

Building a Logical Relation from a Conclusion
— Part I: *The hint from categorical syllogism and beyond*

結論による論理関係の構築
— 第1部：定言的三段論法からのヒント、そしてその先へ

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Abstract

In a previous paper (Lai 2014), I have introduced a research writing pedagogy called the Logical Writing Process Cycle (LWPC). Under LWPC, the basis of writing a research paper is the development of the paper's thesis statement – or research conclusion in some sense, by providing a convincing support for the statement. In order for LWPC to be satisfactory, there must be, among other things, clear and step-by-step instructions on how to build a convincing support for the thesis statement. The purpose of this paper is to provide the first of a three-part instruction series on how to do it. The paper will begin by introducing the core of the convincing support, which is a logical relation between the thesis statement and its premises. The hint of building a logical relation based on a conclusion can be found in the basic concepts of categorical syllogism (section 2). And a recipe on how to logically construct a categorical syllogism from a conclusion is formulated (section 3). However, the logical construction of categorical syllogism is rather arbitrary and limited in application (section 4). In order to learn a more natural and powerful way of building a convincing support for a thesis statement, the primary step is to learn how to identify and build a premise that bears a direct inferential relation to the thesis statement (section 5).

先行研究において、著者はロジカル・ライティング・プロセス・サイクル（LWPC）と呼ばれるライティング教授法を紹介した。LWPCにおいて、研究論文の基礎は論文のテーシス・ステートメント（thesis statement）、すなわち、ある意味では研究の結論を構築することであり、同ステートメントに対する説得力のある裏付けを供与することである。LWPCが満足のゆくものとなるには、とりわけ、どのようにすればテーシス・ステートメントについて説得力ある裏付けを構築できるのかについて明確で段階的な指針が不可欠となる。本論の目的はその方法に関する3部構成の指針シリーズの第1部を供与することである。まず、説得力のある裏付けの核心部分を導入する。それはテーシス・ステートメントと前提との間の論理的な関係に

ある。結論に基づく論理的関係を構築するうえでのヒントは、定言的三段論法の基本的概念の中に見出すことができる（第2節）。さらに、結論から論理的に定言的三段論法を構築するための方法を系統的に説明する（第3節）。しかしながら、定言的三段論法を構築する作業はある程度恣意的であり、適用可能な範囲は限られている（第4節）。テーシス・ステートメントについて説得力ある裏付けを構築するための、より自然で肯定的な方法を習得するうえで最も重要なステップはテーシス・ステートメントと直接的な推論関係を担う前提をどのようにして識別して構築していくかを理解することなのである（第5節）。

Keywords

research writing (リサーチ・ライティング), logical relation (論理的関係), categorical syllogism (定言的三段論法), thesis statement (テーシス・ステートメント), logical writing process cycle (ロジカル・ライティング・プロセス・サイクル)

1. Logical Relation and Its Role in Research Writing

1.1. Logical relation

Two statements are said to be in a logical relation if the truth or falsity of one statement has an inferential effect on the other. For example, consider the two statements in Eg-1:

<p>(Eg-1) Statement-1: Peter is in Nagoya. Statement-2: Peter is in Japan.</p>
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In Eg-1, Statement-1 is logically related to Statement-2 because if Statement-1 is *true*, then Statement-2 is also *true* by inference (this is fundamentally because, as a matter of fact, Nagoya is one part of Japan). In other words, the truth of Statement-1 bears an inferential relation to the truth of Statement-2. A logical relation is an inferential relation.

Now we are looking at the logical relation example through the perspective of an inferential relation connecting the truth of one statement with the truth of another. But we can also look at the same logical relation from a different perspective; that is, if Statement-2 is *false*, then Statement-1 is also *false* by inference. This is the perspective from an inferential relation that connects the falsity of one statement with the falsity of another. Accordingly, a logical relation can be understood not only from the perspective of an inferential relation between the truths but also from the perspective of an inferential relation between the falsities.

1.2. The research writing pedagogy

In the paper, “Logical Thinking Skills in Academic Writing: An introduction to a research-writing course at Nagoya University” (Lai 2014), I have introduced a research writing pedagogy called the Logical Writing Process Cycle, or LWPC. As the name suggests, LWPC focuses on the logical thinking education in academic writing, which is specifically employed to help students develop a clear and convincing research idea in the writing process. In order for LWPC to be satisfactory, it is important to demonstrate how exactly logical thinking skills can be applied to research writing.

