CHAPTER 2
Syllogistic Logic

Syllogistic logic studies arguments whose validity depends on "all," "no," "some," and similar notions. This branch of logic, which goes back to Aristotle, was the first to be developed. It provides a fine preliminary to modern symbolic logic, which we begin in the next chapter.

2.1 Easier translations

We'll now create a little "syllogistic language," with precise rules for constructing arguments and testing validity. Our language will help us to test English arguments; here's how such an argument translates into our language:

All logicians are charming.		all L is C
Gensler is a logician.	➔	g is L
∴ Gensler is charming.		∴ g is C

Our language uses capital letters for general categories (like "logician") and small letters for specific individuals (like "Gensler"). It uses five words: "all," "no," "some," "is," and "not." Its grammatical sentences are called **wffs,** or **well-formed formulas**. Wffs are sequences having any of these eight forms (where other capital letters and other small letters may be used instead):[1]

all A is B	some A is B	x is A	x is y
no A is B	some A is not B	x is not A	x is not y

You must use one of these exact eight forms—but perhaps using other capitals for "A" and "B," and other small letters for "x" and "y":

Correct wffs:	all L is C	g is L	some P is not Q
Incorrect:	all 1 is c	G is L	not all P is Q

Be careful about what sort of letter you use. In two cases, our rule for constructing wffs indirectly tells us whether to use a capital or a small letter:

[1] Pronounce "wff" as "wŏŏf"—as in "wood" or "woofer." This book will consider letters with primes (like A′ and A″) to be distinct additional letters.

Wffs beginning with a *word* (not a letter) use two capital letters:	Wffs beginning with a *letter* (not a word) begin with a small letter:
Right: all L is C *Wrong:* all l is c	*Right:* g is L *Wrong:* G is L

If a wff begins with a small letter, however, then the second letter can be either capital or small; so "a is B" and "a is b" are both wffs. In this case, we have to look at the meaning of the term:

Use capital letters for **general terms** (terms that *describe* or put in a *category*):	Use small letters for **singular terms** (terms that pick out a *specific* person or thing):
B=a cute baby C=charming D=drives a Buick	b=the world's cutest baby c=this child d=David
Use capitals for "a so and so," adjectives, and verbs.	Use small letters for "the so and so," "this so and so," and proper names.

So these translations are correct:

Will Gensler is a cute baby	=	w is B
Will Gensler is the world's cutest baby	=	w is b

We'll see later that whether we use a capital or a small letter can make a difference to the validity of an argument.

Be consistent when you translate English terms into logic; use the same letter for the same idea, and different letters for different ideas. It matters little what letter goes with what idea; "a cute baby" could be "B" or "C" or any other capital. To keep ideas straight, use letters that remind you of the English terms.

Syllogistic wffs all have the verb "is." English sentences with a different verb should be rephrased (to make "is" the main verb) and then translated:

All dogs bark.
= All dogs is [are] *barkers*.
= all D is B

Al left the room.
= Al is a *person who left the room*.
= a is L

In the second example, "person who left the room" is a capital letter, since more than one person might have left the room.

2.1a Exercise—No LogiCola exercise[1]

Which of the following are wffs?

all c is D	This isn't a wff, since both letters after "all" have to be capitals.

[1] Exercise sections have a boxed sample problem worked out and refer to any corresponding LogiCola computer exercises. Some further problems are worked out at the back of the book.

1. no e is f
2. g is H
3. J is K
4. all M is not Q
5. some L is m
6. p is not Q
7. R is not S
8. not all T is U
9. some X is not Y

2.1b Exercise—LogiCola A (EM & ET)

Translate these English sentences into wffs.

John left the room.	j is L

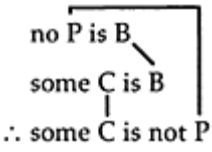
1. This is a sentence.
2. This isn't the first sentence.
3. No logical positivist believes in God.
4. The book on your desk is green.
5. All dogs hate cats.
6. Kant is the greatest philosopher.
7. Ralph was born in Detroit.
8. Detroit is the birthplace of Ralph.
9. Alaska is a state.
10. Alaska is the biggest state.
11. Carol is my only sister.
12. Carol lives in Big Pine Key.
13. The idea of goodness is itself good.
14. All Michigan players are intelligent.
15. Michigan's team is awesome.
16. Donna is Ralph's wife.

2.2 The star test

A syllogism, roughly, is an argument using syllogistic wffs. Here's an English argument and its translation into a syllogism (the Cuyahoga is a river in Cleveland that used to be so polluted that it caught on fire):

No pure water is burnable.	no P is B
Some Cuyahoga River water is burnable.	some C is B
∴ Some Cuyahoga River water is not pure water.	∴ some C is not P

More precisely, a **syllogism** is a vertical sequence of one or more wffs in which each letter occurs twice and the letters "form a chain" (each wff has at least one letter in common with the wff just below it, if there is one, and the first wff has at least one letter in common with the last wff). This diagram shows how the letters "form a chain":



The last wff in a syllogism is the *conclusion;* any other wffs are *premises*. Here are three further examples of syllogisms:

a is C b is not C ∴ a is not b	some G is F ∴ some F is G	∴ all A is A

The last example is a premise-less syllogism. A premise-less syllogism is *valid* if and only if it's impossible for its conclusion to be false.

We need to learn a technical term before getting to our validity test:

> A letter is **distributed** in a wff if it occurs just after "all" or anywhere after "no" or "not."

The distributed letters below are underlined:

all A is B	some A is B	x is A	x is y
no A is B	some A is not B	x is not A	x is not y

Note which letters are underlined (distributed). By our definition:

- The first letter after "all" is distributed, but not the second.
- Both letters after "no" are distributed.
- The letter after "not" is distributed.

Once you know which terms are distributed, you're ready to learn the star test for validity. The star test is a gimmick, but a quick and effective one; for now it's better just to learn the test and not worry about why it works.

The **star test** for syllogisms goes as follows:

> Star the *distributed* letters in the premises and *undistributed* letters in the conclusion. Then the syllogism is **VALID** if and only if every capital letter is starred *exactly* once and there is *exactly* one star on the right-hand side.

