CHAPTER FOUR

NOT and IF

4.1 The NOT Connector

NOT is a negator. It performs the logical role of negation, or denial. It does not connect *two* sentences together as do AND, OR, and IF, but it does produce a compound sentence by *connecting to one* sentence, so we can call it a monovalent connector (connects to one). For example, "Bill is not a physician" is compound, because it contains the monovalent connector NOT and it has the simple sentence "Bill is a physician" as its single component.

RANGE OF THE NEGATOR. We say that "Bill is not a physician" is the negation of "Bill is a physician." The component sentence makes up the *range* of the negator, that is, the part of the sentence affected by NOT. Thus we may analyze "Bill is not a physician" in two parts, the negator at the left, set off by a slash mark /, and the range of the negator, "Bill is a physician," on the right.

NOT/ Bill is a physician.

Putting NOT first in the sentence like this is uncommon in English, but sometimes a phrase like "it is not the case that" "it is false that" or "it is not true that" is used as a synonym for NOT, and then the negator does come first. Thus we might say "It is not true that Bill is a physician," meaning NOT/ Bill is a physician.

The component sentence lying within the range of the negator is called the *negated sentence.* In the case above, "Bill is a physician" is the negated sentence.

DEFINITIONS

Negator: The word NOT or any of its synonyms.
Negation: A sentence whose major connector is NOT.
Negated Sentence: The component in a negation that is denied by the negator.
Range of NOT: The negated sentence in a negation.

4.1.1 Truth Conditions for NOT

Since NOT amounts to negation or denial, its truth conditions are easy to understand. NOT *reverses* the truth value of its component. When the negated sentence (the component) is true, the entire negation is false, and vice-versa. For example, if "John is tall" is true, then "John is not tall" is false. If "Mary does not love John" is false, then "Mary loves John" is true.

TRUTH CONDITIONS FOR NOT

True Negation: The negated sentence is false.
False Negation: The negated sentence is true.

DOUBLE NEGATION. A negation is the denial of a sentence; but how can you deny a negation? By using another negator. When this happens, we say the sentence contains a *double negation.* Since a single negation denies the truth of the negated sentence, a double negation reverses it back again to its original value. Thus to say that a sentence is *not not* true is simply to say that it is true.

It is possible (but bad style) to write a double negation literally, that is, as "not not." More commonly, though, "not" is combined in a sentence with a prefix such as *un-* or *in-* taking the place of the second negator, like "not unable" for "not not able." Here are a few examples of double negations and their analyses.

She is *not not* a tailor = NOT/ She is *not* a tailor = NOT/ NOT/ She is a tailor.
He is *not un*appealing = NOT/ He is *not* appealing = NOT/ NOT/ He is appealing.
Their behavior is *not im*proper = NOT/ Their behavior is *not* proper = NOT/ NOT/ Their behavior is proper.
He is *not* a *non*-communist = NOT/ He is a *non*-communist = NOT/ NOT/ He is a communist.

Since the second NOT in a double negation reverses the truth of the first NOT, two negations in effect cancel each other out: NOT/NOT/Sandra is tall= Sandra is tall..

4.1.2 Inference Rule for NOT

The single inference rule for NOT is the rule of Double Negation, and it is simply a formalization of the discussion of double negation above. In formulating the rule, we will let *A* represent any sentence, and the double negation of A by *not not A*.

DOUBLE NEGATION (DBLNEG) (DN): Add or remove two negators.

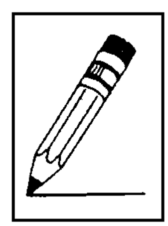
PREMISE:	*not not A*	PREMISE:	*A*
CONCLUSION:	*A*	CONCLUSION:	*not not A*

The DBLNEG rule allows you freely to eliminate any double negations you may find in a sentence without fear of changing the logical character of the sentence. The second form of the rule also allows you to *add* a double negation to any sentence without fear of changing its logical character.

4.1.3 Varieties of NOT

The negator may be shortened to n't (as in "can't") or reduced to a prefix (as in "unable"). Often the word "no" is used to indicate a negation, as in "he's no fool" meaning "he is not a fool." The many faces of NOT make it particularly likely to be overlooked. Logically speaking, it is extremely dangerous to miss seeing the negator in a sentence, since it literally "turns the meaning around" by denying the sentence to which it is attached.

STUDY PROBLEMS. In each case below, what is the negated sentence? Write the negated sentence in the blank that follows the negator. (Answers to study problems are in the appendix)



1. She won't talk = NOT/ ____________________
2. He is unable to come = NOT/____________________
3. This is impossible = NOT/ ____________________
4. We have no money = NOT/____________________
5. George is nonassertive =NOT/____________________
6. The aircraft is invisible = NOT/ ____________________
7. The rules are unbroken = NOT/____________________
8. Lucy isn't a tailor = NOT/ ____________________
9. The weather is unsettled = NOT/____________________
10. No one is in this room = NOT/ ____________________

4.1.4 NOT in Multicompound Sentences

NOT AS MINOR CONNECTOR. NOT may occur in a multicompound sentence without negating the entire sentence. Instead, it may negate only one of the components. For example, consider the sentence below. The two connectors in the sentence are OR and NOT. Which one of them is the major connector?

Either I'm crazy, or John's not what he seems.

Notice how the comma and EITHER are used to help clarify the sentence. OR is the major connector here, because it affects the entire sentence, whereas NOT affects only one of the components: I'm crazy /OR/ John's *not* what he seems. The range of the minor connector NOT in this example is "John's what he seems." If we move the NOT to the beginning of its range, we will have:

I'm crazy, /OR/ (NOT/ John's what he seems)

Here we have placed the right-hand component in parentheses to avoid any possible confusion as to which is the major connector. We will frequently use parentheses like this to help clarify the structure of a compound sentence.

NOT AS MAJOR CONNECTOR. What happens when NOT is the *major* connector in a multicompound sentence? It is not always easy to create an unambiguous English expression that will make it clear that NOT is the major connector. For example, suppose you wanted to negate an alternation such as (a) below.

(a) Susan is in love with John /OR/ Mary is in love with John.

Remembering that since we are using an inclusive OR, it is possible that both Mary and Susan are in love with John. So where would you put the negator? It won't work to put it after just one of the verbs, because this would affect only a single component. But it also won't work to put the negator after both of the verbs.

(b) Susan is *not* in love with John /OR/ Mary is *not* in love with John.

Although (b) may seem to be the negation of (a), it really isn't. For an alternation to be true only *one* of the components needs to be true. For example, if Susan is not in love with John, then (b) is true, even if Mary does love John; and if Mary does love John, (a) is true even if Susan is not in love with John. In these circumstances both (a) and (b) are true at the same time. Thus (b) is not the denial of (a). How, then, can we correctly state the denial of (a)? One way is to use the expression *neither...nor.*

NEITHER...NOR. The true negation of an OR sentence (an alternation) must state that *neither one* of the components is true. This can be accomplished by using neither...nor. Thus the negation of "Either A or B" may be expressed as "Neither A nor B." Following this rule, we may correctly negate sentence (a) above by the formulation in (c) below.

(c) *Neither* Susan *nor* Mary is in love with John.

Isn't (c) essentially the same as (b) above? No, it isn't. (b) is an alternation, but (c) is really a *conjunction* in disguise! Sentence (c) states that neither one of the components is true, that is, that *both of them are false*. (b) doesn't say this; it says only that at least one of them is false. Because of this, (c) can be stated even more directly by negating each component and by using AND for the connector, as in (d) below.

(d) Susan is *not* in love with John /AND/ Mary is *not* in love with John.

Sentences (c) and (d) above are equally correct ways of expressing the negation of (a). What sentence (d) shows us is that *the negation of an alternation is really a kind of conjunction.*

THOUGHT PROBLEM. Is the reverse true? Is the negation of a conjunction really an alternation? You can work this out by considering the truth conditions for AND and OR (inclusive OR).

NOT...OR. The combination "neither...nor" can also be expressed as "not...or," as in "Susan is *not* a doctor *or* a lawyer" which means "Susan is *neither* a doctor *nor* a lawyer." And like "neither...nor," "not...or" can be expressed equally well by negating each component and using AND for the connector: "Susan is not a doctor /AND/ Susan is not a lawyer." Again we see that the negation of an OR turns out to be a kind of AND. Letting *A* and *B* represent any two sentences, we have the definitions below.

> NEGATION OF AN ALTERNATION: The negation of an alternation is actually a conjunction:
>
> (Neither *A* nor *B*) = (Not *A* and Not *B*)
> (Not *A* or *B*) = (Not *A* and Not *B*)

NOT...BOTH. Now let's return to the "thought problem" above and take a look at the negation of a conjunction. How shall we negate the following sentence? Sentences (f) and (g) below are equally correct ways of expressing the negation of (e). Sentence (g) shows us that *the negation of a conjunction is really a kind of alternation.*

(e) John loves Mary /AND/ John loves Susan.

We can negate (e) by using the expression "not...both."

(f) John does *not* love *both* Mary and Susan.

Another way: Make OR the major connector and negate each component.

(g) John does not love Mary /OR/ John does not love Susan.

> NEGATION OF A CONJUNCTION: The negation of an conjunction is actually an alternation:
>
> (Not both *A* and *B*) = (Not *A* or Not *B*)

DeMORGAN'S LAWS: The rules in the two boxes above, for handling the negations of ANDs and ORs, areknown as DeMorgan's Laws after the mathematician Augustus De Morgan (1806–1871) Later on we will find that the DeMorgan's laws are very useful in making logical deductions and avoiding fallacies involving conjunctions and alternations.

4.2 Conditional Statements

A statement that asserts how one thing depends upon another is called a *conditional* statement. Conditional statements involve two components, each of which represents a certain kind of condition for the other component. There are two main kinds of condition, the *sufficient condition* and the *necessary condition.* Suppose, for example, that the instructor for a class has said that a score of 90% or better on your tests

> DEFINITIONS
>
> *Sufficient Condition: A* is a sufficient condition for *B* if whenever *A* is true, *B* must be true also.
>
> *Necessary Condition: B* is a necessary condition for *A* if whenever *B* is not true, *A* cannot be true either.

will give you an A grade, and you do not have to do anything else to get an A. Then getting a score of 90% or better is a *sufficient* condition for getting an A. On the other hand, if the instructor said that to get an A grade you must have a score of 90% or better on your tests, *and* write a term paper that receives an A grade, *and* attend every class session, then having a score of 90% or better would be a *necessary*, but not a sufficient, condition for getting an A: If you don't get 90% or better, you don't get an A, but getting 90% alone is not enough to guarantee an A. Compare the two grading options in this example with the definitions in the accompanying box, to be sure you understand the difference between the necessary and sufficient conditions.

THOUGHT PROBLEM. Imagine several cases from your own experience and your dailyl activities that represent either necessary or sufficient conditions.

