

Logic: What Is It and Why Study It?

- ◆ Logic: What Is It and Why Study It?
- ◆ Reasoning, Proving, Discovery, and Prediction
- ◆ Arguments, Deduction, Induction, and Abduction
- ◆ Truth and Validity
- ◆ Various Fallacies
- ◆ The Notion of a Conditional: The Heart of Logic
- ◆ Logic: What Is It All About?
- ◆ Mathematical Logic
- ◆ Various Philosophical Logics

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Major Text and Reference Books for Undergraduates

♣ Logic

- ◆ I. M. Copi and C. Cohen, "Introduction to Logic," Macmillan, 1953, 1961 (I. M. Copi), 1968, 1972, 1978, 1982, 1986, 1990, Prentice-Hall, 1994, 1998, 2002, 2005, Pearson Education, 2008 (I. M. Copi and C. Cohen), Routledge, 2010 (with K. D. McMahon) (14th Edition), 2019 (with V. Rodych) (15th Edition). [C&C]
- ◆ P. J. Hurley, "A Concise Introduction to Logic," Wadsworth, 1982, 1985, 1988, 1991, 1993, 1997, 1999, 2003, 2005, 2008, 2012, 2014, 2016 (with L. Watson) (13th Edition). [Hurley]
- ◆ D. Kelley, "The Art of Reasoning: An Introduction to Logic and Critical Thinking," W. W. Norton & Company, 1988, 1990, 1994, 1998, 2014 (4th Edition). [Kelley]

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Major Text and Reference Books for Undergraduates

♣ Mathematical Logic

- ◆ E. Mendelson, "Introduction to Mathematical Logic," Chapman & Hall, 1964, 1979, 1987, 1997, 2010, 2015 (6th Edition). [Mendelson]
- ◆ R. M. Smullyan, "A Beginner's Guide to Mathematical Logic," Dover Publications, 2014. [Smullyan]
- ◆ M. Ben-Ari, "Mathematical Logic for Computer Science," Springer, 1993, 2001, 2012 (3rd Edition). [Ben-Ari]
- ◆ W. Rutenber, "A Concise Introduction to Mathematical Logic," Springer, 1979, 2006, 2010 (3rd Edition). [Rutenber]
- ◆ S. Reeves and M. Clarke, "Logic for Computer Science," Addison-Wesley, 1990-2003. [R&C]

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Reference Books on Logic

- ◆ V. Klenk, "Understanding Symbolic Logic," Prentice-Hall, 1983, 1989, 1994, 2002, 2010 (5th Edition). [Klenk]
- ◆ R. M. Johnson, "A Logic Book: Fundamentals of Reasoning," Wadsworth, 1986, 1991, 1999, 2002, 2007 (5th Edition). [Johnson]
- ◆ R. Jeffrey, "Formal Logic: Its Scope and Limits," McGraw-Hill, 1967, 1981, 1991, Hackett Publishing, 2006 (with J. P. Burgess) (4th Edition). [Jeffrey]
- ◆ G. Restall, "Logic: An Introduction," Routledge, 2006. [Restall]
- ◆ C. S. Layman, "The Power of Logic," Mayfield, 1999, 2002, McGraw-Hill, 2005 (3rd Edition). [Layman]
- ◆ C. Allen & M. Hand, "Logic Primer," The MIT Press, 1992, 2001 (2nd Edition). [A&H]
- ◆ G. Priest, "Logic: A Very Short Introduction," Oxford University Press, 2000. [Priest]
- ◆ J. N. Nolt, D. Rohatyn, and A. Varzi, "Schaum's Outline of Theory and Problems of Logic," McGraw-Hill, 1988, 1998 (2nd Edition). [N&R&V]

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Reference Books on Mathematical Logic

