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CM30071 COURSEWORK SPECIFICATION

<i>Date set</i>	4 March 2008
<i>Submission deadline</i>	28 April 2008 at 12 midday
<i>Submission location</i>	in the post boxes outside 1W2.23 for the written parts: 1) a 2-page paper for every group; 2) a group breakdown chart for every group; 3) a questionnaire for every student
<i>Proportion of unit assessment</i>	25%
<i>Feedback provided</i>	in class

Conditions

This is a group coursework: students of CM30071 should gather in groups of at least 2 and at most 4 persons and choose one topic among the ones provided below, in such a way that no two groups deal with the same topic. No student can belong to more than one group.

The coursework consists of two parts:

- 1) one 50-minute lecture on the topic chosen by the group;
- 2) one 2-page paper describing the same lecture.

The lecture and paper will follow guidelines agreed with the course instructor after the groups choose their topic and make a preliminary proposal. The lectures will take place in front of the whole class, in late April and/or beginning of May, at times and dates that will be agreed on in class on 14 March 2008. Each lecture will be delivered by one or—at most and with the agreement of the instructor—two students nominated by each group.

During or after every lecture, the course instructor will ask questions (concerning the topic being presented) to each of the students in the group, and this will be part of the assessment. An individual questionnaire must be filled by every student and submitted, and every group must indicate the contribution of each member in a group breakdown chart to be associated to the paper.

Groups have ten days for agreeing on the topics to deal with and their members, and they have to communicate this to the instructor on 14 March 2008. At all times the instructor will help in the preparation of this coursework with suggestions for an appropriate presentation, both oral and written.

Assessment

Each student will be assessed as follows:

- 1) 40% on the basis of the lecture given by the representative(s) of the group the student belongs to;
- 2) 35% on the basis of the 2-page paper delivered by the group the student belongs to;
- 3) 25% on the basis of the student's individual effectiveness in answering questions during or after the lecture.

Moreover, the individual grade of a student can be scaled up or down by 33% of the grade as determined above based on the personal questionnaire and the group breakdown chart.

Marking guidance

Understanding the material and presenting it properly count, respectively, for 50% of the grading, for each of its components (oral, written and question answering). In particular, please notice that the challenge of this coursework is in presenting some non insignificant material in a limited time (50 minutes including questions) and space (two pages).

It is fundamental that students concentrate on *simplifying* the material and make it accessible, rather than trying to impress the audience with their technical prowess. Also, much attention, especially in the questioning, will be devoted to testing the *global, high level* knowledge of the subject, and the ability to put it in a larger context. This, as opposed to checking the little details in proofs of theorems, for example.

As an indication, here is a guide to the marking:

1st class: excellent, intuitive presentation; perfect understanding of the material and good ability to put it in context.

2:1: good presentation, technically accurate; good understanding of the material and some ability to put it in context.

2:2: the material is properly understood but not enough effort went in presenting it appropriately and effectively.

3rd: there are significant gaps in the understanding of the topic, and consequently the material is rather poorly presented.

Topics

The following topics are possible, together with an indication of sources in the literature. The groups should use these sources as an initial starting point. Once the groups make their choice of topic, it is *highly advisable* that they meet with the instructor and discuss what exactly to present, how and based on which sources. For each topic, a title and an indication of which concepts should be presented in the lecture and in the paper is given.

Topics in Proof Complexity

1) NP vs coNP

- Definition of P;
definition of NP, NP-completeness and SAT (satisfiability problem);
reductions;
Cook's theorem (SAT is NP-complete);
definition of coNP, coNP-completeness and VAL (validity problem);
proof that if $NP \neq coNP$ then $P \neq NP$.
- Sources:
Garey and Johnson, *Computers and Intractability: A Guide to the Theory of NP-Completeness*, W H Freeman & Co. (available in the library);
Urquhart, The Complexity of Propositional Proofs, *The Bulletin of Symbolic Logic*, 1(4), 1995, <http://www.math.ucla.edu/~asl/bsl/0104/0104-003.ps>.