In research writing, the place where logical thinking skills are mostly needed is the development of the paper's thesis statement. Under LWPC, the entire process of writing a research paper focuses on the development of the paper's thesis statement. And such a development is a process of logical argumentation.

The first and foremost task in the development is the creation of a preliminary thesis statement that is clear enough to establish the direction for the writing process. Having had the thesis statement in place, the rest of the development process is to polish up the statement until it is equipped with a convincing support.

Building a convincing support for the thesis statement is building a logical relation that connects the statement with its supporting premises. Since logical relation is an inferential relation between the truths (as well as the falsities), it forms the base of a convincing thesis statement in research writing. Recall that a convincing thesis statement is capable of causing someone to believe that the statement is true (Lai 2014, p. 5). Accordingly, making the thesis statement convincing is establishing the proof that the thesis statement is true by reference to its supporting premises; i.e. by demonstrating that the premises are true.

In the development process, the thesis statement takes the shape of a hypothesis in the early stage, but in the final stage, after collecting and finalizing all the supporting evidences, it will be transformed into the research conclusion of the paper.

Since the thesis statement is the research conclusion, and since LWPC starts with the thesis statement, the key to building the convincing support, as well as the key to making LWPC a satisfactory pedagogy, lies in understanding how to build a logical relation from a conclusion to its premises.

2. A Hint from Categorical Syllogism

To begin with, there is a hint from categorical syllogism that we can build a logical argument from a conclusion.

Categorical syllogism is a classical logical argument invented by Aristotle. Like every other kind of logical argument, the base of a categorical syllogism is an inferential relation that connects the argument's premises to its conclusion. What is special about categorical syllogism is that it contains only three statements, and the inferential relation that connects the premises and conclusion is deductive. Consider the argument in Eg-2.

(Eg-2)

Statement-3: All human beings are mortal.

Statement-4: Peter is a member of human beings.

Statement-5: Peter is mortal.

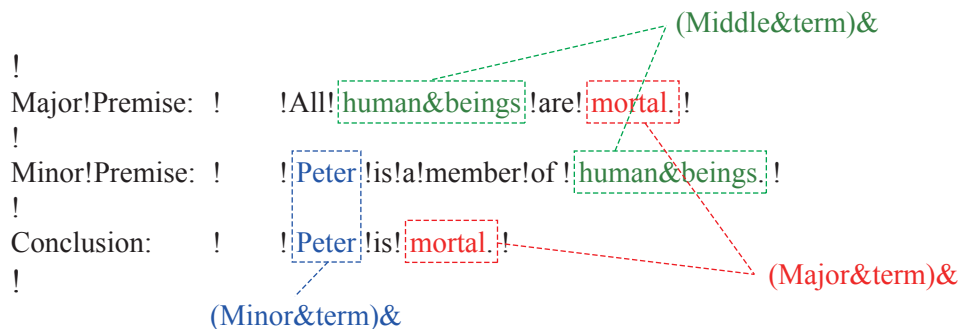
Eg-2 presents a typical categorical syllogism. The argument contains three statements: Statement-3 and Statement-4 are the argument's premises, whereas Statement-5 is the argument's conclusion.

The two premises have their own names in a categorical syllogism. Statement-3 is called *the major premise*, and Statement-4 *the minor premise*. The reason for the naming is straightforward: The major premise comprises a logic term called *the major term*, and the minor premise comprises a logic term called *the minor term*. It is the major term that defines the major premise, and the minor term that defines the minor premise.

Apart from the major term and the minor term, there is a third logic term called *the middle term*. The middle term is what the two premises have in common, and it is in virtue of the middle term that the major term and minor term are connected.

The three logic terms are the fundamental architects of a categorical syllogism, and for this reason, categorical syllogism is also regarded as the three-term logic.

The following diagram illustrates the technical relationship in the categorical syllogism.



As a validity rule, both the major term and minor term must reappear in the argument’s conclusion (Copi and Cohen 2015. p. 219). The major term functions as the conclusion’s predicate term (*P*), whereas the minor term functions as the conclusion’s subject term (*S*). Since the major term and the minor term are the architects of the major premise and the minor premise respectively, and since the major term and minor term also function as the conclusion’s predicate term and subject term respectively, we can get a basic idea about what the premises should look like by studying the conclusion alone. That is, the conclusion contains the essential component of each of the two premises! By studying the conclusion, we know that the conclusion’s predicate term must be in the major premise, and the subject term must be in the minor premise. This is the hint about how to get to the premises from a conclusion.

