1 Arguments

1.1 We begin here.

In everyday discourse, the word *argument* typically refers to a verbal disagreement between two people. In logic and philosophy, however, it has a different and special meaning (although plenty of people do argue, in the everyday sense of the word, in logic and philosophy). We will use *argument* to refer to a set of sentences like these:

1. It is raining heavily.
2. If you do not take an umbrella, you will get soaked.

---

3. Therefore, you should take an umbrella.

In this set, the first two sentences support – or justify – the third sentence. The sentences providing support are the *premises*. The sentence that is supported by (or justified by) the premises is the *conclusion*. Together, *premises* and a *conclusion* comprise an *argument*.

Argument

An ARGUMENT is a set of sentences. One or more of the sentences provide support for another sentence in the set. The sentences providing support are PREMISES. The sentence being supported is the CONCLUSION.

We can also say that, in an argument, the conclusion *follows from* the premises.

That's the definition of an argument, but a broader analysis must include the idea that arguments can be good or bad – or somewhere inbetween. A good argument is one in which the premises do, in fact, support the conclusion. For such an argument, if the premises are true, then we have good reason to believe that the conclusion is true. On the other hand, a bad (or a weak) argument is still an argument. It is just one in which the premises provide little support for the conclusion.

In the definition of an argument, we said that each premise and the conclusion is a sentence. And, as we saw, both premises and the conclusion in the example are individual sentences. All arguments can be expressed this way and many are, but a single sentence can also contain a complete argument, as is shown here:

> Joan was wearing sunglasses, and so it must have been sunny.

This argument has one premise and a conclusion. The premise and the conclusion could both be individual sentences, but here they are just independent clauses separated by the 'and'. (The premise is before the 'and', and the conclusion is after it.)

Many arguments also start with premises and end with a conclusion. But not all arguments are expressed in this order. For instance, here we have our first argument again, but the conclusion is at the beginning:

> You should take an umbrella. After all, it is raining heavily. And if you do not take an umbrella, you will get soaked.

We can also have the conclusion in the middle:

> It is raining heavily. Accordingly, you should take an umbrella, given that if you do not take an umbrella, you will get soaked.

When approaching an argument, we want to know whether or not the conclusion is supported by the premises. So, first, we must identify the premise or premises (the sentences providing support) and the conclusion (and the sentence being supported). As a guide, these words are often used to indicate that a sentence or clause is the conclusion of an argument:

> so, therefore, hence, thus, accordingly, consequently

By contrast, these expressions often indicate that we are dealing with a premise, rather than a conclusion:

> since, because, given that

So that we can undertake a more detailed and precise analysis of some kinds of arguments, in chapter 4, we will begin introducing a formal language: truth functional logic. But before we get there, in this chapter and chapter 2, we will cover some basic logical notions that apply to arguments in a natural language like English. Then, in chapter 3, we will examine logical notions that apply to just sentences (not full arguments), and still in a natural language like English.

1.2 Sentences

Only sentences that can be true or false can be the premises or the conclusion of an argument. The following types of sentences cannot be true or false, and so they cannot be part of an argument.

Questions 'Are you sleepy yet?' is, obviously, a question. Although you might be sleepy or you might be alert, the question itself is neither true nor false. For this reason, questions will not count as sentences in logic.

Imperatives Imperative sentences are, essentially, commands (although they can be nicer than what we usually think of as a command). For instance, 'Wake up!', 'Sit up straight', and 'Please, tell me how to set the table' are all imperatives. Although it might be a good idea for you to sit up, and you may or may not do it, the command is neither true nor false. Note, however, that commands are not always phrased as imperatives. As Cartman might say, "You will respect my authority." This is a command, but it is also true or false – either you will or you will not respect Cartman's authority – and so it counts as a sentence in logic.

Exclamations Some exclamatory sentences can be true or false (and so they are also declarative sentences) and some cannot be. 'It's Friday!' is an exclamation, and it is true or false. It can be part of an argument. On the other hand, a sentence such as 'Ouch!' is neither true nor false, and so it cannot be part of an argument.

1.3 Truth values

Going forward, by SENTENCE, we will mean a declarative sentence. We impose this restriction because the premises and conclusion of an argument must be capable of having a TRUTH VALUE. That is, we must be able to assign a value about its truth to each sentence in an argument. Although more advanced "non-classical" logic systems introduce more options, the two truth values that concern us are just 'true' and 'false'.

truth values
TRUTH VALUES are the logical values that a sentence can have, *true* and *false*.

Practice exercises

Highlight the phrase that expresses the conclusion of each of these arguments:

1. It is sunny. So, I should take my sunglasses.
2. It must have been sunny. I did wear my sunglasses, after all.
3. No one but you has had their hands in the cookie-jar. And the scene of the crime is littered with cookie-crumbs. You're the culprit!
4. Miss Scarlett and Professor Plum were in the study at the time of the murder. Reverend Green had the candlestick in the ballroom, and we know that there is no blood on his hands. Hence Colonel Mustard did it in the kitchen with the lead-piping. Recall, after all, that the gun had not been fired.

2 Validity and other standards

2.1 Validity

Consider this argument:

1. You are reading this book.
2. This is a logic book.
3. Therefore, you are a logic student.

> When we list the premises and the conclusion of an argument this way, the final line is always the conclusion. However many lines there are before the final one are the premises.

