ECE 656: Database Systems (Winter 2018)

Department of Electrical & Computer Engineering
University of Waterloo

About the Course

This is an introductory course on database systems. This course covers data models, file systems, database system architectures, query languages, integrity and security and database design. The course objective will be achieved by focusing on three main areas: the principles of relational database management systems, and in particular the entity-relationship model and the relational model, with focus on its mathematical foundation; the methodology for building applications on top of database management systems and the data-modeling process; the architecture of the modern database and the implications of that architecture for good database design. Students attending this course should have at least a 4A level Electrical Engineering or Computer Engineering background.

Lectures

Dates: Friday Jan 5 - March 30
Time: 11:30am - 2:20pm
Location: RCH 306

Prerequisites: Prereg: ECE 650 or 750 Tpc 26 or instructor consent.
Coreq: ECE 650 or 750 Tpc 26 or instructor consent. Antireq: ECE 750 Topic 18.

Course Website: Announcements, slides, assignments and project information will be posted on Learn. Some additional general information also on http://markcrowley.ca/teaching/ece-656-database-systems. Course calendar information can be found at https://uwaterloo.ca/graduate-studies-academic-calendar/node/4209


Midterm Week: Classes are not held during the reading week, so there will be no class March 23, 2017. There is no midterm exam for this course.

Make-Up Lecture Dates: There will be no class held on Good Friday March 30, 2017. The makeup lecture for this class will be the following week on Wednesday, April 4, 2017 at the same time and location.

Course Staff

For all course staff, office hours are by appointment. Please keep in mind that course staff have other responsibilities, so it may not be possible for them to meet with you at the last minute.

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Mark Crowley</th>
<th>E5-4114</th>
<th><a href="mailto:mcrowley@uwaterloo.ca">mcrowley@uwaterloo.ca</a></th>
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<tr>
<td>TA1</td>
<td>Sushrut Bhalla</td>
<td>TBD</td>
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<td>TA2?</td>
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Evaluation

Grading Scheme

Assignments: 30%
Project: 20%
Final exam: 50%

The University rules say if you miss the final exam, without an acceptable reason, your grade in the class will be DNW - Did Not Write. This is very undesirable. Show up for the final exam.

See also the section about late submissions under the section Course Policies.

I cannot tell you about your final exam grade or your total course grade until after marks become visible in Quest. Please do not e-mail me (or any of the TAs, or the Lab Instructor) after the final exam asking about your grades. You will simply have to be patient.

Assignments: There will be several assignments (at least three, and likely four) which must be completed individually.

Project: The project will require both database literature review and implementation work. Detailed requirements for the project will be given by the end of January. Projects may be done individually or in groups of two.

Learning Outcomes:

By the end of this course, students who have satisfactorily completed the course requirements should be able to:

1. Understand the basics of Entity-Relationship (ER) Models (entities, constraints, relationships, cardinality, primary and foreign keys)
2. Be able to create an appropriate ER model given a broad set of requirements
3. Understand the basics of the Relational Model (Relational Algebra (RA), 3-valued logic)
4. Transform an ER model to a relational model
5. Be able to recognize and create good relational designs for data, including functional dependency, normal forms, and relational decomposition
6. Be able to recognize poor relational designs for data and understand why they are poor
7. Understand the basics of SQL, and DDL and DML specifically
8. Be able to transform RA to SQL
9. Understand the basics of transactions and the relationship between transactions and data integrity
10. Understand the basics of modern database architecture, including hashing and indexing, query optimization, data storage, concurrency control, transaction management, and failure recovery
11. Understand the significance of database architecture for good relational design and be able to apply that to ensure good relational design
12. Understand the basics of database administration, setting up and managing a database, and security basics
Lecture Topics

In the following table are an initial estimate of the lecture topics by week as well as the learning objective(s) to which they contribute. Depending on course progress and feedback some of these may be rearranged or dropped.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Objective(s)</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to database systems</td>
<td>1, 3, 12</td>
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<tr>
<td>1</td>
<td>The SQL language</td>
<td>7, 8</td>
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<td>2</td>
<td>Entity-relationship model</td>
<td>1, 2</td>
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<td>3</td>
<td>Relational model, relational algebra and relational calculus</td>
<td>3, 4</td>
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<td>4</td>
<td>Functional dependencies, relational decomposition, normal forms</td>
<td>5, 6</td>
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<td>5</td>
<td>Storage and file structures</td>
<td>10, 11</td>
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<td>6</td>
<td>Indexing and hashing</td>
<td>10, 11</td>
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<td>7</td>
<td>Query processing and optimization</td>
<td>10, 11</td>
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<tr>
<td>8</td>
<td>Transactions</td>
<td>9, 11</td>
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<td>9</td>
<td>Concurrency control</td>
<td>10, 11</td>
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<tr>
<td>10</td>
<td>Fault-tolerance and recovery</td>
<td>10, 11</td>
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<tr>
<td>11</td>
<td>DB Admin and Security</td>
<td>12</td>
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<tr>
<td>12</td>
<td>Current topics (key-value stores, analytics, warehousing, ...)</td>
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Course Policies

Collaboration & Plagiarism  Plagiarism, taking credit for work that others did, is not permitted, and this applies to source code as well as exams. The course staff will be checking for it through a variety of different methods. Any cases of plagiarism detected will be reported, according to university policy (see the University Policy section below).

You may discuss ideas, algorithms, problems, possible solutions, *etc.*, and help other students debug small fragments of code. However, each student must submit their own, independently developed code for each assignment and project. While it can be very useful to look at someone else’s code (you cannot become a great writer without reading the works of other great writers) you should not be doing that anywhere you might be writing your own code.

Students are not permitted to share code electronically or in written form.

The University of Waterloo takes the issue of plagiarism very seriously. If you are uncertain about this subject, please seek some guidance. There are many resources available to you. You can check the university policies, talk to your course instructor, *etc.*

Or, let’s sum this up in two short instructions:

1. Acknowledge the work of others.
2. If you are uncertain, ask!

Late Submissions  Late assignments and project submissions will be penalized at 10% of the grade per day late up to three days after which the submission will receive zero.

University Policies

Academic Integrity  In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.
Check [www.uwaterloo.ca/academicintegrity/](http://www.uwaterloo.ca/academicintegrity/) for more information.

**Grievance**  A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, [adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://adm.uwaterloo.ca/infosec/Policies/policy70.htm). If in doubt, contact the department’s administrative assistant, who will provide further assistance.

**Discipline**  A student is expected to know what constitutes academic integrity (see above section) to avoid committing an academic offense, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline, [www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm). For typical penalties check Guidelines for the Assessment of Penalties, see [www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm](http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm).

**Appeals**  A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals), [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm).

**Privacy**  Questions about the collection, use, and disclosure of personal information by the University, should be directed to the Freedom of Information and Privacy Coordinator, Secretariat, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, Canada N2L 3G1. The email address of the Freedom of Information and Privacy Coordinator is [fippa@uwaterloo.ca](mailto:fippa@uwaterloo.ca). See also University of Waterloo Policy 19: Access to and Release of Student Information; Information and Privacy. [https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-19](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-19)

**Note for Students with Special Needs**  The AccessAbility Services (formerly known as OPD) located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AccessAbility Services office at the beginning of each academic term.