

Categorical Logic Handout
Logic: Spring 2017

Deductive argument: An argument whose premises are claimed to provide conclusive grounds for the truth of its conclusion.

Validity: A characteristic of any deductive argument whose premises, if they were all true, would provide conclusive grounds for the truth of its conclusion. Such an argument is said to be valid.

Sound: Any valid argument with true premises.

Four Categorical Claims:

A: All S are P (Universal affirmative)

E: No S are P (Universal negative)

I: Some S are P (Particular affirmative)

O: Some S are not P (Particular negative)

Quality, Quantity, and Distribution (Review earlier notes)

Exercise #1: Name the quality and quantity of each of the following propositions, and state whether their subject and predicate terms are distributed or undistributed.

1. Some presidential candidates will be sadly disappointed people.
2. All those who died in Nazi concentration camps were victims of a cruel and irrational tyranny.
3. Some recently identified unstable element were not entirely accidental discoveries.
4. Some members of the military-industrial complex are mild-mannered people to whom violence is abhorrent.
5. No leader of the feminist movement is a major business executive.

Syllogism: Any deductive argument in which a conclusion is inferred from two premises.

Categorical syllogism: A deductive argument consisting of three categorical propositions that contain exactly three terms, each of which occurs in exactly two of the propositions.

No heroes are cowards.

Some soldiers are cowards.

Therefore, some soldiers are not heroes.

Terms: There are three terms in a syllogism: the major term, the minor term, and the middle term.

Major term: The major term is the predicate of the conclusion.

Minor term: The minor term is the subject of the conclusion.

Middle term: The middle term is the term that appears in both premises, but not in the conclusion.

The Principles of the Syllogism: Categorical syllogisms state the identity of two terms, the minor and major terms, by virtue of their mutual identity with a third term, the middle term. Behind the rules that govern the syllogism, there are four principles which are fundamental to all logical thought.

1. The Principle of Reciprocal Identity: *Two terms that are identical with a third term are identical to each other.* For example, in the argument, "All men are mortal. Socrates is a man. Therefore, Socrates is mortal," the term *mortal* is said to be identical with the term *man*; and the term *mortal* is also said to be identical to the term *Socrates*. Since both *Socrates* and *man* are identical to *mortal*, then the terms *Socrates* and *man* must be identical to each other. In other words, if S is identical with M and P is identical with M, then S is identical to P.

2. The Principle of Reciprocal Non-Identity: *Two terms, one of which is identical with a third term and the other of which is nonidentical with that third term, are nonidentical to each other.* Consider the following argument:

No men are angels.

Socrates is a man.

Therefore, Socrates is not an angel.

We see here that although *Socrates* is said to be identical with *man*, *angel* is not identical with *man*. Since *Socrates* is identical with *man* but *angel* is not, *Socrates* cannot be identical with *angel*. In other words, if S is identical with M, but P is not identical with M, then S is not identical with P.

3. The Dictum de Omni: *What is affirmed universally of a certain term is affirmed of every term that comes under that term.* This principle is apparent also in our original syllogism. Since mortality is affirmed universally of man, every term that comes under the extension of *man* shares in it. Since Socrates is included in the extension of *man*, Socrates is said to share in mortality.

4. The Dictum de Nullo: *What is denied universally of a certain term is denied of every term that comes under that term.*

Consider the following argument:

No man is God.
Socrates is a man.
Therefore, Socrates is not God.

The argument denies divinity universally of men. Since *Socrates* comes under *men*, it is denied of Socrates too.

Exercise #2:

1. Explain how to distinguish each of the following: Major term, minor term, middle term.
2. In a syllogism, which is the major premise?
3. In a syllogism, which premise is the minor premise?

In the following syllogisms, indicate the major premise, and the minor premise by writing major or minor next to the appropriate premise. Indicate also the minor, major and middle terms by writing them out and writing S next to the minor term, a P next to the major term, and an M next to the middle term.

4. All men are mortal.
Socrates is a man.
Therefore, Socrates is mortal.
5. All logic problems are difficult.
This problem is a logic problem.
Therefore, this problem is difficult.
6. All good basketball players can shoot well.
Steph Curry is a good basketball player.
Therefore, Steph Curry can shoot well.
7. No men are gods.
Socrates is a man.
Therefore, Socrates is not a god.
8. All apostles are men.
Peter is an apostle.
Therefore, Peter is a man.
9. No beliefs that conflict with the Bible are true.
The belief that the world was created by chance conflicts with the Bible.
Therefore, the belief that the world was created by chance is not true.`

Exercise #3: Indicate whether the following syllogisms illustrate the Principle of Reciprocal Identity (PRI) or the Principle of Reciprocal Non-Identity (PRNI) and the Dictum de Omni (DO) or the Dictum de Nullo (DN). (Be aware that a syllogism can illustrate both PRI or PRNI (but not both) and DO or DN (but not both). (Use the examples (4-9) above.

