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Analyzing Arguments

- 1 Paraphrasing Arguments
- 2 Diagramming Arguments
- 3 Complex Argumentative Passages
- 4 Problems in Reasoning

1 Paraphrasing Arguments

Arguments in everyday life are often exceedingly complex. Premises may be numerous and in topsy-turvy order; they may be formulated awkwardly, and they may be repeated using different words; even the meaning of premises may be unclear. To sort out the connections of premises and conclusions so as to evaluate an argument fairly, we need some analytical techniques.

The most common, and perhaps the most useful technique for analysis is *paraphrase*. We paraphrase an argument by setting forth its propositions in clear language and in logical order. This may require the reformulation of sentences, and therefore great care must be taken to ensure that the paraphrase put forward captures correctly and completely the argument that was to be analyzed.

The following passage, whose premises are confusingly intertwined, was part of the majority decision of the U.S. Supreme Court when, in 2003, it struck down as unconstitutional a Texas statute that had made it a crime for persons of the same sex to engage in certain forms of intimate sexual conduct. Justice Anthony Kennedy, writing for the majority, said this:

The [present] case does involve two adults who, with full and mutual consent from each other, engaged in sexual practices common to a homosexual life style. The petitioners are entitled to respect for their private lives. The state cannot demean their existence or control their destiny by making their private sexual conduct a crime. Their right to liberty under the Due Process Clause [of the 14th Amendment to the U.S. Constitution] gives them the full right to engage in their conduct without intervention of the government. It is a premise of the Constitution that there is a realm of personal liberty which the government may not enter. The Texas statute furthers no legitimate state interest which can justify its intrusion into the personal and private life of the individual.¹

Although the general thrust of this decision is clear, the structure of the argument, which is really a complex of distinct arguments, is not. We can clarify the whole by paraphrasing the decision of the Court as follows:

1. The Constitution of the United States guarantees a realm of personal liberty that includes the private, consensual sexual activity of adults.
2. The conduct of these petitioners was within that realm of liberty and they therefore had a full right, under the Constitution, to engage in the sexual conduct in question without government intervention.

Biography

Peter Abelard

Peter Abelard was born near Nantes, in Brittany, in 1079 CE, to a noble family. He could have become a wealthy knight, but rejected such a life, instead choosing an academic career. He left home for Paris, and studied with William of Champeaux, with whom he quarreled acrimoniously, resulting in his opening a school of his own. Eventually he was elected to the faculty of the school of Notre Dame, where he was extremely popular, attracting students from all over Europe. He was primarily interested in logic, which was then called dialectic, and in metaphysics. He confronted the deep metaphysical problem of universals, or abstract objects. General terms (e.g., *justice*, *yellow*, *smooth*) plainly do exist, but are there abstract *objects* that actually exist, beneath or behind those terms, in some non-physical world? Abelard held that there are no such entities, but that we are sometimes misled by the words we use for the common properties of things. His position came to be known as *nominalism*.

While working as a tutor to Heloise, the seventeen-year-old niece of a Parisian named Fulbert, a relationship developed that resulted in her becoming pregnant. The couple ran away to his home in Brittany, where she gave birth to a child. Abelard eventually married Heloise, later sending her to become a nun. Her uncle, outraged by the scandal, hired thugs to assault Abelard and castrate him. Abelard then became a monk and lecturer, unpopular among colleagues because of his intellectual arrogance. He was obliged to move from abbey to abbey, became embroiled in theological controversies, and died in Paris in 1142.

In logic, Abelard explored the relations of premises and conclusions in deductive arguments. He was one of the first to emphasize the *syntactic* nature of validity. An argument is valid, he pointed out, not because of the semantic content of its propositions, but because of the *formal relations* among those propositions.



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3. The Texas statute intrudes, without justification, into the private lives of these petitioners, and demeans them, by making their protected, private sexual conduct a crime.
4. The Texas statute that criminalizes such conduct therefore wrongly denies the rights of these petitioners and must be struck down as unconstitutional.

In this case the paraphrase does no more than set forth clearly what the premises indubitably assert. Sometimes, however, paraphrasing can bring to the surface what was assumed in an argument but was not fully or clearly stated. For example, the great English mathematician, G. H. Hardy, in *A Mathematician's Apology* (Cambridge University Press, 1940), argued thus: "Archimedes will be

remembered when Aeschylus is forgotten, because languages die and mathematical ideas do not." We may paraphrase this argument by spelling out its claims:

1. Languages die.
2. The plays of Aeschylus are written in a language.
3. So the work of Aeschylus will eventually die.
4. Mathematical ideas never die.
5. The work of Archimedes was with mathematical ideas.
6. So the work of Archimedes will never die.
7. Therefore Archimedes will be remembered when Aeschylus is forgotten.

This paraphrase enables us to distinguish and examine the premises and inferences compressed into Hardy's single sentence.

EXERCISES

Paraphrase each of the following passages, which may contain more than one argument.

1. The [Detroit] Pistons did not lose because of the lack of ability. They are an all-around better team. They lost because of the law of averages. They will beat the [San Antonio] Spurs every two times out of three. When you examine the NBA finals [of 2005], that is exactly how they lost the seventh (last game) because that would have been three out of three. The Spurs will beat the Pistons one out of three. It just so happens that, that one time was the final game, because the Pistons had already won two in a row.

—Maurice Williams, "Law of Averages Worked Against Detroit Pistons,"
The Ann Arbor (Michigan) News, 8 July 2005

2. Hundreds of thousands of recent college graduates today cannot express themselves with the written word. Why? Because universities have shortchanged them, offering strange literary theories, Marxism, feminism, deconstruction, and other oddities in the guise of writing courses.

—Stanley Ridgeley, "College Students Can't Write?"
National Review Online, 19 February 2003

3. Racially diverse nations tend to have lower levels of social support than homogenous ones. People don't feel as bound together when they are divided on ethnic lines and are less likely to embrace mutual support programs. You can have diversity or a big welfare state. It's hard to have both.

—David Brooks (presenting the views of Seymour Lipset),
"The American Way of Equality," *The New York Times*, 14 January 2007

4. Orlando Patterson claims that "freedom is a natural part of the human condition." Nothing could be further from the truth. If it were true, we

could expect to find free societies spread throughout human history. We do not. Instead what we find are every sort of tyrannical government from time immemorial.

—John Taylor, “Can Freedom Be Exported?” *The New York Times*,
22 December 2006

5. *The New York Times* reported, on 30 May 2000, that some scientists were seeking a way to signal back in time. A critical reader responded thus:

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

6. Nicholas Kristof equates the hunting of whales by Eskimos with the whaling habits of Japanese, Norwegians, and Icelanders. The harsh environment of the Inupiat [Eskimos] dictates their diet, so not even the most rabid antiwhaling activist can deny their inalienable right to survive. The Japanese and the European whale-hunting countries can choose the food they consume; they have no need to eat whales. It is not hypocritical to give a pass to the relatively primitive society of the Inupiat to hunt a strictly controlled number of whales for survival while chastising the modern societies that continue to hunt these magnificent mammals for no good reason.

—Joseph Turner, “Their Whale Meat, and Our Piety,” *The New York Times*,
18 September 2003

7. Space contains such a huge supply of atoms that all eternity would not be enough time to count them and count the forces which drive the atoms into various places just as they have been driven together in this world. So we must realize that there are other worlds in other parts of the universe with races of different men and different animals.

—Lucretius, *De Rerum Natura*, First Century BCE

8. If you marry without love, it does not mean you will not later come to love the person you marry. And if you marry the person you love, it does not mean that you will always love that person or have a successful marriage. The divorce rate is very low in many countries that have prearranged marriage. The divorce rate is very high in countries where people base their marriage decisions on love.

—Alex Hammoud, “I Take This Man, for Richer Only,” *The New York Times*,
18 February 2000

9. Our entire tax system depends upon the vast majority of taxpayers who attempt to pay the taxes they owe having confidence that they're being treated fairly and that their competitors and neighbors are also paying what is due. If the public concludes that the IRS cannot meet these basic expectations, the risk to the tax system will become very high, and the effects very difficult to reverse.

