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**Philosophy 240**  
***Symbolic Logic***

**Russell Marcus**  
**Hamilton College**  
**Fall 2010**

Class 1: Arguments; Validity and Soundness  
(§1.1, §1.4)

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# Business

## Handouts

- syllabus
- paper assignment
- course bibliography

## Course website

Grader = Megha Hoon, [mhoon@hamilton.edu](mailto:mhoon@hamilton.edu)

Peer tutoring is available.

## Homework

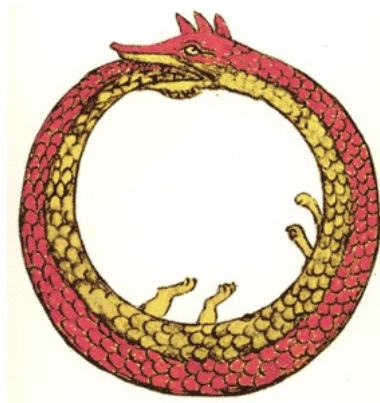
- Everyone must hand in the first six homework sets.
- After the first test, you are only required to hand in homework if you received lower than 85% on the most recent test.

There will be no make-up tests.

# Defining 'Logic'

A: Logic is the study of argument.

B: Arguments are what logic studies.



# Defining 'Logic'

A: Logic is the study of argument.

B': An argument is a set of statements, called premises, intended to establish a specific point, called the conclusion.

- ▶ A 'proposition', or a 'statement', is a declarative sentence that has a truth value.
- ▶ Two truth values: true and false.

Logic is the study of what follows from what.

The rules of reasoning

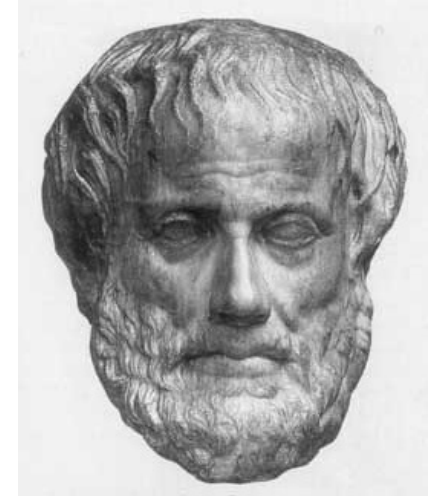
The laws of thought

Question: Is logic descriptive, representing how we actually reason, or is it prescriptive, setting out rules for proper reasoning?

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# **A Short History of Logic**

# Aristotle and the Categorical Syllogisms

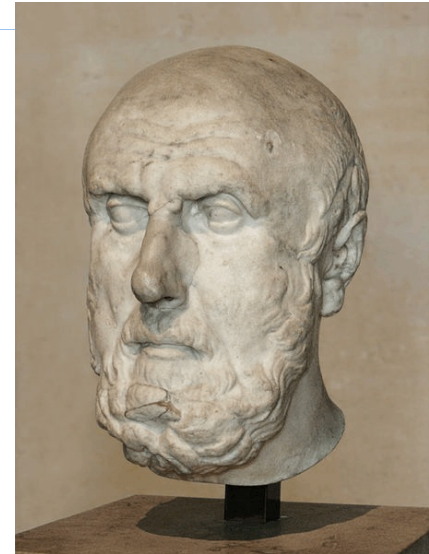


- A. All Fs are Gs.
- E. No Fs are Gs.
- I. Some Fs are Gs.
- O. Some Fs are not Gs.

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.

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# Let's Get to Work

# Separating Premises from Conclusions

- Consider
  - 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.
- The conclusion is: 'Eating meat is wrong.'
- The premises are: 'We must kill to get meat. Killing 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: We must kill to get meat.

P2: Killing is wrong.

C: Eating meat 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

# Exercise

Represent these arguments in premise/conclusion form.

1. The psychological impact and crisis created by the birth of a defective infant is devastating. Not only is the mother denied the normal tension release from the stress of pregnancy, but both parents feel a crushing blow to their dignity, self-esteem, and self-confidence. In a very short time, they feel grief for the loss of the normal, expected child, anger at fate, numbness, disgust, waves of helplessness and disbelief.
2. Neither a borrower nor a lender be,  
For loan oft loses both itself and friend,  
And borrowing dulls the edge of husbandry.
3. If a piece of information is not "job relevant," then the employer is not entitled qua employer to know it. Consequently, since sexual practices, political beliefs, associational activities, etc., are not part of the descriptions of most jobs, that is, since they do not directly affect one's job performance, they are not legitimate information for an employer to know in the determination of the hiring of a job applicant.



# Are these arguments good?

1. All persons are mortal.

Socrates is a person.

∴ Socrates is mortal.

2. All men are fish.

Joe is a man.

∴ Joe is a fish.

3. All Toyotas are cars.

I own a car.

∴ I own a Toyota.

# 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.



# Exercises

Valid? Sound?

1. If it snows more than two feet, there will be no classes at Hamilton. It snowed more than two feet last Monday. Therefore, there were no classes at Hamilton.
2. The Mets are a professional baseball team. Professional baseball teams are sports businesses. So, the Mets are a sports business.
3. If police departments improve their effectiveness, crime rates go down. Crime rates have gone down. So, police departments have improved their effectiveness.
4. Since the sun is pink, and made of cheese, it follows that some cheese is pink.
5. Some cars are green. Some cars are Toyotas. So, some cars are green Toyotas.
6. All great singers have strong voices. Celine Dion does not have a strong voice. So Celine Dion is not a great singer.