A Short History of Logic Diagrams

500BC-1900AD

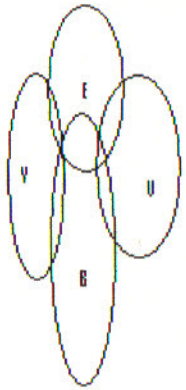
(How did they turn into Logic Machines?)

Andrew Harrell

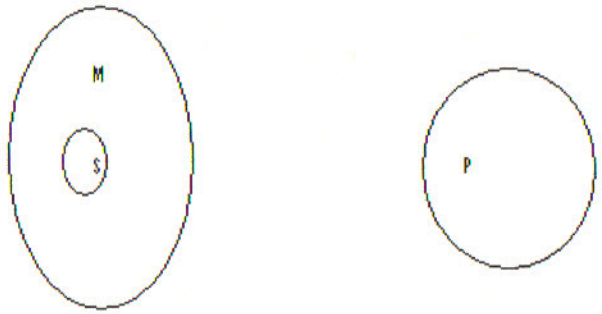
Engineering Research and Development Center (ERDC), United States

This talk can only include a brief introduction to the history of these ideas. But, they form the foundation of many current topics in modern day research in mathematical logic and computer science. The talk will follow the material in Martin Gardner's 1958 book. It summarized everything related to this up until then. According to some famous mathematical philosophers, "Mathematics is the study of what is invariant under change of notation." Of course to agree to this controversial and primary postulate one must accept Dr. Tarski's theory of what logical Truth is. We can have a discussion about this assumption if there is interest. But, its viewpoint about truth explains why the definition of terms and the symbols in the logic diagrams that we choose to make and create can be very important. For the talk, first, we will review Aristotle's classification of syllogistic functions and terms. Then, comes some of Raymond Lull's different theological concepts including his class diagrams of concepts of a concept. Lull's famous student, Leibnitz's idea of a monad, which relates to the modern day set theoretic "What is the Concept of the Number One" in mathematical logic. These ideas will later reappear in the 1990s as a definition of a data structure in computer programming. It only took 400 years for us to figure how to do this. Then we will briefly consider Venn diagrams and how they relate to Lull's diagrams and some precise abstract mathematical definitions of modern day point set topology. Finally, requiring all the previous steps, the origin and the importance of the next historical step: Boolean functions and their algebras, hopefully, will be much clearer.

