



**NATCOR**

## ***Convex Optimization Course***

***13 – 17 June 2016***

### ***Welcome Pack***

This pack contains information about NATCOR, the University of Edinburgh; its facilities, location maps, visiting Edinburgh, and useful contact details, as well as other information that we feel may be useful during your stay with us.

#### **ABSTRACT**

Convex optimization is the fundamental process of optimal decision-making. Although mathematically restrictive, many practical problems may be modelled directly as convex optimization problems. Convex optimization problems are also formed as sub-problems when solving discrete and/or non-convex problems. This course will present convex optimization modelling techniques and theory underlying convex optimization and the methods of solving convex optimization problems efficiently.

#### **PRE-REQUISITES**

This course assumes fluency in undergraduate linear algebra and calculus. Specific background reading for the fundamental components of the course will be set out in advance. Materials supporting the more advanced aspects of the course will be made available electronically.

#### **AIMS**

The course aims to provide an overview of the modelling and solution of convex optimization problems, together with an insight into the underlying theory of convex optimization and efficient methods of solution. On completion of the course, delegates should be better prepared to understand the more sophisticated models, methods and theory that appear in the literature.

#### **LEARNING OUTCOMES**

The course provides opportunities for students to develop and demonstrate knowledge and understanding, qualities, skills and other attributes in the following areas:

(A) Knowledge and Understanding

On successful completion of this course, the students will have

1. knowledge of theoretical underpinning of convexity in optimization and of general nonlinear programming methods. This knowledge will act as a foundation to understand an advanced graduate textbook or a research paper without significant help;
2. understanding of linear programming methods and related theoretical issues;
3. knowledge of semi-definite programming;
4. ability to use an industry standard optimization software system for processing optimization models.

(B) Cognitive Skills

On successful completion of this course, the students will be able to

5. formulate realistic industrial problems as mathematical programming problems;
6. analyze critically the choice of algorithms for solving different classes of a particular optimization model regarding their computational effectiveness;
7. construct elementary proofs related to the properties of optimization methods.

(C) Other Skills and Attributes (Practical/Professional/Transferable)

On successful completion of this course, the students will be able to

8. plan and execute a solution to an optimization problem as a group and will be able to present the results to peers and tutors.

**PROGRAMME FOR RESIDENTIAL COURSE**

13–17 June 2016 (Monday lunchtime to Friday lunchtime)

	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>
<b>Hours</b>	2.5	6	3	6	2
<b>Speaker</b>	PD	PD/JH/JG	JG/JH/SG	AO/JG/SG/MF	Assessment

**Speakers:** MF – Michael Ferris (Wisconsin)  
 PD – Paresh Date (Brunel)  
 JG – Jacek Gondzio (Edinburgh)  
 SG – Sergio García Quiles (Edinburgh)  
 JH – Julian Hall (Edinburgh)  
 MP – Adam Ouorou (Orange Telecom)

