# 1.1.s. Summary

1.1.1. Logic studies reasoning not to explain actual processes of reasoning but instead to describe valued properties of reasoning by stating norms. It is thus a normative discipline.

1.1.2. The central focus of our study of logic will be inference. We will refer to the starting points of inference as assumptions or premises and its end as a conclusion. These two aspects of a stretch of reasoning can be referred to jointly as an argument. We use the lower case Greek $\phi$, $\psi$, and $\chi$ to stand for individual sentences and upper case Greek $\Gamma$, $\Sigma$, and $\Delta$ to stand for sets of sentences; and we join premises $\Gamma$ and conclusion $\phi$ with a solidus to indicate the argument $\Gamma$ / $\phi$ formed from them.

1.1.3. Considering the difference between extracting information from data and either generalizing from data or offering an explanation of it leads us to a distinction between deductive and non-deductive inference. Deductive inference may be distinguished as risk free in the sense that it adds no further chance of error to the data. Deductive logic, the study of this sort of inference, is our topic in this course.

1.1.4. The relation between premises and a conclusion that can be deductively inferred from them is entailment. When the premises and conclusion of an argument are related in this way, the argument is said to be valid. Our symbolic notation for this relation is the rightwards double arrow $\Rightarrow$, so $\Gamma \Rightarrow \phi$ says that the premises $\Gamma$ entail the conclusion $\phi$.

1.1.5. Among deductive inferences, we can distinguish those that depend on the subject matter of the data and those that depend on the logical form of the statements expressing the data; our concern will only be with logical form so our study will be an example of formal logic. The norms of deductive reasoning based on logical form are analogous to some laws of mathematics. The recognition of these analogies (especially by Boole and Frege) has influenced the development of notation for formal deductive logic over the last two centuries, and logic studied from this perspective is often referred to as symbolic logic.

# 1.1.x. Exercise questions

**1.** Assume that a statement of entailment $\Gamma \Rightarrow \phi$ holds when the premises $\Gamma$ listed to the left of the arrow, taken together, contain all the information found in the conclusion $\phi$ displayed to its right.

Using this understanding of entailment, decide for each of the following whether you can be sure that the statement is true (no matter what sentences are put in place of the Greek letters) and briefly explain your reasons. [In some cases a lower case Greek letter (our notation for a single sentence rather than a set) is used on the left of the sign $\Rightarrow$ as shorthand for a set of premises with only a single member.]

**a.** $\phi \Rightarrow \phi$

**b.** if $\phi \Rightarrow \psi$ and $\psi \Rightarrow \chi$, then $\phi \Rightarrow \chi$

**c.** if $\phi \Rightarrow \psi$, then $\psi \Rightarrow \phi$

**d.** if (i) $\Gamma, \phi \Rightarrow \psi$ and (ii) $\Gamma \Rightarrow \phi$, then (iii) $\Gamma \Rightarrow \psi$
[Notice that this says that a premise $\phi$ of a valid argument $\Gamma, \phi$ / $\psi$ may be dropped without destroying validity provided it is entailed by the remaining premises $\Gamma$.]

**e.** if $\chi, \phi \Rightarrow \psi$ and $\chi, \psi \Rightarrow \phi$, then $\phi, \psi \Rightarrow \chi$

**2.** The basis for testing a scientific hypothesis can often be presented as an argument whose conclusion is a prediction about the result of the test and whose premises consist of the hypothesis being tested together with certain assumptions about the test (e.g., about the operation of any apparatus being used to perform the test).

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|---|---|---|
| hypothesis to be tested: | *hypothesis* | premises |
| assumptions about the test: | *assumption* … *assumption* | |
| prediction of the test result: | *prediction* | conclusion |

Suppose that the prediction is entailed by the hypothesis together with the assumptions about the test (i.e., suppose that the argument shown above is valid) and answer the following questions:

**a.** Can you conclude that the hypothesis is true on the basis of a successful test (i.e., one whose result is as predicted)? Why or why not?

**b.** Can you conclude that the hypothesis is false on the basis of an unsuccessful test (i.e., one whose result is not the one predicted)? Why or why not?

# Homework for Mon 8/30

None