A History of Logic
Evangel University
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A Brief History

• “The mainstream of the history of logic begins in ancient Greece and comes down through the Arabian and European logic of the Middle Ages and through a number of post-Renaissance thinkers to the more or less mathematical developments in logic in the nineteenth and twentieth centuries.”*

• Though India has a history of logic going back 45 centuries, and China since Mo Tzu (468-376 BC) a contemporary of Socrates and Plato, the main stream of twentieth century logic in the west has been adopted universally.

* All quoted passages are taken from the “History of Logic” article from the Encyclopedia of Philosophy except as noted.
Greek Logic

• Though Aristotle (384-322 BC) was the first to comprehensively systematize logic in the ancient world, he studied for twenty years at Plato’s Academy.

• “the principle contribution of Aristotle’s precursors …consisted in the development and cultivation of a kind of discourse that involved the use of inference and proof.”

• The need for proof arose out of an examination of ideas that were counterintuitive. For example, Parmenides suggested that in reality there is no movement.
Greek Logic

• “Logic, of course, not only is concerned with inferences and proofs but also involves the study of language, its syntax and semantics.”

• The Sophists, especially Protagoras, “distinguished between different types of sentences.”

• In the Academy also they discovered the difference between nouns and verbs, and were very interested in the difference between true and false statements.
Greek Logic

- Plato’s concern for truth about the world in such a way that the correspondence theory of truth can be attributed to him.

- Briefly, the correspondence theory of truth tries to make the connection between the world and our descriptions of it. Ex, I say, “that is a table” as I point to a table. My true statement corresponds to the real world.
Greek Logic

• Aristotle, though not the originator of logic certainly can be credited with creating the first systematic treatment of it.

• “The logical treatises of Aristotle make up the collection known as the Organon—the ‘tool’”

• “The Organon contains the Categories, the De Interpretatione, the Prior Analytics (two books), the Posterior Analytics (two books), the Topics (eight books), and the De Sophisticis Elenchis.”
Greek Logic

- This is not the place to go into any depth about the contents of this literature, but suffice it to say that until the rise of mathematical logic much of the history of logic centers around commentaries and elaborations of the *Organon*.

- The first part of this course will be taken up with issues raised by these early logicians.

- Of primary concern to us will be his treatment of the syllogism, his form of deduction.
Only after the development of modern logic was it understood that the logic of propositions (statements) is a more fundamental logical theory. The logic of syllogisms presupposes the logic of propositions and requires it.

“Aristotle’s deduction within the framework of syllogistic do not refer explicitly to any laws of propositional logic, but neither do they violate any of these laws.
Greek Logic

• Theophrastus, Aristotle’s student developed a theory of the totally hypothetical syllogism. You will be dealing with these more in the symbolic logic part of the course. They look like this:

  If A then B.
  If B then C.
  Therefore, if A then C.

This is the first most simple formulation that has many elaborations.
Greek Logic

• Plato’s successors were not idle. Chief among them, Chrysippus wrote over 700 treatises on logic.

• It was said of him by Diogenes Laërtius that “if the gods used any logic, it would be the logic of Chrysippus.”

• Many of his theorems in propositional logic will be reviewed and used in the proofs you will do in the latter part of this course, among them Modus Ponens, Modus Tollens and Disjunctive Syllogism.
“Arabic logic, like the rest of medieval Arabic science and philosophy, is entirely Western and has nothing to do with Oriental philosophy.

They translated the Organon into Arabic.

The school of logic in Baghdad was a “closely knit group of Syrian Christians... virtually all of these men—with the notable exception of al-Farabi, a Muslim—were Nestorian Christians.”
Arabic Logic

• In the late ninth and tenth centuries the school in Baghdad was virtually the only Arabic school of logic.

• In the eleventh century at a time when Arabic logic was at a low point, Avicenna departed from the traditional Western, Aristotelian approach. Not all logic is a commentary on Aristotle.
Arabic Logic

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• In twelfth century Muslim Spain, Averroës further refined Aristotle’s work in opposition to Avicenna.
Medieval Logic

• Medieval logic “is customarily used to designate the body of logical doctrine developed in the schools and universities of western Europe between the eleventh and fifteenth centuries.”

• The universities in Paris and Oxford took up the study of logic, but because study of Arabic and Aristotelian texts was “considered dangerous to orthodoxy, study of them was reserved to the higher faculty of theology.”
Medieval Logic

- William of Sherwood made use of the mnemonic verses “Barbara, Celarent, …” that stand for syllogistic forms that we will be studying.

- Toward the end of the thirteenth century, the center of modern logic moved from Paris to Oxford. “Kilwardy’s commentary on the Prior Analytics, written at Oxford… exhibits an acute and critical grasp of formal problems.”
Medieval Logic

• The writings of William of Ockham in the fourteenth century “inaugurated the period of maturity of medieval logic.”

• Ramón Lull who used logic “to prove the truth of the Christian faith,” designed machines that would perform calculations, “which perhaps earns him the right to be called the father of computer programming.”
Let me pass the movements between the medievals and the moderns without much comment. There was refinement but no dramatic change. The real changes are children of the Enlightenment.
Modern Logic

• “Modern logic, or the logic that is loosely called ‘mathematical,’ began in a serious and systematic way with Augustus De Morgan’s *Formal Logic* and George Boole’s *Mathematical Analysis of Logic.*”

• From De Morgan we get De Morgan’s theorems that we will study in chapter 5.

• George Boole gives us Boolean Logic which treats statements as either true or false. We will study truth functional logic in chapter 4. Programmers use boolean statements to test the truth of program results or user feedback.
Modern Logic

- Modern logic has some of its roots in the seventeenth century in “Leibniz, Euler, Lambert, and Bolzano.”
- Chiefly these developments came as a byproduct of their discoveries in mathematics.
- Leibniz stated, “all the predicaments depend on the knowledge of quantity, with which mathematics deals, and therefore the whole of logic depends on mathematics.”
Modern Logic

- Modern Logic in the late nineteenth and twentieth century, is characterized by a desire to systematize the foundations of mathematics through the instrument of logic.

- Logic is seen to be more elementary than mathematics, yet it is the development of logic and mathematics together that provided the impetus toward refinement of both logical and mathematical tools.
Modern Logic

• In 1879 Gottlob Frege gives us “a comprehensive treatment of the ideas of generality and existence, because sentence forms which were hitherto accommodated only by complicated ad hoc theories are here provided with an adequate symbolization by the device of quantification,” which we will study in chapter 6.
• Giuseppe Peano moves both logic and mathematics toward a more strict rule based formalism requiring that truth be based on provability.
Bertrand Russell began a project in 1903, *The Principles of Mathematics* in which he aimed to prove that “all pure mathematics deals exclusively with concepts definable in terms of a very small number of logical principles.”

Russell and Alfred North Whitehead continued the project in *Principia Mathematica*.
Modern Logic

• David Hilbert advanced the program that sought to formalize axiomatic mathematics as opposed to the construction of mathematical propositions piecemeal as needed.
• The tale continues with many luminaries, but for us class is over!