Research Methodology
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Lecture - 12
Logical Reasoning: Syllogism Logic, Truth and Validity

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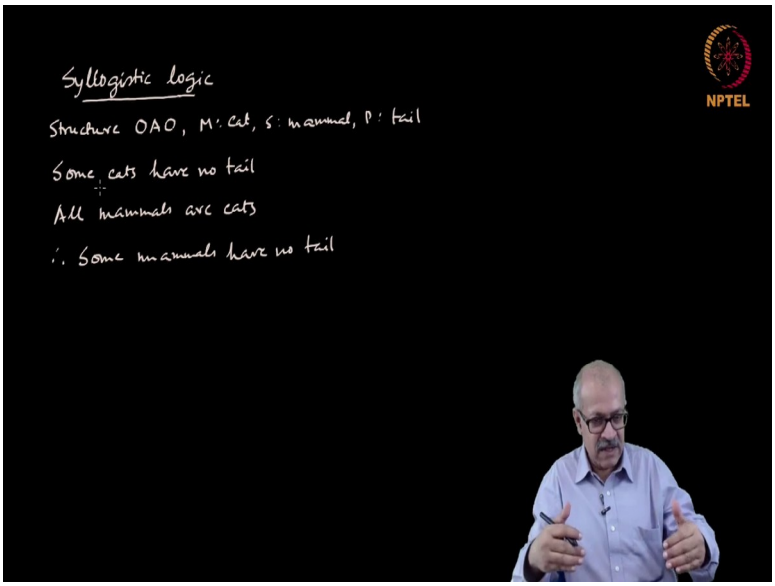

Suppose the structure is OAO. We have not done much of O (some-not) structure. That is why let me do that. And here we consider the middle term as a cat, the subject as, say, mammal and the predicate as, say, tail. So, the major term, in that case, would be ‘some cats have no tail’. Then ‘all mammals are cats’.

Some mammals have no tail, this is ok. But you notice that ‘all mammals are cats’ is definitely a wrong statement. But I do not care, because this is what is given. Whatever is given, on that basis you have to construct what is the logically plausible conclusion. So, this possibility exists: ‘some mammals have no tail’.

I will not continue with this because in books you will find various other possibilities, but you would notice that this is something that you can easily work out, by drawing the Venn diagrams. So, here we are considering the possibilities and these are the possibilities. If these major premise and minor premise are given, then these are the possible conclusions.

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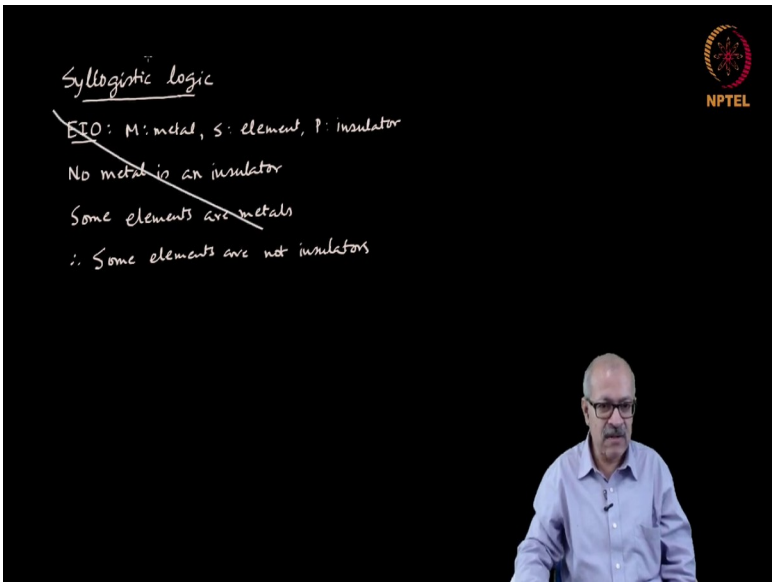

Consider, for example, the structure EIO with the middle term being metal, the subject being element and the predicate being insulator. So, this statement would be, E starting, it is a ‘no’ statement, so ‘no metal is an insulator’. Then the minor premise would have the subject with an I (I means some) therefore, ‘some elements are metals’. The conclusion will have O, i.e., some-not: ‘some elements are not insulators’. You would notice that the starting one is ‘no’, second one is ‘some’ and therefore, the result is in the form of ‘some-not’. So, this is also a possible valid logical structure.

That way, you can continue to check which ones are actually valid logical structures and one has to acquaint to oneself with this kind of logical structures, so that, if faced with the situation, you are able to derive logically valid conclusions.

