Syllogistic Logic

4.1 Definition of concepts

Syllogism is an argument with two premises and a conclusion.

4.2 Types of Syllogism

1. Categorical syllogism is a deductive argument consisting of three categorical propositions with exactly three shared terms, two terms per proposition.

Categorical Syllogism (Contains words All, No, some)

2. Hypothetical syllogism is a type of syllogism which is characterized by its use of conditional sentences as either a premise, or a conclusion , or both.-(*if-then*)

3. Disjunctive syllogism is a type of syllogism which is characterized by its use of either-or type statements.

4.3 Categorical proposition is a statement that relates two classes or categories. The **Two categories** of categorical syllogisms are **subject term** and **predicate term.**

Categorical propositions may be found either in **ordinary** or **standard** forms.

Compare the following pairs of propositions which are presented in **ordinary** and **standard forms** respectively.

All dogs bark.

All dogs are animals that bark.

Not a single horse is mule.

No horses are mules.

Some laptops are expensive.

Some laptops are expensive computers.

Not everyone who preaches is a theologian.

Some preachers are not theologians.

4.3.1 Standard form

A categorical Proposition is in standard form when it contains the four components in the following order:

1 Quantifier	→	2 Subject Term	→	3 Copula	→	4 Predicate Term
1 *All*		2 *cats*		3 *are*		4 *animals.*

Component Parts

1. Quantifiers are words that show quantity.

Example: All, No Some

2. Subject term is a word or group of words that can serve as the

3. Copula is a word or that connect the subject term and the predicate term.

Example: are

4. Predicate Term is a word or group of words that tell us something about the subject.

Example: animals

Types and codes

There are **four** types of categorical propositions which are codified in the first four vowel letters: **A, E, I** and **O.**

Example:

A **All** cats are mammals.

E **No** cats are mammals.

I **Some** cats are mammals.

O **Some** cats are *not* mammals.

4.3.2. Attributes of Categorical propositions

1. Quality

It refers to whether the proposition is in **affirmative** or in the **negative**.

A and **I** have **negative** attribute

E and **O** have **affirmative** attribute

2. Quantity

It refers to whether categorical proposition is either **universal** or **particular**.

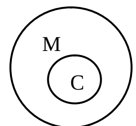
A and **E** have **universal** attribute

E and **O** have **Particular** attribute

3. Distribution

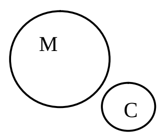
It refers to whether the proposition makes an assertion about **every member** of the class denoted by the **term**; otherwise it is undistributed.

All **cats (C)** are **mammals (M)**.



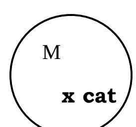
The proposition "**A**" asserts about **every member** of the **subject term** "cat"**.** Thus the **subject term** is **distributed** in proposition **"A"**

No **cats (C)** are **mammals (M)**.

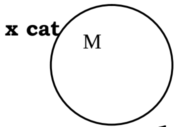


The proposition "E" asserts about **every member** of the **subject term** "cat" and the **predicate term** "mammals"**.** Thus both the **subject** and **predicate terms** are **distributed** in proposition **"E"**

Some (at least one) ***cats (C)*** *are* ***mammals (M)***.



The proposition "**I**" assert about **at least one member** of the **subject and the predicate terms.** Thus neither the **subject term** nor the **predicate term** is **distributed** in proposition **"I"** ot



The proposition "**O**" assert about **at least one member** of the **subject term** but it asserts about **every member** of the predicate term**.** Thus the **predicate term** is **distributed** in proposition "**O**"

Consider the following table

Two mnemonic devices for distribution	
"Unprepared Students Never Pass" **U**niversals distribute **S**ubjects. **N**egatives distribute **P**redicates.	"Any Student Earning B's Is Not On Probation" **A** distributes **S**ubject. **E** distributes **B**oth. **I** distributes **N**either. **O** distributes **P**redicate

Summary

Type	Quantity	Quality	Distribution
A	**Universal**	**Affirmative**	**S**
E	**Universal**	**Negative**	**S & P**
I	**Particular**	**Affirmative**	**None**
O	**Particular**	**Negative**	**P**

4.3.3. Venn Diagrams

Venn diagram is an arrangement of *overlapping circles* such that each circle represents the *class* denoted by the term in categorical propositions.

John Venn, the C19th logician, developed the system of diagrams.

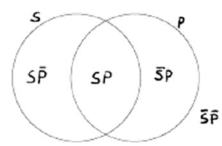
Categorical propositions can be represented by Venn diagrams.

Steps

To represent Categorical propositions we should follow the three steps given below:

1. Represent the subject and predicate term with letters.

2. Draw overlapping circles in which the left hand represent the subject term, and the right hand- the predicate term.



Area 1 ($S\bar{P}$)

Area 2 (SP)

Area 3 ($\bar{S}P$)

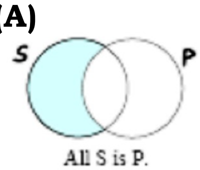
$S\bar{P}$ = S that are not P

SP = S that are P

$\bar{S}P$ = P that are not S

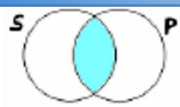
3. Indicate the various **areas** of the diagram whether they are **empty** (by **shading** the area) or contain at least one member of the class (by putting letter **x**).

