

Essential Logic

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Chapter 1: WHY STUDY LOGIC?

You can fool some of the people all of the time, and all of the people some of the time, but you cannot fool all of the people all of the time. **Abraham Lincoln**

A King can stand people fighting, but he can't last long if people start thinking. **Will Rogers**

Logic as a Defensive Tool

Why study logic? Most people often take for granted that thinking logically is a good thing and that studying logic will make us better persons. But will logical thinking help us be more ethical in our behavior? Will it help us be nicer to people in our families, to our friends, to strangers? Will it help us be more objective and more tolerant of other ways of life? Will it make us more intelligent, wiser, more likely to make the right decisions in a complex world? Will it make us happier?

As promised in the Introduction, this book will be more than a standard introduction to logic and will address the above philosophical issues. But for now consider that your study of logic has a more focused mission. Logic can be viewed as a *defensive tool*, a tool that allows us to defend ourselves against the onslaught of powerful persuasive appeals that bombard us daily. As an example of this, bear with me and take the brief critical thinking test below.

Items 1-4 require an evaluation of commonly used advertisements. Select the option that you think is the best answer.

1. "No other digital video recorder retailer can beat Sam Kung's prices."

If the above statement is true, which one of the following must also be true?

- a) Only Sam Kung has low prices for digital video recorders.
- b) Sam Kung's digital video recorders are the least expensive of all video recorders.
- c) The best buys in digital video recorders are at Sam Kung's.

- d) Sam Kung's digital video recorders are priced at least as low as other digital recorders sold at other retail shops.

2. "Now you can save up to 50% and more on many famous brand items at PayLess."

For this claim to be true, which one of the following must also be true? What are the minimum conditions necessary for this claim to be true?

- a) At least one famous brand item must be more than 50 percent off.
- b) At least some of the famous brand items must be 50 percent off, and a few must be more than 50 percent off.
- c) At least half the store's items must be 50 percent off and a few famous brand items must be more than 50 percent off.
- d) At least half of the famous items must be more than 50 percent off.

3. "Only Chrysler offers 11.9% financing on new cars."

Even if this statement is true, which one of the following could be true?

- a) Some of Chrysler's more expensive cars could have a higher financing rate.
- b) Another carmaker could have a lower financing rate.
- c) Many other carmakers could have a lower financing rate.
- d) a, b, and c.

4. "Dunlop's SP-4 radial tire had the highest rating in *Car and Driver's* tire test."

The persuasiveness of the above claim is weakened by its ambiguous or vague use of the word(s)

- a) test.
- b) rating.
- c) tire.
- d) highest.
- e) a, b, c.
- f) a, b, c, and d.

Did you choose *a*, *b*, or *c* in number 1? If you did, then you did exactly what the creators of this advertisement hoped you would -- you were *psychologically tricked* by the language into believing that Sam Kung has the lowest or best prices for the digital video recorders sold at this store compared to the competition. Note also that this trick does not

involve lying or misrepresenting the truth, rather you were tricked into making an illogical *inference* from a statement we said was true to a statement that we do not know to be true. By an inference logicians mean that you were lead **to accept as true a particular belief based on another belief accepted as true**. However, if you read the advertisement carefully -- and the creators of this advertisement are hoping that you will not -- you can see that all this appeal is saying is that no one can be lower, which is very different from saying that Sam Kung's prices are the lowest.

Let's think of a hypothetical scenario by which we can demonstrate that this is so -- that even if the advertisement is true, we would not be entitled to infer that Sam Kung's store has the lowest prices. Suppose upon reading this advertisement we went to shop at Sam Kung's. (Already the advertisement would have served one of its purposes -- it "hooked" us into going to the store where a sales person can work on us.) Suppose we find the latest digital video recorder at a price of \$199.99.¹ Suppose next door at Kaneshiro's TV Sales and Service we find that the same recorder is priced at \$199.99. The advertisement for Sam Kung's would still be true. Kaneshiro's did not "beat" Sam Kung's price, but Sam Kung's price was not the lowest or the best price. All the original advertisement is saying is that Sam Kung's is committed to having the same prices as their competitors, but how many of us would rush down to Sam Kung's if we saw an advertisement that read, "Come to Sam Kung's, we have the same prices as everyone else"?

It is surprising how many people fall for this trick. It is no accident that this same type of appeal is made in many other advertisements, such as "No one can beat United to Chicago," "No one beats Midas," "No regular aspirin product reduces fever better than Bufferin," or the Safeway supermarket slogan, "Nobody does it better." Also consider, "Nothing outlasts an Energizer (battery)," and the Duracell slogan, "You can't top the Copper Top." The last two examples show the empty nature of this general appeal: similar slogans can be used for competing products! These advertisements work, however. It is a sad commentary on the state of human affairs that a great deal of human creativity involves one group of people devising ways to deceive another group of people.² These advertisements are good examples of how a creative writer can create what seems a highly positive statement about a product without really saying anything at all.

However, it is also encouraging to see how many people quickly see the trick in these ads after a little careful reading and common sense reflection. As you progress through the

¹ It should be obvious to you now that advertisers use .99, as in \$199.99, for psychological appeal. We all know that \$199.99 is for all intents and purposes really \$200. But it feels better to say that we paid about \$100. This is a case where advertisers know that they will not be deceiving us, but that we will want to deceive ourselves.

² In his book, *The Biology of Moral Systems*, Harvard naturalist Richard Alexander argues that we cooperate and identify with a group only to compete with another group of human beings. According to Alexander, because of our intelligence we no longer have to worry as much about the hostile forces of nature. So, "Apparently, no other species has accomplished this peculiar evolutionary feat, which has led to an unprecedented level of group-against-group within species competition. It is this competition that draws us toward strange and ominous consequences." This may mean that deception is inevitable, but see Chapter 6, Logic and Hope.

more difficult portions of this book, it will be important to remember for motivational purposes that logic is simply *organized common sense*. Most logic books define logic as the study of principles used in distinguishing correct from incorrect reasoning. For now, from our point of view, all this means is that we will be slowing our thinking down and reflecting carefully on reasoning trails, using our common sense to see if these trails are tricks or not and if we ought to follow them or not. Hence, everyone should be good at logic; it is a mistake to think that logic is something that only a special type of person is good at. Some people may be faster at learning it, just as some people learn languages better than others. But just as in learning a language, we all have the capability if we immerse ourselves in a situation where such a tool is needed all the time. Anyone could learn to speak Russian if they lived in Russia long enough.

Logicians make a living by formalizing reasoning, by identifying the simplest acts of good reasoning and organizing them into principles of inference and analysis, such that more complex presentations of thought can be judged. Thus, logic provides a defensive discipline for staying calm and organized when confronted by the buzzing, confusing voices of all those who want our attention, support, and, most often, money. In our digital, Google, Internet age advertisers have more power than ever. After you post an email on Gmail, the content will be analyzed by powerful computers and the next time you access your account you will see commercials related to the content of your email. Yahoo and the New York Times keep a record of what you read at these sites and post news articles accordingly. If you have read pro or con articles on global warming, most likely you will see a personalized presentation of the news with more articles pro or con. It will be much harder for you to stay objective and see all sides of an issue. Worse, tech visionaries predict that we will soon be able to interface our brains directly with the Internet. But who will be controlling your mind? From the beginnings of the development of logic in ancient Greece, logicians have always been concerned about giving the individual the tools for people to defend against persuasion from the powerful.

In Chapter 2 we will discuss this formalization tool process in more detail, but as an early example we can indicate how our first advertising example could be formalized into various arguments (inferences) -- three bad or "invalid" arguments if *a*, *b*, or *c* are taken as inferences or conclusions from the original advertisement, and one good or "valid" argument, if *d* is taken as the inference.

Invalid Argument #1:

Premise: No other digital video recorder retailer can beat Sam Kung's prices.

(inference) 

Conclusion: Only Sam Kung has low prices for digital video recorders.

Invalid Argument #2:

Premise: No other digital video recorder retailer can beat Sam Kung's prices.

(inference) ↓

Conclusion: Sam Kung's digital video recorders are the least expensive of all video recorders.

Invalid Argument #3:

Premise: No other digital video recorder retailer can beat Sam Kung's prices.

(inference) ↓

Conclusion: The best buys in digital video recorders are at Sam Kung's.

Valid Argument:

Premise: No other digital video recorder retailer can beat Sam Kung's prices.

(inference) ↓

Conclusion: Sam Kung's digital video recorders are priced at least as low as other digital recorders sold at other retail shops.

Unlike the meaning in everyday speech of a verbal fight or quarrel, an *argument* is a technical term in logic that refers to a persuasive appeal involving a chain or a trail of reasoning (inferences) with two or more statements, where there is a *conclusion* offered and reasons or *premises* given to support or lead to the conclusion. Also, unlike the meaning in everyday speech, as when someone refers to a concept, idea, or belief being valid, *validity* in logic is a technical concept that applies only to the reasoning of arguments, not to the premises or conclusions. The individual premises or conclusions of arguments are called statements or propositions. A *statement* is a sentence that makes a claim that is true or false. Hence, statements (premises or conclusions) will be referred to as true or false. Arguments will be referred to as valid or invalid. In logic there is no such thing as a "valid premise" or a "true argument." Sometimes we do say that a conclusion is valid, but we mean that the conclusion follows validly from the premises.

So, if the original advertisement in the first example is taken as a premise, and either the *a*, *b*, or *c* options are considered the conclusion, then we can see that they would make bad or *invalid* arguments: in each case, even if the premise is true, we would not have good grounds for inferring or believing each conclusion true. On the other hand, if option *d* is taken as the conclusion, then the argument would be valid. If the ad is true, then we would know that no one is lower than Sam Kung on digital video recorders. The reasoning trail is solid. If the ad (premise) is true, then option (*d*) (conclusion) is true. We have inferred (believed correctly) the right conclusion from the ad. Much of this book will consist in formalizing and analyzing arguments to see if they are valid or invalid.

For now, let's return to our brief test above and take a look at number 2. Although most thoughtful people will pick *b*, the technically correct answer is *a*.

In a real advertising situation, such as in a newspaper insert, the sizing of the lettering is often significant. The "**50% OFF**" is usually written very large relative to the almost microscopic "up to." This variation of the "fine-print" trick accents the "50% OFF" so that this will stick in our minds and create the impression that a major sale is taking place. The average reader is so busy that he or she most often skims articles, headlines, and advertisements. It is no accident that advertisers take advantage of this and carefully think about how to structure a layout. Particular items of text will be accented for maximum effect, and others will be buried -- stated to perhaps "cover" the advertisers, but hidden nevertheless. But what does the "up to" mean? Clearly it implies some sort of range from a minimum to 50 percent. But what is the minimum? If I said, "Members of the UCLA basketball team are up to seven feet tall," the context implies that the members of the basketball team range from some unspecified minimum height to seven feet tall. That is, because no human being is zero feet tall, and most college basketball players are more than six feet tall, the range must be from some number greater than zero to seven. However, if we are just referring to the bare, mathematical numbering system, and apply it to "up to 50%," then we mean anywhere from zero to fifty, because zero is a number. When a commercial says that "many items are up to 50% OFF" technically the meaning of the "up to" cancels the "many" in the sense that not everything is on sale, and many items may be 0 percent off or the same regular price. Hence, for the phrase "up to 50% and more on many" to be true, only one item would need to be more than 50 percent off its regular price. Everything else could be 0 percent off!

Most people who choose b for number 2 are no doubt partially correct in the sense that the context implies that at least a number of items would be for sale within the range of some minimum positive number and 50 percent off, and a few would even be more than 50% off. Stores would quickly go out of business if on repeated occasions of using an ad like the above only one item was on sale. We may often be gullible, but eventually we realize when we are being tricked. Recall Abraham Lincoln's famous statement, "You can fool some of the people all of the time, and all of the people some of the time, but you cannot fool all of the people all of the time." However, when we contemplate the absolute minimum conditions for the advertisement to escape misrepresenting the truth, we see that, like our first advertisement, this advertisement has been constructed to give maximum flexibility to the store by being vague, while simultaneously creating a maximum positive psychological impression. Such ads get us in the store, and once we are there, even though we may find that what we wanted to buy is not on sale, we often buy something that is on sale anyway. Our time is precious, and we don't want to waste it or admit that we are wasting it by coming to the store for no reason. The managers of the store are well aware of this, and many commercials are devised as "hooks" just to get us into the store.

