

# INTRODUCTION TO LOGIC

## A. Basic Concepts

1. **Logic** is the science of the correctness or incorrectness of reasoning, or the study of the evaluation of arguments.
2. A **statement** is a declarative sentence, or part of a sentence, that can be true or false.

How many statements are there in this example?

*The Winter Olympics are in Italy this year, but four years from now they will be in Vancouver, Canada.*

3. A **proposition** is what is meant by a statement  
(the idea or notion it expresses)  
(this might be the same for different sentences)

## A. Basic Concepts

4. An **argument** is a collection of statements or propositions, some of which are intended to provide support or evidence in favor of one of the others.
5. **Premises** are those statements or propositions in an argument that are intended to provide the support or evidence.
6. The **conclusion** is that statement or proposition for which the premises are intended to provide support.

(In short, it is the point the argument is trying to make.)

*(Important note: premises are always intended to provide support or evidence for the conclusion, but they don't always succeed. It's still an argument either way.)*

## B. Some Example Arguments

- P1. If Bush lied to Congress, then Bush should be impeached.
- P2. Bush lied to Congress.
- C. Therefore, Bush should be impeached.

- P1. If everything it says in the Bible is true, then the world was created in six days.
- P2. The world was not created in six days.
- C. Therefore, not everything it says in the Bible is true.

## B. Some Example Arguments

- P1. All toasters are items made out of Gold.
- P2. All items made out of Gold are time travel devices.
- C. Therefore, all toasters are time travel devices.

- P1. Every wizard uses a wand.
- P2. Dumbledore uses a wand.
- C. Therefore, Dumbledore is a wizard.

## B. Some Example Arguments

- P1. If Hillary Clinton is a communist spy, then she supports socialized health care.
- P2. Hillary Clinton supports socialized health care.
- C. Therefore, Hillary Clinton is a communist spy.

- P1. I live in Massachusetts.
- C. Therefore, 11 is a prime number.

- P1. George W. Bush is a Republican.
- C. Therefore, George W. Bush opposes abortion.

## C. What Makes an Argument a Good One?

1. By definition, an argument is **deductively valid** if and only if the form of the argument makes it impossible for the conclusion to be false if the premises are true.
2. By definition, an argument is **factually correct** if and only if all its premises are true.
3. To be a good argument, an argument needs to be *both* valid and factually correct.

By definition, an argument is **sound** if and only if it is both deductively valid and factually correct.

## C. What Makes an Argument a Good One?

4. In other words, two things are required of a good argument:

- (i) its premises have to be true (factually correct),
- (ii) the premises have to provide support for the conclusion (valid).

5. Notice that an argument can be valid without being factually correct, or be factually correct without being valid.

6. Notice that an argument may be invalid or not factually correct and still have a true conclusion.

## D. Argument Form

1. Whether or not an argument is valid depends on its form; its form can be represented in a schematic way

2. Some common valid forms:

Modus ponens (MP):

If P then Q.

P

Therefore, Q.

Modus tollens (MT):

If P then Q.

not Q.

Therefore, not P.

Multiple modus ponens (MMP):

If P then Q.

If Q then R.

P.

Therefore, R.

## B. Some Example Arguments

- P1. If Bush lied to Congress, then Bush should be impeached.  
P2. Bush lied to Congress.  
C. Therefore, Bush should be impeached.

(modus ponens)

- P1. If everything it says in the Bible is true, then the world was created in six days.  
P2. The world was not created in six days.  
C. Therefore, not everything it says in the Bible is true.

(modus tollens)

## D. Argument Form

Common valid forms, continued.

### Multiple modus tollens (MMT):

If P then Q.  
If Q then R.  
not R.  
Therefore, not P.

### Disjunctive syllogism (DS):

Either P or Q.  
not P.  
Therefore, Q.

### Hypothetical syllogism (HS):

If P then Q.  
If Q then R.  
Therefore, if P then R.

### Constructive dilemma (CD):

Either P or Q.  
If P then R.  
If Q then R.  
Therefore, R.

## D. Argument Form

3. Here are some common invalid forms.

If P then Q.

Q.

Therefore, P.

If P then Q.

not P.

Therefore, not Q.

P1. If Hillary Clinton is a communist spy, then she supports socialized health care.

P2. Hillary Clinton supports socialized health care.

C. Therefore, Hillary Clinton is a communist spy.

P1. If Jerry Garcia jumped off the Eiffel tower, then Jerry Garcia is dead.

