Research Methodology
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Lecture - 08
Logical Reasoning: Deductive Logic Part 01

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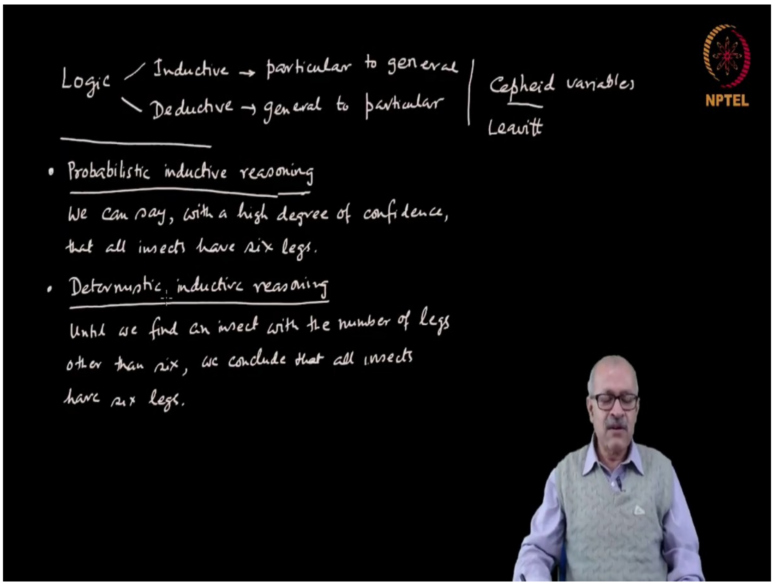

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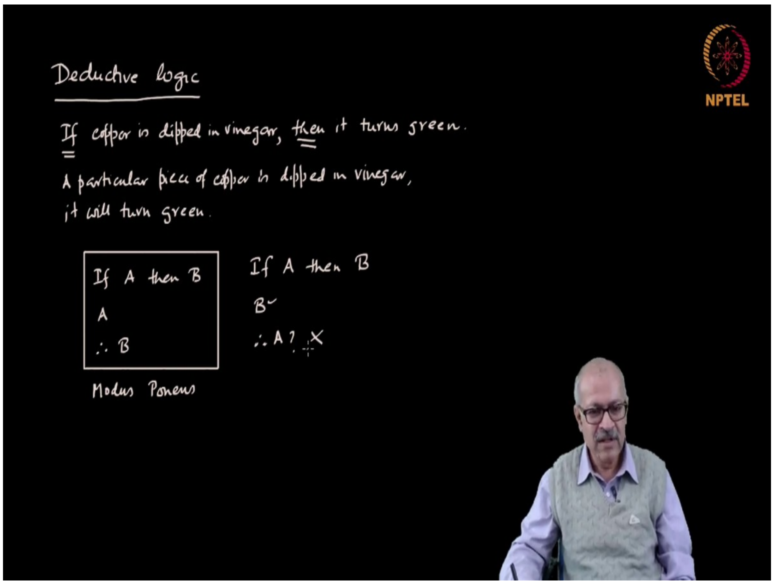

Let us now go into Deductive Logic. Deductive logic is, as I said, going from the general to the particular. So, in order to apply deductive logic you have to have the general premise in hand and then you have to look at a particular situation and try to infer the fact that will be applicable to that particular situation, based on the general premise that is already available. That is the structure of the deductive logic.

The main work on deductive logic was done by Aristotle quite long back and I will talk about that. He actually structured the ways of doing deductive logic. After him, later logicians also contributed to that knowledge and finally we have a reasonably structured situation in the application of deductive logic.

So, let us take the situation that I have already written. This particular inductive inference: if copper is dipped in vinegar then it turns green. Notice this structure: if-then. If something happens then something else happens. That is the structure. If an animal is an insect, then it has 6 legs, so on and so forth.

You can phrase everything in this if-then form, and then this is a general premise that is available to you. Then you are considering situation that I have a beaker of vinegar and I have a piece of copper in my hand. If I dip this particular copper in the vinegar then what will happen? Then a particular copper is dipped in the vinegar and you extract the conclusion that it will turn green. A particular situation, from the general to the particular.

So, if a particular piece of copper is dipped in vinegar, it will turn green. This line of argument may seem obvious. Simple. Now let us again dissect the way we are actually arguing in our minds. The statement given is in the form ‘if A then B’. A is ‘if copper is dipped in vinegar’. B is ‘it turns green’. If A then B. You say A has happened in a particular situation. Then you say, therefore B is true. So, this is the line of logic. Let me block it. This is the line of logic you have followed.

