking of. What does implication mean?
When we say X implies Y or P implies Q that means if P is true then Q is true. P implies Q when P is true then Q is true. But not the other way round. It tells of a sufficient condition. If P is true then Q will certainly be true. For example, if it rains then the roads are wet. So, it rains, that is my P and the roads are wet that is Q. So if it rains, that is if it rains is true then the roads are wet. But if you say if the roads are wet then it rains now is it an implication because if the roads are wet can I always infer that it rains because the roads can be wet because of some other reason also. There might be a sprinkler that has been used to clean the road or the road has been washed it did not rain. So roads are wet is not a sufficient condition to say that it rains. So, in the case of implication when we write P implies Q that means if P is true then Q is true but Q can be true even if P is false. Now this is a sufficient condition but not a necessary condition.

Equivalence is a bi junction that means for example it is a bidirectional statement. If P is true then Q is true and again if Q is true then also you can infer that P is true. Now, here let us try with an example: If two sides of a triangle are equal then two base angles of the triangle are equal. Now we know from our knowledge of geometry two sides of a triangle are equal then that is an isosceles triangle and the base angles of an isosceles triangle are equal. So if I had stated it in a different way that if two base angles of a triangle are equal then the two sides of the triangle are equal that will be true also. Therefore in that case if I say two sides of a triangle are equal that is P and two base angles of a triangle are equal that is Q then I could have said P implies Q and Q implies P.

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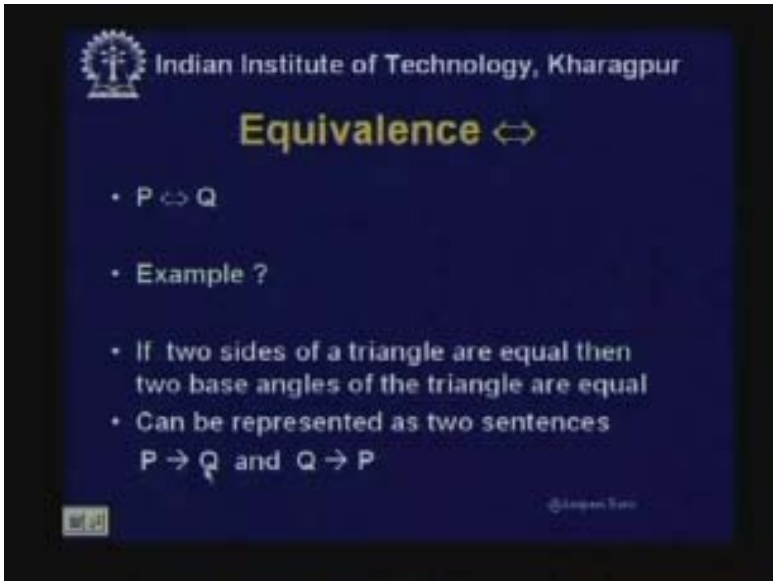

Equivalence can be expressed using two sentences P implies Q, Q implies P. In propositional logic equivalence is not a necessary operator. We have seen that along with AND OR NOT. We had implies operator and with implies operator with two sentences giving both directions of implication we can capture equivalence. So we can have P implies Q and Q implies P. Next is a very important issue.

With this brief discussion on syntax let us come to the semantics the meaning of a propositional sentence. When we try to understand a sentence essentially what we do is we interpret that sentence. We try to understand each of the propositions and try to see whether that is true or false and then we make a decision on the whole. So, if there be a sentence P we must first interpret what does that P mean, Anil is intelligent what is the meaning of intelligent? What is Anil? All these are nothing but symbolic labels. That is, we interpret in a particular world. When we interpret a sentence in a particular world the world can be the world of football match, world of cricket match, the world of picnic, the world of class room all these things are different worlds and each of these worlds have got some known relations some known functions and there are some interpretations we give in a particular world. What is true in this world may not be true in another world. The rule of a baseball match is different from the rule of a cricket match.

