RESEARCH ARTICLE

Mechanisms and Aims of Logical Reduction in Aristotle's Logic

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Abstract

Measurement theory is the mainstay of Aristotle's logic Which has been surrounded by many logical studies, From the question about the nature of this measurement to the problem of the fourth figure and what was raised about it, To the problem of the types produced in the forms of pregnancy measurement, and how to reduce it to 19 times instead of 256.The problem of differentiation between the four forms of load measurement was also raised in Aristotelian scaling theory When Aristotle and his followers judged the second, third, and fourth forms with deficiency And judge the first form with perfection And that if we want the imperfect forms of perfection, Restore it to forms in a manner consistent with the nature of the multiplication and the type of form.

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Introduction

Few are the studies that have thoroughly examined the various forms of categorical syllogism in Aristotle's logic, particularly with regard to the figures and their productive moods. It is worth noting that the fourth figure among these has provoked considerable scholarly debate. Some researchers argue that it was not authored by Aristotle himself, while others believe that Aristotle was indeed aware of its existence but chose to exclude it for reasons he did not disclose.

However, for the sake of clarity, this article proceeds from the assumption that the fourth figure does indeed exist and possesses its own valid moods. If we accept this premise, then each figure of the categorical syllogism may be manifested in sixteen forms or moods. Given that there are four categorical syllogistic figures, we can deduce a total of sixty-four moods: $4 \times 16 = 64$. When the known syllogistic rules are applied—those related to quality (affirmative or negative) and distribution (universal or particular)—only nineteen of these moods remain valid.

Aristotle and his followers preferred certain moods over others, judging those of the first figure to be the most complete, while viewing the remaining moods of the other three figures as deficient. Consequently, efforts were directed toward rendering these deficient moods complete by reducing them to moods of the first figure. This prompts a series of fundamental questions: What criteria did Aristotle employ in deeming the moods of the first figure complete and the

others deficient? What are the causes of this deficiency? What is meant by logical reduction? What are its types, methods, and intended purposes?

I. Concepts Reflected in Language and Terminology

We shall proceed in defining the fundamental concepts of this article from the general to the specific, adhering to the epistemological and logical framework that shapes the structure of the discussion.

1. Definition of Logic – Linguistically

The Arabic term *manṭiq* (logic) derives from the root *naṭqa*, which means "to speak." In linguistic usage, *naṭq* refers to articulated speech, whereas in philosophical usage, it refers to the internal faculty of apprehending universals. Logic is so named because it strengthens human capacity for speech—speech being the expression of what is stored in the intellect. It also protects the mind from error in understanding and conceptualization. (Al-Haydari, 1422, p. 13).

The word *logic* (in English and French: *logique*, *logic*) is derived from the Greek term *logos*, which means "speech" and also implies "the essence and spirit of thought." (Al-Jabiri, 2010, p. 17).

Hence, in its linguistic usage, logic is synonymous with speech(Al-Nashshar, 2000, p. 3). Ibn Fāris explains that the root letters *n-ṭ-q* denote two primary meanings: one concerning speech or similar acts, and the other referring to a type of garment. The first gives *manṭiq* (speech), while the second gives *niṭāq* (belt or sash) (Ibn Faris, 1440, p. 440).

2. Definition of Logic – Terminologically

Aristotle did not himself use the term *logic* in the works that later came to bear that name. His writings, known as the *Organon*, were originally titled as part of the analytic sciences. The term *logic* is more likely the creation of later commentators on Aristotle, intended to distinguish his *Organon* from the Stoic dialectic. (Al-Nashshar, 2000, p. 3).

The term appears first in the works of Andronicus of Rhodes, and then in the writings of Cicero, Alexander of Aphrodisias, Galen, and other late Greek authors. (Al-Nashshar, 2000, p. 4).

Among the most notable definitions of logic are the following:

- Aristotle defined logic as the instrument of science, whose true subject is knowledge itself or the form of knowledge (Al-Nashshar, 2000, p. 4; Lalande, 1966, pp. 742–743).
- Al-Fārābī, in his *The Terms Used in Logic*, stated: "Logic is an instrument by which a person strengthens their capacity to know existing things" (Al-Farabi, 1996, pp. 36–37).
- Thomas Aquinas described it as "the art that directs the intellect in its operation, by which a person proceeds methodically and without error" (Tricot, 1992, p. 22).
- The Port-Royal Logic defined it as "the art by which one directs one's reason in learning or teaching the truth" (Tricot, 1992, p. 22).