The general strategy goes: first star, then count.

Consider these two syllogisms (where I underlined the distributed letters):

all A is B some C is A	←	star distributed	→	no A is B no B is C
∴ some C is B	←	star undistributed	→	∴ no A is C

First star the *distributed* (underlined) letters in the premises and *undistributed* (not-underlined) letters in the conclusion:

all A* is B **Valid**
some C is A
∴ some C* is B*

no A* is B* **Invalid**
no B* is C*
∴ no A is C

Then count. A valid argument must satisfy two conditions:

- Each capital letter is starred in one and only one occurrence. (Small letters can be starred any number of times.)
- Exactly one right-hand letter (letter after "is" or "is not") is starred.

The first syllogism passes the test and is valid. The second fails the test (since "B" is starred twice and there are two right-hand stars) and is invalid.

Here are two short but confusing examples:

a is not b* **Valid**
∴ b* is not a

∴ all A is A* **Valid**

Since the first syllogism has no capital letters, each capital in it is starred exactly once; recall that small letters can be starred any number of times. Since the second syllogism has no premises, we just star the conclusion; here "A" is starred exactly once and there is exactly one right-hand star.

Logic takes "some" to mean "one or more"—and so takes this to be valid:[1]

Gensler is a logician.
Gensler is mean.
∴ Some logicians are mean.

g is L **Valid**
g is M
∴ some L* is M*

Similarly, logic takes this next argument to be invalid:

Some logicians are mean.
∴ Some logicians are not mean.

some L is M **Invalid**
∴ some L* is not M

If *one or more* logicians are mean, it needn't be that *one or more* aren't mean; maybe *all* logicians are mean.

As you begin doing the star test, you may want to first underline the distributed letters—and then star the underlined letters in the premises and the not-underlined ones in the conclusion. Later you can skip the underlining and just star the letters. After practice, the star test takes about five seconds to do.[1]

[1] In English, "some" can have various meanings, including "one or more," "two or more," "at least a few," "one or more but not all," "two or more but not all," and "a few but not all." Only the first meaning makes our argument valid.

[1] The star test is my invention; it came to me one day while I was watching a movie on television. For an explanation of why it works, see my "A simplified decision procedure for categorical syllogisms," *Notre Dame Journal of Formal Logic* 14 (1973): pages 457–66—or my explanation at http://www.jcu.edu/philosophy/gensler/star.htm on the Web.

2.2a Exercise—No LogiCola exercise

Which of these are syllogisms?

no P is B some C is B ∴ some C is not P	This is a syllogism. (Each formula is a wff, each letter occurs twice, and the letters form a chain.)

1. all C is D
   ∴ some C is not E
2. g is not l
   ∴ l is not g
3. no Y is E
   all G is Y
   ∴ no Y is E
4. ∴ all S is S
5. k is not L
   all M is L
   some N is M
   Z is N
   ∴ k is not Z

2.2b Exercise—LogiCola BH

Underline the distributed letters in the following wffs.

some R is not S	some R is not S

1. w is not s
2. some C is B
3. no R is S
4. a is C
5. all P is B
6. r is not D
7. s is w
8. some C is not P

2.2c Exercise—LogiCola B (H and S)

Valid or invalid? Use the star test.

no P is B some C is B ∴ some C is not P	no P* is B* **Valid** some C is B ∴ some C* is not P

1. no P is B
   some C is not B
   ∴ some C is P
2. x is W
   x is not Y
   ∴ some W is not Y
3. no H is B
   no H is D
   ∴ some B is not D
4. some J is not P
   all J is F
   ∴ some F is not P
5. g is not s
   ∴ s is not g
6. all L is M
   g is L
   ∴ g is M
7. all L is M
   g is not L
   ∴ g is not M
8. some N is T
   some C is not T
   ∴ some N is not C
9. all C is K
   s is K
   ∴ s is C
10. all D is A
    ∴ all A is D
11. s is C
    s is H
    ∴ some C is H
12. some C is H
    ∴ some C is not H
13. a is b
    b is c
    c is d
    ∴ a is d
14. no A is B
    some B is C
    some D is not C
    all D is E
    ∴ some E is A

2.3 English arguments

I suggest that you work out English arguments in a dual manner. First use intuition. Read the argument and ask whether it seems valid; sometimes this will be clear, but sometimes it won't. Then symbolize the argument and do the validity test. If your intuition and the validity test agree, then you have a stronger basis for your answer. If they disagree, then something went wrong; so you have to reconsider your intuition, your translation, or your use of the validity test. Using this two-prong attack trains your logical intuitions and gives you a double-check on the results.

When you translate into logic, use the same letter for the same idea, and different letters for different ideas. The "same idea" may be phrased in different ways; often it's redundant or stilted to phrase an idea in the exact same way throughout an argument. If you can't remember which letter translates which phrase, underline the phrase in the argument and write the letter above it; or write out separately which letter goes with which phrase.

Translate singular terms into small letters, and general terms into capital letters (see Section 2.1). Compare these two arguments:

Will is *the world's cutest baby.*	w is b **Valid**
The child over there is *the world's cutest baby.*	o is b
∴ Will is the child over there.	∴ w* is o*
Will is *a cute baby.*	w is B **Invalid**
The child over there is *a cute baby.*	o is B
∴ Will is the child over there.	∴ w* is o*

Intuitively, the first is valid and the second invalid. The symbolizations are identical, except that the first uses a small "b" (for "the world's cutest baby"—which refers to a specific baby) while the second uses a capital "B" (for "a cute baby"—which could describe various babies). We'd get both arguments wrong if we used the wrong case for this letter. We'd likely catch both mistakes if we did the problems intuitively as well as mechanically.

2.3a Exercise—LogiCola BE

First appraise intuitively. Then translate into logic and use the star test to determine validity.

No pure water is burnable.	no P* is B* **Valid**
Some Cuyahoga River water is burnable.	some C is B
∴ Some Cuyahoga River water is not pure water.	∴ some C* is not P

1. All segregation laws degrade human personality.
   All laws that degrade human personality are unjust.
   ∴ All segregation laws are unjust. [From Dr Martin Luther King.]