This is definitely a correct way of logical reasoning and in fact, it has a name called ‘modus ponens’. This is a correct logical structure:

If A then B
A is true
Therefore, B is true.

You have to see that this can be applied in all possible situations.

But there are situations where you have a situation: If A then B. Now B is true. Is A true? So, ‘if A then B’ is a conclusion that has been arrived at earlier by the application of inductive logic. Now, in a particular situation you see B is true, for example, you have seen that a piece of copper has turned green. It is green, therefore, B is true. Can we infer that prior to that it had been dipped in vinegar? No, we cannot infer that, because there can be other ways by which it can turn green. Therefore, this is a wrong argument. So, if A then B, and if B is true, there is no reason to believe that A is true. Therefore, it is a wrong line of argument.

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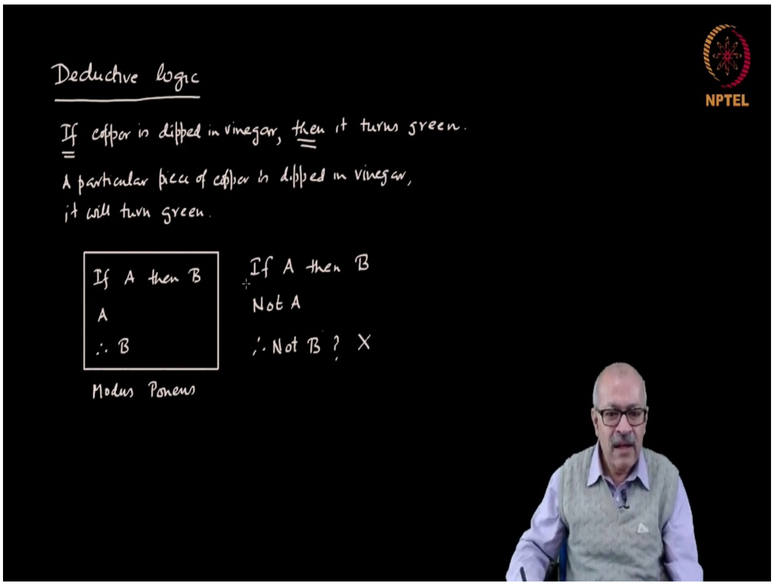

We have to eliminate that. Let me delete this.

Suppose ‘not A’ is true. That means, it was not dipped in vinegar. Can we infer that therefore, ‘not B’. Is this true? Apply in that particular situation. If copper is dipped in vinegar, then it turns green. Copper was not dipped in vinegar, and we are trying to conclude that, no, it will not turn green. Can we infer that? No. We cannot, again because there can be other ways by which it can turn green. Somebody may paint it green. So, that also is a wrong logical argument.

Notice that what I am showing as wrong, are actually logically wrong even though many people use this kind of logical structures. These are actually logically wrong. So, this is also logically wrong.

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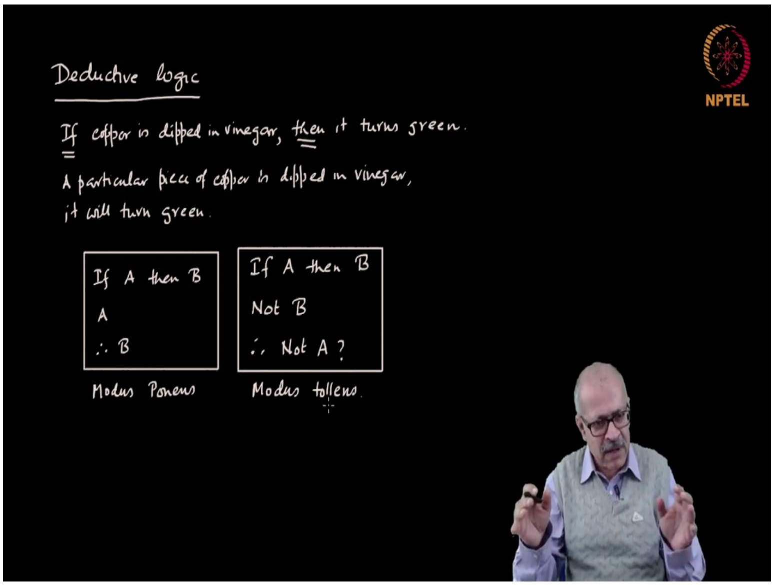

Suppose now you have a situation where we can say what has happened is ‘not B’. Then, can we say that A did not happen? B means it turns green, not B means it did not turn green. Had it been dipped in the vinegar it would have turned green and therefore, you can conclude that it has not been dipped in vinegar.