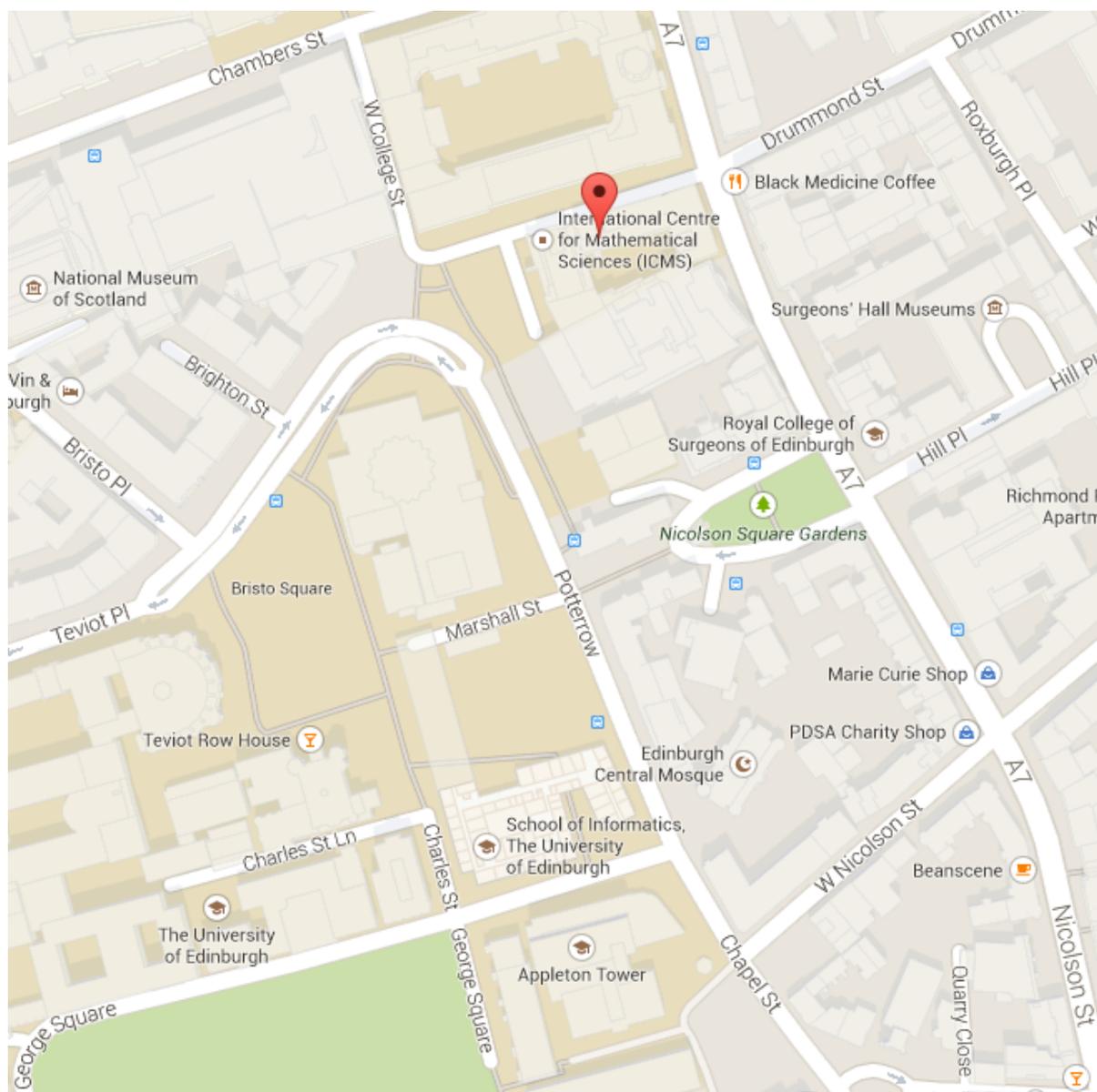
**PREPARATORY MATERIAL**

Students attending this course are very much encouraged to be fully conversant with the preparatory material. This will enable you to obtain the greatest benefit from the course. It is recognised that not all attendees will have a strong mathematical background, but it should be remembered that the courses are designed to provide a broadening of the backgrounds of all OR PhD students. The intention of this course is NOT to turn everyone into a Convex Optimization expert, but rather to indicate the type of methodology which is available within the subject area. However, it is hoped that those specialising in some form of Convex Optimization will find new material which will be helpful in their own PhD studies.

If you do not have a strong mathematical background, please still take the time to read through the preparatory material – even if some of the mathematics is beyond your level of full understanding. We have included case studies and real-life examples in the course which will also be accessible to all students, whatever their mathematical background.

We look forward to seeing you in June, and hope you have an enjoyable and stimulating week.

## UPON ARRIVAL



**On Monday 13 June:** Please make your way to the International Centre for Mathematical Sciences (ICMS), 15 South College Street, Edinburgh EH8 9AA where the first event of the NATCOR course is lunch at 12:30 in the Chapterhouse (on the entrance floor). There will be a secure area where luggage may be left.