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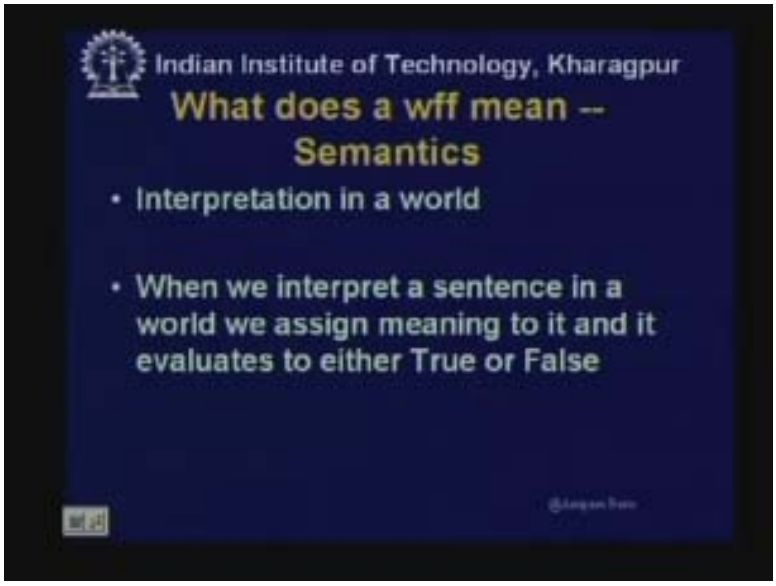

So the cricket match along with all its rules, all its definitions and all these things form a world. Similarly a soccer match or a baseball match forms a different world. So when we interpret a sentence in a world we assign meaning to it and that evaluates to true or false. For example, let us start with a proposition P and suppose that proposition means a child can write that is a proposition. So this proposition P is a level for the child can write. And suppose here we have got a world nursery and there is another world class two, now what is the truth value of this statement the child can write?
When I interpret it in this world nursery probably it evaluates as false because suppose the children in the nursery cannot write. But again when I interpret it in the world of class two then it evaluates to true. The same proposition P can be interpreted in two different worlds in two different ways.

Again suppose this P is now interpreted as another statement the child can speak now the child can speak is an interpretation of P but again that one when I interpret to the world nursery that should evaluate to true, again that thing when interpreted in the world of class two that is true. Therefore this statement P can have value true or false depending on its interpretation.

When I interpret P as the child can write and that is interpreted in the world nursery then it evaluates to false. But when this is interpreted in the world class two then it evaluates to true. Now when P is interpreted to the child can speak that can evaluate to true when interpreted in this world. The statement, when interpreted in a particular world, is very important to note. And this interpretation itself attributes the meaning or the semantics to the proposition. We will see a couple of more examples.

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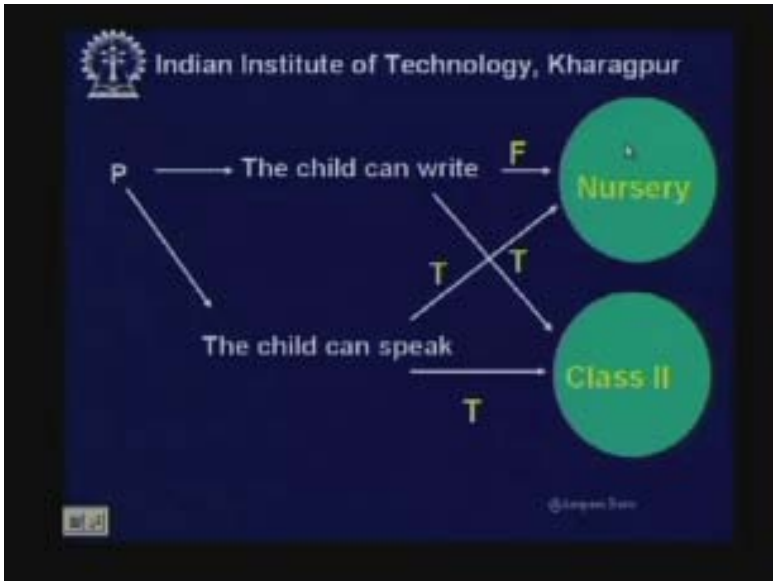

Here is another example P; now P says Ram is intelligent, P is leveled as Ram is intelligent and Q is another statement which is saying Gita is diligent. Now you can say that there is some hidden interpretation here; P: Ram is intelligent. Which Ram I am talking about? I must be meaning some Ram which is constant and that is the subject to the way I have interpreted it.