Let's look at number 3. This advertisement for Chrysler occurred in the late 1970s with a background of high inflation and high interest rates. When this pitch was made on TV, complete with a marching band, pretty girls with batons whirling in the air, and a sports figure announcing this interest rate breakthrough, it was not uncommon for car interest

rates obtained from banks to be around 15 percent.³ The buyer would pay more than \$15,000 for a \$10,000 car on a six-year loan -- more than one half the price of the car extra! So Chrysler's offer seemed like a very good deal. However, note again the vagueness of the ad. The ad leaves open the question of whether this applies to all of Chrysler's cars or is only a special deal for some of Chrysler's cars. It also does not state that this is the lowest interest rate in the industry. For the ad to be true, Chrysler must be the only one to offer this particular rate (note the particular number: not 12, not 11.8, but 11.9). But this does not rule out the possibility of another car company offering a lower rate (how about 11.89!), or many other car manufacturers competing with banks and offering a lower rate. Hence, the answer to number 3 is *d*.

While we are on the subject of car buying, consider the negotiating situation you often face at your local car dealership. First of all, like the above, the advertisements on TV and in the newspaper are designed to get you onto the car lot. During the late 1980s and early 1990s you would often see ads for Honda Accords for \$10,000 -- \$12,000, but on the lot the sticker price for these cars was often near \$21,000. The phrase "sticker shock" became common. Today the disparity between the ad and the car lot sticker price continues, and if you look closely at the advertisement, you will often see a stock number (again it will be very small, almost undetectable). Or, sometimes in fine print you will see the notes, "Cars are subject to prior sale. Vehicle not exactly as shown. Financing rate for selected models only." What this means, of course, is that the price and deal quoted do not refer to Hondas in general, but to some specific car that may or may not even be available any longer -- it may have already been sold.⁴ The advertisement is structured so that the newspaper reader or TV viewer will hastily generalize and conclude that these prices represent a typical price for Hondas. So the real fun begins when you get on the lot and find that the price is much more than you had planned to pay.

Fear not, the car salesperson will come to your "rescue" and negotiate a deal closer to what you can afford, even though it will be a price that the company can "barely" live with in terms of profit margin and will hurt the commission of the poor hardworking car salesperson. Here is how it works. Figure 1-1 and 1-2 show examples of typical car price stickers, in this case a 1990 Honda Accord LX and a 2004 Ford Explorer. Notice that the stickers are divided vertically into two parts. In the Honda case, first we see a basic description of what the car contains and at the bottom is the "suggested retail price." The next part shows the so-called dealer-added equipment and services with a total at the bottom -- your local car dealership's offering price for the car. In reading this or negotiating with a salesperson, you are given the impression that the car manufacturer has charged the car dealership selling the car \$15,645, and the \$21,829 price includes the car dealership's profit and cost of the equipment they have added. So, you start negotiating with the impression that any price that you can get under \$21,829 is a good deal. After a long day of driving the car around and haggling with perhaps several sales people --

³ This time was much before China became a global economic success and the Chinese began buying billions of dollars in U. S. debt and lowering U.S. interest rates.

⁴ Sometimes the car will actually be on the lot, but it will be a dirty, stripped down, less-expensive and less popular version of the car, in the back of the lot. To get to it you will probably have to walk by a fully loaded, immaculate higher-end version of the car.

when you try to leave to shop around you invariably get turned over to another salesperson, who is supposedly in a better mood and can give you a better deal -- if a weary-looking manager finally comes out of some secret back room and offers \$3,000 for your rusted 1965 Volkswagen Bug, you jump at the offer and leave thinking that you have won a major battle of wits. Little do you realize that in this situation the car dealership would make a \$4,529 profit off you! Most likely even more if factory-to-dealer incentives and allowances have been granted to the dealership by the manufacturer.

FIGURE 1-1 A TYPICAL PRICE STICKER FROM A NEW CAR LISTS THE VARIOUS CHARGES THE BUYER INCURS.

Model: 1990 Accord 4DR LX	Color: Gray	Interior: Gray	Manufact. Suggested
Vehicle Identification No: 1HCGD7650MA132151		Eng. No. F 22A2-2495212	Retail Price
			\$15,420.00
2156CC 4 Cylinder 16-Valve Engine w/Programmed Fuel Injection			STD
4-Speed Electronic Automatic Transmission w/sport mode & lock-up torque con/tach			STD
4-Wheel Independent Double Wishbone Suspension			STD
Front Stabilizer Bar/Ventilated Front Disc Brakes			STD
Variable-assist Rack and Pinion Power Steering			STD
P185/70 R14 Michelin LX1 Radial Tires/Full Wheel Covers			STD
Power Windows/Power Doors/Dual Body-Color Power Door Mirrors			STD
AM/FM Electronics Full Logic 12.5W X 4 Stereo Cassette W/12 Radio			
Presets, Four Speakers, and Trunk Mounted Automatic Power Antenna			STD
Soft Touch Heat and Vent Controls w/5-speed Fan Operation			STD
Air Conditioning/ Cruise Control/ Illuminated Vanity Mirror			STD
Etc.			
Etc.			
Etc.			
Destination and Handling Charge			\$225.00
Total (Includes Pre-Delivery Service)			\$15,645.00

ADD-A-TAG

PROTECTING THE CONSUMER*

Model: 1990 Accord 4DR LX	
Vehicle Identification No: 1HCGD7650MA132151	
DEALER-ADDED EQUIPMENT SERVICES	
ADJUSTED MARKET VALUE	4,995
RUST PROOFING	295
PAINT SEALANT	295
CAR COAT INTERIOR	195
SIDE MOLDING	145
STRIPES	125
CARPET MATS	85
REAR MUD GUARDS	49
TOTAL PRICE	\$21,829.00

*This protecting-the-consumer label is not an official factory or government sticker. This label has been affixed

Figure 1-2
2004 Ford Explorer

No charge for the Front License Plate Bracket!
 Do you think that a rear seat entertainment system cost the dealership anywhere near \$1300?

DESCRIPTION VIN 1FMZU63WX4Z **A37780**

EXPLORER 2004 4DR XLT 4X2 EXTERIOR
 114" WHEELBASE BLACK CLEARCOAT
 4.6L SOHC V8 ENGINE INTERIOR
 5-SPEED AUTOMATIC O/D TRANS GRAPHITE CLOTH SPORT BMTS

NO CHARGE

AUXILIARY POWER POINT
 BRAKES, POWER 4-WHEEL DISC
 POWER RACK PINION STEERING
 CARGO MANAGEMENT SYSTEM
SAFETY/SECURITY
 PERSONAL SAFETY SYSTEM
 DUAL STAGE AIRBAGS, CRAS
 SEVERITY SENSOR SEATBELT
 USE SENSOR, DRV SEAT POS.
 SENSOR, SEATBELT PRE-
 TENSIONERS
 ADJ HEIGHT FRT SEAT BELTS
 SIDE IMPACT DOOR BEAMS
 SECURITY LOCK/PASS ANTITHEFT
 CHILD SEAT TETHER ANCHOR
 KEYLESS ENTRY KEYPAD
WARRANTY
 4 HR ROADSIDE ASSISTANCE
 3YR/36,000 MILES

PRICE INFORMATION *Manufacturer's Suggested Retail Price*

STANDARD VEHICLE PRICE **\$29,975.00**

INCLUDED ON THIS VEHICLE
 ORDER CODE 125A-XLT V8
 *AIR CONDITIONING - CFC FREE

OPTIONAL EQUIPMENT

3.55 RATIO REGULAR AXLE	NO CHARGE
FRONT LICENSE PLATE BRACKET	450.00
RUNNING BOARDS	650.00
AUXILIARY CLIMATE CONTROL	60.00
ROOF RAIL CROSS BARS	745.00
3RD ROW SEAT PACKAGE	1,295.00
REAR SEAT ENTERTAINMENT W/DVD	510.00
290W AUDIO SYSTEM W/6 DISC CD	
TOTAL VEHICLE & OPTIONS	33,685.00
DESTINATION & DELIVERY	645.00

ECONOMY GUIDE available at the dealer.

HIGHWAY MPG
20

TROPHY CASE

For Comparison Shopping
 all vehicles classified as
 SPECIAL BUYERS

Here is how. First of all, the suggested retail price is known in the car-selling trade as the "Monroney Price" (Manufacturer's Suggested Retail Price). This price already includes a profit for the car dealership, regardless of the equipment added. In this particular case, the car dealership was charged \$14,300 (Factory Invoice Price) by the car manufacturer (minus any special incentives or allowances). The so-called adjusted market value is pure negotiating hype. But what about the added equipment? Wouldn't it be fair to pay for this in addition to the amount needed for the car dealership to make a profit and the salesperson to make a living? These charges add up to \$1189, so, with the \$15,645 Monroney price, wouldn't a fair price be \$16,834? No, because the added equipment did not cost the car dealership \$1189; the car dealership mass handles these charges, and the actual cost was about \$300! Each item is marked up anywhere from 300 to 600 percent. For instance, the car dealership's actual cost of rust proofing was not \$295, but \$76. And the actual cost of the stripes was nearer \$20 than \$125. At least in the Ford Explorer case, perhaps because the car dealership hopes the average buyer will pay over \$34,000 for the car, there is no charge for the front license plate bracket!

This is not all, however. Someone who pays the full list price (Dealer Sticker Price) of \$21,829 for the Honda or \$34,330 for the Explorer would be given a "full pop" by the car dealership. (This result, by the way, is more likely to happen if the buyer shows a lot of emotional attachment to the car before negotiations begin.) But buyers can be "full popped" through the "front end" or the "back end," and here is where our interest rate example is relevant again. Back end charges can include: paying \$600 for an extended warranty that costs the car dealership \$200; paying a dealer-arranged financing charge much higher than one arranged through a credit union or a bank equity loan; paying \$1200 for a "luxury" preparation package (paint sealant, scotch guard protection for the upholstery or leather, mud guards) that costs the dealership \$300 at most; or purchasing an unnecessary life, accident, and health insurance policy. The latter is unnecessary because it automatically comes with a bank loan!

A lesson that emerges from the planned vagueness of these examples is that when we decide to turn on the critical ability we are all born with, we should give some attention to what an advertisement leaves out. These examples make no explicit mention that the products have the lowest price or interest rate. If the goal of advertising is to state positively everything possible about a product, one should get suspicious when the words "lowest," "highest," or "best" are not there in black and white. Unfortunately, a trick can be involved even when these words are used. Let's look at our last example. The answer is *f*.

Number 4 was given to me by a female student several years ago who was offended initially not so much by the trick involved but by the sexism in the full ad. The original magazine spot showed this statement in bold, dark print above a very pretty girl in a white bikini with one arm wrapped suggestively around a nice, new, black Dunlop tire. Because she was one of the first females in a traditionally all-male automotive technology program at my college, the student asked me if she could do a little research on this claim. She had learned enough through her own interest in automobiles and the critical analysis of advertisements in my class to know that the words "test," "rating," and

"tire" were vague and could mean just about anything. What kind of test was conducted? With what other tires did Dunlop compete? Was a **Brand-X approach** used, in which a radial tire (the Dunlop) was compared to a well-known inferior type of tire? And what was rated? For radial tires, the appropriate traits to test are longevity of tire wear and ability to grip the road in adverse conditions. For all we know from the advertisement, tires were dropped from the Empire State Building and Dunlop's bounced the highest upon hitting the ground!

So my student found the original tire-test publication (she was a little surprised that there actually was one), and initially was disappointed to find that none of her suspicions appeared confirmed. Fifteen radial tires were tested, at least four of which were well-known major competitors to the Dunlop radial: Michelin, Bridgestone, Toyo, and Goodyear. The test appeared objective, and all the pertinent performance characteristics of radial tires were examined. Points were assigned for each characteristic tested, and different tire experts were used to assign points in cases where judgment calls were needed. All tire identification markings were removed to prevent the experts knowing the brand of each tire. An average was then taken from the points assigned by the experts and totaled with other objective point totals. Categories were assigned based on point spreads. For instance, to receive an excellent rating a tire needed to receive 300-350 points, and to receive an above average rating a tire needed 250-299 points. Average was 200-249, and below average was 150-199. This publication was complicated with numerous charts, difficult text, and distracting qualifying footnotes.

