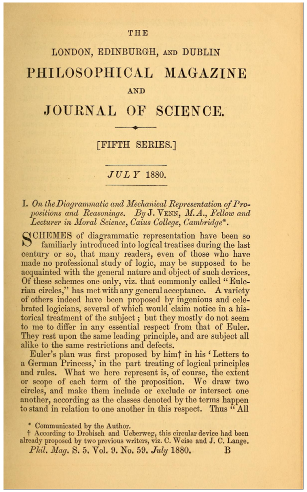
# Venn Diagrams

# What is a Venn Diagram?

*J. Venn M.A. (1880) I. On the diagrammatic and mechanical representation of propositions and reasonings, The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 10:59, 1-18, DOI: 10.1080/14786448008626877*



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I. *On the Diagrammatic and Mechanical Representation of Propositions and Reasonings. By* J. VENN, *M.A., Fellow and Lecturer in Moral Science, Caius College, Cambridge**.

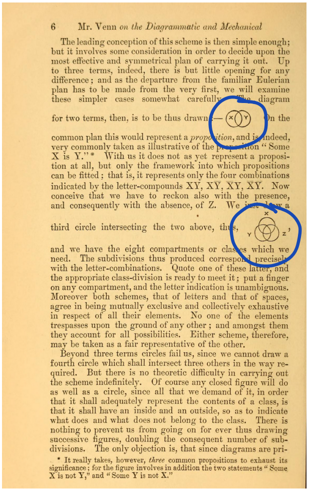
SCHEMES of diagrammatic representation have been so familiarly introduced into logical treatises during the last century or so, that many readers, even of those who have made no professional study of logic, may be supposed to be acquainted with the general nature and object of such devices. Of these schemes one only, viz. that commonly called "Eulerian circles," has met with any general acceptance. A variety of others indeed have been proposed by ingenious and celebrated logicians, several of which would claim notice in a historical treatment of the subject; but they mostly do not seem to me to differ in any essential respect from that of Euler. They rest upon the same leading principle, and are subject all alike to the same restrictions and defects.

Euler's plan was first proposed by him† in his 'Letters to a German Princess,' in the part treating of logical principles and rules. What we here represent is, of course, the extent or scope of each term of the proposition. We draw two circles, and make them include or exclude or intersect one another, according as the classes denoted by the terms happen to stand in relation to one another in this respect. Thus "All

* Communicated by the Author.

† According to Drobisch and Ueberweg, this circular device had been already proposed by two previous writers, viz. C. Weise and J. C. Lange.

*Phil. Mag.* S. 5. Vol. 9. No. 59. *July* 1880. B



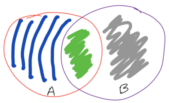
6 Mr. Venn *on the Diagrammatic and Mechanical*

The leading conception of this scheme is then simple enough; but it involves some consideration in order to decide upon the most effective and symmetrical plan of carrying it out. Up to three terms, indeed, there is but little opening for any difference; and as the departure from the familiar Eulerian plan has to be made from the very first, we will examine these simpler cases somewhat carefully. The diagram for two terms, then, is to be thus drawn:— On the common plan this would represent a *proposition*, and is, indeed, very commonly taken as illustrative of the proposition "Some X is Y."* With us it does not as yet represent a proposition at all, but only the framework into which propositions can be fitted; that is, it represents only the four combinations indicated by the letter-compounds $XY$, $X\bar{Y}$, $\bar{X}Y$, $\bar{X}\bar{Y}$. Now conceive that we have to reckon also with the presence, and consequently with the absence, of Z. We just draw a third circle intersecting the two above, thus, and we have the eight compartments or classes which we need. The subdivisions thus produced correspond precisely with the letter-combinations. Quote one of these latter, and the appropriate class-division is ready to meet it; put a finger on any compartment, and the letter indication is unambiguous. Moreover both schemes, that of letters and that of spaces, agree in being mutually exclusive and collectively exhaustive in respect of all their elements. No one of the elements trespasses upon the ground of any other; and amongst them they account for all possibilities. Either scheme, therefore, may be taken as a fair representative of the other.

Beyond three terms circles fail us, since we cannot draw a fourth circle which shall intersect three others in the way required. But there is no theoretic difficulty in carrying out the scheme indefinitely. Of course any closed figure will do as well as a circle, since all that we demand of it, in order that it shall adequately represent the contents of a class, is that it shall have an inside and an outside, so as to indicate what does and what does not belong to the class. There is nothing to prevent us from going on for ever thus drawing successive figures, doubling the consequent number of subdivisions. The only objection is, that since diagrams are pri-

* It really takes, however, *three* common propositions to exhaust its significance; for the figure involves in addition the two statements "Some X is not Y," and "Some Y is not X."