Then I will again look at class 2 and there is class 3 and there is a Ram in class 3 who is intelligent. Then, this, 'Ram is intelligent' evaluates to true and might be Gita is diligent, that is talking about new proposition, Gita is diligent is false. When I talk about Gita, Gita studies in class 2, but Ram is intelligent, also, there is another Ram in class 2 and that Ram is not that intelligent so that evaluates to false.

Similarly Gita is diligent and that evaluated to true for Gita who was in class 2 but if I interpret for Gita who is in class 3 she is also intelligent so both of them are intelligent. Here we will be dealing with these two symbols P and Q. Now whether P is true or P is false Q is true or Q is false is totally dependent on the way we interpret it in a particular world. These are the two examples of worlds we are talking of. So how do you get the meaning of it? Remember that sentences can be compound propositions.

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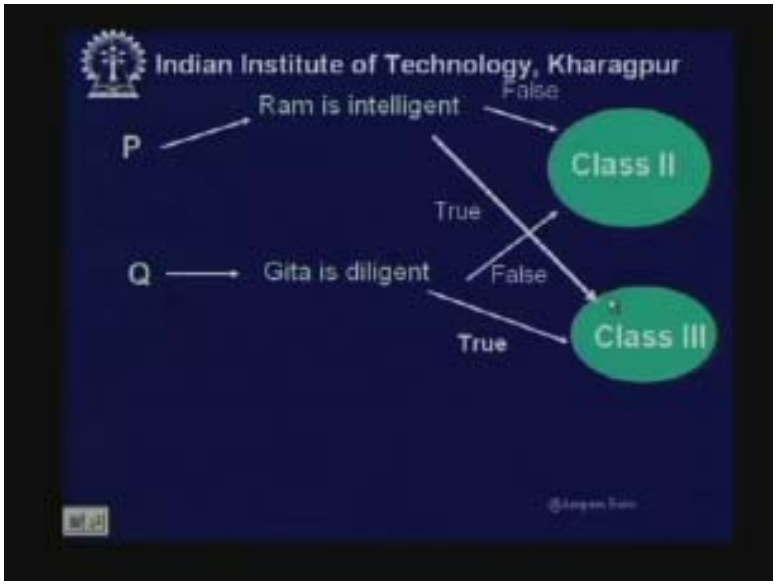

We have seen that P is a sentence; Q is a sentence now we can connect them in different ways and thereby we can get different compound statements. So sentences can be compound propositions. For that, in order to understand the meaning of the sentence we have to interpret each individual atomic proposition in the same world and that is important. And unless we interpret it in the same world it will not be really meaningful. So the first step is, we interpret each atomic proposition in the same world and assign truth values to each of the atomic interpretations. We take atomic propositions we assign truth values to the interpretation of each of the atomic propositions and compute the truth value of the compound proposition.

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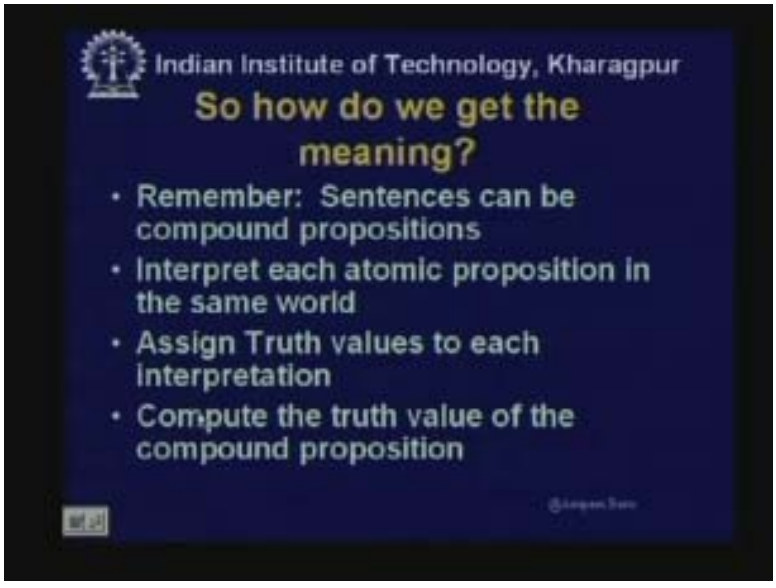

