PHI455: Philosophical Logic

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About the Course:

Philosophical logic embraces logic in both its pure and applied forms, examining the philosophical issues arising out of each. Theoretical work in logical AI and in philosophical logic overlap to a large extent. There is substantial overlap in theoretical emphasis with *The Journal of Philosophical Logic*, where topics such as tense logic, epistemic logic, logical approaches to practical reasoning, belief change, and vagueness account for a large percentage of the contributions.

The objective of this course is to introduce basic concepts of non-classical logic and to study philosophical motivations for considering various alternatives to the classical first order logic. On completion of the course, students are expected to have a good understanding of the technical details of the logic(s) covered, and of philosophical debates surrounding these logics. This course in a nutshell, focuses on philosophical aspects of *possibility* and *Paradox*. The three central topics include that we study are modality, conditionals and vagueness.

Prerequisites:

Basic course in Logic but not necessary

Lecture,Tutorial & Lab Schedule & Venue

Discussion Hour : Monday,wednesday, Friday: 16:00- 18:00 PM

Office Hours:

Mode of Contact: Email: `avrs[at]iitk.ac.in`

or Discussion on Mookit, zoom or Piazza platform, `https://cs335.te2ch.com/`

Instructional aspects:

1. Emphasis of this course is on problem solving. There are seven assignments spanning over seven weeks of this course. The course begin on June 7th and ends on July 28, 2021.
2. Some of the concepts of logic are introduced through puzzles.

Course Policies

Zero Tolerance of Cheating & Plagiarism Plagiarism means using words, ideas, or arguments from another person or source without citation. Cite all sources consulted.

Course Evaluation

1. Mid-Sem Exam (online+openbook): 30%.
2. End-Sem Exam (online+openbook) 50% Both examinations will be based on true or false questions and multiple choice questions.
3. Term paper needs to be written on topic of your interest within the area of logic, preferably on logic of possibility and paradox (Max: 5000 words (11-12 pages)).
4. The deadline for submission of term paper is *July 28, 2021.*

Course Content

Overview of Propositional logic: Validity, Logical Consequence, Semantic Tableuax method for Propositional Logic. **Extensions of First order Logic**: Basic concepts of Normal Modal propositional Logic, Epistemic Logic, Conditional Logic.
Deviant Logics: Many- valued Logic-1: Three valued Logics, Many Valued Logic-2: Many valued logic and Degrees of truth, Sorites Paradox and Basic concepts of Fuzzy Logic;

Topics to be covered in the Course

Basic Concepts: Week 1
1. What is Logic? What is Philosophical Logic? Why study Philosophical Logic/What is going to be taught in the course.
2. Language of Classical Logic: Syntax and Semantics, Some definitions (Tautology, validity, logical consequence, consistency, Satisfiability)
3. Properties of First Order Logic: Consistency, Monotonicity, Logical Consequence
4. Tableaux Method (refutation tree method)
5. Knights and Knaves puzzles
6. Limitations of First order Logic.

Modal Logic: Week 2-3
1. Origin of Modal Logic: Syntactical tradition of Modal Logic
2. Motivation: Lewis on Strict Implication
3. Normal Modal Logic systems: Syntax
4. Kripke Semantics
5. Validity of Modal Logic formulas: Semantic tableaux rules
6. Normal Modal Logic: S4 and S5 systems in detail

Week 3
1. Applications: Logic of conditionals
2. (C, C+,S, C1, C2) and Counterfactuals.

Epistemic Logic: Week 5
1. What is Epistemic Logic?:
2. Axioms of Knowledge, Common Knowledge, Distributive Knowledge
3. Puzzles: Muddy Children Puzzle
4. Byzantine Generals problem, Coordinated attack.
5. The problem of logical omniscience: Explicit vs Implicit beliefs

6. Summary:

Many-valued Logic Week(6-7)

1. Motivation: Sorites paradox, Liars Paradox.
2. Aristotle Sea Battle example
3. L3: Luckasewich three valued logic, Fatalism and Problem of Determinism
4. K3: Kleene's three Valued Logic
5. B3: Logic of nonsense, Liars Paradox.
6. Luckasewicz: Finite Many valued logic
7. Liars paradox.
8. Sorites Paradox and basics of Fuzzy Logic.

