Chapter 6
A Boolean Logic Approach to Issues of Vagueness, Heuristics, Subjectivity, and Data Mining: A Boolean Logic, 0-1, Approach

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ABSTRACT

This chapter introduces several modules that can be used to supplement an introductory logic course. The modules cover advanced topics such as rule heuristics, association rules, polythetic vs. monothetic grouping, and subsective adjectives. These topics are all approached using ordinary propositional logic, Boolean algebra with 0-1 variables. The topics are presented using a computational approach. The computations and concepts are elementary and accessible to an undergraduate without further prerequisites. The modules besides introducing advanced topics also facilitate discussion of other logic topics such as the law of the excluded middle, the concept of vagueness, and privative adjectives. This chapter presents new solutions to these problems. The chapter reviews the place of these modules within the context of introductory logic courses and the history of science. The supplementation of an introductory logic course with these modules is expected to strongly motivate students to pursue advanced topics and to increase interest in topics related to logic.

INTRODUCTION

Current Logic Courses

The purpose of this chapter is to propose supplementary modules to introductory logic courses. The proposed supplements use elementary means but provide students with exposure to advanced topics.

Towards this end, this introductory section reviews both the core curriculum of logic courses as well as more advanced topics in logic courses. The following section then discusses the criteria of using el-

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ementary means to provide students with exposure to more advanced topics. The following section also details the innovations proposed by this chapter.

Although details will be given in the next section, a brief snapshot of the changes proposed in this chapter may be valuable. This chapter explores the capabilities of using propositional logic, Boolean algebra with 0-1 variables, to expose students to advanced concepts in logic. Certain advanced topics – semantic vagueness, borderline cases and fuzziness, data mining, avoiding the law of the excluded middle, rule heuristics, types of adjectives, and the theory of definition – can be presented with challenge and richness. Contrastively, other advanced topics such as modal logic and category theory cannot be presented using 0-1 logic.

A good description of both the broad nature of logic and the core curriculum requirements for an introductory logic course may be found in Smith (2017).

'Logic', in the broad sense, is a big field. Its technical development is of concern to philosophers and mathematicians, not to mention computer scientists (and others). Different constituencies will be particularly interested in different areas and give different emphases. Core 'classical 1st-order logic' is basic by anyone's lights. But after that, interests can diverge. For example, modal logic is of considerable interest to some philosophers, not so much to mathematicians, though parts of this sub-discipline are of concern to computer scientists. Set theory (which falls within the purview of mathematical logic, broadly understood) is an active area of research interest in mathematics, but because of its (supposed) foundational status even quite advanced results can be of interest to philosophers too. Type theory started out as a device of philosophy-minded logicians looking to avoid the paradoxes: it has become primarily the playground of computer scientists. The incompleteness theorems are relatively elementary results of the theory of computable functions, but are of particular conceptual interest to philosophers. Finite model theory is of interest to mathematicians and computer scientists, but perhaps not so much to philosophers. And so it goes.

The serious study of logic always starts with a reasonably rigorous treatment of quantification theory, covering both a proof-system for classical first-order logic (FOL), and the standard classical semantics, getting at least as far as a soundness and completeness proof for your favorite proof system.

Mathematical logic programs typically comprise in one order or another and in various proportions three or perhaps four elements in addition to a serious treatment of FOL: model theory; computability and decidability; introductory set theory; and variants of standard FOL such as second order logic, intuitionist logic, free logic and pure logic.

Smith (2015) provides a detailed survey of about two dozen introductory logic texts. The survey spans several decades and includes classical as well as recent texts.

Criteria for Inclusion of New Topics in an Introductory Logic Course

Logic is a vast subject. It is therefore necessary to set down criteria for the inclusion of new material to assure that it is within the grasp of introductory students. The criteria selected are the following: