Introduction to Logic

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Philosophy is difficult. If questions are easy to decide, they usually don’t end up in philosophy.

The easiest way to proceed on difficult questions is to formulate and evaluate various arguments.

Logic is the study of arguments.

An argument is a set of sentences, one of which is trying to be proven. The sentence to be proven is called the conclusion.

The claims in an argument which are not the conclusion are called premises.
Once you have a set of a set of sentences in which premises try to establish a conclusion, you have an argument. Then what?

In philosophy, we are not just concerned with arguments, but with good arguments.

What makes an argument good or bad? Consider the following:

(1) Notre Dame is in Indiana
(2) Indiana is in the midwest
(C) Notre Dame is good at football.
What is Logic?

Important Forms

Making Arguments Explicit

(1) Notre Dame is in Indiana
(2) Indiana is in the midwest
(C) Notre Dame is good at football.

Why is this a bad argument?

(1) is true. (2) is true. (C) is true...usually. So what is the problem?

The issue is not with one of the statements, but with how the argument moves from the premises to the conclusion. The premises have nothing to do with whether or not the conclusion is true. Some years, sadly, both premises are true and the conclusion is false.

If an argument is such that all its premises could be true and its conclusion false we call it invalid.

Conversely, if it is impossible for all the premises of an argument to be true and the conclusion false (i.e. the premises guarantee the conclusion) we call it valid.
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

(1) Tom Brady plays for the Patriots.
(2) The Patriots are all cheaters.
(C) Tom Brady is a cheater. **Valid**

(1) Russell Wilson doesn’t play for the Patriots.
(2) The Patriots are all cheaters.
(C) Russell Wilson isn’t a cheater. **Invalid**
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

(1) If Frodo destroys the ring Sauron will die.
(2) Sauron died.
(C) Frodo destroyed the ring. **Invalid**

(1) If Harry blows up the Death Star, Sauron will die.
(2) Harry blew up the Death Star.
(C) Sauron died. **Valid**
An argument is valid if and only if it is impossible for the premises to be true and the conclusion false.

- Logic is concerned entirely with the reasoning of arguments. This means logicians only evaluate validity and invalidity.
- As philosophers, there are more ways we can evaluate arguments, but we should always start with evaluating validity.
- One other thing we are concerned with is whether or not the premises are true.
- However, it does us no good to merely know the truth of the premises and conclusion. Consider:
  (1) The sun is bigger than the moon. True
  (2) Milk comes from cows. True
  (C) Tigers are carnivorous. True
- Is this argument helpful in any way?
- Why not?
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

- We only care about the truth of the premises if we already know that the argument is valid.
- If an argument is valid and its premises are true, then we call the argument **sound**.
- Notice that a sound argument will **always** have a true conclusion. This is precisely why sound arguments are useful.
Examples

An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

(1) Tom Brady plays for the Patriots.  True
(2) The Patriots are all cheaters.  False
(C) Tom Brady is a cheater.  Valid Unsound

(1) Russell Wilson doesn’t play for the Patriots.
(2) The Patriots are all cheaters.
(C) Russell Wilson isn’t a cheater.  Invalid Unsound
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

(1) Everett Golson plays for Florida State. True
(2) No Florida State player plays for Notre Dame. True
(C) Everett Golson does not play for Notre Dame. True

Valid Sound

(1) Notre Dame plays Georgia Tech this year. True
(2) Georgia Tech is in the Big 12. False
(C) Notre Dame plays a team in the Big 12 this year.

Valid True Unsound
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

- There are many other ways one could evaluate an argument. The last one we will look at is a bit subjective, but still can be important for certain purposes.
- Consider the following argument:

  (1) If atheists’ belief that there is no God is true, then there is no God. **True**

  (2) Atheists’ belief that there is no God is true. **Maybe**

  (C) There is no God.

  **Valid Sound?**

  - Suppose this is a sound argument; is it then a *good* argument? Why might someone be unsatisfied with it?
  - Let us call an argument **informative** if and only if the premises
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

An argument is **informative** if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

1. All men are mortal.
2. Socrates is a man.
3. Socrates is mortal.

<table>
<thead>
<tr>
<th>(1)</th>
<th>All men are mortal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>Socrates is a man.</td>
</tr>
<tr>
<td>(3)</td>
<td>Socrates is mortal.</td>
</tr>
</tbody>
</table>

**Valid Sound Informative**
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

An argument is **informative** if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

(1) Everyone who shows up to class gets an A.

(2) Johnny got an A.

(C) Johnny showed up to class.

**Invalid Unsound**
Examples

An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

An argument is **informative** if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

(1) Some Students have false beliefs.

(2) I am a student who has false beliefs.

(C) I have false beliefs.

<table>
<thead>
<tr>
<th>Valid</th>
<th>Sound</th>
<th>Uninformative</th>
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Introduction to Logic
What is Logic?

Important Forms

Making Arguments Explicit

Examples

An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

An argument is **informative** if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

(1) Snow is white.

(2) Snow is cold.

(C) Today is Tuesday.

Invalid
What is Logic?

Important Forms
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Examples

An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

An argument is **informative** if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

(1) All men are mortal.

(C) All men are mortal.

Valid Sound Uninformative
Examples

An argument is valid if and only if it is impossible for the premises to be true and the conclusion false.