The trick involved in Dunlop's use of this tire test was not easy to see. But after considerable reflection, my student finally saw that the trick was in the apparently clear phrase *the highest rating*. To receive the highest rating of excellent in this test a tire had to get at least 300 points, but could rate as high as 350. More than one tire could receive this rating, and receiving this rating did not eliminate the possibility of other tires receiving a much higher rating within the category. So, guess which tire had the lowest rating within this category? Dunlop rated lower than its four major competitors -- the above-named tires all had a higher rating within the category of excellent -- but with a little creative use of an ambiguity on the phrase *the highest*, Dunlop was able to advertise that their product had achieved the highest rating in this test, which was true from one perspective -- it did make enough points to be rated excellent, while actually being the lowest rated among other major competitors.⁵

It is an important theme of this book that logic and critical thinking are not ways of life, but tools to be used in appropriate situations. There are times in which we desire to clear our minds of details and problems, times in which it is healthy and appropriate to avoid

⁵ Many of my students get very cynical after covering these examples, concluding that all advertisements must be out to "get us." But this is a hasty conclusion. Not all advertisements are bad, and some impart very important information. For instance, for years in Honolulu a tire retailer by the name of Lex Brodie published no-nonsense ads in the daily newspapers, listing the failure rates of tires that his staff had kept track of over the years. He showed that the most expensive radial tires had the lowest failure rate. He did not make a hard-sale pitch for everyone to buy the most expensive tire, but just presented the information, allowing people to make up their own minds based on the kind of driving they did, the price they could afford, and the risk they wanted to take.

cutting life into little pieces of analysis and instead let our thoughts bubble away until we are perhaps rewarded by quiet insight. However, it should be clear from these examples that logic and critical analysis are also valuable tools, because it is very easy to use language to "set us up" for mistaken inferences. As individuals we are up against an enormous external power pounding on our mental doors daily. Billions of dollars are spent on commercial and political advertising every year. Even the names that corporations give themselves are often the result of a large investment intended to produce maximum psychological effect.

For instance, in the early 1970s what we now call the Exxon corporation consisted of several regional oil and gas companies, such as Esso and Standard Oil. The directors of the corporation realized that the United States would soon be competing in a global market economy and that the company needed a unifying logo and branding effort to take up this challenge. What could be involved in simply coming up with a name? Well, quite a lot. Would you believe \$100 million? First of all, the company wanted a name that was culturally sensitive to all the major countries in the world in which they might compete. One of the first choices for the new name was "Enco," but this meant "stalled engine" in Japanese! Hardly a hallmark for a company that wants to sell its oil products in Japan. Second, they wanted a name that provided for maximum name recognition in all the cultures of the world, a name that went beyond the particulars of culture to tap something deep within human nature. They also wanted a name that was distinctive and could not be translated into any other language. So they hired computer experts, psychologists, linguists, and other research specialists on human nature and spent \$100 million to arrive at the name "Exxon." Then they raised the price of gas a little to pay for it and deducted this expense from their income tax so that as much as possible of the \$6 billion annual profit stayed in company hands.⁶

For further examples of our defensive-tool theme, consider the language tricks politicians use to paint favorable pictures of themselves. In 1982, President Reagan was not running for reelection, but the Democrats decided that they had a major issue with which to challenge the Republicans during the congressional races. The Reagan administration had been busy the last two years attempting to gradually eliminate the Federal Department of Education, believing that almost all matters of governance should be decentralized with the exception of defense. By 1982, a middle-class backlash was developing because the programs in jeopardy involved grants and services for middle-class college students. There were also numerous negative reports on the state of U.S. education and warnings of our eventual noncompetitiveness in a global arena. The Democrats thought that they could make some political gains from emphasizing the massive cuts in education proposed by the Reagan administration. While campaigning for Republican congressional candidates, Reagan responded by claiming that the Democratic charges that his administration was anti-education were not true by noting that,

"We will propose \$3 billion more for (the budget in) education this year than last year."

⁶ By 2010 Exxon's yearly profit was about \$65 billion.

The trick here is, of course, in the word 'propose.' In 1981, the budget for the Department of Education was \$15 billion. For the 1982 budget, the Reagan administration proposed a budget of \$9 billion! After compromising with panicked members of Congress who would have to face angry constituents, the actual budget for 1982 was \$12 billion. When for 1983, the Reagan administration planned to offer \$3 billion more than the \$9 billion they "proposed" the year before, the actual budget would be the same as the year before, or less when inflation is factored in. Again note: Reagan's claim did not involve lying or misstatement of the facts; instead we were cleverly offered an opportunity to mistakenly *infer* that the Reagan administration was increasing the education budget, when actually they were proposing to lower it.⁷

Being logical is like being picky. We don't need to be picky all the time, but when something like buying a car and a lot of money are at stake, it is important to turn on one's picky (critical) ability. One should also be very picky when deciding to go to war or not.

Here is an example related to the "up to" trick in advertising. In the fall of 2002 President Bush (Republican) was busy making his case to the American people about the necessity of war with Iraq. Other than the possession of weapons of mass destruction by Saddam Hussein (eventually none were found), again and again implied was that Al Qaeda and bin Laden were working with Saddam to hurt Americans, even though most intelligence and cultural experts claimed that Saddam and bin Laden were enemies, that Saddam had persecuted Shiite Muslims for many decades and that Saddam was not likely to give any biological, chemical, and/or nuclear weapons, if he had any, to someone like bin Laden who might use them against him.

So, in a speech on October 7, 2002 Bush stated that as for the Saddam-Osama link,

"We know that Iraq and the al-Qaida terrorist network share a common enemy — the United States of America. We know that Iraq and al-Qaida have had high-level contacts that go back a decade. . ."

In Bush's speech, the insertion of this phrase made it seem that there was a dangerous ongoing relationship. However, similar to the "up to" advertising trick, this phrase is vague. To be minimally true all one had to establish was one contact a decade ago. In fact, all that any intelligence agency could establish was that there were contacts between Saddam and a just developing Al Qaeda organization in the early 1990s. There was no evidence that Saddam was involved in 9/11 or that there was any current contact with bin Laden's organization. Eventually Bush was forced to admit publicly that there was no evidence that Iraq was involved in 9/11.

⁷ Reagan also said during this time that we spent more on education than on defense. Yet the average annual budget for defense during the Reagan years was \$300 billion. When asked about this, Reagan said he meant education spending throughout the entire United States, including at the state and local levels. But this fact, although true, was misleading related to the issue of whether we were spending enough of federal tax money on education.

Democrats surely have their own problems with deliberately misleading statements. A few years after Bush's statement when the Iraq war became much less supported by the American people, John Kerry, the democratic presidential candidate running against President Bush, attempted to explain his apparent inconsistent positions on the Iraq War by saying,

"I actually voted for the \$87 billion (to support the Iraq war) before I voted against it."

In 2010, the Attorney General of Connecticut, Richard Blumenthal, running for the United States Senate as a Democrat, kept finding ways to note his alleged service in Vietnam with phrases mixed into his speeches, such as "the days that I served in Vietnam" and that he had "served in the Marines in Vietnam." He never served in Vietnam, had five deferments to stay out of harm's way during the time of the controversial draft, and finally did serve in the Marine Corps Reserve, requiring political connections to get in. Plus, the Marine Reserve was known at the time to be a way that privileged young men could avoid going to Vietnam. His unit in Washington D.C. was involved in fixing up campgrounds for underprivileged Washington children. When the New York Times published a scathing article about Blumenthal's non-service in Vietnam, Blumenthal claimed that he had merely inadvertently mixed up the prepositions "in" and "during" in his speeches. He meant to say that he "served in the Marines *during* the Vietnam era."

And after the BP Deepwater Horizon oil spill became the greatest environmental disaster in U. S. history, President Obama addressed the nation in June 2010, and declared,

In the coming days and weeks, these efforts [of BP and the United States government] should capture up to 90% of the oil leaking out of the well.

Deductive Reasoning

One of the major purposes of this book is to help you avoid mistaken inferences. To do this, we need not only to practice recognizing inferences or arguments, but also we need to study criteria that separate good inferences from bad ones. The most important concept in the study of logic is what logicians call a valid deductive argument. Many of the practical tasks offered in this book, as well as the wider philosophical message as to the nature of logic and its relationship to science and technology, will be better understood if you can fully grasp the concept of a valid deductive argument. In preparation for a more technical discussion of this concept in the next section, let's take another little test. This time we are going to work on a little brainteaser. Its solution is much simpler than it first appears, and it provides not only a nice example for the technical concepts discussed in the next section, but also a thoughtful analogy for many aspects of life and reasoning.

Here is the situation. Imagine that we know of three prisoners who share a particular jail cell. A particular security guard is somewhat of a friend with these three men because

they are all quite intelligent and they often have philosophical discussions and play games such as chess together. Let's refer to these three men simply as prisoners x, y, and z. Imagine further that prisoner x has perfect vision, prisoner y has sight in only one eye, and prisoner z is totally blind. One day, our security guard brings in a little basket with five small hats in it. Because the blind man can't see, the security guard announces that there are three white hats and two red hats as he explains the intent of bringing the basket of hats with him this day. He has decided, he says, to offer freedom to the first one who can solve a little logic riddle. He intends, he says, to blindfold each of the men who can see and then mix up the hats and randomly place a hat on each of their heads. Then he will remove the remaining hats and basket and place them in a nearby empty closet. Upon removing the blindfolds, the first man who can tell what color hat he has on will go free. (Because the hats are small -- like flat berets -- no man can see the color of his own hat.) All three prisoners agree to the challenge, but after being surprised how readily the blind man agrees given his distinct disadvantage, the two prisoners with sight demand that all of them be blindfolded. Although they have known the blind man for years, and are almost positive that he is indeed blind and will not have the advantage of seeing the color of the hats of their opponents, they decide to take no chances.

So the security guard complies with their request. He blindfolds all three men, mixes the hats up, places one on each of the prisoners' heads, removes the basket and the remaining hats to the closet, and then removes the blindfolds. The two prisoners with sight begin to look around quickly at their colleagues, and just before both begin to give their answer based on what they see, the security guard stops them with a warning. He explains that there is one more major item that must be a condition for their answer. This condition, he says, is a result of prior consultation with the blind man. The blind man agreed to participate in this riddle if and only if each answer was based on *deductive reasoning*; that is, *inductive reasoning* and answers based on probability would not be allowed. We will discuss inductive reasoning in Chapter 3. For now, think of good inductive reasoning as the inferring of a reasonable, but not completely certain, conclusion from available evidence. For instance, upon the removal of his blindfold if prisoner x saw two white hats, one on prisoner y and one on prisoner z, because there would remain only one white hat but two red hats, the probability would be greater that x would have one of the red hats on, and it would be reasonable, although not conclusive, for him to "guess" red. In other words, a *good inductive inference* would be for prisoner x to conclude that he probably has a red hat on given the premises of y and z both having on a white hat.

Originally 3 white, 2 red -- if one white and two red left, then

x y z

(probably *red*) (white hat) (white hat)

Inductive Reasoning

Although a good inference, as an inductive inference by prisoner x, concluding "probably red" will not be allowed. To ensure that all answers will be deductive, the security guard has decided to impose a severe penalty for a wrong answer. If one of the prisoners answers without being deductively sure what color hat he has on and is then wrong, that prisoner will be executed! After all, it would be reasonable for prisoner x to pick red in

the above situation based on inductive reasoning, but it would still be possible for him to have the one remaining white hat and be wrong and dead. (It will be important later when we discuss scientific method and inductive reasoning in Chapter 3 to remember that an inference can be reasonable even though it could be wrong in terms of the conclusion drawn.)

So here is the situation now. No prisoner will use inductive reasoning. Each prisoner will use only deductive reasoning. With deductive reasoning, if the reasoning is good, there is no doubt about the conclusion, given the truth of the initial information. For instance, assuming we know no hats were already in the closet and there were only five hats initially, we know that with three on the prisoner's heads, there remain only two in the closet. This is an elementary deduction; we are not guessing that there are only two, we are not assuming that it is probable that there are only two, we know that there are only two hats in the closet. So, each prisoner will either answer "no" to avoid being executed, if he is not certain of what color hat he has on, or "yes" when he is certain what color hat he has on. (Notice that mathematics is a type of deductive reasoning and a method for making predictions. Based on the above reasoning, we predict that when we open the closet we will find two hats, not three, four, etc.)