4.3 The IF Connector

Conditional statements are often expressed with the IF connector. But the form of the sentence will vary depending on which condition is emphasized. When the sufficient condition is to be emphasized, it will usually come first in the sentence, preceded by IF. The necessary condition comes last. For clarity, the sufficient condition is usually separated from the necessary condition by a comma, or by the *connector auxiliary* "then," or sometimes both. The general pattern is

> DEFINITION
> *Conditional Sentence:* A sentence whose major connector is IF.

IF *sufficient condition,* then *necessary condition*

Example: If the candle is burning, then there is oxygen present.

On the other hand, when the necessary condition is emphasized, it may be placed first in the sentence, with the IF connector in the middle of the sentence and the sufficient condition after.

necessary condition IF *sufficient condition*

Example: There is oxygen present if the candle is burning.

Sometimes no cues are present, and you have to let your understanding of grammar tell you when the sufficient condition ends and the necessary condition begins. In the example below, where is the break between the two conditions?

If John is to get the loan he will have to have good credit.

The break between the sufficient and necessary conditions must come after "loan" because the expression "loan he" makes no grammatical sense. "Loan" must be the end of the sufficient condition, and "he" begins the necessary condition. The sufficient condition is "John gets the loan" and the necessary condition is "John has good credit." Here we are ignoring the future tense of the example, because having good credit is a necessary condition for John getting the loan regardless of when this happens:

If John gets the loan then he has good credit
If John got the loan then he had good credit
If John is to get the loan then he will have to have good credit

All of these are expressing the idea that having good credit is a necessary condition for getting the loan.

If we let *A* and *B* stand for any two sentences, we can state the general pattern of this kind of conditional statement like this: *If A then B.* To save space, we will sometimes shorten this general pattern to *A then B,* which we will still understand as meaning *If A then B.*

STANDARD FORM. Conditional statements may be expressed in many ways other than the pattern shown above. In later sections we will take a look at the main variations. For the sake of uniformity in the way we analyze sentences, however, we will adopt the IF...then pattern as our *standard form* of the conditional. When a conditional sentence appears in an argument in some other form, we will convert it to the standard form before continuing with the analysis.

4.3.1 Truth Conditions for IF

FALSE CONDITIONAL. A conditional sentence is false when the sufficient condition is true, but the necessary condition is false. For example, suppose that in a room there are several candles, but only one of them, a blue candle, is burning; then we know that the conditional sentence “If a candle is burning in the room, it is a yellow candle” is false. We know it is false because the sufficient condition “A candle is burning in the room” is true, but the necessary condition “It is a yellow candle” is false (it is a blue candle).

TRUE CONDITIONAL. In any other circumstance than the one above, a conditional sentence is considered to be true: when a conditional sentence has both components false, both components true, or the sufficient false but the necessary true, we will say the conditional sentence is true. Sometimes it seems strange to beginners to say that a conditional sentence is true even though both of its components are false; but a little reflection will reveal that *many* true conditional sentences have false components. For example, “If I win the lottery, I will live in Switzerland” is a true conditional, but (unfortunately for me) I have not won the lottery nor do I live in Switzerland. Neither component is true, but the conditional is quite true (I can assure you of that!).

This characteristic of conditionals, that they can be true even when both components are false, is a very important one; it is part of the reason conditionals are so valuable to us. Being able to say what would happen *if* something took place is an indispensable part of our ability to plan, project, and avoid future mistakes.

Nevertheless, our truth conditions, while covering most cases quite well, may also lead us into saying odd things. For example, we must say that a conditional sentence like “If the moon is square, then I'm a green cheesecake,” is true (because both components are false!). This always sounds strange to people at first, because it seems to them at first glance that the sentence must be false. But although the sentence seems nonsensical, it is not false, and it does very little logical harm to consider it as true for the purposes of our elementary logic. One reason it causes very little logical harm is that you are not ever likely to run into such a sentence in the course of analyzing any arguments that have genuine practical significance. (And if you did, after you’ve passed this course you would know exactly what to do about it!).

TRUTH CONDITIONS FOR IF

False Conditional: The sufficient condition is true but the necessary condition is false.

True Conditional: All other cases (both components false, both true, sufficient false and necessary true).

FOR PHILOSOPHERS ONLY. The idea that a conditional sentence is true when both components are false is applicable only to the limited logical system we are discussing here. There are deeper logical and philosophical issues which involve questioning this idea. However, even though the logical system presented here, which is called “Sentential Logic” (Sentence-Logic), is *in a philosophical sense* limited, it still covers a very large part of ordinary everyday discussion, and study of this limited logical system opens the door to a stronger understanding of logic in general.

4.3.2 Inference Rules for Conditionals

There are two inference rules for conditionals. The first covers the case when the sufficient condition is true, and the second covers the case where the necessary condition is false.

(1) SUFFICIENT ESTABLISHED (SUFEST) (SE): If the sufficient is true, then the necessary is true.

PREMISE:	*A then B*
PREMISE:	*A*
CONCLUSION:	*B*

(2) NECESSARY DENIED (NECDEN) (ND): If the necessary is false, then the sufficient is false.

PREMISE:	*A then B*
PREMISE:	*not B*
CONCLUSION:	*not A*

> HISTORICAL NOTE: The rule of SUFEST is traditionally known as "Modus Ponens." The rule of NECDEN is traditionally known as "Modus Tollens."

Arguments (a) and (b) below are examples of SUFEST and NECDEN. Which is an instance of SUFEST, and which is an instance of NECDEN? To find out, match each argument with the appropriate general pattern given above.

(a) If the candle is burning, then there is oxygen present. There is no oxygen present. Therefore the candle is not burning.

(b) If the Presidential Commission releases its report too early, there will be a negative reaction on Wall Street. The Presidential Commission does release its report too early. Therefore, there will be a negative reaction on Wall Street.

4.3.3 Conditional Fallacies

The rules above do not work "in reverse." When a necessary condition is fulfilled, this alone does not assure us that the sufficient condition actually will occur. For example, there must be oxygen for a candle to burn, but knowing that there is oxygen is not enough for us to know that the candle will burn. The wick may be wet, or too short, or there are no more matches, etc. For this reason the necessary condition is most significant when it is *not* present. Then we know that the sufficient condition cannot be present either. If there is no oxygen, we know the candle cannot burn.

It is quite different in the case of the sufficient condition. The sufficient condition is most significant when it *is* present. Then we are assured that the necessary condition is also fulfilled. Thus when the candle is burning we know for certain that there is oxygen. Knowing that the candle is not burning, on the other hand, tells us nothing about the presence or absence of oxygen.

These differences between necessary and sufficient conditions are often overlooked, and when they are, fallacies can result. In particular, there are two classic fallacies associated with conditionals. These are the *fallacy of concluding the sufficient is true,* and the *fallacy of concluding the necessary is false.* The definitions of these fallacies are given in the accompanying box. These two fallacies underlie a great many mistakes in reasoning, including many fallacies of generalization, which we will take up in our later discussion of ALL and SOME.

> CONDITIONAL FALLACIES
>
> *Concluding the Sufficient is True:* Incorrectly concluding that because a necessary condition is true, the sufficient condition must be true also.
>
> *Concluding the Necessary is False:* Incorrectly concluding that because the sufficient condition is false, the necessary condition must be false also.

One of the two arguments below is invalid because it commits the fallacy of concluding the sufficient is true, while the other argument is invalid because it commits the fallacy of concluding the necessary is false. Which is which? Find out by comparing the arguments with the definitions of the two fallacies given above.

(1) If that young man is drinking beer legally, then he is over twenty-one. He is over twenty-one. Therefore, he is drinking beer legally.
(2) If these trees are to be cut down, the environmental report must be favorable. These trees are not to be cut down. Therefore, the environmental report is not favorable.

> HISTORICAL NOTE: Traditionally the sufficient condition has been called the "antecedent" and the necessary condition has been called the "consequent." However since conditionals do not always occur in standard form, this terminology could be misleading.

4.4 IF-in-the-Middle

When the emphasis is to be placed on the necessary condition, the IF connector may appear in the middle of the sentence. This makes the necessary condition come first. The sufficient condition stays right after IF. We call this position for the connector "IF-in-the-middle." The conversion to standard form is easy: move IF to the beginning of the sentence and reverse the order of the components. In this conversion, the sufficient condition stays with IF. Place the auxiliary "then" between the sufficient and the necessary conditions. A comma is optional. Sentence (b) below is the correct conversion of (a).

> CONVERSION FOR
> IF-IN-THE-MIDDLE
>
> *B IF A = IF A then B*

(a) There is oxygen present IF the candle is burning.
(b) IF the candle is burning, then there is oxygen present.

4.5 Synonyms of IF

There are a number of synonyms for IF in English, and many of them will appear in the middle of a sentence, replacing IF-in-the-middle. The list in the accompanying box is not complete, because English is very flexible and the connectors can all be expressed in a variety of ways. But the list does cover most of the usual synonyms. When you convert a sentence using a synonym for IF into standard form, you will replace the synonym with IF. If the synonym is in the middle, first change the synonym to IF, then follow the procedure for IF-in-the-middle. For example, suppose you wish to convert the sentence "He will agree to the terms on the condition that payment is placed in a Swiss bank." The IF synonym in this sentence is the expression *on the condition that.* Replacing this with IF, we have an IF-in-the-middle sentence: "He will agree to the terms IF payment is placed in a Swiss bank." Next, treat this just like any IF-in-the-middle. Move IF to the beginning, reverse the order of the components, and add the auxiliary "then." Here are the three steps of this conversion sequence.

> PROVIDED THAT
> ON THE CONDITION THAT
> ASSUMING THAT
> GIVEN THAT
> IN CASE

Some Synonyms of IF

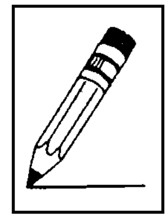
(1) He will agree to the terms *on the condition that* payment is placed in a Swiss bank.
(2) He will agree to the terms IF payment is placed in a Swiss bank.
(3) IF payment is placed in a Swiss bank, then he will agree to the terms.

When the IF synonym appears at the beginning of the sentence instead of in the middle, the conversion is even easier. Replace the synonym with IF and add "then." For example,

(1) *Given that* the train arrives early, we should have time for sightseeing
(2) IF the train arrives early, then we should have time for sightseeing.

Of course the comma is not absolutely necessary, but if there is any chance of confusion the strategic placement of the comma may be called for.

STUDY PROBLEMS. Now try your skill at converting to standard form. Convert the conditionals below. (Answers in the appendix.)



1. The car will never start if you keep pumping the gas pedal.
   IF ________________________________,
   then ________________________________

2. Assuming that the agreement is not ratified, the president will resign.
   IF ________________________________,
   then ________________________________

3. Your risk of heart attacks is reduced if you stop smoking.
   IF ________________________________,
   then ________________________________

4. Jones will leave tomorrow provided that he gets his pay.
   IF ________________________________,
   then ________________________________

5. The committee will agree to the plan on the condition that clause 24A is deleted.
   IF ________________________________,
   then ________________________________

4.6 ONLY Marks the Necessary Condition

ONLY identifies the necessary condition of a conditional statement by preceding it. When ONLY comes first in the sentence, the necessary condition is especially emphasized. For example, the sentence below uses ONLY to state that fresh tomatoes are a necessary condition for a genuine Italian sauce. (b) below is the correct conversion of (a).

