

# **A WORKBOOK FOR ARGUMENTS**

A Complete Course in Critical Thinking

*Second Edition*

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## Chapter VI

### Deductive Arguments

Consider this argument:

If there are no chance factors in chess, then chess is a game of pure skill.

There are no chance factors in chess.

Therefore, chess is a game of pure skill.

Suppose that the premises of this argument are true. In other words, suppose it's true that *if* there are no chance factors in chess, then chess is a game of pure skill—and suppose there *are* no chance factors in chess. You can therefore conclude with perfect assurance that chess is a game of pure skill. There is no way to admit the truth of these premises but deny the conclusion.

Arguments of this type are called *deductive arguments*. That is, a (properly formed) deductive argument is an argument of such a form that if its premises are true, the conclusion must be true too. Properly formed deductive arguments are called *valid* arguments.

Deductive arguments differ from the sorts of arguments so far considered, in which even a large number of true premises does not guarantee the truth of the conclusion (though sometimes they may make it very likely). In non-deductive arguments, the conclusion unavoidably goes beyond the premises—that's the very point of arguing by example, authority, and so on—whereas the conclusion of a valid deductive argument only makes explicit what is already contained in the premises.

In real life, of course, we can't always be sure of our premises either, so the conclusions of real-life deductive arguments still have to be taken with a few (sometimes many) grains of salt. Still, when strong premises can be found, deductive forms are very useful. And even when the premises are uncertain, deductive forms offer an effective way to organize arguments.

This chapter provides a brief introduction to the much larger topic of deductive logic. The "Resources" section on this book's companion Web site has links to books and online resources for those who would like to explore deductive logic in more depth. Many of these resources are free, and some are interactive.

*Modus ponens*

Using the letters **p** and **q** to stand for declarative sentences, the simplest valid deductive form is

If [sentence **p**] then [sentence **q**].

[Sentence **p**].

Therefore, [sentence **q**].

Or, more briefly:

If **p** then **q**.

**p**.

Therefore, **q**.

This form is called *modus ponens* ("the mode of putting": put **p**, get **q**). Taking **p** to stand for "There are no chance factors in chess" and **q** to stand for "Chess is a game of pure skill," our introductory example follows *modus ponens* (check it out). Here is another:

If drivers on cell phones have more accidents, then drivers should be prohibited from using them.

Drivers on cell phones *do* have more accidents.

Therefore, drivers should be prohibited from using cell phones.

To develop this argument, you must explain and defend both of its premises, and they require quite different arguments (go back and look). *Modus ponens* gives you a way to lay them out clearly and separately from the start.

*Modus tollens*

A second valid deductive form is *modus tollens* ("the mode of taking": take **q**, take **p**).

If **p** then **q**.

Not-**q**.

Therefore, not-**p**.

Here "Not-**q**" simply stands for the denial of **q**, that is, for the sentence "It is not true that **q**." Similarly for "not-**p**."

Remember Sherlock Holmes' argument, discussed under Rule 1:

A dog was kept in the stables, and yet, though someone had been in and fetched out a horse, [the dog] had not barked. . . .

## Rule 24: Hypothetical syllogism

Obviously the . . . visitor was someone whom the dog knew well.

Holmes' argument can be put as a *modus tollens*:

If the visitor was a stranger, then the dog would have barked.

The dog did not bark.

Therefore, the visitor was not a stranger.

To write this argument in symbols, you could use **s** for "The visitor was a stranger" and **b** for "The dog barked."

If **s** then **b**.

Not-**b**.

Therefore, not-**s**.

"Not-**b**" stands for "The dog did not bark," and "not-**s**" stands for "The visitor was not a stranger." As Holmes puts it, the visitor was someone whom the dog knew well.

Be careful not to confuse *modus ponens* and *modus tollens* with their evil twins, "affirming the consequent" and "denying the antecedent." For details on those two invalid argument forms, see page 249 in Appendix I: Fallacies.