2. All Communists favor the poor.
   All Democrats favor the poor.
   ∴ All Democrats are Communists. [This reasoning could persuade if expressed emotionally in a political speech. It's less apt to persuade if put into a clear premise-conclusion form.]

3. All too-much-time penalties are called before play starts.
   No penalty called before play starts can be refused.
   ∴ No too-much-time penalty can be refused.

4. No one under 18 is permitted to vote.
   No faculty member is under 18.
   The philosophy chairperson is a faculty member.
   ∴ The philosophy chairperson is permitted to vote. [Applying a law (like ones about voting) requires logical reasoning. Lawyers and judges need to be logical.]

5. All acts that maximize good consequences are right.
   Some punishing of the innocent maximizes good consequences.
   ∴ Some punishing of the innocent is right. [This argument and the next give a mini-debate on utilitarianism, which holds that all acts that maximize the total of good consequences for everyone are right. Moral philosophy would try to evaluate the premises; logic just focuses on whether the conclusion follows.]

6. No punishing of the innocent is right.
   Some punishing of the innocent maximizes good consequences.
   ∴ Some acts that maximize good consequences aren't right.

7. All huevos revueltos are buenos para el desayuno.
   All café con leche is bueno para el desayuno.
   ∴ All café con leche is huevos revueltos. [To test whether this argument is valid, you don't have to understand its meaning; you only have to grasp the form. In doing formal (deductive) logic, you don't have to know what you're talking about; you only have to know the logical form of what you're talking about.]

8. The belief that there's a God is unnecessary to explain our experience.
   All beliefs unnecessary to explain our experience ought to be rejected.
   ∴ The belief that there's a God ought to be rejected. [St Thomas Aquinas mentioned this argument in order to dispute the first premise.]

9. The belief in God gives practical life benefits (courage, peace, zeal, love,…).
   All beliefs that give practical life benefits are pragmatically justifiable.
   ∴ The belief in God is pragmatically justifiable. [From William James, an American pragmatist philosopher.]

10. All sodium salt gives a yellow flame when put into the flame of a Bunsen burner.
    This material gives a yellow flame when put into the flame of a Bunsen burner.
    ∴ This material is sodium salt.

11. All abortions kill innocent human life.
    No killing of innocent human life is right.
    ∴ No abortions are right.

12. All acts that maximize good consequences are right.
    All socially useful abortions maximize good consequences.
    ∴ All socially useful abortions are right.

13. That drink is transparent.
    That drink is tasteless.

All vodka is tasteless.
∴ Some vodka is transparent.

14. Judy isn't the world's best cook.
The world's best cook lives in Detroit.
∴ Judy doesn't live in Detroit.

15. All men are mortal.
My mother is a man.
∴ My mother is mortal.

16. All gender-neutral terms can be applied naturally to individual women.
The term "man" can't be applied naturally to individual women. (We can't naturally say "My mother is a man"—see the previous argument.)
∴ The term "man" isn't a gender-neutral term. [This is from the philosopher Janice Molton's discussion of sexist language.]

17. Some moral questions are controversial.
No controversial question has a correct answer.
∴ Some moral questions don't have a correct answer.

18. The idea of a perfect circle is a human concept.
The idea of a perfect circle doesn't derive from sense experience.
All ideas gained in our earthly existence derive from sense experience.
∴ Some human concepts aren't ideas gained in our earthly existence. [This argument is from Plato. It led him to think that the soul gained ideas in a previous existence apart from the body, and so can exist apart from matter.]

19. All beings with a right to life are capable of desiring continued existence.
All beings capable of desiring continued existence have a concept of themselves as a continuing subject of experiences.
No human fetus has a concept of itself as a continuing subject of experiences.
∴ No human fetus has a right to life. [From Michael Tooley.]

20. The bankrobber wears size-twelve hiking boots.
You wear size-twelve hiking boots.
∴ You're the bankrobber. [This is circumstantial evidence.]

21. All moral beliefs are products of culture.
No products of culture express objective truths.
∴ No moral beliefs express objective truths.

22. Some books are products of culture.
Some books express objective truths.
∴ Some products of culture express objective truths. [How could we change this argument to make it valid?]

23. Dr Martin Luther King believed in objective moral truths (about the wrongness of racism).
Dr Martin Luther King disagreed with the moral beliefs of his culture.
No people who disagree with the moral beliefs of their culture are absolutizing the moral beliefs of their own culture.
∴ Some who believed in objective moral truths aren't absolutizing the moral beliefs of their own culture.

24. All claims that would still be true even if no one believed them are objective truths.
    "Racism is wrong" would still be true even if no one believed it.
    "Racism is wrong" is a moral claim.
    ∴ Some moral claims are objective truths.

25. Some shivering people with uncovered heads have warm heads.
    All shivering people with uncovered heads are losing much body heat through their heads.
    All who are losing much body heat through their heads ought to put on a hat to stay warm.
    ∴ Some people who have warm heads ought to put on a hat to stay warm. [This was from a ski magazine.]

2.3b Mystery story exercise—No LogiCola exercise

Herman had a party at his house. Alice, Bob, Carol, David, George, and others were there; one or more of these stole money from Herman's bedroom. You have the data in this big box, which may or may not give conclusive evidence about a given suspect:

1. Alice doesn't love money.
2. Bob loves money.
3. Bob isn't the richest person at the party.
4. Carol knew where the money was.
5. David works for Herman.
6. David isn't the nastiest person at the party.
7. All who stole money love money.
8. The richest person at the party didn't steal money.
9. All who stole money knew where the money was.
10. All who work for Herman hate Herman.
11. All who hate Herman stole money.
12. The nastiest person at the party stole money.

Did Alice steal money? If you can, prove your answer using a valid syllogism with premises from the big box.

Alice *didn't* steal money:
a is not L*—#1
all S* is L—#7
∴ a* is not S

1. Did Bob steal money? If you can, prove your answer using a valid syllogism with premises from the big box.
2. Did Carol steal money? If you can, prove your answer using a valid syllogism with premises from the big box.