Arabic philosophers referred to logic by various names. It was sometimes called *'ilm al-manṭiq* (the science of logic), and other times *'ilm al-mīzān* (the science of balance). Al-Fārābī considered it "the chief of the sciences," due to its regulative function in all disciplines (Al-Farabi, 1968, p. 67).

In contrast, Ibn Sīnā regarded it as the "servant of the sciences," meaning that it is not an end in itself, but a means to other sciences. According to the philosophical maxim, that which is pursued as an end is superior to that which is pursued as a means (Ibn Sina, 1964, p. 15).

3. The Concept of Inference(Istidlāl)

Inference is the derivation of a proposition from one or more premises, such that the conclusion necessarily follows due to a logical relationship among them, regardless of the truth or falsity of the premises or the conclusion. (Fadlallah, 1977, p. 117).

Inference is divided into two types: **direct inference** and **indirect inference**, the latter of which includes syllogism (*qiyās*), induction (*istiqrā'*), and analogy (*tamthīl*).

In this article, we will focus exclusively on syllogism (*qiyās*) for reasons pertaining to the core subject under examination. This raises several questions: What is meant by *qiyās*? What are its forms? And what types of *qiyās* yield valid conclusions? These issues will be addressed in more detail later through the discussion of figures (*ashkāl*) and moods (*adhribah*).

Syllogism is a discourse composed of two or more statements, from which another statement necessarily follows by the intrinsic logical structure of the premises. Aristotle defines syllogism as: "A discourse in which, certain things being posited, something other than what is posited necessarily follows because of their being so" (Aristotle, as cited in Yaqubi, 1993, p. 105).

Ibn Rushd concurs, stating: "Syllogism is a discourse in which, when multiple things are posited, something else necessarily follows from them, by virtue of their nature, not by coincidence" (Ibn Rushd, 1977).

Syllogism is divided into hypothetical, disjunctive, and categorical types. The categorical syllogism is further divided into categorical and conditional types. Our discussion will focus only on the categorical syllogism, as it is most pertinent to the theme of this article.

Categorical Syllogism(*al-qiyās al-iqtirānī al-ḥamlī*)

This is a simple form of inference composed of three statements: a major premise, a minor premise, and a conclusion that necessarily follows.

Example:

- Every human is mortal. (Major Premise)
- Every philosopher is a human. (Minor Premise)
- Therefore, every philosopher is mortal. (Conclusion)

The Principles of Syllogism

Like other theoretical systems, syllogism is based on foundational principles necessary for reasoning. Upon close analysis, these principles reduce to two simple logical forms:

1. If two things are equal to a third, they are equal to each other.

2. If one of two things is equal to a third, and the other is different from that third, then they are different from each other. (Yaqubi, 1993, p. 114).

These are known respectively as the principle of a common third and the principle of a separating third. According to Mahmoud Ya'qūbi, they are two forms—affirmative and negative—of a single fundamental principle: the principle of identity .

While these principles govern both concrete and mental entities, abstract and universal reasoning requires additional logical principles to enable valid inference. Without them, logical thought would be rendered inoperative.

Thus, two more principles are introduced:

- (A) What is predicated of an entire subject is predicated of all its members (known as the "universal predicate principle").
- (B) What is denied of an entire subject is denied of all its members (known as the "universal negation principle").

Given the central role of the middle term in syllogism—as the cause of the inference—it must fulfill certain conditions: it must appear in both premises but not in the conclusion; it must be distributed at least once in the premises; and it must be universal. The universality of the middle term is therefore often treated as an independent principle of syllogistic reasoning. (Yaqubi, 1993, p. 123).

4. Definition of the Figure(*al-shakl*)

The **figure** is the form resulting from the placement of the **middle term** (*m*) in both premises of the syllogism, depending on whether it appears as subject or predicate. When we trace this positioning, we find four distinct figures, each arising from the specific arrangement of the middle term in the premises where it appears. (Yaqubi, 1993, p. 123).

5. Definition of the Mood(*al-ḍarb*)

If the figures of syllogism arise from the variation in the placement of the middle term across the two premises, then each of these four figures gives rise to specific **moods**—or formal syllogistic configurations—stemming from variations in **quantity** and **quality** of the premises.

