

Notes for Elementary Symbolic Logic

Table of contents

1. Introduction

1.1. Formal deductive logic

1.1.0. Overview — 1.1.1. Logic — 1.1.2. Inference — 1.1.3. Arguments — 1.1.4. Deductive vs. non-deductive inference — 1.1.5. Bounds on inference — 1.1.6. Entailment and exclusion — 1.1.7. Inconsistency and exhaustiveness — 1.1.8. Formal logic — 1.1.s. Summary — 1.1.x. Exercises — 1.1.xa. Exercise answers

1.2. What is said: propositions

1.2.0. Overview — 1.2.1. Truth values and possible worlds — 1.2.2. Truth conditions and propositions — 1.2.3. Ordering by content — 1.2.4. Equivalence in content — 1.2.5. The extremes of content — 1.2.6. Logical space and the algebra of propositions — 1.2.7. Contrasting content — 1.2.8. Deductive relations in general — 1.2.s. Summary — 1.2.x. Exercises — 1.2.xa. Exercise answers

1.3. Beyond saying: pragmatics

1.3.0. Overview — 1.3.1. A model of language — 1.3.2. Some complications — 1.3.3. Speech acts — 1.3.4. Implicature — 1.3.5. Indexicality — 1.3.6. Vagueness — 1.3.7. Pre-supposition — 1.3.s. Summary — 1.3.x. Exercises — 1.3.xa. Exercise answers

1.4. General principles of deductive reasoning

1.4.0. Overview — 1.4.1. A closer look at entailment — 1.4.2. Separation — 1.4.3. Content and coverage — 1.4.4. Relative exhaustiveness — 1.4.5. A general framework — 1.4.6. Reduction to entailment — 1.4.7. Laws for entailment — 1.4.8. Duality — 1.4.s. Summary — 1.4.x. Exercises — 1.4.xa. Exercise answers

2. Conjunctions

2.1. **And**: adding content

2.1.0. Overview — 2.1.1. A connective — 2.1.2. A truth function — 2.1.3. Conjunction in English — 2.1.4. Limits on analysis — 2.1.5. Multiple conjunction — 2.1.6. Some sample analyses — 2.1.7. Logical forms — 2.1.8. Interpretations — 2.1.s. Summary — 2.1.x. Exercises — 2.1.xa. Exercise answers

2.2. Proofs: analyzing entailment

2.2.0. Overview — 2.2.1. Proofs as trees — 2.2.2. Argument trees — 2.2.3. Derivations — 2.2.4. Rules for derivations — 2.2.5. An example — 2.2.6. Two perspectives on derivations — 2.2.7. More rules — 2.2.8. Resources — 2.2.s. Summary — 2.2.x. Exercises — 2.2.xa. Exercise answers

2.3. Failed proofs and counterexamples

2.3.0. Overview — 2.3.1. When enough is enough — 2.3.2. Dead ends and counterexamples — 2.3.3. Validity through the generations — 2.3.4. Sound and safe rules — 2.3.5. Confirming counterexamples — 2.3.6. Reaching decisions — 2.3.7. Soundness and completeness — 2.3.8. Formal validity — 2.3.s. Summary — 2.3.x. Exercises — 2.3.xa. Exercise answers

2.4. Using lemmas

2.4.0. Overview — 2.4.1. Premises, assumptions, and suppositions — 2.4.2. The dangers of lemmas — 2.4.3. Lemmas for *reductio* arguments — 2.4.4. Attachment rules — 2.4.s. Summary — 2.4.x. Exercises — 2.4.xa. Exercise answers

3. Negations

3.1. **Not**: contradicting content

3.1.0. Overview — 3.1.1. Connectives — 3.1.2. Contradictory propositions — 3.1.3. Negation in English — 3.1.4. Negated conjunctions and conjoined negations — 3.1.5. Some sample analyses — 3.1.s. Summary — 3.1.x. Exercises — 3.1.xa. Exercise answers

3.2. *Reductio* arguments: refuting suppositions

3.2.0. Overview — 3.2.1. The duality of premises and alternatives — 3.2.2. Drawing negative conclusions — 3.2.3. Some examples — 3.2.s. Summary — 3.2.x. Exercises — 3.2.xa. Exercise answers