Here is what now happens: Prisoner x looks at his fellow prisoners and without much thought looks discouraged and says "no," he cannot tell what color hat he has on with deductive certainty. Prisoner y, with a very thoughtful look, at first stares straight ahead, neither looking at x nor z. Then after an "aha!" expression of insight, without looking at x at all, he turns his head to look at z with great expectation. Then a look of discouragement appears, and he says "no," he also cannot tell with deductive certainty what color hat he has on his head. Upon y's failure, the security guard and prisoners x and y begin to depart and go about their business. Upon hearing them leaving, the blind man asks casually if he is not going to be given an opportunity to give his answer. Surprised at this request given his disadvantaged state, all three men remind him that he must answer deductively; he must know with certainty what color hat he has and cannot just guess; that he may have a three out of five chance of having a white hat on, but he risks execution if he chooses white and in fact has a red hat on. The blind man replies, "I do not need to have my sight, from what my friends with eyes have said I clearly see that my hat is ?." He has the right answer and he does not use induction or probability, nor does he simply venture a guess. Based on the information he is given, he knows what color hat he has on, just as we know that there must be only two hats in the closet.

Take a break here from your reading and see if you can recreate the blind man's reasoning. What color hat does he have on, and how does he figure it out? What trail of reasoning does he use to arrive correctly at the right deductive conclusion? Believe it or not, the reasoning used by the blind man is not much different than the trail of reasoning we used to conclude that there are two hats in the closet. If there were five hats initially (premise), if three are used for the prisoners (premises), if the closet is indeed empty initially (premise), and if the remaining hats are put into the closet (premise), then we know with certainty that there are two hats in the closet (conclusion). The blind man reasons that if x said no, then we know ? And if y also said no, then based also on what

we know from x, he must have on ___?

Valid, Invalid, and Sound Arguments

Before we see how close you came to reconstructing the blind man's reasoning, note that your problem is similar to many daily situations. First, I have flooded your mind with a lot of information. Is it all relevant to the problem to be solved? You not only have to draw the correct inference from the information, you also have to select the right starting place. Is it relevant to solving the problem that one man has perfect vision and another has sight in only one eye? Second, do we know that all the information is true? Does the blind man know for sure that there are three white hats and two red hats? After all, he is blind. And finally, are there assumptions we need to make in constructing the correct reasoning trail? And how reasonable are these assumptions?

Many people after a little thought are able to see the first step in how the blind man figures out his hat color. When the man with perfect vision (prisoner x) answers first, we can at least know what he does not see in order for him to say "no." If there are only two red hats, then it is not possible for him to see two red hats (one each on the other two prisoners), for if he did, he would know conclusively that he had on one of the remaining white hats, and the game would be over. Because he said that he could not tell with deductive certainty what color hat he had, we can conclude that he did not see simultaneously a red hat on y and a red hat on z. This is an elementary deduction, just like the case where we knew there were only two hats in the closet.

x	y	z
(would have to be white)	(red hat)	(red hat)
(not possible)		

Deductive Reasoning

The common sense form of deductive reasoning being used here has a fancy name -- ***reductio ad absurdum*** (reduction to the absurd). We start off assuming a possible truth -- that x saw two red hats. We show that this would lead to a contradictory result compared to the actual events -- x would know for sure he had on a white hat and would go free. So, we can conclude that the initial assumption was wrong because it led to an impossible (absurd) result.

With this simple insight we have started a trail of reasoning. The next step -- and there is only one more step -- is just as easy. If we have been able to figure out that prisoner x could not see two red hats, then so too would the man with one eye (y) and our blind man (z). This is an assumption, but given the information that these men are intelligent, it is a reasonable assumption and thus used as a premise for the blind man's reasoning. A similar little assumption was made even when we concluded that prisoner x could not see two red hats. We must assume that he is at least smart enough to remember that there were only two red hats to begin with. If he is mentally disabled or has some sort of deficit disorder that impairs his memory, he may have forgotten that information. So, given the reasonable assumptions that x is intelligent, that nothing is wrong with his memory

and/or focus, and that he really wants to go free, we can conclude conclusively that he did not see two red hats. Similarly, we can conclude that y and z know as soon as x says "no" that x did not see two red hats.

So, if y knows that x did not see a red hat on his (y's) head at the same time he saw one on z's head, then what is y thinking when he looks quickly and expectantly at z? What is he hoping to see? He is hoping to see a red hat on z. If he does, he would know conclusively that he must have a white hat on, and he would be the one to go free. If both hats can't be red on y and z, then at least one is white. If z has on a red hat, then y must have on a white hat. But y also said "no," implying (and this is the last step) that he did not see a red hat on z, and if he did not see a red hat, he had to have seen a white hat. Because two reds are not possible (one on y and one on z), it is also not possible for there to be a red on z, otherwise y would know that he had a white hat on.

x	y	z
(would have to be white)	(red hat)	(red hat)
	(not possible)	

x	y	z
	(would have to be white)	(red hat)
(also not possible, because the above case is not possible)		

Deductive Reasoning

So, we know, as the blind man knows, that there cannot be a red hat on the blind man. He must have a white hat. It is crucial now to reflect to what extent we know this, to reflect on the strength of this knowledge. The blind man is able to construct what logicians call a valid deductive argument. It is not possible for all the information he uses to construct his trail of reasoning to be true and his conclusion that he has on a white hat be false.

Unfortunately for the blind man, he does not know conclusively whether all the information that he has been given is true. For all he knows the security guard and the other two prisoners planned an elaborate hoax to lie to him about the color of the hats. There could be two white hats and three red hats, or the hats could be blue and yellow and when the blind man answers white, he could still be executed! This possibility does not change the nature of the blind man's logical reasoning; it is still impeccable. It only shows that a good reasoning trail is a very neutral thing, and that the content of a reasoning trail (the starting place) and the reasoning trail itself (the steps given the starting place) are two different things. The blind man's starting place, the information he was given, could have been incorrect, but his reasoning steps were perfect.

It is very important to understand the possibility of valid reasoning in spite of false information to fully understand the nature of logic and its role in our modern technological society. Computers, for instance, are marvelous logic machines. But not only do human beings construct the logic trails for them to follow, but also, and more importantly, we give them (input) the premises. This means even the most sophisticated computer analysis (economic, military, and such) is a fallible process; if the information put into the computer to analyze is wrong, the conclusion could be wrong. Today, just about every person living in the United States over the age of 18 who has ever used a

credit card or borrowed money has a credit rating. These ratings are the result of tracking credit card and bill payments and crunching out a number based on sophisticated computer algorithms. Your rating is a prediction of how creditworthy you are and it can drastically affect your life in terms of getting loans and saving lots of money on interest rates. The logic is usually flawless, but the conclusion (the credit number) could be wrong if any of the initial information is wrong.

Let's summarize all of this technically. Logicians define a *valid deductive argument* as one in which *it is not possible to have true premises and a false conclusion*. Notice some important implications that follow from this definition. It is not true, as some students interpret this to mean, that given any argument with true premises and a true conclusion that argument must be valid. Furthermore, to say that in a valid argument, it is impossible to have true premises and a false conclusion is not the same as saying that valid arguments always must have true premises and a true conclusion. At this point it is natural to be a little confused, because this definition implies we can have valid arguments with false premises and even a false conclusion, and that we can have arguments with true premises and a true conclusion and the reasoning not be valid. But stay calm. Let's look at a simple example.

You don't know me, so you don't know if what I am about to tell you is true. Suppose I tell you that in my garage I have a normal car that runs on gasoline. I believe my car has no gasoline, and I tell you this. Because you know that for my car to start it must have at least some gasoline, you conclude that my car will not start. Here is a formalization of your reasoning:

EXAMPLE 1-1 (Valid)

(Premise) In order for my car to start, it must have at least some gasoline.

(Premise) My car does not have any gasoline.

(Conclusion) Therefore, my car will not start.

Based on our definition, this example is a valid argument. A good reasoning trail is created. If it were really true that I have a normal gasoline car, and that car needs at least some gas to start, and if it were really true that it has none, then my car will not start. If the premises of this argument are true, then the conclusion is true. Remember, however, you do not know me. For all you know I could go out in my garage right now and start my car, which happens to be a new solar-powered car or electric vehicle (EV) running on a hydrogen fuel cell or batteries, and drive happily away. In other words, the conclusion of the above example could be false. But this would not change the form of the reasoning of the above example; it would only mean that not all of the content of the argument is true. (If I have a solar-powered car or EV, the first premise would be false, the second premise would be true, and the conclusion could be true or false. But the reasoning would still be valid.)

Let's look at another example. Several years ago I decided with great resolve that I would end the decades-long frustration of trying to get every student to understand the full implications of a valid deductive argument. I thought I had an example that was so clear that anyone living in the state of Hawaii, where I teach, would understand. To my great surprise, the example totally bombed, and I had at first an even harder time making this concept clear. Here is the example I gave: Because Sandy Beach is north of Kona, and Haleiwa is north of Sandy Beach, and because Hanalei is north of Haleiwa, Hanalei must be north of Kona. Here is the formalization:

EXAMPLE 1-2 (Valid and Sound)

(Premise) Sandy Beach is north of Kona.
(Premise) Haleiwa is north of Sandy Beach.
(Premise) Hanalei is north of Haleiwa.

(Conclusion) So, Hanalei must be north of Kona.

I had thought that we could start with an example that students could easily relate to, one that used familiar places in the island chain. This way they would not be distracted by unfamiliar content and would have a comfortable example of an argument with a valid reasoning trail. The example bombed not because the students were unfamiliar with the places mentioned, but because to my surprise many local people living on Oahu (the island where I teach) don't use the directions north, south, east, and west. Instead they give directions by referring to Mauka (in the direction of the mountains), Makai (in the direction of the ocean), Diamond Head (in the direction of the major Waikiki landmark), or Ewa (a leeward or westward part of the island). Because they didn't understand yet the difference between the reasoning trail and the content of that trail, they were distracted by their lack of understanding of the phrase "north of" and were hesitant to agree that this was a valid argument.

As you read this you may be in a similar situation. If you don't know the places mentioned above, you can't judge whether these statements are true. Like the blind man, you and some of my students are blind as to what the truth is, but also like the blind man, you should be able to judge the reasoning trail to be valid anyway. In other words, it does not matter if you know the premises to be true or not; all you need to understand is the meaning of the statements. Let's show this by representing what these statements claim to be true, by representing the argument with a picture. We will represent "north of" as "up" and see what the premises imply.⁸

⁸ As a North American I reflect here the North American bias that north is "up." From space we know there is no up and down, and thus we could just as well make all our globes with the South Pole facing upward rather than the North Pole. I wonder what long-term political and cultural ramifications would ensue if children in South America grew up with globes in their classrooms with the South Pole on top?

Hanalei ----- (north of) above Haleiwa, and hence (north of) above Kona

Haleiwa ----- (north of) above Sandy Beach

Sandy Beach --- (north of) above Kona

Kona

Pictured this way, we see that there is no doubt that if Sandy Beach is really (north of) above Kona, and if Haleiwa is really (north of) above Sandy Beach, and if Hanalei is really (north of) above Haleiwa, then Hanalei must also be above (north of) Kona. We can judge this argument to be valid absolutely, even if the truth of each statement is uncertain. We can illustrate this point further by showing that we can create a valid argument that contains statements that contradict the statements in the above example, such as: Because Sandy Beach is south of Kona, and Haleiwa is south of Sandy Beach, and because Hanalei is south of Haleiwa, Hanalei (conclusion) must be south of Kona. We can again see that this argument is valid by representing the claims within the argument with a picture, now using "below" for "south of."

Kona

Sandy Beach ----- (south of) below Kona

Haleiwa ----- (south of) below Sandy Beach

Hanalei ----- (south of) below Haleiwa, and hence (south of) below Kona

Notice that in both examples the conclusion is already contained in the premises; that once we represent the premises we are "locked into" the conclusion, because in a sense we have already stated the conclusion. Our method of representation shows that stating the conclusion is only making explicit what was already implicit. This feature is the hallmark of all valid deductive arguments.

Two very important points about logic and rationality follow from these examples. ***Being logical does not guarantee truth*** or being right all the time, and ***rational people can still disagree*** -- two people can disagree over a belief but each have logically valid reasons for holding their respective beliefs. Consider these two examples.

EXAMPLE 1-3 (Valid)

(Premise) If the U.S. Constitution implies that each person has a right to self-determination concerning matters of a person's physical body, then abortion should be legal.

(Premise) The U.S. Constitution does imply this.

(Conclusion) Therefore, abortion should be legal.

EXAMPLE 1-4 (Valid)

(Premise) If the U.S. Constitution grants every person the right to self-determination, then the involuntary termination of life is wrong.