The **mood** is thus the structure or form taken by the syllogism through "the condition of the premises with respect to affirmation and negation, and universality and particularity." In other words, it is the resulting configuration formed by combining the two premises according to their quantity and quality (Ya'qūbī, 1993, p. 123).

II. Aristotle's Classification of Syllogisms

Aristotle classifies syllogisms into complete and incomplete syllogisms. He states:

"A complete syllogism is one that requires no demonstration beyond what is entailed by its premises. An incomplete syllogism is one that, in order to demonstrate what follows from its premises, requires the use of one or more additional propositions—propositions that are themselves necessary consequences of those premises but were not originally employed therein" (Aristotle, 1994, p. 143).

The four moods of the first figure are considered complete because they conform directly to the double supreme principle upon which syllogism rests: the principle of total inclusion (maqālat al-kull) and the principle of exclusion

(maqālat lā wāḥid). This is because the extension of the major term in those moods is broader than that of the middle term, and the middle term's extension is broader than that of the minor term. Thus, the major term always serves as a predicate, the minor as the subject, and the middle term is placed as the subject in the major premise and the predicate in the minor. It thereby assumes a mediating position in both premises and between the two extremes (Aristotle, 1994, p. 163).

Reduction of syllogisms is essentially a reduction to the **complete syllogism**, namely the **first figure**. Aristotle affirms in another passage:

"Syllogisms that are not complete become complete when they are converted to the first figure" .

Moreover, Aristotle grants varying degrees of completeness to the four moods of the first figure. He considers **Celarent** and **Barbara** to be the most perfect among them .

III. Causes of Incompleteness in the Categorical Syllogistic Figures

It is well established that Aristotle considers the productive moods of the second, third, and fourth figures to be **incomplete (deficient)**, as their conclusions are not intuitively evident based on the inclusion of the minor term in the major via the middle term. The foundational principles of syllogism—such as the **principle of predication upon the whole** and the **principle of predication upon none**—do not clearly manifest within these moods .

In the second figure, the extension of the major term is smaller than that of the middle term and greater than that of the minor term. Accordingly, the dual supreme principle does not apply unless through a special condition that some logicians call the "principle of contradiction," which states: *"If a predicate (M) is affirmed of a universal subject (P) and denied of it, then anything (S) for which this predicate cannot be either affirmed or denied is not included under the subject"* (Yaqubi, 1993, p. 137).[21]

In the third figure, it is observed that the extension of the major term is greater than that of the middle term, yet the extension of the minor term is smaller than that of the middle term in this figure. Based on this observation, the previously mentioned principles—namely, the principle of "predication over all" and the principle of "predication over none"—apply only through a special principle known as the "principle of participation," or as Lambert (1728–1777) terms it, the "principle of similarity" (Yaqubi, 1993, p. 138).[22] According to this principle: *"Two terms sharing a common part (M) partially agree with each other. However, if one of them contains a part not shared by the other, they partially differ"* (Tricot, 1992, p. 237).[23]

If we carefully examine the productive moods of the first figure from the perspective of quantity, we find they are four in number: two universal and two particular. From the perspective of quality, there are also four: two affirmative and two negative. Thus, when considered by both quantity and quality, the four moods are: **BARBARA, CELARENT, DARII, and FERIO**.

It is noteworthy, first, that all their conclusions are derived in the most perfect form from the premises. Second, these conclusions encompass all four types of categorical propositions, a feature unique to this figure. It alone can produce universal affirmatives, universal negatives, particular affirmatives, and particular negatives. Moreover, there is no mood in the second, third, or fourth figures that does not have a complete counterpart in the first figure.

IV. The Forms of the Categorical Syllogism

If we designate the major term as (M), the minor term as (m), and the middle term as (t), the four figures of the categorical syllogism can be schematically illustrated as follows:

Figure	First Figure	Second Figure	Third Figure	Fourth Figure
Major Premise	t → M	M → t	t → M	M → t
Minor Premise	m → t	m → t	t → m	t → m
Conclusion	m → M	m → M	m → M	m → M

Since medieval logicians recognized only the first three figures, they summarized them in a mnemonic verse coined by **William Shyreswood**:

Bis prae secunda tertia bis sub, sub-prae prima. (Tricot, 1992, p. 237) which **Mahmoud Yaqubi** translated as: *"Subject-predicate in the first, predicate twice in the second, subject twice in the third"* (Tricot, 1992, p. 237).