$A \cup B$




$x \in A$ but $x \notin B$

$A - B$

$x \in A$ and $x \in B$

$A \cap B$

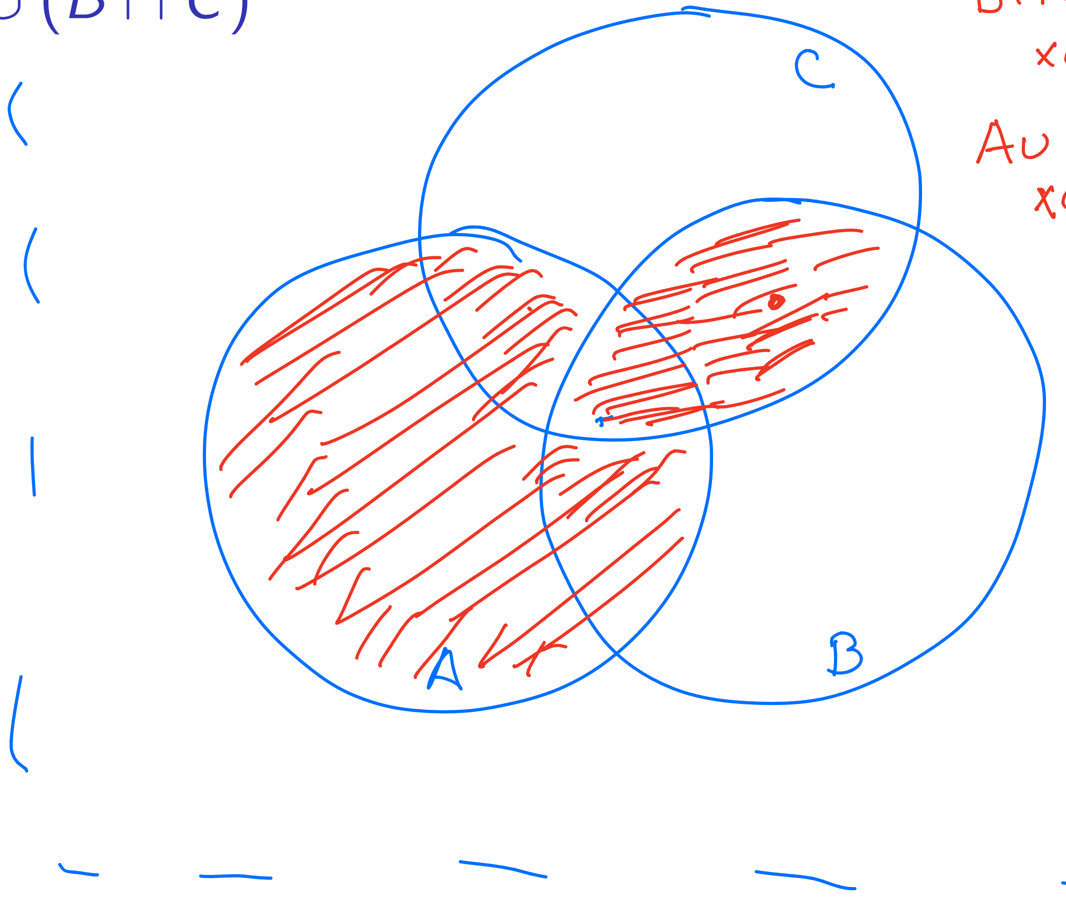
$x \in B$ and $x \notin A$

$A \cup B$ is whole diagram

# Venn Diagrams continued

- Graphical representation of set operations
- Convenient as check or for presentation and explanation but (like any diagram) not conclusive without explanation.