(Premise) If the involuntary termination of life is wrong, then abortion should not be legal.

(Premise) The U.S. Constitution does grant every person the right to self-determination.

(Conclusion) So, abortion should not be legal.

Both of these arguments are valid. The reasoning is not the cause of the disagreement shown in the conclusions. The problem is in the premises and the disagreement over the implications of the U.S. Constitution in the case of abortion -- whether an absolute right of self-determination should be given to a woman for control of what takes place in her body or whether this normal right should be limited because the fetus is also a person with a right to self-determination. The acceptance or rejection of these premises is not an easy matter, but at least both arguments follow a valid reasoning trail.

In the north and south examples, however, the truth is known -- the first example (1-2) contains true premises, and thus, also contains a true conclusion. However, as the abortion examples show, in many situations that deal with major issues of life, the beliefs that serve as premises are either not agreed upon or are not known to be true. Thus, being logical alone will not suddenly make everyone in the world agree. However, as we shall see, being logical will go a long way toward encouraging us to objectively discuss and test our beliefs.

Example 1-2 illustrates what logicians call a *sound argument*, an argument that *is valid and has true premises*. The islands of Hawaii line up in a southeast to northwest direction. They were created by a Pacific plate that is passing over what geologists call a "hot spot" -- essentially a hole in the Earth through which molten material oozes from deep within the Earth. This plate has been moving in a northwest direction for millions of years, and as it passes over the hot spot islands are formed and then eroded to make nice beaches for tourists. Kona is on what local people call the "Big Island," the island of Hawaii, the southernmost island in the island chain. It is also not far from South Point, a location on the Big Island that has the distinction of being the southernmost point in the entire United States. Sandy Beach is on the island of Oahu, the fourth island "up," or northwest, of the Big Island. This beach is on what local people call the "south shore" of Oahu. Haleiwa is also located on Oahu and is part of what the local people call the "north shore." Finally, Hanalei is on Kauai, the next island up the chain about ninety miles northeast of Oahu, and Hanalei is on the "north shore" of Kauai.

We will see that truth is a much more controversial and difficult matter to establish than logical validity. Do you know whether all the things I just told you about the Hawaiian

islands are true? Should you just take my word for it? You could look at a map, but how do you know the map is correct? Almost everywhere these days -- in advertisements, in textbooks, on TV -- we see a picture of our fragile little biological paradise floating in space. It is spherical and possesses north and south poles. But how do we know these pictures are not fake and part of a massive conspiracy? A group of a few thousand people who call themselves the International Flat Earth Research Society believe not only that the Earth is flat, but also that astronauts from the United States never went to the moon. They also assert that science is a "false religion," and that the accepted scientific belief that the Earth is a spinning globe is the result of a massive government conspiracy and successful brainwashing campaign that starts in elementary school. Can you attest absolutely that they are wrong? If you think they are wrong, do you "know" this just on the basis of testimony? Are you taking someone else's word for it? Are you accepting the belief that the Earth is spherical on the basis of authority -- because they say it is true? Who are "they," and what evidence do they have?

These questions are more difficult than they first seem, and they involve some complex issues in what philosophers call epistemology, or theory of knowledge acquisition. But, for what it is worth, I believe that not only is the world round but that we "knew"⁹ this in the third century BC, not in 1492 from Columbus's expeditions as my generation was told in elementary school. We will discuss this knowledge and its status in more depth shortly (Chapter 3), but for now consider that even Flat Earth supporters will agree on what is a valid argument.

So, let's take one thing at a time. We claim that logical validity gives us at least a framework of rationality, a way to test our beliefs. Let's see why by looking at an example of an *invalid argument*. Logicians define invalid arguments as arguments where it is *possible to have true premises and a false conclusion*. Suppose we changed our gasoline car example as follows:

EXAMPLE 1-5 (Invalid)

(Premise) In order for my car to start, it must have at least some gasoline.

(Premise) My car has at least some gasoline.

(Conclusion) My car will start.

Clearly this argument is invalid, because even if it is true that I have a normal car and I have just looked at the gas gauge and see that it has some gas, as we have all been made painfully aware at one time or another, I am not guaranteed that my car will start. Unfortunately, many things could go wrong with the car, even though in this case being out of gas is not one of them. The conclusion could *be* false, *even if* the premises are true. An invalid argument does not follow a good reasoning trail; it does not lock us into the conclusion even when the premises are true. Argument (1-5) makes the same mistake as

⁹ In the sense that at least one person knew this and that anyone who followed his evidence and reasoning would also know. See the Eratosthenes' example in Chapter 3.

EXAMPLE 1-5A (Invalid)

(Premise) If it is raining, the streets are wet.

(Premise) The streets are wet.

(Conclusion) It is raining.

The first premise is not stating that streets only get wet when it rains. It is essentially stating that being rained on is one way the streets get wet. Thus, because the streets could be wet for other reasons, we don't know that it is raining, even if the premises are true. Recall we also said above that an argument that has true premises and a true conclusion is not necessarily valid. Invalid arguments can also have true premises and a true conclusion. So, in considering the reasoning of **1-5**, could my car still start anyway? Of course it could, and I reason every day (unconsciously) that because my car has gas it will start. Only sometimes am I disappointed. However, this is the point: I am not guaranteed a true conclusion when I use invalid reasoning. Even though it is possible for the above arguments to have true premises and true conclusions, having true premises does not guarantee a true conclusion when we use invalid reasoning. This shows that invalid reasoning does not guarantee a false conclusion either. All we mean by calling an argument invalid is that it is a *weak* argument; its conclusion may be true, but the premises do not provide good deductive reasons to believe this is so. The main problem with an invalid argument is that even if its premises are true, we know nothing about its conclusion -- the conclusion could be true or false. If we always knew that the conclusions of invalid arguments were false, this would be valuable information -- we would at least know what not to believe. But we don't even know this.

Valid arguments preserve truth. They don't guarantee truth unless the premises are true; when the premises are true, we know the conclusion is true. We also know something about the premises if the conclusion is false. At least one premise will be false, if the conclusion is false, because valid arguments do not allow for true premises and a false conclusion. Invalid arguments do not preserve truth; even if the premises are true the conclusion could be false. The conclusions of invalid arguments could be true, but even if the premises are also true, the connection to the conclusion is such that it is not the premises that are locking us into the truth of the conclusion. The conclusion would be true based on independent reasons not stated in the argument. In the above case (**1-5**), I am lucky, in a sense. I think that because my car has gas, it will start. But my reasoning does not guarantee that it will start, even if my premises are true. Compare the above case to this valid argument:

EXAMPLE 1-6 (Valid)

(Premise) In order for my car to start, it must have at least some gasoline.

(Premise) My car starts.

(Conclusion) My car must have at least some gasoline.

Like the example of an invalid argument (1-5), the conclusion of this example could be false. I could have a solar-powered car, or my car could really be completely out of gasoline. But if the conclusion is false, I would also know that at least one of the premises must be false. It is not possible for the premises of this argument to be true and the conclusion false. If the premises are true, it is not a matter of luck that the conclusion is true. The premises lock us into the conclusion.

You may be experiencing the same confusion that many students experience at this stage. Valid arguments can have false conclusions; invalid arguments can have true conclusions. Aren't valid arguments supposed to be the "good guys"? Unfortunately, it is not a black-and-white world, and uncertainty and tentativeness prevail in many important parts of our lives. But such a world is not inconsistent with rationality. To understand what logic is and what it means to follow a logical trail correctly (a valid deductive argument), you must be able to distinguish between the *form* (reasoning) of an argument and its *content* (whether you believe or know the individual statements -- the premises and conclusion -- to be true or false). Consider the following argument given to me some time ago by a student, and before you read further make a judgment whether it is valid or invalid.

EXAMPLE 1-7

(Premise) Only people who believe in the Christian God are moral.

(Premise) John Smith is moral.

(Conclusion) Therefore, John Smith must believe in the Christian God.

As a teacher in Hawaii, I am often faced with a multicultural, mixed-background student population. I teach many "local" students from the surrounding community, but also (because Hawaii is such a popular place to visit) many transfer students from all over the U.S. mainland, Europe, and Asia-Pacific region. One particular semester, I had a transfer student from a very conservative, Christian fundamentalist southern Bible college. He felt it was his mission in life to persuade as many people as possible to convert to his version of the Christian religion, and he would bring his Bible wherever he went and read it to others at every opportunity. When I asked the class to give me an example of a valid argument, he volunteered the above argument and proceeded to read to us Biblical passages that in his mind demonstrated the truth of the first premise. His constant conversion techniques did not sit well with many of the students in my class, many of whom held Buddhist, Islamic, or other religious beliefs. In general, most people in Hawaii have culturally tolerant beliefs. When I asked the class whether this was an example of a valid argument, most of the students responded that it was invalid. Did you make the same mistake? This argument is valid. If it is true that only people who believe in the Christian God are moral, that is, if it is really true that all people who are good, kind, don't steal, and so on must believe in the Christian God, and John is good, kind, and so on, then it must be also true that John believes in the Christian God. Essentially this

argument says that if you are moral, you must believe in the Christian God; John is moral, so he must believe in the Christian God.

What my students should have said is that this argument is indeed valid, but based on their beliefs it is not sound. It is an objective logical fact that the reasoning is valid, but the content is another matter. Most of my students did not agree that to be moral one had to be a Christian; they believed that people can be good to each other and have other religious beliefs, or none at all for that matter.

However, you may still be puzzled, as most of my students usually are, as to why we should be logical if this is the nature of logic: rational people can disagree, arguments with offensive premises can be valid, valid arguments can have false conclusions, and invalid arguments can have true premises and true conclusions. If you can be wrong after being logical, and right after being illogical, why be logical? The answer to this important question is very long. In fact, this entire book is an answer to this question. For now, however, in addition to the defensive-tool points made at the beginning of this chapter, consider the following little story as my answer.

Logic and Belief Testing

Many years ago I had the good fortune to be an assistant coach on a Little League baseball team. My team's district had a long tradition of support for Little League baseball. The families were also mostly ethnic Japanese, and many still had strong ties to relatives or friends in Japan. They loved their baseball, and each summer the games were quite a social event for the whole family -- elaborate "pupu" (appetizer) parties followed every game, fundraisers were conducted yearly for an all-star team to be sent to play teams in Japan, and families would host visiting teams from Japan. At the beginning of each spring, tryouts would be held for new players, usually eight-year-olds who would begin an important four years of socialization. We would line up new children opposite another and let them throw a baseball to each other. We were determining primarily if they were ready to play and would not get hurt, whether they watched the ball when they tried to catch it. If it looked like they were not experienced enough, we asked the parents to keep the child out one more year and practice a little with them. Only in rare cases was this necessary, however. Almost all the children who wanted to play were allowed to play at the eight-year-old level. If they were boys, that is! I can still remember my father shouting at me when I didn't watch the ball, "Don't catch like a girl!"

One particular year, a little eight-year-old girl calmly and confidently walked out and took up a position in a line and began playing catch with a boy in the opposite line. Everyone knew who she was. She was the all-star coach's daughter and the younger sister of the coach's twelve-year-old son, one of the best players in the league. Evidently, she had watched how much attention her brother had received during the last four years, and how much of the family's life revolved around Little League baseball. She had decided, without consulting anyone, that it was her turn regardless of the unstated, but accepted, restriction that Little League baseball was only for boys. When we realized what was going on, that she was not just playing or trying to help out by playing catch with a boy

trying out, one of the coaches ran over to the far side of the field where her father was supervising the advanced players. When he heard what she was doing the father rushed over in an agitated mood. He grabbed his daughter's arm and pulled her aside, and an argument ensued. The next thing we knew, the little girl was walking home alone crying.

The father had given his daughter the following argument for why she could not play Little League baseball. He pointed out to her that her grandfather had been one of the first Little League baseball players in this district. Then, years later, he (the girl's father) had followed in his father's footsteps and also played in this district. Now her brother was following the family tradition. "Don't you see," he said, "it's always been this way, only boys play Little League baseball." Later in this book we will examine a common informal fallacy (a type of bad argument) called *Traditional Wisdom*. The father had committed this fallacy, but it is worth our time to contemplate exactly what is wrong with this argument independent of the fallacy specifics. When I ask my students what was the real tragedy of the father's argument, some will usually refer to some vague principle prohibiting discrimination against women in our society. This may be true from a constitutional or ethical perspective, but I tell them that from a logical perspective this is only an indirect concern. Why is discrimination wrong? Why was discrimination wrong in this case? What was the father really worried about?