- ◆ B. Meltzer (translation) and R. B. Braithwaite (Introduction), K. Gödel, "On formally undecidable propositions of Principia Mathematica and related systems I," Basic Books, 1962, Dover Publications, 1992. [Gödel]
- ◆ R. M. Smullyan, "A Beginner's Guide to Mathematical Logic," Dover Publications, 2014; "A Beginner's Further Guide to Mathematical Logic," World Scientific, 2017. [Smullyan]
- ◆ D. van Dalen, "Logic and Structure," Springer, 1980, 1983, 1994, 2004, 2013 (5th Edition). [Dalen]
- ◆ Y. I. Manin, "A Course in Mathematical Logic for Mathematicians," Springer, 1977, 2010 (2nd Edition). [Manin]
- ◆ G. S. Boolos, J. P. Burgess, and R. C. Jeffrey, "Computability and Logic," Cambridge University Press, 1974, 1980, 1990, 2002, 2007 (5th Edition). [B&B&J]
- ◆ H. B. Enderton, "A Mathematical Introduction to Logic," Academic Press, 1972, 2001 (2nd Edition). [Enderton]
- ◆ H.-D. Ebbinghaus, J. Flum, and W. Thomas, "Mathematical Logic," Springer, 1978, 1994 (2nd Edition). [E&F&T]
- ◆ A. G. Hamilton, "Logic for Mathematicians," Cambridge University Press, 1978, 1989 (2nd Revised Edition). [Hamilton]
- ◆ J. R. Shoenfield, "Mathematical Logic," Association for Symbolic Logic, Addison-Wesley, 1967. [Shoenfield]

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Reference Books on Mathematical Logic for CS

- ◆ J. H. Gallier, "Logic for Computer Science -- Foundations of Automatic Theorem Proving," Harper & Row, 1986, **2003** (Revised Online Edition), Dover Publications, 2015 (2nd Edition). [Gallier]
- ◆ M. Ben-Ari, "Mathematical Logic for Computer Science," Springer, 1993, 2001, **2012** (3rd Edition). [Ben-Ari]
- ◆ M. Huth and M. Ryan, "Logic in Computer Science: Modelling and Reasoning about Systems," **2004** (2nd Edition). [H&R]
- ◆ S. Reeves and M. Clarke, "Logic for Computer Science," Addison-Wesley, 1990-**2003**. [R&C]
- ◆ A. Nerode and R. A. Shore, "Logic for Applications," Springer, **1993**, 1997 (2nd Edition). [N&S]
- ◆ M. Fitting, "First-Order Logic and Automated Theorem Proving," Springer, 1990, **1996** (2nd Edition). [Fitting]

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Reference Books on Philosophical Logic

- ◆ G. Priest, "An Introduction to Non-Classical Logic: From If to Is," Cambridge University Press, 2001, 2008 (2nd Edition).
- ◆ G. E. Hughes and M. J. Cresswell, "A New Introduction to Modal Logic," Routledge, 1968.
- ◆ P. Blackburn, M. de Rijke, and Y. Venema, "Modal Logic," Cambridge University Press, 2001.
- ◆ P. Ohlstrom and P. F. V. Hasle, "Temporal Logic: From Ancient Ideas to Artificial Intelligence," Kluwer Academic, 1995.
- ◆ J.-J. Ch. Meyer and W. van der Hoek, "Epistemic Logic for AI and Computer Science," Cambridge University Press, 1995.
- ◆ N. Rescher, "Epistemic Logic: A Survey of the Logic of Knowledge," University of Pittsburgh Press, 2005.
- ◆ H. van Ditmarsch, W. van der Hoek, and B. Kooi, "Dynamic Epistemic Logic," Springer, 2007.
- ◆ A. R. Anderson and N. D. Belnap Jr., "Entailment: The Logic of Relevance and Necessity," Vol. I, Princeton University Press, Princeton, 1975.
- ◆ A. R. Anderson, N. D. Belnap Jr., and J. M. Dunn, "Entailment: The Logic of Relevance and Necessity," Vol. II, Princeton University Press, Princeton, 1992.
- ◆ E. D. Mares, "Relevant Logic: A Philosophical Interpretation," Cambridge University Press, Cambridge, 2004.

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Classical/Important Reference Books on Logic

- ◆ A. Tarski, "Introduction to Logic and to the Methodology of the Deductive Sciences," Oxford University Press, 1941, 1946, 1965, 1994 (4th Edition, Revised).
- ◆ W. Kneale and M. Kneale, "The Development of Logic," Clarendon Press, 1962, 1984 (Paperback Edition with Corrections).
- ◆ P. H. Nidditch, "The Development of Mathematical Logic," Thoemmes, 1962.
- ◆ H. DeLong, "A Profile of Mathematical Logic," Addison-Wesley, 1970, Dover Publications, 2004.
- ◆ J. N. Crossley, et al., "What is Mathematical Logic?" Oxford University Press, 1972, Dover Publications 1990.
- ◆ H. Wang, "Popular Lectures on Mathematical Logic," Van Nostrand Reinhold, 1981, Dover Publications, 1993.
- ◆ D. M. Gabbay (ed.), "What is a Logical System?" Oxford University Press, 1994.