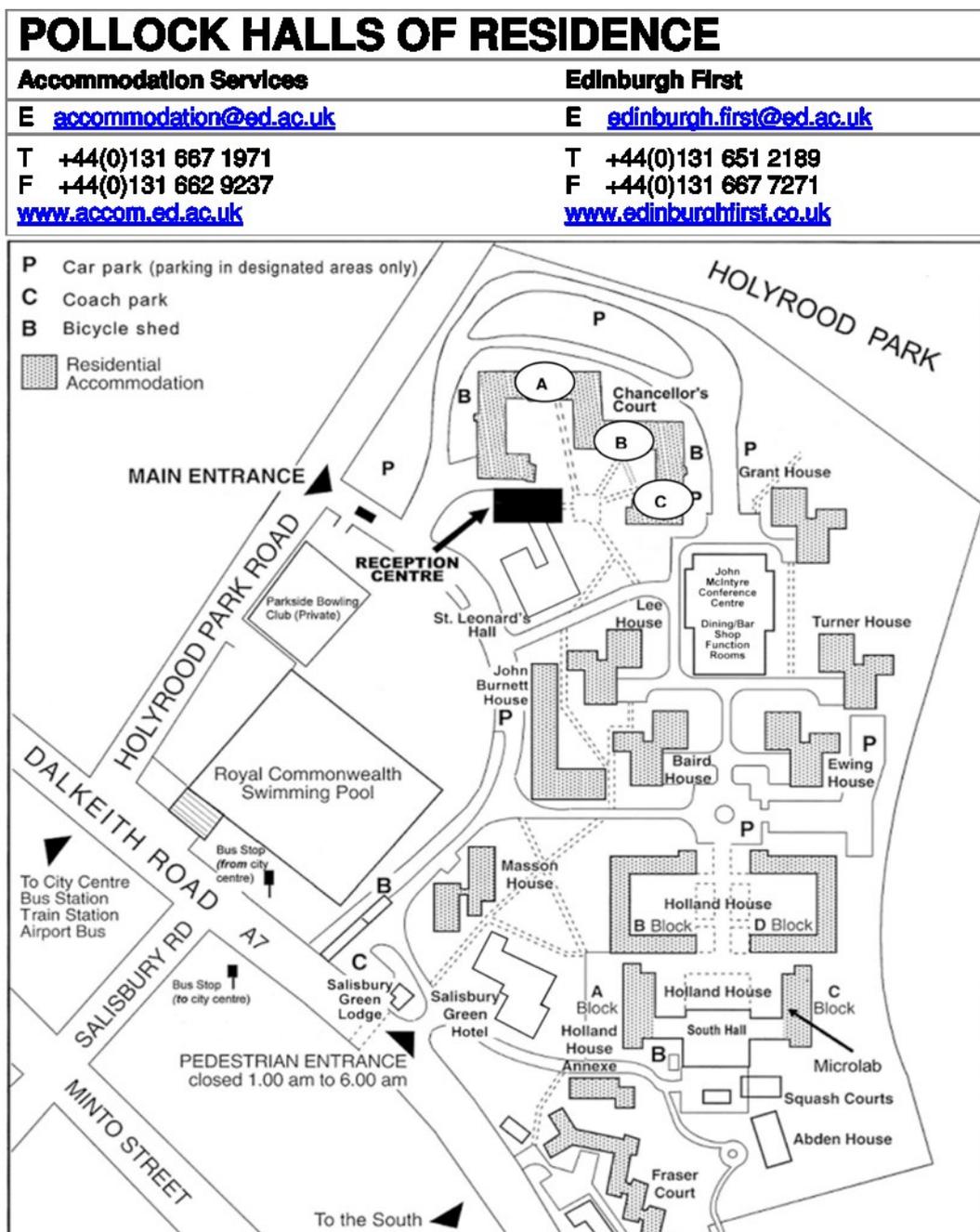
## TRAVEL DIRECTIONS

Since Pollock Halls and ICMS are pretty much in the centre of Edinburgh, travel directions are unnecessary.

## CONFERENCE RECEPTION

Between 09:00 and 17:00 you may use ICMS Reception as a point of contact. The course organisers will check regularly for any queries or messages. Outside these hours, if you are staying in the accommodation provided you may use Reception at Pollock Halls as a point of contact.

## ACCOMMODATION AND DEPARTURE



Following the first afternoon of the course, please make your way to Reception on the Pollock Halls campus (see Pollock Halls map above). There you will register and be directed to your accommodation. You will be staying in Chancellor's Court on the Pollock Halls residential campus. We ask that your room be vacated by 10:30 am on the morning of your departure and your key be returned to Reception. Note that Reception is open 24 hours so don't worry when you arrive or leave.

Please note that failure to return your key may result in excess charges being made.

Breakfast will be served between 07:30 and 10:00 hrs in the John McIntyre Centre (see Pollock Halls map above).

## PARKING

Those staying in the accommodation provided may park at Pollock Halls. It is on a first come first served basis but, during June, there will be no problem with this.

## INTERNET ACCESS

Those staying in the accommodation provided will have high speed wireless and wired internet. ICMS has “eduroam” wireless but if you are not able to use this then you will be provided with a username and password for the University’s “central” wireless when you register on Monday.

## CATERING, SHOPS AND AMENITIES

The accommodation provided and ICMS are pretty much in the centre of Edinburgh where there are many places to eat according to your tastes and pocket. There are also all the shops and amenities that one would expect in a city the size of Edinburgh.

