UNIT-14: TRANSLATING EVERYDAY LANGUAGE

UNIT STRUCTURE

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14.1 LEARNING OBJECTIVES

After going through this unit you will be able to-

- explain the different uses of symbols in everyday language
- discuss different kinds of symbols of predicate logic and propositional logic
- discuss the process of symbolization with the help of quantifiers.
- analyse the process of symbolization with the help of set notations.

14.2 INTRODUCTION

Validity of an argument is a function of its form. But ordinary linguistic usage often obscures the form of an argument. In order to dispel this obscurity, logic introduces various simplifying procedures. For example, a syllogism can be simplified by using of letters to represent its terms. The validity of the argument depends on the arrangement of the terms within the premises and conclusion. By this process of putting letters for terms, form recognition becomes easy. Again, form recognition can be facilitated through the introduction of special symbols called operators, or connective. When we say that the logical operators may be used to translate expressions

in ordinary language, we mean that the operators capture a certain aspect of their correlative linguistic expression. If an argument is expressed in terms of these symbols, determining validity becomes only a matter of visual inspection. Therefore, the process of symbolization of our everyday language plays an important role in formal logic.

In our day to day use of language symbol, sign, mark etc. are used as synonymous. But they are not identical. The national flag or national emblem is used as symbol for the country. When see a national flag of a country we may come to know which country is represented by that flag. That particular flag belongs to a particular country, it is predetermined. Hence regarding symbol it may be stated that symbols are pre determined signs. Prof. Stout mentioned three types of sign. These are- Expressive sign, Suggestive sign and Substitutive sign. Generally the words which are used in our day to day language are expressive sign. Again, different images that are affix on the playing cards such as king, queen etc. are suggestive sign. On the other hand the signs such as: $\supset$, $\therefore$, $\equiv$, $\supseteq$, $\subseteq$, $\in$, $\notin$, p, q, r, s, x, y, z etc. that are used in logic and mathematics are substitutive symbols.

L. S. Stebbing defines symbols as "A sign consciously designated to stand for something will be called a symbol". By following L. S. Stebbing it may be stated that symbols are the artificial signs that are used consciously to represent something. Depending on the nature symbols may be classified into two types' namely verbal symbol and non-verbal symbol. In our day to day language we use different words. These words represent certain things, activities, qualities, command, request etc. All these words represent something by means of words. That is why these symbols are verbal symbols. Verbal symbols are the symbols in which something is deliberately represented by means of words. For example: Book, Pen, Honesty, kindness etc.

Uses of symbols serve different utility in the domain of logic. With the use of symbols we may find out the form of argument adequately and thereby validity and invalidity of argument may be determined easily with the use of general rules. Uses of symbols help us to remove the linguistic

difficulties that are arises from the use of ordinary language in the study of logic. Uses of symbols help us to frame general rules and principles for the study of argument and argument form in logic. The use of symbols ensures clarity and economy of expression. The uses of symbols pave the way for application of mathematical methods into the study of logic. As a result of uses of symbols in logic help us to find out validity or invalidity of argument by means of mathematical operation.

14.3 SYMBOLIZATION OF ORDINARY LANGUAGE

In the Unit IV, there has been a discussion on the basic components and the symbolization of the sentences of propositional logic. With the aid of logical constant and variable we may symbolize the statements of language. Logical constants are the symbols which have definite meaning and whose value cannot be changed from person to person, time to time and place to place. In symbolic logic there are five logical constants which are most commonly used. These are- •, v, ⊃ , ≡ , ~ respectively. In symbolic logic except '~' this all other logical constants are also used as connectives. Generally for symbolization of statement of everyday language as well as to form truth function logical constants are used. Variables are the symbols which are used to substitute something consciously. In the context of logic variable may be defined as follows: Variables are the symbols that are used to substitute something deliberately. For example- p, q, r, s etc.

For the symbolization of the statements of language first of all we have to observe the statement carefully so that we may have the idea about the components of the statement. For the symbolization of the statement according to the need of the statement we have to use variable and logical constants. If the given statement is a simple proposition, such proposition may be symbolized by means of a single variable. If the given proposition or statement is compound, for the symbolization of such statement we have to identify different parts of it and for each par we have to use separate variable. Again, to correlate different parts we have to use

logical constants. On the other hand to ensure the scope the logical constant we have to use brackets as per need of the proposition.

