**Symbolic Logic**
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**Lecture No - 10**
Symbolization with connectives

Hello! And welcome to this module 10 of the NOC course on symbolic logic. We just have finished understanding symbolization, how it is done, in the previous module. And I asked you to sort of give yourself a little bit of practice, and careful reading and patient analysis, and so on. So if you have done that, then you have grasped how symbolization works in PL. If not, we will try to address that, but together today, what our plan is to move forward with symbolization a little bit. We just started in a very sort of elementary way. Today you might see some more complex symbolization.

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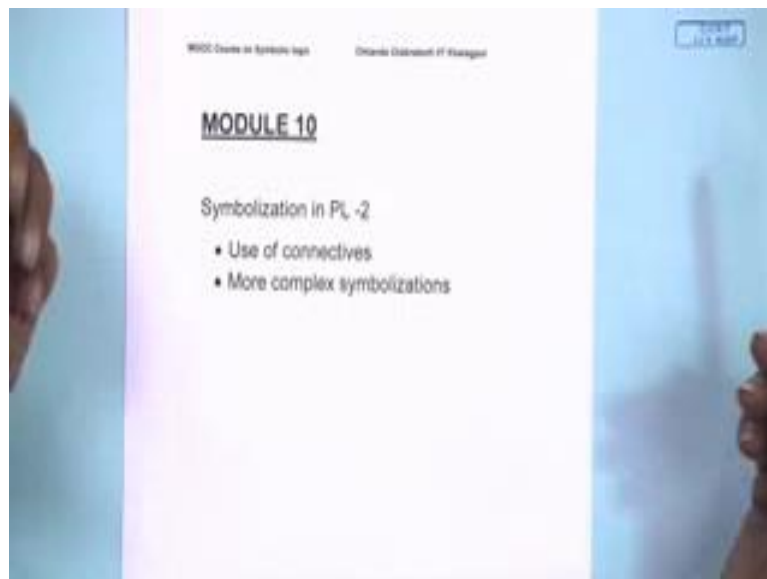
So today's agenda is to see the use of connectives in other contexts, in various contexts, and then also to understand more complex symbolization. When I say complex symbolization, I mean that where you do not have those 5 standard connectives. But there are these words, and these are logical words that are thrown at you, and you are supposed to decipher them with the use of the 5 connectives. So we are going to see some of those situations with English examples and then we do the translation together. So, that is going to be our agenda today.
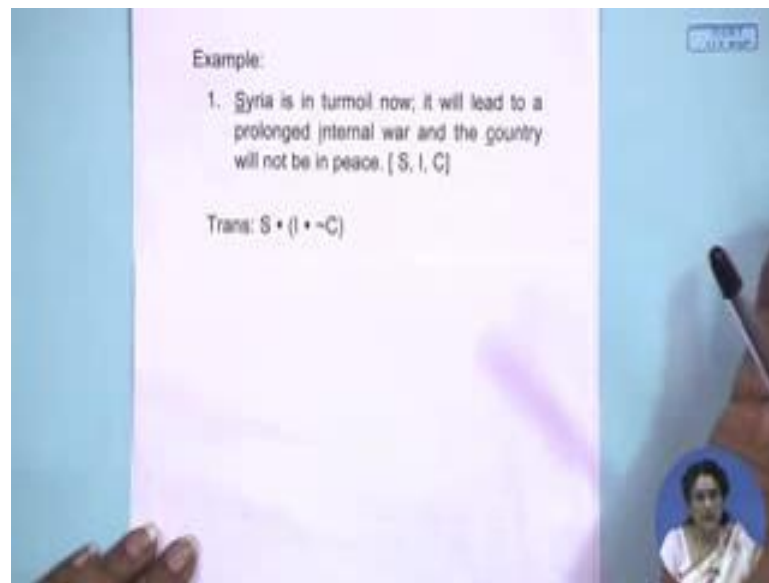
Let's start by doing some symbolizations together. Here is a sentence, 'Syria is in turmoil now. It will lead to a prolonged internal war and the country will not be in peace.' Alright? So here you are that given S, I, C. S stands for 'Syria is in turmoil now', I is for 'it will lead to a prolonged internal war' and C stands for 'the country will not be in peace'.