Therefore there are three steps: We interpret each atomic proposition, assign truth values to each interpretation and then compute the truth value of the compound proposition.

Examples: P is a proposition that is actually meaning likes(Sumit, Sunil). My interpretation is that Sumit likes Sunil and Q is knows (Jyoti, Sudhir) that means Jyoti knows Sudhir. Suppose Sumit likes Sunil is my syntactic aspect now the world that we are talking of is that Sumit and Sunil are friends and Jyoti and Sudhir are known to each other. Then what will happen? Sumit and Sunil are friends so obviously friends like each other so this one will evaluate to true and Jyoti and Sudhir are also known to each other so this is also true in that world. But might be Gita and Sudhir do not know each other so the proposition knows Gita Sudhir will evaluate to false. But knows (Jyoti, Sudhir) evaluates to true.

Here we see that P evaluates to true and Q also evaluates to true. Therefore in this case P AND Q is true because both of them are correct. But what happens to P AND NOT Q? Here Q was true and here NOT of Q means knows (Jyoti, Sudhir). I negate that which means does not know (Jyoti, Sudhir). But Jyoti and Sudhir know each other so knows (Jyoti, Sudhir) is true and the statement does not know (Jyoti, Sudhir) is false.

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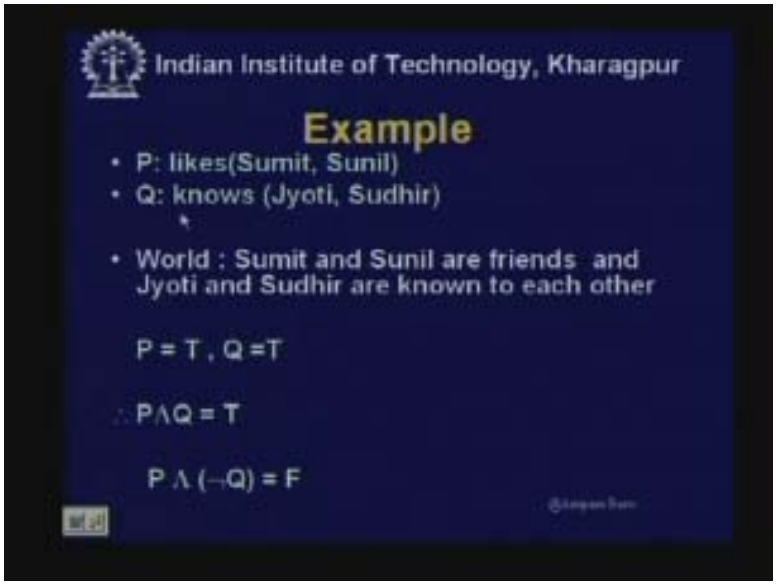

Here the world we are talking about plays a very important role because the truth value of this proposition would have varied depending on the world in which you are interpreting. Here you find P AND Q is true but now NOT Q means that this part which was true in this world NOT Q is false in the same world. So now this is false P is true so P AND NOT Q is false. We have seen the world part. Now there is a very important concept validity of a sentence.

Often you say this is valid this is invalid but in the case of logic this validity is a very important notion and we must try to understand that. A propositional sentence is said to

be valid if under all possible interpretations it is true. If a proposition sentence is true under all possible interpretations then it is called valid. So, irrespective of the world in which we interpret it if the propositional sentence always evaluates to true then it is a valid proposition. There are other definitions like satisfiability which we will look into later. Therefore whenever a proposition is evaluated to true in a particular world then that is satisfied by that world but it is not a valid statement. When we say a particular statement is valid then it will be true irrespective of the world in which I interpret.