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Logic: What Is It ?

Logic: What Is It ?

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"Logic is the science of sciences, and the art of arts."

"Logic is the science of sciences, and the art of arts."

-- John Duns Scotus, 13th century.

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"Nothing can be more important than the art of formal reasoning according to true logic."

"Nothing can be more important than the art of formal reasoning according to true logic."

-- Gottfried Wilhelm Leibniz

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"Logic is the basis for all other sciences"

◆ "There is a special discipline, called logic, which is considered to be the basis for all other sciences."

"Logic evolved into an independent science long ago, earlier even than arithmetic and geometry."

-- A. Tarski, 1941.

◆ "Mathematical Logic, it is a science prior to all others, which contains the ideas and principles underlying all sciences."

-- K. Gödel, 1944.

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"Logic is the basis for all other sciences"

◆ "The development of Western Science has been based on two great achievements, the invention of the formal logical system (in Euclidean geometry) by the Greek philosophers, and the discovery of the possibility of finding out causal relationships by systematic experiment (at the Renaissance)."

-- A. Einstein, 1953.

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"Fields of Science and Technology" by UNESCO

◆ "Proposed International Standard Nomenclature for Fields of Science and Technology," UNESCO/NS/ROU/257 rev.1, 1988.

◆ 11. **Logic**, 12. Mathematics

◆ 21. Astronomy and Astrophysics, 22. Physics, 23. Chemistry, 24. Life Sciences, 25. Earth and Space Science

◆ 31. Agricultural Sciences, 32. Medical Sciences, 33. Technological Sciences

◆ 1203. **Computer Science**

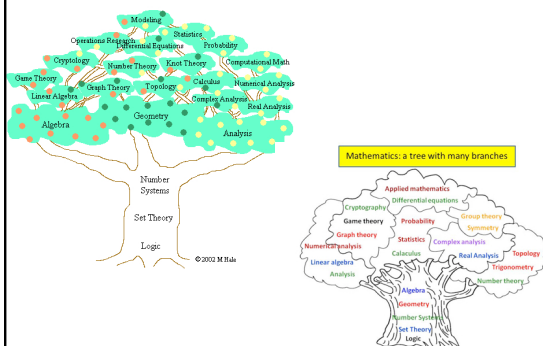
◆ 3304. **Computer Technology**

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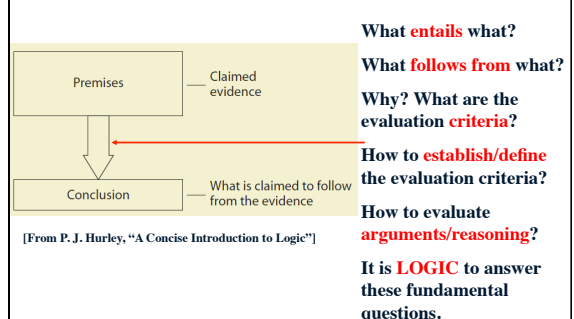
Logic as the Fundamental Basis for all Mathematics



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Logic: What Is It?



[From P. J. Hurley, "A Concise Introduction to Logic"]

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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 1

- ◆ { (1) NEU is located in ShenYang,
(2) ShenYang is in LiaoNing }
=> (3) NEU is located in LiaoNing (China? HunNan?)
- ◆ Note: (1), (2), (3) are true; this reasoning is correct/
reasonable.
- ◆ Note: If in (3) “LiaoNing” is replaced by “China/HunNan”,
then the reasoning is NOT correct / reasonable. (Why?)

♣ Example 1'

- ◆ { (1) N is located in SY,
(2) SY is in LN }
=> (3) N is located in LN (C? HN?)
- ◆ Note: This reasoning is correct/reasonable without regard to
the meaning of N, SY, and LN.

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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 1

- ◆ { (1) SUSTech is located in ShenZhen,
(2) ShenZhen is in GuangDong }
=> (3) SUSTech is located in GuangDong (China?NanShan?)
- ◆ Note: (1), (2), (3) are true; this reasoning is correct/
reasonable.
- ◆ Note: If in (3) “GuangDong” is replaced by “China/
NanShan”, then the reasoning is NOT correct / reasonable.
(Why?)