Now, this one we see the reason, I have chosen this one, is that there is a something little unusual about the first proposition. In what sense? That we find that this sentence ends with a semi-colon, and then the second proposition starts. So, in a way, this semi colon is a connective, that we need to interpret using all 5 basic connectives. What will be the proper connective to use here? That's first question and then the remaining one is there.

Second point is that, if you think this semi colon is one of those 5 connectives, which one you think it is the closest approximation to? Is it "not"? Is it "and"? Is it "either-or"? Is it "if then"? Or, is it "if and only if"? Now if you read the sentence, you will say this has to be closest one that is going to be is "and" or conjunction, because anything else doesn't fit into the scheme of the way we can understand the proposition.

So if it is conjunction, then here is also an "and"; see this semicolon is an "and", and then there is an "and". In that case again the question comes about the grouping. How am I going to, if all of this there is these two dots, how do I group it? And your answer lies from the reading of the proposition; how to group it, which one is going to be my main

dot, the main connective? Read again, and you will find that the sentence naturally pauses at a certain place, which is here. 'Syria is in turmoil now', pause; 'it will lead to prolonged internal war and the country will not be in peace'. So this is going to be your main pause, main connective. This whole thing is going to be your other conjunct.

So, let's see if we have picked up these nuances from the proposition, then how to translate this. Okay. So as I said, there is this dot instead of the semi colon. This "and" is very clearly the "dot" here. Why this dot is the main and this dot is sub? I have tried to give that answer also, that there is a natural pause in the way that the sentence is constructed, so that this whole thing becomes another conjunct.

Some of you will say, but why are you using not-C, ∼C, isn't C the whole thing: the country will not be in peace. I have given the answer earlier also, the usual way to read this key is that when you have C, it stands for the simple proposition. What is the simple preposition? "The country will be in peace. "The country will not be in peace" or "it is not the case the country will be in peace", that is a compound proposition, which is why C stands for the simple "The country will be in peace". Therefore, the translation is "not C" (∼C). Has that helped? So slowly. Go slow in the beginning, but this is how to pick up on your translation skills.