(a) *Only* fresh tomatoes make a genuine Italian sauce.
(b) IF a sauce is a genuine Italian sauce, then it contains fresh tomatoes.

ONLY may also be placed in the middle of the sentence, where it is often accompanied by an auxiliary term: ONLY WHEN, ONLY AFTER, ONLY UPON, ONLY IF. It is still followed by the necessary condition. The sufficient condition appears first.

(a) An Italian sauce is genuine *only when* it uses fresh tomatoes.
(b) If a sauce is a genuine Italian Sauce, then it uses fresh tomatoes.

ONLY IF. Earlier we said that IF always comes before the sufficient condition, but when it is accompanied by "only" as the phrase *only if,* it precedes the necessary condition. There seems to be a conflict between the two rules that "only" identifies the necessary condition and IF precedes the sufficient condition. In this conflict, "only" wins. It overrides the usual tendency of IF to appear before the sufficient condition, and puts it before the necessary condition instead. To avoid confusion, it is best to think of "only if" as a special phrase that is synonymous with "then." Imagine that "only if" is a

CONVERSION FOR "ONLY IF,"
"ONLY WHEN," ETC.

A ONLY IF B = IF A then B
A ONLY WHEN B = IF A then B
A ONLY AFTER B = IF A then B

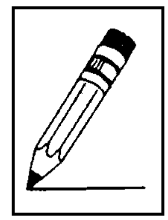
run-together word. Then we could think like this: ONLYIF = THEN. (But since “onlyif” sounds kind of Russian we won’t insist on using it!)

WARNING: It is a very common mistake for beginners to ignore “only” when they see the phrase “only if” and treat the sentence as though it were an IF sentence. You will do well if you begin right now to watch carefully for the presence of “only” before “if” and remember that “only” overrides “if” and forces it to precede the necessary condition.

When expressions like *only if* or *only when* appear at the beginning of the sentence, they are still replaced by “then,” but the order of the components will have to be rearranged. Example (b) below is the correct conversion to standard form of sentence (a).

(a) Only if *the money is paid* will you receive the merchandise.
(b) If you wish to receive the merchandise, then *you must pay the money.*

In other words, paying the money is a necessary condition for receiving the merchandise.



STUDY PROBLEMS. The conditional sentences below use ONLY to identify the necessary condition. Convert them to standard form, using the techniques described in this section. Remember that you may have to smooth out the grammar of a sentence to make the converted form more readable. (Answers are in the appendix.)

1. Plants grow only if watered.
IF ____,
then ______________________________________

2. Only upon the rising of the moon does the hound leave his lair.
IF ____,
then ______________________________________

3. Only this serum will counteract the adder's bite.
IF ____,
then ______________________________________

4. Mary will cancel her trip to Europe only if John decides not to marry Margaret.
IF ____,
then ______________________________________

5. Only the wood-thrush has a call like that.
IF ____,
then ______________________________________

4.7 UNLESS and WITHOUT

Conditionals may also be expressed by using the terms “unless” and “without.” These expressions usually express a necessary condition, but with a peculiar logical twist that involves an added negation. Consider this sentence, where UNLESS appears in the middle:

(1) George will be tried for burglary unless the money is found

The first step is to place the UNLESS component at the beginning:

(2) Unless the money is found, George will be tried for burglary

Now we come to the special "twist" that involves a negation. Rreplace the UNLESS component with IF...NOT:

(3) IF the money is NOT found, George will be tried for burglary

That's all there is to it! Of course, if the UNLESS or WITHOUT component is already at the beginning, you can simply replace it directly with the IF...NOT combination. The two sequences below illustrate this procedure.

(1) We will die of thirst *unless* the oasis is located today.
(2) *Unless* the oasis is located today, we will die of thirst.
(3) *If* the oasis is *not* located today, we will die of thirst."

(1) You cannot have a genuine Italian sauce *without* fresh tomatoes.
(2) *Without* fresh tomatoes you cannot have a genuine Italian sauce.
(3) *If* you do *not* have fresh tomatoes, then you cannot have a genuine Italian sauce.

SMOOTHING THE GRAMMAR. When a conditional is expressed using UNLESS or WITHOUT, the emphasis is somewhat different than when using standard form. The result of this is that when you make the conversion, you may have to "smooth" the grammar a bit to have the sentence sound correct. Here is an example.

(1) Original sentence: WITHOUT oxygen, the candle will not burn.
(2) Crude conversion: IF/ (NOT/ oxygen), the candle will not burn.
(3) Smoothed version: IF there is NO oxygen, then the candle will not burn.

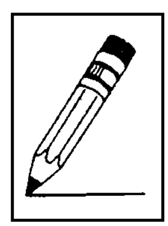
CONVERSION OF UNLESS AND WITHOUT

B UNLESS A = UNLESS A, B = IF (NOT A), then B
B WITHOUT A = WITHOUT A, B = IF (NOT A), then B

(Notice that we have used parentheses in these examples to make sure the range of NOT is just the first component rather than the entire sentence.)

EXCEPTIONS: Not every sentence that contains "without" expresses a conditional. Sometimes you must think through the meaning of the sentence carefully to determine whether it expresses a conditional or not. In the sentence "George went outside without his jacket" the phrase "without his jacket" is just a description of the way George was dressed when he went out. The sentence is not a conditional. In contrast, consider "You may not go outside without your Jacket." In this case having the jacket is asserted to be a necessary condition for going outside: "If you want to go outside, then you must have your jacket" or "If you do not have your jacket, you may not go outside.".

STUDY PROBLEMS: Convert the sentences below into standard form. You will find all variations, including UNLESS, WITHOUT, ONLY, and IF-in-the-middle. Prepare to discuss these in class.



1. Unless the instruments are out of calibration, what we have is a rare double comet.
IF ____,
then ____

2. Without definite knowledge of his intentions, our hands are tied.
IF ____,
then ____

3. There will definitely be a revolution unless the Guerilla leader is captured immediately.
IF ____,
then ____

4. We can go no further with our plans without advice from the Alpha team.
IF ____,
then ____

5. The aliens will take over the ship unless we seal the ventilator shaft.
IF ____,
then ____

6. These plants will not grow without daily watering.
IF ____,
then ____

7. Without Julie beside him, William does not present a strong image to the public.
IF ____,
then ____

8. The horse cannot win unless the boy is allowed to ride him.
IF ____,
then ____

9. Unless the well is over fifty feet deep, you will not find water.
IF ____,
then ____

10. The cashiers work best only when given six-hour shifts.
IF ____,
then ____

11. You will lose your sense of reality if you watch too much TV.
IF ____,
then ____

12. The broth will be spoiled if there are too many cooks.
IF ____,
then ____

13. Bartania will agree to the pact only if Torentina disarms.
IF ____,
then ____

14. Only fresh tomatoes make a genuine Italian sauce.
IF ____,
then ____

15. Only in Germany will you find a beer worth its name.
IF ____,
then ____

16. Without a certified receipt he will be unable to claim the prize.
IF ____,
then ____

17. Unless winter snows are early, Hannibal will cross the Alps by mid-August.
IF ____,
then ____

18. Only after the hostages are released will the members of the alliance negotiate.
IF ____,
then ____

19. Von Kranz will reveal the formula if you free Helga at once.
IF ____,
then ____

20. Von Kranz will reveal the formula only if you free Helga at once.
IF ____,
then ____

4.8 Cause and Effect

In the sciences conditionals are very important. The simple kind of conditional we are studying here, expressing the truth relation between sufficient and necessary conditions, is not really adequate for full expression of the scientific laws that establish cause and effect. This is one reason that the truth conditions for a true conditional, as we have defined them in this chapter, are limited in their application (see section 4.3.1). However, once causes and effects have been established, it is common for people to state a cause as a sufficient condition and its effect as a necessary condition. Our definition of the truth conditions for conditionals will work quite well within the bounds of much of ordinary argument using statements of causality. For example, "striking that match will cause an explosion" is not strictly identical to "If you strike that match, then there will be an explosion." But for purposes of ordinary argument the differences between the two are relatively unimportant.

A causal relation between events may be expressed without using the word "cause." Expressions like *will result in* or *will bring about* generally indicate a causal relation, and may be converted to standard IF...then form as shown in the conversion below.

(a) The assassination of the King *will bring about* a general uprising.
(b) *If* the King is assassinated, *then* there will be a general uprising.

> *We must not make the assumption that conditionals always express cause and effect, or that the sufficient condition is always an earlier event than the necessary.*

The conditional as described in this chapter is often used to express a cause-effect relationship between events, but there are many conditionals that are *not* about cause and effect. A cause always precedes its effect in time, but a sufficient condition does not always precede a necessary condition in time, and in some cases a conditional may not express any movement from earlier to later time at all. For example, When we say "if the radio is playing, then it is plugged in," the sufficient condition does not come earlier in time than the necessary condition. In fact it is the other way around--you must plug in the radio before it plays. In neither case does the one cause the other: the radio's playing does not cause it to be plugged in, nor does plugging the radio in cause it to play.

Or consider "if this is a genuine Italian sauce, then it contains fresh tomatoes." This does not express any particular time-relation between the sufficient and the necessary conditions. The sauce does not come first, and the fresh tomatoes afterward; Nor does the presence of fresh tomatoes in the sauce come first, and the sauce afterward. Time is really not the issue here, but rather how the sauce is constituted.

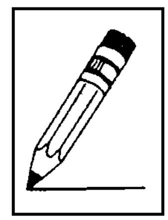
We must not make the assumption, then, that conditionals always express cause and effect, or that the sufficient condition is always an earlier event than the necessary condition. No general rule can be made about the time relations between necessary and sufficient conditions. Each case must be evaluated as you meet it. In particular, the logic of truth conditions has definite limitations. Nevertheless, it does approximate a great majority of the logical relations we use in daily life, and in addition, it forms a basis for understanding richer and more complex modes of logical analysis, including the logic of generalizations (ALL and SOME) discussed later in this text.

4.9 Conditionals and Arguments

Sometimes beginners confuse "then" with "therefore" and this leads them to confuse conditional statements with arguments. An argument does suggest that IF the premises are true, THEN the conclusion is true, and to this extent an argument asserts a kind of conditional relation between the premises and the conclusion. But an argument goes much further than a conditional does. When a person makes an argument, he or she normally intends to assert that the premises are true, and that the conclusion is true as well. But you can make a conditional statement without intending to assert that either the sufficient condition or the necessary condition are true. Furthermore, conditionals are single statements, while arguments always involve two or more statements -- the premises and the conclusion.

IMPLICATION AND INFERENCE. The difference between "then" and "therefore" can be explained by noting the difference between *implication* and *inference.* "Then" refers to implication, while "therefore" refers to inference. When I say "If A, then B," I am saying that A *implies* B; if A is true, B should be true also. But I am not asserting that A is true. In contrast, when I say "A, therefore B," I am ordinarily asserting that A is true, and on the basis of A's truth I am *inferring* that B is true.