—David Cay Johnston, “Adding Auditors to Help IRS Catch Tax Cheaters,”
The New York Times, 13 February 2000

10. People and governments want to talk, talk, talk about racism and other forms of intolerance; we are obsessed with racial and ethnic issues. But we come to these issues wearing earplugs and blinders, and in a state of denial that absolves us of complicity in any of these hateful matters.

Thus, the other guy is always wrong.

—Bob Herbert, “Doomed to Irrelevance,” *The New York Times*,
6 November 2001

2 Diagramming Arguments

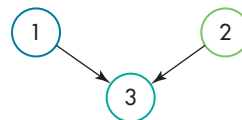
A second technique for the analysis of arguments is *diagramming*. With a diagram we can represent the structure of an argument graphically; the flow of premises and conclusions is displayed in a two-dimensional chart, or picture, on the page. A diagram is not needed for a simple argument, even though drawing one can enhance our understanding. When an argument is complex, with many premises entwined in various ways, a diagram can be exceedingly helpful.

To construct the diagram of an argument we must first number all the propositions it contains, in the order in which they appear, circling each number. Using arrows between the circled numbers, we can then construct a diagram that shows the relations of premises and conclusions without having to restate them. To convey the process of inference on the two-dimensional page, we adopt this convention: A conclusion always appears in the space *below* the premises that give it support; coordinate premises are put on the same horizontal level. In this way, an argument whose wording may be confusing can be set forth vividly in iconic form. The structure of the argument is displayed visually.²

Here follows a straightforward argument that may be readily diagrammed:

- ① There is no consensus among biologists that a fertilized cell is alive in a sense that an unfertilized egg or unused sperm is not. ② Nor is there a consensus about whether a group of cells without even a rudimentary nervous system is in any sense human.
③ Hence there are no compelling experimental data to decide the nebulous issue of when “human” life begins.³

The circled numbers serve to represent the propositions, so we can diagram the argument as follows:



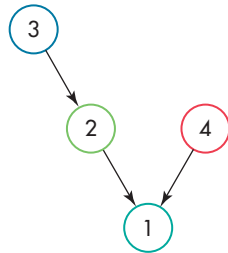
When the several premises of an argument are not all coordinate—that is, when some premises give direct support not to the conclusion but to other premises that support the conclusion—the diagram can show this quite clearly. Here is an argument illustrating this feature of diagramming:

- ① Football analysis is trickier than the baseball kind because ② Football really is a team sport. ③ Unlike in baseball, all eleven guys on the field are involved in every play. ④ Who deserves the credit or blame is harder to know than it looks.⁴

The diagram looks like this:



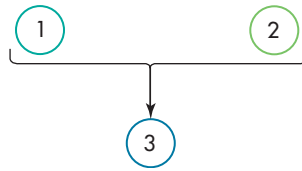
An alternative plausible interpretation of this argument can be represented by a different diagram:



Another strength of diagrams is their ability to exhibit relations between the premises—relations that may be critical to the argument. Each premise of an argument may support its conclusion separately, as in the arguments above. In some arguments, however, the premises support the conclusion only when they are considered *jointly*—and this is a feature of the reasoning that a diagram is well suited to display, by providing a visual representation of that connection. The following argument illustrates this:

- ① General Motors makes money (when it does) on new cars and on the financing of loans. ② Car dealers, by contrast, make most of their money on servicing old cars and selling used ones. ③ So car dealers can thrive even when the automaker languishes.⁵

By bracketing the premises in the diagram of this argument, we show that its premises give support only because they are joined, thus:

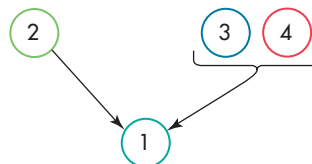


In this argument, neither premise supports the conclusion independently. It is the combination of the facts that General Motors makes most of its money in one way, while car dealers make most of their money in another way, that supports the conclusion that the latter may thrive while the former languishes.

Often we can *show* what we cannot as conveniently say. Diagrams are particularly useful when an argument's structure is complicated. Consider the following argument:

① Desert mountaintops make good sites for astronomy. ② Being high, they sit above a portion of the atmosphere, enabling a star's light to reach a telescope without having to swim through the entire depths of the atmosphere. ③ Being dry, the desert is also relatively cloud-free. ④ The merest veil of haze or cloud can render a sky useless for many astronomical measures.⁶

Proposition ① is plainly the conclusion of this argument, and the other three provide support for it—but they function differently in giving that support. Statement ② supports, by itself, the claim that mountaintops are good sites for telescopes. But statements ③ and ④ must work together to support the claim that desert mountaintops are good sites for telescopes. A diagram shows this neatly:



Some complications may be revealed more clearly using paraphrase. When an argument has a premise that is not stated explicitly, a paraphrase allows us to formulate the tacit premise and then add it to the list explicitly. A diagram requires the representation of the tacit premise in some way that indicates visually that it has been added (a broken circle around a number is commonly used), but even then the added premise remains to be precisely formulated. Thus the argument

Since there are no certainties in the realm of politics, politics must be the arena for negotiation between different perspectives, with cautious moderation likely to be the best policy.⁷

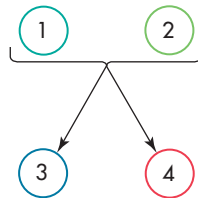
is best clarified by a paraphrase in which its tacit premise and internal complexity is made explicit, thus:

1. There are no certainties in the realm of politics.
2. Where there are no certainties, those with different perspectives must negotiate their differences.
3. The best policy likely to emerge from such negotiation is one of cautious moderation.
4. Therefore politics is the realm for negotiation between different perspectives, with cautious moderation likely to be the best policy.

The number of arguments in a passage is determined, most logicians agree, by the number of conclusions it contains. If a passage contains two or more arguments, and a number of propositions whose relations are not obvious, a diagram may prove particularly useful in sorting things out. A passage in a letter from Karl Marx to Friedrich Engels illustrates this nicely:

① To hasten the social revolution in England is the most important object of the International Workingman's Association. ② The sole means of hastening it is to make Ireland independent. Hence ③ the task of the "International" is everywhere to put the conflict between England and Ireland in the foreground, and ④ everywhere to side openly with Ireland.⁸

There are two conclusions in this passage and hence two arguments. But both conclusions are inferred from the same two premises. A diagram exhibits this structure:



Two conclusions (and hence two arguments) may have a single stated premise. For example,

Older women have less freedom to fight sexual harassment at their jobs or to leave a battering husband, because age discrimination means they won't easily find other ways of supporting themselves.⁹

The single premise here is that older women cannot easily find alternative ways to support themselves. The two conclusions supported by that premise are (a) that older women have less freedom to fight sexual harassment at their jobs, and (b) that older married women have less freedom to leave a battering husband. A *single argument* ordinarily means an argument with a single conclusion, regardless of how many premises are adduced in its support.

When there are two or more premises in an argument, or two or more arguments in a passage, the order of appearance of premises and conclusions may need to be clarified. The conclusion may be stated last, or first; it may sometimes be sandwiched between the premises offered in its support, as in the following passage:

The real and original source of inspiration for the Muslim thinkers was the Quran and the sayings of the Holy Prophet. It is therefore clear that the Muslim philosophy was not a carbon copy of Greek thought, as it concerned itself primarily and specifically with those problems which originated from and had relevance to Muslims.¹⁰

Here the conclusion, that “Muslim philosophy was not a carbon copy of Greek thought,” appears after the first premise of the argument and before the second.