Laboratory Sessions:

Nil

Suggested text and reference material:

1. **James Graham Priest, An Introduction to Non-Classical Logic, Cambridge: Cambridge University Press 2001 (Standard Text for the course).** `https://www.researchgate.net/publication/265374356_An_Introduction_to_Non-Classical_Logic`
2. Rod Girle, Modal Logics and Philosophy, 2009
3. M.J. Cresswell, G.E. Hughes, A new introduction to Modal Logic, Routledge, 1996.
4. Melvin Fittting AND, Richard L. Mendelsohn, First order Modal Logic, Synthese Library, vol 277, 1998.
5. Ronald Fagin, Joseph Y. Halpern, Yoram Moses, Moshe Y. Vardi, reasoning about Knowledge, MIT Press, 2003
6. Rosanna Keefe, Theories of vagueness, Cambridge studies in Philosophy, 2000
7. George J Klir, Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 1995.
8. John MacFarlane, Philosophical Logic:A Contemporary Introduction, Routledge , 2021
9. Papineau, David. Philosophical devices: Proofs, probabilities, possibilities, and sets. Oxford University Press, 2012.
10. Timothy J. Ross, Fuzzy Logic with Engineering Applications, 2nd Edition, John Wiley Sons Ltd, 2004

Some Research Papers worth reading

Modal Logic:

1. Kripke, S. A. (1963). Semantical analysis of modal logic i normal modal propositional calculi. Mathematical Logic Quarterly, 9(5-6), 67-96.
2. Kripke, S. A. (1959). A completeness theorem in modal logic. The journal of symbolic logic, 24(1), 1-14.
3. Hintikka, J. (1967). Individuals, possible worlds, and epistemic logic. Nous, 33-62.
4. McCarthy, J., & Hayes, P. J. (1969). Some philosophical problems from the standpoint of artificial intelligence. Readings in artificial intelligence, 431-450.
5. Van Benthem, J. (2006). Epistemic logic and epistemology: The state of their affairs. Philosophical Studies, 128(1), 49-76.
6. Smullyan, R. M. (1986, March). Logicians who reason about themselves. In Proceedings of the 1986 conference on Theoretical Aspects of Reasoning about Knowledge (pp. 341-352). Morgan Kaufmann Publishers Inc..
7. Hacking, I. (1963). What is strict implication?. The journal of symbolic Logic, 28(1), 51-71.
8. Stalnaker, R. C., & Thomason,R. H.(1970). A semantic analysis of conditional logic. Theoria, 36(1), 23-42.
9. Stalnaker, R. (1991). The problem of logical omniscience, I.Synthese, 89(3), 425-440.

Many-Valued Logic

1. Łukasiewicz, J. (1968). On determinism. The Polish Review, 47-61.
2. Bochvar, D. A., & Bergmann, M. (1981). On a three-valued logical calculus and its application to the analysis of the paradoxes of the classical extended functional calculus. History and Philosophy of Logic, 2(1-2), 87-112.
3. Quine, W. V. (1981). What price bivalence?. The Journal of Philosophy, 78(2), 90-95.
4. Zadeh, L. A. (1996). Fuzzy sets. In Fuzzy Sets, Fuzzy Logic, And Fuzzy Systems: Selected Papers by Lotfi A Zadeh (pp. 394-432).
5. Tye, M. (1994). Sorites paradoxes and the semantics of vagueness. Philosophical perspectives, 8, 189-206.

Web Links:

- Mooc Course on Basic Concepts of Modal Logic: `https://www.youtube.com/playlist?list=PLPHX0JKJbx2aNMH41OWPhLoVfyBQ6JAu9`
- Introduction to Logic: `https://www.youtube.com/playlist?list=PLbMVogVj5nJS1F-yeDwn16nsu`
- `http://philog.ruc.dk/links.html`
- *Stanford Encyclopedia of Philosophy*(`http://plato.stanford.edu/`)
- Mathematical Logic: `http://world.logic.at/`
- General Philosophy: `http://dailynous.com/heap-of-links/`
- `http://www.columbia.edu/~av72/links.html`

- Research Papers: https://konstanz.summon.serialssolutions.com/
- http://sakharov.net/foundation.html
- Possible Worlds: http://www.sfu.ca/~swartz/pw/
- https://www.springer.com/journal/10992
- Handbook(s) of Philosophical Logic: https://link.springer.com/search?facet-series=%226024%22&facet-content-type=%22Book%22