Philosophy 240
Symbolic Logic

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Hamilton College

Fall 2011

Class 1: Arguments; Validity and Soundness
(§1.1 - §1.2)

Business

Syllabus and Course Requirements

- Six exams
- Philosophy Fridays
- Paper assignment
- Course bibliography
- Reference sheet

Textbook: *What Follows*

Course website

Grader = Jess Gutfleish

Peer tutoring is available.

Homework

- Everyone must hand in the first six homework sets.
- After the first test, you are only required to hand in homework if you received lower than 85% on the most recent test.

There will be no make-up tests.

On Grades

Grades on assignments will be posted on Blackboard, along with a running total, which I call your grade calculation. Your grade calculation is a guide for me to use in assigning you a final grade. There are no rules binding how I translate your grade calculation, which will appear in Blackboard as a percentage, into a letter grade. In particular, the Hamilton College key for translating your letter grades into percentages, used for graduate school admissions, is not a tool for calculating your final grade. I welcome further discussion of the purposes and methods of grading, as well as my own grading policies.

Defining ‘Logic’

A: Logic is the study of argument.

B: Arguments are what logic studies.

1. Useless
2. Circularity is a formal result.

- Sheep are the things that shepherds tend.
- Shepherds are things that tend sheep.
- Glubs are extreme cases of woozles.
- Woozles are ordinary forms of glubs.

A Better Definition

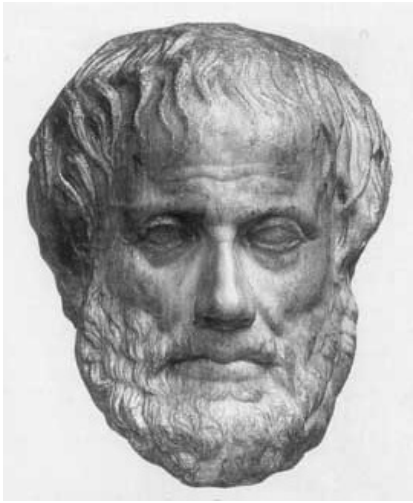
- Logic is the study of argument.
- An argument is a set of statements, called premises, intended to establish a specific claim, called the conclusion.
  - To establish a claim is to justify or provide evidence for it.
  - A ‘proposition’, or a ‘statement’, is a declarative sentence that has a truth value.
  - The truth values are true and false.
- Logic is the study of what follows from what.
  - The rules of reasoning
  - The laws of thought

Inductive and Deductive Reasoning

- Deductive
  Polar bears are carnivorous.
  Polar bears are mammals.
  So, some mammals are carnivorous.
- Inductive
  47 percent of Americans in a recent poll approve of the way the Supreme Court does its job.
  There were 1003 adults polled.
  The margin of error for this poll is ±3 percent.
  So, between 44 and 50 percent of Americans approve of the way the Court does its work.

A Short History of Logic

Aristotle and the Categorical Syllogisms



A. All Fs are Gs.

E. No Fs are Gs.

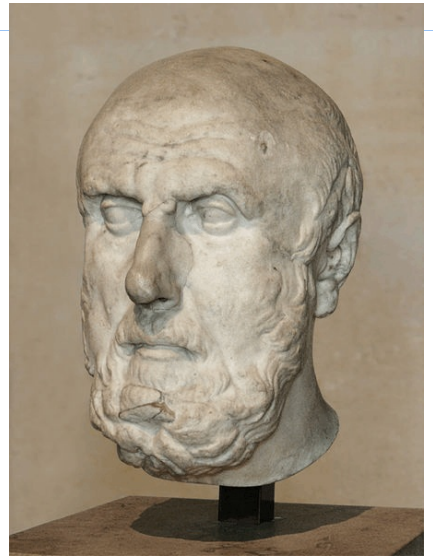
I. Some Fs are Gs.

O. Some Fs are not Gs.

In categorical logic, the fundamental elements are terms, portions of assertions.

We will look at the modern version of term logic, called predicate or quantificational logic, in the second half of the course.

Stoic Logic



- Chrysippus developed a propositional logic, in which the fundamental elements are complete assertions.
- Some assertions are simple, others are complex.
  - The cat is on the mat.
  - If the cat is on the mat then the dog is in the bog.
- Complex assertions are composed of simple assertions combined according to logical rules.
- In the first half of the course, we will look at the rules of propositional logic.

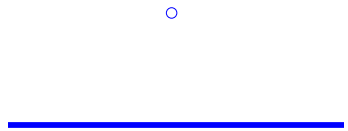
Modern Logic

- Through the middle ages, while there were some major advances in logic, the structure of the discipline was generally stable.
- Kant: “Since Aristotle, [logic] has not required to retrace a single step...To the present day this logic has not been able to advance a single step, and is thus to all appearance a closed and completed body of doctrine.”
- Oops.
- Kant’s logic: how human beings create their experiences by imposing, *a priori*, conceptual categories on an unstructured manifold given in sensation.
- Logic became the description of human psychology, instead of the rules of logical consequence.

