Logic 06 Reading

Section 1: What is Deductive Inference?

Introduction.
In the past readings, we have discussed **proposition**, which is the verbal expression of judgment. We discussed how they are logically opposed and how they are logically equivalent. We also discussed how terms are distributed in each kind of proposition. In the preceding sections, we discussed simple apprehension (or **term**). Simple apprehension is the first logical operation of the mind, judgment is the second. In this section, we will turn to the study of the third logical operation of the moind: syllogism, which is the verbal expression of deductive inference.

Mental Act	Verbal Expression
Simple Apprehension	Term
Judgment	Proposition
Deductive Inference	**Syllogism**

_____ **Reasoning.** Deductive inference is one kind of reasoning. Reasoning is defined as follows:

Reasoning is the act by which the mind acquires new knowledge by means of what it already knows.

When we reason, we take truths that are already known to us and, by the use of reasoning, arrive at another truth. There are two kinds of reasoning:

1. Deduction (i.e. Deductive Inference)
2. Induction

For now, we are only studying deduction.

Let's look, once again, at the following argument:

All men are mortal.
Socrates is a man.
Therefore, Socrates is mortal.

There are three acts which occur in our minds when we make an argument like this. First, we perceive the first premise ("All men are mortal") as being true. Secondly, we perceive the second premise ("Socrates is a man") is also true. These two steps are together called the **antecedent**. The word **antecedent** is made up of two Latin words; **ante**, which means **before**,

and *cedere*, which means *to go*. These first two steps – the recognition that each of the two premises is true—*go before* or precede in the act of reasoning.

Each one of the first two steps is an act of judgment, which is, as we said, the second operation of the mind. The third step is an act of deductive inference, the third logical operation of the mind. This third step takes place when we realize that, given the truth of the two premises ("All men are mortal" and "Socrates is a man"), the conclusion ("Socrates is mortal") must also be true. Our minds stop, or *conclude* at this third step, which is why this final statement is called the *conclusion*. The conclusion is the *consequent* in our reasoning.

> All men are mortal.
> Socrates is a man.
> Therefore, Socrates is mortal.

The definition of deductive inference is as follows:

Deductive inference is the act by which the mind establishes a connection between the antecedent and the consequent.

As we said, deductive inference is the mental act, and it corresponds to the verbal expression we call a *syllogism*. What is the definition of *syllogism*?

A syllogism is a group of propositions in orderly sequence, one of which (the consequent) is said to be necessarily inferred from the others (the antecedent).

A syllogism will always contain two premises and a conclusion. The premises are the antecedents and the conclusion is the consequent.

_____ Validity.

All reasoning presupposes what we may call the ***Essential Law of Argumentation:***

If the antecedent (premises or reasons) is true, the consequent (conclusion) must also be true.

All valid syllogisms are governed by this law. A valid syllogism is one which contains a conclusion that logically follows from the premises. We see this law in operation by once again looking at the argument we started out with:

> All men are mortal.
> Socrates is a man.
> Therefore, Socrates is mortal.

We can see that if the antecedent is true (i.e. if both "all men are mortal" and "Socrates is a man" are true), then the statement "Socrates is mortal" must also be true.

This rule has two corollaries to it:

1. If the syllogism is valid and the consequent is false, then the antecedent (i.e. one or both of the two premises) must be false.
2. In a valid syllogism with a true consequent, the antecedent is not necessarily true (i.e. one or both of the premises may still be false).

Let's give an example of corollary 1:

> All men are sinners.
> My dog Spot is a man.
> Therefore, my dog Spot is a sinner.

This syllogism is valid. By saying it is valid, however, we simply mean that if the premises are true, the conclusion must also be true. But the conclusion is false. By applying corollary 1, we see that, if the conclusion is false, one or both of the premises must be false. In this particular argument, we see the problem right away: the second premise ("My dog Spot is a man") is obviously false.

Let's also give an example of corollary 2:

> All vegetables are philosophers.
> Socrates is a vegetable.
> Therefore, Socrates is a philosopher.

In this syllogism, we notice that the conclusion is true: Socrates was, indeed, a philosopher. But we know from corollary 2 that just because the conclusion is true doesn't mean that the antecedent (i.e. the two premises) must be true. Indeed, we see in this argument that even though the consequent (which we also call the conclusion) is true, neither of the premises are.

_____ Terms in a Syllogism
There are three terms in a syllogism: the ***major term***, the ***minor term***, and the ***middle term***. They are arrayed in a valid syllogism as follows:

> Major term: The major term is the predicate of the conclusion.
> Minor term: The minor term is the subject of the conclusion.
> Middle term: The middle term is the term that appears in both premises, but not in the conclusion.