Now a typical example is; P OR NOT P. Now P can be true, if P is true then NOT P will be false. But we know that in OR connector P OR NOT Q in that case if any one of them is true it will be true. Now what will happen if P is false?
If P is false then NOT P will be true so any one of them will ultimately be true always irrespective of whatever P means. If P means Gita is intelligent, Sita is diligent etc whatever interpretation you give it does not really matter P OR NOT P will always be true for any particular interpretation you give in any particular world. If P is some statement from the world of cricket and NOT P is also computed in that particular domain then of course P or NOT P either of them will always be true and hence this proposition will always be true. Therefore this is known as tautology and tautology is a classical example of a valid sentence.

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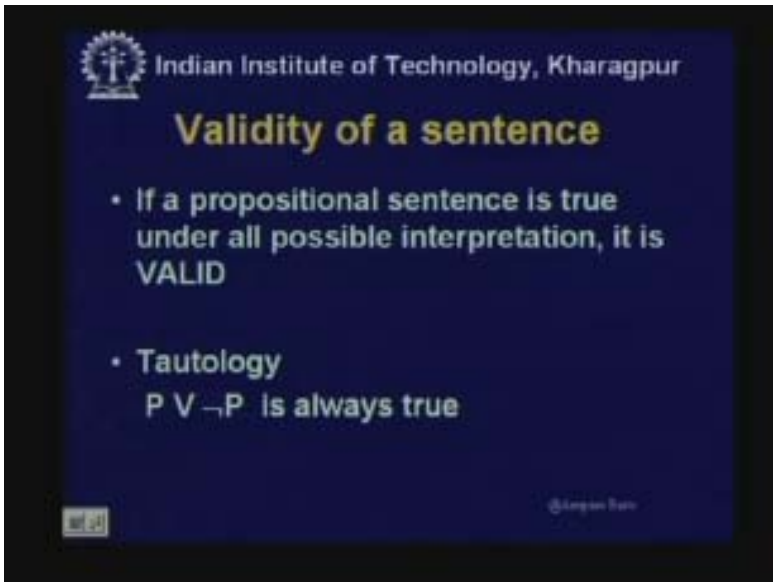

So once again I repeat, what is a valid sentence?
A sentence that is true irrespective of interpretation. Before going to the quiz let me once again summarize whatever we have looked at. We said at the very beginning that, in order to represent knowledge we have to take recourse to a particular language. And any language if it has to be very easily and mechanically understood, if it has to be understood by machine then it must adhere to a strict syntax and that syntax will be interpreted by the machine which will understand its meaning.

We also said that, knowledge is important in order to exhibit intelligent behavior because whenever we sense something from the world we have to act according to it. Now, in order to act according to it we will have to sense it but just merely sensing will not do but we will also have to act according to it and how do you know how to act? For that we will have to have some knowledge that will be accumulated and kept.

Now we may keep the knowledge in some way. But it will be not it will not at all be useful unless we use that knowledge. In order to use that knowledge we need an inference mechanism which must understand the knowledge and in order that an inference mechanism can understand it and can interpret it then it must have a strict syntax language structure. And we started with logic and specifically propositional logic which is a part of logic. This propositional logic has got a set of vocabulary.

A vocabulary consists of some atomic statements like P, Q, and R each of which we have given examples of. Each of them are sentences and there are some rules using which we can form compound sentences. We can use AND OR NOT implication and using this we will make compound sentences. And the semantics of a particular sentence may be compound or simple depends on its interpretation in a particular world. We have shown how to interpret it. After interpretation we will find out the truth value of that. Now in the next lecture we will see how the actual inferencing is done in case of propositional logic. In this lecture we have just introduced you so that you can take it up from here. In the meanwhile it will be good to have a couple of these exercises done.