The same proposition that serves as a conclusion in one argument may serve as premise in a different argument, just as the same person may be a commander in one context and a subordinate in another. This is well illustrated by a passage from the work of Thomas Aquinas. He argues:

Human law is framed for the multitude of human beings.
The majority of human beings are not perfect in virtue.
Therefore human laws do not forbid all vices.¹¹

The conclusion of this argument is used immediately thereafter as a premise in another, quite different argument:

Vicious acts are contrary to acts of virtue.
But human law does not prohibit all vices. . . .
Therefore neither does it prescribe all acts of virtue.¹²

No special techniques are needed to grasp these arguments of St. Thomas. However, when the cascade of arguments is compressed, a paraphrase is helpful in showing the flow of reasoning. Consider the following passage:

Because ① the greatest mitochondrial variations occurred in African people, scientists concluded that ② they had the longest evolutionary history, indicating ③ a probable African origin for modern humans.¹³

We might diagram the passage thus:



A paraphrase of this passage, although perhaps more clumsy, exhibits more fully the cascade of the two arguments that are compressed in it:

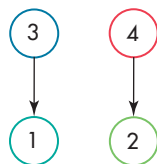
1. The more mitochondrial variation in a people, the longer its evolutionary history.
2. The greatest mitochondrial variations occur in African people.
Therefore African people have had the longest evolutionary history.
1. African people have had the longest evolutionary history.
2. Modern humans probably originated where people have had the longest evolutionary history.
Therefore modern humans probably originated in Africa.

These examples make it evident that the same proposition can serve as a premise where it occurs as an assumption in an argument; or as a conclusion where it is claimed to follow from other propositions assumed in an argument. “Premise” and “conclusion” are always *relative* terms.

Multiple arguments may be interwoven in patterns more complicated than cascades, and these will require careful analysis. The diagramming technique then becomes particularly useful. In John Locke’s *Second Treatise of Government*, for example, two arguments are combined in the following passage:

It is not necessary—no, nor so much as convenient—that the legislative should be always in being; but absolutely necessary that the executive power should, because there is not always need of new laws to be made, but always need of execution of the laws that are made.

The component propositions here may be numbered thus: ① It is not necessary or convenient that the legislative [branch of government] should be always in being; ② it is absolutely necessary that the executive power should be always in being; ③ there is not always need of new laws to be made; ④ there is always need of execution of the laws that are made. The diagram for this passage is



which shows that the conclusion of the second argument is stated between the conclusion and the premise of the first argument, and that the premise of the first argument is stated between the conclusion and the premise of the second argument. The diagram also shows that both conclusions are stated before their premises.

That very same diagram shows the logical structure of two related arguments of the Roman philosopher Seneca, in support of the deterrence theory of punishment. He wrote:

① No one punishes because a sin has been committed, ② but in order that a sin will not be committed. [For] ③ what has passed cannot be recalled, but ④ what lies in the future may be prevented.

That “no one punishes because a sin has been committed” is the conclusion of one argument; its premise is that “what has passed cannot be recalled.” That “[we do punish] in order that a sin will not be committed” is the conclusion of a second argument, whose premise is that “what lies in the future may be prevented.”

Diagramming and paraphrasing are both very useful tools with which we can analyze arguments so as to understand more fully the relations of premises to conclusions.

EXERCISES

A. Diagram each of the following passages, which may contain more than one argument.

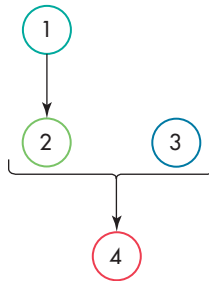
EXAMPLE

1. In a recent attack upon the evils of suburban sprawl, the authors argue as follows:

The dominant characteristic of sprawl is that each component of a community—housing, shopping centers, office parks, and civic institutions—is segregated, physically separated from the others, causing the residents of suburbia to spend an inordinate amount of time and money moving from one place to the next. And since nearly everyone drives alone, even a sparsely populated area can generate the traffic of a much larger traditional town.¹⁴

SOLUTION

① The dominant characteristic of sprawl is that each component of a community—housing, shopping centers, office parks, and civic institutions—is segregated, physically separated from the others, causing ② the residents of suburbia to spend an inordinate amount of time and money moving from one place to the next. And since ③ nearly everyone drives alone, ④ even a sparsely populated area can generate the traffic of a much larger traditional town.



2. At any cost we must have filters on our Ypsilanti Township library computers. Pornography is a scourge on society at every level. Our public library must not be used to channel this filth to the people of the area.

—Rob. J. and Joan D. Pelkey, *The Ann Arbor (Michigan) News*, 3 February 2004

3. At his best, Lyndon Johnson was one of the greatest of all American presidents. He did more for racial justice than any president since Abraham Lincoln. He built more social protections than anyone since Franklin Roosevelt. He was probably the greatest legislative politician in American history. He was also one of the most ambitious idealists. Johnson sought power to use it to accomplish great things.

—Alan Brinkley, “The Making of a War President,”
The New York Times Book Review, 20 August 2006

4. Married people are healthier and more economically stable than single people, and children of married people do better on a variety of indicators. Marriage is thus a socially responsible act. 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

5. The distinguished economist J. K. Galbraith long fought to expose and improve a society exhibiting “private opulence and public squalor.” In

his classic work, *The Affluent Society* (Boston: Houghton Mifflin, 1960), he argued as follows:

Vacuum cleaners to insure clean houses are praiseworthy and essential in our standard of living. Street cleaners to insure clean streets are an unfortunate expense. Partly as a result, our houses are generally clean and our streets generally filthy.

6. Defending the adoption of the euro in place of the pound as the monetary unit of the United Kingdom, Prime Minister Tony Blair said this: "The argument is simple. We are part of Europe. It affects us directly and deeply. Therefore we should exercise leadership in order to change Europe in the direction we want."

—Reported by Alan Cowell in the *The New York Times*, 9 December 2001

7. California's "three strikes and you're out" law was enacted 10 years ago this month (March, 2004). Between 1994 and 2002, California's prison population grew by 34,724, while that of New York, a state without a "three strikes" law, grew by 315. Yet during that time period New York's violent crime rate dropped 20 percent more than California's. No better example exists of how the drop in crime cannot be attributed to draconian laws with catchy names.

—Vincent Schiraldi, "Punitive Crime Laws,"
The New York Times, 19 March 2004

8. No one means all he says, and yet very few say all they mean, for words are slippery and thought is viscous.

—Henry Adams, *The Education of Henry Adams* (1907)

9. The first impression becomes a self-fulfilling prophesy: we hear what we expect to hear. The interview is hopelessly biased in favor of the nice.

—Malcom Gladwell, "The New-Boy Network," *The New Yorker*, 29 May 2000

10. No government can ever guarantee that the small investor has an equal chance of winning. It is beyond dishonest to pretend that rules can be written to prevent future financial scandals. No set of regulations can insure fairness and transparency in the [securities] markets.

—Lester Thurow, "Government Can't Make the Market Fair,"
The New York Times, 23 July 2002

B. There may be one argument or more than one argument in each of the following passages. Paraphrase the premises and conclusions (or use diagrams if that is helpful) to analyze the arguments found in each passage.

EXAMPLE

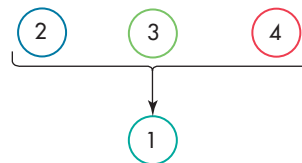
1. An outstanding advantage of nuclear over fossil fuel energy is how easy it is to deal with the waste it produces. Burning fossil fuels produces 27,000 million tons of carbon dioxide yearly, enough to make, if

solidified, a mountain nearly one mile high with a base twelve miles in circumference. The same quantity of energy produced from nuclear fission reactions would generate two million times less waste, and it would occupy a sixteen-meter cube. All of the high-level waste produced in a year from a nuclear power station would occupy a space about a cubic meter in size and would fit safely in a concrete pit.

—James Lovelock, *The Revenge of Gaia: Earth's Climate Crisis and the Fate of Humanity* (New York: Basic Books, 2006)

SOLUTION

① An outstanding advantage of nuclear over fossil fuel energy is how easy it is to deal with the waste it produces. ② Burning fossil fuels produces 27,000 million tons of carbon dioxide yearly, enough to make, if solidified, a mountain nearly one mile high with a base twelve miles in circumference. ③ The same quantity of energy produced from nuclear fission reactions would generate two million times less waste, and it would occupy a sixteen-meter cube. ④ All of the high level waste produced in a year from a nuclear power station would occupy a space about a cubic meter in size and would fit safely in a concrete pit.