STUDY PROBLEMS (A). Each of the sentences below expresses a conditional relation, but the wording used is not specifically discussed in this chapter. Test your understanding of sufficient and necessary conditions by putting each sentence into IF...then form. (Answers to study problems are in the appendix.)



1. To be honest, you must put all your cards on the table.
   IF ____,
   then ____

2. It is necessary to locate and correct crankshaft defects early to prevent more serious trouble later.
   IF ____,
   then ____

3. When Deborah becomes alarmed, she takes immediate action.
   IF ____,
   then ____

4. Michael always acts like a fool when Nancy is around.
   IF ____,
   then ____

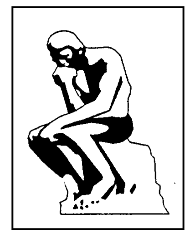
5. Upon payment of the fee, my client will release the papers.
   IF ____,
   then ____

STUDY PROBLEMS (B). The sentences below contain the expressions neither...nor, not...or, and not...both. Rewrite the sentences below to express all connectors in AND, OR, NOT, or IF...then form. You will need to use the information given in Chapters 3 and 4. The first one is solved for you. (Answers in the Appendix). Be prepared for class disc

1. Tom is not to be found in the cellar or the attic.
   SOLUTION: Tom is not to be found in the cellar and Tom is not to be found in the attic.
2. Joan is not both a veterinarian and a philanthropist.
3. This painting is neither a Van Gogh nor a Gaugin.

4. The car was bright red and was not a Ferrari or a Porsche.
5. Either this horse is Tom's , or it is neither for sale nor will it ever be for sale.
6. Neither the Captain nor the Bosun's Mate saw who took the strawberries.
7. The President said "I will neither raise taxes nor lower interest rates."
8. This horse is not Tom's or Susan's, so Barry won't bet on it.
9. Unless I am mistaken, the medallion is neither gold nor copper.
10. George will not purchase both Tom's horse and Susan's, assuming that Barry has told him the truth.
11. George will not purchase both Tom's and Susan's horses unless he knows for sure that Barry is telling the truth.
12. Without knowing that Barry is telling the truth, George will not purchase Tom's or Susan's horses.

EXERCISE 6. Convert each sentence below into standard IF...then form. Smooth the phrasing if necessary to make the sentences read clearly. Do you see any that may be interpreted in more than one way? Are there any that seem confusing? Be prepared to discuss the more interesting examples in class.



1. The radio will not play unless it is plugged in.
2. The car will not start unless the key is turned clockwise.
3. The car will start unless something else has gone wrong.
4. The patient will not live unless serum is given at once.
5. There will be no time for sightseeing unless the train is early.
6. Unless winter snows are early, Hannibal will cross the Alps by mid-august.
7. Unless you give the dog a bone, the barking will continue.
8. Only unwatched pots boil.
9. Only Kryptonite is effective against Superman.
10. Lassie is interested in a bone only when it is well aged.
11. Von Kranz will turn the dial too high only if he is distracted by Helga's moaning.
12. Without inside help the robbery is impossible.
13. The treaty will never be implemented without the concurrence of the Torentinans.
14. The Torentinans will agree to the treaty only if it puts the Bartanians at a disadvantage.
15. The treaty will put the Bartanians at a disadvantage if it includes a statement of Torentina's territorial rights.
16. The committee could estimate the percentage of vehicles in violation of the new code only if statistics were gathered from seven or more counties.
17. The roadway will be widened only if the environmental impact report is favorable.
18. An eclipse is visible at Mount Vision only when the sun rises just after the moon sets.
19. The law would not be necessary if the corporations had not abused their power and even profited from these questionable practices.
20. Mother will have a fit unless you don't go.
21. Unless there had been a fantastic coincidence, the alignments of the stones had to have been for the purpose of eclipse prediction.
22. Even a very bright star like Spica can only be seen at rising when there is very clear weather.
23. To bear live young an animal must be a mammal.
24. To drive a vehicle of more than three tons you must have a special license.
25. Students must complete 24 units in order to qualify for the minor.
26. Unless the wind dies down soon, all of those trees will be uprooted.
27. The letters will be mailed only when we have the authorization.
28. This strongbox cannot be opened without the key.
29. How many more young boys will die if Wilkerson decides to attack again?
30. The serum is effective when given in large doses.

EXERCISE 7. Some of the arguments below contain examples of the inference rules introduced in Chapters Three and Four (CONJUNCT, JOINUP, ALTDEN, DBLNEG, SUFEST, NECDEN). Some of them are examples of the fallacies introduced in this chapter (Concluding the Sufficient is True, Concluding the Necessary is False). Identify which rules (or fallacies) apply to each example.

1. Superman is not invulnerable to Kryptonite. If Superman is vulnerable to Kryptonite, he will have to be cautious in dealing with interplanetary criminals. Therefore Superman will have to be cautious in dealing with interplanetary criminals.
2. Only if it was brewed in Germany will this beer be worthy. This beer is not unworthy. Therefore this beer was brewed in Germany.
3. Unless I am mistaken, that cow was raised in Sonoma County. But I am mistaken. Therefore, that cow was not raised in Sonoma County.
4. Either I am mistaken in this case, or that cow was raised in Sonoma County. I am not an expert on cows, but I am not mistaken in this case. Therefore that cow was raised in Sonoma County.
5. George's Airplane will fly provided that it has a new propellor and the landing gear is fixed. George's airplane has a new propellor. The landing gear on George's plane has been repaired. Therefore George's airplane will fly.
6. If DeVroot tests the medallion in the laboratory, he will discover that it is not authentic. However, DeVroot will not discover that the medallion is not authentic. We may rest assured, then, that DeVroot will not test the medallion in the laboratory.
7. We know that the Engineer is drunk, because the train would arrive early if he was sober, and the train did not arrive early.
8. If the CFC's continue to pollute the atmosphere at the present rate, within ten years the earth's average temperature will rise by at least four degrees centigrade. But the CFC's will not continue to pollute the atmosphere at the present rate. Therefore it's not true that within ten years the earth's average temperature will rise by at least four degrees centigrade.
9. Susan is neither a lawyer nor a veterinarian. Either Susan has been misrepresenting herself, or she is a lawyer. Therefore Susan has been misrepresenting herself.
10. Lassie will love this bone on the condition that it is well aged. This bone is well aged. I conclude that Lassie will love this bone.

TRUTH CONDITIONS IN THIS CHAPTER

NOT: When the negation is true, the negated sentence is false. When the negation is false, the negated sentence is true.

IF: A conditional using the IF connector is false in only one situation: when the sufficient condition is true but the necessary condition is false. In any other situation the conditional is considered true.

FALLACIES IN THIS CHAPTER

CONCLUDING THE SUFFICIENT IS TRUE: This fallacy occurs when a person incorrectly assumes that because a necessary condition is true, the sufficient condition must be true also.

CONCLUDING THE NECESSARY IS FALSE: This fallacy occurs when a person incorrectly assumes that because the sufficient condition is false, the necessary condition must be false also.

INFERENCE RULES IN THIS CHAPTER

DOUBLE NEGATION (DBLNEG) (DN): Add or remove two negators.

PREMISE:	*not not A*	PREMISE:	*A*
CONCLUSION:	*A*	CONCLUSION:	*not not A*

SUFFICIENT ESTABLISHED (SUFEST) (SE):
Obtain a result from a conditional.

PREMISE:	*A then B*
PREMISE:	*A*
CONCLUSION:	*B*

NECESSARY DENIED (NECDEN) (ND):
Obtain a result from a conditional.

PREMISE:	*A then B*
PREMISE:	*not B*
CONCLUSION:	*not A*

HISTORICAL NOTES

Sufficient Condition	= Antecedent
Necessary Condition	= Consequent

CHAPTER FIVE

Simple Sentence Analysis

5.1 The Memory Pad

To evaluate the validity of a deductive argument, you will undertake the following three steps.

1. Determine the declarative value of its sentences, using the DSF as shown in Chapter Two.

2. Identify the particular logical characteristics of each sentence by identifying major and minor connectors (Chapters Three and Four).

3. Compare the premises and the conclusion to see if they have the kinds of special logical relationships that establish deductive validity.

This comparison is made much easier by putting the sentences into an abbreviated form, which we call the *memory equivalent form*, or MEF for short. It is the topic of this chapter and Chapter Six to show you how to create the memory equivalent form of an argument.

MEFs are created by abbreviating the connectors and the simple sentences they connect, then grouping these abbreviations in a way that clearly distinguishes the major and minor connectors. To do this, we must have a systematic way of analyzing compound sentences into the simple sentences that make them up. As the compound sentence is analyzed, each simple sentence component is stored on a "memory pad." Each page of the memory pad contains fifteen storage locations and their corresponding addresses. The address of the sentence on the memory pad becomes its abbreviation. The addresses on the first page are the capital letters A through K. If more pages are needed, they will use addresses AA through KK, then AAA through KKK, etc. For the exercises and examples in this text, you will never need to use more than the first fifteen addresses. Here is a picture of the first four storage locations on the first page of a memory pad.