3. Building a Categorical Syllogism based on a Conclusion: the Recipe!

Based on the hint from the three-term argument, together with the validity rules of categorical syllogism that specify the location of the three terms in the argument (ibid. p. 221), a recipe can be formulated to show exactly how a categorical syllogism is developed based on a conclusion!

According to the validity rules of categorical syllogism, the conclusion of a categorical syllogism can be only one of the four kinds; namely (i) the conclusion that is *universal affirmative* (All *S* is *P*), (ii) the conclusion that is *universal negative* (No *S* is *P*), (iii) the conclusion that is *particular affirmative* (Some *S* is *P*), (iv) the conclusion that is *particular negative* (Some *S* is not *P*).

And according to the rules (ibid. p. 221), there are only four valid forms for the three terms to be located in a categorical syllogism, depending on the kind of the conclusion.

Without going into details, there are fifteen valid forms of categorical syllogism derived from the kind of the conclusion and the location of the terms (ibid. p. 250), and each of them has a unique name. In the paragraphs that follow, I shall only demonstrate the practical steps of building one particular form of categorical syllogism, called *Darii*. But the basic concept behind the recipe is common to all the other fourteen forms.

3.1. The recipe of building *Darii* based on its conclusion

Step 1: Study the conclusion.

Since we start building the argument from its conclusion, the first step is to study the conclusion and make sure that it falls into one of the four valid forms. For demonstration purpose, the argument called *Darii* has been chosen in this recipe. Its conclusion is in the form of *particular affirmative* (Some *S* is *P*) (ibid. p. 250).

As an example, let’s consider the following conclusion.

<i>(Step 1)</i>	
Conclusion:	Peter is a teacher.

Clearly, what the conclusion expresses is in the form of particular affirmative. It is about a particular individual, “Peter”, and the individual’s being “a teacher”.

By studying the conclusion, we can obtain some clues about the two premises to be established.

First, both premises must be affirmative. As far as a valid categorical syllogism is concerned, an affirmative conclusion should be followed by two affirmative premises (ibid. p. 239 - 240), whereas a negative conclusion should be followed by only one negative premise. Since we are now building a categorical syllogism based on an affirmative conclusion, in the following steps we must establish two affirmative premises.

Second, since the conclusion’s subject term is also the argument’s minor term, we know that the minor term is “Peter”. In like manner, since the conclusion’s predicate term is also the argument’s major term, we know that the major term is “teacher”.

Step 2: Allocate the space for the premises.

The second step is merely mechanical. Allocate, right above the conclusion, a two-line space for the premises. Write “Major Premise” on the first line, and “Minor Premise” on the second. In a valid categorical syllogism, the major premise is always placed on the first line, the minor premise the second.

<i>(Step 2)</i>	
Major Premise:	
Minor Premise:	
Conclusion:	Peter is a teacher.

Step 3: Accommodate the major term and the minor term.

The third step is also mechanical. Place, according to the validity rules of categorical syllogism, the major term and the minor term on their appropriate premise location. According to the formal structure of Darii, the major term occupies the predicate position of the major premise, and the minor term the subject position of the minor premise. We also need to add the quantifier, “All” or “Every”, in front of the subject position of the major premise. The major premise of Darii is a universal affirmative statement.

<i>(Step 3)</i>	
Major Premise:	All/Every ... teacher.
Minor Premise:	Peter ...
Conclusion:	Peter is a teacher.

Step 4: Accommodate the middle term.

Step 4 is another mechanical step. So far we already know the location of the major term and the minor term in the argument. The blank area in the major premise and the minor premise are the locations of the middle term. Since we still do not know what the middle term is, for now just fill the blank areas with the word, “Middle term”.

<i>(Step 4)</i>	
Major Premise:	All/Every Middle term teacher.
Minor Premise:	Peter Middle term.
Conclusion:	Peter is a teacher.

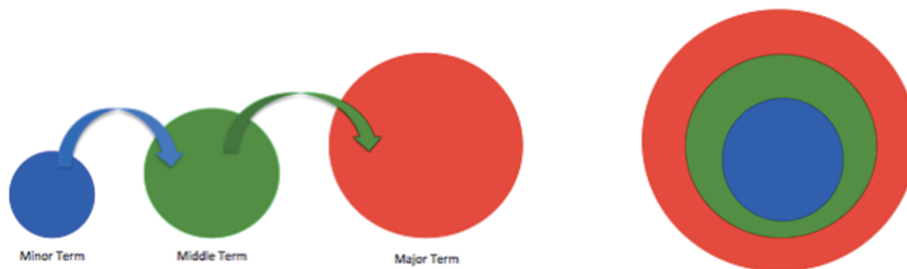
Step 5: Find the middle term.