Universal affirmative proposition (A)



"All s is p." means No members of S is outside P.

(E) No S is P." means

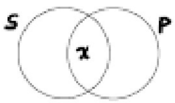


No S is P.

No members of S is inside P.

Particular affirmative proposition

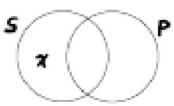
(I) Some S is P." means at least one S exists and that S is a P.



Some S is P.

Particular negative proposition

(O) Some S is not P." means at least one S exists and that S is not a P.



Some S is not P.

3.3.2 Immediate Inferences

Immediate Inferences are arguments with **single** premise and conclusion.

Venn Diagrams and **Square of oppositions,** as well as the rules of **conversion, obversion and contraposition** can be used to test the validity of these arguments.

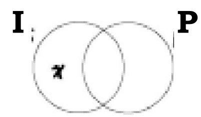
Let us practice to using **Venn Diagrams** to test the validity of an inference:

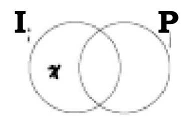
Example:

Some instructors are not professional teachers. Therefore, it is false that all instructors are professional teachers.

Step 1. Draw overlapping circles for both the premise and conclusion as we have seen earlier.

Step 2. Compare the two, if they are identical the argument is valid; if not it is invalid.



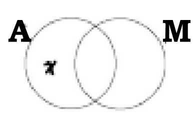


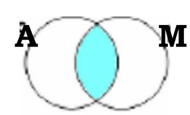
Premise Conclusion

Since they are identical the argument is **valid.**

Example

It is false that that all animals are mammals. Therefore, no animals are mammals.





Premise Conclusion

It is **invalid**, because they are not identical.

4.3.4. Square of Oppositions

It is an arrangement of lines that illustrates **logically** necessary **relations** among the four kinds of categorical propositions.

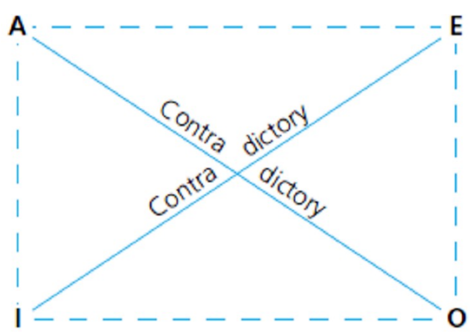
Types of squares

A. **Aristotelian (Traditional)**

While the **modern square** is **neutral** about whether universal (A and E) propositions make claims about actually existing things, the **Aristotelian** interpretation assumes that the **subject term** of universal propositions denotes things that **actually exist**.

Because of this existential assumption the traditional square contains more relations than the modern square.

A. Modern square of Opposition



Modern square of opposition has **contradictory** relations. And they necessarily have **opposite** truth value.

Thus, if **A** is true **O** must be false.

If **I** is true **E** must be false.

Given the truth value of an **A** or **E** the **Corresponding** propositions **E** and **I** have logically **undetermined** truth value.

Given the truth value of an **I** or **E** propositions, **A** and **O** propositions have logically **undetermined** truth value

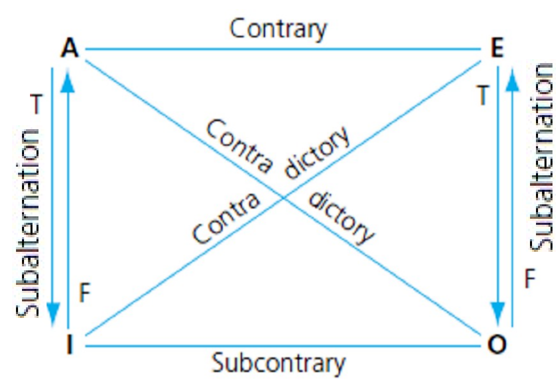
Thus, if **I** is given True, we cannot determine the truth value of the corresponding **A** or **O** propositions.

Example:

All camels are mammals. Therefore, it is false that some camels are not mammals.

Since the premise is an **A** proposition (which is given True) and the conclusion is an O proposition (which is given False), the argument is Valid

B. Traditional (Aristotelian) Square of opposition



There are four types of relations among the propositions according to Aristotelian interpretation.

propositions.

Example

If A = T, O must be false

If A=T, E or I is undetermined

2. **Contrary** expresses only partial opposition. That is (at least one is false, not both true)

Example

If A= True, E must be False

If A= False, E is undetermined

3. **Sub contrary** expresses only partial opposition. That is (at least one is True, not both false)

Example

If I= True, O is undetermined

If I= False, O must be True

4. **Subalteration** expresses truth goes downward and falsity goes upward.