♣ Example 1'

- ◆ { (1) S is located in SZ,
(2) SZ is in GD }
=> (3) S is located in GD (C? NS?)
- ◆ Note: This reasoning is correct/reasonable without regard to
the meaning of S, SZ, and GD.

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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 2

- ◆ { (1) NEU is located in ShenYang,
(2) ShenYang is in LiaoNing }
=> (3) NEU is located in JiLin (China? HunNan?)
- ◆ Note: (1), (2) are true, but (3) is false; this reasoning is
incorrect/unreasonable.
- ◆ Note: If in (3) “JiLin” is replaced by “China/HunNan”, then
the reasoning is still incorrect/unreasonable. (Why?)

♣ Example 2'

- ◆ { (1) N is located in SY,
(2) SY is in LN }
=> (3) N is located in JL (C? HN?)
- ◆ Note: This reasoning is incorrect/unreasonable without
regard to the meaning of N, SY, LN, and JL.

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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 2

- ◆ { (1) SUSTech is located in ShenZhen,
(2) ShenZhen is in GuangDong }
=> (3) SUSTech is located in FuJian (China? NanShan?)
- ◆ Note: (1), (2) are true, but (3) is false; this reasoning is
incorrect/unreasonable.
- ◆ Note: If in (3) “FuJian” is replaced by “China/NanShan”,
then the reasoning is still incorrect/unreasonable. (Why?)

♣ Example 2'

- ◆ { (1) S is located in SZ,
(2) SZ is in GD }
=> (3) S is located in FJ (C? NS?)
- ◆ Note: This reasoning is incorrect/unreasonable without
regard to the meaning of S, SZ, GD, and FJ.

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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 3

- ◆ { (1) NEU is located in ShenYang,
(2) ShenYang is in JiLin }
=> (3) NEU is located in LiaoNing (China? HunNan?)
- ◆ Note: (1), (3) are true, but (2) is false; this reasoning is
incorrect/unreasonable.
- ◆ Note: If in (3) “LiaoNing” is replaced by “China/HunNan”,
then the reasoning is still incorrect/unreasonable. (Why?)

♣ Example 3'

- ◆ { (1) N is located in SY,
(2) SY is in JL }
=> (3) N is located in LN (C? HN?)
- ◆ Note: This reasoning is incorrect/unreasonable without
regard to the meaning of N, SY, JL, and LN.

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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 3

- ◆ { (1) SUSTech is located in ShenZhen,
(2) ShenZhen is in FuJian }
=> (3) SUSTech is located in GuangDong (China?NanShan?)
- ◆ Note: (1), (3) are true, but (2) is false; this reasoning is
incorrect and/or unreasonable.
- ◆ Note: If in (3) “GuangDong” is replaced by “China/
NanShan”, then the reasoning is still incorrect/
unreasonable. (Why?)

♣ Example 3'

- ◆ { (1) S is located in SZ,
(2) SZ is in FJ }
=> (3) S is located in GD (C? NS?)
- ◆ Note: This reasoning is incorrect/unreasonable without
regard to the meaning of S, SZ, FJ, and GD.

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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 4

- ◆ { (1) NEU is located in ChangChun,
(2) ShenYang is in LiaoNing }
=> (3) NEU is located in ShenYang (China? HunNan?)
- ◆ Note: (2), (3) are true, but (1) is false; this reasoning is incorrect / unreasonable.
- ◆ Note: If in (3) “ShenYang” is replaced by “China/HunNan”, then the reasoning is still incorrect/unreasonable. (Why?)

♣ Example 4'

- ◆ { (1) N is located in CC,
(2) SY is in LN }
=> (3) N is located in SY (C? HN?)
- ◆ Note: This reasoning is incorrect/unreasonable without regard to the meaning of N, CC, LN, and SY.



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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 4

- ◆ { (1) SUSTech is located in FuZhou,
(2) ShenZhen is in GuangDong }
=> (3) SUSTech is located in ShenZhen (China? NanShan?)
- ◆ Note: (2), (3) are true, but (1) is false; this reasoning is incorrect / unreasonable.
- ◆ Note: If in (3) “ShenZhen” is replaced by “China/NanShan”, then the reasoning is still incorrect/unreasonable. (Why?)