P2. Jerry Garcia did not jump off the Eiffel tower.

C. Therefore, Jerry Garcia is not dead.

## E. Evaluating Arguments

1. There are all sorts of ways of evaluating an argument:

Is it well-written?

Is it sensitive to its audience?

Was it made to the appropriate people at the appropriate time?

Is it relevant for the issue under discussion?

2. However, to evaluate it **logically**, there are only two things to ask:

a) Does the argument have a valid form?

b) Are the premises true?

3. If the answers to both questions are "yes", the argument is sound, and if the argument is sound, its conclusion is true.

## E. Evaluating Arguments

4. If you think the conclusion of a given argument is false, you must show that the argument is either invalid, or find a premise of the argument that is false.

P1. All acts of killing humans are morally wrong.

P2. If all acts of killing humans are morally wrong,  
then abortion is always morally wrong.

C. Therefore, abortion is always morally wrong.

This argument has a valid form (*modus ponens*). So either one of its premises is false, or its conclusion is true.

## E. Evaluating Arguments

5. What can you conclude about an argument's conclusion if the argument is unsound?

a) Answer: not much.

b) An unsound argument can still have a true conclusion.

Here are some examples:

P1. All hamsters are refrigerators.

P2. All refrigerators are mammals.

C. All hamsters are mammals.

## E. Evaluating Arguments

P1. Lindsay Lohan starred in *The Parent Trap* at age 11.

P2. Every recursively axiomatizable first-order deductive calculus for natural number theory in which all recursive functions are representable includes infinitely many sentences that are neither theorems nor negations of theorems.

C. Therefore, the Steelers won the last superbowl.

What about the abortion example from a few slides ago?

## E. Evaluating Arguments

What about:

P1. If God exists, then God created everything in the universe.

P2. If God created everything in the universe then everything in the universe is good.

P3. If everything in the universe is good, then unnecessary pain and suffering does not exist.

P4. Unnecessary pain and suffering does exist.

C. Therefore, God does not exist.

Be clear whether you're claiming that an argument is no good, or that its conclusion is false.



# THE PURPOSES OF LOGICAL RIGOR

A. Why are we so obsessed with logic?

Isn't ethics a highly personal thing that deals with issues that touch our lives every day?

It would be silly, distracting and probably distorting to apply such rigorous evaluation techniques to other everyday activities like deciding what to wear or where to eat.

Applying it to one's love life would likely make a love life impossible.

Why here?

# THE PURPOSES OF LOGICAL RIGOR

B. The answer is:

1. Most of the issues we'll be discussing are controversial.

So we need to figure out *why* we disagree when we do.

2. Many of us have attitudes about ethical issues that we may not realize are inconsistent or incongruous with each other.

The reason we have not realized this is that we haven't paid enough attention to the logical relationships between our beliefs.

## THE PURPOSES OF LOGICAL RIGOR

C. Here's how logical rigor can help. An example.  
Suppose I am pro-life and someone asks me why I think  
abortion is morally wrong, and I answer:

- P1. All acts of killing humans are morally wrong.
- P2. If all acts of killing humans are morally wrong,  
then abortion is always morally wrong.
- C. Therefore, abortion is always morally wrong.

I can then consider the consequences of each premise.

Maybe P1 is inconsistent with other beliefs I have, such as  
about the death penalty.

## THE PURPOSES OF LOGICAL RIGOR

I might then refine my argument:

- P1. All acts of killing innocent humans are morally wrong.
- P2. If all acts of innocent killing humans are morally  
wrong, then abortion is always morally wrong.
- C. Therefore, abortion is always morally wrong.

This second argument may better reflect what I "really"  
believed all along.

Once you have it in the new form, you can apply the same  
process.

# EXTRACTING ARGUMENTS

## A. What is Argument Extraction?

1. I've been giving you arguments in a fixed format, using "P1.", "P2.", "P3.", etc., and the conclusion listed as "C."
2. In actual writings, authors are not as explicit about the logical structure of their arguments.
  - retorical elements may be mixed in
  - obvious premises may be unstated
  - an obvious conclusion may be taken for granted
3. To evaluate an argument, it is best to "reconstruct" it in a form that's easier to evaluate

## B. Step one: Identifying the Conclusion

What's the conclusion in this example?

Hint: it isn't always the last sentence.