3.3. Negations as premises

3.3.0. Overview — 3.3.1. Indirect proof — 3.3.2. Using lemmas to complete *reductios* — 3.3.3. More examples — 3.3.s. Summary — 3.3.x. Exercises — 3.3.xa. Exercise answers

3.4. Counterexamples to *reductios*

3.4.0. Overview — 3.4.1. When *reductios* fail — 3.4.2. Some examples of consistency — 3.4.s. Summary — 3.4.x. Exercises — 3.4.xa. Exercise answers

3.5. Being guided by the rules

3.5.0. Overview — 3.5.1. Approaching derivations — 3.5.2. An example — 3.5.3. A procedure — 3.5.s. Summary — 3.5.x. Exercises — 3.5.xa. Exercise answers

4. Disjunctions

4.1. **Or**: taking common content

4.1.0. Overview — 4.1.1. Hedging — 4.1.2. Inclusive and exclusive disjunction — 4.1.3. Disjunction in English — 4.1.4. Further examples — 4.1.s. Summary — 4.1.x. Exercises — 4.1.xa. Exercise answers

4.2. Arguing from and for alternatives

4.2.0. Overview — 4.2.1. Proofs by cases — 4.2.2. Proving disjunctions — 4.2.3. Further examples — 4.2.4. The duality of conjunction and disjunction — 4.2.s. Summary — 4.2.x. Exercises — 4.2.xa. Exercise answers

4.3. Detachment: eliminating alternatives

4.3.0. Overview — 4.3.1. Detachment rules — 4.3.2. More attachment rules — 4.3.s. Summary — 4.3.x. Exercises — 4.3.xa. Exercise answers

5. Conditionals

5.1. **If**: trimming content

5.1.0. Overview — 5.1.1. Conditions — 5.1.2. The conditional as a truth-functional connective — 5.1.3. Doubts about truth-functionality — 5.1.4. Examples — 5.1.s. Summary — 5.1.x. Exercises — 5.1.xa. Exercise answers

5.2. **Only if** and **unless**

5.2.0. Overview — 5.2.1. **Only if** — 5.2.2. Necessary and sufficient conditions — 5.2.3. **Unless** — 5.2.4. Three forms compared — 5.2.s. Summary — 5.2.x. Exercises — 5.2.xa. Exercise answers

5.3. Conditional proofs: bottling inference

5.3.0. Overview — 5.3.1. Conditionalization — 5.3.2. Detachment — 5.3.s. Summary — 5.3.x. Exercises — 5.3.xa. Exercise answers

5.4. Extreme measures

5.4.0. Overview — 5.4.1. Last resorts — 5.4.2. Optional extras — 5.4.s. Summary — 5.4.x. Exercises — 5.4.xa. Exercise answers

6. Predications

6.1. Naming and describing

6.1.0. Overview — 6.1.1. A richer grammar — 6.1.2. Logical predicates — 6.1.3. Extensionality — 6.1.4. Identity — 6.1.5. Analyzing predications — 6.1.6. Individual terms — 6.1.7. Functors — 6.1.8. Examples and problems — 6.1.s. Summary — 6.1.x. Exercises — 6.1.xa. Exercise answers

6.2. Predicates and pronouns

6.2.0. Overview — 6.2.1. Abstracts — 6.2.2. Bound variables — 6.2.3. Variables and pronouns — 6.2.4. Expanded and reduced forms — 6.2.s. Summary — 6.2.x. Exercises — 6.2.xa. Exercise answers

6.3. Arguments involving equations

6.3.0. Overview — 6.3.1. Logical properties of identity — 6.3.2. A law for aliases — 6.3.3. Derivations for identity — 6.3.s. Summary — 6.3.x. Exercises — 6.3.xa. Exercise answers

6.4. Describing models

6.4.0. Overview — 6.4.1. Extensions and ranges — 6.4.2. Building structures — 6.4.3. Structures as counterexamples — 6.4.s. Summary — 6.4.x. Exercises — 6.4.xa. Exercise answers

7. Generalizations

7.1. Generalizations in English

7.1.0. Overview — 7.1.1. Theories of quantifier phrases — 7.1.2. Pronouns and quantifier phrases — 7.1.3. Finding quantifier phrases — 7.1.4. Kinds of generalizations — 7.1.5. Bounds and exceptions — 7.1.s. Summary — 7.1.x. Exercises — 7.1.xa. Exercise answers