Example

If A= True, I = True

If A= False, I is undetermined

But:

If I= True, A is undetermined

If I= False, A=F

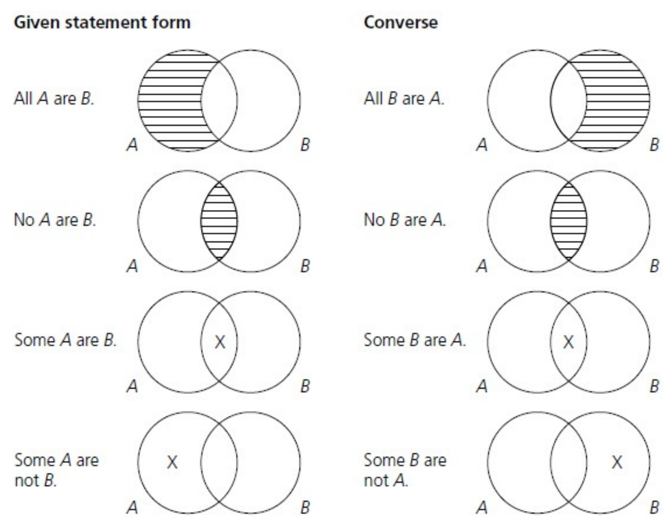
4.3.5. Categorical Operations (Conversion, Obversion, Contraposition)

1. **Conversion** switching the subject term with the predicate term.

Example

Proposition	**Example**	**T/Value**
A	All S are P.	Undetermined
Converse A	All P are S.	
E	No S are P.	Same
Converse E	No P are S.	
I	Some S are P.	Same
Converse I	Some P are S.	
O	Some S are not P.	Undetermined
Converse O	Some P are not S.	

Compare the Venn Diagrams



2. Obversion

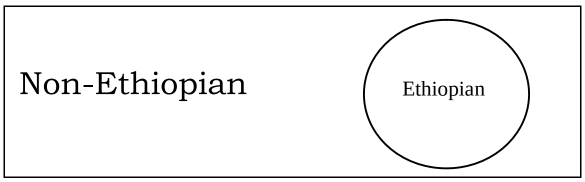
It involves two steps:

1. Changing the quality without changing the quantity
2. Replacing the predicate term with its term complement.

group consisting of everything outside the class.

Example

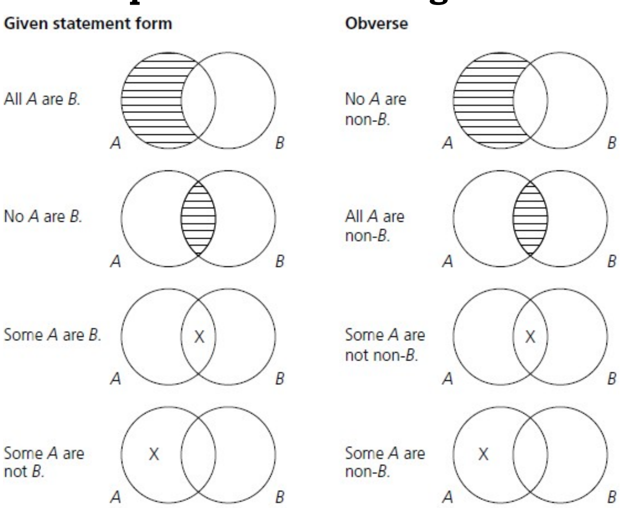
The complement of the class of Ethiopian is the group that includes people who are not Ethiopian.



Look at the following table

Proposition	Example	T/Value
A	All S are P.	Same
Obverse A	No S is non-P.	
E	No S are P.	Same
Obverse E	All S are non-P.	
I	Some S are P.	Same
Obverse I	Some S are not non-P.	
O	Some S are not P.	Same
Obverse O	Some S are non-P.	

Compare the Venn Diagrams



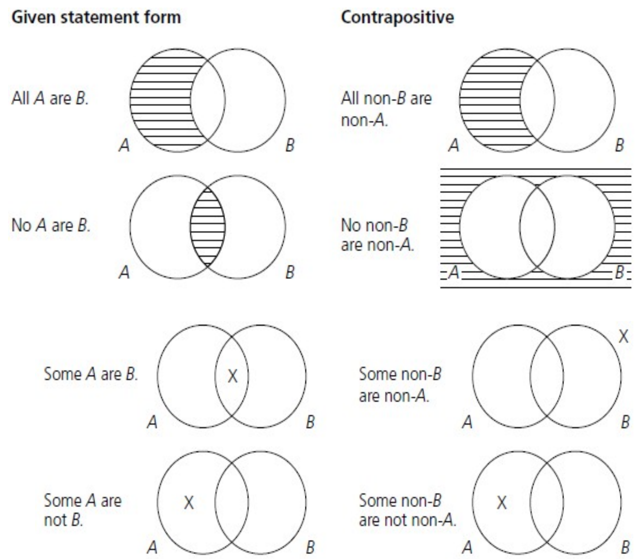
3. Contraposition

It involves two steps:

1. Converting the proposition
2. Replacing the subject and the predicate terms with their term complements

Proposition	Example	T/Value
A	All S are P.	Same
Contra pose A	All non-P are non-S.	
E	No S are P.	Undetermined
Contra pose E	No non-P are non-S.	
I	Some S are P.	Undetermined
Contra pose I	Some non-P are non-S.	
O	Some S are not P.	Same
Contra pose O	Some non-P are not non-S.	