In most presidential elections in the United States, more than half the states are ignored; voters who don't live in so-called swing states are in effect bystanders in these quadrennial events. An Amendment to the U.S. Constitution should replace the archaic electoral vote system with a direct vote. Only in this manner will citizens in all 50 states be able to take part fully in selecting our nation's leaders. (Lawrence R. Foster, "End of the Electoral College," *The New York Times*, 27 September 2000)

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Answer: it's the sentence in the middle.

## B. Step one: Identifying the Conclusion

Sometimes the conclusion may be left implicit, or stated in the form of a question.

It is in the national interest to have an educated populace. On average, college graduates earn almost twice the annual salary of high-school graduates. The cost of the nation's investment in the education of student borrowers is recouped many times over through the increased productivity and greater earnings. By making college education possible for millions of Americans, federally sponsored student loans produce a tremendous return for the U.S. Treasury and students, whose incomes—and tax payments—are greatly increased with their college degrees. ... Why shouldn't Washington have a bigger share of the student loan industry? (Richard W. Riley, *Insight*, 29 April 1996, slightly modified)

Although the conclusion here is stated as a question, it is clear that the author means to argue that Washington *should* have a bigger share of the student loan industry.

## B. Step one: Identifying the Conclusion

Here's another example:

It seems obvious to me that scientists in the future will never find a way to signal back in time. If they were to do so, wouldn't we have heard from them by now? (Ken Grunstra, "Reaching Back in Time," *The New York Times*, 6 June 2000)

What's the conclusion?

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What's the conclusion?

The conclusion is that scientists will never in the future find a way to signal back in time. (The part about it being obvious to him isn't really the main issue.)

### C. Step two: Identifying the Premises and the Form of the Argument

Let us stick with our previous example:

It seems obvious to me that scientists in the future will never find a way to signal back in time. If they were to do so, wouldn't we have heard from them by now? (Ken Grunstra, "Reaching Back in Time," *The New York Times*, 6 June 2000)

What are the premises? Again, we have a question in rhetorical form.

One of the premises is "if scientists will find a way to signal back in time in the future, we would have heard from them by now".

Is that the only premise?

### C. Step two: Identifying the Premises and the Form of the Argument

No, another premise is *taken for granted* as obvious. It is "We have not heard back from scientists by now."

P1. If scientists will find a way to signal back in time in the future, we would have heard from them by now.

P2. We have not heard back from scientists by now.

C. Scientists will not find a way to signal back in time in the future.

(This is a *modus tollens* argument.)

## C. Step two: Identifying the Premises and the Form of the Argument

Another example:

Married people are healthier and more economically stable than single people, and children of married people do better on a variety of indicators. There ought to be some way of spreading the principle of support for marriage throughout the tax code. (Anya Bernstein, "Marriage, Fairness and Taxes," *The New York Times*, 15 February 2000)

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Another example:

Married people are healthier and more economically stable than single people, and children of married people do better on a variety of indicators. There ought to be some way of spreading the principle of support for marriage throughout the tax code. (Anya Bernstein, "Marriage, Fairness and Taxes," *The New York Times*, 15 February 2000)

The conclusion is the last sentence (in yellow).

The first sentence is a premise. The question is, is it the only premise? Let us suppose that it is.

## C. Step two: Identifying the Premises and the Form of the Argument

The argument would then be:

P1. Married people are healthier and more economically stable than single people and children of married people do better on a variety of indicators.

C. There ought to be some way of spreading the principle of support for marriage throughout the tax code.

The form of this argument is:

P and Q

Therefore, R.

This is obviously invalid. But is this really *that bad* of an argument? No, it doesn't seem to be.

## C. Step two: Identifying the Premises and the Form of the Argument

If we insert the right premise, we can make it valid.

P1. Married people are healthier and more economically stable than single people and children of married people do better on a variety of indicators.

P2. If married people are healthier and more economically stable than single people and children of married people do better on economic indicators, then there ought to be some way of spreading the principle of support for marriage throughout the tax code.

C. There ought to be some way of spreading the principle of support for marriage throughout the tax code.



## C. Step two: Identifying the Premises and the Form of the Argument

The argument now has the form:

P and Q  
If P and Q then R.  
Therefore, R.

This is a *valid* argument form.

The argument might not be *sound*: the added premise can be questioned.

But at least we're no longer wrongly accusing the author of an obvious *logical* blunder.