2. Why decry the wealth gap? First, inequality is correlated with political instability. Second, inequality is correlated with violent crime. Third, economic inequality is correlated with reduced life expectancy. A fourth reason? Simple justice. There is no moral justification for chief executives being paid hundreds of times more than ordinary employees.

—Richard Hutchinsons, "When the Rich Get Even Richer," *The New York Times*, 26 January 2000

3. Genes and proteins are discovered, not invented. Inventions are patentable, discoveries are not. Thus, protein patents are intrinsically flawed.

—Daniel Alroy, "Invention vs. Discovery," *The New York Times*, 29 March 2000

4. Ultimately, whaling's demise in Japan may have little to do with how majestic, smart, or endangered the mammals are, but a good deal to do with simple economics. A Japanese newspaper conducted a survey in Japan regarding the consumption of whale meat, and reported that of all the thousands of respondents, only 4 percent said that they actually ate whale meat at least sometimes. The newspaper then wrote this: "A growing number of Japanese don't want to eat whale meat. And if they won't eat it, they won't buy it. And if they won't buy it, say goodbye to Japanese whaling."

—Reported in *Asahi Shimbun*, April 2002

5. On the 18th of July, 2002, the *Consejo Juvenil Sionista Argentino* (Young Zionists of Argentina) held a mass demonstration to promote

widespread remembrance of the horror of the bombing of the Jewish Community Center in Buenos Aires, exactly eight years earlier. At this demonstration the Young Zionists carried a huge banner, which read: “*Sin memoria, no hay justicia. Sin justicia, no hay futuro.*” (“Without remembrance, there is no justice. Without justice, there is no future.”)

6. Back in 1884, Democratic nominee Grover Cleveland was confronted by the charge that he had fathered an out-of-wedlock child. While Republicans chanted, “Ma, Ma, where’s my Pa,” Cleveland conceded that he had been supporting the child. No excuses, no evasions. One of his supporters—one of the first spin doctors—gave this advice to voters:

Since Grover Cleveland has a terrific public record, but a blemished private life, and since his opponent, James G. Blaine, has a storybook private life but a checkered public record, why not put both where they perform best—return Blaine to private life, keep Cleveland in public life.

7. “Wars don’t solve problems; they create them,” said an October 8 letter about Iraq.

World War II solved problems called Nazi Germany and militaristic Japan, and created alliances with the nations we crushed. The Revolutionary War solved the problem of taxation without representation, and created the United States of America. The Persian Gulf War solved the problem of the Iraqi invasion of Kuwait. The Civil War solved the problem of slavery.

These wars created a better world. War is the only way to defeat evil enemies with whom there is no reasoning. It’s either us or them. What creates true peace is victory.

—Keith Kraska, “Necessary Wars,”
The New York Times, 15 October 2002

8. In the *Crito*, Plato presents the position of the Athenian community, personified as “the Laws,” speaking to Socrates or to any citizen of the community who may contemplate deliberate disobedience to the state:

He who disobeys us is, as we maintain, thrice wrong; first, because in disobeying us he is disobeying his parents; secondly, because we are the authors of his education; thirdly, because he has made an agreement with us that he will duly obey our commands.

9. The reality is that money talks. Court officers, judges and juries treat private lawyers and their clients differently from those who cannot pay for representation. Just as better-dressed diners get prime tables at a restaurant, human nature dictates better results for those who appear to have money.

—Desiree Buenzle, “Free Counsel and Fairness,” *The New York Times*,
15 January 2007

10. The town of Kennesaw, GA passed a *mandatory gun ownership* law, in 1982, in response to a *handgun ban* passed in Morton Grove, IL. Kennesaw’s crime rate dropped sharply, while Morton Grove’s did not. Criminals, unsurprisingly, would rather break into a house where they aren’t at risk of being shot. . . . Criminals are likely to suspect that towns with

laws like these on the books will be unsympathetic to malefactors in general, and to conclude that they will do better elsewhere. To the extent that's true, we're likely to see other communities adopting similar laws so that criminals won't see them as attractive alternatives.

—Glenn Reynolds, “A Rifle in Every Pot,” *The New York Times*, 16 January 2007

Biography

William of Ockham

William of Ockham, sometimes spelled Occam, (c. 1288–c. 1348) was an influential Franciscan friar, born in the village in Surrey, England, after which he was named. Sent while young to a monastery, he went on to study theology and philosophy at Oxford, and then at the University of Paris, where he eventually taught.

The great intellectual theme of William's life was *simplification*. This was manifested most famously in what came to be known as “Ockham's Razor” —the drive for parsimony in the construction of theories. If any phenomenon can be explained without the assumption of this or that hypothetical entity, we ought not assume that entity; one should not multiply entities beyond necessity. In metaphysics this drive for simplification led him to the position known as *nominalism*: what exists in the universe are only individuals. The universals, or Platonic forms, of which some philosophers write, he believed to be no more than the products of abstraction by the human mind.

William became deeply involved in the theological controversies of those medieval days. He was summoned to the Papal court in Avignon in 1324, apparently under charges of heresy. While there a dispute arose concerning the poverty of Christ, many zealous Franciscans insisting that Jesus and his apostles owned no personal property. William came to share that view; he asserted that Pope John XXII, unwilling to accept the poverty of Jesus, was himself an heretic. William was then obliged to take refuge in the court of the Holy Roman Emperor, Ludwig of Bavaria, and while there, not surprisingly, was himself excommunicated. He died in Munich in 1348.

William of Ockham was an inventive logician, suggesting that we might better rely upon a logical system that did not force us to view all propositions as either true or false (a so-called *two-valued logic*), but that a *three-valued logic*, developed more fully many centuries later, would permit a better reflection of the state of our knowledge. Some central logical equivalences, which came later to be known as De Morgan's theorems, he well understood and actually wrote out in words, not having at his disposal the modern notation with which we now express them.

A powerful and widely respected mind, William of Ockham was referred to by many as *Doctor Invincibilis*—“unconquerable teacher.”



INTERFOTO/Alamy Images

3 Complex Argumentative Passages

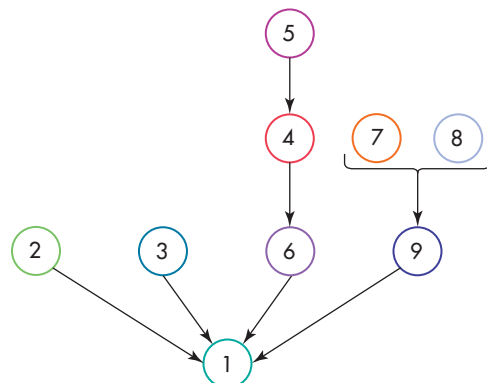
Some arguments are exceedingly complicated. Analyzing passages in which several arguments are interwoven, with some propositions serving as both premises and subconclusions while other propositions serve only as premises, and still others are repeated in different words, can be a challenge. The diagramming technique is certainly helpful, but there is no mechanical way to determine whether the diagram actually does represent the author's intent accurately. More than one plausible interpretation may be offered, and in that case more than one diagram can reasonably be used to show the logical structure of that passage.

To analyze fairly, we must strive to understand the flow of the author's reasoning, and to identify the role of each element in the passage as part of that flow. The examples that follow (in which component propositions have been numbered for purposes of analysis) show the ways in which we can set forth the connections between premises and conclusions. Only after that is done, when we have identified the arguments within a passage and the relations of those arguments, can we go about deciding whether the conclusions do indeed follow from the premises affirmed.