7.2. Generalizations and quantifiers

7.2.0. Overview — 7.2.1. The universal quantifier — 7.2.2. Analyzing generalizations — 7.2.3. Compound restrictions — 7.2.s. Summary — 7.2.x. Exercises — 7.2.xa. Exercise answers

7.3. Quantifiers and connectives

7.3.0. Overview — 7.3.1. Generalizations and counterexamples — 7.3.2. Generalizations as components — 7.3.3. **Any** and **every** — 7.3.s. Summary — 7.3.x. Exercises — 7.3.xa. Exercise answers

7.4. Multiple generality

7.4.0. Overview — 7.4.1. Multiple generality — 7.4.2. Judging the scope of quantifier phrases — 7.4.s. Summary — 7.4.x. Exercises — 7.4.xa. Exercise answers

7.5. General arguments

7.5.0. Overview — 7.5.1. Conjunction and universal quantification — 7.5.2. Instantiation — 7.5.3. Generalization — 7.5.4. Adding instances — 7.5.5. General arguments in derivations — 7.5.6. Syllogisms — 7.5.s. Summary — 7.5.x. Exercises — 7.5.xa. Exercise answers

7.6. Insuring generality

7.6.0. Overview — 7.6.1. How generality can fail — 7.6.2. Multiply general arguments — 7.6.s. Summary — 7.6.x. Exercises — 7.6.xa. Exercise answers

7.7. Soundness & completeness

7.7.0. Overview — 7.7.1. Aspects of adequacy — 7.7.2. Soundness — 7.7.3. Thoroughness — 7.7.4. Effectuality — 7.7.s. Summary — 7.7.x. Exercises — 7.7.xa. Exercise answers

7.8. Finite & infinite structures

7.8.0. Overview — 7.8.1. Finding finite structures — 7.8.2. The failure of decisiveness — 7.8.s. Summary — 7.8.x. Exercises — 7.8.xa. Exercise answers

8. Numerations

8.1. **Some**

8.1.0. Overview — 8.1.1. Exemplification — 8.1.2. Obversion — 8.1.3. Conversion — 8.1.4. Existentials exemplified — 8.1.5. Existential commitment — 8.1.s. Summary — 8.1.x. Exercises — 8.1.xa. Exercise answers

8.2. Uniform generality

8.2.0. Overview — 8.2.1. General and uniformly general exemplification — 8.2.2. Quantifier scope ambiguities — 8.2.3. Controlling ambiguity — 8.2.s. Summary — 8.2.x. Exercises — 8.2.xa. Exercise answers

8.3. Numerical quantification

8.3.0. Overview — 8.3.1. Else — 8.3.2. Numerical quantifier phrases — 8.3.3. Exactly n — 8.3.s. Summary — 8.3.x. Exercises — 8.3.xa. Exercise answers

8.4. Definite descriptions

8.4.0. Overview — 8.4.1. The problem of definite descriptions — 8.4.2. Definite descriptions as quantifier phrases — 8.4.3. Definite descriptions as individual terms — 8.4.4. Examples: restrictive vs. non-restrictive relative clauses — 8.4.s. Summary — 8.4.x. Exercises — 8.4.xa. Exercise answers

8.5. Proofs by choice & proofs of existence

8.5.0. Overview — 8.5.1. Proof by choice — 8.5.2. Constructive and non-constructive proof — 8.5.3. Derivations for existentials — 8.5.4. First-order logic — 8.5.s. Summary — 8.5.x. Exercises — 8.5.xa. Exercise answers

8.6. Arguments involving descriptive reference

8.6.0. Overview — 8.6.1. The role of definite descriptions in entailment — 8.6.2. Derivations for the description operator — 8.6.3. Consequences for adequacy — 8.6.s. Summary — 8.6.x. Exercises — 8.6.xa. Exercise answers

Appendices

A. Reference

A.0. Overview — A.1. Definitions and notation for basic concepts — A.2. Logical forms — A.3. Truth tables — A.4. Derivation rules

B. Laws for relative exhaustiveness

Index and glossary

Glen Helman 12 Jul 2012