3. Did David steal money? If you can, prove your answer using a valid syllogism with premises from the big box.
4. Based on our data, did more than one person steal money? Can you prove this using syllogistic logic?
5. Suppose that, from our data, we could deduce that a person stole money and also deduce that this same person didn't steal money. What would that show?

2.4 Harder translations

Suppose we want to test this argument:

Every human is mortal.	all H is M
Only humans are philosophers.	all P is H
∴ All philosophers are mortal.	∴ all P is M

To symbolize such arguments, we need to translate idioms like "every" and "only" into our standard "all," "no," and "some." Here "every" is easy—since it just means "all." But "only" is more difficult. "Only humans are philosophers" really means "All philosophers are humans."

This box lists some common ways to express "all" in English:

Different ways to say "all A is B":

Every (each, any) A is B.	Only B's are A's.
Whoever is A is B.	None but B's are A's.
A's are B's.[1]	No one is A unless he or she is B.
Those who are A are B.	Nothing is A unless it's B.
If a person is A, then he or she is B.	A thing isn't A unless it's B.
If you're A, then you're B.	It's false that some A is not B.

The forms on the left are fairly easy. The ones at the top right (with "only" and "none but") are tricky because they require switching the order of the letters:

Only men are sumo wrestlers.	only M is S
= All sumo wrestlers are men.	= all S is M
≠ All men are sumo wrestlers.	

So "only" translates as "all," but with the terms reversed; "none but" works the same way. The forms at the bottom right (starting with "no…unless") are tricky too, because here "no" really means "all":

No one is a sumo wrestler unless they are men.	no one is S unless they are M
= All sumo wrestlers are men.	= all S is M

[1] Logicians take "A's are B's" to mean "all A is B"—even though in ordinary English it also could mean "most A is B" or "some A is B."

So "no" with "unless" translates as "all." Don't reverse the letters here; only reverse letters with "only" and "none but."

This box lists some common ways to say "no A is B":

Different ways to say "no A is B";	
A's aren't B's.	No one that's A is B.
Every (each, any) A is non-B.	There isn't a single A that's B.
Whoever is A isn't B.	Not any A is B.
If a person is A, then he or she isn't B.	It's false that there's an A that's B.
If you're A, then you aren't B.	It's false that some A is B.

Never use "all A is not B." This form isn't a wff, and in English is ambiguous between "no A is B" and "some A is not B."

These last two boxes give some common ways to say "some":

some A is B =
A's are sometimes B's.
One or more A's are B's.
There are A's that are B's.
It's false that no A is B.

some A is not B =
One or more A's aren't B's.
There are A's that aren't B's.
Not all A's are B's.
It's false that all A is B.

Formulas "no A is B" and "some A is B" are contradictories: saying that one is false is equivalent to saying that the other is true:

It's false that no days are sunny = Some days are sunny.
It's false that some days are sunny = No days are sunny.

Similarly, "all A is B" and "some A is not B" are contradictories:

It's false that all cats are white = Some cats are not white.
It's false that some cats are not white = All cats are white.

Study these translation rules carefully. Idiomatic sentences can be difficult to untangle, even though they're part of our everyday speech. Our rules cover most, but not all, cases. If you find an example that our rules don't cover, you'll have to puzzle out the meaning yourself; you might try substituting concrete terms, like "sumo wrestler" and "men," as we did above.

2.4a Exercise—LogiCola A (HM & HT)

Translate these English sentences into wffs.

Nothing is worthwhile unless it's difficult.	all W is D

1. Only free actions can justly be punished.
2. Not all actions are determined.
3. Socially useful actions are right.
4. None but Democrats favor the poor.
5. At least some of the shirts are on sale.
6. Not all of the shirts are on sale.
7. No one is happy unless they are rich.[1]
8. Only rich people are happy.
9. Every rich person is happy.
10. Not any selfish people are happy.
11. Whoever is happy is not selfish.
12. Altruistic people are happy.
13. All of the shirts (individually) cost $20.
14. All of the shirts (together) cost $20.
15. Blessed are the merciful.
16. I mean whatever I say.
17. I say whatever I mean.
18. Whoever hikes the Appalachian Trail (AT) loves nature.
19. No person hikes the AT unless he or she likes to walk.
20. Not everyone who hikes the AT is in great shape.

2.5 Deriving conclusions

Suppose you're given these premises and want to derive a conclusion that follows validly using the syllogistic rules:

Some cave dwellers use fire.
All who use fire have intelligence.

You might use intuition. Then you'd read the premises reflectively, say "therefore" to yourself, hold your breath, and hope that the conclusion comes. If you get a conclusion, write it down; then translate the argument into syllogistic logic and test for validity using the star test. Do as many exercises as you can in this intuitive way; this will help develop your intuition.

If your intuition fails, you can use four steps based on the star test:

(1) Translate the premises and star:	(2) Figure out the letters in the conclusion:	(3) Figure out the form of the conclusion:	(4) Add the conclusion and do the star test:
some C is F all F* is I	"C" and "I"	some—is—	some C is F all F* is I some C* is I

[1] How would you argue against this example (and the next two)? Would you go to the rich part of town and find a rich person who was miserable? Or would you go to the poor part of town and find a poor person who was happy?

(1) Translate the premises into logic and star the distributed letters. Check to see if rules are broken. If we have two right-hand stars, or a capital letter that occurs twice without being starred exactly once, then no conclusion validly follows—and so we can write "no conclusion." In our example, no rules are broken; so we continue with the problem.

(2) Figure out which letters will occur in the conclusion; these will be the two letters that occur just once in the premises. In our example, "C" and "I" will occur in the conclusion.

(3) Figure out the form of the conclusion. In this case, since we have two capitals, the conclusion will start with "all" or "no" or "some." This rule tells what form to use if both conclusion-letters are capitals:

Use one of these conclusion forms if both conclusion-letters are capitals.

all A is B	Use "all" if every premise has "all."
no A is B	Use "no" if the premises have a mix of "all" and "no" (or else a single "no").
some A is B some A is not B	Use "some" if any premise has "some" or small letters. Then use "is not" if any premise has "no" or "not"; otherwise, use "is."