But we have to understand that something being logically valid and something being true: two entirely different things. Something that is logically valid need not be true and something that is true need not be logically valid. Let me illustrate that, because this is something that often student do not understand and make mistakes.

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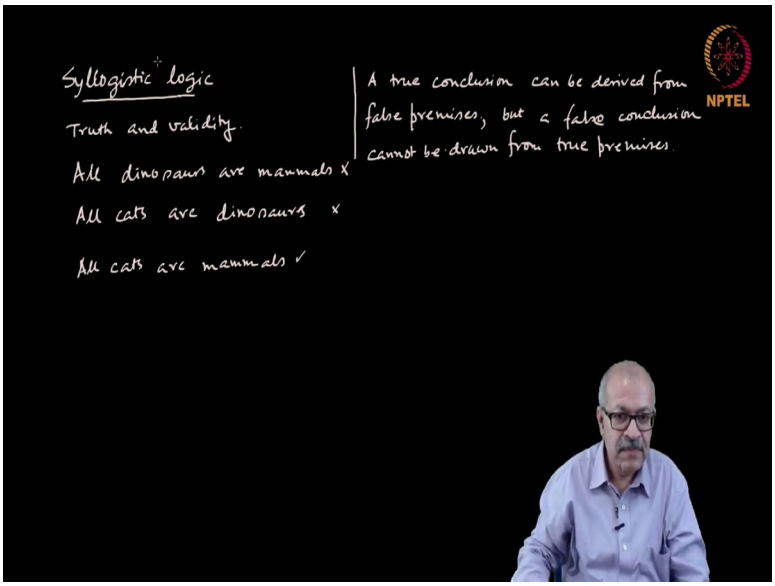

So, we are talking about truth and validity. Now, these are two entirely different things and this is very important in science, because often a scientist comes across a situation that, the premises that are assumed cannot be directly tested. But using those premises one can go on logically deriving things and arrive at a conclusion.

So, you are applying deductive logic starting from those premises and arrive at conclusion which can be tested. Now, suppose I test that and we come to the conclusion that, test tells that, this derived result is invalid, wrong, false. Can we say then that the starting point, the premises, are also wrong, false? Yes, we can. So, the point is that if you start from false premises you will arrive at false conclusions.

But it is also possible to start from false premises and arrive at a true conclusion. Let me give an example:
All dinosaurs are mammals (obviously, something false)
All cats are dinosaurs.
So, ‘all’ leading to ‘all’, so we have got ‘all’ as a conclusion and the middle term gets cancelled and we conclude that ‘all cats are mammals’. Notice that this is a correct conclusion arrived from two incorrect premises. So, what does it mean? It means that if you start from completely wrong premises, still it is possible to arrive at a correct conclusion.

Now, if you test this one to be true in a scientific situation—where you are starting from some premises and you do not know whether the premises are correct or not—you have derived something and you have tested that, and you have found that to be true. A situation like this; does that mean that the starting premises are true? No, and this is a very common mistake that people make in science.

So, a derived result being true, experimentally validated to be true, does not immediately mean that what it started from or the premises are correct because the there is a logical flaw. I mean, it is possible to have arrive at a correct conclusion, true conclusion, starting from false premises. And that is why we know now that a true conclusion can be derived from false premises.

But a false conclusion cannot be drawn from true premises. Let me write it here.

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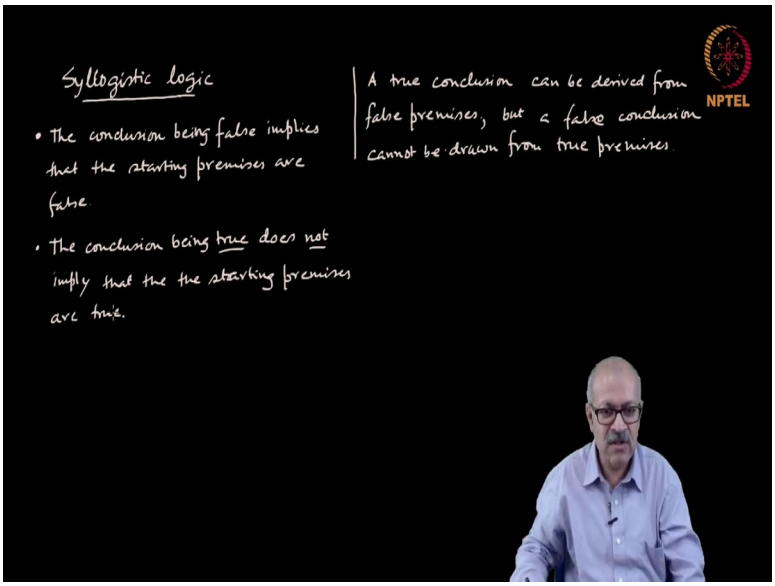

Then this has very important logical implications used in science: that the conclusion being false implies that the starting premises are false. And the conclusion being tree, a conclusion that has been found to be true, does not imply that the starting premises are true. A very important conclusion.

