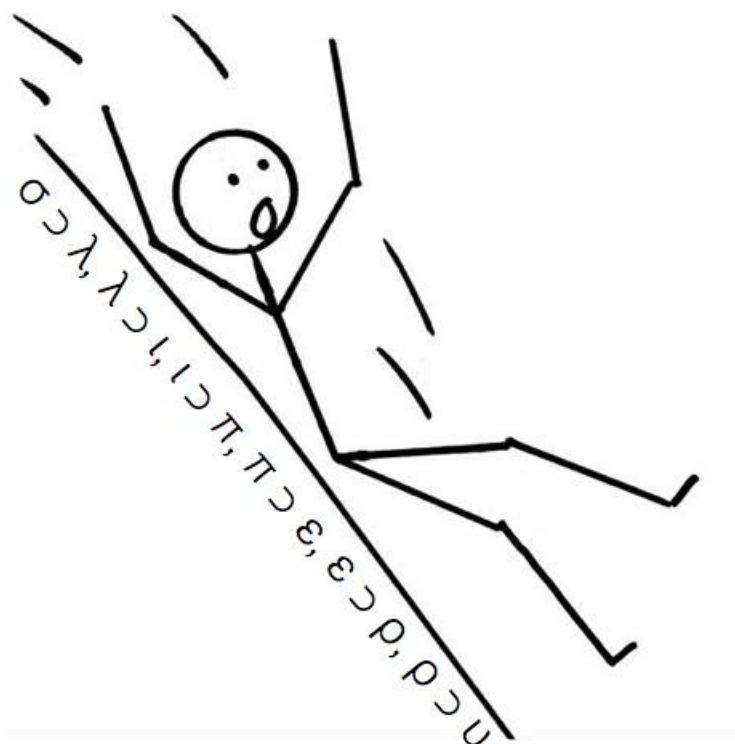


# Introduction to Logic and Critical Thinking

Version 1.4



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### 1.1 What is an argument?

This is an introductory textbook in logic and critical thinking. Both logic and critical thinking centrally involve the analysis and assessment of arguments. “Argument” is a word that has multiple distinct meanings, so it is important to be clear from the start about the sense of the word that is relevant to the study of logic. In one sense of the word, an argument is a heated exchange of differing views as in the following:

Sally: Abortion is morally wrong and those who think otherwise are seeking to justify murder!

Bob: Abortion is not morally wrong and those who think so are right-wing bigots who are seeking to impose their narrow-minded views on all the rest of us!

Sally and Bob are *having an argument* in this exchange. That is, they are each expressing conflicting views in a heated manner. However, that is not the sense of “argument” with which logic is concerned. Logic concerns a different sense of the word “argument.” An argument, in this sense, is *a reason for thinking that a statement, claim or idea is true*. For example:

Sally: Abortion is morally wrong because it is wrong to take the life of an innocent human being, and a fetus is an innocent human being.

In this example Sally has given an argument against the moral permissibility of abortion. That is, she has given us a reason for thinking that abortion is morally wrong. The **conclusion** of the argument is the first four words, “abortion is morally wrong.” But whereas in the first example Sally was simply asserting *that* abortion is wrong (and then trying to put down those who support it), in this example she is offering a reason for *why* abortion is wrong.

We can (and should) be more precise about our definition of an argument. But before we can do that, we need to introduce some further terminology that we will use in our definition. As I’ve already noted, the conclusion of Sally’s argument is that abortion is morally wrong. But the reason for thinking the conclusion is true is what we call the **premise**. So we have two parts of an argument: the premise and the conclusion. Typically, a conclusion will be supported by two or more premises. Both premises and conclusions are statements. A **statement** is a type of sentence that can be true or false and

corresponds to the grammatical category of a “declarative sentence.” For example, the sentence,

The Nile is a river in northeastern Africa

is a statement. Why? Because it makes sense to inquire whether it is true or false. (In this case, it happens to be true.) But a sentence is still a statement even if it is false. For example, the sentence,

The Yangtze is a river in Japan

is still a statement; it is just a false statement (the Yangtze River is in China). In contrast, none of the following sentences are statements:

Please help yourself to more casserole

Don’t tell your mother about the surprise

Do you like Vietnamese pho?

The reason that none of these sentences are statements is that it doesn’t make sense to ask whether those sentences are true or false (rather, they are requests or commands, and questions, respectively).

So, to reiterate: all arguments are composed of premises and conclusions, which are both types of statements. The premises of the argument provide a reason for thinking that the conclusion is true. And arguments typically involve more than one premise. A standard way of capturing the structure of an argument is by numbering the premises and conclusion. For example, recall Sally’s argument against abortion:

Abortion is morally wrong because it is wrong to take the life of an innocent human being, and a fetus is an innocent human being.