## Rule 24

### Hypothetical syllogism

A third valid deductive form is "hypothetical syllogism."

If **p** then **q**.

If **q** then **r**.

Therefore, if **p** then **r**.

For instance:

If you study other cultures, then you start to realize the variety of human customs.

If you start to realize the variety of human customs, then you become more tolerant.

Therefore, if you study other cultures, then you become more tolerant.

Using the letters in boldface to stand for the component sentences in this statement, we have:

If **s** then **v**.  
 If **v** then **t**.  
 Therefore, if **s** then **t**.

Hypothetical syllogisms are valid for any number of premises as long as each premise has the form "If **p** then **q**" and the **q** (called the "consequent") of one premise becomes the **p** (the "antecedent") of the next.

## Disjunctive syllogism

A fourth valid deductive form is "disjunctive syllogism."

**p** or **q**.  
 Not-**p**.  
 Therefore, **q**.

Consider, for instance, Bertrand Russell's argument discussed under Rule 2:

Either we hope for progress by improving **morals**, or we hope for progress by improving intelligence.

We can't hope for progress by improving **morals**.

Therefore, we must hope for progress by improving intelligence.

Again using the boldface letters as symbols, this argument goes

**m** or **i**.  
 Not-**m**.  
 Therefore, **i**.

There is one complication. In English the word "or" can have two different meanings. Usually "**p** or **q**" means that at least one of **p** or **q** is true and possibly both. This is called an "inclusive" sense of the word "or" and is the sense normally assumed in logic. Sometimes, though, we use "or" in an "exclusive" sense, in which "**p** or **q**" means that either **p** or **q** is true but *not* both. "Either they'll come by land or they'll come by sea," for example, suggests that they won't come both ways at once. In that case you might be able to infer that if they come one way, then they're *not* coming the other way (better be sure!).



## Exercise Set 6.1: Identifying deductive argument forms

**Objective:** To give you practice recognizing uses of Rules 22–26 in plain English.

**Instructions:** State which of the preceding rules each of the following arguments follows.

**Tips for success:** It's easier to recognize which rule a deductive argument uses if you use letters to abbreviate the different parts of the argument. For instance, recall how we used the letters **s** and **b** to stand for different independent clauses in discussing *modus tollens* (Rule 23). We used **s** to abbreviate "The visitor is a stranger" and **b** to stand for "The dog barked."

How do you figure out which parts of the argument to abbreviate? The first step is to look for uses of "if," "and," and "or." When these words are used to connect two independent clauses, they are called "logical connectives." (An independent clause is a part of a sentence that could be a sentence on its own. For instance, the sentence "If there are no chance factors in chess, then chess is a game of pure skill" has two independent clauses: "There are no chance factors in chess" and "Chess is a game of pure skill.")

When you find one of these logical connectives, circle it. Then, underline the independent clauses that it connects. Assign a letter to each of those clauses; write the letter underneath or beside the clause. Logicians often use the letters **p** and **q**, but you can use any letters you want.

Remember that "if," "and," and "or" are not always used as logical connectives. For instance, the word "and" appears in lists of two or more things (e.g., "Lions and tigers and bears!"). Look for sentences that use these words to connect two independent clauses. Those are the most likely to be genuine logical connectives.

Once you've found all of the logical connectives in an argument and assigned letters to the independent clauses that they connect, see if any of those clauses appear elsewhere in the argument. If so, underline the clause and write the letter for it underneath or beside it. Again, you can use any letters you want, but you must be consistent. If you used **p** to stand for "There are no chance factors in chess" once, you must use **p** for all and only instances of "There are no chance factors in chess" in that argument.

Finally, check for sentences that say the *opposite* of one of the clauses that you've symbolized. Put a "not" in front of the letter for that clause. For instance, if you're using **b** to stand for "The dog barked," look for sentences that say that the dog did not bark. Underline that sentence and write "not-**b**" underneath or beside it.