Step 5 is the most crucial and difficult step of building a categorical syllogism. We must now consider what could be the crucial middle term.

Finding an appropriate middle term is really crucial for building a categorical syllogism. The function of the middle term in the argument is to bridge the major term, which is the conclusion's predicate term, with the minor term, which is the conclusion's subject term. Thus whether the subject and predicate in the conclusion are properly connected – and hence justified – or not fundamentally depends on whether the middle term is appropriate or not.

To establish the connection between the major term and the minor term, there must be, on the one hand, a connection between the middle term and the major term in the major premise, and on the other hand, a connection between the middle term and the minor term in the minor premise. And in order for the whole connection to be proper, the middle term must be *distributed* in at least one of the two premises, meaning that the term must designate the whole of the category of objects with which the major term or the minor term is connected. If the middle term is not distributed, then it is possible that the major term and minor term are connected to different part of what the middle term designates, and therefore are not necessarily connected with each other (ibid. p. 238).

Returning to the construction of our argument, we can see from Step 4 that the middle term occupies the subject position of the major premise as well as the predicate position of the minor premise. And according to the formal structure of Darii, the term that occupies the subject position of the major premise is distributed. The concept regarding how the three terms are connected is illustrated below.



The illustration shows the distribution of the middle term by showing that the category designated by the middle term is a member of the category designated by the major term. It also shows that the category designated by the minor term is a member of the category designated by the middle term. In this way, the minor term is guaranteed a connection with the major term.

From the illustration, we can somehow get an idea about what the middle term should look like. The candidate for the middle term can be found in the category that is smaller than “teacher” but larger than “Peter”.

One suggestion is given below.

<i>(Step 5)</i>	
Major Premise:	Every Mei graduate is a teacher .
Minor Premise:	Peter is a MEI graduate .
Conclusion:	Peter is a teacher .

The argument is built!

4. Going Beyond Categorical Syllogism

The recipe of building Darii illustrates exactly how a categorical syllogism can be built from its conclusion. Most of the steps in the recipe are purely mechanical. And the idea behind them is applicable to all the other forms of categorical syllogism.

However, the method is rather arbitrary, and it has very limited applications.

First of all, it is necessary to refer to the validity rules of categorical syllogism in order to build the argument. The locations of the logic terms as well as the nature of the premises were already decided by the rules, leaving very limited room for flexibility.

But most importantly, categorical syllogisms are classical deductive arguments that are based on the inferential relations between categories or classes of objects (ibid. p. 217). Under this argumentation method, building an inferential relation between P and Q will have to be accomplished via an inferential relation between the class that contains P and the class the contains Q, rather than P and Q exclusively. In this way, the explanation of the inferential relation between P and Q is given by means of things other than *this P* and *this Q*; i.e. by means of all the other Ps and Qs in the respective classes. But in building an inferential relation between P and Q, we want to know what is it about this P and this Q that makes one inferred from another.

The method is no doubt very powerful; even a novice in logic can easily understand the inferential relation it demonstrates. However, it is rather counterintuitive, especially during the process of everyday reasoning, to construct an inferential relation based on a relation between classes of objects. Detectives, for instance, do not normally draw their inferences based on the relation between a class of criminals and a class of crimes.

5. A New Approach to Logical Thinking Education

In order to learn a more natural and powerful way of building logical relations based on a conclusion, one needs to learn logical thinking skills that are radically different from those offered by conventional logic studies.

Based on the account given in section 2, for a thesis statement to be convincing, there must be an inferential relation linking the statement with the supporting premises so that the thesis statement can be proven true by demonstrating that the premises are true. In order for this to be possible, one needs to know how to identify and build the premises that bear an appropriate inferential relation to the thesis statement. Specifically speaking, it involves knowing (i) how to distinguish between the premises that constitute a convincing support for the thesis statement and the premises that do not, (ii) how to build a premise that is necessary for supporting the thesis statement, (iii) how to find and eliminate the obstacles that are blocking the inferential relation between the necessary premise and the thesis statement. In the rest of the paper, I shall only highlight the first two skills. This would be enough to demonstrate the basic idea about how to make a thesis statement convincing.