♣ Example 4'

- ◆ { (1) S is located in FZ,
(2) SZ is in GD }
=> (3) S is located in SZ (C? NS?)
- ◆ Note: This reasoning is incorrect/unreasonable without regard to the meaning of S, FZ, GD, and SZ.



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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 5

- ◆ { (1) NEU is located in ShenYang,
(2) ShenYang is in JiLin }
=> (3) NEU is located in JiLin (China? HunNan?)
- ◆ Note: (1) is true, but (2), (3) are false; this reasoning is correct / reasonable!
- ◆ Note: If in (3) “JiLin” is replaced by “China/HunNan”, then the reasoning is NOT correct/reasonable. (Why?)

♣ Example 5'

- ◆ { (1) N is located in SY,
(2) SY is in JL }
=> (3) N is located in JL (C? H?)
- ◆ Note: This reasoning is correct/reasonable without regard to the meaning of N, SY, and JL!



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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 5

- ◆ { (1) SUSTech is located in ShenZhen,
(2) ShenZhen is in FuJian }
=> (3) SUSTech is located in FuJian (China? NanShan?)
- ◆ Note: (1) is true, but (2), (3) are false; this reasoning is correct/reasonable!
- ◆ Note: If in (3) “FuJian” is replaced by “China/NanShan”, then the reasoning is NOT correct/reasonable. (Why?)

♣ Example 5'

- ◆ { (1) S is located in SZ,
(2) SZ is in FJ }
=> (3) S is located in FJ (C? NS?)
- ◆ Note: This reasoning is correct/reasonable without regard to the meaning of S, SZ, and FJ!



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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 6

- ◆ { (1) NEU is located in ChangChun,
(2) ChangChun is in JiLin }
=> (3) NEU is located in JiLin (China? HunNan?)
- ◆ Note: (2) is true, but (1), (3) are false; this reasoning is correct/reasonable!
- ◆ Note: If in (3) “JiLin” is replaced by “China/HunNan”, then the reasoning is NOT correct/reasonable. (Why?)

♣ Example 6'

- ◆ { (1) N is located in CC,
(2) CC is in JL }
=> (3) N is located in JL (C? HN?)
- ◆ Note: This reasoning is correct/reasonable without regard to the meaning of N, CC, and JL!



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Argument Examples: Correct/Incorrect Reasoning?

♣ Example 6

- ◆ { (1) SUSTech is located in FuZhou,
(2) FuZhou is in FuJian }
=> (3) SUSTech is located in FuJian (China? NanShan?)
- ◆ Note: (2) is true, but (1), (3) are false; this reasoning is correct / reasonable!
- ◆ Note: If in (3) “FuJian” is replaced by “China/HunNan”, then the reasoning is NOT correct/reasonable. (Why?)

♣ Example 6'

- ◆ { (1) S is located in FZ,
(2) FZ is in FJ }
=> (3) S is located in FJ (C? NS?)
- ◆ Note: This reasoning is correct/reasonable without regard to the meaning of S, FZ, and FJ!



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What Can You Think of from These Examples?

What Can You Think of from These Examples?

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What Questions should We Consider?

♣ What is the correctness/validity criterion?

- ◆ When we say something is good or bad (for anything), there should be a correctness criterion such that we use it to distinguish good things from bad things.
- ◆ When we say a reasoning is good or bad, there should be a correctness/validity criterion such that we use it to distinguish good reasoning from bad reasoning.

♣ What the correctness/validity criterion should be about?

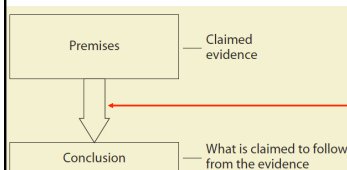
- ◆ The criterion should be about the truth of conclusion.
- ◆ The criterion should be about not only the truth of conclusion but also the truth of premises.
- ◆ The criterion should be about not only the truth of conclusion and the truth of premises but also some **relevant/evidential relationship** between conclusion and premises.

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Logic: What Is It?



[From P. J. Hurley, "A Concise Introduction to Logic"]

What **entails** what?

What **follows from** what?

Why? What are the evaluation **criteria**?

How to **establish/define** the evaluation criteria?

How to **evaluate arguments/reasoning**?

