PHILOSOPHY NOTES

VAIBHAV KARVE

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Chapter 12: Explorations in Deductive Reasoning: Categorical Logic

(1) Categorical logic is the branch of logic that treats categorical arguments.

(2) A *categorical sentence* relates one category of things to another by asserting that all/some/none of one category do/don't belong to the other.

(3) A *categorical argument* is a deductive argument composed of categorical sentences.

(4) Four patterns that a categorical sentence might follow:
   (a) All A are B.
   (b) No A are B.
   (c) Some A are B.
   (d) Some A are not B.

(5) A is the *subject term* and states what the categorical sentence is about.

(6) B is the *predicate term* and says something about the subject.

(7) The words in {all, none, some} are *quantifiers* as they denote the quantity of things in the subject category that are said to belong to the predicate category.

(8) The words in {are, are not} are *copula* because they "couple" the subject and the predicate.

(9) The word "some" is to be understood to mean "one or more (and possibly all)". In other words, "some" means "at least one". In set-theoretic notation, some means $\subseteq$ and not just $\subset$.

(10) Every categorical sentence has a *quantity* and a *quality*.

(11) The quantity of a categorical sentence is:
   - *universal* if the sentence makes a claim about every member of the subject term category. For example: all A are B; no A are B.
   - *particular* if the sentence makes a claim about some members of the subject term category. For example: some A are B; some A are not B.

(12) The quality of a sentence is:

- *affirmative* if the copula affirms membership in the predicate category.
- *negative* if the copula denies membership in a predicate category.

(13) This gives us the classification table:

Type	Quantity/Quality	Logical form
A	Universal affirmative	All A are B
E	Universal negative	No A are B
I	Particular affirmative	Some A are B
O	Particular negative	Some A are not B

(14) A categorical sentence is in *standard form* if it can be written as

$$\text{Quantifier} + \text{subject term} + \text{copula} + \text{predicate term},$$

in that specific order.

(15) Sentences not in standard form can be modified to fit into standard form without loss of meaning:
- If the predicate term is an adjective instead of a noun, change it to a noun or a noun-like expression.
- If the quantifier is missing or not in standard form, then replace it with all/none/some using common sense by trying to figure out what the speaker intends (and employing the principle of charity).
- Missing or nonstandard copulas can be changed to are/are-not based on common sense.

(16) A *categorical syllogism* is a specific kind of categorical argument, having the following properties:
   (a) It is composed of exactly two premises and one conclusion – all three being categorical sentences.
   (b) Each sentence in the argument contains exactly two terms – no more, no less.
   (c) The argument as a whole contains exactly three different terms, each appearing exactly twice in the argument.
   (d) No term appears twice in the same sentence.

   For example, the following is a categorical syllogism:
   (a) All A are B.
   (b) All A are C.
   (c) Therefore, some C are B.

(17) Number of possible syllogisms? 256?

(18) The term appearing in both premises (and hence not in the conclusion) is the *middle term*. The predicate term of the conclusion is the *major term*. The term appearing as the subject of the conclusion is the *minor term*.

(19) The *major premise* is the premise containing the major term. The minor premise is the premise containing the minor term.

(20) Example:
   (a) All A are B.

(b) All B are C.
(c) Therefore, all A are C.

C is the major term. A is the minor term. B is the middle term. (a) and (b) are the minor and major premises respectively.

(21) A categorical syllogism is in *standard form* if the major premise is listed first, followed by the minor premise, and finally the conclusion.