True or False

- T F The two kinds of reasoning are deduction and induction.
 T F A syllogism contains three premises and a conclusion.
 T F In a valid argument, if the premises are true, the conclusion must be true.
 T F The minor term is the subject of the conclusion and the major term is the predicate of the conclusion.
 T F The major premise is the premise that contains the major term.
 T F The middle term is the term that does not appear in either premise.
 T F If S is identical with M and P is identical with M, then S is identical with P.

Figure and Mood of Syllogisms

Mood: Each sentence occurring in a categorical syllogism is a categorical proposition, each is one of four forms A, E, I O. The mood of a syllogism is indicated by the three letters representing the forms of the major premise, minor premise, and the conclusion in that order. For example:

No P is M E
 All S is M A
 Therefore, Some S is not P O

Has the mood EAO.

Figure: The *figure* of a syllogism represent the pattern of occurrences of the middle term in the syllogism. There are four figures.

| | 1 st Figure | | 2 nd Figure | | 3 rd Figure | | 4 th Figure | |
|---------------|------------------------|---|------------------------|---|------------------------|---|------------------------|---|
| Major premise | M | P | P | M | M | P | P | M |
| Minor premise | S | M | S | M | M | S | M | S |

The combination of mood and figure gives a complete classification of the logical forms of categorical syllogisms. The standard way of representing a categorical syllogism is by writing its mood followed by its figure; for example, AII-3 is a syllogism of the form

All M is P
 Some M is S
 Therefore, some S is P.

Exercise #4: Use the syllogisms 4-8 used for Ex. #3 and identify the mood and figure for each.

1. _____ 2. _____ 3. _____ 4. _____ 5. _____

Rules for Categorical Syllogisms

There are seven rules of validity for categorical syllogisms.

Terminological Rules

I. There must be three and only three terms.

II. The middle term must not occur in the conclusion.

Quantitative Rules

III. If a term is distributed in the conclusion, then it must be distributed in the premises.

IV. The middle term must be distributed at least once.

Qualitative Rules

V. No conclusion can follow from two negative premises.

VI. If the two premises are affirmative, the conclusion must also be affirmative.

VII. If either premise is negative, the conclusion must be negative.

The following is an error related to rule **I**. It is called the *fallacy of four terms*.

All mammals have hair.

All horses have manes.

Therefore, some mammals have hair.

Another example of an error. It is called the fallacy of equivocation:

All planes are two-dimensional.

All Boeing 747s are planes.

Therefore, all 747s are two-dimensional.

An example of an error regarding rule **II**.

All plants are living things.

All animals are living things.

Therefore, all living things are plants or animals.

Exercise #5.

1. How many of these rules does a syllogism have to comply with in order to be considered valid?

2. Why are the first two rules called *terminological* rules?

3. Tell whether the following syllogisms are examples of the Fallacy of Four Terms (FFT) or the Fallacy of Equivocation (FE):

All wildebeasts are mammals.
All lions are felines.
Therefore, all felines are mammals.

All mice eat cheese
Some computer parts are mice.
So some computer parts eat cheese.

All animals are irrational.
All dogs are mammals.
Therefore, all mammals are irrational.

All kings are powerful.
No queens are men.
Therefore, some men are powerful.

All accidents are life-threatening.
This new recipe was an accident.
Therefore, this new recipe is
life-threatening.

All aliens are from outer space.
All foreigners are aliens.
So, foreigners are from outer space.

All banks contain money.
All rivers have banks.
Therefore, all rivers contain money.

All roses have thorns.
All flowers are beautiful.
So, beautiful things have thorns.

4. Indicate whether the syllogisms below violate Rule II. (Yes or No)

All lions are felines.
All felines are animals.
Therefore, some felines are lions.

All animals are living beings.
All mice are animals.
Therefore, all mice are living things.

All animals are irrational.
All horses are animals.
Therefore, all horses are irrational.

Some men are kings.
All kings are powerful.
Therefore, some kings are men.

All things life-threatening should be
avoided.
All accidents are life-threatening.
Therefore, all accidents should be avoided.

All aliens are supposed to be registered.
All foreigners are aliens.
Therefore, all foreigners are supposed to
be registered.

All that contain water are wet.
All rivers contain water.
Therefore, all rivers are wet.

All flowers are beautiful.
All beautiful things should be admired.
Therefore, some beautiful things have
flowers.

In the following syllogisms indicate the major premise (**major**), the minor premise (**minor**). Indicate the minor, major, and middle terms by using S, P, and M. Determine whether the syllogism is valid or invalid. If it is invalid, tell whether it

violates Rule I or Rule II. (Hint: if you have a hard time determining the minor and major terms, it is probably because it violates one of these rules):

A horse is a quadruped.
All mammals breathe oxygen.
Therefore, some mammals are quadrupeds.

All Romans were brave.
Julius Caesar was a Roman.
Therefore, Julius Caesar was brave.

All horses are fast.
Secretariat is a horse.
Therefore, some horses are fast.

All food should be eaten.
This logic problem is food for thought.
Therefore, this logic problem should be eaten.