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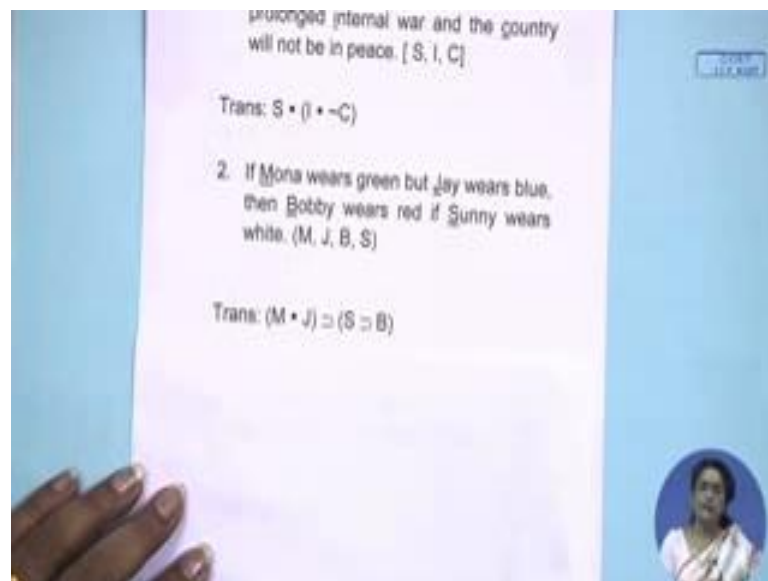
Let's try another one. "If Mona wears green, but Jay wears blue, then Bobby wears red, if Sunny wears white". Right? These are colorful people. So here you are and these are
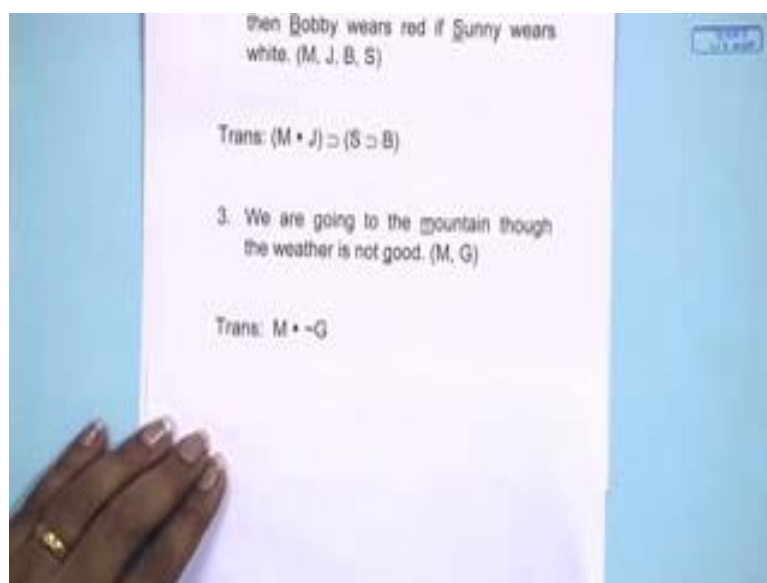
obvious choices M, J, B, S standing for names. Now what is happening here? And what is the main connective? There are so many connectives here. Here is "but", here is "if", here is "then", there is "if", and so on. But what is the main connective here, which one ranges over the whole sentence? How to read that? And then again we start at the beginning and we go here. Here is a comma, and then comes the "then". Right? So this portion seems to be an antecedent, and this portion seems to be the consequent. So this "if" and this "then" is your main connective. So, this is a conditional statement or a horseshoe statement. So, if this happens, then this happens. Alright? So that is our first thing that we have figured out.

What will happen in the antecedent? We find that there is "but". By now we know that "but" is the closest one that we can replace it with the conjunction or the 'dot' (·) Alright? That is easy.

So we are talking about M dot J (M • J). Then what is happening in the consequent? 'Bobby wears red, if Sunny wears white'. So we find that there is an "if then" sentence even here. But what is the antecedent? I said what follows the 'if' is the antecedent. Therefore, in this case 'Sunny wears white' is the antecedent, 'Bobby wears red' is the consequent. So if you have grasped that, then the translation is going to be easy to do, and we are going to require some bracketing also. So, let's check what we can do.

We said the "if then" is the main connective. So here is the main connective. And I said the antecedent is like "Mona wears green, 'and' or 'but', "Jay wears blue". Fine? And then here comes the other "if then" sentence, which is your consequent, which I said whatever follows the "if" is the antecedent. So "Sunny wears white" is your antecedent, "Bobby wears red" is your consequent. Right? And no need to have a separate parenthesis (Refer Time: 08:55) around this. Because remember, the horseshoe (⊃) is a binary connective. So, its range goes from here and goes up to here. This is its antecedent; this is its consequent. Alright? So, that is your translation of the second sentence.

then Bobby wears red if Sunny wears white. (M, J, B, S)

Trans: (M • J) ⊃ (S ⊃ B)