We could capture the structure of that argument like this:

1. It is morally wrong to take the life of an innocent human being
2. A fetus is an innocent human being
3. Therefore, abortion is morally wrong

By convention, the last numbered statement (also denoted by the “therefore”) is the conclusion and the earlier numbered statements are the premises. This is what we call putting an argument into **standard argument form**. We can now give a more precise definition of an argument. An **argument** is a set of statements, some of which (the premises) attempt to provide a reason for thinking that some other statement (the conclusion) is true. Although arguments are typically given in order to convince or persuade someone of the conclusion, the argument itself is independent of one’s attempt to use it to convince or persuade. For example, I have just given you this argument not in an attempt to convince you that abortion is morally wrong, but as an illustration of what an argument is. Later on in this chapter and in this book we will learn some techniques of *evaluating* arguments, but for now the goal is to learn to *identify* an argument, including its premises and conclusion(s). It is important to be able to identify arguments and understand their structure, whether or not you agree with conclusion of the argument. In the next section I will provide some techniques for being able to identify arguments.

## **1.2 Identifying arguments**

The best way to identify whether an argument is present is to ask whether there is a statement that someone is trying to establish as true by basing it on some other statement. If so, then there is an argument present. If not, then there isn’t. Another thing that can help in identifying arguments is knowing certain key words or phrases that are premise indicators or conclusion indicators. For example, recall Sally’s abortion argument:

Abortion is morally wrong *because* it is wrong to take the life of an innocent human being, and a fetus is an innocent human being.

The word “because” here is a premise indicator. That is, “because” indicates that what follows is a reason for thinking that abortion is morally wrong. Here is another example:

I know that the student plagiarized *since* I found the exact same sentences on a website and the website was published more than a year before the student wrote the paper.

In this example, the word “since” is a **premise indicator** because what follows it is a statement that is clearly intended to be a reason for thinking that the student plagiarized (i.e., a premise). Notice that in these two cases, the premise indicators “because” and “since” are interchangeable: I could have used “because” in place of “since” or “since” in the place of “because” and the meaning of the sentences would have been the same. In addition to premise indicators, there are also conclusion indicators. Conclusion indicators mark that what follows is the conclusion of an argument. For example,

Bob-the-arsonist has been dead for a year, so Bob-the-arsonist didn’t set

the fire at the East Lansing Starbucks last week.

In this example, the word “so” is a **conclusion indicator** because what follows it is a statement that someone is trying to establish as true (i.e., a conclusion). Here is another example of a conclusion indicator:

A poll administered by Gallup (a respected polling company) showed candidate x to be substantially behind candidate y with only a week left before the vote, *therefore* candidate y will probably not win the election.

In this example, the word “therefore” is a conclusion indicator because what follows it is a statement that someone is trying to establish as true (i.e., a conclusion). As before, in both of these cases the conclusion indicators “so” and “therefore” are interchangeable: I could have used “so” in place of “therefore” or “therefore” in the place of “so” and the meaning of the sentences would have been the same.

Table 1 contains a list of some common premise and conclusion indicators:

Premise indicators	Conclusion indicators
since	therefore
because	so
for	hence
as	thus
given that	implies that
seeing that	consequently
for the reason that	it follows that
is shown by the fact that	we may conclude that

Although these words and phrases can be used to identify the premises and conclusions of arguments, they are not failsafe methods of doing so. Just because a sentence contains them does not mean that you are dealing with an argument. This can easily be shown by examples like these:

I have been running competitively *since* 1999.

I am so happy to have finally finished that class.

Although “since” can function as a premise indicator and although “so” can function as a conclusion indicator, neither one is doing so here. This shows that you can’t simply mindlessly use occurrences of these words in sentences to show that there is an argument being made. Rather, we have to rely on our understanding of the English sentence in order to determine whether an argument is being made or not. Thus, the best way to determine whether an argument is present is by asking the question: Is there a statement that someone is trying to establish as true or explain why it is true by basing it on some other statement? If so, then there is an argument

present. If not, then there isn't. Notice that if we apply this method to the above examples, we will see that there is no argument present because there is no statement that someone is trying to establish as true *by basing it on some other statement*. For example, the sentence "I have been running competitively since 1999" just contains one statement, not two. But arguments always require at least two separate statements—one premise and one conclusion, so it cannot possibly be an argument.

Another way of explaining why these occurrences of "so" and "since" do not indicate that an argument is present is by noting that both premise indicators and conclusion indicators are, grammatically, conjunctions. A grammatical conjunction is a word that connects two separate statements. So, if a word or term is truly being used as a premise or conclusion indicator, it must connect two separate statements. Thus, if "since" were really functioning as a premise indicator in the above example then what followed it would be a statement. But "1999" is not a statement at all. Likewise, in the second example "so" is not being used as a conclusion indicator because it is not conjoining two separate statements. Rather, it is being used to modify the extent of "happy." In contrast, if I were to say "Tom was sleeping, so he couldn't have answered the phone," then "so" is being used as a conclusion indicator. In this case, there are clearly two separate statements ("Tom was sleeping" and "Tom couldn't have answered the phone") and one is being used as the basis for thinking that the other is true.