Compare the Venn Diagrams



…ve may identify different formal fallacies

1. The fallacy of **illicit contrary** committed when we detect an argument depends on an incorrect application of the contrary relation.

Example:

Illicit contrary

It is false that all *A* are *B.*

Therefore, no *A* are *B.*

It is false that no *A* are *B.*

Therefore, all *A* are *B.*

2. The fallacy of **illicit subcontrary** committed when we detect an argument depends on an incorrect application of the subcontrary relation.

Example:

Illicit subcontrary

Some *A* are *B.*

Therefore, it is false that some *A* are not *B.*

Some *A* are not *B.*

Therefore, some *A* are *B.*

3. **Illicit subalternation.** depend on an illicit application subalternation

Example:

Illicit subalternation

Some *A* are not *B.*

Therefore, no *A* are *B.*

It is false that all *A* are *B.*

Therefore, it is false that some *A* are *B.*

4. Cases of the incorrect application of the contradictory relation are so infrequent that an "illicit contradictory" fallacy is not usually recognized.

5. **Existential fallacy,** is committed whenever contrary, subcontrary, and subalternation are used (in an otherwise correct way) on propositions about things that do not exist.

   In other words, if the traditional square of opposition is used with propositions about things that do not exist.

   Example:

All witches who fly on broomsticks are fearless women.

Therefore, some witches who fly on broomsticks are fearless women.

No wizards with magical powers are malevolent beings.

Therefore, it is false that all wizards with magical powers are malevolent beings.

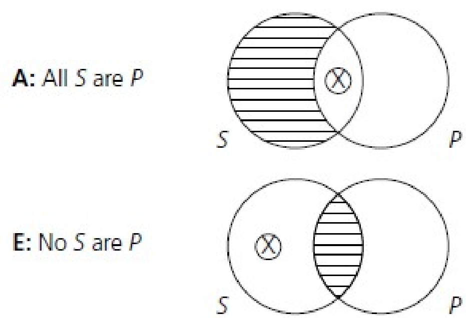
e relation, and the second on an otherwise correct use of the contrary relation. If flying witches and magical wizards actually existed, both arguments would be valid. But since they do not exist, both arguments are invalid and commit the existential fallacy.

4.3.7. Representing Aristotelian standpoint I Venn diagram

The difference between the Boolean standpoint and the Aristotelian standpoint concerns only universal (**A** and **E**) propositions.

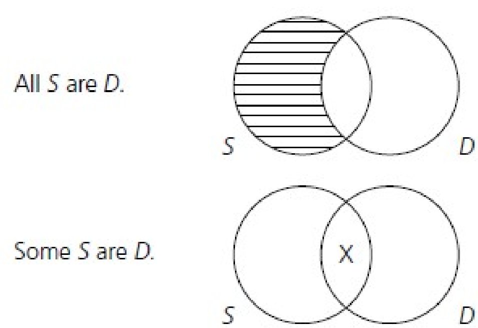
The Boolean interpretation of these propositions makes no assumption that the subject term denotes actually existing things, whereas the Aristotelian interpretation does. Therefore, if we are to construct a Venn diagram to represent the Aristotelian interpretation of such a statement, we need to introduce some symbol that represents this assumption of existence.

The symbol that we will introduce for this purpose is an "X" surrounded by a circle. Like the "X"s that we have used up until now, this circled "X" signifies that something exists in the area in which it is placed. However, the two symbols differ in that the uncircled "X" represents the positive claim of existence made by particular (**I** and **O**) propositions, whereas the circled "X" represents the assumption of existence made by universal (**A** and **E**) propositions. The Aristotelian interpretation of universal propositions may now be diagrammed as follows:



Example:

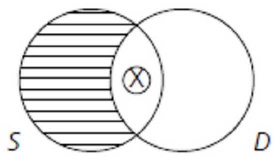
All sugar plum fairies are delicate creatures.
Therefore, some sugar plum fairies are delicate creatures. (Hurley 227)
First we test the argument from the Boolean standpoint:



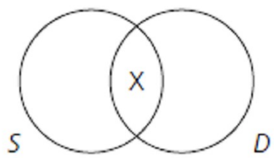
proceed to the second step and place a circled "X" in the unshaded part of the left-hand premise

circle:

All S are D.



Some S are D.