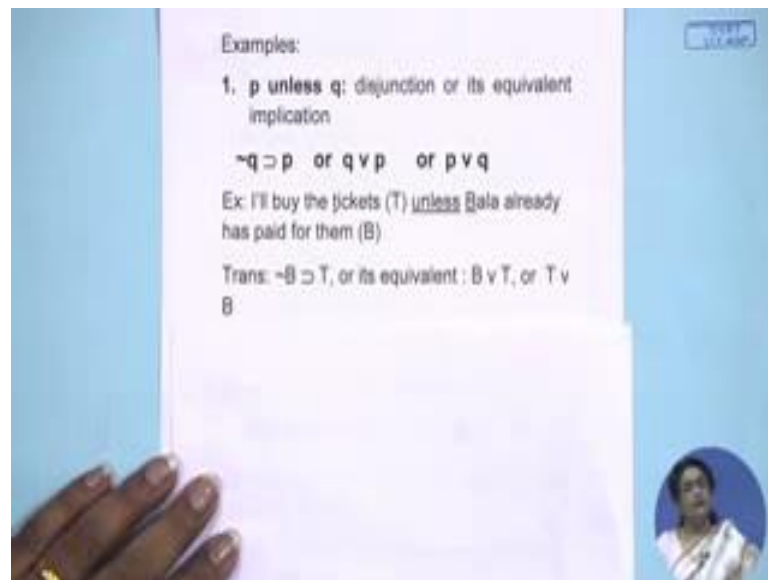3. We are going to the mountain though the weather is not good. (M, G)

Trans: M • ~G

Here is another one. 'We are going to the mountain though the weather is not good'. There are two sentences; so M and G; and by now you should know what it's for about. So 'we are going to the mountain' is your M, and 'weather is good' is G. Alright? So 'weather is not good' is not-G. G stands for 'weather is good'. Main thing to find out in this case is how to read the 'though'. What is the closest connective to 'though'? Again, is it "not"? Is it the "either or"? Is it the "and"? Is it the "if then"? Or is it the "if and only if"? And again a little bit brain racking will tell you that this is going to be again a conjunction, a dot. This 'though' this. Ok? And that's a conjunction sense; sense of conjunction. If you know this now, this is going to be your main connective, and we are going to just connect these two sentences. The translation is going to be very easy. This is simple: M dot not-G (M •~G) for reasons that I have explained with. So I leave it in front of you. These are just beginning of your translation skills and slowly we are going to, you need to practice a little bit. So take sentences of your choice, and try to plug this new-found knowledge of connectives into it to see how the translation in PL is going to be done.

What I have just shown you are rather, still more or less at the elementary level, though we have tried to understand them with some finesse. But now let me take some connectives which are not at all, they do not even pretend to be simple.

Say for example, take a look.

Examples:

1. **p unless q**: disjunction or its equivalent implication

$\sim q \supset p$ or $q \lor p$ or $p \lor q$

Ex: I'll buy the tickets (T) <u>unless</u> Bala already has paid for them (B)

Trans: $\sim B \supset T$, or its equivalent : $B \lor T$, or $T \lor B$

Suppose we talk about "unless". 'p unless q'. 'p unless q'. What am I saying? p happens, unless q happens. So when q does not happen, p holds. This is one way to read it. You will say: But you can also read it as that 'if q happens, p is not going to happen' True. That is also is the case. But you are a beginner. So 'p unless q' you can safely say that 'if q does not happen, p is going to hold'. p's holding is default, unless q. Alright? So let's take a look. The way to translate it will be through some sort of 'if then', or its equivalent disjunction. As we progress, we will see how the implication and disjunction, implication means horseshoe, and disjunction means the 'either or', or the *vel*, how they are equivalent. We will try to learn that as we go along, but right now, take my word, and this is how to translate. 'p unless q'. So 'if q does not happen, p holds ($\sim q \supset p$) or equivalent of this is going to be q wedge p ($q \lor p$), or p vel q, ($p \lor q$) . Alright?