5.1. Distinguishing between two kinds of premises

Premise, according to Irving Copi, is what provides the ground or reason for a conclusion (ibid. p. 7). But treating a premise as a reason can be quite misleading. There are many kinds of reasons. And not every reason for a conclusion can be also the premise for the conclusion. Being able to draw a principled distinction between the premises that constitute a convincing support for the thesis statement and others that do not is essential to identifying and building the appropriate premises for the statement. But this is not an easy task. Most of the students I came across had a difficulty to do so. Consider the following exercise.

<i>Class Exercise: Judge which one of the reasons (in either Group A or Group B) constitutes a convincing support for the conclusion.</i>	
Group A	Group B
Peter is in Nagoya because Peter has a house in Nagoya.	Peter is in Nagoya because Peter is not in Tokyo.

All the graduate students taking my course were asked, during the first lesson, to do a class exercise similar to the one shown above. But unfortunately, most of them failed the exercise. For instance, nearly 90% of the forty students who enrolled my course in the first semester of 2015 chose the reason in Group A.

Contrary to what it seems, the reason in Group A, “Peter has a house in Nagoya”, does not constitute a convincing support for the conclusion, “Peter is in Nagoya”. Even though it is true that Peter has a house in Nagoya, it does not follow that Peter is in Nagoya. On the other hand, Peter could well be in Nagoya even though he does not have a house there. Thus whether Peter has a house in Nagoya or not has no direct inferential effect on Peter’s being in Nagoya. The reason does not bear a direct¹ inferential relation to the conclusion.

The reason in Group B, “Peter is not in Tokyo”, does constitute a convincing support for the conclusion, “Peter is in Nagoya”. There is a direct inferential relation linking the two. The easiest way to see this is to imagine what if it is false that “Peter is not in Tokyo”. If it is false that Peter is not in Tokyo, then Peter is in Tokyo. And if Peter is in Tokyo, then Peter cannot be in Nagoya – hence it is false that Peter is in Nagoya. From this perspective, the reason bears a direct inferential relation to the conclusion; the reason is the premise for the conclusion.

5.2. A different perspective: the method of falsification

The students failed the exercise because they failed to see the relation between premise and conclusion from a different perspective. Undeniably, the relation between a premise and conclusion can be quite tricky. Even though there is an inferential relation linking a premise to a particular conclusion, it might not be easily spotted, especially to the untrained eye. This is shown by the fact that nearly 90% of the students failed to choose the correct premise. Although the premise, “Peter is not in Tokyo”, bears a direct inferential relation to the conclusion, “Peter is in Nagoya”, the truth of the former is not immediately followed by the truth of the latter. Peter’s not being in Tokyo is not directly followed by Peter’s being in Nagoya. There are other possibilities that are blocking the inferential relation that link the truth of the premise to the truth of the conclusion. Thus it might be difficult to detect the presence of an inferential relation linking one statement to another if we only consider the relation from the perspective of how the *truth* of one statement is connected to the *truth* of another.

In order to effectively identify the presence of an inferential relation, we need to look at the relation from a different perspective. This way of detecting the inferential relation was already hinted in the exercise above. It is called the method of falsification.

The method of falsification works by falsifying a premise and see if the result has a direct inferential effect on the conclusion the premise is thought to be supporting. This way of identifying the appropriateness of a premise is highly effective. We can see straightaway whether the premise is appropriate or not. If the falsification of the premise directly results in the falsification of the conclusion, then the premise bears a direct inferential relation to the conclusion.

¹ The reason may nevertheless be used to support the conclusion if a direct inferential relation with the conclusion is established through the inclusion of some additional premise or premises. The definition of “direct inferential relation” will become clearer as we move on.

5.3. Building a Necessary Premise

So far I have explained that a direct inferential relation linking the premise and the conclusion is what constitutes a convincing support for the conclusion. Furthermore, we now have a method to effectively identify whether the convincing support is present or not. The next important step is to learn how to build a premise that bears a direct inferential relation to a conclusion.

The meaning of “direct inferential relation” is defined by the direct inferential effect on a conclusion. For instance, a premise bears a direct inferential relation to a conclusion if the falsification of the premise directly results in the falsification of the conclusion; e.g. if it is false that Peter is not in Tokyo, then it is also false that Peter is in Nagoya. Similarly, if the truth of a premise directly results in the truth of a conclusion, then the premise is also regarded as bearing a direct inferential relation to the conclusion; e.g. if it is true that Peter is in Tokyo, then it is also true that Peter is not in Nagoya.

