CS1021

Discrete Mathematics

Graham Gough

School of Computer Science

Room 2.105

1: Background

Oh no, not more maths!

Oh no, not more maths!

- “But I did CS to get way from maths”

Oh no, not more maths!

- “But I did CS to get way from maths”
- “Who needs maths to hack C/Java/VB/.NET/perl programs?”

Oh no, not more maths!

- “But I did CS to get way from maths”
- “Who needs maths to hack C/Java/VB/.NET/perl programs?”

This lecture will make a start at attempting to answer these complaints.

What is ‘discrete’ maths anyway?

Most of maths seen before has been aimed at modelling continuous processes.

Real numbers

Calculus

Mechanics

etc etc

In discrete maths objects of interest are separate (discrete) rather than members of a continuum like the reals

Often finite objects (like computers)

Interested in sets of objects with interesting properties – discrete structures

Mathematical models

‘Applied’ maths usually about modelling ‘real world’ objects

eg real numbers and mechanics

$$F = m \times a$$

Mathematical models

Mathematical models

- Create a piece of mathematics that resembles in some way a real world phenomenon

Mathematical models

- Create a piece of mathematics that resembles in some way a real world phenomenon
- Use the maths to describe situation in the real world

Mathematical models

- Create a piece of mathematics that resembles in some way a real world phenomenon
- Use the maths to describe situation in the real world
- Use the maths to deduce information about the real world by doing calculations using the model

Mathematical models

- Create a piece of mathematics that resembles in some way a real world phenomenon
- Use the maths to describe situation in the real world
- Use the maths to deduce information about the real world by doing calculations using the model

Model always an abstraction of thing being modelled

Mathematical models

- Create a piece of mathematics that resembles in some way a real world phenomenon
- Use the maths to describe situation in the real world
- Use the maths to deduce information about the real world by doing calculations using the model

Model always an abstraction of thing being modelled

Mathematical models aid clarity of thought

Mathematical models

- Create a piece of mathematics that resembles in some way a real world phenomenon
- Use the maths to describe situation in the real world
- Use the maths to deduce information about the real world by doing calculations using the model

Model always an abstraction of thing being modelled

Mathematical models aid clarity of thought

Can identify common aspects of apparently disparate phenomena

Abstraction

Abstraction is one of the ways human mind uses to manage complexity

Ignore unnecessary detail

eg Newton's laws of Universal Gravitation

Can predict accurately orbits of planets by treating them as though they are point masses

Abstraction used to simplify description of complex objects by ignoring all but 'important' features

Also procedural abstraction – simplifies description of activities

Do this all the time

eg walking across the room

Without abstraction human thought could have made no progress

In CS usually need to model discrete (and finite) objects

State of memory

Databases

Process of computation

Hardware

Programs

Knowledge bases

Parallel computing

etc etc

When make abstraction of these and many other aspects of computer science some relatively simple discrete mathematical structures emerge.

Some of these are the subject of this course

Course contents

Course contents

- Discrete structures

Course contents

- Discrete structures
- Sets and functions

Course contents

- Discrete structures
- Sets and functions
- Logic

Course contents

- Discrete structures
- Sets and functions
- Logic
- Relations and Graphs

Course contents

- Discrete structures
- Sets and functions
- Logic
- Relations and Graphs
- Induction

Course contents

- Discrete structures
- Sets and functions
- Logic
- Relations and Graphs
- Induction
- Combinatorics and Probability

Course structure

- 21 lectures (twice weekly)
- Examples classes – weekly in lab groups. These will start **next week**.
  Group Z, Monday at 4:00. Group Y, Thursday at 12:00.
  Exercises, which are contined in course notes, should be done in your log book.
- Assessment – mid semester test (15%) and exam in January (85%)

Books

Lots of them, none of them exactly fit the course

Books

Lots of them, none of them exactly fit the course

- Discrete Mathematics for Computer Scientists
  J.K. Truss
  Addison Wesley
  one of the better ones

Books

Lots of them, none of them exactly fit the course

- Discrete Mathematics for Computer Scientists
  J.K. Truss
  Addison Wesley
  one of the better ones
- Discrete Mathematics for Computing
  R Haggarty,
  Addison Wesley 2002

Books

Lots of them, none of them exactly fit the course

- Discrete Mathematics for Computer Scientists
  J.K. Truss
  Addison Wesley
  one of the better ones
- Discrete Mathematics for Computing
  R Haggarty,
  Addison Wesley 2002
- Discrete Mathematics and its Applications
  K H Rosen
  McGraw-Hill 2002

Books

Books

- Discrete Mathematics for New Technology

  R. Garnier and J. Taylor

  Institute of Physics Publishing

Books

- Discrete Mathematics for New Technology

  R. Garnier and J. Taylor

  Institute of Physics Publishing

- and

  An introduction to Mathematical Reasoning

  Peter Eccles

  CUP

Books

- Discrete Mathematics for New Technology
  R. Garnier and J. Taylor
  Institute of Physics Publishing
- and
  An introduction to Mathematical Reasoning
  Peter Eccles
  CUP
- The last two cover only a part of the material in the course. Let me know of any others that you find useful

Web page

The course web page is at

`http://www.cs.man.ac.uk/~graham/cs1021.html`