Philosophy 470: Logical Theory I[1]

Description

This course has two goals. The primary goal is to give students a thorough understanding of the proof theory and semantics of classical propositional and first-order logic, as well as the rudiments of set theory; we prove fundamantal metatheoretic results, such as soundness, completeness, and compactness. The secondary goal of the course is to provide an overview of some of the most important alternatives to and extensions of classical logic, such as intuitionistic or modal logics.

Time and place

The class meets Thursdays from 2:00 till 4:30 in ARM 0110.

Office, phones, etc.

Office: AV Williams 3133, and also somewhere in Skinner Hall. Office phone: x56749. Home phone: 301-585-8714. You are welcome to call me at home, but not after 9pm, please. I'll announce office hours once they sort themselves out. The most likely time is Tuesday afternoons, but I'm not sure yet which office.

Course work

There will be regular assigned exercises, and at least two exams, which may have the form of take-home problem sets. Students and auditors will be asked to help with official note-taking, and may also be asked to give short presentations of straightforward material.

Materials

Many to the topics to be covered are treated in the following books, available in the bookstore:

- B. Chellas. *Modal Logic: an Introduction*, Cambridge University Press (1980).

- R. Thomason. *Symbolic Logic: an Introduction*, Macmillan Company (1970).

In addition, I'll be handing out lots of selections from various books and articles.

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[1] Please ignore the fact that the official number is temporarily 688L.

Topics

1. Background

   (a) Informal set theory
   (b) Induction

2. Classical propositional logic

   (a) Fitch-style deduction formulations
   (b) Hilbert-style axiomatic formulations
   (c) Equivalence of formulations

       i. Deduction theorem
       ii. Equivalence of F-style and H-style formulations

   (d) Resolution

       i. CNF and clauses
       ii. Resolution rule

   (e) Semantics for classical logic

       i. Valuation
       ii. Satisfaction
       iii. Satisfiability
       iv. Simultaneous satisfiability
       v. Semantic implication
       vi. Validity

   (f) Soundness, completeness

       i. Soundness theorem
       ii. Completeness theorem (Henkin)
       iii. Completeness theorem (Kalmar)
       iv. Compactness theorem
       v. Interpolation therorem
       vi. Decidability

3. First-order logic

   (a) Fitch-style formulations
   (b) Hilbert-style formulations
   (c) Equivalence of formulations

       i. Deduction theorem
       ii. Equivalence of F-style and H-style formulations

   (d) Resolution

       i. Unification and mgu's
       ii. Resolution with unification

   (e) Semantics for first-order logic

       i. Model (domain and valuation)
       ii. Satisfaction —=

  iii. Satisfiability

  iv. Simultaneous satisfiability

  v. Semantic implication ——-

  vi. Validity

(f) Soundness, completeness

  i. Soundness theorem

  ii. Completeness theorem (Henkin)

  iii. Compactness theorem

  iv. Interpolation theorem

(g) First order logic with identity

  i. Fitch and Frege style formulations

  ii. Semantics of identity

  iii. Modifications of completeness proof

  iv. Elimination of function symbols and constants

(h) Some elementary model theory

  i. Isomorphic models, categoricity

  ii. Lowenheim-Skolem theorem

4. Definitions and theories

 (a) Classical account of definitions

  i. Eliminability and conservativeness

  ii. Rules for definition

  iii. Beth's definability theorem

 (b) Formalizing some theories

  i. Number theory

  ii. Set theory

5. Some nonclassical logics

 (a) Many-valued logics

 (b) Modal logics (K,T,B,S4,S5)

  i. Possible worlds semantics

  ii. Fitch-style formulations

  iii. Hilbert-style formulations

  iv. Soundness

  v. Completeness (Henkin style)

 (c) Intuitionistic logic

  i. Fitch-style formulations

  ii. Hilbert-style formulations

  iii. Double-negation interpretations into classical logic

  iv. Interpretations into S4

  v. Kripke semantics