In the following set of arguments, the final conclusion of the passage appears in the very first statement, which is not unusual. Four premises directly support this conclusion; two of these are subconclusions, which in turn are supported, in different ways, by other premises affirmed in the passage:

- ① It is very unlikely that research using animals will be unnecessary or poorly done. ② Before an experiment using a vertebrate animal is carried out, the protocol for that experiment must be reviewed by an institutional committee that includes a veterinarian and a member of the public, and ③ during the research the animal's health and care are monitored regularly. ④ Researchers need healthy animals for study in science and medicine, because ⑤ unhealthy animals could lead to erroneous results. This is a powerful incentive for ⑥ scientists to make certain that any animals they use are healthy and well nourished. Furthermore, ⑦ research involving animals is expensive, and because ⑧ funding is limited in science, ⑨ only high-quality research is able to compete effectively for support.¹⁵

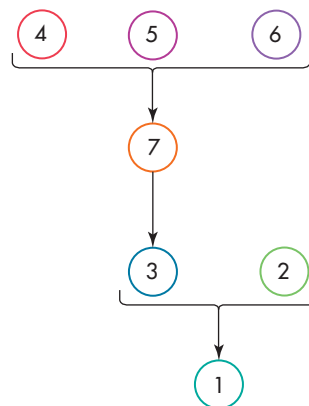
The following diagram shows the logical structure of this passage. To "read" the diagram we replace the numbers with the indicated propositions, beginning with those highest on the page and therefore earliest in the logical cascade. We thus follow each of the several paths of reasoning to the final conclusion.



Repetition complicates the task of analysis. Individual propositions are sometimes repeated within an argument in differently worded sentences, sometimes for emphasis and at other times by oversight. The diagram reveals this because we can assign the same number to different formulations of the same proposition. The following passage, comprising three distinct arguments, exhibits this confusing duplication of propositions:

① The Big Bang theory is crumbling. . . . ② According to orthodox wisdom, the cosmos began with the Big Bang—an immense, perfectly symmetrical explosion 20 billion years ago. The problem is that ③ astronomers have confirmed by observation the existence of huge conglomerations of galaxies that are simply too big to have been formed in a mere 20 billion years. . . . Studies based on new data collected by satellite, and backed up by earlier ground surveys, show that ④ galaxies are clustered into vast ribbons that stretch billions of light years, and ⑤ are separated by voids hundreds of millions of light years across. Because ⑥ galaxies are observed to travel at only a small fraction of the speed of light, mathematics shows that ⑦ such large clumps of matter must have taken at least one hundred billion years to come together—five times as long as the time since the hypothetical Big Bang. . . . ③ Structures as big as those now seen can't be made in 20 billion years. . . . ② The Big Bang theorizes that matter was spread evenly through the universe. From this perfection, ③ there is no way for such vast clumps to have formed so quickly.¹⁶

In this passage the premises that report observational evidence, ④, ⑤, and ⑥, give reasons for ⑦, the great length of time that would have had to elapse since the Big Bang. This passage of time is used to support the subconclusion (formulated in three slightly different ways) that ③ structures as big as those now seen are too big to have been formed in that period of time. From that subconclusion, combined with ②, a short statement (formulated in two slightly different ways) of the original symmetry and spread that the Big Bang theory supposes, we infer the final conclusion of the passage, ①: that the Big Bang theory is crumbling—the proposition with which the passage begins. The following diagram shows this set of logical relations:

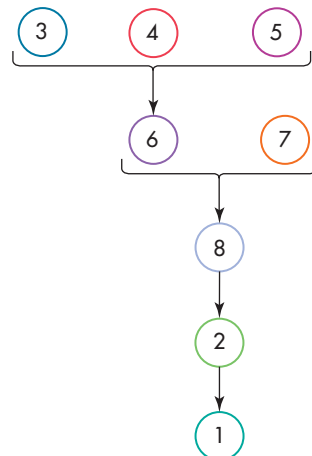


The fact that a premise may appear in compressed form, sometimes as a short noun phrase, must be borne in mind. In the following argument the phrase “the scattering in the atmosphere” serves as a premise, ④, that may be reformulated as

“the sun’s energy is scattered in the atmosphere.” This compression, along with repetition, makes it more difficult to analyze this argument:

① Solar-powered cars can never be anything but experimental devices. ② Solar power is too weak to power even a mini-car for daily use. ③ The solar power entering the atmosphere is about 1 kilowatt per square yard. Because of ④ the scattering in the atmosphere, and because ⑤ the sun shines half a day on the average at any place on earth, ⑥ average solar power received is 1/6 kilowatt, or 4 kilowatt hours a day. . . . Tests on full-size cars indicate that ⑦ 300,000 watt hours are required in a battery for an electric car to perform marginally satisfactorily. So, ⑧ 40 square yards of cells would be needed to charge the car batteries, about the size of the roof of a tractor-trailer. ① It is not undeveloped technologies that put solar power out of the running to be anything but a magnificently designed experimental car. It is cosmology.¹⁷

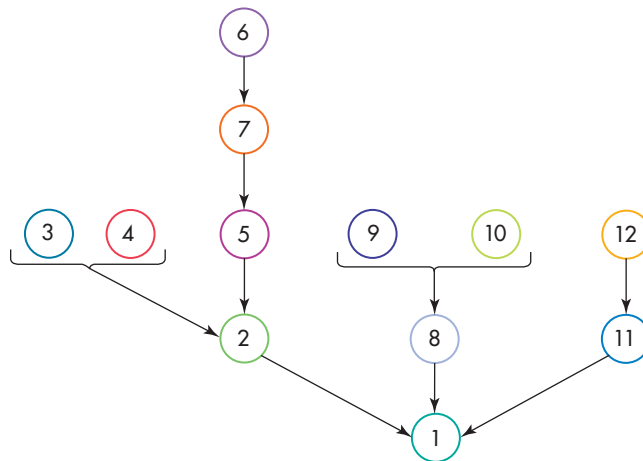
The first proposition in this passage, asserting that “solar powered cars can never be more than experimental,” is the final conclusion. It is repeated in more elaborate form at the end of the passage, as a diagram of the passage shows:



Complex argumentative passages can be entirely cogent. The following complex argument, for example, was offered by a distinguished editor in defense of her highly controversial editorial policy:

The *Journal* [the *New England Journal of Medicine*] . . . has taken the position that ① it will not publish reports of unethical research, regardless of their scientific merit. . . . There are three reasons for our position. First, ② the policy of publishing only ethical research, if generally applied, would deter unethical work. ③ Publication is an important part of the reward system in medical research, and ④ investigators would not undertake unethical studies if they knew the results would not be published. Furthermore, ⑤ any other policy would tend to lead to more unethical work, because, as I have indicated, ⑥ such studies may be easier to carry out and thus ⑦ may give their practitioners a competitive edge. Second, ⑧ denying publication even when the ethical violations are minor protects the principle of the primacy of the research subject. ⑨ If small lapses were permitted we would become inured to them, and ⑩ this would lead to larger violations. And finally, ⑪ refusal to publish unethical work serves notice to society at large that even scientists do not consider science the primary measure of a civilization. ⑫ Knowledge, although important, may be less important to a decent society than the way it is obtained.¹⁸

Again, the final conclusion appears at the beginning of the passage, and the three major premises that support it directly, ② ⑧, and ⑪, are themselves supported by various other premises arranged differently. However, each of the many propositions in the passage has a clear logical role in leading to the conclusion that the passage aims to justify: Reports of research done in unethical ways will not be published in the *New England Journal of Medicine*, regardless of their scientific merit. The following diagram shows the logical structure of this complicated but carefully reasoned passage:



Arguments in newspaper editorials and letters-to-the-editor columns often fall short of this standard. They may include statements whose role is unclear; connections among the statements in the argument may be tangled or misstated; the flow of argument may be confused even in the mind of the author. Logical analysis, paraphrase supported by diagrams, can expose such deficiencies. By exhibiting the *structure* of a reasoning process, we can better see what its strengths and weaknesses may be. The aim and special province of logic is the evaluation of arguments, but successful evaluation presupposes a clear grasp of the structure of the argument in question.

EXERCISES

Each of the following famous passages, taken from classical literature and philosophy, comprises a set of arguments whose complicated interrelations are critical for the force of the whole. Construct for each the diagram that you would find most helpful in analyzing the flow of argument in that passage. More than one interpretation will be defensible.