So look at the way this is translated. 'p *unless* q' is a rather strange kind of a connective, but this is how it works. If that did not help you to understand this, let me take you an actual proposition. 'I will buy the tickets unless Bala already has paid for them'. This is your T, this is your B. I will do this, that holds, *unless* this happens. Ok? So if this does not happen, this is going to hold.   That is the way, one way to read that. So translationwise you might go like this, 'if not B then T' ($\sim B \supset T$) or what is its equivalent, 'B wedge T' ($B \lor T$) or 'T wedge B' ($T \lor B$). Ok? This is how to translate "unless".
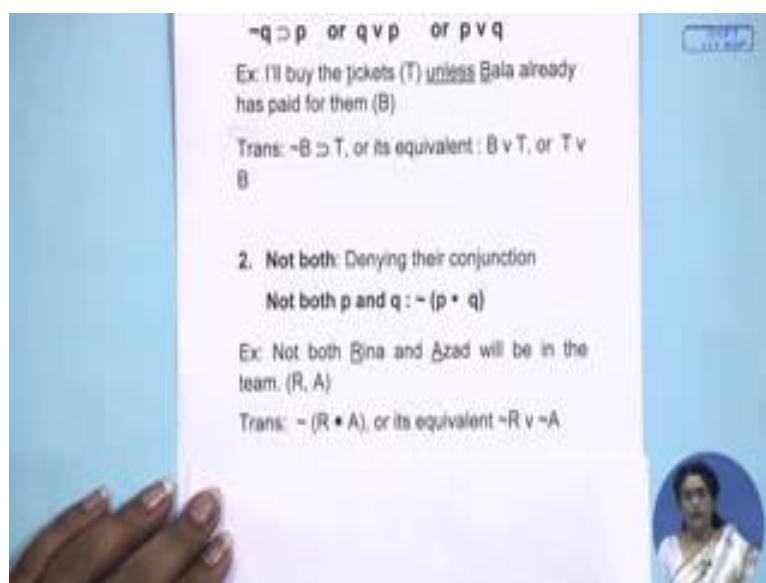
There are more connectives like this, which is rather strange. For example, 'not both'. 'Not both'. When you say both A and B, obviously that is a conjunction. But what is it that you are saying, when you are saying 'not both' ?. What you are doing remember, you are *denying* the conjunction. You are saying it is not the case that "both". How does that work? How do we represent that with the symbols? So where p and q are any two given propositions, 'not both p and q' you are saying, 'it's not the case that both p and q' $\sim(p \bullet q)$ Alright? You are denying their conjunction, not individually, not both; both of them will not be done. "Not both" for example. And 'not both Rina and Azad will be in the team'. One of them might get in, but not both. So the correct way to approach this is to understand it as 'it's not the case, that both of them will be in the team'. You are beginner, so I suggest that you try to get this here as not both. Its equivalent is of course, this 'either it will not be Rina or it will not be Azad' . That is sure. But may be at the beginning, get used to looking at 'not both' as a ' it is not the case that both'. And that should help you in your translation key.

So this was sort of a different kind of thing, and here comes our other one, equally confusing. Sometimes students get confused over this. ' Neither nor' . Earlier we have seen the 'not both', here we are saying 'neither this, nor this', 'neither p, nor q'. When you say that, what is it that you are doing? What you are doing is that you are denying their disjunction. This is very different from saying 'not both'. This is where you are *individually* rejecting each of them. So you are denying their disjunction, or the

equivalent whatever comes out. Many of you have done through the CNF, DNF, so you may have some idea about the equivalents, but we will come there when the time comes.

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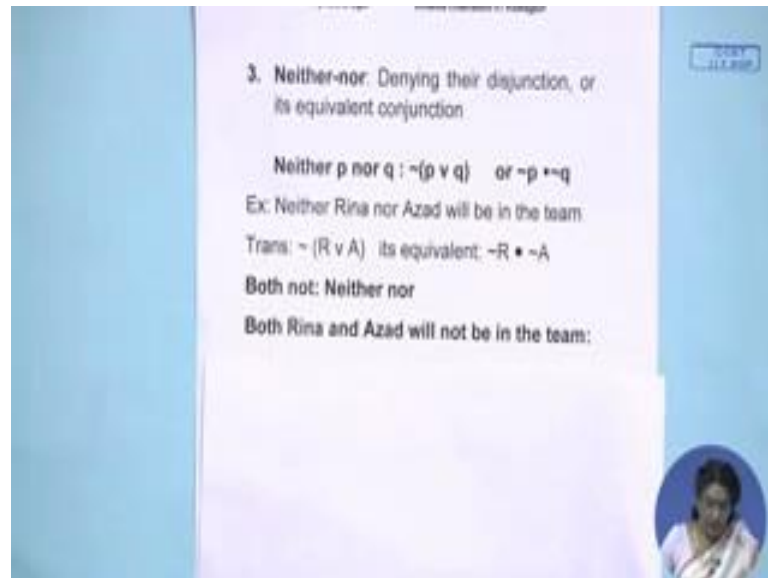
So let us take this. I am saying neither p nor q. What I am telling 'its not the case either p or q'. It is not the case either p or q, or its equivalent, p is not going to be the case and q is not going to be the case. Whichever suits you to understand this. But 'neither nor' is not to treated like 'not both'. That's my first request for you to consider. I will plug the same sentence for you to understand this. This is 'Neither Rina nor Azad will be in the team'. So we are not saying 'not both'. We are saying she is not going to be in the team, he is also not going to be in the team. So you can go like this, or you can say 'it's not the case either Rina or Azad is going to be in the team.' Ok? Does that help?

