Syllabus: MAT 5932

Computational Mathematics

Department of Mathematical Sciences
Charles E. Schmidt College of Science
Florida Atlantic University

Spring 2009. MAT 5932 (CRN #17718), Computational Mathematics, 3 credits.

Instructor
Rainer Steinwandt, Office SE 280
Phone: (561) 297-3353
Email: rsteinwa@fau.edu

Class Time and Place
Monday, Wednesday and Friday: 4:00 – 4:50 p.m., SE 215.

Office Hours
Monday, Wednesday, Friday: 10:30 – 12:00 or by appointment. Also, feel free to just come to the office—whenever time permits, questions and discussions are welcome. (If there should be any timing conflicts, like inevitable meetings during regular office hours, this will be announced beforehand in class, whenever possible.)

Course Web Site
http://www.math.fau.edu/~srainer/CompMath2008/

Required Text and Materials
The book Modern Computer Algebra (J. von zur Gathen and J. Gerhard, Cambridge University Press, 2nd edition, 2003) covers large parts of the course material. If supplementary material is needed, this will be distributed in class or on the course web site as needed.
Course Objectives

The course explains standard techniques from computer algebra. At this, the main focus is on basic techniques for manipulating large integers, matrices, and polynomials. After completion of the course, you should be able to analyze and compare the complexity of fundamental algorithms. You should be able to give examples of efficient algorithms that enable computations with large integers and large polynomials. Similarly, you should be able to give examples and explain techniques used to handle univariate and multivariate polynomials. After completion of the course, you should be able to explain and apply a number of standard techniques for computing greatest common divisors in different rings and you should be acquainted with techniques to find irreducible factors of univariate polynomials.

Lecture Schedule

The lecture covers—in this order—a subset of the topics discussed in Chapters 2, 3, 6, 8, 12, 14, 15, 16 the book Modern Computer Algebra (J. von zur Gathen and J. Gerhard, Cambridge University Press, 2nd edition, 2003):

1. Fundamental Algorithms
2. Euclidean Algorithm
3. Resultants and GCD Computation
4. Fast Multiplication
5. Fast Linear Algebra
6. Factoring over Finite Fields
7. Hensel Lifting
8. Short Vectors in Lattice

The exact time frame per item varies (also in dependence of previous knowledge of the course participants), but a typical time frame is two weeks per chapter. To the extent possible, suggestions of course participants for specific topics are taken into account, too.

Assessment Procedures

There will be three homework projects \{H_1, H_2, H_3\} plus two exams \(X_1\) and \(X_2\). The scheduled dates and maximum number of points for each of these items are given in the following table.

<table>
<thead>
<tr>
<th>Item</th>
<th>Date</th>
<th>Max. points</th>
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<tbody>
<tr>
<td>(H_1)</td>
<td>Jan 15, 2009</td>
<td>20</td>
</tr>
<tr>
<td>(H_2)</td>
<td>Feb 6, 2009</td>
<td>20</td>
</tr>
<tr>
<td>(X_1)</td>
<td>Feb 25, 2009</td>
<td>20</td>
</tr>
<tr>
<td>(H_3)</td>
<td>Mar 20, 2009</td>
<td>20</td>
</tr>
<tr>
<td>(X_2)</td>
<td>Apr 27, 2009</td>
<td>30</td>
</tr>
</tbody>
</table>
Exams will be given as take home exam, as written exam or as oral exam. Homework projects and take home exams will be assigned in class at the date specified in the above table and collected on the date specified on the assignment. Late assignments will not be accepted and graded with 0 points.

In addition to the above five items, there is a discussion score $D_1$ in the range from 0 to 10 points, which reflects your participation in class: To achieve the maximal score for $D_1$, regular active participation in the discussions in class is expected. Your overall grade in the course is derived from your cumulative performance as follows:

1. The lowest number of points achieved in the items $\{H_1, H_2, H_3\}$ is dropped. The points from the remaining two items and of the items $\{D_1, X_1, X_2\}$ are added, yielding a final number of points $0 \leq P \leq 100$.
2. Your grade is derived from $P$ according to the following table.

<table>
<thead>
<tr>
<th>Value of $P$</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 94</td>
<td>A</td>
</tr>
<tr>
<td>&gt; 90 – 94</td>
<td>A–</td>
</tr>
<tr>
<td>&gt; 87 – 90</td>
<td>B+</td>
</tr>
<tr>
<td>&gt; 83 – 87</td>
<td>B</td>
</tr>
<tr>
<td>&gt; 80 – 83</td>
<td>B–</td>
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<tr>
<td>&gt; 75 – 80</td>
<td>C+</td>
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<tr>
<td>&gt; 65 – 75</td>
<td>C</td>
</tr>
<tr>
<td>&gt; 60 – 65</td>
<td>C–</td>
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<tr>
<td>&gt; 57 – 60</td>
<td>D+</td>
</tr>
<tr>
<td>&gt; 53 – 57</td>
<td>D</td>
</tr>
<tr>
<td>≥ 50 – 53</td>
<td>D–</td>
</tr>
<tr>
<td>&lt;50</td>
<td>F</td>
</tr>
</tbody>
</table>

Graded exams and homework projects will be returned in class or can be picked up during office hours at the instructor’s office. At the end of the course, the final grades will, in anonymized form, be available in front of the instructor’s office (room SE 280).

Please keep all your exams and documentation of homework projects, so that a possible disagreement about your grade can be resolved.

**Make-up Tests and Extra Credit**

If you cannot attend an exam or hand in a homework project in time due to a relevant reason like significant health problems or being involved in a major traffic accident, you can make up the respective assignment.

Extra credit work is not possible.
**Course Procedure**

The course is conducted in lecture/discussion style. Discussions in class form an essential class of the course, and their importance is reflected in the component \( D_1 \) of the assessment procedure. As computers are a crucial tool in cryptanalysis, some homework projects may require the use of a computer. For these assignments, you can use the hardware platform and programming language of your choice.

**Students with Disabilities**

In compliance with the Americans with Disabilities Act (A.D.A.) – Students who require special accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) located in Boca – SU 133 (561-297-3880), in Davie – MOD I (964-236-1222), or in Jupiter – SR 117 (561-799-8585) and follow all OSD procedures.

**Incomplete Grades**

A grade of \( I \) (incomplete) will only be given under certain conditions and in accordance with the academic policies and regulations put forward in FAU’s *University Catalog*. The student has to show exceptional circumstances why requirements cannot be met. A request for an incomplete grade has to be made in writing with supporting documentation, where appropriate.

**Classroom Etiquette and Academic Integrity**

Please refer to FAU’s *Student Handbook* (http://www.fau.edu/handbook/).