But regardless of the form of the direct inferential effect, if a premise has a direct inferential effect on a conclusion, then the conclusion shares the same truth condition with the premise. For example, the statement, “Peter is in Nagoya”, shares basically the same truth condition as the one, “Peter is not in Tokyo”. Nagoya is not Tokyo; hence for Peter to be in Nagoya is for Peter to be not in Tokyo. Accordingly, in order to build a premise that bears a direct inferential relation to a conclusion, we must build a premise with which the conclusion shares basically the same truth condition.

One way to build such a premise is to build a Necessary Premise, or the premise that is necessary for proving the conclusion to be true.

The Necessary Premise of an argument basically functions as the basis for supporting the argument’s conclusion. It is a premise the falsification of which guarantees the falsification of the argument’s conclusion. The Necessary Premise provides, among other things, a justification for the existence of the conclusion. It may not be sufficient for making the conclusion true, but without which the conclusion is certainly false or not possible. Thus the presence of a conclusion suggests the presence of at least one premise that is necessary for making the conclusion possible.

The idea that every argument has a premise that functions as the basis of the argument is not really new. Contemporary studies of argumentation schemes have postulated the presence of one special premise in each argument scheme (Arthur Hastings, 1963; Douglas Walton, 1996). Hastings calls such a premise the “Toulmin warrant”, whereas Walton calls it the “Major premise”. But both of them see it as a generalization or rule that functions to link other premise or premises to the conclusion (Walton 2010, p. 9). However, the exact nature of the premise remains largely unclear in the contemporary studies, and as a result the method of building such a statement is rather arbitrary.

On the contrary, the nature of the Necessary Premise is very clear. It is what justifies the existence of the conclusion in an argument, and there are straightforward and systematic steps of getting to the premise based on the conclusion. Very briefly, since a Necessary Premise is the one the falsification of which guarantees the falsification of the conclusion, we can treat the falsification of a Necessary Premise as the counterstatement to the conclusion. In this way, the steps of building a Necessary Premise become really straightforward as long as a conclusion is in place. First of all, we study the conclusion carefully, and then find, by comparing it with the research conclusions of some previous studies that are significantly different from the present one, a counterstatement to the conclusion. Once the counterstatement is ready, we can then find a reason for rejecting the counterstatement and build a statement that summarizes the reason (in basically the same way as building a thesis statement). The statement that rejects the counterstatement is the Necessary Premise. To illustrate the idea with a very simple example, if a thesis statement is: “Peter is in Nagoya”, then a possible counterstatement to it is: “Peter is in Tokyo (hence not in Nagoya)”. As a result, a Necessary Premise for the thesis statement is the rejection of the counterstatement; hence “Peter is not in Tokyo”.

The Necessary Premise built in this way shares the same truth condition as the thesis statement, and therefore constitutes a direct inferential support for the statement. After building a Necessary Premise, the remaining task of making the thesis statement fully convincing is to develop, based on the Necessary Premise, a sufficient ground for

proving the statement to be true. The way to do it is by building additional premise or premises that eliminate the obstacles blocking the truth connection between the Necessary Premise and the thesis statement.

6. Conclusion So Far

So far I have presented the first of a three-part instruction series on how to build a logical relation from a conclusion. A step-by-step account of such a logical construction is vital to the success of the application of LWPC, the core of which lies in the logical argumentation based on a paper's thesis statement.

The best hint of the logical construction comes from the basic concepts of categorical syllogism. Based on the hint, a recipe was formulated to show exactly how a categorical syllogism is developed based on a conclusion! But the construction method of categorical syllogism is rather arbitrary and it has a very limited range of applications.

In order to help the LWPC users develop a natural and powerful skill of the logical construction, the primary step is to help them develop the ability to identify the premises that bear an appropriate inferential relation to a thesis statement. For this purpose, a method called "falsification" was introduced. The falsification method uses an unconventional perspective of logical relations to help identify the appropriate premises that bear a direct inferential relation to the thesis statement. It paves the ground for learning how to build a Necessary premise for the statement.

In this paper, I have provided only a brief account about what a Necessary premise is and how to build one. A comprehensive account on why a Necessary premise is needed and a step-by-step recipe on how to build one will be the focus of the second part of the instruction series. In the second part, we shall also look at the sufficient conditions for proving a thesis statement to be true.

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