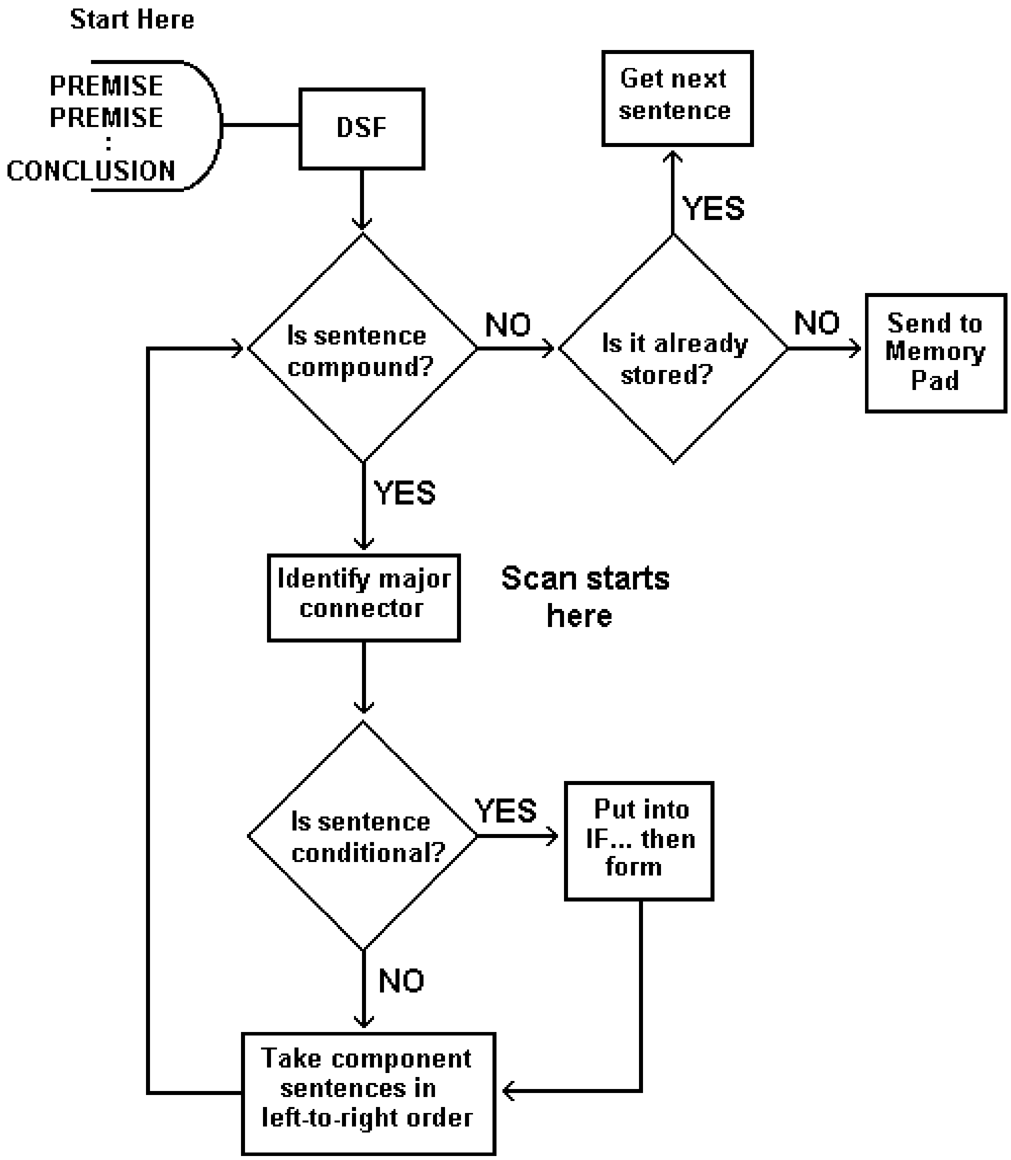
Address	Storage Location
A	
B	
C	
D	

After the simple sentences that make up the premises and conclusion of an argument are stored on the memory pad, their addresses are used as their abbreviations. For example, if the simple sentence "John is tall" is stored in memory location A, then the memory equivalent for "John is tall" is just its address, the letter A. Thus the English meaning of an abbreviated sentence can always be recovered by a glance at the memory pad. Of course, the memory pad is simply something you note down on a sheet of paper. But just as our "DSF" was not really some kind of machine but represents your own skill at identifying declarative sentences, the "memory pad" is a concept you can use when you are creating the abbreviations for the simple sentences in an argument. Of course, the memory pad is essentially a visual representation of a scheme of abbreviation. It is not necessary actually to create the memory pad in a table form as shown above. As long as you have a clear notation of what letters will be the "addresses" of each simple sentence, in the order they occur in the argument, that constitutes a correct memory pad.

(NOTE: Do not confuse capital letters A, B, C, etc. on the memory pad with italicized letters *A, B, C,* etc. used to state rules. The former are addresses for specific individual sentences. The latter are general and represent any sentence at all.)

5.2 Analysis Flowchart

To help avoid errors in the analysis, the simple sentences are stored on the memory pad in a set order. The flowchart below gives a step-by-step picture of the process.



Does this look complicated? Actually it's very simple! Once you have run a few sentences through the flowchart to see how it works, sentence analysis becomes very easy without going through the flowchart procedure step by step (or at all). The detailed steps described here are just an aid to learning the process. You will quickly learn to skip the details and move directly to the memory pad. Nevertheless, the flowchart is still there as an aid should you need it.

A sentence that has first been authenticated as declarative by the DSF is checked to see if it is compound (first step after the DSF). If it is not (that is, if it is simple), it will be placed in the next available location on the memory pad – unless the same sentence has already been given a location. (There can be no duplicate sentences in storage.) But if the sentence is compound, it must be further analyzed. First the major connector is identified, and, if the sentence is a conditional, it is converted to standard IF...then form. Then the *component* sentences are taken in left-to-right order and tested in the same way as before. This creates a flowchart "loop" that continues until all the simple sentences have been stored on the memory pad in a predetermined order.

5.3 Sentence Scanning

NOTE: Traditional logic texts do not usually give a detailed explanation of the abbreviation process. This often leads to confusion and difficulty. Our method simplifies the procedure and makes it virtually automatic. It also helps you to understand the logical structure of a sentence.

When the answer to the first question on the flowchart "is the sentence compound?" is YES, we carry out the remaining steps by performing a *scan* of the sentence. The scan identifies the major connector of the sentence and numbers the components according to their left-to-right positions. The left-hand component is the *first* component; the right-hand component is the *second* component. When the major connector is monovalent (NOT), there is just one component. When it is bivalent (AND, OR, IF), there are exactly two components (there are never more than two components around a major connector). To show you how to use the flowchart, we will first analyze a compound sentence that has the form of a conjunction. Then we will analyze the premises and conclusion of an entire argument. As we go through each step, refer to the flowchart to see exactly how it is being used to guide the analysis. Let us assume this is the first premise of an argument:

John loves Susan, and he intends to marry her.

What we need to do is to identify the simple sentences in this compound sentence, and place them in left-to-right order into the memory pad. You might think this is easy and skip the flowchart altogether, just writing

A	John loves Susan
B	He intends to marry her

But wait! Something's not quite right. The sentence in address B, taken alone, is not declarative because it contains unspecified pronouns. Maybe we'd better follow the flowchart anyway just to be sure we don't miss anything.

1. The DSF (top of flowchart) will restructure this sentence to fill in the referent for the pronoun, so the first step in the analysis results in:

John loves Susan, and *John* intends to marry *Susan.*

2. Now the flowchart asks "is the sentence compound?" The answer is YES, so a scan takes place. This scan is called the primary scan (see the middle of flowchart). The scan identifies the major connector and locates the first and second components.

John loves Susan /AND/ John intends to marry Susan.

The scan identifies the sentence as a conjunction. The sentence is compound. The first component (left to right) is "John loves Susan" and the second component is "John intends to marry Susan" (thanks to the DSF!).

3. The next question on the flowchart is "Is the sentence a conditional?" This sentence is not a conditional, so we move directly to the bottom of the flowchart.

4. Now the component sentences are passed through a *loop* that starts at the bottom of the flowchart and goes back up to the question "Is sentence compound?" at the top of the flowchart. What this loop will do is to eventually break down any compound sentences in the original until all that gets into the memory pad are simple sentences. The components are taken through this loop in left-to-right order, starting with the first component, "John loves Susan." If this component were compound we would have to perform a *secondary scan*. But since it is simple it is sent to the memory pad (top right of flowchart). Before it gets to the memory pad, a check is made to see if it is already stored. This is to prevent duplicate sentences from getting into the memory pad. Since this sentence is not already stored, we can write it in the first available storage location, which is location A.

5. Finally, we return to the start of the loop (bottom of flowchart), where the second component, "John intends to marry Susan," is still waiting to be processed. This sentence is simple, and also has not yet been stored, so it goes quickly through the loop and is put in location B.

Address	Storage Location
A	John loves Susan
B	John intends to marry Susan

Now let's use this technique to analyze an entire argument. You are familiar with this argument, since it was initially presented as an example in Chapter One. (If you think you already understand how the flowchart works, you might try doing this one yourself before reading the detailed instructions below!)

> Susan will be awarded the trophy if she manages to win the final race. Furthermore, Susan will win the final race provided that the Swedish competitor does not enter. Therefore if the Swedish competitor does not enter, Susan will be awarded the trophy.

The premises are processed first and the conclusion last, so we begin by checking the first premise with the DSF (top of flowchart). The premise is "Susan will be awarded the trophy if she manages to win the final race." The DSF detects a pronoun "she" in the sentence, and replaces it with its referent, "Susan." The restructured premise is "Susan will be awarded the trophy if *Susan* manages to win the final race." Now, following the flowchart, we next ask "is the sentence compound?" Yes: the sentence contains the connector IF. To identify the major connector, we complete a scan:

Susan will be awarded the trophy /IF/ Susan manages to win the final race.

Is the sentence a conditional? Yes. This answer sends us off on the branch to the right, where we are instructed to convert the sentence into IF...then form. The conversion pattern for IF-in-the-middle requires us to reverse the components, keeping IF with the sufficient condition (Chapter Four).

IF/ Susan manages to win the final race, then Susan will be awarded the trophy.

> *When a sentence is a conditional, convert it to standard form before beginning the flowchart loop.*

The first component is now "Susan manages to win the final race" and the second component is "Susan will be awarded the trophy." This is the order of the components we will use when we move to the next instruction in the flowchart. (Whenever a sentence is a conditional, it must be converted to standard form before beginning the loop at the bottom of the flowchart.) Now the component sentences are taken through the loop in their left-to-right order. The left-hand component, “Susan manages to win the final race,” is simple, so it is assigned to address A on the memory pad. The second component, “Susan will be awarded the trophy,” is also simple, so it goes to location B. Our memory pad now looks like this:

Address	Storage Location
A	Susan manages to win the final race
B	Susan will be awarded the trophy

5.4 Handling Connector Synonyms

Now we are ready for the second premise, "Susan will win the final race provided that the Swedish competitor does not enter." This sentence passes the DSF smoothly without any change, since it is declarative in the strict sense. Now for the question, "is the sentence compound?" We know the sentence is compound, because we can see at least one connector, NOT. But NOT doesn't look like the major connector, since it appears to affect only the part about the

Swedish competitor. Remembering the synonym table from Chapter Four, we identify "provided that" as a synonym for IF. This is the major connector. The sentence is a conditional, and IF is in the middle, so it must be converted to standard form.

IF/ the Swedish competitor does not enter, then Susan will win the final race.

After the conversion, the first component is "The Swedish competitor does not enter" and the second component is "Susan will win the final race." This is the order in which the components will pass through the flowchart loop.

5.5 Handling Compound Components

Taking the components in left-to-right order, we send the first component, "The Swedish competitor does not enter," through the loop. The flowchart asks, "Is it compound?" Yes. It contains the NOT connector, so we must undertake a *secondary* scan. A secondary scan is a scan of one of the components from the primary scan.

NOT/ The Swedish competitor enters.

In this scan we have dropped "does" from the original sentence, because "does" was merely a grammatical requirement needed when NOT was placed within the sentence. When the NOT is moved to the beginning, the "does" becomes superfluous. (To be very exact, you might have changed this to “The Swedish competitor does enter the race” but since we understand the context of the argument there is no need to do this.)

The secondary scan proceeds just like the primary scan, that is, its components are sent through the loop in order. In this case, there is only one component to go through the loop, "The Swedish competitor enters." It is a simple sentence, so it is placed in the next available memory slot.