Once you have done this, you will probably notice that there are phrases, clauses, or entire sentences that you have not yet symbolized. This is perfectly normal. You will usually find arguments embedded in larger passages. The passage might include background information or commentary on the premises of the argument. You do not need to symbolize these. They are probably not premises of the argument.

Note that the arguments you encounter in your daily life may not always express one idea in the same way every time. If you're confident that two different clauses express the same idea, you can use the same letter to symbolize them, even if they don't use exactly the same words. For instance, consider the argument:

Either the dog knew the visitor or the dog barked. The dog did not bark. Therefore, the visitor was not a stranger.

The first clause and the last sentence express the same idea—namely, that the dog knew the visitor—in different words. It makes sense to symbolize them with the same letter.

Once you've assigned letters to the clauses in your argument, compare the symbolized version of the argument to each of the preceding rules. If the symbolized version matches the form given by one of the rules, then the argument follows that rule. If not, it doesn't. Note that the order of the premises doesn't matter, though of course it does matter which sentence is the conclusion and which are the premises.

### Sample

If money is the most important thing in life, then we will pursue it for its own sake. We do not pursue money for its own sake, but rather as a means to achieving something else. Thus, money is not the most important thing in life.

*Adapted from: Aristotle, Nicomachean Ethics, 2nd ed., trans. Terence Irwin (Indianapolis: Hackett Publishing Company, 2000), 5*

#### Modus tollens.

*To see why the answer is modus tollens, let  $p$  stand for "money is the most important thing in life" and  $q$  stand for "we will pursue money for its own sake." We could symbolize the first sentence as "If  $p$  then  $q$ ." The third sentence is not- $q$  and the fourth sentence is not- $p$ . This fits the form of modus tollens. Notice that the phrase "but rather as a means to achieving something else" is not part of the argument itself.*

1. If I am thinking, then I exist. I am thinking. Therefore, I exist.

*Adapted from: René Descartes, Discourse on Method, 4th ed., trans. Donald A. Cress (Indianapolis: Hackett Publishing Company, 1998), 18*

2. Determinism is the view that everything that happens is fully determined by the laws of nature and the way the world was long before we were born. Either determinism is false or humans have no free will. Humans do have free will. Thus, determinism is false.

*Adapted from: Peter van Inwagen, "The Incompatibility of Free Will and Determinism," Philosophical Studies 27 (1975), 185–99*

3. If the Great Spirit had desired me to be a white man, he would have made me a white man. He did not make me a white man. Hence, he did not desire me to be a white man.

*Adapted from: Chief Sitting Bull, quoted in David Ross, 1,001 Pearls of Wisdom (San Francisco: Chronicle Books, 2006), 21*

4. I'm offering you two pills: one red, one blue. You can take the red pill or you can take the blue pill. It's up to you. But once you've made your choice, there's no turning back. If you take the blue pill, you'll forget this ever happened and you'll go on living your life in blissful ignorance. If you take the red pill, your life will be changed forever by what I am about to show you. Thus, your choice is really between the life you know now and a totally different life that you cannot begin to imagine.

*Adapted from: The Matrix, directed by Andy Wachowski and Lana Wachowski (Burbank, CA: Warner Bros., 1999)*

5. Many medical texts suggest that the best way to treat bee stings is by scraping the stinger without squeezing or pulling the stinger. In 1996, some researchers tested this by allowing honeybees to sting them repeatedly. They scraped some stingers out and pulled the others out. They said that if scraping worked better than pulling, then scraping the stingers should leave a smaller welt. They found

that scraping the stingers did not leave a smaller welt. Therefore, scraping the stingers out did not work better than pulling them out.

*Adapted from: Anahad O'Connor, "The Claim: Bee Stings Can Be Treated by Scraping out Stingers," New York Times, May 30, 2006, <http://www.nytimes.com/2006/05/30/health/30real.html>*

6. The prosecution has presented a lot of evidence to show that the defendant killed her husband. But if my client *had* killed her husband, then she wouldn't want to get caught, would she? And if she didn't want to get caught, then she wouldn't have left all that evidence behind. So, you see, if my client were guilty, then she wouldn't have left behind all of the evidence that the prosecution has presented!