Thus this argument is Valid from the Aristotelian standpoint.

4.4. Categorical syllogism

Categorical syllogism is a deductive argument consisting of three categorical propositions with exactly three shared terms, two terms per proposition.

4.4.1. Basic Concepts

Major term – the term occurring in the **predicate** of the conclusion in a standard form categorical syllogism.

Minor term – the term occurring in the **subject** of the conclusion in a standard form categorical syllogism.

Middle term – the term occurring in **both** the major and minor premises of a standard form categorical syllogism, but not in the conclusion.

Major premise – the premise of a categorical syllogism that contains an instance of the **major term**.

Minor Premise – the premise of a categorical syllogism that contains an instance of the **minor term**.

Note: The major and minor premises are not determined by their placement in a categorical syllogism, but by terms that are contained within them. Both premises of a syllogism contain the middle term, but only the major premise and the conclusion contain the major term, and only the minor premise and the conclusion contain the minor term.

4.4.2 Standard Form of categorical Syllogism

A categorical syllogism is in **standard form** when it fulfills the following four conditions:

1. All the propositions must be in **standard form**.

2. Each term appears **twice** in the argument

4. The **major** premise is listed **first**, the **minor** premise **second** and the **conclusion last**.

Example

Some disciples are preachers.

All disciples are Saints.

Therefore some saints are preachers.

3.4.2. Mood and Figure

All standard form categorical syllogisms can be described in terms of their ***mood*** and ***figure***.

Mood

The **mood** of a syllogism is represented by the three letters that represent the type of each proposition in the syllogism.

Example:

A standard form syllogism with three universal affirmative propositions has a mood of ***AAA.*** However, the mood of a syllogism does not fully characterize its form. For example consider these two arguments each of which has a mood of ***AAA.***

Example

All men are mortal.

All preachers are men.

All preachers are mortal.

Example

All Christians are men.

All preachers are men.

All preachers are Christians.

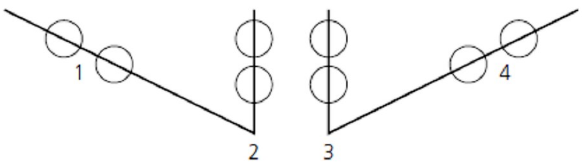
Both of these arguments have a mood of ***AAA,*** but they differ in how the **middle term** is placed. The first argument places the middle term in the subject of the major premise, and the predicate of the minor premise, but the second argument places the middle term in the predicate of both major and minor premises. So, although both have the same mood, they differ in form.

Figure

Figure refers to the **placement** of the middle term in the argument. There are **four** different figures that an argument can have as illustrated in this table:

M – *P*	*P* – ***M***
S – ***M***	*S* – ***M***
S – *P*	*S* – *P*
Figure 1	***Figure 2***
M – *P*	*P* – ***M***
M – *S*	***M*** – *S*
S – *P*	*S* – *P*
Figure 3	***Figure 4***

er



The form of a standard form categorical syllogism can be represented by noting the argument's mood and figure.

In the two arguments given above the first argument is ***AAA*** in the first figure (or ***AAA-1***) and the second is of the form ***AAA*** in the second figure (***AAA-2***).

If we were to list all of the possible moods that an argument could have, we would find that **sixty four** moods are possible (4x4x4). Then if we add the figures to the number (64) arguments of the first figure, 64 for the second figure, and so on), we find that there are **256** possible argument forms which are possible (4x4x4x4). Most of these forms, however, are invalid forms.

The form of an argument is the most important aspect of an argument when considering

its validity, because validity and invalidity depend exclusively on the argument's form. In general if an argument's form is valid, the argument is valid, and if an argument's form is invalid, the argument will be invalid.

Example

All men are mortal.

All preachers are men.

All preachers are mortal.

This argument with the form ***AAA-1*** is a **valid** argument.

Example

All Christians are men.

All preachers are men.

All preachers are Christians.

This argument with the form ***AAA-2*** is **invalid**. Because any argument with an invalid form is an invalid argument, it is sometimes useful to draw analogies between an argument which is asserted as a proof and another argument of the same form with an obviously false conclusion.

Example:

All trees are plants.

All flowers are plaints.

Therefore all flowers are trees.

The fact that this argument has true premises and an obviously false conclusion proves that the argument invalid, and any argument of the form ***AAA-2*** is invalid. (See the table below)

Summary

Unconditionally Valid forms

Unconditionally valid			
Figure 1	Figure 2	Figure 3	Figure 4
AAA EAE AII EIO	EAE AEE EIO AOO	IAI AII OAO EIO	AEE IAI EIO

Conditionally Valid Forms

Conditionally valid				
Figure 1	Figure 2	Figure 3	Figure 4	Required condition
AAI EAO	AEO EAO		AEO	*S* exists
		AAI EAO	EAO	*M* exists
			AAI	*P* exists

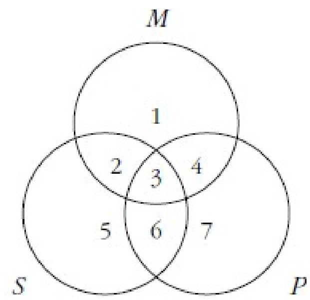
The reason for these additional valid forms is that the Aristotelian standpoint (when properly adopted) recognizes that the premises of a syllogism convey information about existence where as the Boolean stand point does not.