Address	Storage Location
A	Susan manages to win the final race
B	Susan will be awarded the trophy
C	The Swedish competitor enters

When a component is compound, then, we must continue scanning, sending the resulting components through the loop repeatedly until we find no more components that are compound. If a component of a secondary scan is itself compound, a tertiary scan would be required. The end result is that all the simple sentences in the argument are placed on the memory pad in a predictable order. Notice that the connectors themselves never enter the memory pad. (What happens to the connectors will be explained in a moment.)

Having completed scanning of the first component of the premise, we now turn to the second component, which is still waiting to go through the loop: "Susan will win the final race." This is not compound, but simple, so it is cleared for storage on the memory pad. What location will it receive?

5.6 Handling Synonymous Sentences

You might think that it would be placed in location D, which is the next available address. However, before making this decision, you must answer the question "is it already stored?" by checking all previously stored sentences to see if any of them mean essentially the same thing as the current sentence. Are there any sentences currently stored on the memory pad that match "Susan will win the final race?" Yes. The sentence already stored at address A, "Susan manages to win the final race," has the same *practical meaning* as far as the argument is concerned: both sentences refer to the same situation -- the situation in which Susan wins the final race.

It is true that taken out of context the two sentences "Susan manages to win the final race" and "Susan will win the final race" are rather different in meaning. "Susan manages to win the final race" describes a present situation, while "Susan will win the final race" describes a future situation. However, in the context of the argument and of the compound sentences in which these simple sentences appear, the difference in tense of the sentences is not significant. Both of the sentences really refer to the same race, and to the situation in which Susan wins that race. To satisfy yourself on this point, consider the following example.

If Abby gets number 3099472, she will win the lottery. Abby does get number 3099472.

What should be our conclusion? We might readily conclude, "Abby wins the lottery." In this context, the difference in tense between "Abby will win the lottery", "Abby wins the lottery", and "Abby has won the lottery" makes no practical difference. The reason for this is that the first premise is hypothetical in character, referring to *whatever time* number 3099472 is received. When it is received, Abby has in effect won. Future tense is often used this way: when imbedded in a conditional, it has a general meaning referring to any time that the sufficient condition becomes realized. (Another way to see this point is to notice that the first sentence could have been stated as "If Abby gets number 3099472, she wins the lottery.")

For this reason, we will not assign "Susan will win the final race" a different location from "Susan manages to win the final race." Instead, we will modify the sentence already in location A to reflect the most economical way of expressing the practical situation referred to by both sentences. Please note the modification at address A carefully:

Address	Storage Location
A	Susan wins the final race
B	Susan will be awarded the trophy
C	The Swedish competitor enters

The present tense form of the sentence adequately covers the practical value of both of the other sentences as they occur in the original argument. As a general rule, when a sentence appears as the necessary condition of a conditional statement in an argument, you can convert future tense to present tense without distorting the practical meaning of the sentence.

5.7 The Conclusion of the Argument

The last step is to process the conclusion of the argument: "If the Swedish Competitor does not enter, Susan will be awarded the trophy." This is compound and it is a conditional, already in IF...then form so it requires no conversion.

IF/ the Swedish competitor does not enter, Susan will be awarded the trophy.

Now we send the left-hand component through the loop. It is compound, so we must undertake a secondary scan. The scan identifies NOT as the major connector:

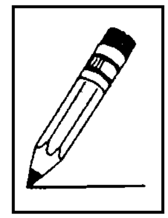
NOT/ the Swedish competitor enters.

The component, "The Swedish competitor enters," goes into the loop. We find that it is simple, so it heads for storage. But when we ask "is it already stored?" we find that the exact same sentence has already been given location C (it was a component of premise #2). Therefore no new storage location is required. The memory pad remains unchanged. Finally, we reach the second component of the conclusion, "Susan will be awarded the trophy." It is a simple sentence with a duplicate already in location B, so again no new locations are assigned. We end up with just three simple sentences on the memory pad. If you were writing your memory pad in a notebook, it might just as well look like this:

A = Susan wins the final race
B = Susan will be awarded the trophy
C = The Swedish competitor enters

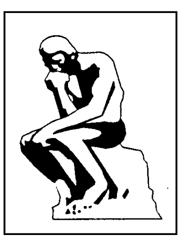
Although the original argument was much longer in appearance, it was actually composed of only three simple sentences. But where have the connectors gone?

Besides the data on the memory pad, we have saved (or remembered) the scans, because they show the logical structure of the sentences by identifying their major and minor connectors as well as the exact positions of the components. In actual practice, "saving the scan" doesn't necessarily mean you have to write down all the scans. Unless the argument is very long and complicated, your understanding of the sentences and their logical structure will simply be a matter of remembering and you will go on to the final stage with no interruption. In the final stage of formatting, we will use all of this information to produce the *memory equivalent form* of the argument. We will accomplish this in the next chapter.



STUDY PROBLEMS. Process the sentences below, using the DSF first, then the flowchart procedure until all the simple sentences are on the memory pad. Assume that the memory pad is cleared between each example. When you are finished, you should have a record of all the scans and the completed memory pad. (Answers are in the appendix.)

1. Either Tom has forgotten the payment, or he has run out of funds.
2. Either Burroughs and Tomlinson are both mistaken, or DeVroot is not the expert he claims to be.
3. Joan is an expert veterinarian, and she will treat the dog free if its owner is not able to pay.
4. It is not the case that Joan and Michael have separated.
5. Assuming that the fine is paid and there are no pending charges, Richard should be free by morning.
6. If this is an American car and it is in good operating condition, then it will start if the key is turned clockwise.
7. Are not the rich and famous worth watching?
8. Are not the Baratarians and the Torentinans continually at war?
9. If William likes potatoes only if they are cooked with the skins on, then he is certainly a health faddist.
10. If if William likes potatoes then they are cooked with the skins on, then he is certainly a health faddist.



EXERCISE 8. Here are some real brain-teasers. Pay careful attention to the hints given with some of them. Take each case through the DSF and flowchart operations, ending up with all the simple sentences in storage just as you did with the sentences in the exercise above. Some of these problems are entire arguments, so you will want to follow the correct order for premises and conclusions.

1. We must pray, for the agents of sin are among us. (Hint: this is a complete argument.)
2. There is no need for anyone to pray, because the world is a mechanical combination of mindless particles, and there is no deity to help us. (Hint: another complete argument!)
3. I think, therefore I am. (Hint: this argument was written by the philosopher Rene Descartes.)
4. Oh, ye fountains, meadows, hills, and groves, forebode not any severing of our loves!
5. Patrons of the main library can now buy time on a coin-operated computer.
6. Oh, dear! William's dropped half the eggs, and these tomatoes are badly bruised. Whatever shall we do for breakfast?
7. Look out! There's either a pit or a pendulum in that house, and something creepy in the attic. (Hint: this is multi-compound)
8. Dear Jane!
   The guitar was sweet,
   But the song you trilled was sad,
   Or was not rightly heard.
   (Hint: Treat `but' as a synonym for AND)
9. The law would not be necessary if the corporations had not abused their power and even profited from these questionable practices.
10. There will be no time for sightseeing unless the train is early.

CHAPTER SIX

Memory Equivalent Formatting

6.1 MEF Templates

> HISTORICAL NOTE: In traditional texts, the memory equivalent form or MEF is called a "well-formed formula" (WFF). This is mostly because the logic of sentences was developed primarily by mathematicians who thought in mathematical terminology, such as "formula." But a MEF is not a mathematical formula. It is simply an abbreviation for a sentence.

Now that you have learned how to analyze compound sentences into their components and how to store the simple sentences on the memory pad, you are ready to create the *memory equivalent form* (MEF) of simple and compound sentences. You will develop the MEF for a sentence at the same time that you perform the scans and store the simple sentences on the memory pad. This chapter describes the procedure, which is called memory equivalent formatting (converting the sentence into its memory equivalent by using the addresses on the memory pad). Again, although the procedure below may appear to be a bit complicated, it is essentially just a way to show you explicitly what is to be done. Once you understand it you will just go directly to the MEF without having to go through these steps. However, if there is any question about how to handle any particular sentence, the procedure below is always there to help you.

The "device" we use for formatting is the *MEF template.* There are four different templates, one for the monovalent connector (NOT) and one each for the bivalent connectors (AND, OR, IF).

1. Template for negations (NOT as the major connector). The word NOT is abbreviated "n." The blank in the template is to be filled in with the MEF for the negated sentence. There are no parentheses associated with the NOT template as there are for the other templates.

   n ______________

2. Template for conjunctions (AND as major connector). The blanks in the template are to be filled in with the MEFs for the conjuncts. The parentheses at the beginning and end are part of the template.

   (____________ and ______________)

3. Template for alternations (OR as major connector). The blanks are to be filled in with the MEFs for the alternates. The parentheses at each end are part of the template.

   (____________ or ______________)

4. Template for conditionals (IF...then form of the IF connector). The MEFs for the sufficient and necessary conditions fill the blanks in the order shown. For brevity, we leave out the word "IF." (It is always of course understood because of the word "then" in the template.) The sufficient condition goes in the left-hand blank, and the necessary condition after "then" in the right-hand blank. The parentheses at each end are part of the template.

   (____________ then ______________)

Now that we have displayed the MEF templates, let's see how they are used.

6.2 Formatting an Argument

Let us suppose that our memory pad is clear and we are entering a new argument. This is an argument that a father might present to his five-year-old, who doesn't like vegetables.

Popeye eats spinach, and Wimpy does not eat spinach. Wimpy eats Hamburgers. Popeye is strong and Wimpy is weak. Therefore if you eat spinach, you will be strong; but you will be weak if you eat hamburgers.

Is this argument valid, or invalid? Rather than draw any conclusions as to the validity of the argument, our task here is just to put the entire argument into MEF form. To do this we will first set up a memory pad using the flowchart, and then create the correct MEFs using MEF templates.

6.2.1 Formatting a Conjunction and Formatting a Negation

The first premise is "Popeye eats spinach and Wimpy does not eat spinach."The DSF OK's this without difficulty. It scans as a conjunction, so we take the components in left-to-right order. The first component is not compound so it goes directly into the first available location on the memory pad without needing one of the templates above. The second component is a negation, but as we learned in Chapter Five NOT remains with the scan and does not go into the memory pad.

A	Popeye eats spinach
B	Wimpy eats spinach

Now we are ready to create the memory equivalent of the first premise. Since the premise is a conjunction, we will use the template for conjunctions.

PREMISE 1. (____________ and ____________)

Our job is to drop the MEFs of the components into their proper places in the template. The first component is a simple sentence with no connectors whose address is A, so it goes into the first blank space.

PREMISE 1. (A and ____________)

The second component, however, isn't B but is the *negation* of B. The template for negations is

n ____________

Since the second component is B, we just drop this address into the blank:

nB

Now the MEF for the second component goes into the blank remaining for the first premise.

PREMISE 1. (A and nB)

The next premise of the argument is "Wimpy eats hamburgers." This is a simple sentence which passes right through the flowchart into the memory pad. (A simple sentence needs no template, so we can also write premise 2.)