*Adapted from: Zach Weinersmith, "Comic for February 26, 2007," Saturday Morning Breakfast Comics, Feb 26, 2007, <http://www.smbc-comics.com/index.php?id=743>*

7. Steve Salerno, a former self-help book editor for Rodale Press, said, "If the self-help books we sold worked, then one would not expect people to need further help from us on the same topic." But he found that most of his company's customers did need further help from them—on the same topic—after reading their self-help books. This implies that the self-help books he sold did not work.

*Adapted from: Michael Shermer, "SHAM Scam," Scientific American, May 2006, <http://www.scientificamerican.com/article.cfm?id=sham-scam>*

8. If all the other Baratheon children have dark hair, then it is unlikely that the king's son would be blond. And if it is unlikely that the king's son would be blond, then the prince probably isn't the king's child! Thus, if all the other Baratheon children have dark hair, the prince probably isn't the king's child.

*Adapted from: George R. R. Martin, A Game of Thrones (New York: Bantam Spectra, 1996), 486*

9. You say I'm some kind of demon. Well, either you're right about that, and I really am a demon, or you're wrong about me, and I'm just a poor old country boy. Now, if I'm just a poor old country boy, you'd better be nice to me. But if I'm actually a demon, then you had really better be nice to me, because I could cause you all kinds of trouble. So either way, you'd better be nice to me!

*Adapted from: Montgomery Pittman, "The Last Rites of Jeff Myrtlebank," The Twilight Zone video, 24:55, Feb 23, 1962, <http://www.hulu.com/watch/440889>*

10. After drinking a potion labeled “DRINK ME,” which had made her smaller, Alice found herself trapped. There was only one door out of the room, but it was locked. The key sat on top of the table, far out of her reach. Looking about for a solution to her problem, she discovered a tiny little cake labeled “EAT ME.” She surmised that the cake might change her size too, although she wasn’t sure in what way. It might make her grow back to her original size, or it might make her shrink even further. If it made her grow, then she would be able to reach the key and unlock the door. If it made her shrink, then she would be able to slip under the door. Therefore, she reasoned, she would be able to unlock the door or she would be able to slip under the door. Either way, she could escape from the room!

*Adapted from: Lewis Carroll, Martin Gardner, and John Tenniel, The Annotated Alice: The Definitive Edition (New York: W. W. Norton, 1999), 18*

## Exercise Set 6.3: Drawing conclusions with deductive arguments

**Objective:** To train you to draw conclusions using deductive argument forms.

**Instructions:** Each of the following sets of premises enables you to draw a specific conclusion using a deductive argument. State the conclusion that you can draw from each set of premises and the deductive argument form(s) that you used to draw the conclusion.

**Tips for success:** As in Exercise Sets 6.1 and 6.2, it will help to start by symbolizing each statement. Look for statements containing logical connectives first. Once you've symbolized everything you can, see whether the statements you've symbolized match the premises of any argument forms. If so, use that argument form to draw a conclusion.

## Sample

If dolphins act similarly to us under similar circumstances, the psychology behind their behavior is probably similar to ours. Dolphins do act similarly to us under similar circumstances.

*Adapted from: Franz de Waal, "Looking at Flipper, Seeing Ourselves," New York Times, Oct 9, 2006, <http://www.nytimes.com/2006/10/09/opinion/09dewaal.html>*

using modus ponens, we can conclude that the psychology behind dolphins' behavior is probably similar to ours.

Using  $p$  to stand for "dolphins act similarly to us under similar circumstances" and  $q$  to stand for "the psychology behind dolphins' behavior is probably similar to ours," we can symbolize the premises as:

(1) If  $p$  then  $q$ .

(2)  $p$ .

These are the premises needed for modus ponens, which allows us to conclude that  $q$  is true—that is, that the psychology behind dolphins' behavior is probably similar to ours.