## D. Employing the Principle of Charity

1. Being *charitable* in philosophy means:

- \* attempting to state positions or arguments or views in the best possible way  
(especially those with which you disagree)
- \* making sure not to dismiss a contrary position without considering it in its best possible form
- \* never reconstructing an argument in a way that distorts the author's intent
- \* never reconstructing an argument in a way that makes a position easier to refute than it is

## D. Employing the Principle of Charity

2. Suppose someone is protesting outside an abortion clinic, and shouts, "Abortion kills a human being, therefore it is wrong."

How should we reconstruct the argument? At least, we need to add the missing premise:

- P1. Abortion is an act that kills a human being.
- P2. If abortion is an act that kills a human being, then abortion is morally wrong.
- C. Therefore, abortion is morally wrong.

Even so, it is not clear that the protester has anything so simple in mind.

## D. Employing the Principle of Charity

Instead, we might attribute to the protester the slightly more sophisticated version:

- P1. Abortion is an act that kills an *innocent* human being.
- P2. If abortion is an act that kills an *innocent* human being, then abortion is morally wrong.
- C. Therefore, abortion is morally wrong.

Yet even this is a pretty flimsy argument.

## D. Employing the Principle of Charity

3. It is possible to improve upon this argument?

Ask yourself this even if you reject the conclusion

When possible, you should simply *ask* the person about exactly what he/she means.

But often this is not possible, or the person may not be very good at expressing him/herself.

It's *up to you* to think about the best possible form a line of argument could take.

Then and only then can you safely reject it.

## D. Employing the Principle of Charity

4. The principle of charity means we should *always* reconstruct an argument in a logically valid form.

Remember that an invalid argument can always be made valid by adding the right premise.

Do this even when the argument *appears* invalid.

## D. Employing the Principle of Charity

An example from a well known philosopher:

Total pacifism might be a good principle if everyone were to follow it. But not everyone does, so it isn't.  
(Gilbert Harman, *The Nature of Morality*)

Taken literally, this seems to have this form:

- P1. If everyone follows total pacifism, then total pacifism would be a good principle.
- P2. Not everyone follows total pacifism.
- C. Total pacifism is not a good principle.

This argument form is invalid. In fact, it is one of the invalid forms I gave as an example last week.

## D. Employing the Principle of Charity

But it's probably not what he really meant.

He probably meant instead something like:

- P1. Total pacifism is a good principle if *and only if* everyone follows total pacifism.
- P2. Not everyone follows total pacifism.
- C. Total pacifism is not a good principle.

This form is valid. You can think for yourself about whether or not it's sound.

## E. Fallacies to Avoid

These recommendations apply when reconstructing arguments, giving your own arguments, and evaluating the arguments of others.

1. *Strawman Fallacy*: Oversimplifying or distorting the position, argument or belief of someone else in a way that makes it easier to argue against.

*Exaggerated Example*: President Bush is opposed to stem cell research. He must think that if we succeed in cloning human beings, an army of clone soldiers will be created that will overrun the planet. But this is science fiction, not reality. Hence, stem cell research is perfectly OK.

## E. Fallacies to Avoid

2. *Begging the Question*: An argument *begs the question* when it makes use of a premise that no one who didn't already accept the conclusion would believe.

Simply put, an argument *begs the question* when it reasons in a circle or presupposes the truth of the very thing it's trying to prove.

*Exaggerated Example*: God exists, because it says that God exists in the Bible, and everything in the Bible is the true word of God.

## E. Fallacies to Avoid

3. *The Appeal to Ignorance Fallacy*: Concluding something is true simply because it hasn't been proven to be false ...or..  
Concluding something is false just because it hasn't been proven to be true.

Reasoning in such a way is invalid. Something can be true even if no one has succeeded in showing it to be true.

*Exaggerated Example*: No one has even proven that there is life after death. Therefore, there is no life after death.

## E. Fallacies to Avoid

4. *The "Ad Hominem" Fallacy*: Rejecting a position or argument not in virtue of its logical merits, but rather in virtue of the character, personality, background or motivation of the person giving it.

A position can be true, and an argument can be sound, no matter how deplorable the person giving it is.

*Who* holds a belief usually has nothing to do with its truth.

*Exaggerated Example*: Former president Clinton has argued in favor of increasing restrictions on the sale of guns. But President Clinton is a lecherous, adulterous, untrustworthy, draft-dodging old pervert, so his views must surely be misguided.

## E. Fallacies to Avoid

What I call the “who’s to say” fallacy is an instance of *ad hominem* reasoning.

E.g.: “Kant argued that suicide is morally wrong because no one could will it to be a universal law. However, who is Kant to say what people can or cannot will to be a universal law?”