Let's take a closer one also. When you say 'both not'. Both of them will not be in the team. 'Not both' is one way to go, this is 'both not'. 'Both not', remember, is the same as saying neither nor'. So both Rina and Azad will not be in the team, you can go you can treat it as a neither nor proposition or statement.
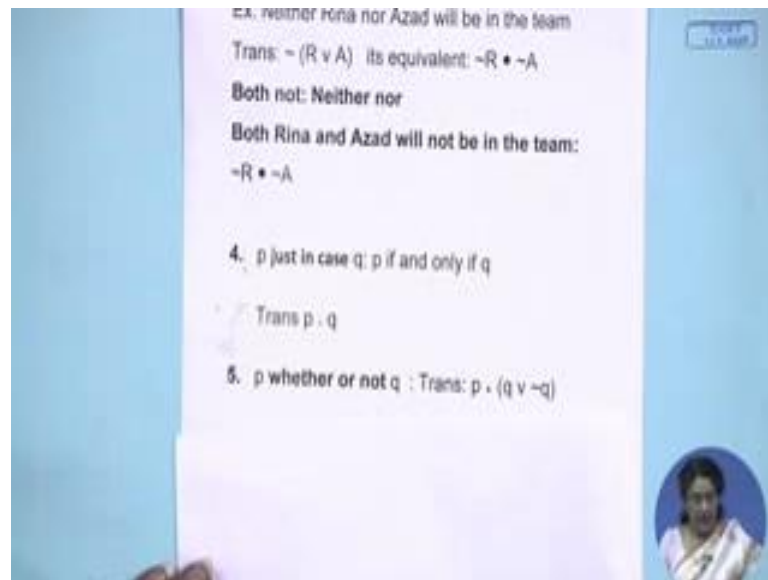
There are many other connectives, that you can also encounter and try to translate. I am not going to mention all of them. But just few; so that you have some idea that how the translation might work, that just because we have five connectives, it does not limit us to what. Say for example, you have 'p just in case q'. 'just in case' is not any of the connectives that we have been exposed to so far, but 'just in case' stands for both necessary and sufficient condition. So in a way 'just in case' is the other name for if and only if. Alright? This I am not saying that you are supposed to know this, but the readings are such and the logical analysis will tell you why this has to be the case. As a beginner, note that 'just in case' is nothing but a triple bar in your connective. So translation of this is going to be p triple bar q. ($p \equiv q$).

This is a rather interesting one: 'p whether or not q'. p happens or p holds, whether q holds or doesn't. So one way to go about that is to say p happens, and q or not q; p $\bullet$ ($q \lor \sim q$). So this is one way to capture what we are trying to say p whether or not q.

Now these two, the last two, are left little bit advanced, and I just thought about introducing you to this so that you understand that translation is more interesting and it can get quite complex. But this is how far at least we need to know, and translationwise I always say that, you know, slow understanding and a little careful and, rather what should I say. more patient treatment of the proposition will help you in getting the translation. But you need to understand the connectives, you need to understand what is

the scope of the connective, and you also need to understand the intended grouping in the proposition, and that's how symbolization in PL will work. So this is how far I will go in this module and next module onwards we are going to start something else.

Thank you very much.