

Logic!

PHI 154 Symbolic Logic (Eliot)

Welcome. Who's here?

You.

Plan for today

1. Who's here?
2. What's logic? (most of the time)
3. Look at the syllabus
4. Look at the course site.

What is logic?

What are some other ways of asking “Is x logical?”

Like, “Is x _____?”

Synthesis?

Can we frame some of our answers in terms of

- rational beliefs
- good inferences

?

Some logical questions about beliefs?

Is it reasonable for you to try to finish a degree while looking out for your kids? Would I be rational in hoping to get rich and drive a Mercedes E-Class while pursuing a career as a philosophy professor? Should I be worried about aliens abducting my brother?

In this class, we will be studying truth-preservation. (Not like elephant-preservation, but as a property of some inferences.)

Truth-preservation is the feature of the best inferences. When we put together inferences to persuade, we call that making an argument.

It's hard to imagine human social life without persuasion. But it becomes especially important in civil democracy and our collective institutions like science, academics, commercial culture — even possibly, love, friendship, and family?

What are some ways to persuade?

1. We ought, morally, to respect others rational beings as such.¹
2. Respecting rationality means acknowledging that others are capable of reasoning, of thinking.
3. In persuading others, we can fully respect rationality only by presenting reasons inviting others' examination.
4. The only moral way to get people to do or believe things is to present them with such reasons.

In giving an argument, we try to display how selected reasons support our conclusion, and we invite a conversation rather than just asserting our views.

¹See Kantian ethics.

Argument

Arguments are sets of sentences, one of which is the **conclusion** and the rest of which are **premises**.

Typically, the premises are intended to offer a set of reasons intended to support the conclusion. However, that support is not built into the definition. (Think about why.)

But if we want to persuade people — others, or even ourselves — we're not just interested in any arguments. We want *good* arguments, arguments that *work*.

There're lots of reasons why arguments might not succeed. Here are three categories of failure:

1. **Rhetorical reasons** Presenting poorly. Ex.: Didn't say it loud enough, used words that are too big, were too long winded so we got bored, you shouldn't have talked quite so much about your stuffed bunny.
2. **Factual reasons.** Got the facts wrong, false premises.

3. **Logical reasons.** Reasons aren't appropriate ones for the conclusion. They're not premises such that if they *were* true, that truth would be preserved into the conclusion. Put in another way, the argument has bad logical *form*.

So: rhetorical, factual, and logical failures. (Are these all the categories?)

Which kind of failure is exhibited?

1. Hofstra is conveniently located in the Maldives. So, it's near the beach! (*Everywhere* in the Maldives is near a beach.)
2. "Phenomenological truth (disclosedness of being) is *veritas transcendentalis*." (as a premise) – Martin Heidegger
3. She's cool; she met Beyoncé.

The study of logic is ancient, though it has changed enormously.

About the 5th to 3rd centuries BCE: in several places in the world, an interest in *proof*. What *forms* of arguments prove their conclusions?

Awareness of the fact that the form of argument is crucial to its being good is found in a Buddhist work of the third century BCE, Moggaliputta Tissa's Kathā-vatthu.²

²Stanford Encyclopedia of Philosophy "Logic in Classical Indian Philosophy"

The Mohist Canons are a set of brief statements on a variety of philosophical and other topics by anonymous members of the Mohist school, an influential philosophical, social, and religious movement of China's Warring States period (479–221 B.C.). Written and compiled most likely between the late 4th and mid 3rd century B.C.³

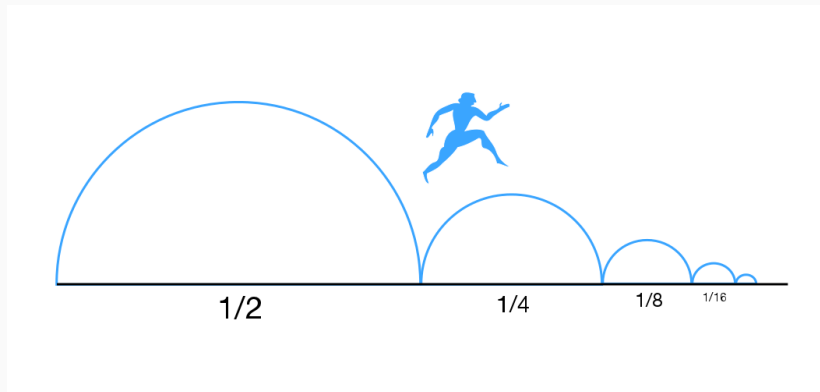
³SEP “Mohist Canons”

“Philosophers” and “sophists” tried to prove things that were not immediately obvious, or which in some cases contradicted what seemed immediately obvious. So, philosophers tried to develop methods of proof that helped support points.