From a logical point of view, the tragedy in this situation was that the real issue was not tested. The real issue was whether the little girl had the potential skill to play at the eight-year-old level without getting hurt. If the father's reasoning was followed, we would never find out. In discussions of gender and racial discrimination issues this point often seems forgotten. Discrimination against a race or a sex is not just bad for those being discriminated against, it is bad for all of us. In a democracy we assume that whenever people congregate in a social situation, that situation -- be it in a game, a business, or a country -- is best if individuals have the freedom to develop their full potential. We all lose if a valuable potential is stifled. Little League baseball and the father both lose if the daughter is not tested. She might be good. The father loved his daughter and feared that she would get hurt or embarrass herself. The real tragedy of the father's reasoning, however, was that it shifted attention away from what was relevant and shielded him from testing his beliefs. And this is the reason for my little story: Much of the *bad reasoning* identified in this book is just like this example -- *an excuse not to test our beliefs*. Most often, bad reasoning is no more than an excuse not to think about what we should think about, to not test our beliefs against the world of experience.

We are not always right when we use good reasoning. However, this is the point. Because valid arguments cannot have true premises and a false conclusion, when the conclusion is false -- when we realize that we are wrong even though we have followed a good reasoning trail -- we know something must be wrong with our premises and we must think about them. With invalid reasoning, because the conclusion can be false even if the premises are true, having a false conclusion tests nothing, the premises can be true or false. Because we carry with us a web of beliefs that often act as premises for decisions, if we do not infer valid implications from our beliefs, we will not be testing our beliefs even if we are often successful in using them.

An additional virtue of good reasoning is that it helps us localize what we disagree about. Too often many arguments between people are just arguments in the sense of fighting or quarreling, where egos are at stake and the goal is not to understand each other but just to disagree in an unfocused way for its own sake. If two people disagree on whether a conclusion is true or false, but the reasoning that led to that conclusion is valid, then these two people know that they must also disagree over at least one of the premises. (The abortion examples, (1-3) and (1-4), are examples of this.) Both the localization of disagreement and the knowledge that our premises or beliefs must be reexamined if they lead to false conclusions constitute at least progress, if we assume as we do in a democracy that the critical discussion and examination of freely expressed beliefs is the way better ideas are found.

As a final aside, you might be interested how my little story turned out. The next weekend the little girl was back trying out again for one of the eight-year-old teams, under the watchful eye of a now sheepish-looking father. Evidently, the mother of the little girl -- a very quiet, traditional wife in many respects -- stepped in during the week and demanded that the daughter be given a chance. So the little girl played, and guess what? She was very good. Evidently for the past few years she had to shag balls for her brother and his friends when they were practicing, so she had developed (for an eight-year-old) a very powerful and accurate throwing arm. At any level, but especially at the eight-year-old level, this is a major asset. Few children could make an accurate throw from the shortstop position, the position she eventually played. She was so good that she made the district all-star team that year, and guess who was the proudest parent at the playoffs?! Lucky for him, the father was forced to test his beliefs.

However, our story is not over, and it is worth finishing to illustrate some additional points that we will be discussing in detail later. The next year, after the little girl's success, many girls in the district, perhaps at the urging of their parents, hastily concluded that they too could compete. Unfortunately, most of these girls were acting more on a whim or fad and had little real motivation or previous baseball experience. The results were disastrous. Some got hit on the head, and many were embarrassed and soon quit. More surprising, the little girl who had been so successful the year before also quit! Between seasons the father had begun to work with his daughter earnestly, probably dreaming that his daughter would be the first woman to play in the major leagues. However, the little girl wanted no part of the next level that the father was preparing her for. At the next level, the pitching was overhand and much more difficult and dangerous. Just before the season started, she quit, much to the dismay of her father. She had proved her point and went on to be a successful soccer player.

The world has a way of breaking through our most cherished belief-shields regardless of how hard we try to insulate ourselves from its sometimes-painful touch. But, as Harvard scientist Melvin Konner has commented, "The truth may not always be helpful, but the concealment of it cannot be." Confronting the world and getting a clear response from it is what we call learning. Following correct reasoning trails keeps us on track and forces us to discuss the relevant issues related to testing our beliefs. Like an adventure, good

reasoning forces us to take risks with the world of experience, but also like an adventure we expand our horizons in the process.¹⁰

A number of important philosophical consequences follow from an understanding of good reasoning. Good reasoning is not a panacea. Although good reasoning is a neutral tool, reasonable people can still disagree. We will be studying objective processes that check for valid reasoning. Two people can agree on the validity of the reasoning, yet come to different conclusions by disagreeing on the truth status of the information in the premises. This does not mean that logic is useless, rather it shows that often the world is complicated and that arriving at truth or consensus is difficult. People often have different initial opinions, but this does not necessarily imply that truth is subjective and only a matter of opinion. Most philosophical descriptions of democracy assume that truth is objective but difficult to find, and so the more points of view available, the more likely truth will be known. As the philosopher Socrates stated many centuries ago, we will be "better, braver, and less idle" if we believe there are answers to our questions and solutions to our disagreements, than if we believe there are no answers or solutions and that we need not even try. In this regard, logic can be a valuable tool in localizing genuine disagreement and showing where further investigation is needed.

It also follows from the above understanding of good reasoning that a person can reason impeccably and still be dead wrong. The conclusions of the greatest economic experts, the most sophisticated computer studies, the most eminent scientists can all be incorrect regardless of the precision or sophistication of the reasoning involved. All that is needed is a little false information somewhere in their premises. This is all the more reason why as individuals we should not rely solely on experts and authorities, and learn to think for ourselves.

Why Logicians Don't Think Too Much

Understanding the big picture in the abstract is very important, but soon we will need to see if you can apply these concepts in analyzing arguments to be valid or invalid yourself (Exercise III below). Consider though that when logicians examine reasoning to be valid or invalid, they have been trained not to think too much. You have heard the expressions. "Don't think so much, you're making it too complicated." "He can't see the forest for the trees." We use expressions such as these when we claim that someone is getting lost in detail and missing the simple principle or concept that organizes all the details into a clear picture. We will see that logicians invented symbolic reasoning because behind the scenes so to speak, behind the details of any argument, there is a pattern that can be represented symbolically. Logicians have been trained to look for these patterns and to ignore and not be misled by the details.

¹⁰ As you contemplate this paragraph, keep in mind that it expresses a set of values -- primarily Western-inherited from the ancient Greeks. The ancient Greek culture (seventh century BCE to second century BCE), the historical source of democratic government, modern science and technology, had a philosophy that assumed it was good to test beliefs, to think critically, to challenge opposing viewpoints, so that in time better beliefs would be found.

So, before we try some exercises, let's see how a professional logician would examine some arguments. Consider these arguments.

1-8 (Invalid)

Anyone who lives in Seattle, Washington also lives in the United States.
Jasmine lives in the United States.
Therefore, Jasmine lives in Seattle, Washington.

1-9 (Valid)

Anyone who lives in Seattle, Washington also lives in the United States.
Jasmine does not live in the United States.
Therefore, Jasmine does not live in Seattle, Washington.

1-10 (Invalid)

Anyone who lives in Seattle, Washington also lives in the United States.
Jasmine does not live in Seattle, Washington.
Therefore, Jasmine does not live in the United States.

1-11 (Valid)

Anyone who lives in Seattle, Washington also lives in the United States.
Jasmine does live in Seattle, Washington.
Therefore, Jasmine does live in the United States.

1-12 (Invalid)

All crows are black.
John is black.
Therefore, John is a crow.

1-13 (Valid)

Only crows are black.
John is black.
Therefore, John is a crow.

Hopefully you can see that something is obviously wrong with **1-8**, **1-10**, and **1-12**. For instance, for **1-10** you should be able to see that even if it is true that anyone who lives in Seattle, Washington also lives in the United States, it does not follow that if anyone does not live in this particular city, they don't live anywhere in the United States. So, even if the premises are true, the conclusion could be false. Everyone with a little training in logic should be able to judge an argument this way. We check the reasoning by noting

what the premises are saying and what they are not saying. For **1-10**, the key premise says that if you live in Seattle, Washington, then you live also live in the United States. But this premise is not saying that if you don't live in Seattle, Washington, then you don't live anywhere in the United States!

Similarly, we can reason through any of the valid arguments and see that if the premises are true, then the conclusion is true. For instance, for 1-9, if it is true that anyone who lives in Seattle in Washington State also lives in the United States, then it would follow that anyone who does not live in the entire United States would not then live in a particular city in the United States.

For most people these arguments are easy because they are familiar with Seattle being a major city in the United States. But sometimes the content of an argument will fool some people, even though the content should be irrelevant. For instance, many people are often fooled by this argument.

1-14

If a majority of the people voted for Bush in 2000, then he is legally the President of the United States.

A majority of the people did not vote for Bush in 2000.

Therefore, Bush is not legally the President of the United States.

Some people will judge this argument to be valid. No, it is **invalid**, and it is invalid not because of any problem with the truth or falsity of any premise or the conclusion. The first premise and the conclusion are false; the second premise is true. But these facts are not relevant to the reasoning. What makes this argument invalid is that *even if* the premises are true, we would not be guaranteed that the conclusion is true. The first premise is saying that a majority vote is a sufficient condition to be the legal President of the United States, but it is not saying that a majority vote is a necessary condition. In other words, the first premise is *not* saying "Only if a majority of the people voted for Bush in 2000, then he is legally the President of the United States," or "Bush is legally the President of the United States only if a majority of the people voted for him in 2000."

However, there is an easier way to see that this argument is invalid. Each of these arguments has a pattern behind the scenes. Example **1-14** has the same pattern as **1-10**. So if **1-10** is invalid, so is **1-14**.

Determining valid or invalid for the arguments in Exercise III will be easier if you know how to look for patterns. For instance, argument **1-8** contains the pattern:

For any x, if x is an A, then x is a B.

x is a B.

So, x is an A.

Or simplified:

If A, then B
B
So, A

These patterns are ALWAYS **invalid**, so any argument that fits one of these patterns is always invalid.

For **1-9**, the pattern is:

For any x, if x is an A, then x is a B.
x is not a B.
So, x is not an A.

Or simplified:

If A, then B
Not B
So, not A

These patterns are ALWAYS **valid**. For **1-10** and **1-14**, the pattern is:

For any x, if x is an A, then x is a B.
x is not an A.
So, x is not a B.

Or simplified:

If A, then B
Not A
So, not B

These patterns are ALWAYS **invalid**.

For **1-11**, the pattern is:

For any x, if x is an A, then x is a B.
x is an A.
So, x is a B.

Or simplified:

If A, then B
A
So, B

These patterns are ALWAYS **valid**.

Can you see how **1-12** has the same pattern as **1-8**? Invalid.

As for **1-13**, remember that it does not matter that the premise "Only crows are black" is false. What matters is what this premise is saying. It is saying that all black things are crows. So, if John is black, then John is a crow. But an easier way to see that this argument is valid is to see that it is really the pattern of **1-11** in disguise. Here is the trick to understanding "Only" statements. To say that "Only C's are B's" is the same as saying "All B's are C's." "Only crows are black" has the same meaning as "All black things are crows." So **1-13** has the pattern:

For any x, if x is a B, then x is a C.
x is a B.
So, x is a C.

Or simplified:

If B, then C
B
So, C

One final thought. Beware of seeing a pattern where there is not one, or of committing a hasty conclusion inference. At this stage it is common for some students to say, "Oh, I get it, if an argument has 'all' in a premise, the argument is invalid; if an argument has 'only' in it, it is valid." In other words, some students will see that we have had two examples of arguments with the word "only" in this chapter (1-7 and 1-13). Both were strange in a sense but both were valid. So, some students conclude that all arguments with "only" will be valid. No. Consider this argument.

1-15 (Invalid)

Only conservative Republicans oppose President Obama's huge economic stimulus plan.
Bill Bradley is a conservative Republican.
So, Bill Bradley opposes President Obama's huge economic stimulus plan.

Do you see why this argument is invalid? Again, there are two ways we can judge this argument to be invalid. We can reason it through by asking what the premises are saying and not saying. The first premise is saying that only conservative Republicans oppose President Obama's huge economic stimulus plan, but this is not the same as saying that all conservative Republicans oppose President Obama's plan. So, even if the first or "only" premise is true, the premise does not eliminate the possibility that some conservative Republicans can support the stimulus plan. Hence, the mere fact that Bradley is a conservative Republican tells us nothing about Bradley's support or non-support for the plan. Even if the premises are true, the conclusion can be false.