A	Popeye eats spinach
B	Wimpy eats spinach
C	Wimpy eats hamburgers

PREMISE 1. (A and nB)
PREMISE 2. C

The next premise of the argument is again a conjunction, “Popeye is strong and Wimpy is weak.”This premise is declarative and it is compound, each conjunct passing easily through the DSF. Since the components are all simple sentences, and they are not already on the memory pad, they go into the next two addresses.

A	Popeye eats spinach
B	Wimpy eats spinach
C	Wimpy eats hamburgers
D	Popeye is strong
E	Wimpy is weak

The scan has revealed that the premise is a conjunction, so choose a conjunction template as before, and drop the addresses into their appropriate locations on the template. This completes the third premise.

PREMISE 1. (A and nB)
PREMISE 2. C
PREMISE 3. (D and E)

Except for the simple sentence by itself, the parentheses that come with the templates must be retained in the MEF. You can easily read in the English equivalent of the premises by referring to the addresses on the memory pad.

6.2.2 Formatting Conditional Sentences

The conclusion of our argument is a multicompound sentence having two conditional sentences as its components: “If you eat spinach, you will be strong; but you will be weak if you eat hamburgers.” Do you think you can now complete the memory pad and write out the MEF for this conclusion? If so give it a try right now, using the templates and the flowchart if you need them, before going on. Then look below to see if you have done it correctly.

The "but" after the semicolon is the major connector. As we learned in Chapter Three, it is a synonym for AND.

If you eat spinach, you will be strong /AND/ you will be weak if you eat hamburgers.

The sentence is a conjunction, so the primary template is again a conjunction template.

(_____________ and ______________)

Now the first component, "If you eat spinach, you will be strong," goes through the flowchart loop. It is compound, so we can't just assign it an address on the memory pad and drop its letter into the blank in the template. Instead, it must receive a secondary scan. The result is a conditional in standard form:

IF/ you eat spinach, then you will be strong.

This is a conditional statement, so you must prepare a *secondary template* to hold its components. In this case we will need a conditional template: (____ then ____). Where does this secondary template go? Since it is a template for the first component of the premise, it goes where it belongs, in the blank for the first component of the premise. The result is a multicompound template! The primary one represented by the outermost parentheses, and the secondary one by its own required parentheses. For clarity, we will replace the outermost parentheses with brackets.

[(____ then ____) and ______________]

Notice that the major connector "and" is enclosed only by the *outermost* set of parentheses. The minor connector "then" is enclosed by both sets of parentheses. Visually, it is quite easy to distinguish between the major and minor connectors. This visual characteristic of the MEF, that it is easy to see its logical structure, is one of the reasons that we are converting the English sentences of arguments into MEFs.

Now that the template is ready, continue the analysis by sending the components of the secondary scan through the loop. The components "you eat spinach" and "you will be strong" are simple and are new to the argument, so they go at once into locations F and G on the memory pad.

F	You eat spinach
G	You will be strong

Why didn't the DSF stop cold because of the pronoun "you?" Remember from Chapter Two (2.6) we learned that when the pronoun does not refer to any particular individual but to "you" (anyone) in general, it does not need any specific referent. So in this case it can remain as it is.

The simple components just placed in addresses E and F now go to their proper positions in the template. Here is the result:

[(F then G) and ______________]

Read aloud "If E then F, and..."

Now we must deal with the second component to complete the MEF. This component is "You will be weak if you eat hamburgers." Send it through the flowchart loop. It is compound, and because it is a conditional with IF-in-the-middle, your secondary scan converts it to standard form.

IF/ you eat hamburgers, then you will be weak.

Again a conditional template goes into the component's position. This time it is the right-hand component.

((F then G) and (____ then ____))

Both components of the secondary scan are new simple sentences, so they go to memory pad locations G and H, respectively.

H	You eat hamburgers
I	You will be weak

At the same time, the addresses are dropped into their proper locations in the template. To make the MEF a bit easier to read, you may replace the outermost parentheses with square brackets..

[(E then F) and (H then I)]

The MEF for the conclusion of the argument is now written on the analysis sheet. For convenience, we will begin now to use two-letter abbreviations, PR for PREMISE and DD for DEDUCE.

1.	PR	(A and nB)	
2.	PR	C	
3.	PR	(D and E)	
	DD	[(F then G) and (H then I)]	(To be proven)

Notice that while the premises are given line numbers, the DEDUCE line must not have a line number. This is because it has not yet been proven, so it does not have the same status as the premises.

In a traditional text, the argument above might look something like this:

1. $(p \bullet \sim q)$
2. r
3. $(s \bullet t)$

Prove: $[(u \supset v) \bullet (w \supset x)]$

Does this look a like math? Well of course there is a certain relation between mathematical formulas and MEFs, which unfortunately can lead to confusion between math and the logic of sentences The table below shows the math-like symbols for the connectors used in traditional texts.

HISTORICAL NOTE: In traditional formal logic, MEFs are called "Well-Formed Formulas," or WFFs. Besides confusing sentence structures with arithmetical structures, a problem with traditional logic texts is that some use one kind of symbol for the connectors, others use another kind. Here is a table of the most commonly seen symbols for the connectors.

Connector	One Way	Another Way	Our text
AND	•	∧	and
OR	∨	(none)	or
NOT	—	~	n
IF ... then	⊃	→	then

When you have finished this course, if you take an advanced course in logic using traditional texts you will find it very easy to make the transfer to these kinds of symbols. But not everyone who wishes to increase his or her logical skill is necessarily going on to study logic in an advanced mathematical or philosophical context. That is why we use abbreviations and ideas that reflect what the logic of sentences is really about. It is not about numbers or mathematical variables and operations. It is about sentences and arguments.

6.2.3 Spotting Invalidity

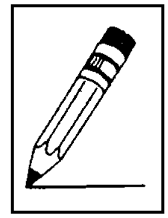
Now that we have a MEF version of the argument about Popeye and Wimpy, can we tell whether the argument is valid or invalid? In most cases, more work needs to be done on exploring the logical relations between the premises and the conclusion. However, in this case, our fictional father is somewhat conning his son. Just a quick look at the MEFs shows that there is *no connection at all* between the premises and the conclusion! The premises involve sentences A, B, C and D, while the conclusion only contains the sentences E, F, G and H. You can't get a conclusion from premises that have nothing to do with the conclusion. Let's write out the correct scenario. The son calls his father's bluff:

FATHER: "Popeye eats spinach, and Wimpy does not eat spinach. Wimpy eats Hamburgers. Popeye is strong and Wimpy is weak.

SON: "Yeah? So what else is new?"

FATHER: "Well, that means if you eat spinach, you will be strong; but you will be weak if you eat hamburgers.
SON: "How come? I'm not Popeye and I'm not Wimpy either. I think eating mashed potatoes and hot dogs makes me strong."

STUDY PROBLEMS. For each argument below, write out the PREMISE and CONCLUSION lines as MEFs, developing the MEFs by using the procedure shown above. Show your memory pad in each case. Answers to study problems are in the Appendix.



1. We must pray, for the agents of sin are among us and the judgement day is not far off.
2. There is no need for anyone to pray, because the world is a mechanical combination of mindless particles, and there is no deity to help us.
3. If the moon is square, then Bill's a green cheesecake. The moon is square. Therefore, Bill's a green cheesecake.
4. If The Baratarians are evil monsters with no regard for human life, they must be killed. The Baratarians are evil monsters with no regard for human life. Therefore the Baratarians must be killed.
5. Tim Galloway will be strong and fast if he drinks MAXIM SUPER- PROTEIN daily. Tim Galloway drinks MAXIM SUPER-PROTEIN daily. Therefore, Tim Galloway is strong and fast. (Hint: remember how the future tense "will" is treated in chapter five).
6. If the radio is playing, it is attached to a power source. However, the radio is not playing. Therefore, it is not attached to a power source. (Hint: "However" is a transition word that may be dropped from the argument.)
7. Steven told Ralph, "If you give me ten dollars, I'll give you the information you need." Ralph gives Steven ten dollars. Therefore Ralph will get the information he needs.
8. You will get better schools, since the candidate said "If you vote for me, you will get better schools," and you did vote for the candidate.
9. Lassie eats Dog-Gro dog food, and lassie is loyal. Therefore, if Doris eats Dog-Gro dog food she will be loyal.
10. You doubt that you exist, and if you doubt, then you are thinking. But you exist if you are thinking. Therefore you must exist. (Hint: "but" here serves as a transition word rather than a connector, and should be dropped the same way as "however" in 6.)

6.3 Major and Minor Connectors in MEF

For any MEF that has an outermost set of parentheses, the major connector is the connector that is enclosed *only* by those outermost parentheses. In the MEF below, only the outermost parentheses enclose the "and," so the major connector is AND. The two occurrences of "then" in the MEF are enclosed both by the outermost parentheses and a set of inner parentheses, so neither of them can be the major connector.

((E then F) and (G then H))

Don't all MEF's have an outermost set of parentheses? No: a simple sentence MEF standing alone, like "A," needs no parentheses; and a negation never has outermost parentheses. We have already run into simple sentence MEF's and negations of simple sentences like "nC." Beginners often think they have to write "n(C)" but this is unnecessary.

RANGE OF THE NEGATOR. In section 4.1 we said that the negated sentence is the sentence that lies within the RANGE of the negator. In MEFs, the range of the negator is the first *complete* MEF that follows the negator. In "nC" the letter C is the first complete MEF that follows the negator, so C is the entire range of that negator. What happens when NOT is applied to a compound, like the MEF below?

n(A then B)

Range of the Negator: The first complete MEF that follows the negator.

Since a left-hand parenthesis comes right after the negator, the MEF that follows the negator is not complete until you reach the right-hand parentheses. This way we know that the range of the negator extends across the entire remainder of the MEF. (A then B) is the negated sentence. The parentheses accompanying (A then B) did not come as part of the NOT template; they were already there as a result of the conditional template for the component, (A then B).

6.4 Interpreting MEFs Correctly

MEFs should not be ambiguous, of course. Every MEF should be written so that it has one clearly understandable meaning. In particular, it should be perfectly clear which connector in a multicompound statement is the major connector, and which are minor connectors. The parentheses are your chief means of doing this. Below we describe some of the most common confusions about how to interpret MEFs and how to avoid them.

6.4.1 Parentheses with NOT

To avoid confused or incorrect interpretation of MEFs containing "not," it is important to remember what has been said about the *range* of the negator and watch carefully for parentheses, which tell you how far the range extends in any particular case. What is the range of the negator in the two sentences below?

(a) (nA and B)
(b) n(A and B)

Although (a) and (b) look very similar, logically they are as different as night and day. (a) is a conjunction, while (b) is a negation. In (a) the negator applies only to A. Its range does not extend to B. This should not be confused with (b), where the negator's range is the entire conjunction, (A and B). Now consider the two MEFs below. What is their difference?