In our example, the conclusion will use "some" (since the "some C is F" premise has "some"); it will use "is," since no premise has "no" or "not."

In some cases, one or both of the conclusion-letters will be small. Then the conclusion will have a small letter, "is" or "is not," and then the other letter. Follow this rule about whether to use "is" or "is not":

Use one of these conclusion forms if some conclusion-letter is small.

x is A x is y x is not A x is not y	Use "is not" if any premise has "no" or "not"; otherwise, use "is."

(4) Add the conclusion and test for validity; if it comes out invalid, try switching the order of the letters to see if this makes it valid. In our example, we add "some C is I"—and it comes out valid. Our conclusion in English is "Some cave dwellers have intelligence":

Some cave dwellers use fire.
All who use fire have intelligence.

Some cave dwellers have intelligence.

"Some who have intelligence are cave dwellers" is equivalent and also correct. The order of the terms doesn't matter with these four forms:

no A is B some A is B x is y x is not y

Here's another problem:

No one held for murder is given bail.
Smith isn't held for murder.

Do you intuitively want to conclude "Smith is given bail"? If so, consider that Smith might be held for something else (like kidnapping) for which bail is denied; or maybe Smith isn't held for anything. If we work it out using the rules, we translate the premises into logic and star the distributed letters:

(1) Translate the premises and star:	(2) Figure out the letters in the conclusion:	(3) Figure out the form of the conclusion:	(4) Add the conclusion and do the star test:
no M* is B* s is not M*	← "M" is starred twice! ← Rules are broken!		no M* is B* s is not M* no conclusion

Here "M" is starred twice (and there are two right-hand stars), and so rules are broken. So no conclusion follows.

If no rules had been broken, then the conclusion would have a small "s" and a capital "B." The form would be "—is not—." So the conclusion would be "s is not B." But, since "M" is already starred twice, this would be invalid.

2.5a Exercise—LogiCola BD

Derive a conclusion in English (not in wffs) that follows validly from and uses all the premises. Leave blank or write "no conclusion" if no such conclusion validly follows.

No pure water is burnable. Some Cuyahoga River water is not burnable.	no P* is B* some C is not B* no conclusion

Do you want to conclude "Some Cuyahoga River water is pure water"? Consider that all non-burnable parts of the river might be polluted by something that doesn't burn.

1. All human acts are determined (caused by prior events beyond our control).
   No determined acts are free.

2. Some human acts are free.
   No determined acts are free.

3. All acts where you do what you want are free.
   Some acts where you do what you want are determined.

4. All men are rational animals.
   No woman is a man.

5. All philosophers love wisdom.
   John loves wisdom.

6. Luke was a gospel writer.
   Luke was not an apostle.

7. All cheap waterproof raincoats block the escape of sweat.
   No raincoat that blocks the escape of sweat keeps you dry when hiking uphill.

8. All that is or could be experienced is thinkable.
   All that is thinkable is expressible in judgments.
   All that is expressible in judgments is expressible with subjects and predicates.
   All that is expressible with subjects and predicates is about objects and properties.

9. All moral judgments influence our actions and feelings.
   Nothing from reason influences our actions and feelings.

10. No feelings that diminish when we understand their origins are rational.
    All culturally taught racist feelings diminish when we understand their origin.

11. I weigh 180 pounds.
    My mind does not weigh 180 pounds.

12. No acts caused by hypnotic suggestion are free.
    Some acts where you do what you want are caused by hypnotic suggestion.

13. All unproved beliefs ought to be rejected.
    "There is a God" is an unproved belief.

14. All unproved beliefs ought to be rejected.
    "All unproved beliefs ought to be rejected" is an unproved belief.

15. Jones likes raw steaks.
    Jones likes champagne.

16. Some human beings seek revenge in a self-destructive way.
    No one seeking revenge in a self-destructive way is motivated only by self-interest.
    All purely selfish people are motivated only by self-interest.

17. All virtues are praised.
    No emotions are praised.

18. God is a perfect being.
All perfect beings are self-sufficient.
No self-sufficient being is influenced by anything outside of itself.

---

19. God is a perfect being.
All perfect beings know everything.
All beings that know everything are influenced by everything.

---

20. All basic moral norms hold for all possible rational beings as such.
No principles based on human nature hold for all possible rational beings as such.

---

21. All programs that discriminate simply because of race are wrong.
All racial affirmative action programs discriminate simply because of race.

---

22. Some racial affirmative action programs are attempts to make amends for past injustices toward a given group.
No attempts to make amends for past injustices toward a given group discriminate simply because of race. (Instead, they discriminate because of past injustices toward a group.)

---

23. Some actions approved by reformers are right.
Some actions approved by society aren't approved by reformers.

---

24. Some wrong actions are errors made in good faith.
No error made in good faith is blameworthy.

---

25. All moral judgments are such that disputes about them are impossible to resolve by reason.
No objective truths are such that disputes about them are impossible to resolve by reason.

Here problems 1–3 give the three classic views on free will: hard determinism, indeterminism, and soft determinism; 8 and 20 are from Immanuel Kant; 9 is from David Hume; 10 is from Richard Brandt; 17 and 18 are from Aristotle; and 19 is from Charles Hartshorne.

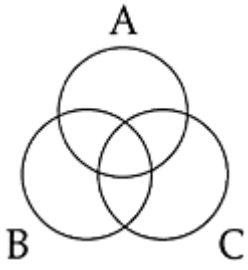
2.6 Venn diagrams

Now we'll learn a second validity test. **Venn diagrams** are a way of testing syllogisms that involves diagramming the premises using three overlapping circles. Venn diagrams are more intuitive than the star test, even though the star test is easier to use. We'll apply Venn diagrams only to **traditional syllogisms** (two-premise syllogisms with no small letters).

Here's how to do the Venn-diagram test on a traditional syllogism:

> Draw three overlapping circles, labeling each with one of the syllogism's letters. Then diagram the premises following the directions below; as you draw the premises, try *not* to draw the conclusion. The syllogism is **VALID** if and only if drawing the premises *automatically* draws the conclusion.