4.4.3. Venn Diagrams

Venn diagrams introduced by John Venn (1834-1923) provide one means for testing the validity of categorical syllogisms.

Venn diagram for categorical syllogisms is the extension of Venn diagrams for categorical propositions. (See section 4.5)

Diagramming a categorical syllogism requires the addition of a third circle in order to represent the three categories in the three terms of such syllogisms.



In the diagram above three circles are used to represent the three categories of a standard form categorical syllogism.

The letters label the terms of the syllogism and in this case the S, P, and M terms which stand for the **minor term** (the subject of the conclusion), the **major term** (the predicate of the conclusion) and the **middle term**.

Just as the two circle diagram represents more than two categories, the three circle diagram represents much more than three categories.

S

(10) non-M, (11) S non-P, etc.

Such a diagram as that above says nothing about the categories represented. In order to represent the propositions of a syllogism we use shading to represent empty classes, and the letter “x” to represent where at least one member of a class exists.

Preliminary Pointers to represent categorical syllogisms with Venn diagrams

1. Marks (shading or placing "x") are entered only for the premises; no marks are made for the conclusion.

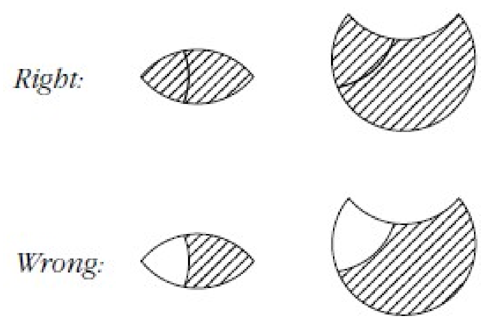
2. If the argument contains one universal premise, this premise should be entered first in the diagram. If there are two universal premises, either one can be done first.

3. When entering the information contained in a premise, one should concentrate on the circles corresponding to the two terms in the statement. While the third circle cannot be ignored altogether, it should be given only minimal attention.

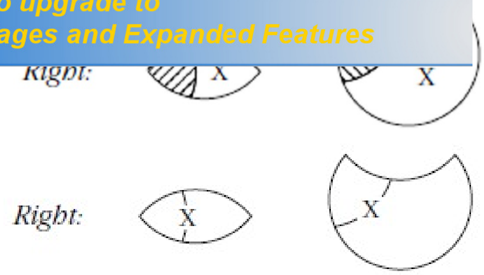
4. When inspecting a complete diagram to see whether it supports a particular conclusion, one should remember that particular statements assert two things. "Some S are P." means "at least one S exists and that s is a P.";

"Some S are not P." means "at least one S exists and that s is not a P."

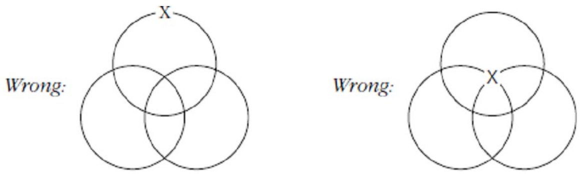
5. When shading an area, one must be careful to shade all of the area in question.



6. The area where an "x" goes is always initially divided in to two parts. If one of these two parts is already been shaded, the "x" goes in the unshaded part. If one of the two parts is not shaded, the "x goes on the line separating the two parts." This means that the "x" may be in either (or both) of the two areas- but it is not known which one.



7. An "x" should never be placed in such a way that it dangles outside of the diagram, and it should never be placed on the intersection of two lines.



Let's note a few **examples** first involving only universal propositions.

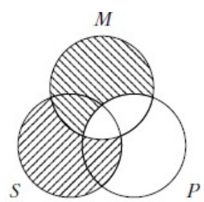
Example 1

AAA-1. This argument has the following format:

All M are P.

<u>All S are M</u>.

All S are P.



First we shade the part of M that does not overlap P. This says that there are no members of M that exist outside of P. This represents the **major** premise of the argument.

Next we shade the part of S that does not overlap M. Again this represents that there are no members of S that are not M. This represents the **minor** premise.

Now we can ask if the premises of the proposition justify the conclusion, "All S are P," and we can see that it does. The only non-shaded part of S is within the P circle, and that represents the conclusion that all S are indeed P. Because we have shown with this example that the **AAA-1** syllogism is valid in this argument, we know that **AAA-1** syllogisms are valid in for all arguments where it occurs.

Note:

The position of the three circles may vary. In the above example the middle term was represented with the circle at the top, (recommended) however, in the following examples you will find the middle tem at the bottom. You can use either; but you need to be consistent.