(c) nn(A and B)
(d) n(nA and B)

(c) is a double negation. After the double negation has been dropped according to the DBLNEG rule, (c) is really just an ordinary conjunction, (A and B). But (d), in contrast, is a true negation. The range of the first *not* covers the entire remainder of the MEF. The second *not* in (d) is a minor connector that affects only A. Thus the position of the parentheses in (a), (b), (c) and (d) is all-important in determining what kind of a sentence each is logically. Also note that (c) is the negation of (b), while (d) is the negation of (a).

6.4.2 Repeated "Then"

When a sentence is multicompound and all of the connectors in the sentence are identical, there can be some danger of ambiguity regarding the major connector. For example, in this (incorrect) expression, there is no way to tell which of the two connectors is the major connector:

(A then B then C)

Why is this expression incorrect? In the first place, if the templates are used correctly, such an incorrect MEF could never result. Each "then" template carries with it its own set of parentheses, so it is impossible to use the templates correctly and come up with a MEF containing two "thens" and only one set of parentheses. When the second set of parentheses is omitted as in the above, we end up with an ambiguous would-be MEF that has two possible interpretations.

(a) (A then (B then C))
(b) ((A then B) then C)

In (a) the *first* "then" is the major connector. In (b) the *second* "then" is the major connector. Since we cannot make proper logical comparisons without precise identification of the major connector, an ambiguity of this sort cannot be allowed in any MEF. In the case of a sentence with more than one IF connector, the ambiguity is taken care of by the scan. The major connector is pinpointed on the primary scan, and the English sentence almost always will provide enough clues. The secondary scan will locate the minor connector. When you use the templates correctly as described earlier, no ambiguous MEFs will result.

NESTED CONDITIONALS. Sentences like (a) and (b) above are called *nested conditionals,* because they contain one conditional nested inside another. Here is an English example of a nested conditional:

If it rains only in the afternoon, then you are in South America.

Let's take this example through the flowchart to a completed MEF. Here is the first scan.

IF/ it rains only in the afternoon, then you are in South America.

The sentence scans as a conditional in standard form, so you will select a conditional template.

(_____________ then ______________)

Now you must take the components in left-to-right order. The first component is "It rains only in the afternoon." Is this sentence compound? Yes. It is a conditional that uses ONLY to identify the necessary condition. The flowchart requires you to put this conditional into standard form. See section 4.6 for this conversion.

IF/ it rains, then it is afternoon.

Since this first component is a conditional, you will want to put a conditional template into the first position, creating a template for a nested conditional.

((____ then ____) then ______________)

Now you take the components in left-to-right order. The first component is "It rains." This is simple, so it goes into memory location A. The second component is "It is afternoon." This too is simple, so it goes into memory location B. At the same time, drop the correct addresses into the first and second positions, respectively:

((A then B) then ______________)

Continue by going on to the second component of the original sentence. This component is "You are in South America." It is also simple, so it goes into memory address C. Drop the C into the second component position. The final MEF is a nested conditional. In this case the internal conditional is in the first component.

((A then B) then C)

In a later chapter you will find further discussion of the logic of nested conditionals, and will see how our logical system deals with them easily.

6.4.3 Repeated ANDs and ORs

When a multicompound sentence contains all ANDs or all ORs, there really is no major or minor connector. As you know, we have decided to allow arbitrary selection of the major connector in such cases. When you have no particular reason for choosing one rather than another, a good rule is to choose the rightmost connector. For example, we would scan "Red, blue, and yellow are colors" like this.

Red is a color and blue is a color /AND/ yellow is a color.

The MEF will accordingly group the parentheses to the left:

((A and B) and C).

But it would not be incorrect to group them the other way.

(A and (B and C)).

Similarly, "Either Tom, Manuel, or Klaus is capable of operating the deactivator," which contains repeated ORs, would have the MEF

((A or B) or C)

Where A is "Tom is capable of operating the deactivator," B is "Manuel is capable of operating the deactivator," and C is "Klaus is capable of operating the deactivator." Remember, our indifference as to which is the major connector applies only to these special cases where there are no mixed connectors. All the connectors in the MEF must be the same, and they must be either all ANDs or all ORs. This freedom to choose the major connector does not apply to conditionals.

6.4.4 Not...both and Neither...nor In MEF

In section 4.1.4 we discussed how to interpret the connector in sentences containing "not both" and "neither...nor." Here we will extend this discussion to cover the creation of MEFs for such sentences.

NOT...BOTH. A sentence using Not...both is the negation of a conjunction. There are two ways to express "not both" in MEF.

Not both C and A = n(C and A)

or

Not both C and A = (nC or nA)

NEITHER...NOR. Neither...nor is the negation of an alternation. It may also appear as Not...or (as explained in Chapter Four). Again there are two ways to create the proper MEFs.

Neither C nor A = n(C or A)

or

Neither C nor A = (nC and nA)

Logically, it does not matter which of the two ways you choose. However, in the context of an argument, it will sometimes be best to use one of the ways, and sometimes best to use the other, because of how these may interact with other sentences in the argument. The equivalence between the two ways of expressing these phrases will be further elaborated under the topic of *DeMorgan's Law* in Chapter Seven.

6.5 A Pause for Parentheses

Now that we are writing more complex multicompound sentences, we will introduce a few informal rules that make MEFs more readable. We have already used the first of these once before.

1. Square brackets may be alternated with curved parentheses to help make the grouping easier to see. For example, ((A or B) and C) may be written [(A or B) and C].

2. If a compound or multicompound MEF is not connected to some other MEF, the *outermost* parentheses can be omitted, provided, however, that they are always restored whenever the MEF is linked again to some other MEF. For example,

   [A then (B or C)]

   may be written:

   A then (B or C)

3. When a MEF contains repeated ANDs or repeated ORs, with no other connectors, *all* parentheses may be omitted. For example,

   [A or (B or C)] may be written: A or B or C

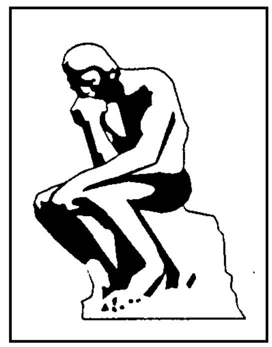
When the parentheses are restored, the way you group the components is left up to you. Thus you may restore the parentheses above as (A or B) or C or you may write A or (B or C). Remember that this applies only when all the connectors are ORs or when all the connectors are ANDs, and when the MEF stands alone and is not embedded in some other larger multicompound sentence.

4. In a multicompound MEF containing mixed connectors, no internal parentheses may be omitted that would make it unclear which of the connectors is the major connector. This restriction is intended to prevent the fallacy of the misplaced connector. For example, in the MEF below

[(A and B) or C]

the *outermost* parentheses may be omitted in accordance with clause 2 above, but the internal parentheses may not be omitted, because then you would lose track of which connector is the major connector.

EXERCISE 9. Write out the MEFs for each of the sentences below. (You have already written out the scans for some of them in an earlier exercise).



1. Either Tom has forgotten the payment, or Tom has run out of funds.
2. Either Burroughs and Tomlinson are both mistaken, or DeVroot is not the expert he claims to be.
3. Joan is an expert veterinarian, and she will treat the dog free if its owner is not able to pay.
4. It is not the case that Joan and Michael have separated.
5. Assuming that the fine is paid and there are no pending charges, Richard should be free by morning.
6. If this is an American car and this car is in good operating condition, then this car will start if the key is turned clockwise.
7. Pride, ambition, and lust for life would make Sylvia dangerous but interesting. (Hint: review the discussion of AND in Chapter Three, and the discussion of Cause and Effect in Chapter Four.)
8. Given that the carbon test proves positive, we can assume that this bone is at least four million years old.
9. If Tom has not run out of funds, he is distracted by his new responsibilities.
10. Tom's bank will release the funds only when Tom has signed the mortgage papers and agreed to lay off one-third of his company's employees.

EXERCISE 10. For each argument below, write out the PREMISE and CONCLUSION lines. Example 1 is solved for you. Show your memory pad for each example. (Remember, we are using PR for “Premise” and DD for “Deduce”)

1. Susan will be awarded the trophy if she manages to win the final race. Susan will win the final race provided that the Swedish competitor does not enter. Therefore If the Swedish competitor does not enter, Susan will be awarded the trophy.

MEMORY PAD: A = Susan wins the final race
B = Susan is awarded the trophy
C = The Swedish competitor enters

1. PR	(A then B)
2. PR	(nC then A)
DD	(nC then B)

(Notice that we have changed future tense "will" to present tense, because the sentences appear as part of a conditional, as explained earlier.) Now try the rest on your own.

2. Bill put the barrel in the storeroom yesterday. No one has moved the barrel since yesterday. Therefore, either the barrel is in the storeroom or the laws of physics have been overturned.
3. The Balkanese Islands belong to Bartania, for what land does not belong to those who settled it? And Bartanians settled the Balkanese Islands in 400 A.D. Down with Torentina!
4. Given that the carbon test proves positive, we can assume that this bone is at least four million years old. If this bone is at least four million years old, it is well aged. But if it is well aged, Lassie will love it. Therefore Lassie will love this bone provided that the carbon test proves positive. (HINT: "But" in this example is not a connector. When "but" begins a sentence it merely acts as a bridge between sentences.)
5. If John marries Margaret, he will not marry a physician or an actress. If John does not marry a physician, then he does not wed Mary. Mary will leave for Europe at once if John does not marry her. Therefore, if John marries Margaret, Mary will leave at once for Europe.
6. If the guerilla leader leaves the country, the movement will collapse. The collapse of the movement will bring about a power vacuum, but will also stabilize the economy. If the economy is stabilized, the minority party will win the next election. Either the guerilla leader leaves the country, or foreign support for the movement continues. However, foreign support for the movement does not continue. Therefore, the minority party will win the next election.
7. Pride, ambition, and lust for life would make Sylvia dangerous but interesting. Sylvia is a proud person with a great zest for living, but she has no ambition. I conclude that Sylvia is interesting but not dangerous. (HINT: "With" in the second sentence can be translated as AND because it adds further information about Sylvia. Discuss this in class.)
8. Either Tom has run out of funds or he has forgotten the payment. If Tom has forgotten the payment, he is distracted by his new responsibilities. Therefore if Tom has not run out of funds, he is distracted by his new responsibilities.
9. Holmes discovered arsenic in the teacup, so it is likely that the victim was poisoned. Sir George had no opportunity to poison the tea, so if it is likely that the victim was poisoned, Sir George is no longer a suspect. To have poisoned the tea, Martin Queems would have to be a member of the household staff. Martin Queems is not on the household staff, since he was fired a year ago. Therefore neither Sir George nor Martin Queems is a suspect. (HINTS: Treat "so" in the first two premises as "and." Treat "To have poisoned the tea..." as "If Martin Queems poisoned the tea..." Treat "since" in the last premise as "and." Discuss these suggestions in class.)
10. Donald will lose the case unless he gets Mike on the witness stand, but Mike is a member of the Roaring Raiders, and no member of the Roaring Raiders will ever testify, so Donald won't get Mike on the witness stand. We will just have to live with the fact that Donald will lose the case. (HINT: Treat "so" as you did for #9 above.)