## UNIVERSITY BARS

Teviot Row House is the oldest purpose-built student union in the world and is home to six bars. The heart of Teviot is the Library Bar. Another favourite is the stylish Loft Bar, with its beautiful roof terrace and impressive cocktail menu, which will be the venue for the welcome reception.

## TRAVEL INFORMATION & NUMBERS

**Taxis:** 0131 228 1211, 0844 448 8576 and “black cabs” available on the street.

**Trains:** Pollock Halls Reception will be happy to look up train times for you.

**Buses:** Although it is only a 20 minute walk between ICMS and the accommodation, the 2, 14, 30 and 33 buses can also be used (at a price of £1.60 per journey with no change given). There is an excellent free “Transport for Edinburgh” app for navigation and virtual tickets (min spend £10) available for iOS and Android.

## THE CITY

Hundreds of thousands of people are drawn to visit Edinburgh each year, and for good reason. Its riches in terms of architecture, history and culture are unmatched in Scotland and the setting is stunning. It is a UNESCO World Heritage Site and what city in Britain has a rocky 250m “mountain” in a royal park close to its centre? Enjoy!

## COURSE TIMETABLE

The International Centre for Mathematical Sciences (ICMS) has one main lecture theatre (level 4) where all lectures take place. Registration, lunch (on Monday only) and morning/afternoon coffee/tea take place in the Chapterhouse (level 1). Within the course there are “Theoretical” and “Modelling” streams. The former is assessed via a multiple-choice test; the latter via a case study presentation.

### Monday 13 June

<b>12:30 – 13:30</b>	Registration and lunch. Please go to the Chapterhouse on the entrance floor of ICMS. Luggage can be left securely.
<b>13:30 – 14:00</b>	Registration and introduction in the Chapterhouse.
<b>14:00 – 15:30</b>	Foundations of convexity (PD)
<b>15:30 – 16:00</b>	Coffee in the Chapterhouse
<b>16:00 – 17:00</b>	General convex optimization I (PD)
<b>17:00</b>	Guided walk to Reception on the Pollock Halls residential campus.
<b>19:00</b>	Welcome reception in the Loft Bar of “Teviot Row House” (see Google map above). Drinks and nibbles will be provided, but not enough to count as a meal.

### Tuesday 14 June

<b>09:00 – 11:00</b>	General convex optimization II (PD)
<b>11:00 – 11:30</b>	Coffee in the Chapterhouse
<b>11:30 – 12:30</b>	Linear Programming I (JH)
<b>12:30 – 13:30</b>	Lunch break [Lunch not provided]
<b>13:30 – 15:30</b>	Interior Point Methods for LP (JG)
<b>15:30 – 16:00</b>	Coffee in the Chapterhouse
<b>16:00 – 17:00</b>	Interior Point Methods for convex QP I (JG)

### Wednesday 15 June

<b>09:00 – 13:30</b>	Excursion/free time in Edinburgh
<b>13:30 – 14:30</b>	Interior Point Methods for convex QP II (JG)
<b>14:30 – 15:30</b>	Theoretical: Structure and matrix sparsity I (JH) Modelling: Xpress (SG)

- 15:30 – 16:00**      Coffee in the Chapterhouse
- 16:00 – 17:00**      Theoretical: Structure and matrix sparsity II (JH)  
Modelling: Xpress (SG)
- 19:00**                Conference dinner in the Dining Room of “Teviot Row House” (see Google map above).

**Thursday 16 June**

- 09:00 – 10:30**      Michael Ferris I (MF)
- 10:30 – 11:00**      Coffee in the Chapterhouse
- 11:00 – 13:00**      Theoretical: IPM for SDP (JG)  
Modelling: Xpress (JH/SG)
- 13:00 – 14:00**      Lunch break [Lunch not provided]
- 14:00 – 15:00**      Convex optimization in industry [AO]
- 15:00 – 15:30**      Coffee in the Chapterhouse
- 15:30 – 17:00**      Theoretical: Michael Ferris II (MF)  
Modelling: Xpress (JH/SG)

**Friday 16 June**

- 09:00 – 11:00**      Theoretical: Assessment  
Modelling: Xpress presentations (JH/SG) and assessment
- 11:00 – 11:30**      Coffee in the Chapterhouse
- 11:30 – 17:00**      NATCOR delegates are welcome to attend the workshop “Computational Optimization in Action” but please register via the (local) NATCOR website.