MODULE INFORMATION SHEET 2009
MODULE F10PC1: AUTOMATA THEORY

LECTURER INFORMATION

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MODULE INFORMATION

The aim of the module is to study the logical development of an axiomatic theory that provides a general framework for ideas important in many areas in mathematics, and to pursue within that framework, problems of classification and the use of invariants. Specifically, this course is an introduction to automata theory a subject with applications including computer science, linguistics and biology.

Prerequisites You should know basic set theory, and have been exposed to various proof techniques, such as proof by induction. Otherwise, everything will be covered from scratch.

Syllabus

Introduction to finite automata: Alphabets and strings; languages and language operations; motivation for and definition of finite automata. (5 lectures)

Recognisable languages: Designing automata; automata over one letter alphabets; incomplete automata; automata that count; automata that locate patterns; Boolean operations. (5 lectures)

Non-deterministic automata: Accessible automata; non-deterministic automata and their applications. (5 lectures)

Automata with ε-transitions: Automata with ε-transitions and their applications. (5 lectures)

Kleene's theorem: Regular expressions and regular languages; algorithmic proof of Kleene's theorem. (5 lectures)

Minimal automata: The indistinguishability relation and how to calculate it; isomorphisms of automata; the minimal automaton of a regular language and its properties; the rank of a regular language. The Method of Quotients. (5 lectures)

Learning outcomes

- Understand and use the definitions of string theory; understand the significance of languages of strings and their relation to decision problems.
- Understand the motivation for and definition of finite automata.
- Construct automata recognising given languages using a variety of techniques.
- Convert a deterministic automaton into an accessible automaton recognising the same language.
- Convert a non-deterministic automaton into a deterministic automaton recognising the same language.
- Convert an epsilon automaton into a non-deterministic automaton recognising the same language.
- State and prove Kleene's theorem: know the definition of regular languages; convert a regular expression into an automaton, and to compute a regular expression from an automaton.
- Convert a deterministic automaton into an accessible, reduced automaton.
- Understand the rationale for the concept of 'isomorphism' in automata theory; understand the proof that two accessible reduced automata recognising the same language are isomorphic.
- Construct a minimal automaton ditrectly from a regular expression using the method of quotients.

ASSESSMENT

Exam There will be one 2-hour end-of-semester closed-book exam worth 100% of the overall assessment. Exams are organized centrally between 7th and 18th December. I will have no information about the exact time until you do.

Content of exam You will be examined on the whole course as defined by the lecture notes available via VISION.

Calculators in examinations You won't need calculators for this module.

HELP WITH YOUR STUDIES

Lectures These have a number of functions:

- To provide a steady pace through the module.

- To provide motivation and context for each topic studied. My goal is to get you interested in each topic and to help you understand why it is important.
- To provide a first place to ask questions.

The lectures take place on Monday 13.15 to 14.15, Tuesday 15.15 to 16.15 and Friday 9.15 to 10.15. All lectures will take place in CM G01. Please make every effort to be on time because late arrivals cause disruption.

Tutorials These provide you with with help in answering the exercise questions. Tutorials take place on Friday 10.15 to 11.15 in CM G01. **Tutorials start in week 2**.

If you have problems Tell me right away! Do not leave it several weeks and hope for the best but contact me immediately and we'll see if we can sort them out.

Private study At university you are *expected* to do whatever work is necessary in your own time so that you can keep up with the lectures and exercises.

Homeworks I will set four homeworks based on past exam papers during the semester. These will **not** count towards the module grade. However, I will mark and return them thus providing essential *feedback* on how you are doing.

Revision Towards the end of the module, I will spend some time on revision. The revision period at the end is just that — a re-vision period; it is not intended to be the first time you work on the material. Steady work sessions at regular intervals are better than irregular cramming.

Lectures notes etc All of the material you need to study this module is available on VISION. You can also access this information via my homepage. You will find there: a full set of lecture notes; a full set of exercises; solutions to the exercises; the 2008 exam paper and solutions.

AND FINALLY ...

This is *your* degree not mine. By working hard in your studies you are investing in *your* future. Good luck! I hope you enjoy the module and your last year at Heriot-Watt.

Please tear off the slip below and return it to me.

I have received a copy of the module information sheet during the first lecture.

NAME (please PRINT)

SIGNATURE

DATE