First we draw three overlapping circles:



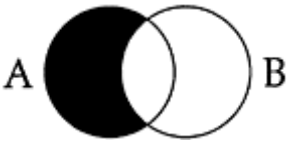
Visualize circle A containing all A things, circle B containing all B things, and circle C containing all C things. Within the circles are seven distinct areas:

- The central area is where all three circles overlap; this contains whatever has all three features (A and B and C).
- Further out are areas where two circles overlap; these contain whatever has only two features (for example, A and B but not C).
- Furthest out are areas inside only one circle; these contain whatever has only one feature (for example, A but not B or C).

Each of the seven areas can be either empty or non-empty. We shade the areas that we know to be empty. We put an "×" in the areas that we know to contain at least one entity. An area without either shading or an "×" is unknown; it may be either empty or non-empty, but we don't know which it is.

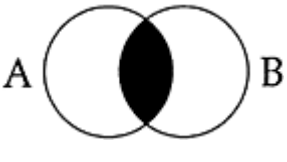
After we've drawn our three overlapping circles, we first draw "all" and "no" premises, by shading empty areas (showing that there are no existing things in these areas):

"all A is B"
Shade areas of A that aren't in B.



"All animals are beautiful"="everything in the animal circle is in the beautiful circle."

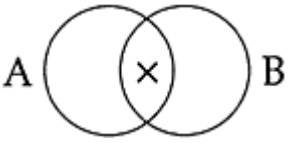
"no A is B"
Shade areas where A and B overlap.



"No animals are beautiful"="nothing in the animal circle is in the beautiful circle."

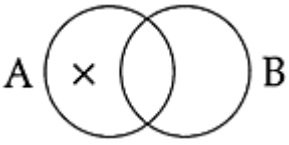
Lastly, we diagram "some" premises, by putting an "×" (symbolizing an existing thing) in some area that isn't already shaded:

"some A is B"
"×" an unshaded area where A and B overlap.



"Some animals are beautiful"="something in the animal circle is in the beautiful circle."

"some A is not B"
"×" an unshaded area in A that is outside B.



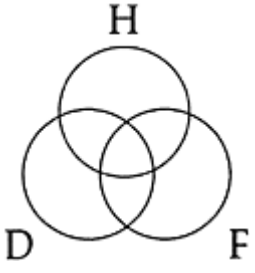
"Some animals are not beautiful"="something in the animal circle is outside the beautiful circle."

In some cases, consistent with the above directions, we could put the "×" in either of two distinct areas. When this happens, the argument will be invalid; to show this, put the "×" in an area that *doesn't* draw the conclusion. The syllogism is valid if drawing the premises *automatically* draws the conclusion; it's invalid if we *can* draw the premises without drawing the conclusion.

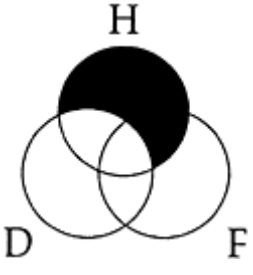
Let's try the test on this valid "hard determinism" argument:

All human acts are determined.	all H is D	**Valid**
No free acts are determined.	no F is D	
∴ No human acts are free.	∴ no H is F	

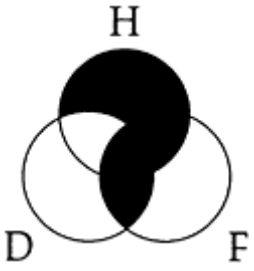
First we draw three overlapping circles:



Then we draw the premise "all H is D"—by shading areas of H that are outside D:



Then we draw the premise "no F is D"—by shading where F and D overlap:



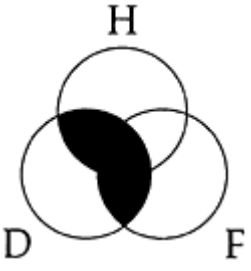
But then we've automatically drawn the conclusion "no H is F"—since we've shaded where H and F overlap. So the argument is valid.

Here's an invalid argument:

No human acts are determined.
No free acts are determined.
∴ No human acts are free.

Invalid

no H is D
no F is D
∴ no H is F



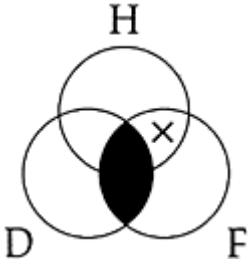
Here we draw "no H is D" (by shading where H and D overlap) and "no F is D" (by shading where F and D overlap). But then we haven't automatically drawn "no H is F" (since we haven't shaded all the areas where H and F overlap). So the argument is invalid.

Here's a valid argument using "some":

No determined acts are free.
Some human acts are free.
Some human acts are not determined.

Valid

no D is F
some H is F
∴ some H is not D

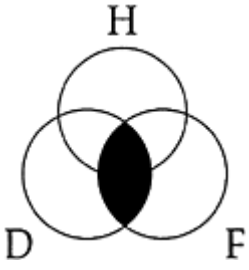


Recall that we first draw premises with "all" and "no" (by shading areas) before drawing premises with "some" (by putting an "×" in non-shaded areas). So here we first draw "no D is F" (by shading where D and F overlap) and then "some H is F" (by putting an "×" in the only non-shaded area where H and F overlap). But then we've automatically drawn "some H is not D"—since we've put an "×" in some area of H that is outside D. So the argument is valid.

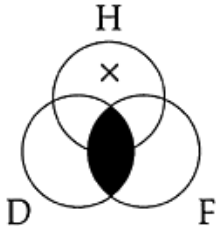
Here's an invalid argument using "some":

No determined acts are free.	no D is F	**Invalid**
Some human acts are not determined.	some H is not D	
∴ Some human acts are free.	∴ some H is F	

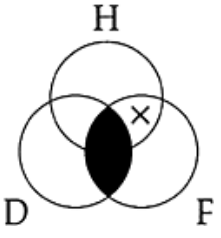
We first draw "no D is F"—by shading where D and F overlap):



Then we have to draw "some H is not D"—by putting an "×" in some area of H that is outside D. There are two ways we could do this:

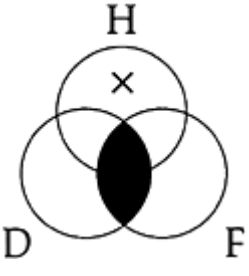


We can draw "some H is not D" in two ways. Pick the way that *doesn't* draw the conclusion.



