Introduction to Logic

What is logic?

- Logic is the systematic study of *logical consequence*
- In other words: what *follows from* what, what *entails* or *implies* what.

Why care about logic?

- One reason: understanding what follows from what is of great importance to the universal human activity of *reasoning*, trying to figure out what to believe in a reasonable manner.
  - If I believe that P, and I understand that Q follows from P, then I should believe Q, or else give up my belief that P.
- It's also of great importance to those who want to persuade others, and to resist being persuaded by them.

Arguments

- 'An *argument* is any series of statements in which one (called the *conclusion*) is meant to follow from, or be supported by, the others (called the *premises*)' (B&E, 41)
- If the conclusion really does follow from the premises, we say that the argument is *valid* (a.k.a. '*deductively valid*', '*logically valid*'.)

- Not all invalid arguments are bad arguments: the premises might *support* the conclusion even if they don't *entail* it.
- Example: 'The murderer was a one-armed man with a grudge against the victim; Jones was a one-armed man with a grudge against the victim; therefore, Jones was the murderer.'

- We'll sometimes use "Fitch format" for presenting arguments, thus:

  All healthy dogs are active dogs.

  Fido is an active dog.

  Fido is a healthy dog.

What is it for an argument to be valid?

- The conclusion follows from, or is entailed by, or is a (logical) consequence of, its premises.
- *If* the premises are all true, the conclusion *must* be true too.
- The premises can't all be true without the conclusion being true too.

Soundness

- Definition: A *sound* argument is a valid argument, all of whose premises are true.
  - Could there be a sound argument with a false conclusion?
  - Could there be an unsound argument with a true conclusion?
  - Could there be an unsound but valid argument with a true conclusion?

Which of these arguments are valid?

1. All dogs have fleas. Lassie is a dog. Therefore, Lassie has fleas.
2. Donald Trump is a bachelor. Therefore, Donald Trump is unmarried.
3. The Atlantic Ocean contains water. Therefore, the Atlantic Ocean contains hydrogen.

- 1 and 2 are valid. The status of 3 is doubtful: it depends on what we mean by 'valid', 'follows from', 'must', etc.

- What we're concerned with in logic is validity *insofar as it is explained by grammatical structure together with the meanings of certain words* (the 'logical vocabulary')
- In this course, we'll be primarily concerned with words like 'and', 'or', 'not', 'if...then', 'some', and 'all', and grammatical structures involving them.
- Given this restricted focus, it doesn't matter whether we understand 'valid' in such a way that argument 3 counts as valid. The only argument whose validity is explained by the meanings of the words on our list is 1.

- Terminological note: people sometimes use ‘logically valid’ to mean ‘valid in virtue of grammatical structure and the meanings of logical words’ (and similarly for ‘logical consequence’ and so forth.) But that’s not how B&E use the expression.
  - When I want to talk about this notion, I’ll speak of an argument being logically valid *in the restricted sense*.

Why is this restricted notion interesting?

- You've got to start somewhere...
- The process of determining the validity of an argument involving complicated sentences with multiple occurrences of 'and', 'or', etc., can be quite complex, even once you have mastered the basic principles.
  - That's why you'll have to acquire some special new skills, and why this course satisfies your math requirement.

- Consider argument (2) again: 'Donald Trump is a bachelor, therefore Donald Trump is unmarried'.
- It seems we can *define* 'bachelor' as 'unmarried man'. Given this definition, the argument is equivalent to 'Donald Trump is an unmarried man, therefore Donald Trump is unmarried'.
- Perhaps all valid arguments can be reduced, via "definitions", to arguments that are valid in the restricted sense.