Discussion of Quantitative Rules: These are called *quantitative* because they have to do with the quantity of the statements in a syllogism. The quantity of a statement has to do with whether the statement is universal or particular.

Review of *distribution* (See earlier class notes.)
Distribution is the status of a term in regard to extension.

Example for analysis:
All angels are spiritual beings.
No men are angels.
Therefore, no men are spiritual beings.

Syllogisms that violate Rule III are said to commit the *Fallacy of Illicit Process*. There are two ways the fallacy is committed. The first is called the *Fallacy of Illicit Major* and the second is called the *Fallacy of Illicit Minor*.

The Fallacy of Illicit Major occurs when the major term (the predicate of the conclusion) is distributed in the conclusion, but not in the major premise.

The Fallacy of Illicit Minor occurs when the minor term (the subject of the conclusion) is distributed in the conclusion, but not in the minor premise. An example of the Fallacy of Illicit Minor is:

All men are animals.
All men are mortal
Therefore, all mortals are animals.

Because the middle term, *spiritual beings*, is not distributed in either premise, it cannot serve to connect the minor and major terms. When this occurs, we have committed the *Fallacy of Undistributed Middle*.

Exercise #6: Mark the following syllogisms indicating the minor, major, and middle terms (S, P, and M). Indicate whether the term is distributed or undistributed (*d* or *u*). (Note that negative statements in which the subject term is a proper noun are E statements. For example, "Jeff is not rude" is "No S is P.")

All boys__are human__.
Nathaniel__is a boy__.
Therefore, Nathaniel__is human__.

No truth__is simple__.
Hinduism__is the truth__.
Therefore, Hinduism__is not simple__.

No boys__are rude__.
Jeff__is a boy__.
Therefore, Jeff__is not rude__

All Romans__are brave__.
Caesar__is a Roman__.
Therefore, Caesar__is brave__.

All cars__are fast__.
A Corvette__ is a car__
Therefore, a Corvette__is fast__.

All generals__are great__
Hannibal__is a general__.
Therefore, Hannibal__is great__.

All girls__ are smart__.
Suzy__ is a girl__
Therefore, Suzy__ is smart__.

No wars__ are fun__.
World War II__ was a war__.
Therefore, WWII__ was not fun__.

Identify the rule that is violated in the following syllogisms. Indicate minor, major, and middle terms (S, P, and M) and whether the terms are distributed or undistributed (*d* and *u*). If Rule III is violated, indicate which fallacy is committed, Illicit Major (IMj) or Illicit Minor (IMn). If no fallacy is committed, mark NF.

All boys are human.
No girls are boys.
Therefore, no girls are human.

All towns are safe.
Jerusalem has high walls.
Therefore, Jerusalem is safe.

All victories are glorious.
No defeat is a victory.
Therefore, no defeat is glorious.

All Gorgons have snakey hair.
All Gorgons are sisters.
Therefore, al sisters have snakey hair.

All men are animals.
All men are mortal.
Therefore, all mortals are animals.

All Southerners eat grits.
No Yankee is a Southerner.
Therefore, no Yankee eats grits.

All cars are fast.
My car is a Corvette.
Therefore, my car is fast.

All Romans are brave.
No Gaul is a Roman.
Therefore, all brave men are great.

Practicing the Qualitative Rules: These are called *qualitative* because they have to do with the quality of the statements in a syllogism. The quality has to do with whether the statement is affirmative or negative.

Example violating Rule V. (*Fallacy of Exclusive Premises*).

No plants are animals.
Some minerals are not animals.
Therefore, some minerals are not plants.

Example violating Rule VI (*Fallacy of Drawing a Negative Conclusion from Affirmative Premises*.)

All men are mortals.
All mortals make mistakes.
Therefore, some things that make mistakes are not men.

Example violating Rule VII (*Fallacy of Drawing an Affirmative Conclusion from a Negative Premise*.)

All cannibals are bloodthirsty.
Some accountants are not bloodthirsty.
Therefore, some accountants are cannibals.

Exercise #7: Indicate which rule is violated. Indicate minor, major, and middle terms (S, P, and M) and whether the terms are distributed (d and u) Just identify which rule is violated (I – VII). If no fallacy is committed, then simply mark it valid.

No saints are villains.
Some robbers are not villains.
Therefore, some robbers are saints.

Some vegetables are not sweet.
No vegetable is a fruit.
Therefore, some fruits are not sweet.

All floods are devastating.
No drought is a flood.
Therefore, no drought is devastating.

All symphonies are beautiful.
No opera is a symphony.
Therefore, no opera is beautiful.

All Protestants believe in the trinity.
All Catholics believe the trinity.
Therefore, some Catholics are Protestant.

No maples are pines.
No oaks are pines.
Therefore, no oaks are maples.

No Greeks are Romans
Some soldiers are not Romans.
Therefore, some soldiers are not Greeks.

No man is as wise as Solomon.
Einstein is a man.
Therefore, Einstein is not as wise as
Solomon.