Later, when the **fourth figure** was formally recognized, the **scholastics** formulated a Latin verse to represent all four figures:

tum prae-prae, tum sub-sub, denique prae-sub, sub-prae which translates as: *"Subject-predicate, then predicate-predicate, then subject-subject, and finally predicate-subject"* (Tricot, 1992, p. 238).

V. Moods of the Categorical Syllogism

Considering that each syllogistic figure may assume sixteen different moods or forms, and given that there are four categorical figures, we can deduce a total of 4 × 16 = **64 possible moods**. Of these, only **nineteen** are logically valid and productive. We use the following symbolic notations for the types of propositions:

- (A) universal affirmative
- (E) universal negative
- (I) particular affirmative
- (O) particular negative

Productive moods of the first figure: 4 moods

1. **BARBARA**: major premise is universal affirmative, minor is universal affirmative.
2. **CELARENT**: major is universal negative, minor is universal affirmative.
3. **DARII**: major is universal affirmative, minor is particular affirmative; conclusion is particular affirmative.
4. **FERIO**: major is universal negative, minor is particular affirmative.

Productive moods of the second figure: 4 moods

1. **CESARE**: both premises are universal negative.
2. **CAMESTRES**: major is universal affirmative, minor is universal negative.
3. **FESTINO**: major is universal negative, minor is particular affirmative.
4. **BAROCO**: major is universal affirmative, minor is particular negative.

Productive moods of the third figure: 6 moods

1. **DARAPTI**: both premises are universal affirmative.
2. **FELAPTON**: major is universal negative, minor is universal affirmative.
3. **DATISI**: major is universal affirmative, minor is particular affirmative.
4. **DISAMIS**: major is particular affirmative, minor is universal affirmative.
5. **BOCARDO**: major is particular negative, minor is universal affirmative.
6. **FERISON**: major is universal negative, minor is particular affirmative.

Productive moods of the fourth figure: *5* moods

1. **BRAMANTIP**: both premises are universal affirmative.
2. **CAMENES**: major is universal affirmative, minor is universal negative.
3. **DIMARIS**: major is particular affirmative, minor is universal affirmative.
4. **FESAPO**: major is universal negative, minor is universal affirmative.
5. **FRESISON**: major is universal negative, minor is particular affirmative.

VI. Reduction of Incomplete Syllogistic Figures

Reduction is defined as:

"The process of expressing all moods of the second, third, and fourth figures in terms of moods of the first figure, thereby demonstrating the validity of their conclusions through the framework of the first figure."

The reason for this lies in Aristotle's conviction that only the first figure is complete, as it alone directly embodies the principles of inclusion (universal predication) and exclusion (universal negation)—the foundation of syllogistic reasoning. As such, it produces necessary conclusions that require no further demonstration. By contrast, the other figures, though valid, do not offer this same level of certainty and must be reduced to the first figure in order to confirm the validity of their conclusions (Fadlallah, 1977, p. 183; Abu Rayan & 'Abd al-Mu'ti, 1975, pp. 294–295; Mehran, 1994, pp. 249–257).

As we have seen, each productive mood across the four figures was assigned a Latin name, composed with precision to facilitate memorization and, more importantly, to assist with operations of logical reduction applied to incomplete moods.

- The first three vowels in the Latin name indicate the quantity and quality of the premises, using the symbolic letters A, E, I, and O.
- The first consonant (e.g., F, D, C, B) in the name of a mood from the second, third, or fourth figure refers to the corresponding mood in the first figure to which it is to be reduced (e.g., D to DARII; B to BARBARA).
- The other consonants in the name indicate the specific logical operation needed for reduction. Each applies to the proposition marked by the vowel that immediately precedes it.

These operations are as follows:

- **S** indicates **simple conversion**: e.g., in **CESARE**, the universal negative (E) must be converted into another universal negative.
- **P** refers to **conversion by limitation** (accidental): e.g., in **DARAPTI**, the universal affirmative (A) in the minor premise must be converted into a particular affirmative (I).
- **M** refers to **interchanging the premises** (major ↔ minor).
- **C** signifies **reduction by absurdity (reduction ad impossibile)**, as in the cases of **BAROCO** and **BOCARDO**.