The easier way is to apply what we learned about seeing patterns. Remember that "Only conservative Republicans oppose President Obama's huge economic stimulus plan" would be the same as "All those who oppose President Obama's plan are conservative Republicans."

In general,

Only A's are B's = All B's are A's

So we have:

All those who oppose President Obama's huge economic stimulus plan are conservative Republicans.

Bill Bradley is a conservative Republican.

So, Bill Bradley opposes President Obama's huge economic stimulus plan.

This argument has the same pattern or form as **1-8**, and, as discussed, any argument with this underlying pattern will be invalid.

Suggestion. Type each argument above (**1-8** to **1-11**) and put the pattern underneath. Study these arguments and their patterns. Use this list as a guide for Exercise III (some will apply).

Key Terminology

Inference

Statements (Propositions)

Arguments

Premise

Conclusion

Deductive Reasoning

Inductive Reasoning

Valid arguments

Invalid arguments

Sound arguments

Form of an argument

Content of an argument

Concept Summary

Logical thinking can be seen as slow, disciplined, defensive thinking. Often we can be tricked into believing something, not because we have been lied to, but because we have accepted an inference that we ought not to accept. As a practical, critical tool, logic can be used to avoid being tricked into accepting an **inference** that we ought not to accept.

Advertisements and political claims are often deliberately vague or misleading in such a way that they invite incorrect inferences.

Logicians have learned to practice this slow, critical thinking by analyzing persuasive appeals in terms of **arguments** -- series of **statements** that contain **premises** (evidence) and a **conclusion** (an inference from the evidence). The goal of this analysis is to be able to separate good inferences from bad ones.

The most important concept in this regard is that of a *valid deductive argument*. Valid deductive arguments allow for all possible inferences but one -- they do not allow for an inference from true premises to a false conclusion. Valid arguments make no claim about the specific truth content of the premises and the conclusion; we are assured only that truth will be preserved by using this mode of reasoning, that if the premises are true, the conclusion will be true. Another way of understanding this concept is to think of a reasoning trail that stays on track; each step in the reasoning leads firmly to the next. Valid reasoning trails stay on track, even though we can't be assured whether we started our trail in the right place. The blind man stayed on track; he correctly carried out the implications of the information he was given. But he didn't know if his starting place -- three white hats and two red hats -- was absolutely guaranteed. Valid arguments may have false premises and false conclusions, but if the conclusion of a valid reasoning trail is false, then we know at least one of the premises is also false. Hence, reasonable people can disagree and being reasonable does not guarantee being successful. Valid arguments, however, encourage us to test our beliefs.

Invalid deductive arguments do not stay on track. They allow for all possible inference situations, including the very important one of having all true premises and a false conclusion. Because the conclusion of an invalid argument can be true or false, even if the premises are all true, we do not test any of the content when we use this form of reasoning. When we use invalid reasoning the truth or falsity of the conclusion of our inference is a matter of luck or some other factor, rather than the work of our inference. Unlike a valid argument, if the conclusion of an invalid argument is false, the premises could be true or false. Because testing our beliefs is desirable and we want the effort of our inferences to mean something, we should value valid reasoning.

Ideally, we should strive for *sound arguments* -- arguments that are valid and have premises that are known to be true.

We live in a complicated, uncertain world, where there are many conflicting opinions about what is true and false, wise and unwise. Logical thinking will not remedy this situation completely, nor is it intended to. To get along, to reach agreement on what is true and what is false, or right and wrong, to establish consensus on courses of action, all these require more human abilities than just being logical. To be open to new ideas, to be tolerant of other opinions and ways of life, and to understand our fallible nature are important practical virtues. However, having the skill and understanding the nature of logical thinking not only aid the implementation of these virtues by allowing for focused, disciplined discussion, but help us understand the practical value of having these virtues

in the first place. If logical thinking gave us more of a guarantee than that provided by a valid argument, we would not need to be tolerant of other opinions. Truth would be too easy to establish.

For the technical application of these concepts in judging arguments, remember that the key question to ask in judging deductive arguments to be valid or invalid is not whether the premises are true or false. Rather, the question is what are the premises saying and what are they not saying, and whether if they were true would the conclusion be true. If the answer is yes, then the argument is valid. If the answer is no, then the argument is invalid.

Exercises

EXERCISE I (Note: items with * have answers at the end of the Chapter.)

Indicate whether the following are true or false

1. Being logical is an activity that only a special type of person can be good at.
2. An inference is the accepting of a belief as true based on another belief believed to be true.
3. The conclusion of a computer analysis will always be true.
4. *Arguments that have all true premises and a true conclusion will always be valid.
5. Arguments that have all false premises and a false conclusion will always be invalid.
6. The blind man knows that he has on a white hat, if the information he is given is true.
7. If an argument is valid, but the conclusion is known to be false, then at least one of the premises is false.
8. If an argument is invalid, and the conclusion is known to be false, then at least one of the premises must be false.
9. Invalid arguments always have false conclusions.

10. *The conclusions of experts who use valid reasoning are always true.
11. People who reason illogically are always wrong about the truth of the conclusions they infer.
12. Sound arguments always have true conclusions.
13. If two people disagree on the truth of a conclusion, then they must also disagree on the validity of the reasoning.
14. In logic, correct usage of terminology requires that we refer to arguments as valid or invalid and statements as true or false. In logic, we do not refer to arguments being “true” and statements being “valid.”
15. The belief that it is good to test beliefs is totally neutral and not part of any cultural tradition.

EXERCISE II

Identify vague phrases and explain what each of the following statements imply in terms of the minimum conditions needed for each statement to be true.

1. Sale -- up to 30% OFF! Now you can save between 10 and 30% on our most popular models at Shelley cars.
2. *When it comes to first class treatment, no one can beat American Airlines' airfares to Hawaii.
3. There is no diner finer than Big City Dinner.
4. Advertisement: “My doctor says nothing is better than Aleve.” (Keep in mind that Aleve competes with Tylenol, Advil, Motrin, Bayer, Bufferin, and regular generic aspirin.)
5. Johnsons' Hotels have consistently had one of the highest ratings in customer satisfaction in the past 10 years.
6. Full page JC Penney advertisement: Up to 30% to 50% OFF THOUSANDS OF ITEMS THROUGHOUT OUR STORES!

Very fine print in lower left corner: "Regular prices are offering prices only. Sales may or may not have been made at regular prices. Percentages off represent savings on regular prices. Intermediate markdowns may have been taken."

7. TV advertisement showing a man towing with a rope a severely broken down car with a missing door, tape on the windows, and a detached steering wheel. The announcer can be heard exclaiming with dramatic background music, "Absolutely guaranteed! In celebration of our 10th anniversary at Westwood Cars, all this month, \$3,000 for any trade-in. Bring in your car now regardless of its condition."

8. E-mail Spam:

Save up to 70% this week only!

Get Viagra/Cialis for men's health

Buy Valium for CHEAP

Get Xanax for Anti-Anxiety

Buy Meridia online for weight loss

Get Ambien to help you sleep

Click *here* for discreet service and private online ordering

EXERCISE III

Read the introduction to each of the following deductive arguments and then write out a short essay response explaining why each of the arguments is valid or invalid.

Remember that to explain why an argument is valid or invalid, you need to explain how the definition of each fits what the premises are saying or not saying. If the argument is valid, you need to explain what the premises are saying and why they lock us into the conclusion. In other words, why is the conclusion true, if the premises are true? If the argument is invalid, you need to explain what the premises are not saying, and why, even if they are true, we are not locked into the conclusion being true. In other words, even if the premises are true, why is the conclusion not necessarily true? Be sure to answer the follow-up question asked at the end of each argument. Be sure to develop and explain your answer to the follow-up question consistent with your explanation on the validity or invalidity of the argument. (The last statement in each argument is the conclusion, and the other statements are premises.)

1. *Suppose that the police chief in San Francisco is running for reelection. He wants to demonstrate that under his leadership the police department is more efficient in protecting the citizens of San Francisco. Suppose he offered the following argument:

We all know that if police departments do a better job crime will decrease.

**Crime has decreased in San Francisco.
Therefore, the police department in San Francisco must be doing a better job.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: If the premises of the above argument are true, what would be known about the conclusion?

2. A coach of a high school football team has a rule that having short hair is a necessary condition for being on the team. Eric, who knows this rule, overhears another student saying that the new boy Greg is not on the football team. Although he has not met Greg yet, he reasons as follows that Greg does not have short hair:

**Everyone on the football team must have short hair.
Greg is not on the football team.
So, Greg does not have short hair.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Because the first and second premises are true, what would we know about the conclusion?

3. The issues of gay marriage and gay rights are very controversial in the United States. Examine this argument. (Hint: Remember that logicians distinguish between valid and sound arguments.)

**All crimes against nature are immoral and ought to be prohibited. Homosexuality is a crime against nature and a crime against God.
So, homosexuality is immoral and ought to be prohibited.¹¹**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Suppose you disagree with the conclusion -- do you need to also disagree with one of the premises? With all the premises? Explain.

4. In December 1999 Dr. Wen Ho Lee, a scientist at the Los Alamos National Laboratory, was arrested for downloading restricted material on nuclear weapons. There was concern at the time that China had stolen the plans for a

¹¹ In case you think that no one believes premises such as these anymore, in 2011 presidential candidate Michelle Bachman was noted for saying, "Any of you who have members of your family in the [gay] lifestyle, we have a member of our family that is . . . This is not funny. It's a very sad life. It's part of Satan, I think, to say that this is gay."

bomb, the W-88 warhead, and that the Clinton administration did not pursue this matter vigorously because of illegal political donations from China. As a Chinese American, with relatives in China, Dr. Lee had visited China. But nine months after his arrest, Dr. Lee was released and the charges dropped. Defenders of Dr. Lee claimed that the FBI was guilty of racial profiling. Examine this argument.

**All nuclear weapons' spies for the Chinese government are Chinese.
Wen Ho Lee is Chinese.
Therefore, Wen Ho Lee is a nuclear weapons' spy for the Chinese government.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Suppose the conclusion is false? What would we know about the premises?

5. At the zoo, a father is attempting to demonstrate to his children his knowledge of zoology by stating that a particular bird they are viewing must be a crow. He gives the following argument.

**Only crows are black.
This bird is black.
Therefore, this bird is a crow.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer these follow-up questions: Suppose we know that the conclusion is false, that a zoo attendant overhears the father and tells him that the bird in question is a rare black honeycreeper. How would this affect the validity of this argument? What would this imply about the first premise? Would knowing that the conclusion is false and the second premise true constitute a test of the first premise?

6. Suppose John is explaining to his girlfriend why he has no money to take her out on the upcoming weekend. He explains that he has just had to install safety belts in his recently purchased very used 1969 car because he received a traffic citation on the way home from the purchase. All U.S.-made cars by law must now have safety belts, whether or not they were originally so equipped. His girlfriend is suspicious, because although John's car is very old, she believes that all cars have always had safety belts installed at the factory. John gives his girlfriend the following argument:

**No U.S.-manufactured car built before 1970 was equipped with safety belts at the factory.
John has a U.S.-manufactured car built in 1969.
So, John's car was not equipped with safety belts at the factory.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer these follow-up questions: If the premises of the above argument are true, what would we know about the conclusion? Suppose John's girlfriend finds out that Congress passed a law in 1969 mandating factory installed safety belts for all U. S.-manufactured cars by 1970. Should she now be convinced that John's conclusion is true? (Hint: Think of the different meanings of (1) "No U.S. manufactured car built before 1970 was equipped with safety belts at the factory" and (2) "All U.S.-manufactured cars built from 1970 on had safety belts installed at the factory.")

7. *In general, political liberals were against Ronald Reagan's plan for a missile defense system in space, nicknamed "Star Wars." They argued that it would cost trillions of dollars by the time it was in place, probably not even work, establish a dangerous precedent by placing nuclear weapons in space, and in general make us all less secure rather than protect us. Suppose you are a newspaper reporter and you are trying to estimate the outcome of a congressional vote allocating funds for the continuation of this program. Although you have not checked his voting record, you are told that John Dunn, a senator from New York, is a political liberal. You reason as follows:

**All liberals are in favor of discontinuing funding for the Star Wars program.
John Dunn is a liberal.
Therefore, John Dunn must be in favor of discontinuing funding for the Star Wars program.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Suppose, when the actual vote is taken you find out that the conclusion is false, that Mr. Dunn is definitely in favor of funding the Star Wars program. What would we know about the premises?