When there are two places to put an "×," always pick the way that *doesn't* draw the conclusion. So here we pick the first way:

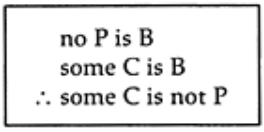
No determined acts are free.	**Invalid**	
Some human acts are not determined.	no D is F	
∴ Some human acts are free.	some H is not D	
	∴ some H is F	

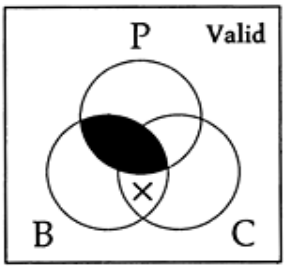


Since it's possible to draw the premises without drawing the conclusion, the argument is invalid.

2.6a Exercise—LogiCola BC

Test for validity using Venn diagrams.





1. all A is B
   some C is B
   ∴ some C is A
2. no B is C
   all D is C
   ∴ no D is B
3. all E is F
   some G is not F
   ∴ some G is not E
4. no Q is R
   some Q is not S
   ∴ some S is R
5. all A is B
   all B is C
   ∴ all A is C
6. all P is R
   some Q is P
   ∴ some Q is R
7. all D is E
   some D is not F
   ∴ some E is not F
8. all K is L
   all M is L
   ∴ all K is M
9. no P is Q
   all R is P
   ∴ no R is Q
10. some V is W
    some W is Z
    ∴ some V is Z

11. no G is H
    some H is I
    ∴ some I is not G

12. all E is F
    some G is not E
    ∴ some G is not F

2.7 Idiomatic arguments

Our arguments so far have been phrased in a clear premise-conclusion format. Unfortunately, real-life arguments are seldom so neat and clean. Instead we may find convoluted wording or extraneous material. Important parts of the argument may be omitted or only hinted at. And it may be hard to pick out the premises and conclusion. It often takes hard work to reconstruct a clearly stated argument from a passage.

Logicians like to put the conclusion last:

Socrates is human. All humans are mortal. *So Socrates is mortal.*	s is H all H is M ∴ s is M

But people sometimes put the conclusion first, or in the middle:

Socrates must be mortal. After all, he's human and all humans are mortal.	Socrates is human. *So he must be mortal*—since all humans are mortal.	s is H all H is M ∴ s is M

In these examples, "must" and "so" indicate the conclusion (which always goes *last* when we translate the argument into logic). Here are some typical words that help us pick out the premises and conclusion:

These often indicate premises:	∴	*These often indicate conclusions:*
Because, for, since, after all… I assume that, as we know… For these reasons…		Hence, thus, so, therefore… It must be, it can't be… This proves (or shows) that…

When you don't have this help, ask yourself what is argued *from* (these are the premises) and what is argued *to* (this is the conclusion).

In reconstructing an argument, first pick out the conclusion. Then translate the premises and conclusion into logic; this may involve untangling idioms like "Only A's are B's" (which translates into "all B is A"). If some letters occur only once, you may have to add unstated but implicit premises; using the "principle of charity," interpret unclear reasoning in the way that gives the best argument. Finally, test for validity.

Here's an example of a twisted argument:

"You aren't allowed in here! After all, only members are allowed."

First we pick out the premises and conclusion:

Only members are allowed in here.	all A is M
∴ You aren't allowed in here.	∴ u is not A

Since "M" and "u" occur only once, we need to add an implicit premise linking these to produce a syllogism. We add a plausible premise and test for validity:

You aren't a member. (implicit)	u is not M*	**Valid**
Only members are allowed in here.	all A* is M	
∴ You aren't allowed in here.	∴ u* is not A	

2.7a Exercise—LogiCola B (F & I)

First appraise intuitively; then translate into logic (making sure to pick out the conclusion correctly) and determine validity using the star test. Supply implicit premises where needed. Be sure to use correct wffs and syllogisms.

Whatever is good in itself ought to be desired. But whatever ought to be desired is capable of being desired. So only pleasure is good in itself, since only pleasure is capable of being desired.

all G* is O **Valid**
all O* is C
all C* is P
∴ all G is P*

The conclusion is *"Only pleasure is good in itself":* "all G is P."

1. Racial segregation in schools generates severe feelings of inferiority among black students. Whatever generates such feelings treats students unfairly on the basis of race. Anything that treats students unfairly on the basis of race violates the 14th Amendment. Whatever violates the 14th Amendment is unconstitutional. As a result, racial segregation in schools is unconstitutional. [This is the reasoning behind the 1954 Brown vs. Topeka Board of Education Supreme Court decision.]
2. You couldn't have studied! The evidence for this is that you got an F- on the test.
3. God can't condemn agnostics for non-belief. For God is all-good, anyone who is all-good respects intellectual honesty, and no one who does this condemns agnostics for non-belief.
4. Only what is under a person's control is subject to praise or blame. Thus the consequences of an action aren't subject to praise or blame, since not all the consequences of an action are under a person's control.
5. No synthetic garment absorbs moisture. So no synthetic garment should be worn next to the skin while skiing.
6. Not all human concepts can be derived from sense experience. My reason for saying this is that the idea of "self-contradictory" is a human concept but isn't derived from sense experience.
7. Analyses of humans in purely physical-chemical terms are neutral about whether we have inner consciousness. So, contrary to Hobbes, we must conclude that no analysis of humans in purely physical-chemical terms fully explains our mental

activities. Clearly, explanations that are neutral about whether we have inner consciousness don't fully explain our mental activities.