A very important result coming from logic. Actually this is where sometimes scientists professional scientists, go wrong, because if they have the validation of a derived result

they often assume that then it implies that what they started from is true which is not correct.

I have just logically showed it cannot be correct. Now, one has to be very careful about applying logic because there are certain situations, where the statements coming out of a logical structure being actually true, often fools a scientist into believing that it is also valid. Valid means given the premises this is what follows.

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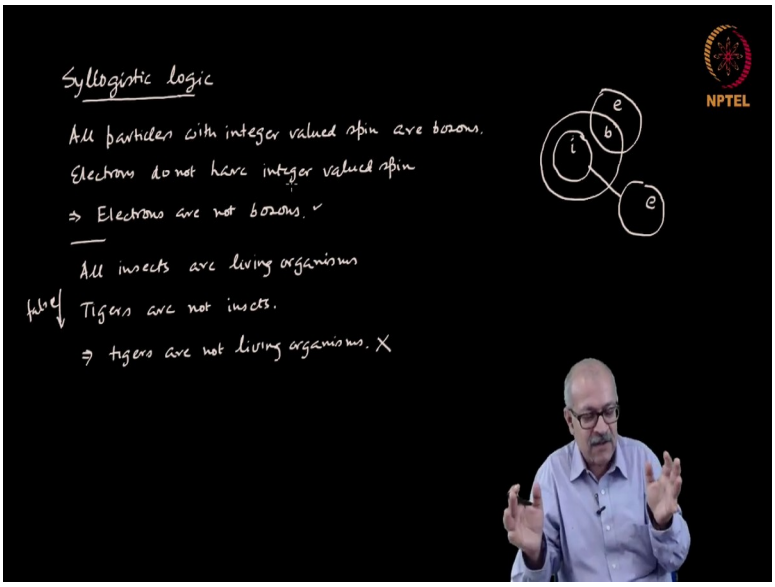

Let me give an example. All particles with integer valued spin are bosons, this is a correct statement. And then electrons do not have integer value spin. And then suppose you conclude that, therefore, electrons are not bosons. All three statements are correct. And such situations often leads a person not trained in logic to believe that the logical structure is also correct.

But that is not quite so. To illustrate why it is not so. All particles with integer valued spin are bosons. So, these are the particles with integer values of spin. Let me call it i. This is the blob for bosons. This I should say small i, because capital I means something else.

And then, electrons do not have integer valued spin. So, the electrons will have no contact with i, but that means, we can either place the e-blob here or place it there. Both are valid positions of the blob e and therefore, this statement cannot be made.

‘Electrons are not bosons’--this statement cannot be made, starting from this premise. But since this statement is factually correct, it often fools a scientist to believing that the logical structure is also correct. It is not true.

And if I now change the subject, predicate and middle term, you immediately see the fallacy. For example, if I say ‘all insects are living organisms’, exactly the same form. And then ‘tigers are not insects’. True. Exactly the same form. And therefore, we conclude that ‘tigers are not living organisms’. Obviously, a false statement.

So, two correct statements, by false logic, wrong logic, can lead to a correct conclusion. So, the point is that, if the premises as well as the conclusion, apparent conclusion, is factually correct, do not be fooled into believing that the logical structure is also correct.

Logical structure is something that has to be obtained independently, and that requires quite a bit of practice. And only when, starting from true conclusions, you go in a valid progression, then you can reach a valid and true conclusion.

But the conclusion being true does not mean the premises are true, and if you start from a wrong premise you can arrive at valid conclusion, correct conclusion, true conclusion. And if you start from correct premise it is possible to arrive at wrong conclusion, if your logical derivation is not correct.

So, it is important therefore, to learn how to do correct logical derivations. Deductive logic is essentially starting from some inductive premise, you do a logically correct valid deduction, arrived at something else, and that then has to be tested to be true or not. So, this is how science functions and therefore, it is very important for a budding scientist to be able to apply logic correctly.