$A \cup (B \cap C)$




$B \cap C$

$x \in B$ and $x \in C$

$A \cup (B \cap C)$

$x \in A$

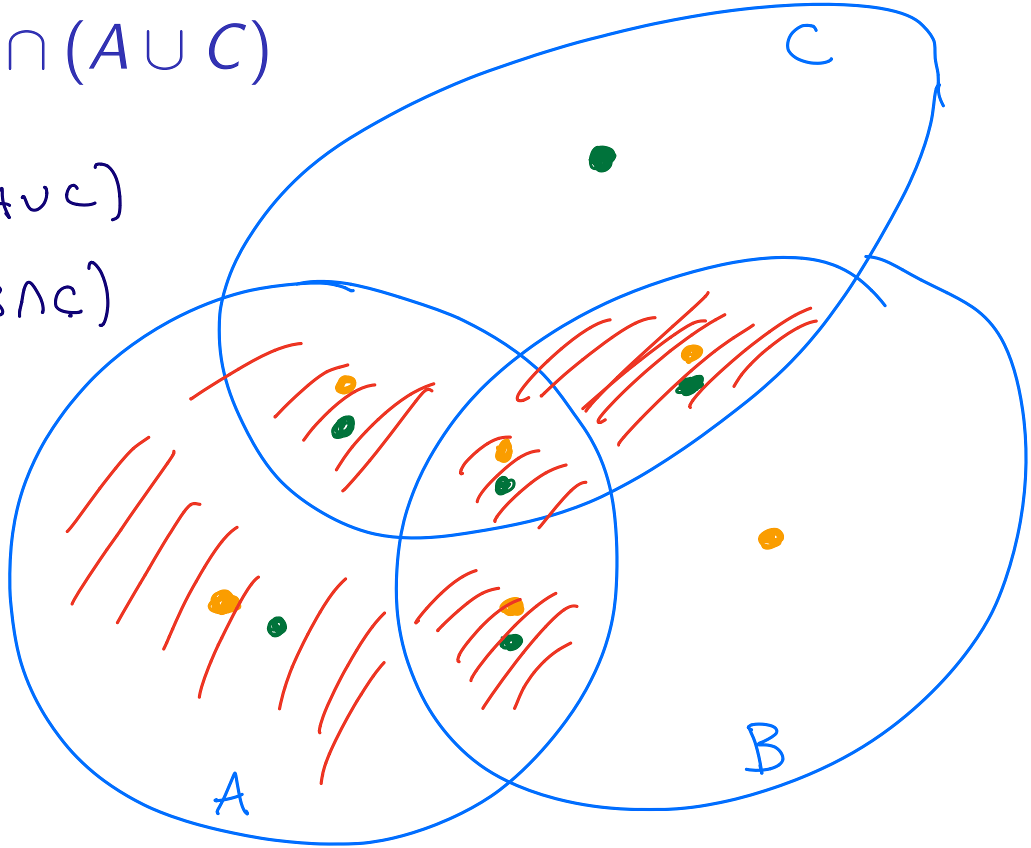
OR

$x \in B \cap C$

$(A \cup B) \cap (A \cup C)$

$(A \cup B) \cap (A \cup C)$

$= A \cup (B \cap C)$

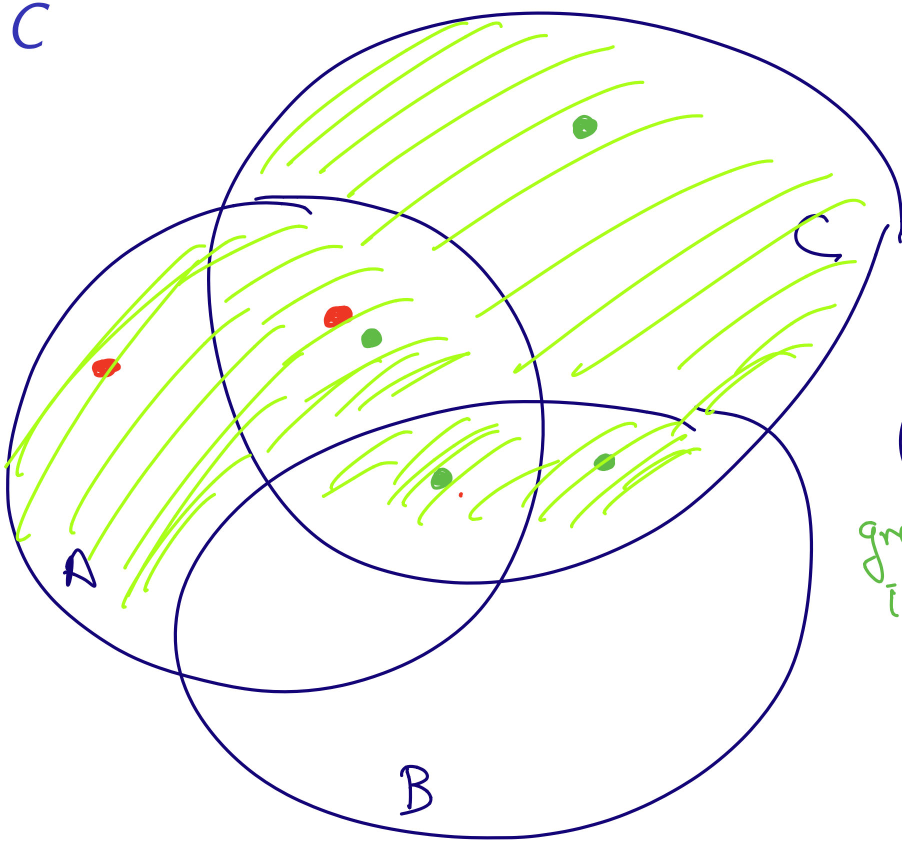



Both orange and green

$A \cup B = \{x : x \in A$ OR $x \in B\}$

$A \cup C = \{x : x \in A$ OR $x \in C\}$

$(A - B) \cup C$

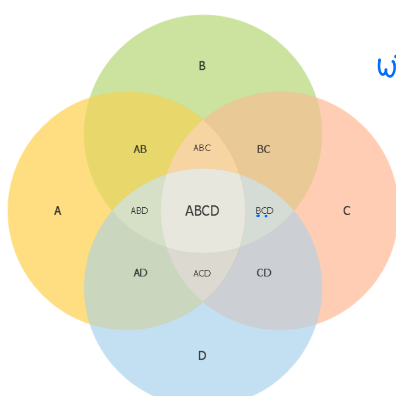



$(A - B) \cup C$