8. Only what is based on sense experience is knowledge about the world. It follows that no mathematical knowledge is knowledge about the world.
9. Not all the transistors in your radio can be silicon. After all, every transistor that works well at high temperatures is silicon and yet not all the transistors in your radio work well at high temperatures.
10. Moral principles aren't part of philosophy. This follows from these considerations: Only objective truths are part of philosophy. Nothing is an objective truth unless it's experimentally testable. Finally, of course, moral principles aren't experimentally testable. [From the logical positivist A.J.Ayer.]
11. At least some women are fathers. This follows from these facts: (1) Jones is a father, (2) Jones had a sex change to female, and (3) whoever had a sex change to female is (now) a woman.
12. Only language users employ generalizations. Not a single animal uses language. At least some animals reason. So not all reasoners employ generalizations. [From John Stuart Mill.]
13. Only pure studies in form have true artistic worth. This proves that a thing doesn't have true artistic worth unless it's abstract, for it's false that there's something that's abstract but that isn't a pure study in form.
14. Anything that relieves pressure on my blisters while I hike would allow me to finish my PCT (Pacific Crest Trail) hike from Mexico to Canada. Any insole with holes cut out for blisters would relieve pressure on my blisters while I hike. I conclude that any insole with holes cut out for blisters would allow me to finish my PCT hike from Mexico to Canada. [So I reasoned—and it worked.]
15. We know (from observing the earth's shadow on the moon during a lunar eclipse) that the earth casts a curved shadow. But spheres cast curved shadows. These two facts prove that the earth is a sphere.
16. Whatever is known is true, and whatever is true corresponds to the facts. We may conclude that no belief about the future is known.
17. No adequate ethical theory is based on sense experience, because any adequate ethical theory provides necessary and universal principles, and nothing based on sense experience provides such principles. [From Immanuel Kant.]
18. At least some active people are hypothermia victims. Active people don't shiver. It follows that not all hypothermia victims shiver. [From a ski magazine.]
19. Iron objects conduct electricity. We know this from what we learned last week—namely, that iron objects are metallic and that nothing conducts electricity unless it's metallic.
20. Only things true by linguistic convention are necessary truths. This shows that "God exists" can't be a necessary truth. After all, existence claims aren't true by linguistic convention.
21. No bundle of perceptions eats food. Hume eats food, and Hume is a human person. From this it follows (contrary to David Hume's theory) that no human person is a bundle of perceptions.

22. Whatever events we could experience as empirically real (as opposed to dreams or hallucinations) are events that could fit coherently into our experience. So an uncaused event isn't something we could experience as empirically real. I assume that it's false that some uncaused event could fit coherently into our experience. [From Immanuel Kant.]
23. I think I'm seeing a chair. But there are some people who think they're seeing a chair who are deceived by their senses. And surely people deceived by their senses don't really know that they're seeing an actual chair. So I don't really know that I'm seeing an actual chair.
24. No material objects can exist unperceived. I say this for three reasons: (1) Material objects can be perceived. (2) Only sensations can be perceived. And finally, (3) no sensation can exist unperceived. [Bertrand Russell criticized this argument for an idealist metaphysics.]
25. Only those who can feel pleasure or pain deserve moral consideration. Not all plants can feel pleasure or pain. So not all plants deserve moral consideration.
26. True principles don't have false consequences. There are plausible principles with false consequences. Hence not all true principles are plausible.
27. Only what divides into parts can die. Everything that's material divides into parts. No human soul is material. This shows that no human soul can die.

2.8 The Aristotelian view

Historically, "Aristotelian" and "modern" logicians disagree about the validity of some syllogism forms. They disagree because of conflicting views about allowing empty terms (general terms that don't refer to any existing beings).

Compare these two arguments:

All underwater fish are animals.	All unicorns are animals.
∴ Some animals are underwater fish.	∴ Some animals are unicorns.

Intuitively, the first seems valid while the second seems invalid. Yet both have the same form—one that tests out as "invalid" using our star test:

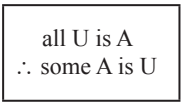
all U* is A **Invalid**
∴ some A* is U*

What is going on here?

When we read the first argument, we tend to presuppose that there is at least one underwater fish. Given this, as an assumed additional premise, it follows validly that some animals are underwater fish. When we read the second argument, we don't assume that there is at last one unicorn.[1] Without this additional assumption, it doesn't follow that some animals are unicorns.

[1] Unicorns are mythical creatures that are like horses but have a single horn on the forehead. Since there are no such beings, "unicorn" is an empty term and doesn't refer to existing beings.

Logically, what we have is this:



This is *valid* if we assume as a further premise that there are U's. It's *invalid* if we don't assume this.

The **Aristotelian view,** which assumes that each general term in a syllogism refers to at least one existing being, calls the argument "valid." The **modern view,** which allows empty terms like "unicorn" that don't refer to existing beings, calls the argument "invalid."

I prefer the modern view, since we often reason without presupposing that our general terms refer to existing entities. Someone may write a paper disputing the existence of angels; it would be awkward if we couldn't reason using the term "angel" without presupposing that there are angels. Or a teacher may say, "All students with straight-100s may skip the final exam"; this rule doesn't presuppose that anyone in fact will get straight-100s. On the other hand, in many cases we *can* presuppose that our general terms all refer; then the Aristotelian test seems more realistic.

Suppose we have an argument with true premises that's invalid on the modern view but valid on the Aristotelian view. Should we draw the conclusion or not? We should draw the conclusion if we know that each general term in the premises refers to at least one existing being; otherwise, we shouldn't.

Some logic books use the Aristotelian view, but most use the modern view. It makes a difference in very few cases; all the syllogisms in this chapter prior to this section test out the same on either view.

Use this version of the star test for the Aristotelian view:

> Star the distributed letters in the premises and undistributed letters in the conclusion. Then on the Aristotelian view (that is, presuming as an implicit premise that all the general terms refer), the syllogism is **VALID** if and only if every capital letter is starred *at least once* and there is exactly one star on the right-hand side.

The Aristotelian view requires capital letters to be starred *at least once* (once or twice), while the modern view requires them to be starred *exactly once.*

If you want to use Venn diagrams for the Aristotelian view, add this rule:

> Any circle with only one non-shaded area must have an "×" put in this area.

This is equivalent to assuming that the circle in question isn't entirely empty.