If there is any doubt about whether a word is truly a premise/conclusion indicator or not, you can use the **substitution test**. Simply substitute another word or phrase from the list of premise indicators or conclusion indicators and see if the resulting sentence still makes sense. If it does, then you are probably dealing with an argument. If it doesn't, then you probably aren't. For example, we can substitute "it follows that" for "so" in the Bob-the-arsonist example:

Bob-the-arsonist has been dead for a year, *it follows that* Bob-the-arsonist didn't set the fire at the East Lansing Starbucks last week.

However, we cannot substitute "because" for "so" in the so-happy-I-finished- that-class example:

I am *because* happy to have finally finished that class.

Obviously, in the latter case the substitution of one conclusion indicator for another makes the sentence meaningless, which means that the “so” that occurred originally wasn’t functioning as a conclusion indicator.

### **1.3 More complex argument structures**

So far we have seen that an argument consists of a premise (typically more than one) and a conclusion. However, very often arguments and explanations have a more complex structure than just a few premises that directly support the conclusion. For example, consider the following argument:

No one living in Pompeii could have survived the eruption of Mt. Vesuvius. The reason is simple: the lava was flowing too fast and there was nowhere to go to escape it in time. Therefore, this account of the eruption, which claims to have been written by an eyewitness living in Pompeii, was not actually written by an eyewitness.

The **main conclusion** of this argument—the statement that depends on other statements as evidence but doesn’t itself provide any evidence for any other statement—is:

- A. This account of the eruption of Mt. Vesuvius was not actually written by an eyewitness.

However, the argument’s structure is more complex than simply having a couple of premises that provide evidence directly for the conclusion. Rather, some statement provides evidence directly for the main conclusion, but that statement itself is supported by another statement. To determine the structure of an argument, we must determine which statements support which. We can use our premise and conclusion indicators to help with this. For example, the passage contains the phrase, “the reason is...” which is a premise indicator, and it also contains the conclusion indicator, “therefore.” That conclusion indicator helps us to identify the main conclusion, but the more important thing to see is that statement A does not itself provide evidence or support for any of the other statements in the argument, which is the clearest reason why statement A is the main conclusion of the argument. The next question we must answer is: which statement most directly supports A? What most directly supports A is:

- B. No one living in Pompeii could have survived the eruption of Mt. Vesuvius.

However, there is also a reason offered in support of B. That reason is that:

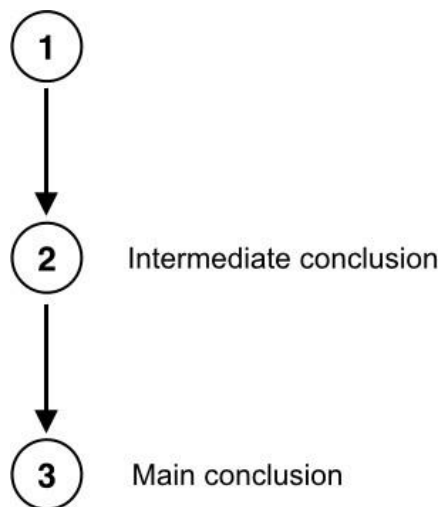
- C. The lava from Mt. Vesuvius was flowing too fast and there was nowhere for someone living in Pompeii to go in order to escape it in time.



So the main conclusion (A) is directly supported by B, and B is supported by C. Since B acts as a premise for the main conclusion but is also itself the conclusion of further premises, we refer to B as an **intermediate conclusion**. The important thing to recognize here is that one and the same statement can act as both a premise and a conclusion. Statement B is a premise that supports the main conclusion (A), but it is also itself a conclusion that follows from C. Here is how we would put this complex argument into standard form (using numbers this time, as we always do when putting an argument into standard form):

1. The lava from Mt. Vesuvius was flowing too fast and there was nowhere for someone living in Pompeii to go in order to escape it in time.
2. Therefore, no one living in Pompeii could have survived the eruption of Mt. Vesuvius. (from 1)
3. Therefore, this account of the eruption of Mt. Vesuvius was not actually written by an eyewitness. (from 2)

Notice that at the end of statement 2 I have written in parentheses “from 1” (and likewise at the end of statement 3 I have written “from 2”). This is a shorthand way of saying: “this statement follows from statement 1.” We will use this convention as a way of keeping track of the structure of the argument. It may also help to think about the structure of an argument spatially, as figure 1 shows:



The main argument here (from 2 to 3) contains a subargument, in this case the argument from 1 to 2. A **subargument**, as the term suggests, is a part of an argument that provides indirect support for the main argument. The **main argument** is simply the argument whose conclusion is the main conclusion.

