MA352-10 Combinatorial Optimisation

24/25

Department
Warwick Mathematics Institute
Level
Undergraduate Level 3
Module leader
Oleg Pikhurko
Credit value
10
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The focus of combinatorial optimisation is on finding the "optimal" object (i.e. an object that maximises or minimises a particular function) from a finite set of mathematical objects. Problems of this type arise frequently in real world settings and throughout pure and applied mathematics, operations research and theoretical computer science. Typically, it is impractical to apply an exhaustive search as the number of possible solutions grows rapidly with the "size" of the input to the problem. The aim of combinatorial optimisation is to find more clever methods (i.e. efficient algorithms) for exploring the solution space.

Module web page

Module aims

To introduce students to basic concepts and techniques of combinatorial optimisation.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

This module provides an introduction to combinatorial optimisation. Our main focus is on several

fundamental problems arising in graph theory and algorithms developed to solve them. These include problems related to shortest paths, minimum weight spanning trees, matchings, network flows, etc. We will also discuss "intractable" (e.g. NP-hard) problems.

Learning outcomes

By the end of the module, students should be able to:

- Upon completion of the module the students will be able to apply various combinatorial structures and algorithmic techniques to describe and solve fundamental problems of combinatorial optimization,
- apply covered techniques to concrete combinatorial problems,
- state and prove key results presented in the module,
- creatively adapt the presented methods to other combinatorial settings.

Indicative reading list

Main Reference:

D. Du, P. Pardalos, X. Hu, & W. Wu, Introduction to Combinatorial Optimization, Springer 2022.

Other Resources:

- W.J. Cook, William H. Cunningham, W. Pulleybank, & A. Schrijver, Combinatorial Optimization, Wiley-Interscience Series in Discrete Mathematics, 1998.
- B. Korte & J. Vygen, Combinatorial Optimization: Theory and Algorithms, Springer, 6th Edition, 2018.
- J Lee, A First Course in Combinatorial Optimization, Cambridge University Press, 2010.
- C.H. Papadimitriou & K. Steiglitz, Combinatorial Optimization: Algorithms and Complexity, Dover Publications, 1998.
- L.A. Wolsey & G.L Nemhauser, Integer and Combinatorial Optimization, Wiley 1999.

Subject specific skills

The module will help the students to develop an algorithmic style of thinking.

Transferable skills

Upon completion of the module the students should be able to formalise real-life optimisation problems and apply formal methods to solve them.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (30%)
Seminars	9 sessions of 1 hour (9%)
Private study	61 hours (61%)
Total	100 hours

Private study description

Review lectured material and work on set exercises.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group B

	Weighting	Study time
2 hour examination (Summer)	100%	

- Answerbook Pink (12 page)

Assessment group R

	Weighting	Study time
In-person Examination - Resit	100%	

- Answerbook Pink (12 page)

Feedback on assessment

Exam feedback.

Past exam papers for MA352

Availability

Anti-requisite modules

If you take this module, you cannot also take:

- MA252-10 Combinatorial Optimisation

Courses

This module is Core option list A for:

- UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year
    - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year
    - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year

This module is Core option list C for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
    - Year 3 of GV17 Mathematics and Philosophy
    - Year 3 of GV17 Mathematics and Philosophy
    - Year 3 of GV17 Mathematics and Philosophy
- Year 3 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list F for:

- Year 4 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Option list A for:

- Year 4 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- UMAA-G100 Undergraduate Mathematics (BSc)
    - Year 3 of G100 Mathematics
    - Year 3 of G100 Mathematics
    - Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G100 Mathematics
    - Year 3 of G103 Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
- UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
    - Year 3 of GF13 Mathematics and Physics
    - Year 3 of GF13 Mathematics and Physics
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
    - Year 3 of GF13 Mathematics and Physics
    - Year 3 of FG31 Mathematics and Physics (MMathPhys)
    - Year 3 of FG31 Mathematics and Physics (MMathPhys)
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year