A new method for the graphical verification of all 256 syllogistic moods

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Abstract: This paper introduces a fast and efficient graphical method (arrows with symbols and distribution signs) to verify all 256 syllogistic moods, including conditional ones. By emphasizing the role of distribution signs, the method achieves high accuracy and offers an intuitive approach, making it accessible to a large audience interested in logical analysis.

Keywords: logic, syllogism, inference, deductive, reasoning

Introduction

The method is language-independent and operates without inherent limitations within its intended scope. Its applicability to other complex syllogistic structures is a subject of ongoing research. The algorithm focuses on determining the validity of arguments, not the truth value of the premises or conclusion, and it does not analyze moral implications or ambiguity within propositions. This responsibility remains with the user, who must evaluate the truth of each proposition based on their knowledge and understanding. This method leverages the laws of syllogism, term distribution, and the four syllogistic figures. It surpasses the limitations of Aristotelian analytic moods, offering broader applicability. In the educational field, the algorithm leads to teachable models (mechanical, analogical, or digital devices) based on its steps, making it easier for students to visualize and understand syllogisms. The algorithm lends itself to software implementation by assigning variables to graphical symbols and establishing relationships based on syllogistic laws. In the future, this software could support organizational environments that perform argument analysis, including legal settings, and have the potential for broader applications within artificial intelligence platforms.

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Clarifications Regarding Distribution Signs
Distribution signs serve as logical functions within the syllogistic mechanism, acting as filters in decision-making processes, revealing meanings, determining the scope of statements, and limiting how much the predicate (and about what type of subject) can say.

The general rule of signs mandates that subject distribute in universals and predicate in negatives.

A distributed term is involved in that relation to its entire extension. Distribution signs ensure the validity of a syllogism by directing the judgment process toward the only possible and necessary conclusion.

In this method, particularly concerning conditional moods, the non-zero term (which represents the supplementary conditional premise, always present) does not imply the complete set of elements denoted by a term because of its undistributed nature. This weaker term bears a (–) distribution sign, as imposed by the significance of the condition line. The "/" line is the minimal symbolic element that reduces the number of elements in the set of the conditional term down to at least one, which is why, when it is present, his (+) sign becomes (–).

Description of the Algorithm's Graphical Representation (Figure 1)
The algorithm employs a set of signs and symbols to accomplish its designated function. A rightward arrow represents the universal affirmative proposition **A**, while a rightward arrow with a small circle in the middle signifies the universal negative proposition **E**. Similarly, a rightward arrow with a small oblique line in the middle corresponds to the particular affirmative proposition **I**, and a rightward arrow with a small circle overlapped over a small oblique line in the middle represents the particular negative proposition **O**. An oblique line "/" show the condition, a (+) sign denotes a distributed term, and a (–) sign denotes an undistributed term.

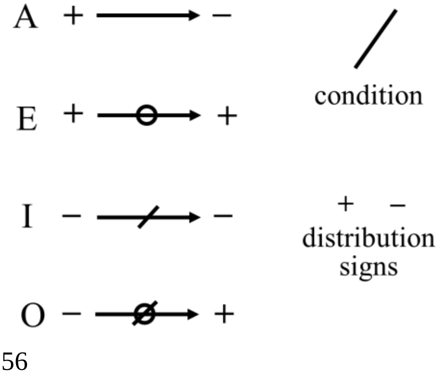

Figure 1. *The specific symbols used in the algorithm*

The algorithm

1. Start with the first premise arrow, related to the syllogistic figures accordingly oriented. Then, graphically represent the minor premise. Add the corresponding distributions (**+** or –). The middle term must overlap.
2. If two identical symbols appear contained in the premise arrows, report the mood as invalid and stop the algorithm.
3. The middle term must have at least one (**+**) distribution sign. Else, stop the algorithm.
4. Overlap the arrows. Then, examine the distribution signs of the resulting conclusion to determine its validity.

Ad extra for conditional moods

5. For conditional moods, the conclusion **I** will appear from premises containing two terms with a (–) distribution sign. Before adding the "/" symbol line, the remaining term *outside* the terms with a (–) sign is always the one different from 0. An exception is the **AAA** III mood, where the condition **M** is *between* the **S** and **P** terms (undistributed). For conditional moods with the conclusion **O**, before adding the "/" symbol line, the condition is the term that does not have a (–) sign between **S** and **M**; it follows those moods that have two universals, one of which **E**, do not receive a condition if the **P** term is undistributed. The condition symbol, over one premise, has the intended effect of changing or maintaining (in conclusion) the (–) sign next to the conditional term (because it is undistributed). On the **M** term, it would not make sense. All the nine conditional moods (with the particular conclusion from universal premises) are valid if the distribution signs of the terms in the conclusion are correct. (Buzduga 2015)

Demonstration

This brief demonstration will illustrate how the algorithm handles various premise configurations following the laws of syllogism.

a) *Two affirmative premises cannot result in a negative conclusion*.

