MATH5295

FINITE ELEMENTS AND QUASI-MONTE CARLO METHODS

Semester 1, 2015
Math5295 – Course Outline

Information about the course

Course Authorities: A/Prof. W. McLean RC-2085, email w.mclean@unsw.edu.au and A/Prof. Frances Kuo, RC-4077, email f.kuo@unsw.edu.au

Consultation: The consultation hours will be posted on Moodle (see below).

Classes: We have three hours of class contact per week:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>Wednesday</td>
<td>1–3pm</td>
<td>EE-G24</td>
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<tr>
<td>Friday</td>
<td>10–11am</td>
<td>EE-G25</td>
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Moodle: You can access the online materials for the course by logging on to

https://moodle.telt.unsw.edu.au/

Textbook: For the first half of the course you will need to purchase of copy of the textbook.


The UNSW bookshop sells the Dover edition for $24.26 but note the comment on their web site: “In Stock - will despatch next working day. Walk-in shoppers should ring ahead to ensure shelf availability”.

Course aims

Weeks 1–6 (A/Prof McLean)

This part of the course introduces the finite element method (FEM), a numerical technique for computing an approximate solution to a partial differential equation. In its standard form, the method is suitable for treating a wide class of elliptic boundary value problems, and has numerous applications in science and engineering.

We cover the mathematical basis of the finite element method and its algorithmic implementation, that is, both theoretical and practical aspects of the FEM.
Weeks 7–12 (A/Prof Kuo)

High-dimensional problems, that is, problems involving hundreds or thousands of variables, are becoming ever more important, with examples from finance, health statistics, oil reservoir modeling, and physics, among others. Quasi-Monte Carlo (QMC) methods are numerical techniques which are designed for approximating high-dimensional integrals.

This part of the course introduces the theory and construction of some families of QMC methods, and shows how they can be applied to high-dimensional integrals arising from a number of practical examples. It concludes with an example where the integrand involves the solution of an elliptic partial differential equation.

Relation to other mathematics courses

The most closely related course is Math3101/5305 Mathematical Computing.

Assessment

You must complete the following assessment tasks:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>5%</td>
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<tr>
<td>Assignment 2</td>
<td>20%</td>
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<tr>
<td>Assignment 3</td>
<td>5%</td>
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<tr>
<td>Assignment 4</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>50%</td>
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</table>

Assignments 1 and 3 will simply be a matter of handing in your solutions to some tutorial problems.

Assignments 2 and 4 will require you to develop ideas from lectures to a new setting, and may include a computing component.

The usual University rules for assignments apply:

http://www.lc.unsw.edu.au/plagiarism

Additional resources and support

Moodle

We will post any course materials on the Moodle course module. In particular, you can download the lecture notes and tutorial problems.
Software for the finite element part

We will use a small finite element package written in the [Julia programming language](https://julialang.org/) and a mesh generation program called [Gmsh](https://gmsh.info/). This software is free and runs on Linux, Windows and OSX.

Reference books for the finite element part

A good reference on the more theoretical aspects of the course is


The library has electronic access to the Third Edition of this work.

You might find also find the following books useful.


Reference books for the quasi-Monte Carlo part

You might find the following books useful.


References to relevant journal articles will be provided in class.
Administrative matters

Additional Assessment, School Rules and Regulations

UNSW assesses students under a standards based assessment policy. For how this policy is applied in the School of Mathematics and Statistics see http://www.maths.unsw.edu.au/currentstudents/assessment-policies

Plagiarism and academic honesty

Plagiarism is the presentation of the thoughts or work of another as one’s own. Issues you must be aware of regarding plagiarism and the university’s policies on academic honesty and plagiarism can be found at http://www.lc.unsw.edu.au/plagiarism and http://www.lc.unsw.edu.au/plagiarism/plagiarism_STUDENTBOOK.pdf.