These rules were summarized in two mnemonic Latin lines:

S vult simpliciter verti, p. verso acid; M vult mutari, c per impossible duci.

Translated as:
"S requires simple conversion, p conversion by limitation, m demands premise-switching, and c requires reduction by the impossible" (Tricot, 1992, p. 238).[28]

A table illustrating the reduction of incomplete moods using their Latin names:

Reduced to First Figure	From Other Figures
FERIO → D	FESTINO → CESARE
DARII → C	CAMESTRES → BAROCO
CELARENT → B	FELAPTON, FERISON, DARAPTI
BARBARA → –	DISAMIS, DATISI, BOCARDO
–	FESAPO, FRESISON, DIMARIS, CAMENES, BRAMANTIP

Types of Reduction

There are two types:

a) Direct Reduction:
A process by which the mind converts the incomplete mood into a complete one of the first figure—by applying operations such as simple conversion, conversion by limitation, and interchanging premises—to all moods where these apply. The only exceptions are BAROCO (second figure) and BOCARDO (third figure).

b) Indirect Reduction:
This method, described by Mahmoud Ya'qūbī as *reduction to the impossible*, involves assuming the negation of the original conclusion. By combining this negated conclusion with one of the accepted premises, a new syllogism is formed whose conclusion contradicts the other accepted premise. This contradiction forces the mind to accept the original conclusion to avoid inconsistency. Notably, this method is applicable to all incomplete moods without exception (Yaqubi, 1993, p. 139).

1. Direct Reduction of the Moods of the Second Figure

The process of direct reduction involves applying certain modifications through conversion, transposition of the premises, or a combination of both. This enables the incomplete moods in the second, third, and fourth figures to take the form of moods from the first figure, thus demonstrating that their conclusions are valid by reducing them to the complete first figure.

If we apply these steps to the incomplete moods across the three figures, the reduction to moods of the first figure would proceed as follows:

a) Reduction of the First Mood in the Second Figure: CESARE → CELARENT

Original Mood After Conversion

¬M – P ¬P – M

S – M S – M

∴ ¬S – P ∴ ¬S – P

To reduce this to the first figure and prove the validity of its conclusion, we apply simple conversion to the major premise. We now have a syllogism in which the middle term (M) is the subject of the major premise and the predicate of the minor. Notably, the conclusion remains unchanged from the original CESARE mood, confirming its validity through the first figure.

Example:

- No Muslim is a Christian (CES) → No Christian is a Muslim (CE)
- Every Frenchman is a Christian (A) → Every Frenchman is a Christian (LA)
- ∴ No Frenchman is a Muslim (RE) → No Frenchman is a Muslim (RENT)

b) Reduction of the Second Mood in the Second Figure: CAMESTRES → CELARENT

Original Mood After Transformation

P – M (major, A) M – P (converted major, W – B)

¬S – M (minor, E) ¬S – M (unchanged)

∴ ¬S – P

It is clear that no valid conclusion can be drawn from a particular major and a negative minor premise. Hence, we perform a transposition of the premises and then convert the minor premise and the conclusion. This leads to:

After Transposition and Conversion

¬S – M → ¬S – M

M – P

∴ ¬S – P (with converted conclusion)

Thus, we obtain a syllogism in the form of the first figure with the middle term in its appropriate position. Even though the conclusion has inverted subject and predicate, we convert it again to match the original. This confirms the validity of the mood by reducing it to the first figure.

Example:

- Every diligent person is successful (CAM)
- No successful person is lazy (CE)
- ∴ No lazy person is diligent (TRES) → No successful person is lazy (RENT)

c) Reduction of the Third Mood in the Second Figure: FESTINO → FERIO

Original Mood After Conversion

Original Mood	After Conversion
¬P – M	¬M – P (converted)
S – M	S – M
∴ ¬S – P	∴ ¬S – P

Example:

- No Muslim is a Jew (FES) → No Jew is a Muslim (FE)
- Some people are Jews (TI) → Some people are Jews (RI)
- ∴ Some people are not Muslims (NO) → Some people are not Jews (O)

d) Reduction of the Fourth Mood in the Second Figure: BAROCO → BARBARA (Indirect Reduction)

This mood **cannot be reduced directly**, and therefore it is reduced **indirectly** to the first mood of the first figure (*Barbara*), as shown below:

Original Mood	Indirectly Reduced Form
All doctors are wise (BA)	All doctors are wise (BAR)
Some people are not wise (ROC)	All people are doctors (BA)
∴ Some people are not doctors (O)	All people are wise (RA)

2. Direct Reduction of the Moods of the Third Figure

The third figure is characterized by the middle term being the **subject** in both premises. When compared with the first figure, the only difference lies in the **minor premise**. Therefore, by **converting the minor premise simply**, the syllogism assumes the form of the first figure.

a) Reduction of the First Mood in the Third Figure: DARAPTI → DARII

If we take the first mood of the third figure:

Original Form	After Reduction (DARII)
M – P (major premise)	M – P
M – S (minor premise)	S – M (converted)
∴ S – P (conclusion)	∴ S – P

The conclusion remains the same, thereby confirming its validity by reduction to the first figure.

Applied Example:

- Every mathematician is logical (DA)
- Every mathematician is creative (RAP)
- ∴ Some creatives are logical (TI) → Some creatives are logical (I)

b) Reduction of the Second Mood: FELAPTON → FERIO

Original Form After Reduction

M – ¬P M – ¬P

M – S S – M (partially converted)

∴ ¬S – P ∴ ¬S – P

Applied Example:

- No atheist is a believer (FE)
- Every atheist is a disbeliever (LAP) → Some disbelievers are atheists (RI)
- ∴ Some disbelievers are not believers (TON) → Same conclusion (O)

c) Reduction of the Third Mood: DATISI → DARII

Original Form After Reduction

M – P M – P

M – S S – M (converted)

∴ S – P ∴ S – P

Applied Example:

- Every diligent person is successful (DA)
- Some diligent people are intelligent (TIS) → Some intelligent people are diligent (RI)
- ∴ Some intelligent people are successful (I) → Same conclusion (I)

d) Reduction of the Fourth Mood: DISAMIS → DARII

Original Form	After Transformation
M – S (original minor)	M – P (after switch)
M – P (original major)	S – M (converted)
∴ S – P	∴ S – P

If we directly convert the original minor premise "Every M is S," it becomes "Some M are S," resulting in two particular premises—which cannot yield a conclusion. So instead, we **convert the major premise** "Some M are P" to "Some P are M," then **switch the premises**, yielding a mood in the first figure. The conclusion will be inverted and must be **converted again** to match the original conclusion.

Applied Example:

- Some writers are poets (DIS)
- Every writer is creative (DA)
  → Every writer is creative (AM)
  → Some creatives are writers (RI)
  ∴ Some creatives are poets (IS) → ∴ Some poets are creative

e) Reduction of the Fifth Mood: FERISON → FERIO

Original Form After Reduction

M – ¬P	M – ¬P
M – S	S – M (converted)
∴ ¬S – P	∴ ¬S – P

Applied Example:

- No hypocrite is honest (FE)
- Some hypocrites are frauds (RIS) → Some frauds are hypocrites (RI)
- ∴ Some frauds are not honest (ON) → Same conclusion (O)

f) Reduction of the Sixth Mood: BOCARDO → BARBARA (Indirect Reduction)

This mood **cannot be reduced directly**, but only **indirectly** through the first figure. Here's an illustrative example:

Original Mood (BOCARDO):

- Some students are not diligent (BOC)
- All students are absent (AR)
- ∴ Some absentees are not diligent (DO)

Indirect Reduction (BARBARA):

- All absentees are diligent (BAR)
- All students are absentees (BA)
- ∴ All students are diligent (RA)

3. Direct Reduction of the Moods in the Fourth Figure

This is carried out using one of two methods:

- **First**: By applying *simple conversion* to **both premises**.
- **Second**: By *transposing the premises* without converting either, while applying *simple conversion to the conclusion*.

Upon careful examination of the moods in this figure, it becomes evident that some moods are reducible by the first method, and others by the second.

a) Reduction of the First Mood in the Fourth Figure: BAMALIP → BARBARA

To reduce this incomplete mood to a complete one from the first figure, it is necessary to **transpose the major and minor premises** without converting either, and then apply **simple conversion to the conclusion**.