Nineteenth Century Developments in Mathematics

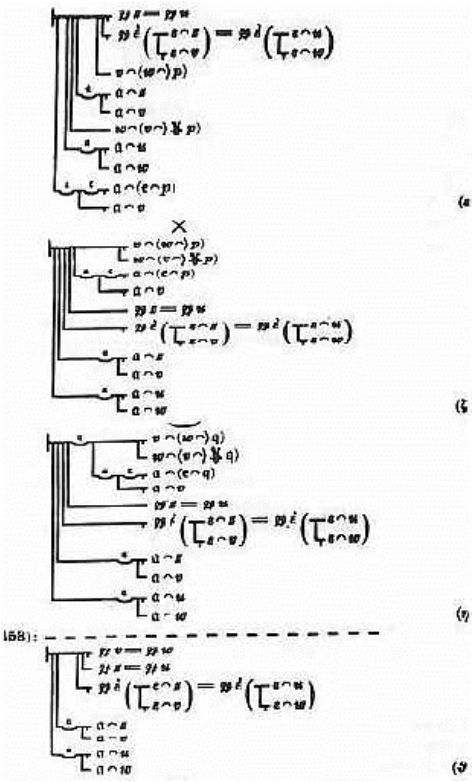
worries about logical entailments

- The calculus of infinitesimals
- Cantor's proof that there are different sizes of infinity
- Non-Euclidean geometries
  - Euclid's parallel postulate (via Playfair's postulate): given a line, and a point outside that line, there is one and only line which passes through the point parallel to the given line.
  - no parallel lines: the geometry of spheres
  - more than one parallel line: hyperbolic geometry
  - Hyperbolic geometry is not only to be consistent, it's the correct geometry for space-time.
- Mathematicians and philosophers began to think more carefully about the notion of logical consequence.



Frege and Peirce

- Frege's *Begriffsschrift*, 1879, subsumed both the term logic of Aristotle and the propositional logic of the stoics.
- Frege's logic extended and refined the rules of logic, generalizing results.
- Peirce, working independently, developed quantification theory.
- Fifty years of intense research in the logical foundations of mathematics and reasoning generally.
- Early 1930s
  - Alfred Tarski's work on truth
  - Kurt Gödel's incompleteness theorems
- Frege's logic, in a neater and more perspicuous notational variant, is the focus of this course.



Let's Get to Work

Separating Premises from Conclusions

- Consider
  - We may conclude that texting while driving is wrong. This may be inferred from the fact that texting is distracting. And driving while distracted is wrong.
- The conclusion is: ‘Texting while driving is wrong.’
- The premises are: ‘Texting is distracting. Driving while distracted is wrong.’
- Note the elimination of indicators.

Conclusion Indicators

- therefore
- we may conclude that
- we may infer that
- entails that
- hence
- thus
- consequently
- so
- it follows that
- implies that
- as a result.

Premise Indicators

- since
- because
- for
- in that
- may be inferred from
- given that
- seeing that
- for the reason that
- inasmuch as
- owing to
- ‘And’ often indicates the presence of an additional premise.

Premise/Conclusion Form

We may conclude that eating meat is wrong. This may be inferred from the fact that we must kill to get meat. And killing is wrong.

P1. Texting is distracting.
P2. Driving while distracted is wrong.
C. Texting while driving is wrong.

- The order of the premises is unimportant.
- The number of premises is unimportant: you may combine or separate premises, at times.
- Sometimes, a sentence may contain both a premise and a conclusion, and so must be divided.
- Enthymemes: arguments with suppressed premises

Are these arguments good?

Argument 1

P1. All philosophers are thinkers.

P2. Socrates is a philosopher.

C. Socrates is a thinker.

Argument 2

P1. All persons are fish.

P2. Barack Obama is a person.

C. Barack Obama is a fish.

Argument 3

P1. All mathematicians are platonists.

P2. Jerrold Katz is a platonist.

C. Jerrold Katz is a mathematician.

Validity and Soundness

- The validity of an argument depends on its form.
- An argument is valid if the conclusion follows logically from the premises.
  - Certain forms are valid.
  - Certain forms are invalid
- The soundness of a valid argument depends on truth of its premises.
- A valid argument is sound if its premises are true.
- Only valid arguments can be sound.
- Validity is independent of truth.
- Validity is related to possibility, while soundness is related to truth.

The Most Important Sentence of This Course

In deductive logic, if the form of an argument is valid and the premises are all true, then the conclusion must be true.

The Form of an Argument

1. Either the stock market will rise or unemployment will go up.
   The market won't rise.
   So, unemployment will increase.
2. You will get either rice or beans.
   You don't get the rice.
   So, you'll have the beans.
3. The square root of two is either rational or irrational.
   It's not rational.
   So, it's irrational.

All three arguments have the same form, called 'Disjunctive Syllogism':
Either p or q
not-p
So, q.

Homework

- Premises and Conclusions
- Valid or Invalid; sound or unsound