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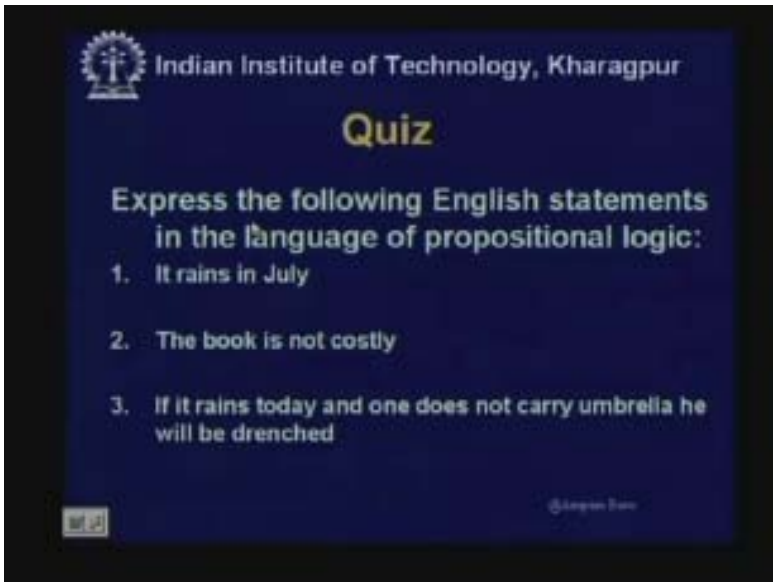

Quiz: Express the following English statements in the language of propositional logic. It rains in July. The book is not costly. If it rains today and one does not carry umbrella he will be drenched. Some of these will be very easy and some of them will be little difficult. We will look at in the next lecture how to solve them. Now you can see, here

this one is a compound proposition. It will require some compound proposition and these are simple propositions. But here again you will need some logical operators.

And the second part is; if P is true and Q is true then are the following true or false? P implies Q, so if P is true and Q is true then I am asking whether this entire proposition is true or false. NOT P OR Q implies Q, NOT P OR Q implies Q, NOT P, the third one is NOT P OR Q implies P, P OR NOT P implies T where T is a logical constant true. In the first one what we are showing here is, we want you to first translate these in the language of propositional logic. Just follow the syntax and transform them in the language of propositional logic. The second one, the book is not costly, if it rains today and one does not carry umbrella he will be drenched etc.

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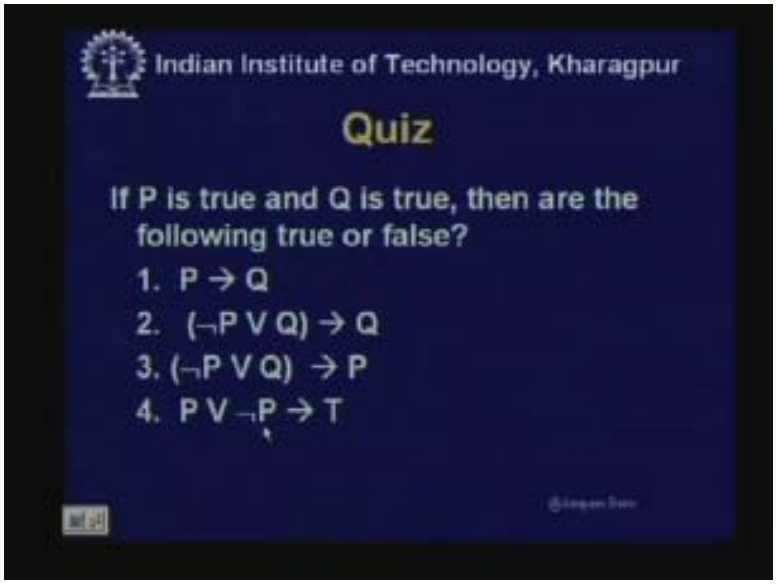

In the second assignment here there is a little bit of semantics. When you look at it you have to know whether they are evaluating true or false. You have to try to compute the truth value for these. In the next lecture we will be talking about inferencing and how we will automatically find the truth value of the propositional sentences.