The absence of a circle symbol in the graphical representations of the affirmative premises does not allow for negative conclusions. Overlapping of two arrows **A** premises will be **A** conclusion, or **I** on conditional mood. The potential arrows superposition of **A** and **I** premises will always be **I**.

b) *Two negative premises cannot have a conclusion*.

When the algorithm encounters a configuration with two lines or circles, it halts the verification process and declares the syllogism invalid.

c) *Two particular premises do not allow for a conclusion*.

The line divides the arrow (and implicitly the extension-signified set) into two parts. In the algorithm, the circle symbol signifies the absence. If those symbols repeat, the exclusionary relationship between the middle term and the extremes will make the premises meaningless. The two lines of **I** or **O** premises arrows will stop the algorithm.

d) *The conclusion inherits the properties of the weaker element*.

The premise that is not positive generates a negative conclusion. If a premise is particular, the conclusion cannot be universal. The algorithm adheres to the laws of syllogism by using the circle and the line symbols. If these symbols appear at most once, their overlap in the conclusion forces it to contain them, meaning they must be negative and particular.

Examples

1. A first example regarding the occurrences of the conclusion from the premises, both in unconditional and conditional states, mood **AA** I (Figure 2). According to Aristotle, this mood is perfect.

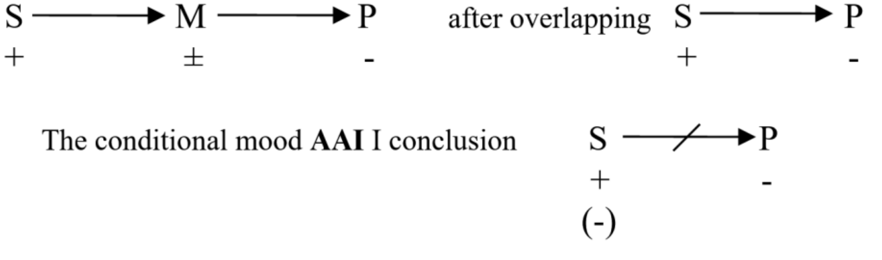

Figure 2. *Syllogistic moods with **AA** I premise*

Graphically represent the two **A** arrows with their corresponding distribution signs, (+) then (–). Since the middle term **M** has one (+) distribution sign, overlap the arrows. Then, copy the signs of **S** and **P** in the conclusion. The distribution signs in the conclusion are correct, so this mood is valid. Both premises contain universal propositions. The first step toward the conditional mood is to identify the non-zero term, which for the conclusion is (before adding the "/" symbol line) the term without a (–) distribution sign (in this case, **S**). The algorithm requires adding a "/" symbol line with the role of a minimal element to the condition, which makes it possible for the conditional term to be non-zero. After superposition, the conclusion **I** have resulted. Another rule specifies that the sign of the conditional term changes to (–) or maintains if it is already undistributed. Checking the distribution signs will reveal the validity of the conclusion **I**. Therefore, the syllogism mood **AAI** I is valid.

2. Here is an example of how to apply the algorithm when the conclusion is present, in **OAO** III (Figure 3).

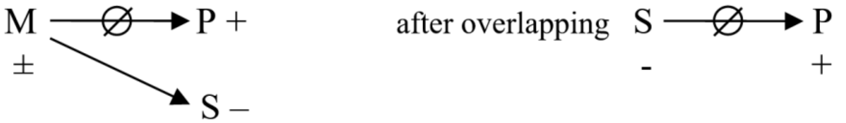

Figure 3. *The valid mood **OAO** III*

It is possible to overlap the arrows because of the middle-term **M** distribution. In the resulting conclusion, the distribution signs of the terms are correct for **O**, so this mood is valid.

3. In this example, **AAI** II (Figure 4), the algorithm stops because the middle term **M** is undistributed.

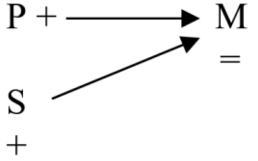

Figure 4. *The invalid mood **AAI** II*

This syllogistic mood is invalid because the extremes in the premises do not have (–) signs from the start, and **M** has two (–) signs, meaning it is undistributed. The next step with the "/" symbol makes no sense.

Anticipating possible syllogistic structures from one known premise or conclusion

The algorithm permits verification of all 256 syllogistic forms with an experimental situation with one syllogistic proposition: the premise or the conclusion. For each syllogistic figure, valid moods will appear by examining the constraints imposed by the distribution of the terms.

Conclusion

This paper has introduced a novel approach to syllogistic analysis. Future research directions could involve applications in educational settings and other domains that rely on logical analysis.

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