Basically two sorts of logic are distinguished depending on the term based and sentence base components. On the one hand there is the propositional or sentential logic, and on the other hand, there is the predicate or quantifier logic. Pointing out the difference between propositional logic or sentential logic and quantifier logic or predicate logic Virginia Klenk in her book *Understanding Symbolic Logic writes*, " in sentential logic we take the sententially simple sentence as an unanalyzed whole, whereas in predicate logic we analyze these simple sentences into their component parts" (p. 220). In order to translate or symbolize into logical forms, the diverse language of everyday life have their own set of rules depending on being a form of propositional or predicate logic.

14.4 SYMBOLIZING PROPOSITIONS OF PREDICATE LOGIC

Predicate logic is concerned with the interior structure of both atomic and compound sentences. The fundamental component in predicate logic is the predicate. The letters which are used to symbolize these predicates are called predicate letters. Predicates are the words or expressions that we use to refer to properties or attributes that things have. For example: "Arne Naess is an environmentalist"-in this proposition the term "environmentalist" is a predicate letter, because "being an environmentalist" is predicated to Arne Naess. The property of "being an environmentalist" may be symbolized by the **predicate letter** 'E', i.e. a predicate is symbolized by uppercase letters (A, B, C,….X, Y, Z). Again, to denote individuals the lowercase letters from a through w (the first twenty three letters of the alphabet) are used. These symbols are known as individual constants. Their function is to denote only one, unique individual or object from the domain of discourse. Since their reference remains fixed or constant within a given context, they are called individual constants. The first letter of an individual

or an entity is used to denote the individual. We may use letter r to denote Ramachandra Guha, v to denote Vandana Shiva and so on.

An atomic sentence or singular proposition is that where no truth functional connective is present. That is to say a singular proposition cannot contain logical connectives like 'and', 'either-or', 'if-then', 'if and only if' etc. It is not possible for a singular proposition to contain any quantity indicating words like 'all', 'every' 'some' etc. A singular proposition is that proposition which can be analyzed into terms, but not to propositions, because it is the simplest kind of non-compound proposition. In order to know how to symbolize singular propositions the concepts of "Predicate Letters" or "Predicate Symbols" and "Individual Constants" are important. Consider the sentence "Amal is happy." This sentence asserts that some particular object or entity, Amal, has a certain property-namely, the property of being happy. If we let the capital letter H denote the property of being happy, and the lowercase letter a name the individual, Amal, we can symbolize this sentence as Ha. Similarly, the sentence "Bimal is happy" can be symbolized as Hb, the sentence "Amal is friendly" as Fa, and the sentence "Bimal is friendly" as Fb. The sentences Fa, Fb, Ha, and Hb are alike in that they have the same general structure. In each of these sentences a property is ascribed to some individual entity. This is one of the basic patterns of atomic sentences or singular propositions.

Let us see the process more elaborately. In order to symbolize a singular proposition, we write the symbol for its predicate term to the left of the symbol for its subject term. To put it in other words, the predicate constant in a singular proposition is written first. Then the predicate constant is followed by the individual constant. For example Sankaradeva is a philosopher will be symbolized as 'Ps' ('P' stands for 'philosopher' and 's' stands for 'Sankaradeva'). Again,the proposition "Madhabdeva is a Vaishnava" is to be symbolized as "Vm," where capital letter "V" stands for the predicate "Vaishnava" and lowercase letter "m" stands as individual variable for the individual "Madhabdeva." Individual variables are those which indicate where an individual constant can be written to produce a

singular proposition. Moreover, a negative proposition like "Banta is not intelligent" is symbolized as '~ Ib'.

Another basic pattern is illustrated by the sentence "Champak is taller than Dhruba." This sentence asserts that there is a particular property (being taller than) that holds between the two individual objects Champak and Dhruba. If we let c denote Champak, d Dhruba, and T the property of one thing being taller than another we can symbolize this sentence as Tcd. Similarly, we can symbolize the sentence "Dhruba is taller than Champak" as Tdc. And if we let F denote the property of one thing being a friend of another (is a friend of), then we can symbolize the sentence "Champak is a friend of Dhruba" as Fcd, and so on. Properties such as is taller than and is a friend of, which hold between two or more entities, are called relational properties. The particular properties in question are two place relational properties, since they hold between two entities.