An argument is sound if and only if it is valid and the premises are true.

An argument is informative if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

(1) All gingers have souls.
(2) Some students are not gingers.
(C) Some students do not have souls.

Invalid
An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

An argument is **informative** if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

1. No one should judge someone who is a part of a different culture.
   - Valid

2. None of us was a part of Nazi culture.
   - Valid

3. None of us should judge the Nazis.
   - Unsound
Examples

An argument is **valid** if and only if it is impossible for the premises to be true and the conclusion false.

An argument is **sound** if and only if it is valid and the premises are true.

An argument is **informative** if and only if its premises are more plausible than its conclusion.

Evaluate the following for validity, soundness, and informativeness. If it is invalid, show that it is invalid:

1. If a student plagiarizes a paper, they will get a 0 on that paper.
2. Last semester a student plagiarized a paper.
3. Last semester a student got a 0 on a paper.

   Valid  Sound  Informative
 Certain types of argument recur often enough that they deserve special attention. The ones we will focus on for this class are those involving if-then statements.

If-then statements occur often in philosophy both because they can be used to express causal or other connections, and because they are connected with/can be supplied by necessary and sufficient conditions, which we have seen can be used to analyze concepts.

- If $P$ then $Q = P \implies Q$
- $P$ only if $Q$ (If $Q$ then $P$) = $P \iff Q$
- $P$ iff $Q = P$ is necessary and sufficient for $Q = P \iff Q$
The 4 forms

- There are 4 and only 4 ways one can argue using an if-then statement.

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Deny</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) If P then Q</td>
<td>(1) If P then Q</td>
</tr>
<tr>
<td>(2) P</td>
<td>(2) Not P</td>
</tr>
<tr>
<td>(C) Q</td>
<td>(C) Not Q</td>
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<tr>
<td><strong>Modus Ponens</strong></td>
<td><strong>Denying the Antecedent</strong></td>
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<table>
<thead>
<tr>
<th>Consequent</th>
<th>Affirm</th>
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<td>(1) If P then Q</td>
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<tr>
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<td>(C) Not P</td>
</tr>
<tr>
<td><strong>Affirming the Consequent</strong></td>
<td><strong>Modus Tollens</strong></td>
</tr>
</tbody>
</table>
Is the following argument Modus Ponens, Modus Tollens, Affirming the Consequent, or Denying the Antecedent? Is it valid?

(1) If Notre Dame goes undefeated, they will win the playoffs.
(2) Notre Dame will go undefeated.
(C) Notre Dame will win the playoffs.

**Modus Ponens**

(1) If it rains, the sidewalks will be wet.
(2) It did not rain.
(C) The sidewalks are not wet.

**Denying the Antecedent**
Examples

Is the following argument Modus Ponens, Modus Tollens, Affirming the Consequent, or Denying the Antecedent? Is it valid?

(1) If a student goes to Notre Dame, then they are Catholic.
(2) Pope Francis does not go to Notre Dame.
(C) Pope Francis is not Catholic.

Denying the Antecedent

(1) If the government tracks where you are, they are invading your privacy.
(2) The government is invading your privacy.
(C) The government tracks where you are.

Affirming the Consequent
Examples

Is the following argument Modus Ponens, Modus Tollens, Affirming the Consequent, or Denying the Antecedent? Is it valid?

(1) If something is a table, then it has a flat surface.
(2) The chair does not have a flat surface.
(C) The chair is not a table.
   Modus Tollens

(1) If this argument is not Modus Ponens, then it is Modus Tollens.
(2) This argument is not Modus Tollens.
(C) This argument is Modus Ponens.
   Modus Tollens
Outside of a philosophy classroom you will rarely encounter arguments in explicit premise-conclusion form. Instead, you are much more likely to come across them as paragraphs following no rigorous structure. So why do philosophers bother to state them in this way?

**CLARITY!**—when arguments are stated in premise-conclusion form it is much easier to evaluate whether or not they are valid.

Furthermore, if an argument is valid but rests on a false assumption, it is much easier to point out the false assumption if one can point to an explicit premise which is false.
When turning paragraphs into explicit arguments there are a few things to keep in mind:

- Figure out what is actually being argued—the conclusion isn’t always the last sentence of the paragraph
- Eliminate unnecessary information—Paragraphs will often include other information not relevant to the argument at hand
- Simplify the premises as much as possible
- Try to make arguments valid; be as charitable as possible when interpreting people.
- If there is an assumption that is needed to make an argument valid fill it in, but mark it as something you added.
Turn the following argument into explicit premise-conclusion form:

Every person has a right to life. So the fetus has a right to life. Not doubt the mother has a right to decide what shall happen in and to her body; everyone would grant that. But surely a person’s right to life is stronger and more stringent than the mother’s right to decide what happens in and to her body, and so outweighs it. So the fetus may not be killed; an abortion may not be performed.
Turn the following argument into explicit premise-conclusion form:

The development of a human being from conception through birth into childhood is continuous; to draw a line, to choose a point in this development and say “before this point the thing is not a person, after this point it is a person” is to make an arbitrary choice, a choice for which in the nature of things no good reason can be given. Therefore, the fetus is, or should be treated like, a person from the moment of conception.