On-line course materials

MATH43032 - Non-Standard Logics (Reading Course)

Year: 4 - **Semester:** 2 - **Credit Rating:** 15

Requisites

Prerequisites

A good working knowledge of the propositional calculus such as that given by MATH20302 Propositional Logic.

Aims

The aim of this course unit is to expose the students to the formal mathematical and philosophical aspects of a range of non-standard logics which are currently of importance in IT.

Brief Description

Non-standard logics are logics which capture other features of arguments, or reasoning, beyond those expressible in the basic, classical, propositional and predicate calculi. As such they have always been of direct interest and relevance to Philosophers and Logicians. However, this subject has taken off in the last 25 years or so because of the need in Computer Science (and especially in the sub-area of Information Technology) to formalise a range of patterns of reasoning for use in so called 'intelligent computers'.

The course notes (this is largely a reading course) covers three such families of (propositional) logics, nonmonotonic, modal and many valued (or 'fuzzy'). The approach will, however, remain very much within the tradition of mathematical logic and philosophy, concentrating on understanding the key ideas and theorems (in particular deriving completeness theorems), rather than studying practical IT applications.

Learning Outcomes

Learning Outcomes

On successful completion of this course unit students will be able to

- appreciate how non-standard logics can be developed and used to formalise various patterns of reasoning;
- be able to construct simple (formal) proofs within the non-standard logics studied;
- understand the proofs of the relevant completeness theorems and be able to apply these theorems to give semantic arguments for, or against, formal derivability.

Future topics requiring this course unit

None.

Syllabus

1.Nonmonotonic Logic: The GM rules, rational consequence relations. The LMK Representation Theorem and the rational closure of a conditional knowledge base. Theory revision. [9 lectures]

2.Modal Logic: Necessity and possibility. The systems K, T, D, B, S4 and S5. Examples of proofs. Normal forms. Frames and semantics. The Completeness Theorems for K and S4. [8]

3.Intuitionistic Logic: Kripke Structures and relationship to S4 frames. The proof theory for Propositional Intuitionistic Logic and the Completeness Theorem. [5]

4.Real Valued Logic: Fuzzy Logic, degrees of truth, truth functionality, ukasiewicz, Gdel and Product Logics and the Mostert-Shields theorem (statement only). McNaughton's Theorem. The proof theory for ukasiewicz Logic, examples of proofs and the statement of its Completeness Theorem. [8]

Teaching & Learning Process (Hours Allocated To)

Lectures	**Tutorials/ Example Classes**	**Practical Work/ Laboratory**	**Private Study**	**Total**
11	0	0	139	150

Assessment and Feedback

- Mid-semester coursework: two take home tests weighting 20%
- End of semester examination: two and a half hours weighting 80%

Further Reading

The course is self contained and you will not be required to consult any books. However the following cover some of the same material as the course and may provide interesting complementary reading.

- G.E. Hughes and M.J. Cresswell, A Companion to Modal Logic, Methuen,
- G.E. Hughes and M.J. Cresswell, An Introduction to Modal Logic, Methuen,
- B.F. Chellas, Modal Logic: An Introduction, Cambridge University Press.
- P. Hjek, Metamathematics of Fuzzy Logic, Kluwer, 1998.

- J.B. Paris, The Uncertain Reasoner's Companion, Cambridge University Press, 1994.
- E. Schecht, Classical and Non-Classical Logics, Princeton University Press, 2007.

Staff Involved

Prof Jeffrey Paris - Lecturer

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