1. A question arises: whether it be better [for a prince] to be loved than feared or feared than loved? One should wish to be both, but, because it is difficult to unite them in one person, it is much safer to be feared than loved, when, of the two, one must be dispensed with. Because this is to

be asserted in general of men, that they are ungrateful, fickle, false, cowards, covetous. . . . and that prince who, relying entirely on their promises, has neglected other precautions, is ruined, because friendships that are obtained by payments may indeed be earned but they are not secured, and in time of need cannot be relied upon. Men have less scruple in offending one who is beloved than one who is feared, for love is preserved by the link of obligation which, owing to the baseness of men, is broken at every opportunity for their advantage; but fear preserves you by a dread of punishment which never fails.

—Niccolò Machiavelli, *The Prince*, 1515

2. Democratic laws generally tend to promote the welfare of the greatest possible number; for they emanate from the majority of the citizens, who are subject to error, but who cannot have an interest opposed to their own advantage. The laws of an aristocracy tend, on the contrary, to concentrate wealth and power in the hands of the minority; because an aristocracy, by its very nature, constitutes a minority. It may therefore be asserted, as a general proposition, that the purpose of a democracy in its legislation is more useful to humanity than that of an aristocracy.

—Alexis de Tocqueville, *Democracy in America*, 1835

3. “. . . You appeared to be surprised when I told you, on our first meeting, that you had come from Afghanistan.”
“You were told, no doubt.”
“Nothing of the sort. I *knew* you came from Afghanistan. From long habit the train of thoughts ran so swiftly through my mind that I arrived at the conclusion without being conscious of intermediate steps. There were such steps, however. The train of reasoning ran, ‘Here is a gentleman of medical type, but with the air of a military man. Clearly an army doctor, then. He has just come from the tropics, for his face is dark, and that is not the natural tint of his skin, for his wrists are fair. He has undergone hardship and sickness, as his haggard face says clearly. His left arm has been injured. He holds it in a stiff and unnatural manner. Where in the tropics could an English army doctor have seen much hardship and got his arm wounded? Clearly in Afghanistan.’ The whole train of thought did not occupy a second. I then remarked that you came from Afghanistan, and you were astonished.”
“It is simple enough as you explain it,” I said, smiling.

—A. Conan Doyle, *A Study in Scarlet*, 1887

4. Nothing is demonstrable unless the contrary implies a contradiction. Nothing that is distinctly conceivable implies a contradiction. Whatever we conceive as existent, we can also conceive as nonexistent. There is no being, therefore, whose nonexistence implies a contradiction. Consequently there is no being whose existence is demonstrable.

—David Hume, *Dialogues Concerning Natural Religion*, Part IX, 1779

Challenge to the Reader

In the *Ethics* (1677), Baruch Spinoza, one of the most influential of all modern thinkers, presents a deductive philosophical system in which the central conclusions—about God, about nature, and about human life and human freedom—are demonstrated in “geometrical” fashion. Here follows an example. Proposition 29 of the first book of the *Ethics* (there are five books in all) reads:

In nature there is nothing contingent, but all things are determined from the necessity of the divine nature to exist and act in a certain manner.

Immediately after the statement of each proposition in the *Ethics* appears its proof. The proof of Prop. 29 (from which internal references to proofs given earlier in the same work have been omitted for the sake of clarity) appears immediately below. Analyze this proof, by constructing a diagram that shows the structure of the argument, or by paraphrasing it in a way that makes it clear and persuasive to a modern reader.

Whatever is, is in God. But God cannot be called a contingent thing, for He exists necessarily and not contingently. Moreover, the modes of the divine nature [the creations which depend on, or have been created by, God immediately] have followed from it necessarily and not contingently. . . . But God is the cause of these modes not only in so far as they simply exist, but also in so far as they are considered as determined to any action. If they are not determined by God it is an impossibility and not a contingency that they should determine themselves; and, on the other hand, if they are determined by God it is an impossibility and not a contingency that they should render themselves indeterminate. Wherefore all things are determined from a necessity of the divine nature, not only to exist, but to exist and act in a certain manner, and there is nothing contingent. ●

4 Problems in Reasoning

In reasoning we advance from premises known (or affirmed for the purpose) to conclusions. We construct arguments of our own every day, in deciding how we shall act, in judging the conduct of others, in defending our moral or political convictions, and so on. Skill in devising good arguments (and in deciding whether a proffered argument is good) is of enormous value, and this skill can be improved with practice. Ancient games of reasoning, such as chess and go, exercise that skill, and there are some widely known commercial games (Clue and Mastermind are examples) that also have this merit.

Problems may be contrived which are designed to test and strengthen logical skills; some of these are presented in this section. Such problems are far neater than those that arise in real life, of course. But solving them may require extended reasoning in patterns not very different from those employed by a detective, a journalist, or a juror. Chains of inferences will be needed, in which subconclusions are used as premises in subsequent arguments. Finding the solution may require the creative recombination of information given earlier or discovered. Contrived problems can prove frustrating—but solving them, like every successful

application of reasoning, is quite satisfying. In addition to being models for the employment of reason, logical games and puzzles are good fun. “The enjoyment of the doubtful,” wrote the philosopher John Dewey, “is a mark of the educated mind.”

One type of reasoning problem is the common brainteaser in which, using only the clues provided, we must determine the names or other facts about certain specified characters. Here is a simple example:

In a certain flight crew, the positions of pilot, copilot, and flight engineer are held by three persons, Allen, Brown, and Carr, though not necessarily in that order. The copilot, who is an only child, earns the least. Carr, who married Brown’s sister, earns more than the pilot. What position does each of the three persons hold?

To solve such problems we look first for a sphere in which we have enough information to reach some conclusions going beyond what is given in the premises. In this case we know most about Carr: he is not the pilot, because he earns more than the pilot; and he is not the copilot because the copilot earns the least. By elimination we may infer that Carr must be the flight engineer. Using that subconclusion we can determine Brown’s position. Brown is not the copilot because he has a sister and the copilot is an only child; he is not the flight engineer because Carr is. Brown must therefore be the pilot. Allen, the only one left, must therefore be the copilot.

When problems of this type become more complex, it is useful to construct a graphic display of the alternatives, called a *matrix*, which we fill in as we accumulate new information. The helpfulness of such a matrix will be seen in solving the following problem:

Alonzo, Kurt, Rudolf, and Willard are four creative artists of great talent. One is a dancer, one is a painter, one is a singer, and one is a writer, though not necessarily in that order.

1. Alonzo and Rudolf were in the audience the night the singer made his debut on the concert stage.
2. Both Kurt and the writer have had their portraits painted from life by the painter.
3. The writer, whose biography of Willard was a best-seller, is planning to write a biography of Alonzo.
4. Alonzo has never heard of Rudolf.

What is each man’s artistic field?

To remember the facts asserted in these premises, as well as the subconclusions that may be inferred from them, would be a demanding task. Written notes could become a confusing clutter. We need a method for storing and exhibiting the information given and the intermediate conclusions drawn, keeping it all available for use as the number of inferences increases and the chain of arguments lengthens. The matrix we construct allows us to represent all the relevant possibilities and to record each inference drawn.

For this problem the matrix must display an array of the four persons (in four rows) and the four artistic professions (in four columns) that they hold. It would look like this:

	Dancer	Painter	Singer	Writer
Alonzo				
Kurt				
Rudolf				
Willard				

When we conclude that one of those individuals (named at the left of one of the rows) cannot be the artist whose profession is at the top of one of the columns, we write an N (for “No”) in the box to the right of that person’s name and in the column headed by that profession. We can immediately infer, from premise (1), that neither Alonzo nor Rudolph is the singer, so we place an N to the right of their names, in the third (singer) column. We can infer from premise (2) that Kurt is neither the painter nor the writer, so we enter an N to the right of his name in the second (painter) and the fourth (writer) columns. From premise (3) we see that the writer is neither Alonzo nor Willard, so we enter an N to the right of their names in the fourth column. The entries we have made thus far are all justified by the information given originally, and our matrix now looks like this:

	Dancer	Painter	Singer	Writer
Alonzo			N	N
Kurt		N		N
Rudolf			N	
Willard				N

From the information now clearly exhibited, we can conclude by elimination that Rudolf must be the writer, so we enter a Y (for “Yes”) in the box to the right of Rudolf’s name in the fourth (writer) column, and we place an N in the other boxes to the right of his name. The array now makes it evident that the painter must be either Alonzo or Willard, and we can eliminate Alonzo in this way: Rudolf had his portrait painted by the painter (from premise 2), and Alonzo has never heard of Rudolf (from premise 4)—therefore Alonzo cannot be the painter. So we enter an N to the right of Alonzo’s name under column 2 (painter). We may conclude that Alonzo must be the dancer, so we enter a Y to the right of Alonzo’s name in the first (dancer) column. In that same column we can now enter an N for both Kurt and Willard. The only possible category remaining for Kurt is singer, and therefore we enter a Y in that box for him, and an N in the singer column for Willard. By elimination, we conclude that Willard must be the painter and put a Y in the last empty box in the matrix. Our completed graphic display looks like this:

	Dancer	Painter	Singer	Writer
Alonzo	Y	N	N	N
Kurt	N	N	Y	N
Rudolf	N	N	N	Y
Willard	N	Y	N	N

Our matrix now filled in, the full solution is evident: Alonzo is the dancer; Kurt is the singer; Rudolf is the writer; Willard is the painter.