If the premises of this argument are true—which, as it turns out, they are—it is very likely that the conclusion is true. But it is possible that someone besides a logic student is reading this book. If, say, the roommate of the book's owner picked it up and began looking through it, he or she would not immediately become a logic student. So, for this argument, we can say that, if the premises are true, then it is *likely*, but not certain, that the conclusion is also true.

Now, take this one:

1. Paris is in France, or it is in Germany.
2. Paris is not in Germany.
3. Therefore, Paris is in France.

For this argument, if the premises are true—which, again, they are—then the conclusion has to be true. There is no way for the premises to be true and the conclusion to be false.

Here is another example,

1. Paris is in Sweden, or it is in Spain.
2. Paris is not in Sweden.
3. Therefore, Paris is in Spain.

Although this argument might strike you as a bit odd, we can say almost the exact same thing about this one as we did for the previous one:

> In this argument, if the premises are true, then the conclusion has to be true. There is no way for the premises to be true and the conclusion to be false.

We have to drop the bit about the premises being true because the first one is false. But nonetheless, *if the premises are true*, then the conclusion has to be true.

This brings us to an important definition as well as an important point about doing logic. First the definition.

Valid

These are two equivalent definitions of VALID (or DEDUCTIVELY VALID):

1. An argument is VALID when, and only when, it is the case that, if the premises are true, then the conclusion has to be true.
2. An argument VALID when, and only when, it is impossible for all of the premises to be true and the conclusion to be false.

Every argument that does not satisfy the definition of *valid* is INVALID (or DEDUCTIVELY INVALID).

Typically, the study of logic focuses on determining when the conclusion of an argument follows from the premises with certainty. From the perspective of logic, whether the premises actually are true is less important. Of course, determining whether or not they are true can be important for many reasons, but this task is normally left to historians, scientists, or the Hardy boys.

We want to know whether, if all the premises *were* true, would the conclusion also have to be true? Consider this argument:

1. Paris is a large city in France, or Paris is a large city on Jupiter.
2. Paris is not a large city in France.
3. Therefore, Paris is a large city on Jupiter.

This argument is valid. *If* both premises are true (they're not, but if they were), then the conclusion has to be true. Now, let's think about this argument:

1. London is in England.
2. Beijing is in China.
3. Therefore, Paris is in France.

The premises and conclusion of this argument are all true, but the argument is invalid. If Paris were, somehow, to become independence from the rest of France, then the conclusion would be false, even though both of the premises would remain true. Thus, it is *possible* for the premises of this argument to be true and the conclusion false. Hence, the argument is *invalid*.

The important point to remember is that validity is not about the actual truth or falsity of the sentences in the argument. It is about whether it is *possible* or *impossible* for all of the premises to be true and the conclusion to be false. (Or, to say the same thing in a different way, whether or not the conclusion has to be true *if* all of the premises are true.)

We can, however, classify the arguments that are valid and have all true premises. We call these SOUND.

Sound

An argument is SOUND when, and only when, it is valid and has all true premises.

The second argument on p. 7 is sound.

2.2 Inductively strong arguments

Many good arguments are invalid. Consider this one:

1. In January 2017, it rained in London.
2. In January 2018, it rained in London.
3. In January 2019, it rained in London.
4. In January 2020, it rained in London.
5. In January 2021, it rained in London.
6. In January 2022, it rained in London.
7. In January 2023, it rained in London.
8. Therefore, next January, it will rain in London.

This argument generalizes from observations about several cases to a conclusion about all cases. This argument could be made stronger by adding additional premises, for instance: 'In January 2016, it rained in London,' 'In January 2015, it rained in London,' and so on. But, however many premises like this we add, the argument will remain invalid. Even if it has rained in London every January for the past 10,000 years, it remains *possible* that it won't rain in London next January. Hence, this argument is invalid. But, at the same time, you might think, "but it's still a good argument!" It is, and we have a way of classifying such arguments.

Inductively strong

An argument is INDUCTIVELY STRONG when (and only when) [1] it is not valid and [2] it is the case that if the premises are true, then their being true makes it likely that the conclusion is true.

An inductively strong argument is one for which the conclusion has a high probability of being true (if the premises are). Arguments that are invalid, but not inductively strong, can have conclusions with every possible probability of being true (if the premises are true) from very high to zero. To simplify matters, we can say that the options are *inductively strong*, *medium*, or *weak*. Since we are on a continuum, we could be much more fine grained than this. (But we won't. See table 2.1.)

And finally, we have a concept for inductively strong arguments that serves the role that *sound* does for valid ones.

The premises being true,	↩ These are all invalid.
make it very probable that the conclusion will be true.	inductively strong
...	
make it somewhat probable that the conclusion will be true.	inductively medium
...	
do not make it very likely that the conclusion will be true.	inductively weak

Table 2.1: Every argument is valid or invalid. Invalid arguments can have any degree of inductive strength, depending on how likely the conclusion is to be true given the premises.

Reliable

An argument is RELIABLE when (and only when) it is inductively strong and has all true premises.

In this textbook, however, we will set aside the analysis of inductively strong arguments and focus on just valid versus invalid ones.

Practice exercises

A. Determine if each of the following arguments is valid or invalid.

(1)
1. Socrates is a man.
2. All men are carrots.
3. Therefore, Socrates is a carrot.

(2)
1. Either today is Labor Day, or the building is full.
2. The building isn't full.
3. Therefore, today is Labor Day.

(3)
1. If the green van is missing, then Claire is at the beach.
2. The green van is missing.
3. Therefore, Claire is at the beach.