1. If the SAT were a useful test, then it would test skills like research and critical analysis. It does not test those skills.

*Adapted from: Jeanne Heifetz, letter to the editor, New York Times, Sep 22, 2006, <http://www.nytimes.com/2006/09/22/opinion/122test.html>*

2. Either moral judgments are derived from reason or they are caused by emotion. Moral judgments are not derived from reason.

*Adapted from: David Hume, A Treatise of Human Nature: Two-Volume Set, edited by David Fate Norton and Mary J. Norton (Oxford: Clarendon Press, 2007), 293–301*

3. I believe that South America and Africa used to be joined together into a single supercontinent, but that they have since drifted apart. If this "continental drift" hypothesis is correct, then there would have been animals that lived nowhere but near the place where the old supercontinent split apart. And if there were

such animals, then there will be fossils in eastern South America that can be found nowhere else but in western Africa.

*Adapted from: Alfred Wegener, The Origin of Continents and Oceans, translated by John Biram (Mineola, NY: Dover, 1966), 70*

4. Unless we can be sure of the existence of objects, we cannot be sure that other people's bodies exist. If we cannot be sure that other people's bodies exist, then we cannot be sure that other people's minds exist.

*Adapted from: Bertrand Russell, The Problems of Philosophy (1912; repr., New York: Barnes & Noble, 2004), 9*

5. Either light consists of tiny particles or it consists of waves. Light does not consist of tiny particles.

*Adapted from: M. Shamos, Great Experiments in Physics (New York: Holt, Rinehart and Winston, 1959), 93–107*

6. If the rich countries had become rich purely by stealing from the rest of the world, then the rest of the world would be poorer now than it used to be. But the rest of the world is richer now than it used to be, even though it is not nearly as wealthy as the rich countries.

*Adapted from: Jeffrey D. Sachs, The End of Poverty (New York: Penguin, 2005), 31*

7. We've become slaves to our smartphones, constantly connected to each other and to a barrage of information. For many busy professionals, this has become a real problem, with work texts and emails interrupting their personal lives. Individuals could try to cut back their use on their own, or they could do it in cooperation with their colleagues. If they try to cut back on their own, however, then their colleagues may resent their time offline. Their colleagues will appreciate their time offline, however, if workers cut back in cooperation with everyone else.

*Adapted from: "Slaves to the Smartphone," The Economist, Mar 10, 2012, <http://www.economist.com/node/21549904>*

8. The nametag on your mattress says "J. Watson." If your nametag says "J. Watson," then your first name is probably James.

*Adapted from: Young Sherlock Homes, directed by Barry Levinson  
(Hollywood, CA: Paramount Pictures, 1985)*

9. In 2012, a Turkish court convicted 330 military officers guilty of plotting a coup back in 2003. The court's main evidence came from computer files allegedly created in 2003. But computer experts who examined the files found that they had been created using Microsoft Office 2007, which didn't exist in 2003. Obviously, the files couldn't have been created in 2003 if they had been created using Office 2007.

*Adapted from: Dani Rodrik, "Turkish Court Provides (Lack of) Reasoning Behind Sledgehammer Verdict," Dani Rodrik's Weblog, Jan 8, 2013,  
[http://rodrik.typepad.com/dani\\_rodriks\\_weblog/2013/01/turkish-court-provides-lack-of-reasoning-behind-sledgehammer-verdict.html](http://rodrik.typepad.com/dani_rodriks_weblog/2013/01/turkish-court-provides-lack-of-reasoning-behind-sledgehammer-verdict.html)*

10. You can either measure the position of a subatomic particle or you can measure its momentum. A law of physics known as the Heisenberg uncertainty principle entails that if you measure its position, then you cannot know its momentum precisely, but if you measure its momentum, then you cannot know its position precisely.

*Adapted from: George Gamow, Mr. Tompkins in Paperback (1965; repr.,  
Cambridge University Press, 1993), 65–80*