# Syllabus

The following is required reading for the course.

1. Undecidability of predicate logic. Post's correspondence problem. (Huth and Ryan (2004), Chapter 2.5).

2. The completeness and soundness theorem for propositional and predicate logic (any proof you like).

3. Constructive and non-constructive proofs. Typed lambda-calculus. Constructive interpretation of logic, BHK-interpretation. Intuitionistic logic. Relation to classical logic via the negative interpretation. Martin-Löf type theory: simple proofs in the theory. Principles of formalising mathematics in ML type theory. Elements of Bishop set theory. (Coquand *et al.* (2005), Chapters 1.1 – 1.7 and 3.4 (pages 58-68) and the notes Granström (2006))

4. Semantics of intuitionistic propositional logic. Heyting algebras. (Palmgren 2006).

5. Modal logic: Kripke models for modal logic. Common axiom schemes. Correspondence theory for modal frames. Various readings of modal operators in natural languages and interpretations as knowledge, obligation and truth over time. Natural deduction for modal logic. Reasoning about knowledge in multiagent systems. (Huth and Ryan (2004), Chapter 5.)

6. Model-checking and CTL. The labelling algorithm for CTL. (Huth and Ryan (2004), Chapters 3.1, 3.4, 3.6.1.)

7. Binary decision diagrams (BDDs), ordered BDDs, reduced BDDs, operations on BDDs. Canonicity theorem for reduced OBDDs (Theorem 6.7) and its applications to tests. (Huth and Ryan (2004), Chapters 6.1 – 6.2.)

8. Term algebras and unification. The Martelli–Montanari algorithm. (Palmgren 2004a.)

9. Skolem normal form, Skolemization, refutation methods and resolution. (Palmgren 2002.)

## Course literature and supplementary material

M R A Huth and M F Ryan. *Logic in Computer Science: Modelling and reasoning about systems. 2nd edition.* Cambridge University Press 2004.

E. Palmgren (2002), *Some logical background to the resolution method.* Lecture notes. Matematiska institutionen, Uppsala universitet. 7 pages.

E. Palmgren (2004a), *Equational logic.* Lecture notes. Matematiska institutionen, Uppsala universitet. 12 pages.

E. Palmgren (2006), *Semantics of intuitionistic propositional logic.* Lecture notes. Matematiska institutionen, Uppsala universitet. 16 pages.

T. Coquand, P. Dybjer, E. Palmgren and A. Setzer. Type-theoretic Foundations of Constructive Mathematics. August 5, 2005.

### Reference literature

D. van Dalen (1994) *Logic and Structure.* Third edition. Springer.

P. Martin-Löf (1984). *Intuitionistic Type Theory.* Notes by Giovanni Sambin. Bibliopolis.

# Notes allowed during the written test

- Two pages (A4) of your own handwritten notes.
- J.G. Granström (2006), *Summary of Martin-Löf's polymorphic type theory.*

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