In predicate logic two symbols, called quantifiers, are used to state how many. Words that indicate quantity such as 'all', 'every', 'most' are called quantifiers. The first is the universal quantifier, used to assert that all entities have some property or properties. A universal quantifier can be defined as an expression that, when prefixed to a propositional function, yields a universal proposition. Statements which contain words like 'all', 'every', 'each', 'any', 'everything', 'anything' or any word conveying the sense of 'all' are symbolized by the aid of universal quantifier. The symbols (x), (y), and so on-that is, individual variables placed between parentheses-are used for this purpose. Thus, to symbolize the sentence "Everything moves" or "All things move," start with the sentence form Mx and prefix the universal quantifier (x) to obtain the sentence (x)(Mx), which is read as "For all x, Mx," or "Given any x, Mx." Let us try to explain the process of its symbolization. Consider the proposition: 'Everything is temporary'. It can be expressed as:

Given any individual thing whatever, it is temporary.

We can use x (an individual variable) in place of both the pronoun 'it' and its and its antecedent 'thing'. We can paraphrase the proposition as:

Given any x, x is temporary.

Here, we have got a property, i.e. 'being temporary'. In order to symbolize this property, as it is already mentioned in the previous section, we need predicate symbol. We can symbolize the property 'being temporary' as 'Tx'. The phrase 'given any x' is called a universal quantifier. 'Given any x' is conventionally symbolized as '(x).' The general proposition 'everything is temporary' can be symbolized as, (x) Tx.

The existential quantifier is used to assert that some individual or individuals have one or more properties. An existential quantifier can be defined as an expression that, when prefixed to a propositional function, yields an existential proposition. Here we use a symbol that looks like a backward letter E along with an individual variable, placing both symbols within parentheses, as in (∃x), (∃y), and so on. The existential quantifier '(∃x)' is used to assert that some entities (at least one) have a given property. Thus, to symbolize "Some things move," we again start with the sentence form Mx but this time we prefix the existential quantifier (∃x) to obtain the sentence (∃x) (Mx), which is read as "There is an x, Mx" or "For some x, Mx."Thus, to symbolize the proposition "Something is light" or the proposition "At least one thing is light," start with the proposition form Lx and prefix an existential quantifier to it. The result is the sentence ((∃x) Lx, read "For some x, x is light," or "There is at least one x such that x is light," or just "Some x is light."

Let us take a negative proposition: Something is not temporary. It can be written as, There is at least one x, such that x is not temporary. Here one important point is to be noted that the 'not' appears before the predicate, it does not appear in the quantity part. With the help of Existential quantifier it can be translated as:

(∃x) ~Tx

When we use the universal quantifier, (x), we are saying something about all the individuals represented by the variable x in the quantifier. Just how many x's constitute all depends on how many things we want our language to be able to deal with. For instance, in some systems for

arithmetic, we want the individual constants to denote numbers, so in such a system the number of x's will be infinite. Let us see the symbolization of four categorical propositions by means of using quantifiers:

Let us take the sentence "All humans are mortal." It is correctly symbolized as (x)(Hx ⊃ Mx) (where Hx ="x is human" and Mx = "x is mortal") and is read "For all x, if x is human, then x is mortal" or "Given any x, if x is human, then x is mortal," which is roughly what the sentence "All humans are mortal" asserts. Similarly, "No philosopher is dishonest"---can be written as: Given any individual thing whatever, if it is philosopher, then it is not dishonest. Given any x, if x is a philosopher, then x is not dishonest. Given any x, x is philosopher ⊃ x is not dishonest. Thus, it is symbolized as, (x) (Px⊃ ~ Dx).

Let us take a particular affirmative proposition: Some philosophers are philanthropists. This sentence can be written as: There is at least one thing that is philosopher and philanthropist. This again can be restructured as "There is at least one thing such that it is philosopher and it is philanthropist". To be more precise, it is formulated as: There is at least one x such that x is philosopher and x is philanthropist. To quantify it by quantifiers, it is to be shaped as "There is at least one x such that x is philosopher ox is philanthropist". Thus, it can be symbolized as (x) (Px• Hx). Similarly, "Some philosophers are not philanthropists" --- can be written as: There is at least one thing that is philosopher but not philanthropist. It implies, "There is at least one thing such that it is philosopher and it is not philanthropist". To quantify it, "There is at least one x such that x is philosopher and x is not philanthropist". Thereby, it is symbolized as, (x) (Px • ~Hx).