It is **LOGIC** to answer these fundamental questions.

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Logic: What Is It?

◆ "Logic is the science of sciences, and the art of arts."

-- John Duns Scotus, 13th century.

◆ "Now logic while it is the science of reasoning in general is in a more especial sense the science of reasoning by signs. It investigates the forms and expressions to which correct reasoning may be reduced and the laws upon which it is founded."

-- G. Boole, "The Nature of Logic," 1848, in I. Grattan-Guinness and G. Bornet (Eds.), "George Boole - Selected Manuscripts on Logic and its Philosophy," Birkhauser Verlag, 1997.

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Logic: What Is It?

- ◆ "Logic has always made high claims as the scientia scientiarum, **the science of sciences**."
-- W. Minto, "Logic: Inductive and Deductive," C. Scribner's Sons, 1893, Kessinger Publishing, 2004 (Reprint).
- ◆ "Logic in the narrower sense is that science which concerns itself primarily with **distinguishing probable reasonings into good and bad reasonings**, and with **distinguishing probable reasonings into strong and weak reasonings**. Secondly, logic concerns itself with all that it must study in order to draw those distinctions about reasoning, and with nothing else."
-- C. S. Peirce, "Reasoning and the Logic of Things - The Cambridge Conferences Lectures of 1898," K. L. Ketner (Ed.), Harvard University Press, 1992.

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Logic: What Is It?

◆ "The essential purpose of logic is attained if we can **analyse the various forms of inference and arrive at a systematic way of discriminating the valid from the invalid forms**."

-- M. R. Cohen and E. N. Nagel, "An Introduction to Logic and Scientific Method," Routledge and Kegan Paul, 1934.

◆ "There is a special discipline, called **logic**, which **is considered to be the basis for all other sciences**, and where one aims to establish the precise meaning of such terms (as "not", "and", "or", "is", "every", "some", and many others belong here) and to determine the most general laws which govern them. **Logic evolved into an independent science long ago, earlier even than arithmetic and geometry**."

-- A. Tarski, "Introduction to Logic and to the Methodology of the Deductive Sciences," Oxford University Press, 1941, 1946, 1965, 1994 (4th Edition, Revised).

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Logic: What Is It?

- ◆ “Mathematical Logic, which is nothing else but a precise and complete formulation of formal logic, has two quite different aspects. On the one hand, it is a section of Mathematics, treating of classes, relations, combinations of symbols, etc. instead of numbers, functions, geometric figures, etc. On the other hand, **it is a science prior to all others, which contains the ideas and principles underlying all sciences.** It was in the second sense that Mathematical Logic was first conceived by Leibniz in his *Characteristica universalis*, of which it would have formed a central part.”
- K. Gödel, “Russell’s Mathematical Logic,” in Schilpp (Ed.) “*The Philosophy of Bertrand Russell*,” Open Court Publishing Company, 1944.

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Logic: What Is It?

- ◆ “**Logic is the study of the methods and principles used to distinguish good (correct) from bad (incorrect) reasoning.**”
- “**The aim of the study of logic is to discover and make available those criteria that can be used to test arguments for correctness.**”
- “The distinction between correct and incorrect reasoning is the central problem with which logic deals. The logician’s methods and techniques have been developed primarily for the purpose of making this distinction clear.”
- I. M. Copi and C. Cohen, “Introduction to Logic,” Macmillan, 1953, 1961 (I. M. Copi), 1968, 1972, 1978, 1982, 1986, 1990, Prentice-Hall, 1994, 1998, 2002, 2005, Pearson Education, 2008 (I. M. Copi and C. Cohen), Routledge, 2010 (with K. D. McMahon) (14th Edition).

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Logic: What Is It?

- ◆ “**Logic is the study of the methods and principles used to distinguish correct reasoning from incorrect reasoning.** There are objective criteria with which correct reasoning may be defined. If these criteria are not known, then they cannot be used. **The aim of the study of logic is to discover and make available those criteria that can be used to test arguments, and to sort good arguments from bad ones.**”
- I. M. Copi and C. Cohen, “Introduction to Logic,” Macmillan, 1953, 1961 (I. M. Copi), 1968, 1972, 1978, 1982, 1986, 1990, Prentice-Hall, 1994, 1998, 2002, 2005, Pearson Education, 2008 (I. M. Copi and C. Cohen), Routledge, 2010 (with K. D. McMahon) (14th Edition).