Hopcroft, Motwani and Ullman, *Introduction to Automata Theory, Languages, and Computation*, Addison Wesley (available in the library). The first edition (without Motwani) is appropriate as well.

2) Frege vs extended Frege

- Definition of Frege systems;
theorem by Cook and Reckhow: Frege systems are equivalent to Gentzen systems;
definition of extended Frege systems and, more in general, of Tseitin's extension;
explanation of the problem of whether Frege and extended Frege systems are equivalent.
- Sources:
Buss, *Propositional Proof Complexity—An Introduction*,
<http://www.math.ucsd.edu/~sbuss/ResearchWeb/marktoberdorf97/paper.pdf>;
Urquhart, The Complexity of Propositional Proofs, *The Bulletin of Symbolic Logic*, 1(4), 1995, <http://www.math.ucla.edu/~asl/bsl/0104/0104-003.ps>.
Beame, *Proof Complexity*, lecture notes,
<http://www.cs.toronto.edu/~toni/Courses/Proofcomplexity/Papers/paul-lectures.ps>.

Topics in Proof Theory

3) The correspondence between natural deduction and sequent calculus

- Show how to translate an intuitionistic natural deduction proof into one in the sequent calculus and vice versa.
- Source:
Gallier, *Constructive Logics Part I: A Tutorial on Proof Systems and Typed λ -Calculi*, *Theoretical Computer Science*, 110(2), 249-239 (1993),
<ftp://ftp.cis.upenn.edu/pub/papers/gallier/conslog1.ps>.

4) The undecidability of first order logic

- Definition of undecidability;
definition of Post's Correspondence Problem (PCP) and statement of its undecidability;
reduction of decidability of first order logic to PCP.
- Sources:
Boolos, Burgess and Jeffrey, *Computability and Logic*, Cambridge University Press.
(Available in the library)
The instructor will provide a handout about the PCP and its use in the problem at hand.

Topics in Proof Theory and Automated Deduction

5) From resolution to Prolog

- Definition of resolution for propositional logic;
extension to first order logic, its soundness and completeness;
definition of SLD-resolution;
its use in Prolog.
- Source:
Gallier, *Logic for Computer Science: Foundations of Automatic Theorem Proving*, Wiley. (The book is out of print and available at <http://www.cis.upenn.edu/~jean/gbooks/logic.html>)

6) Introduction to abstract logic programming

- Give all the definitions necessary for the language of (first order) hereditary Harrop formulas and show how programs can be executed in it.
- Source:
Bruscoli, Guglielmi, *A Tutorial on Proof Theoretic Foundations of Logic Programming*, Invited tutorial at ICLP '03, LNCS 2916, pp. 109–127,
<http://cs.bath.ac.uk/~ag248/p/PrThFoundLP.pdf>.

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Group Breakdown Chart

Note: The group is expected to fill in this chart together, it is intended to convey the group view. Any dissent may be noted as well.

Group Topic:

Please fill in the following table listing all group members, and indicating how much effort each group member put into the project. The individual group members must sign their entry to signify agreement with it. If there are disagreements, please note these too in the explanation.

Member Name	% total effort	Explanation	Signature

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Personal Questionnaire

Note: This questionnaire is confidential and will only be seen by the examiner, please put it personally in the submission box.

Name:

Group Topic:

Answers to the questions should be kept brief and to the point. One or two lines should be sufficient in most cases. Please do not submit more than two sides of paper.

Your personal views on the group

1. Did your group work well together? Give reasons why it did or did not.
2. Was the work well structured? Again, give reasons for your views.
3. Was the work allocated fairly?
4. Was any work wasted (and why?)
5. Did everyone in the group make an even effort, or were there outstanding exceptions?

Your views on your own work

6. What have you learned from doing this coursework? (Indicate both technical and social skills.)
7. Was your personal organisation and time management to your satisfaction?
8. Did you contribute your full share to the project, or did you contribute more or less than you should have, and why?
9. Any mitigating circumstances for not making a full contribution?

10. Approximately how many hours did you spend on the coursework?

11. Did you enjoy it?

12. Any other comments?