Example: Parmenides (5th C BCE) claimed that reality was a unified and unchanging whole. Others didn't like that. So Zeno of Elea argued that if reality is multiple and in motion, lots of absurd stuff seems true also.

Reductio ad absurdum

Zeno of Elea's paradoxes of motion.



Socrates repeatedly deploys this kind of argument in Plato's works.

⁴CC:BY Martin Grandjean via *Wikimedia Commons*

What was lacking

But none of these developments included *a formal system of proof*. They didn't produce theories of why some proofs work and others don't, of what kinds of proofs are truth-preserving, and what kinds aren't.

Examples:

- recognizing that “Let’s eat Mom” includes an error, but not being able to lay out comma rules.
- knowing that your tires have higher pressure when they’re warm, but not knowing $PV = nRT$;
- knowing that the angles of a particular triangle add up to 180° , but not being sure if that’s true for all triangles, or what rules we would use to prove that.

Aristotle was the first person we know about to have recorded such a set of rules. His, and his followers', primary way of doing this was through listing kinds of legitimate *syllogisms* — a specific kind of argument pattern

examples:

- All A's are B's. Some C is A. Therefore some C is B.
- All A's are B's. All B's Are C's. Therefore all A's are C's. (“Barbara”)

3 features of syllogisms

Syllogism

1. a 3 part if-then statement: if P and Q then R , where P , Q , and R are all statements;
2. the if-then statement is true for the values of all variables involved;
3. P and Q share at least one variable, and R includes the remaining variables.

The statements in syllogisms were permutations of:

- All A 's are B 's.
- No A 's are B 's.
- Some A 's are B 's.
- Some A 's are not B 's.

3 serious limitations of syllogistic logic

1. It deals only very awkwardly with individuals
2. Most arguments have more than 2 premises. []
3. Doesn't handle relations [tastier,funnier]

Logic through the middle ages was largely a matter of listing syllogisms, and thinking about their relationships with one another. And continued on roughly in this vein (with more interesting stuff happening towards the end) until the late 19th century.

German philosopher/logician/mathematician Gottlob Frege launched modern formal logic in his short book *Begriffsschrift* (1879).

Frege developed a system in which all of a certain set of argument forms could be described and related to one another. And moreover shown to be consequences of a few basic, central rules, or “axioms.”

A parallel example of axiomatization

Euclidian geometry

Euclid of Alexandria worked in North Africa around 300 BCE. He established axioms of geometry. (It is possible to describe a circle with any center and any radius.) An axiom system starts with a set of basic assumptions called axioms. It is accompanied by a set of *allowed moves*. If you can deduce a claim from an axiom or set of axioms, using the allowed moves, it's a *theorem*.

Frege developed an axiomatic proof system for logic. Many of the axioms were not his. He put them together in a system. Consider the Law of Non-contradiction for instance, as a potential axiom.

The logical concepts we will study are contained in Frege's system.

However,

- Frege's notation is hard to read, and we will use a different system of notation.
- And Frege's proof system doesn't fit very well the way we ordinarily reason, so we will use a different one that does.

Aside: Frege's developments had a powerful influence on the development of computing.

An argument is a set of two or more sentences, one of which is designated the conclusion and the others, premises.

The relationship among sentences that makes an argument successful is its ability to preserve truth in establishing something new.

Standard form puts the conclusion last, though we don't always do so in English. [Nadal will win the US Open because, of the remaining players, he has the fastest serve (+ tacit premise!)]

- often, a list with a line before the conclusion;
- sometimes, as in *forall* x , the three dots, like this: $\therefore$

TRUTH-VALUE is the property of being either true or false. To have it is to be either one or the other. Having a truth value *does not require* being true!

The sentences in arguments have truth values. Their truth values are T and F.

(But note that there is deep philosophical disagreement about what “truth” is, and also about what kinds of things can have it — sentences? propositions?)