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Logic: What Is It?

- ♣ **Logic is a normative and/or prescriptive discipline**
- ◆ Logic deals with *what entails what* or *what follows from what*, and aims at determining which are the correct conclusions of a given set of premises, i.e., to determine which arguments and/or reasoning are correct/valid.
- ◆ It is a normative science to evaluate various arguments.
- ♣ **Logic is NOT a discipline dealing with thinking**
- ◆ “It is a familiar misconception to believe that to do mathematical logic is to be engaged primarily in formal thinking. The important point is rather to make precise the concept of formal system and thereby be able to reason mathematically about formal systems. And this adds a new dimension to mathematics.”
- H. Wang, “Popular Lectures on Mathematical Logic,” Van Nostrand Reinhold, 1981, Dover Publications, 1993.

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Logic: Why Study It ?

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Logic: Why Study It?

- ◆ “The development of Western Science has been based on two great achievements, **the invention of the formal logical system** (in Euclidean geometry) by the Greek philosophers, and the discovery of the possibility of finding out causal relationships by systematic experiment (at the Renaissance).”
- A. Einstein, 1953.

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Logic: Why Study It?

- ◆ “The most immediate benefit derived from the study of logic is **the skill needed to construct sound arguments of one’s own and to evaluate the arguments of others.**”
- “In accomplishing this goal, logic instills a sensitivity for the formal component in language, a thorough command of which is **indispensable to clear, effective, and meaningful communication.**”
- P. J. Hurley, “A Concise Introduction to Logic,” Wadsworth, 1982, 1985, 1988, 1991, 1993, 1997, 1999, 2003, 2005, 2008, 2012 (11th Edition).

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Logic: Why Study It?

- ◆ “On a broader scale, by **focusing attention on the requirement for reasons or evidence to support our views**, logic provides a fundamental defense against the prejudiced and uncivilized attitudes that threaten the foundations of our democratic society.”
- “Finally, **through its attention to inconsistency as a fatal flaw in any theory or point of view**, logic proves a useful device in disclosing ill-conceived policies in the political sphere and, ultimately, in distinguishing the rational from the irrational, the sane from the insane.”
- P. J. Hurley, “A Concise Introduction to Logic,” Wadsworth, 1982, 1985, 1988, 1991, 1993, 1997, 1999, 2003, 2005, 2008, 2012 (11th Edition).

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Logic: Why Study It?

- ◆ “**Nothing is more natural to conversation than argument.** We try to convince the person we are arguing with that we are right, that our conclusion follows from something that they will accept. It would be no good if we could not tell when one thing followed from another. What is often passed off in conversation as an argument does not fit the bill.”
- D. Cryan, S. Shatil, and B. Mayblin, “Introducing Logic,” Icon Books, 2001.

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Logic: Why Study It?

- ♣ “Logic is the science of sciences, and the art of arts.”
- ◆ “**不以规矩，不成方圆。**” – 孟子(约前372–前289)《离娄章句上》“不以规矩，不能成方圆。” (about BC372–BC289)
- ◆ “Nothing can be accomplished without norms or standards.”
- ◆ To study logic is to discover and make available those criteria (principles and methods) that can be used to distinguish correct reasoning from incorrect reasoning.
- ♣ “**Nothing can be more important than logic.**”
- ◆ “**Nothing can be more important than the art of formal reasoning according to true logic.**” – G. W. Leibniz

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Logic: What Is It and Why Study It?

♣ Homework

- ◆ (1) Read my teaching material “Logic: What Is It? – A Collection of Definitions of ‘Logic’ and ‘Mathematical Logic’” (JD.Cheng_L_Logic-What.is.it.pdf),
- (2) select the five definitions that are most convincing you, and
- (3) explain why the five definitions are convincing you.

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Logic: What Is It and Why Study It?

- ◆ Logic: What Is It and Why Study It?
- ◆ **Reasoning, Proving, Discovery, and Prediction**
- ◆ Arguments, Deduction, Induction, and Abduction
- ◆ Truth and Validity
- ◆ Various Fallacies
- ◆ The Notion of a Conditional: The Heart of Logic
- ◆ Logic: What Is It All About?
- ◆ Mathematical Logic
- ◆ Various Philosophical Logics

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