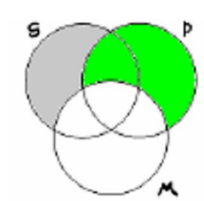
Example 2

Now let us look at an argument of the form **AAA-2**, which has this form:

All P are M.

<u>All S are M.</u>

All S are P.



r
ow, but to prevent confusion, it is a good place to start when it is allowed. We shade out all parts of P that are not part of M (green).

Next we represent the **minor premise** by shading all parts of S which are not M (grey). In this case part of S was already shaded when we represented the major premise.

Now we can see if the conclusion, "All S are P," is represented in the diagram, and we see that it is **not**. There is still a part of S that falls outside of P, so we are not justified in drawing the stated conclusion. The diagram represents categories in which the major premise and the minor premise are true, but the conclusion is false. No valid argument can have true premises and a false conclusion, so the argument format **AAA-2** is **invalid** wherever it is found.

It is important to note that proving that an argument is invalid is not the same thing as proving that the conclusion is false. It proves only that the truth of the premises do not justify the conclusion. Note this example **AAA-2** argument:

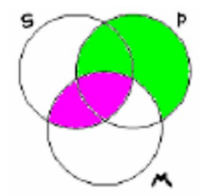
All Priests are Men.

<u>All Saints are Men.</u>

All Saints are Priests.

This argument has a true conclusion, but the conclusion is not proven from the premises given.

Example 3: AEE-2



All P are M.

<u>No S are M.</u>

No S are P.

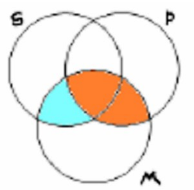
We **start** as we did in the preceding example by shading all of P that is not a part of M (green). Again this represents the proposition that "All P are M."

The **minor premise** states that no part of S is a part of M, so we shade out the part of S that intersects with the circle that represents M.

Now we can see if we can correctly infer the conclusion of the proposition, and it is easy to see that no part of S can be part of P, so the diagram proves that the argument is **valid**, and that the argument form **AEE-2** can be properly used with other arguments.

Example 4

...e
...f
such an argument:



No M are P.

<u>No M are S</u>.

No S are P.

Starting with the **major premise** we shade out all of P that intersects with M (burnt orange).

Next we shade out the part of S that intersects with M to represent the minor premise (light blue).

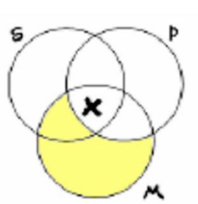
Then we note if the conclusion is represented in the diagram.

The conclusion says that no part of S could be part of P, but that is not represented in the diagram, so the syllogism is **invalid**.

A little extra care is necessary when diagramming categorical syllogisms with particular propositions within them. When doing so, diagram universal propositions before the particular propositions.

Example 5

Let's diagram an **AII-1** proposition first.



All M are P.

<u>Some S are M</u>.

Some S are P.

In this case the major premise is universal, and the minor premise is particular, so we start by diagramming the **major premise** which states that there is no M which is not P. To indicate this on the diagram we shade out all of M which is not P (yellow).

The **minor premise** indicates that there is at least one thing that is both S and M. This is indicated in the diagram by placing an "*x*" in the white space that is shared by S and M.

Don't place the "*x*" in the shaded area, because the other proposition says there is nothing there.

Now we can check to see if the conclusion is justified. The conclusion says that there is at least one thing that is both S and P, and we can see that the diagram confirms that conclusion. The argument is a **valid** argument.

Example 6

Let us see how an invalid argument with particular propositions appears in a diagram.

Consider this **AII-2** argument:

Some S are P.

Again we **start** with the **universal proposition** (we would do this whether or not it was the major premise) which says that there is no P that is not M, so we shade out the part of P that is not M (grey).

The **minor premise** states that there is at least one S that is also an M. To indicate this we need to put an "*x*" in the white area that is shared by S and M, but should it go in the area within P or without P? The propositions do not tell us, so we avoid saying more than the propositions by placing the letter on the line between the two areas.

The **next** thing to do is to check to see if the diagram indicates that the conclusion has been proven true. The conclusion says that there is at least one S that is also a P, but the diagram does not say that! We cannot tell where the "*x*" should go relative to P, so the conclusion does not follow from the premises, and the argument form is **invalid**.

Example 7

This argument is invalid from the Boolean standpoint but valid from the Aristotelian.

No fighter pilots are tank commanders.

All fighter pilots are courageous individuals.

Therefore, some courageous individuals are not tank commanders.

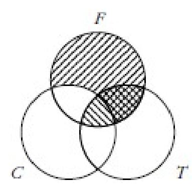
Step 1

We test the syllogism from the Boolean standpoint:

No *F* are *T*.

All *F* are *C*.

Some *C* are not *T*.