(22) Syllogisms can be divided into four *figures* (that is, groups) as follows:
(a) In figure 1, the middle term is the subject term in the major premise while being the predicate term in the minor premise.
Barbara AAA-1 : All M are P; all S are M. So, all S are P.
Celarent EAE-1 : No M are P; all S are M. So, no S are P.
Darii AII-1 : All M are P; some S are M. So, some S are P.
Ferio EIO-1 : No M are P; some S are M. So, some S are not P.
(b) In figure 2, the middle term is the predicate term in both premises.
Cesare EAE-2 : No P are M; all S are M. So, no S are P.
Camestres AEE-2 : All P are M; no S are M. So, no S are P.
Festino EIO-2 : No P are M; some S are M. So, some S are not P.
Baroco AOO-2 : All P are M; some S are not M. So, some S are not P.
(c) In figure 3, the middle term is the subject term in both premises.
Darapti AAI-3 : All M are P; all M are S. So, some S are P.
Disamis IAI-3 : Some M are P; all M are S. So, some S are P.
Datisi AII-3 : All M are P; all M are S. So, some S are P.
Felapton EAO-3 : No M are P; all M are S. So, some S are not P.
Bocardo OAO-3 : Some M are not P; all M are S. So, some S are not P.
Ferison EIO-3 : No M are P; some M are S. So, all S are not P.
(d) In figure 4, the middle term is the predicate term in the major premise and the subject term in the minor premise.
Bramantip AAI-4 : All P are M; all M are S. So, some S are P.
Camenes AEE-4 : All P are M; no M are S. So, no S are P.
Dimaris IAI-4 : Some P are M; all M are S. So, some S are P.
Fesapo EAO-4 : No P are M; all M are S. So, some S are not P.
Fresision EIO-4 : No P are M; some M are S. So, some S are not P.

(23) Construction rules for Venn diagrams:
(a) Each sentence can be written as 2 (intersecting) circles. A categorical syllogism itself can be represented by 3 properly placed (intersecting) circles.
(b) An empty region gets shaded.
(c) A region that we know to be non-empty gets marked by $\times$.
(d) If we only know what the union of two regions is non-empty but are not sure which region contains the element, then we mark the common interface with $\times$.

(24) The *Aristotelian assumption* is that the subject terms of categorical statements refer to actually existing things. This is also called the *existential assumption*, the *traditional assumption* or the *assumption of existential*

import. This is essential because it prevents us from making vacuous statements.

(25) If we do not presuppose that the subject term denotes or refers to actually existing things when we interpret a universal sentence, we are taking the *hypothetical viewpoint*. This is also called the *Boolean* or *modern* viewpoint.

(26) These assumptions (Aristotelian or Boolean) can only be made for universal categorical statements. Particular categorical statements are always presupposed to follow the Aristotelian or existential standpoint.

(27) Assuming the Boolean viewpoint means not adding $\times$ by default to all the regions of a Venn diagram.

(28) The Venn diagram of a categorical syllogism has 3 circles creating 7 regions in total.

(29) The Venn diagram test for checking validity of a Categorical Syllogism:
   (a) Abbreviate the argument, replacing (consistently) each term with a single capital letter and retaining the quantifiers and copulas of each sentence. By convention, place the conclusion last.
   (b) Draw the three circles and label them using the three letters. The circle for the minor term is drawn to the left. The circle for the major term is drawn to the right. The circle for the middle term is drawn in the "center top".
   (c) Enter the information for both premises and stop. Do not enter information for the conclusion.
   (d) When placing $\times$ in an area, if one part of it is shaded, place $\times$ in the unshaded part.
   (e) When placing $\times$ in an area, if a circle's line runs through the area, and out area does not tell us which side of the line gets $\times$, place it directly on the line. This means that $\times$ can be on one or both sides of this line and we just don't know.
   (f) Look at the two circles representing the subject terms of the two premises. If these terms refer to existing things (depending on our viewpoint), then if there is only one region unshaded in either or both circles, place $\times$ in that unshaded region. If these terms refer to things that do not exist, then go to next step.
   (g) Check if valid or invalid based on the following test: *A* categorical syllogism is valid if, when the information from the two premises has been entered into the diagram, visual inspection of the diagram reveals that the information content of the conclusion is represented as well. Alternately, *a* categorical syllogism is invalid if, when the information from the two premises has been entered into the diagram, the visual inspection of the diagram reveals that information must be added to represent the information content of the conclusion.