green <u>or</u> red dot is in $(A-B) \cup C$

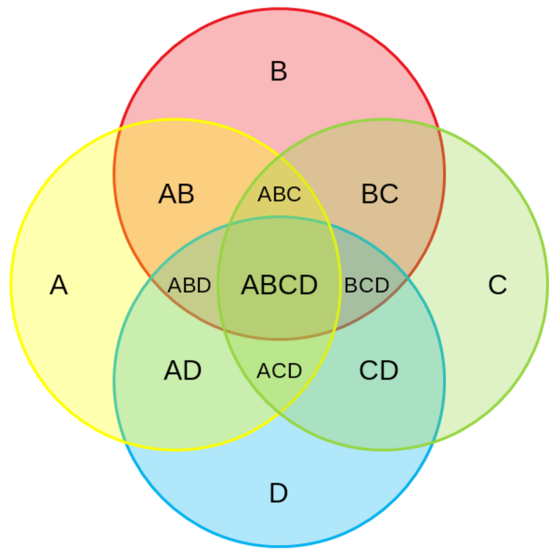
$A - B = \{x \in A \text{ but } x \notin B\}$

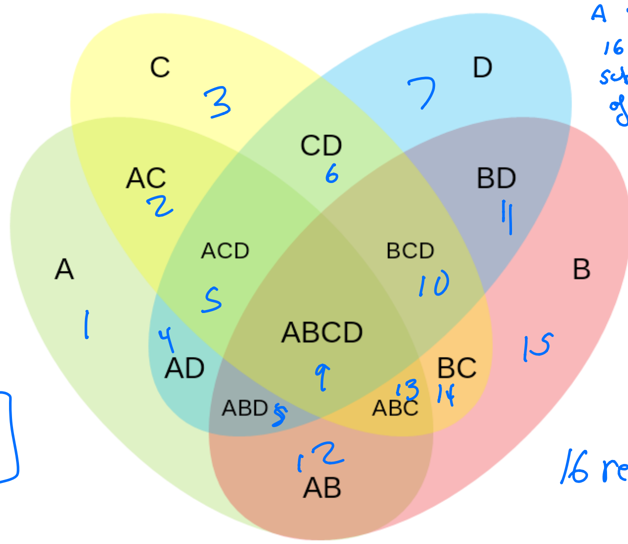
$(A-B) \cup C = \{ x : x \in C \text{ or } x \in A - B \}$




Whe is

$D \cap B$ ?


B
AB
ABC
BC
A
ABD
ABCD
BCD
C
AD
ACD
CD
D




$\boxed{16}$

A B C D
16 possible subsets of $\{A, B, C, D\}$
each subset
$\downarrow$
an intersection
$\{A, B\}$
$\updownarrow$
$A \cap B$

16 regions?