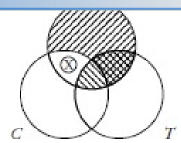
The conclusion asserts that there is an "X" that is inside the *C* circle and outside the *T* circle. Inspection of the diagram reveals no "X"s at all, so the syllogism is invalid from the Boolean standpoint.

Step 2

However, proceeding to step 2, we notice that the *F* circle is all shaded except for one area. Thus, we place a circled "X" in the one remaining area of the *F* circle: (assume F exists)

All *F* are *C*._____

Some *C* are not *T*.



Now the diagram indicates that the argument is valid, so we proceed to **step 3**

We will determine whether the circled "X" represents something that actually exists. This is equivalent to determining whether *F* denotes something that exists. Since *F* stands for fighter pilots, which do exist, the circled "X" does represent something that exists. Thus, the syllogism is **valid** from the Aristotelian standpoint.

Example 2:

All reptiles are scaly animals.

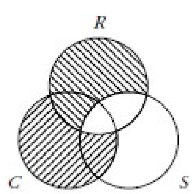
All currently living dinosaurs are reptiles.

Therefore, some currently living dinosaurs are scaly animals.

Step 1

First we test the syllogism from the Boolean standpoint:

All *R* are *S*.
All *C* are *R*.
Some *C* are *S*.

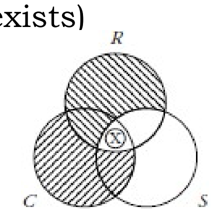


The conclusion asserts that there is an "X" in the area where the *C* and *S* circles overlap. Since the diagram contains no "X"s at all, the argument is **invalid** from the Boolean stand point.

Step 2

Proceeding to step 2, we notice that the *C* circle is all shaded except for one area. Thus, we place a circled "X" in the unshaded area of the *C* circle: (assume C exists)

All *R* are *S*.
All *C* are *R*.
Some *C* are *S*.



The diagram now indicates that the syllogism is valid.

Step 3

Now we proceed to the third step and determine whether the circled "X" stands for something that actually exists. In other words, we determine whether *C* denotes existing things. Returning to the original argument, we see that *C* stands for currently living dinosaurs, which do not exist. Thus, the circled "X" does not stand for something that actually exists, so the syllogism is **invalid**.

in determining whether the circled "X" stands for something that exists, we always look to the Venn circle that is all shaded except for one area. If the term corresponding to that circle denotes existing things, then the circled "X" represents one of those things. In some diagrams, however, there may be two Venn circles that are all shaded except for one area, and each may contain a circled "X" in the unshaded area. In these cases we direct our attention only to the circled "X" needed to draw the conclusion. If that circled "X" stands for something that exists, the argument is valid; if not, it is invalid.

4.4.4 Rules and Fallacies

Today's logicians generally settle on **five rules**, and if any one of these rules is violated, a specific **formal fallacy** is committed and accordingly, the syllogism is **invalid**.

The first two rules are based on the concept of **distribution** and the last three are based on the concept of **quality** and **quantity**.

Rule 1: The middle term must be distributed at least once.

Fallacy: **Undistributed middle**

Example:

All animals are *living things*.
All plants are *living things*.
All plants are animals.

Rule 2: If a term is distributed in the conclusion, then it must be distributed in the premise.

Fallacy:

Illicit major

All professors are *scholars*.
Some lecturers are not professors.
Some professors are not *scholars*.

Illicit minor

All tigers are mammals.
All mammals are *animals*.
All *animals* are tigers.

Rule 3 Two negative premises are not allowed

Fallacy: Exclusive premise

Example:

No B are A.
Some B are **not** C.
Some C are not A.

Rule 4: A negative premise requires a negative conclusion, and a negative conclusion requires a negative premise.

conclusion from a negative premise.

All A are B.

<u>Some C are **not** B.</u>

Some C are A.

Drawing a negative conclusion from affirmative premises.

All A are B.

<u>**All B are C.**</u>

Some A are **not** C.

Rule 5. If both premises are universal, the conclusion cannot be particular.

Fallacy: Existential fallacy

If a categorical syllogism breaks only Rule 5, it is valid from the Aristotelian standpoint but not from the Boolean standpoint. The nine syllogistic forms that fall into this category are those that are included in the "conditionally valid" list in Section 3.4.2. For each of these forms, the list specifies one term that must denote existing things before the syllogism will be valid.

Example:

All A are B. (A exists)

<u>**All** C are A.</u>

Some C are A.

Compare the Two examples

All mammals are animals.

All unicorns are mammals.

Some unicorns are animals.

Invalid (unicorns do not exist)

All mammals are animals.

All tigers are mammals.

Some tigers are animals.

Valid (because tigers exist)

Note

Both of the above syllogisms are invalid from the Boolean perspective. They commit Existential fallacy for their premises are universal and their conclusions are particular. However, based on the existential condition of the terms, the argument may be valid. Thus, in the above syllogisms (AAI-1) the argument is valid when the subject term tiger represents a class of terms which exists, but invalid when it contains the subject term unicorn which does not exist.