Some brainteasers of this kind, requiring solutions on several dimensions, are very challenging and almost impossible to solve without using a matrix.

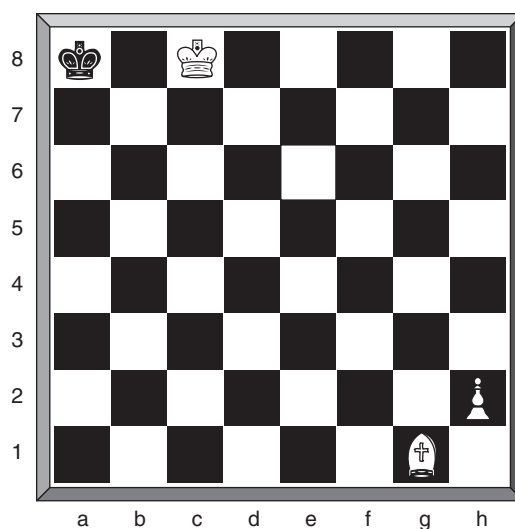
In the real world, we are often called upon to reason from some present state of affairs to its causes, from what is to what was. Scientists—especially archeologists, geologists, astronomers, and physicians—commonly confront events or conditions whose origins are problematic. Reasoning that seeks to explain how things must have developed from what went before is called **retrograde analysis**. For example, to the amazement of astronomers, comet Hyakutake, streaking by the earth in 1996, was found to be emitting variable X-rays a hundred times stronger than anyone had ever predicted a comet might emit. A comet expert at the Max Planck Institute in Germany remarked, “We have our work cut out for us in explaining these data—but that’s the kind of problem you love to have.”

We do love to have them, and for that reason problems in retrograde analysis are often devised for amusement. In the real world, logical problems arise within a theoretical framework that is supplied by scientific or historical knowledge; but in contrived problems that framework must be provided by the problem itself. Some rules or laws must be set forth within which logical analysis can proceed. The chessboard is the setting for the most famous of all problems in retrograde analysis; the rules of chess provide the needed theoretical context. No skill in playing chess is required, but readers who are not familiar with the rules of chess may skip the illustration that follows.

Retrograde problems in chess commonly take this form: An arrangement of pieces on the chessboard is given; it was reached in a game of chess in which all the rules of the game were obeyed. What move, or series of moves, has just been completed? An example of such a problem follows. The diagram presents a position reached in an actual game of chess, all moves in that game having been made in accordance with the rules of chess. The black king has just moved.

Retrograde analysis

Reasoning that seeks to explain how things must have developed from what went before.



For the purpose of analysis, the rows are numbered from bottom to top, 1 to 8, and the columns are lettered from left to right, a to h. Each square on the board can then be identified by a unique letter-number combination: The black king is on a8, the white pawn on h2, and so on. The problem is this: The last move was made by black. What was that move? And what was white's move just before that? Can you reason out the solution before reading the next paragraph?

Solution: Because the two kings may never rest on adjacent squares, the black king could not have moved to its present position from b7 or from b8; therefore we may be certain that the black king has moved from a7, where it was in check.

That much is easily deduced. But what preceding white move could have put the black king in check? No move by the white bishop (on g1) could have done it, because there would have been no way for that bishop to move to that square, g1, without the black king having been in check with white to move. Therefore it must be that the check was *discovered* by the movement of a white piece that had been blocking the bishop's attack and was captured by the black king on its move to a8. What white piece could have been on that black diagonal and moved from there to the white square in the corner? Only a knight that had been on b6. We may therefore be certain that before black's last move (the black king from a7 to a8), white's last move was that of a white knight from b6 to a8.¹⁹

Problems of reasoning that confront us in the real world are rarely this tidy. Many real problems are not described accurately, and their misdescription may prove so misleading that no solution can be reached. In cases of that kind, some part or parts of the description of the problem need to be rejected or replaced. However, we cannot do this when we are seeking to solve logical puzzles of the sort presented here.

In the real world, moreover, even when they are described accurately, problems may be incomplete in that something not originally available may be essential for the solution. The solution may depend on some additional scientific discovery, or some previously unimagined invention or equipment, or the search of some as-yet-unexplored territory. In the statement of a logical puzzle, as in the writing of a good murder mystery, all the information that is sufficient for the solution must be given; otherwise we feel that the mystery writer, or the problem maker, has been unfair to us.

Finally, the logical puzzle presents a sharply formulated question (for example, which member of the artistic foursome is the singer? What were black's and white's last moves?) whose answer, if given and proved, solves the problem definitively. But that is not the form in which many real-world problems arise. Real problems are often identified, initially at least, only by the recognition of some inconsistency or the occurrence of an unusual event, or perhaps just by the feeling that something is amiss, rather than by a well-formed question seeking a clearly defined answer. In spite of these differences, contrived problems and puzzles are useful in strengthening our reasoning skills—and they are fun.

EXERCISES

The following problems require reasoning for their solution. To prove that an answer is correct requires an argument (often containing subsidiary arguments) whose premises are contained in the statement of the problem—and whose final conclusion is the answer to it. If the answer is correct, it is possible to construct a valid argument proving it. In working these problems, readers are urged to concern themselves not merely with discovering the answers but also with formulating arguments to prove that those answers are correct.

1. In a certain mythical community, politicians never tell the truth, and non-politicians always tell the truth. A stranger meets three natives and asks the first of them, “Are you a politician?” The first native answers the question. The second native then reports that the first native denied being a politician. The third native says that the first native is a politician.

How many of these three natives are politicians?

2. Of three prisoners in a certain jail, one had normal vision, the second had only one eye, and the third was totally blind. The jailor told the prisoners that, from three white hats and two red hats, he would select three and put them on the prisoners’ heads. None could see what color hat he wore. The jailor offered freedom to the prisoner with normal vision if he could tell what color hat he wore. To prevent a lucky guess, the jailor threatened execution for any incorrect answer. The first prisoner could not tell what hat he wore. Next the jailor made the same offer to the one-eyed prisoner. The second prisoner could not tell what hat he wore either. The jailor did not bother making the offer to the blind prisoner, but he agreed to extend the same terms to that prisoner when he made the request. The blind prisoner said:

I do not need to have my sight;
From what my friends with eyes have said,
I clearly see my hat is ____!

How did he know?

3. On a certain train, the crew consists of the brakeman, the fireman, and the engineer. Their names, listed alphabetically, are Jones, Robinson, and Smith. On the train are also three passengers with corresponding names, Mr. Jones, Mr. Robinson, and Mr. Smith. The following facts are known:
 - a. Mr. Robinson lives in Detroit.
 - b. The brakeman lives halfway between Detroit and Chicago.
 - c. Mr. Jones earns exactly \$40,000 a year.
 - d. Smith once beat the fireman at billiards.
 - e. The brakeman’s next-door neighbor, one of the three passengers mentioned, earns exactly three times as much as the brakeman.
 - f. The passenger living in Chicago has the same name as the brakeman.

What is the engineer’s name?