Another type of structure that arguments can have is when two or more premises provide direct but independent support for the conclusion. Here is an example of

an argument with that structure:

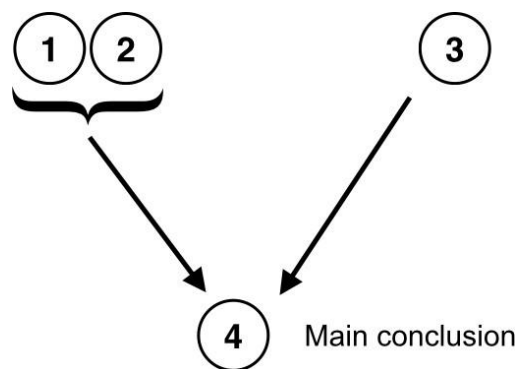
I know that Wanda rode her bike to work today because when she arrived at work she had her right pant leg rolled up (which cyclists do in order to keep their pants legs from getting caught in the chain). Moreover, our coworker, Bob, who works in accounting, saw her riding towards work at 7:45 am.

The conclusion of this argument is “Wanda rode her bike to work today” and there are two premises that provide independent support for it: the fact that Wanda had her pant leg cuffed and the fact that Bob saw her riding her bike. Here is the argument in standard form:

1. Wanda arrived at work with her right pant leg rolled up.
2. Cyclists often roll up their right pant leg.
3. Bob saw Wanda riding her bike towards work at 7:45.
4. Therefore, Wanda rode her bike to work today. (from 1-2, 3 independently)

Again, notice that next to statement 4 of the argument I have written the premises from which that conclusion follows. In this case, in order to avoid any ambiguity, I have noted that the support for the conclusion comes independently from statements 1 and 2, on the one hand, and from statement 3, on the other hand. It is important to point out that an argument or subargument can be supported by one or more premises. We see this in the present argument since the conclusion (4) is supported jointly by 1 and 2, and singly by

3. As before, we can represent the structure of this argument spatially, as figure 2 shows:



There are endless different argument structures that can be generated from these few simple patterns. At this point, it is important to understand that arguments can have these different structures and that some arguments will be longer and more complex than others. Determining the structure of very complex arguments is a skill that takes some time to master. Even so, it may help to remember that any argument structure ultimately traces back to some combination of these.

Exercise 4: Write the following arguments in standard form and show how the argument is structured using a diagram like the ones I have used in this section.

1. There is nothing wrong with prostitution because there is nothing wrong with consensual sexual and economic interactions between adults. Moreover, since there's no difference between a man who goes on a blind date with a woman, buys her dinner and then has sex with her and a man who simply pays a woman for sex, that is another reason for why there is nothing wrong with prostitution.
2. Prostitution is wrong because it involves women who have typically been sexually abused as children. We know that most of these women have been abused from multiple surveys done with women who have worked in prostitution and that show a high percentage of self-reported sexual abuse as children.
3. There was someone in this cabin recently because there was warm water in the tea kettle and because there was wood still smoldering in the fireplace. But the person couldn't have been Tim because Tim has been with me the whole time. Therefore, there must be someone else in these woods.
4. It is possible to be blind and yet run in the Olympic Games since Marla Runyan did it at the 2000 Sydney Olympics.
5. The train was late because it had to take a longer, alternate route since the bridge was out.
6. Israel is not safe if Iran gets nuclear missiles since Iran has threatened multiple times to destroy Israel and if Iran had nuclear missiles it would be able to carry out this threat. Moreover, since Iran has been developing enriched uranium, they have the key component needed for nuclear weapons—every other part of the process of building a nuclear weapon is simple compared to that. Therefore, Israel is not safe.
7. Since all professional hockey players are missing front teeth and Martin is a professional hockey player, it follows that Martin is missing front teeth. And since almost all professional athletes who are missing their front teeth have false teeth, it follows that Martin probably has false teeth.
8. Anyone who eats the crab rangoon at China Food restaurant will probably have stomach troubles afterward. It has happened to me every time, which is why it will probably happen to other people as

well. Since Bob ate the crab rangoon at China Food restaurant, he will probably have stomach troubles afterward.

9. Albert and Caroline like to go for runs in the afternoon in Hyde Park. Since Albert never runs alone, we know that any time Albert is running, Caroline is running too. But since Albert looks like he has just run (since he is panting hard), it follows that Caroline must have ran too.
10. Just because Jeremy's prints were on the gun that killed Tim and the gun was registered to Jeremy, it doesn't follow that Jeremy killed Tim since Jeremy's prints would certainly be on his own gun and someone else could have stolen Jeremy's gun and used it to kill Tim.