Example:

- Every human is a living being (BA) → transpose → Every living being is mortal (BAR)

- Every living being is mortal (MA) → Every human is a living being (BA)
- ∴ Some mortals are humans (LIP) → conclusion converted → ∴ Every human is mortal (RA)

b) Reduction of the Second Mood: CAMENES → CELARENT

The same process applies as with the first mood.

Example:

- Every living being is mortal (CAM) → transpose → No mortal is eternal (CE)
- No mortal is eternal (EN) → Every living being is mortal (LA)
- ∴ No eternal being is living (ES) → converted conclusion → ∴ No living being is eternal (RENT)

c) Reduction of the Third Mood: DIMARIS → DARII

The same steps used for the first and second moods apply here.

Example:

- Some animals are birds (DI) → transpose → All birds have wings (DA)
- All birds have wings (MA) → Some animals are birds (RI)
- ∴ Some winged creatures are animals (RIS) → converted conclusion → ∴ Some animals are winged (I)

d) Reduction of the Fourth Mood: FESAPO → FERIO

To reduce this mood, the **major premise** is converted *simply and completely*, and the **minor premise** is converted *simply but partially*, while the conclusion remains unchanged.

Example:

- No bird is a fish (FE) → complete simple conversion → No fish is a bird (FE)
- All fish are amphibians (SAP) → partial simple conversion → Some amphibians are fish (RI)
- ∴ Some amphibians are not birds (O) → unchanged conclusion

e) Reduction of the Fifth Mood: FRESISON → FERIO

Here, **both the major and minor premises** are converted using complete simple conversion, while the conclusion remains unchanged.

Example:

- No Christian is a Muslim (FRES) → complete simple conversion → No Muslim is a Christian (FE)
- Some Muslims are scholars (IS) → complete simple conversion → Some scholars are Muslims (RI)
- ∴ Some scholars are not Christians (ON) → unchanged conclusion

Indirect Reduction

What are the incomplete moods across all four figures that can only be reduced indirectly?

Indirect reduction is carried out through what is known as **reductio ad absurdum** (*proof by contradiction*), which is based on refuting the negation of the conclusion to affirm its validity.

If we wish to affirm the truth of a conclusion in a given syllogism, we take its **contradictory**, assume it to be **true**, and then construct a syllogism combining this assumption with one of the original premises (assumed to be true). The resulting conclusion will contradict the other original premise (also assumed to be true). This contradiction proves that the negation of the original conclusion is false, and thus the conclusion itself must be **true**.

In what follows, we will limit ourselves to applying **indirect reduction** to the same previous examples used in each figure, illustrating the method accordingly.

1. Indirect Reduction of the Moods in the Second Figure

a) CESARE → DARII

- Major Premise (unchanged): No Muslim is a Christian.
- Negation of the conclusion: Some French people are Muslims.
- Minor Premise (assumed): All French people are Christians.
- Result: Some French people are not Christians (contradiction of the minor premise).

b) CAMESTRES → DARII

- Major Premise (unchanged): Every diligent person is successful.
- Negation of the conclusion: Some lazy people are diligent.
- Minor Premise (assumed): No lazy person is successful.
- Result: Some lazy people are successful (contradiction of the minor premise).

c) FESTINO → CELARENT

- Major Premise (unchanged): No Muslim is a Jew.
- Negation of the conclusion: All people are Muslims.
- Minor Premise (assumed): Some people are Jews.
- Result: Some people are not Muslims (contradiction of the minor premise).

d) BAROCO → BARBARA

- Major Premise (unchanged): Every doctor is wise.
- Negation of the conclusion: All people are doctors.
- Minor Premise (assumed): Some people are not wise.
- Result: Some people are not doctors (contradiction of the minor premise).

2. Indirect Reduction of the Moods in the Third Figure

a) DARAPTI → CELARENT

- Negation of the conclusion: No creative person is logical.
- Minor Premise (unchanged): Every mathematician is creative.
- Major Premise (assumed): Every mathematician is logical.
- Result: Some creatives are logical → contradiction of the major premise.

b) FELAPTON → BARBARA

- Negation of the conclusion: All disbelievers are believers.
- Minor Premise (unchanged): Every atheist is a disbeliever.
- Major Premise (assumed): No atheist is a believer.
- Result: Some disbelievers are not believers → contradiction of the major premise.