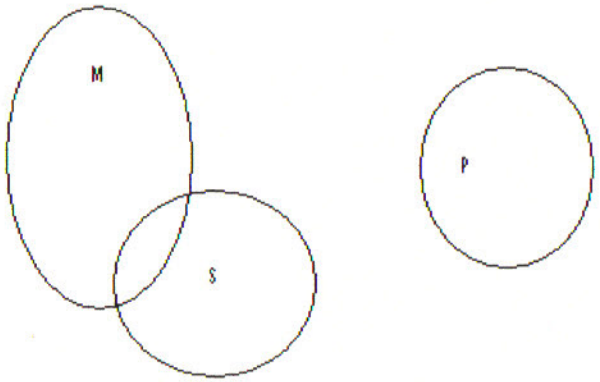
Raymond Lull's Circles

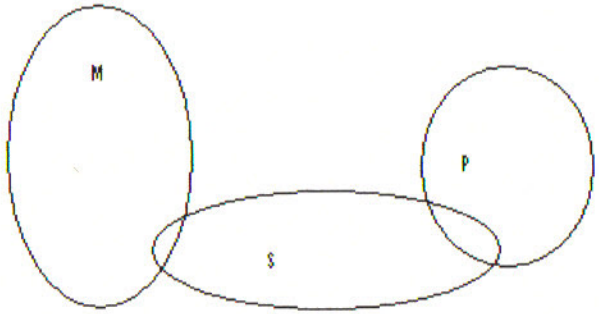


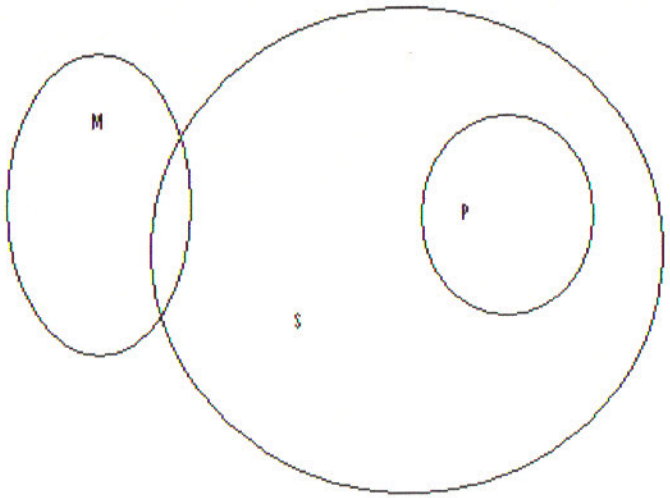
Euler Diagram I



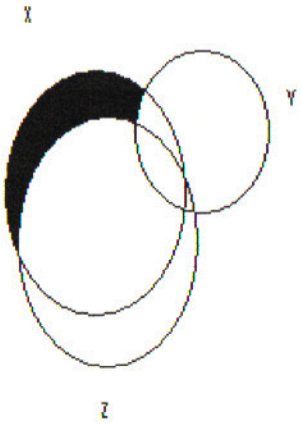
Euler Diagrams II

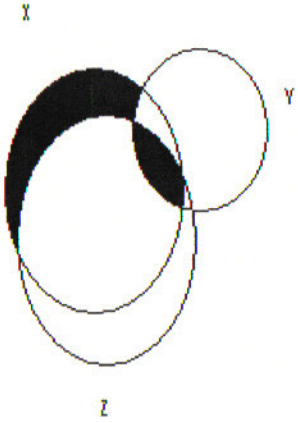


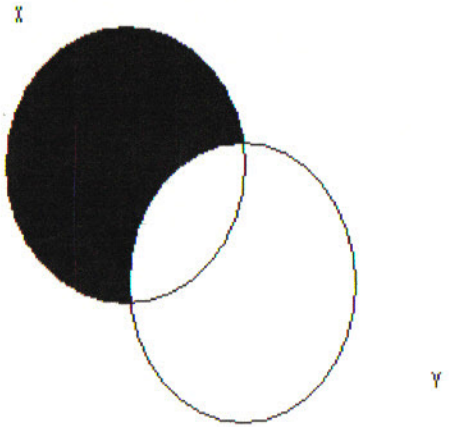


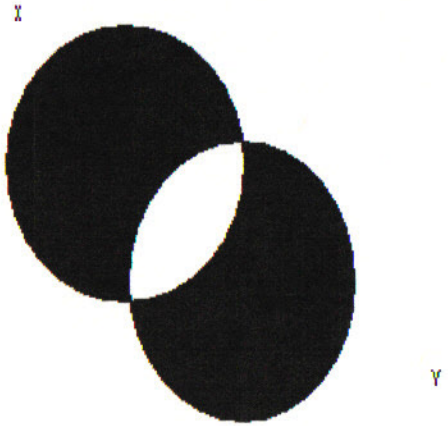


Venn Diagrams

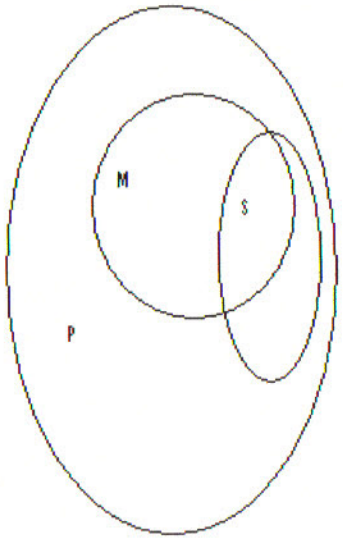








Datisi Syllogism



Aristotle's Classifcation

- First figure
- Barbara
- Celarent
- Darii
- Ferio
-
-

Second Figure
Cesare
Camestres
Festino
Baroco

Third Figure
Datisi
Feriso
Disamis
Bocardo
Darapti
Felapton

Fourth Figure[13]
Calemes
Freison
Dimatis
Bamalip
Fesapo

Boolean Functions

- | ‘Y v Z| M implies P
- |’Z v Y| ; P implies M
- where ‘Y means not Y, X v Y means X or Y, and |X| means the truth value of the variable X. eg |’Y v Z| means the truth value of not Y or Z (which is the same using the normal definition of implication as the truth value of (Y implying Z).

Third Definition of a Concept

- A concept is a data structure. That is, it is a predefined set of object type. These types can be frames with slots [classes], words, numbers, lists, streams, or variables. In certain situations they can be recursively defined. But, the final tree structure is usually limited to have only a finite number of branchs. The information it contains is the values or attributes of the objects that the data structure describe.

References

- Martin Gardner, Logic Machines and Diagrams, 1st edition, 1958
- Symbolic Logic, John Venn, Cambridge U. Press 1881
- Aristotle, Prior Analytics, Book 1, section 1.
- Mathmatical Logic, Hilbert and Ackermann, pg 49, Chelsea Publishing, 1950