More complicated symbolizations are obtained in other ways. Thus, to symbolize the sentence "Something is both heavy and expensive," conjoin Hx (for "x is heavy") with Ex (for "x is expensive") to get (Hx • Ex), and then add an existential quantifier to get (∃x)(Hx • Ex). Similarly, to symbolize "Something is both sweet and fattening," conjoin Sx (for "x is sweet") with Fx (for "x is fattening") to get (Sx • Fx), and then add an existential quantifier to get (∃x)(Sx • Fx).



ACTIVITY: 14.1

Symbolize the following by using quantifiers:

1. Everything is movable.
2. Not everything is movable.
3. Nothing is movable.
4. Everything is immovable.
5. Some people are honest.
6. Some people are not honest.
7. Some honest people are mistreated.
8. Some people are liars and thieves.
9. It's not true that some people are honest.
10. Some people are neither honest nor truthful.
11. Some things are neither expensive nor worthwhile.

14.5 SYMBOLIZATION OF CATEGORICAL PROPOSITIONS BY USING SET NOTATION

A categorical proposition refers to two classes. In order to symbolize a categorical proposition, we use some symbolic notation. The four categorical propositions are symbolized by using set notations. If two classes, s and p, have some members in common, then this common membership is called as the product or intersection of the two classes.

E proposition is the universal negative proposition. It says that no s's are p's, which means one class is totally excluded from another class. Or it says that no member of the class s is members of class p, that is, there are no things that belong to both classes. Thus there is no overlap between the class of p and the class of s. In other words the two classes have no members in common, that they are disjoint; that the region that is both s and p is empty. The intersection of the two classes is symbolized as sp or s $\cap$ p. In order to show that a particular class has no member we use

a zero (0) or lambda (λ). When we find that the intersection of two classes is empty then symbolize it as sp = 0 or as s $\cap$ p = λ. For example:

1. No s is p.

   S $\cap$ p = λ

2. No americans are philosophers.

   a $\cap$ p = λ

I proposition is the contradictory of an e proposition. This proposition says that one class is partially included in another class. It is expressed in the way that there are some s's that are p's. It implies that the class of s is partly included in the class of p. From it we understand that there is some overlap between the class of s and the class of p. From the point of view of members of the class there exists at least one member which is both s and p. In other words the product of the classes s and p is not empty. Therefore, an i proposition can be symbolized as sp $\neq$ 0 or as s $\cap$ p $\neq \lambda$. For example:

1. Some s is p.

   S $\cap$ p $\neq \lambda$

2. Some americans are philosophers.

   a $\cap$ p $\neq \lambda$

3. Some frenchmen drink wine.

   f $\cap$ w $\neq \lambda$

in order to symbolize a and o proposition the concept of class complement is used. The class complement is the class of all things not belonging to the original class. The complement of class s is symbolized as s (s bar). Proposition 'a' is the universal affirmative proposition. It says that all s's are p's, that whatever is in the class of s must also fall into the class of p. This means there can be no s that is not also a p. In other words, all members of the class s are also the members of class p, or by obversion it can be said as "no s is non-p." Thus this proposition says that the product of the classes designated by its subject and predicate terms is empty. A proposition states that the word "all" attaches itself directly to the s and not to the p. As such, an a proposition asserts something definite about s, but it leaves the open question of the extent of the p dominion. Thus we

symbolize an a proposition as sp = 0 or s I ~p = λ. Let us take see the following propositions and their symbolizations.

1. All s are p.

   The set of s is $\subseteq$ p.