4. The employees of a small loan company are Mr. Black, Mr. White, Mrs. Coffee, Miss Ambrose, Mr. Kelly, and Miss Earnshaw. The positions they occupy are manager, assistant manager, cashier, stenographer, teller, and clerk, though not necessarily in that order. The assistant manager is the manager's grandson, the cashier is the stenographer's son-in-law, Mr. Black is a bachelor, Mr. White is twenty-two years old, Miss Ambrose is the teller's stepsister, and Mr. Kelly is the manager's neighbor.

Who holds each position?

5. Benno Torelli, genial host at Miami's most exclusive nightclub, was shot and killed by a racketeer gang because he fell behind in his protection payments. After considerable effort on the part of the police, five suspects were brought before the district attorney, who asked them what they had to say for themselves. Each of them made three statements, two true and one false. Their statements were

Lefty: I did not kill Torelli. I never owned a revolver in all my life. Spike did it.

Red: I did not kill Torelli. I never owned a revolver. The others are all passing the buck.

Dopey: I am innocent. I never saw Butch before. Spike is guilty.

Spike: I am innocent. Butch is the guilty one. Lefty did not tell the truth when he said I did it.

Butch: I did not kill Torelli. Red is the guilty one. Dopey and I are old pals.

Whodunnit?

6. Mr. Short, his sister, his son, and his daughter are fond of golf and often play together. The following statements are true of their foursome:
- a. The best player's twin and the worst player are of the opposite sex.
 - b. The best player and the worst player are the same age.

Which one of the foursome is the best player?

7. Daniel Kilraine was killed on a lonely road, 2 miles from Pontiac, Michigan, at 3:30 A.M. on March 17 of last year. Otto, Curly, Slim, Mickey, and the Kid were arrested a week later in Detroit and questioned. Each of the five made four statements, three of which were true and one of which was false. One of these persons killed Kilraine.

Their statements were

Otto: I was in Chicago when Kilraine was murdered. I never killed anyone. The Kid is the guilty one. Mickey and I are pals.

- Curly:** I did not kill Kilraine. I never owned a revolver in my life. The Kid knows me. I was in Detroit the night of March 17.
- Slim:** Curly lied when he said he never owned a revolver. The murder was committed on St. Patrick's Day. Otto was in Chicago at this time. One of us is guilty.
- Mickey:** I did not kill Kilraine. The Kid has never been in Pontiac. I never saw Otto before. Curly was in Detroit with me on the night of March 17.
- The Kid:** I did not kill Kilraine. I have never been in Pontiac. I never saw Curly before. Otto erred when he said I am guilty.

Whodunnit?

8. Six balls confront you. Two are red; two are green; two are blue. You know that in each color pair, one ball is heavier than the other. You also know that all three of the heavier balls weigh the same, as do all three of the lighter balls. The six balls (call them R1, R2, G1, G2, B1, and B2) are otherwise indistinguishable. You have only a balance scale; if equal weights are placed on the two sides of your scale, they will balance; if unequal weights are placed on the two sides, the heavier side will go down. With no more than two weighings on that balance scale, how can you identify the heavier and the lighter balls in all three pairs?
9. In the same mythical community described in Exercise 1, a stranger meets three other natives and asks them, "How many of you are politicians?" The first native replies, "We are all politicians." The second native says, "No, just two of us are politicians." The third native then says, "That isn't true either."
Is the third native a politician?
10. Imagine a room with four walls, with a nail placed in the center of each wall, as well as in the ceiling and floor, six nails in all. The nails are connected to each other by strings, each nail connected to every other nail by a separate string. These strings are of two colors, red or blue, and of no other color. All these strings obviously make many triangles, because any three nails may be considered the apexes of a triangle.
Can the colors of the strings be distributed so that no one triangle has all three sides (strings) of the same color? If so, how? And if not, why not?

Challenge to the Reader

Here is a final reasoning problem whose solution requires the construction of a set of sustained arguments. It isn't easy—but solving it is well within your power and will give you great pleasure.

You are presented with a set of twelve metal balls, apparently identical in every respect: size, color, and so on. In fact, eleven of them are identical, but one of them is “odd”: It differs from all the rest in weight only; it is either heavier, or lighter, than all the others. You are given a balance scale, on which the balls can be weighed against one another. If the same number of balls are put on each side of the balance, and the “odd” ball is on one side, that side will go down if the odd ball is heavier, or up if the odd ball is lighter; the two sides will balance if the odd ball is not among those weighed and the same number of balls are placed on each side. You are allowed three weighings only; any removal or addition of a ball constitutes a separate weighing.

Your challenge is this: Devise a set of three weighings that will enable you to identify the odd ball wherever it may lie in a random mixing of the twelve balls, *and* that will enable you to determine whether the odd ball is heavier or lighter than the rest. ●

chapter Summary

In this chapter we have discussed techniques for the analysis of arguments, and some of the difficulties confronted in that process.

In Section 1 we explained the paraphrasing of an argumentative passage, in which the essential propositions may be reworded (or supplied if they are assumed but missing), and in which premises and conclusions are put into the most intelligible order.

In Section 2 we explained the diagramming of an argument, in which the propositions of an argument are represented by numbers, and the relations of the premises and conclusions are then exhibited graphically in two dimensions, by showing on a page the relations of those numbered propositions.

In Section 3 we discussed complex argumentative passages, in which the conclusions of subarguments may serve as premises for further arguments, and whose complete analysis generally requires an intricate diagram or an extensive paraphrase.

In Section 4 we discussed contrived problems of reasoning, which often mirror the complexities confronted by many different kinds of investigation in real life, and whose solutions require the construction of extended sets of arguments and subarguments.

END NOTES

¹*Lawrence v Texas*, 539 U.S. 558 (2003).

²This technique was first developed and perfected decades ago by several distinguished logicians: Monroe C. Beardsley, in *Practical Logic* (Englewood Cliffs, NJ: Prentice Hall, 1950); Stephen N. Thomas, in *Practical Reasoning in Natural Language* (Englewood Cliffs, NJ: Prentice Hall, 1973); and Michael Scriven, in *Reasoning* (New York: McGraw-Hill, 1976). We follow their lead.

³John Blass “Stem Cell Research: When Does Life Begin?” *The New York Times*, 25 January 2007.

⁴Adam Gopnick, “The Unbeautiful Game,” *The New Yorker*, 8 January 2007.

⁵James Surowiecki, “Dealer’s Choice,” *The New Yorker*, 4 September 2006.

⁶Blanchard Hiatt, *University of Michigan Research News*, September 1979.

⁷Robert Alter, “Neocon or Not?” *The New York Times Book Review*, 25 June 2006.

⁸Karl Marx, Letter #141, 9 April 1870, in *Karl Marx and Friedrich Engels Correspondence, 1846–1895* (New York: International Publishers, 1936).

⁹Boston Women’s Health Book Collective, *Our Bodies, Ourselves* (New York: Simon & Schuster, 1984).

¹⁰C. A. Quadir, *Philosophy and Science in the Islamic World* (London: Croom Helm, 1988).

¹¹Thomas Aquinas, *Summa Theologiae*, I, Question 96, Article 2, circa 1265.

¹²*Ibid.*, Article 3.

¹³*Science*, 26 May 1995.

¹⁴Paraphrased in part from Andres Duany, Elizabeth Plater-Zyberk, and Jeff Speck, *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream* (New York: North Point Press, 2000).

¹⁵*Science, Medicine, and Animals* (Washington, DC: National Academy of Sciences, 1991).

¹⁶Eric J. Lerner, “For Whom the Bang Tolls,” *The New York Times*, 2 June 1991.

¹⁷Victor Wouk, “You Can’t Drive Solar Cars to Work,” *The New York Times*, 15 July 1991.

¹⁸Marcia Angell, “The Nazi Hypothermia Experiments and Unethical Research Today,” *New England Journal of Medicine*, 17 May 1990.

¹⁹Readers who find retrograde analysis enjoyable will take delight in a collection of such problems, compiled by the logician Raymond Smullyan, and entitled *The Chess Mysteries of Sherlock Homes* (New York: Alfred A. Knopf, 1979).



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