8. During the second term of the Reagan presidency it was discovered that our government sold arms to the Iranian government in hopes of getting American hostages released from Lebanon. This revelation was very embarrassing, because the Reagan policy at the time was to never negotiate with terrorists, that hostage taking was an illegal international action, and that negotiation was therefore totally inappropriate. Negotiation was also argued to be counterproductive as it would encourage more hostage taking, not to mention that Reagan beat Jimmy Carter for the presidency in 1980 in part because he promised to be a stronger president and not let us be kicked around by radical countries such as Iran. After the news story broke, Reagan admitted that he had lied to the American people and that he did know about the arms sale to Iran. It also became known at this time that the money that we received from the Iranians was then given to the

Contras who were fighting a guerrilla war against the communist Sandinistas in Nicaragua. The arms sales to Iran were not illegal, just embarrassing. But the diversion of the money to the Contras was illegal, because at the time Congress had passed a law specifically prohibiting our government from helping the Contras militarily. Hence, if Reagan did know about this, he would have been impeached. Reagan never admitted to knowing anything about the Contra diversion. Analyze the following argument, which claims that we know that Reagan must have lied about the Contra diversion:

If President Reagan lied about the Contra money, then he would also lie about the Iranian arms for hostage deal.

It is clear (because he has admitted this to the American people) that he did lie about the Iranian arms for hostage deal.

So, President Reagan lied also about the Contra money.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Because we know that the second premise is true, what do we know about the conclusion?

9. Suppose a history professor tells her class on the first day of a new semester that a necessary condition for passing her course is to pass the final exam. Suppose a student who is retaking the course reasons that he should be able to pass the final without coming to class the whole semester; he has had most of the material before and should be able to pass the final exam by just reviewing his notes from the previous semester. A key part of the student's reasoning is the following:

A necessary condition for passing this history course is that I pass the final exam.

So, if I pass the final exam, I will be guaranteed to pass the course.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Assuming that the professor was true to her word, would it be possible for a student to pass the final exam and still not pass the course?

10. Suppose John is having a party at his apartment. His hidden agenda for having the party is that he wants to get to know Delia, a new girl at school. He knows that Virginia and Betty do everything together and that if he invites Virginia, Betty will also come. This is important because Delia has recently become close friends with Betty. He reasons as follows:

If Virginia attends John's party, Betty will definitely also attend.

If Betty attends the party, Delia will also come.

So, if Virginia attends John's party, Delia will also come to the party.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Suppose Virginia attends John's party, but Delia does not come as expected. From this, would we be able to infer anything about the premises? If so, what?

11. Suppose John also wants to make his party special by making sure that Ken, the captain of the football team, attends. He reasons as follows:

**If Virginia attends John's party, Sam will definitely attend.
If Sam does not attend the party, then Ken will not attend the party.
So, if Virginia attends, we can be sure that Ken will attend.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: What if Virginia attends, but Ken does not attend as expected? Suppose also that we know that the second premise is true. Would this result (false conclusion and true second premise) constitute a test of the first premise?

12. Suppose that during the Clinton presidency someone is trying to explain to a friend that Bill Clinton is not just another liberal Democrat, but a new type of Democrat who has many things in common with moderate Republicans. She reasons as follows:

**All liberal Democrats oppose the GATT free trade agreement, which will make trade between countries easier.
Bill Clinton does not oppose the GATT free trade agreement, which will make trade between countries easier.
Therefore, Bill Clinton is not a liberal Democrat.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: If the premises of the above argument are true, what would we know about the conclusion? Explain.

13. Consider the difference between number 12 and the following argument.

**All liberal Democrats oppose the GATT free trade agreement, which will make trade between countries easier.
Bill Clinton is not a liberal Democrat.
So, Bill Clinton is not opposed to the GATT free trade agreement, which will make trade between countries easier.**

Valid or invalid? Explain. Give the definition and then explain how the

definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer these follow-up questions: How is this argument different from number 10? If the premises of the above argument are true, what would we know about the conclusion? Explain.

14. Suppose a peace advocate at a U.S. university argues that the cause of U.S. domestic problems is the tendency of the United States to get involved in wars. He argues as follows:

Stopping inflation is a necessary condition for the solution of our domestic problems.

If we are going to stop inflation, we must stop periodically getting involved in wars of choice, such as the war with Iraq.

Hence, if we stop getting involved in wars of choice, such as the war with Iraq, then we will solve our domestic problems.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer these follow-up questions: Suppose most economists dispute the conclusion of this argument, arguing that the link asserted here between war and the United States' domestic problems is too strong. From a logical point of view, would these same economists also necessarily dispute one or both of the premises? Would they necessarily believe that at least one of the premises is false?

15. In late fall 2002 and early 2003 there was intense discussion on the apparent plan of the Bush administration to declare war against Saddam Hussein's Iraq. Suppose a political analyst for a major newspaper offered this argument.

The United States will soon attack Iraq only if a majority of the Congress supports President Bush's assessment of the danger of Iraq supplying terrorists with weapons of mass destruction. A majority of the Congress does support President Bush's assessment of the danger of Iraq supplying terrorists with weapons of mass destruction. Therefore, the United States will soon attack Iraq.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: If the premises of the above argument were true, what would we know about the conclusion? Explain.

16. * Easy one if you see the underlying pattern/form.

All expensive cars are fast.

Ezra has a fast car.

So, Ezra has an expensive car.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Suppose the conclusion is false. What do we know about the premises? Explain.

17. This one is easier if you remember how to turn “only” statements in to “all” statements.

Only liberal democrats were in favor of Obama’s health care plan.

John Boehner was not a liberal democrat.

So, John Boehner was not in favor of Obama’s health care plan.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: The second premise and the conclusion were true. How does knowing this content influence our judgment on whether the argument is valid or invalid?

18. Let’s change “only to “all.” What do we get?

All liberal democrats were in favor of Obama’s health care plan.

John Boehner was not a liberal democrat.

So, John Boehner was not in favor of Obama’s health care plan.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: The second premise and the conclusion are true. How does knowing this content influence our judgment on whether the argument is valid or invalid?

19. Inference on smoking and life expectancy.

All people who smoke will not live to be 100.

Janell does not smoke.

Therefore, Janell will live to be 100.

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: If the premises of the above argument were true, what would we know about the conclusion? Explain

20. Last one. Another chance to show that you know the difference between validity and soundness.

All roses are red.

**I have a rose in my hand.
So, the rose in my hand is red.**

Valid or invalid? Explain. Give the definition and then explain how the definition fits, by explaining what the premises are saying (if valid) or not saying (if invalid). Then answer this follow-up question: Given that we know that the first premise is false, does this turn the argument into an invalid argument? Explain.

EXERCISE IV

Essay questions: Write a short essay response to each of the following. Answer yes or no to the following questions and then explain your answer.

1. Do valid arguments always have true conclusions? Do invalid arguments always have false conclusions? Explain by comparing the difference between validity, invalidity, and soundness.
2. If valid arguments allow for all possible inferences except ones from true premises to a false conclusion, what happens when we know that at least one of the premises of a valid argument is false? Do we know that the conclusion must be false? Look at 1-1 again and explain what we would know about the conclusion if the first premise is false. Assume that I have a solar-powered car, so it is false that my car must have gasoline to start.
3. If an argument is valid and has all false premises, do we know that the conclusion must also be false? Consider 1-1 again, then consider that I have a very special car. It is a regular gasoline car with a specially fitted solar-powered system, such that it can operate either in the normal way with gasoline or by solar power during very sunny days. This would make the first premise of 1-1 false: I do not have to have gasoline for my dual-operated car to start. Suppose at the time we are thinking of 1-1 my car does have gasoline, making the second and hence both premises false. Would we be sure that the conclusion is also false? Would we be sure that the conclusion is true?
4. Explain why invalid reasoning does not allow us to test our beliefs. Explain why valid reasoning does allow us to test our beliefs.
5. In the hat situation, suppose after the blind man solves the problem, the security guard opens the closet to retrieve the remaining hats and finds three red hats. In terms of the valid deductive arguments discussed related to the hat problem in the text, how could the observation of three red hats be explained?

6. Suppose you applied for a car loan and the loan was rejected. You can't believe it. You know that you have paid all your bills on time and that the last time you borrowed money for a car there was no problem. The car salesman suggests you call the Equifax credit rating agency that the car dealership uses. When you do, the agency representative assures you that the computer logic algorithms used by Equifax are the best in the business. Based on your understanding of valid deductive reasoning, what argument would you give the agency? What would you demand that they check?
7. The most difficult aspect of Chapter 1 is to understand that valid arguments can have false conclusions and invalid arguments can have true conclusions. If this is so, why is it still important to think logically and to use valid reasoning? What are the practical benefits?

ANSWERS TO SELECTED STARRED EXERCISES

I.

4. False. Invalid arguments can also have true premises and a true conclusion.

10. False. The conclusion of any valid argument can be false, if any of the premises are false.

II.

2. The phrase "first-class treatment" is vague. It could refer to first-class airfare or the way people are treated in general on American Airlines given the amount of money they pay. Either way, the "no one can beat" phrase implies that no one is better and hence does not claim that American is the best. So this ad does not claim that American has the best prices for first-class airfare or that it treats people better than any other airline. It only claims minimally that no one is better, that American is at least as good as any other airline.

III.

Here is the kind of complete answer you should give for the remaining arguments in part III. Notice the format for these answers. The answer (valid or invalid) is followed by the appropriate definition. Then we explain how the definition fits the particular argument by explaining what the premises are saying (if the argument is valid) or what the premises are not saying (if the argument is invalid). Then the follow-up question is answered.

1.

This argument is invalid. For invalid arguments it is possible for the premises to be true, and the conclusion false. In other words, even if the premises are true, the conclusion could be false. In this argument, to say, as the first premise does, that if police departments do a better job, then crime will decrease is not the same as saying that "only if" police departments do a better job, crime will decrease. The first premise, even if true, leaves open the possibility that there are other ways for crime to decrease. Crime could go down for, say, economic reasons or low unemployment. So, if crime does decrease, as stated in the second premise, it could be for other reasons, and we would not be sure that the police department was the cause. Follow-up: Even if the premises of this argument are true, we would know nothing about the conclusion. It could be true or false.

By the way, appeals such as this are very common during election campaigns. Incumbents will always take credit for anything positive that has happened during their watch, and usually blame their predecessors for anything negative that happened. President Reagan blamed Jimmy Carter for the poor state of the economy for several years into his presidency. When the economy finally turned around, he took the credit. President Clinton also took credit when the economy improved during his administration. President Obama was blamed for the poor state of job growth and the slow-growth economy in 2011 at the beginning of the presidential race for 2012. But defenders of his efforts argued that he had been in office for only three years, we had to unfunded wars and a huge world-wide financial crisis before he was president and Obama kept things from being worse.

7.

This argument is valid. For valid arguments it is not possible for the premises to be true and the conclusion false. In other words, valid arguments guarantee a true conclusion, if the premises are true. In the above case, if it is really true that being a liberal assures us that one is also against Star War funding, and John Dunn is a liberal, then he must also be against Star War funding. However, valid arguments do not guarantee having true premises, nor do they guarantee true conclusions unless all the premises are true. Follow-up: So, if we discover that this conclusion is false, then at least one of the premises must be false, because valid arguments do not allow for true premises and a false conclusion. Although the argument is valid -- if the premises are true, the conclusion must be true -- the first premise could be false, some liberals may be in favor of Star War funding. Likewise, the second premise could be false: John Dunn may not be a liberal. In fact, both premises and the conclusion could be false. But this would not change the logical fact that if the premises were true, the conclusion would have to be true.

16.

Invalid. Even if the premises are true, the conclusion could be false. Easy way to explain: it fits the form

For any x, if x is and E (expensive), then x is F (fast)
x is F

So, x is E (Always invalid)

Harder way to explain: The first premise says that all expensive cars are fast, but it does not say that all fast cars are expensive. So, even if the first premise is true, it is possible to have a fast car that is not expensive. So, if Ezra has a fast car, we do not know if it is expensive or not. Even if the premises are true, we do not know if the conclusion is true.

For the follow-up question: Since this argument is invalid, if the conclusion is true, we know nothing about the premises. They could be all true, one or the other false, or both false.

Essential Logic

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