Let's look at a real syllogism again:

All men are mortal.
Socrates is a man.
Socrates is mortal

We see in this syllogism that there are six terms used, but some of them are the same. There are actually three terms used twice each. Using the definitions of the three kinds of terms above, we can determine what the minor, major, and middle terms in this argument are.

We see that the minor term is the subject of the conclusion. What is the subject of the conclusion in this argument? It is **Socrates**. Therefore, **Socrates** is the minor term.

We see that the predicate of the conclusion is the major term. What is the predicate of the conclusion in the argument? It is **mortal**. Therefore, **mortal** is the major term.

We see that the middle term is the term used in both premises, but not in the conclusion. What term in our argument is used in both premises but not in the conclusion? It is **men**. Therefore, **men** is the middle term.

We know, then, that the minor term is **Socrates**, the major term is **mortal**, and the middle term is **men**.

Let us now label our terms in order to more easily identify them. Let us label the minor term S, since it is the subject of the conclusion. Let us label the major term P, since it is the predicate of the conclusion. And let us label the middle term M. Our syllogism will then look like this:

All men^M are mortal^P
Socrates^S is a man^M
Therefore, Socrates^S is mortal^P

If we wanted to simplify even further, we could reduce all the terms to letters, just like we did when we were studying statements.:

All M are P
All S are M
Therefore, All S are P

In addition to the labels we attach to the terms themselves, there are also labels we attach to the premises in an argument. One of the premises we call the *major premise*; the other we call the *minor premise*. How do we know which is which? It is quite simple:

The <u>major premise</u> is the premise which contains the major term.
The <u>minor premise</u> is the premise which contains the minor term.

In our argument, which is the minor and which is the major premise?

All men are mortal.
Socrates is a man.
Therefore, Socrates is mortal.

We know that the major term is the predicate of the conclusion. The predicate of the conclusion is **mortal**. The term mortal is contained in the first premise. Therefore, the first premise is the major premise. We know also that the minor term is the subject of the conclusion. The subject of the conclusion is **Socrates**. The term **Socrates** is contained in the second premise. Therefore, the second premise is the minor premise.

_____ Proper Formation of a Syllogism.
In the example syllogism we just looked at in order to illustrate how to identify the major and minor premises, we found that the major premise was the first one. It is very important to remember that the major premise should always be put first in a syllogism. We say a syllogism is properly formed if the major premise is first, the minor premise second, and the conclusion third.

Note, however, that when we see a syllogism, we should not automatically assume that the first premise is the major premise. The syllogism could be improperly formed and have the minor premise first instead. In that case we should change it so it is properly formed by placing the major premise first. But, in determining which premise is the major premise, do not assume it is the first premise; instead apply the definition of the major premise given above.

_____ The Principles of the Syllogism.
Categorical syllogisms state the identity of two terms, the minor and major terms, by virtue of their mutual identity with a third term, the middle term. Behind the rules that govern the syllogism, there are four principles which are fundamental to all logical thought.

The Principle of Reciprocal Identity: _Two terms that are identical with a third term are identical to each other._ For example, in the argument above, the term **mortal** is said to be identical with the term **man**: and the term **mortal** is also said to be identical to the term **Socrates**. Since both **Socrates** and **man** are identical to **mortal**, then the terms **Socrates** and **man** must be identical to each other. In other words, if S is identical with M and P is identical with M, then S is identical to P.

The Principle of Reciprocal Non-Identity: *Two terms, one of which is identical with a third term and the other of which is nonidentical with that third term, are nonidentical to each other.* Consider the following argument:

> No men are angels.
> Socrates is a man.
> Therefore, Socrates is not an angel.

We see here that although **Socrates** is said to be identical with **man**, **angel** is not identical with **man**. Since **Socrates** is identical with **man** but **angel** is not, **Socrates** cannot be identical with **angel**. In other words, if S is identical with M, but P is not identical with M, then S is not identical with P.

The Dictum de Omni: *What is affirmed universally of a certain term, is affirmed of every term that comes under that term*. This principle is apparent also in our original syllogism. Since mortality is affirmed universally of man, every term that comes under the extension of *man* shares in it. Since Socrates is included in the extension of *man*, Socrates is said to share in mortality.

The Dictum de Nullo: *What is denied universally of a certain term is denied of every term that comes under that term.* Consider the following argument:

> No man is God
> Socrates is a man
> Therefore, Socrates is not God.

This argument denies divinity universally of men. Since **Socrates** comes under **men**, it is denied of Socrates too.