   S I ~p = λ

2. All americans are philosophers.

   the set of americans is the subset of the set of philosophers.

   a I ~p = λ

3. All women are fickle.

   W I ~f = λ

O proposition is the particular negative proposition. It says that one class is partially excluded from another class. It is expressed in the way that there is something that is s but not p, that is, the class of s falls partly outside the class of p. In other words the categorical form of o proposition "some s is not p" can be logically obverted equivalently to i proposition. As such it can be symbolized as sp $\neq$? or sp $\neq$ 0. Since, o proposition is contradictory to a proposition, we symbolize it as sp $\neq$ 0 or s I ~p $\neq$ λ. For example:

1. Some s is not p.

   S I ~p $\neq$ λ

2. Some americans are not philosophers.

   a I ~p $\neq$ λ

The following are some more examples that will help us to symbolize relatively complex propositions.

4. All americans are clean and strong.

   A $\subseteq$ c I s

5. Fools are drunk men are truth tellers.

   (f u d) $\subseteq$ t

6. Some americans drink both coffee and milk.

   a I c I m $\neq$ λ

7. Some americans who drink tea do not drink either coffee or milk.

   (a I t) I ~ (c u m) $\neq$ λ



CHECK YOUR PROGRESS

Q 1: Answer the following questions

a) '•' What is the name of this symbol?

b) ∃x What is the name of this symbol?

c) '⊃' What is the name of this symbol?

d) I What is the name of this symbol?

e) ' ~ ' is this symbol a logical constant?



ACTIVITY: 14.1

Symbolize the following propositions by means of set notations:

1. No fish are mammals.
2. All tigers are wild.
3. No man is happy and self-controlled.
4. No poem is uninteresting.
5. Some writers are mad.
6. Honest and drunk are truth tellers.
7. All trucks are vehicles.
8. No roses are daisies.
9. Some spaniels are not good hunters.
10. Some carbon compounds are not diamonds.



14.6. LET US SUM UP

- Regarding symbol, it may be stated that symbols are pre determined signs. Prof. Stout mentioned three types of sign. These are- Expressive sign, Suggestive sign and Substitutive sign. Generally the words which are used in our day to day language are expressive sign. Again, different

images that are affix on the playing cards such as king, queen etc. are suggestive sign. On the other hand the signs such as: $\supset$, $\therefore$, $\equiv$, $\supseteq$, $\subseteq$, $\in$, $\notin$, p, q, r, s, x, y, z etc. that are used in logic and mathematics are substitutive symbols.

- L. S. Stebbing defines symbols as "A sign consciously designated to stand for something will be called a symbol".
- Uses of symbols serve different utility in the domain of logic. With the use of symbols we may find out the form of argument adequately and thereby validity and invalidity of argument may be determined easily with the use of general rules.
- Uses of symbols help us to remove the linguistic difficulties that are arises from the use of ordinary language in the study of logic.
- Uses of symbols help us to frame general rules and principles for the study of argument and argument form in logic.
- The use of symbols ensures clarity and economy of expression. The uses of symbols pave the way for application of mathematical methods into the study of logic. Virginia Klenk in her book Understanding Symbolic Logic writes, " in sentential logic we take the sententially simple sentence as an unanalyzed whole, whereas in predicate logic we analyze these simple sentences into their component parts" (p. 220).
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14.7. FURTHER READINGS

1) Chakraborty, Chhanda (2009), Logic: Informal, Symbolic and Inductive, New Delhi: PHI Private Limited.

2) Hurley, Patrick J (2007), Introduction to Logic, New Delhi: Cengage Learning Private Limited.

3) Sharma, Banajit and Jahnabi Deka (2011), A Textbook of Logic, Guwahati: Aak Baak.

14.8 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1:

a) dot

b) existential quantifier

c) Implication

d) Intersection

e) Negation

14.9. MODEL QUESTIONS

A) Objective questions

Q 1: Symbolize the following propositions by means of set notations:

a) No fish are mammals.

b) All tigers are wild.

c) No man is happy and self-controlled.

d) No poem is uninteresting.

e) Some writers are mad.

f) Honest and drunk are truth tellers.

g) All trucks are vehicles. No roses are daisies.

h) Some spaniels are not good hunters.

Q 2: Answer the following questions

a) 'o' What is the name of this symbol?

b) x What is the name of this symbol?

c) ' ' What is the name of this symbol?

d) ? What is the name of this symbol?

B) Long questions (Answer in about 300-500 words)

Q 1: How do we symbolize categorical propositions by using set notation? Explain

Q 2: How do we symbolize the propositions of predicate logic? Explain

Q 3: How do we symbolize ordinary language? Explain

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