Finite Model Theory, Fall 2018

Course diary

Most of the material can be found in Luosto's lecture notes (in Finnish). Below I refer to the textbook of Ebbinghaus and Flum by "E&F".

Thursday 6.9.2018.

- Relations, functions, vocabularies, models, orderings, mappings between models such as homomorphisms.

Monday 10.9.2018.

- Model restrictions, submodels, and ordered models,
- Representation theorem for finite ordered models,
- Partial isomorphisms, (E&F, page 15)
- Preservation of interpretations of terms under homomorphisms.

Thursday 13.9.2018:

- Atomic first-order formulas and the preservation of the truth of atomic formulas under partial isomorphisms, (E&F, page 15)
- First-order formulas and Tarski's truth definition,
- Quantifier-rank of a formula.

Monday 17.9.2018:

- A proof showing the k-equivalence relation has finite index for a finite vocabulary without function symbols, (a direct proof using induction on k. An alternative proof can be found, e.g, in E&F Lemma 2.2.6 on page 18)
- Infinitary logics. (E&F, pages 40-48)

Thursday 20.9.2018:

- The Ehrenfeucht Fraïssé game and Fraïssé systems of partial isomorphisms. (E&F, pages 15-21)

Monday 24.9.2018:

- Theorem showing models A and B are k-isomorphic iff they are k-equivalent (a proof can be found, e.g, in E&F, pages 20-21)
- The k-Pebble game. (E&F, pages 49-54)

Thursday 27.9.2018:

- A theorem showing that models A and B are equivalent up to k variables (k partially isomorphic) iff they satisfy the same sentences with respect to the k-variable infinitary logic. (E&F, pages 49-54).

Monday 1.10.2018.

- Gaifman graph of a model and Hanf's Theorem (E&F, pages 26-28)
- Hintikka formulas (E&F, page 17-18)

Thursday 4.10.2018.

- Proof of Hanf's theorem,
- Basic of formal language theory, word models, and finite automata (E&F: 105-117).

Monday 8.10.2018.

- Finite automata and regular languages,
- Languages defined by invariant equivalence relations on words with finite index are regular (E&F: 105-117),
- Second-order logic (E&F: 37-40)

Thursday 11.10.2018.

- Fragments of second-order logic (E&F: 37-40),
- Definability of regular languages in the existential fragment of MSO (E&F: 110),
- EF-game for MSO, the equivalence relation defined by MSO sentences of quantifier-rank k is finite for every k and it is preserved under ordered sums (E&F: 38-39),

Monday 15.10.2018.

- Finished the proof of Buchi's Theorem,
- Turing machines and complexity classes (E&F: 124-127).

Thursday 18.10.2018.

- Inflationary and Partial Fixed-Point Logics (E&F: 120-122).

Thursday 1.11.2018.

- Transitive closure logic and deterministic transitive closure logic (E&F: 123-124),
- Models as inputs to Turing machines (E&F: 129-133).

Monday 5.11.2018.

- Placing FO(DTC) in LOGSPACE and FO(posTC) in NLOGSPACE (E&F: 147-151).

Thursday 8.11.2018.

- Placing FO(IFP) in PTIME, FO(PFP) in PSPACE, Sigma^1_1 in NPTIME (E&F: 147-151).

Monday 12.11.2018.

- Placing SO in PSPACE (E&F:150).
- Logical descriptions of computations (E&F: 133-137).
- IF K decidable in PSPACE then K is axiomatizable in FO(PFP) (E&F: 137).

Thursday 15.11.2018.

- If K in PTIME (NPTIME) then K axiomatizable in FO(IFP) (Sigma^1_1) (E&F: 138-142).

Monday 19.11.2018.

- If K in LOGSPACE (NLOGSPACE) then K axiomatizable in FO(DTC) (FO(posTC)) (E&F: 143-147).
- Definability of some arithmetic predicates in FO(DTC) (E&F:143-147)

Thursday 22.11.2018.

- A normal form for FO(posTC) and it's closure under negation (E&F: 225-228).

Monday 26.11.2018.

- A normal form for FO(posTC) and it's closure under negation (E&F: 225-228).
- 0-1 laws (E&F: 71-74)

Thursday 29.11.2018.

- 0-1 laws (E&F: 71-74).

Monday 3.12.2018.

- Generalized quantifiers (E&F: 308-311)

Monday 10.12.2018.

- Review of the course material for the exam.

Thursday 13.12.2018.

- Exam 9-12 at B121.