c) DATISI → FERIO

- Negation of the conclusion: No intelligent person is successful.
- Minor Premise (unchanged): Some diligent people are intelligent.
- Major Premise (assumed): Every diligent person is successful.
- Result: Some intelligent people are successful → contradiction of the major premise.

d) DISAMIS → CELARENT

- Negation of the conclusion: No creative person is a poet.
- Minor Premise (unchanged): Every writer is creative.
- Major Premise (assumed): Some writers are poets.
- Result: Some creatives are poets → contradiction of the major premise.

e) FERISON → DARII

- Negation of the conclusion: All fraudsters are honest.
- Minor Premise (unchanged): Some hypocrites are fraudsters.
- Major Premise (assumed): No hypocrite is honest.
- Result: Some fraudsters are not honest → contradiction of the major premise.

f) BOCARDO → BARBARA

- Negation of the conclusion: All absent people are diligent.
- Minor Premise (unchanged): All students are absent.
- Major Premise (assumed): Some students are not diligent.
- Result: Some absent people are not diligent → contradiction of the major premise.

3. Indirect Reduction of the Moods in the Fourth Figure

a) BRAMANTIP → CELARENT

- Negation of the conclusion: No mortal is a human.
- Minor Premise (unchanged): Every living being is mortal.

- Major Premise (assumed): Every human is a living being.
- Result: Some mortals are humans → contradiction of the major premise.

b) CAMENES → DARII

- Negation of the conclusion: Some mortals are immortal.
- Minor Premise (unchanged): No immortal being is mortal.
- Major Premise (assumed): Every living being is mortal.
- Result: Some immortals are living beings → contradiction of the major premise.

c) DIMARIS → CELARENT

- Negation of the conclusion: No winged creature is an animal.
- Minor Premise (unchanged): All birds have wings.
- Major Premise (assumed): Some animals are birds.
- Result: Some winged creatures are animals → contradiction of the major premise.

d) FESAPO → BARBARA

- Negation of the conclusion: All amphibians are birds.
- Minor Premise (unchanged): All fish are amphibians.
- Major Premise (assumed): No bird is a fish.
- Result: Some amphibians are not birds → contradiction of the major premise.

e) FRESISON → DARII

- Negation of the conclusion: All scientists are Christians.
- Minor Premise (unchanged): Some Muslims are scientists.
- Major Premise (assumed): No Christian is a Muslim.

Result: Some scientists are not Christians → contradiction of the major premise

The Aims of Logical Reduction

From everything that has been previously presented, it appears that the reduction of incomplete moods in the second, third, and fourth figures—regardless of whether the method employed is direct or indirect—ultimately serves a clear purpose articulated by Aristotle: to remedy the deficiency inherent in these figures by reducing them to the first figure, which alone is considered complete. This is because the foundational principles of syllogistic reasoning—the universal affirmative (All) and the universal negative (None)—apply directly and inherently to the first figure. Moreover, this figure is seen as the only correct and complete one, whose conclusions are absolutely certain and require no further proof or demonstration.

Conclusion

After having examined the various procedures of reducing the incomplete moods of the imperfect figures to complete moods of the first figure—whether through direct or indirect methods—it becomes evident that the syllogistic figures differ in their structure and epistemological value.

Aristotle, along with his followers, regarded the **first figure** as the **only complete and perfect form**, precisely because the two foundational principles of syllogistic reasoning—**the principle of total inclusion** (*maqālat al-kull*) and **the principle of total negation** (*maqālat lā wāḥid*)—apply directly and unambiguously to it. As such, the first figure alone produces **entirely necessary conclusions** that require no further proof or justification.

In contrast, the other figures and their respective moods, while they do produce valid conclusions, do not possess the same level of **epistemic certainty**, and hence must be **reduced to the first figure** to confirm their soundness.

Moreover, Aristotle distinguished even among the four productive moods of the first figure, assigning **varying degrees of perfection** to them. In his view, **Celarent** and **Barbara** were the most complete and paradigmatic of all moods.

Despite the theoretical superiority of the first figure, **the second and third figures** are more commonly employed in practice. The **second figure**, which yields **negative conclusions**, is often used to **refute an opponent's argument**. Meanwhile, the **third figure**, which produces **particular conclusions**, proves useful when seeking to undermine a universal claim made by an opponent.

As for the **fourth figure**, it is generally seen as artificial and is seldom employed except by affectation or out of formal necessity.

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