The Three Building Blocks of Aristotelian Logic - Syllogisms

"We must determine what a premise is, what a term is, and what sort of deduction is complete and what sort incomplete.'"

(Aristotle, *Prior Analytics*, transl. Robin Smith, 2012)

I. Lesson

We already took a first look at syllogisms in our very first lesson. To be more precise, here's a definition:

- **Syllogisms:** a *syllogism* is a specific form of argument through which we infer a conclusion on the basis of two premises, each of which is a proposition. Syllogisms are distinguished by the fact that the two premises have exactly *one term in common*.

Syllogisms are at the very core of Aristotelian logic; we will look at them in much more depth later in the course. Now that we have an understanding of how to evaluate the truth of a proposition by checking for whether the truth of a proposition corresponds to facts in the world, we can look at two important properties of the syllogism.

[Activity] Before moving on, recall a few of the arguments we looked at in the first lesson. What made each of them "good" or "bad" arguments to you? Discuss with a partner!

a) Validity

A syllogism is *valid* if the truth of the premises guarantees the truth of the conclusion. In other words, *valid* syllogisms are those where, *if* the premises are true and the terms are *clear* and *unambiguous*, it is not possible for the conclusion to be false. We will talk about *vagueness/clarity* and *ambiguity* in the next lesson. Here, we will focus on the truth of premises and validity of syllogisms. If a syllogism is not valid, then it is called *invalid*. Consider the following example:

Premise 1 (P1): All snakes are trees.

Premise 2 (P2): All trees are plants.

Conclusion (C): All snakes are plants.

Despite expressing a completely absurd fact, this syllogism is *valid*. This is because if we *assume* the premises to be true (i.e. that all snakes are trees and all trees are plants), then the conclusion does follow. Whether the premises *are* actually true or not does not matter for the notion of validity. Compare with the following:

Premise 1 (P1): All snakes are trees.

Premise 2 (P2): All trees are plants.

Conclusion (C): No snake is a plant.

This argument is *invalid* because if the premises were true, the conclusion would simply *not follow* logically.

We are interested in studying validity because we want to know what *kinds* of syllogisms will get us from true premises to a true conclusion, *irrespective of their content*. If we manage to elaborate a list of valid syllogisms and invalid ones, we will have a first practical standard for evaluating the strength of an argument – if we find it on the wrong side of our list, then we will know that it is a bad argument and we will know *why*.

b) Soundness

An argument is called *sound* if (1) it is valid, (2) its premises actually *are* true, and (3) its terms are clear and unambiguous. Otherwise, it is called *unsound*. For example, the argument

Premise 1 (P1): All people are mortal.

Premise 2 (P2): Aristotle is a person.

Conclusion (C): Aristotle is mortal.

is sound. Firstly, it is valid – if the premises are true, then so is the conclusion. Secondly, its premises actually *are* true – the respective propositions do correspond to actual states of affairs in the world, since it *is* the case that all people are mortal and it *is* the case that Aristotle is a person. By contrast, the argument

Premise 1 (P1): All snakes are trees.

Premise 2 (P2): All trees are plants.

Conclusion (C): All snakes are plants.

is unsound. Although we have seen that this argument is valid, it is not the case that its premises are true. In particular, P1 is false – it does not correspond to a state of affairs in the world because it is not the case that all snakes are trees! Note that validity is a *precondition* for soundness; in other words, it is not possible for an argument to be invalid, but sound. To be clear, if an argument is sound, then the conclusion *must* be true.

[Activity]: With a partner, come up with your own examples of a valid and sound argument, a valid and unsound argument, and an invalid and sound argument. If one of these is impossible, discuss why.

II. Examples

For future reference, consider this useful table displaying an example of an argument for all four possible arrangements of the two properties.

Validity **Soundness**	**Valid**	**Invalid**
Sound	P1: All people are mortal. P2: Aristotle is a person. C: Aristotle is mortal.	Impossible
Unsound	P1: All snakes are trees. P2: All trees are plants. C: All snakes are plants.	P1: All snakes are trees. P2: All trees are plants. C: No snake is a plant.

III. Exercises

1. In your own words, define a syllogism.
2. Match the concepts on the left-hand column to those on the right-hand column:

i. validity	a. an expression corresponding to a fact of the world
ii. soundness	b. valid, terms are clear and unambiguous, and premises both correspond to facts of the world
iii. true proposition	c. an expression not corresponding to any facts of the world
iv. false proposition	d. conclusion corresponds to a fact of the world if premises do

3. Identify whether the following syllogisms are valid or invalid, sound or unsound. (Hint: one will not need to evaluate the clarity or unambiguity of the terms here).

   a) P1: No chair is a comfortable thing.
      P2: All comfortable things are red.
      C: Some chairs are red.

   b) P1: All shards of glass are transparent things.
      P2: No transparent thing is wooden.
      C: Some shards of glass are wooden.

c) P1: All colors are pretty things.
P2: All pretty things are snakes.
C: All colors are snakes.

d) P1: All working laptops are electronic devices.
P2: All electronic devices are useful.
C: All working laptops are useful.

IV. Conclusion

The three fundamental building blocks of Aristotelian logic are *terms*, *propositions*, and *syllogisms*. Each of these has its own function and specific set of properties. In this lesson, we looked at *syllogisms*. By putting together what we've learned about terms and propositions, we have finally gathered an understanding of this *form of argument*. As we have seen, they can be either *valid*, or *sound*. Using the properties we have learned, we can now characterize certain arguments and their specific components from a logical perspective. In the following lessons, we will nuance our understanding of each building block as matters become more and more complex.

V. Lesson Goals

At the end of this lesson, students will be able to:

- define a syllogism;
- evaluate syllogisms with respect to their validity and soundness;
- apply previous knowledge of terms and propositions to syllogisms
- refute instances of the fallacy of equivocation;

Answer Key:

Exercise 1

Answers may vary. Lesson definition: a *syllogism* is a specific form of argument through which we infer a conclusion on the basis of two premises, each of which is a declarative sentence expressing a proposition; the two premises have exactly *one term in common*.

Exercise 2

i. - d.; ii. - b.; iii. - a.; iv. - c.

Exercise 3

a) invalid, unsound; b) invalid, unsound; c) valid, unsound; d) valid, sound.