Therefore, if not B is true then not A is a possible conclusion. This is a valid reasoning. So, I will again block it. This is a valid reasoning and it is called modus tollens.

Let us apply it to another situation. First modus ponens. If an animal is an insect, it has 6 legs. I have got an insect, an animal which is an insect. Therefore, it will have 6 legs. True.

If an animal is an insect it will have 6 legs. ‘Not B’: I have counted the legs and found that it is not 6. It does not have 6 legs. Therefore, we conclude that it is not an insect. It can be a horse. So, it is not an insect. That is a valid reasoning, called modus tollens.

So, with that, we learnt two very basic structures that are permissible in deductive logic.

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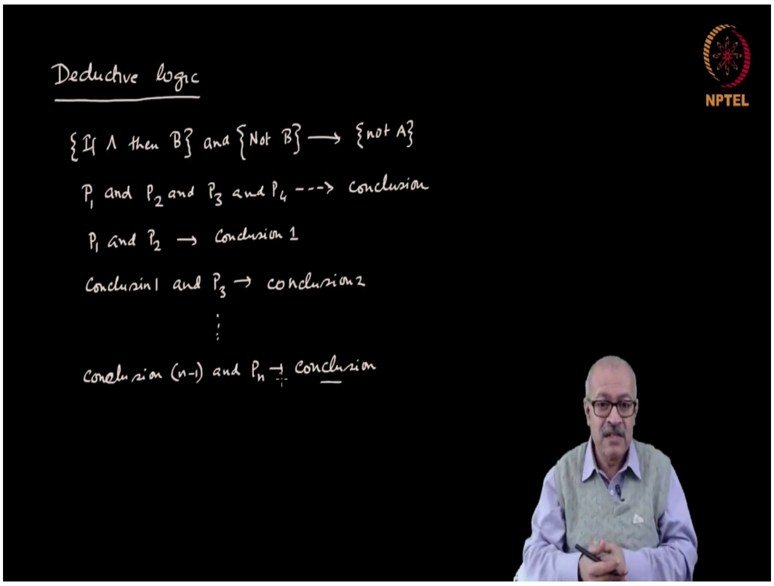

Well, in many situations you have to apply a chain of reasoning. What I showed just now was a single step in the reasoning process. But a chain of reasoning is where one conclusion leads to another conclusion, leads to another conclusion, so on and so forth. For example, if you are using modus tollens, your line of argument is something like this: if A then B, and not B—this led to the conclusion that not A. Then this conclusion can be added to another particular premise, leading to another conclusion and so on and so forth.

So, the situation may be that premise 1 and premise 2 and premise 3 and premise 4 all that put together gives a conclusion. The final conclusion.

So, far we have learnt only a step. But now a series of deductions can be made. How do we actually do that? We actually do that by inferring step by step. P_1 and P_2 which are premise 1 premise 2, something like this, leading to conclusion 1. And then conclusion 1 and premise 3 leads to conclusion 2 and so on and so forth. It goes on.

And finally, the (n-1)th conclusion and premise number n finally gives the conclusion, the nth conclusion. You can say the final conclusion. So, you see, you started with a few premises and ultimately you were able to reach a conclusion. But in that case, each step has to be justified, has to be valid reasoning, and there are two ways of valid reasoning that I just enumerated. One is modus ponens, another is modus tollens. And then, using these, you can make a series of such deductions, finally arriving at something that is valid.

For example, we know that if you cut trees then it leads to climate change. Now this logical connection is very long. If you cut trees then light can go right up to the ground. So, you have cut the trees and light goes right up to the ground: conclusion number 1. Then light falling on the ground, hits the ground, and heats the air in contact with the ground. And therefore, air rises. Therefore, starting from the first one, you come to the conclusion that it will result in air going up. When air goes up it moves away, it drives away, the cloud that are there in the upper atmosphere. So, it will reduce rain, so on and so forth.

You see, each step will lead to a second step and third step and so on and so forth. Each step will lead to a conclusion, that conclusion plus something else will lead to something more and finally it will lead you to the conclusion that: if you cut trees, it will cause climate change. We do apply this kind of reasoning in science and therefore, it has to be learnt properly.