University Of Macau
Faculty of Science and Technology
Department Of Computer and Information Science
CISB351 Advanced Database Systems
Syllabus
1st Semester 2014/2015
Part A – Course Outline

Elective course in Computer Science

Course description:
(2-2) 3 credits. This course provides an in-depth study of: query optimization and evaluation; transaction management; concurrency control; database recovery; database security and authorization; and distributed database systems. In which, some advanced topics will be briefly introduced and reviewed.

Course type:
Theoretical with substantial laboratory/practice content

Prerequisites:
- CISB221/SFTW370

Textbook(s) and other required material:
- A. Silberschatz, H. F. Korth and S. Sudarshan, ***Database System Concepts***, Sixth edition, McGraw Hill, 2011.

References:
- Ramez Elmasri & Shamkant B. Navathe, ***Fundamentals of Database Systems***, Six edition, Addison-Wesley, 2011.
- C.J. Date, ***An Introduction to Database Systems***, Eighth edition, Addison-Wesley, 2004.
- Raghu Ramakrishnan & Johannes Gehrke, ***Database Management Systems***, Third edition, McGraw Hill, 2003.

Major prerequisites by topic:
- Fundamentals of database systems
- Computers and programming
- Data structures and algorithms.

Course objectives:
1. Learn internal structures, query evaluation and optimization.
2. Learn database transaction management and crash recovery.
3. Learn distributed databases and the related query evaluation and transaction.
4. Learn security mechanism for the web-based database applications.
5. Construct and implement one or more internal database components with the case study problems.

Topics covered:
- **Query processing (3 hrs) –** Introduction of the basic steps in query processing, various algorithms for relational operations, such as selection operation, join operation and other operations, external merge sort and the evaluation of the entire expression tree.
- **Query optimization (5 hrs) –** Overview of query optimization, transformation of relational expressions, alternative evaluation plans and estimating statistics of expression results.
- **Transaction management (5 hrs) –** Present the transaction concept and schedules, ACID properties and concurrent execution of transactions, introduce serializability and recoverability, implementation of isolation and testing for serializability.

- **Concurrency control (5 hrs) –** Introduction of lock-based protocols and time-based protocols, Two-Phase Locking (2PL), lock conversions, dealing with deadlocks, special locking techniques, and the concurrency control without locking.
- **Crash recovery (5 hrs) –** Introduction of ARIES recovery algorithm, log-based recovery, other recovery-related structures, the Write-Ahead Log protocol, check-pointing, recovering from a system crash, media recovery.
- **Application Security (3 hrs) –** Overview of application security, encryption and its applications, security for Internet applications, additional issues related to security.
- **Distributed databases (2 hrs) –** Realize the distributed DBMS architectures, storing data in a distributed DBMS, distributed query processing, distributed transactions, concurrency control and recovery.

Class/laboratory schedule:

Timetabled work in hours per week			No of teaching weeks	Total hours	Total credits	No/Duration of exam papers
Lecture	Tutorial	Practice				
2	1	1	14	56	3	1 / 3 hours

Student study effort required:

Class contact:	
Lecture	28 hours
Tutorial	26 hours
Mid-term exam	2 hours
Other study effort	
Self-study	20 hours
Homework assignment	10 hours
Project / Case study	22 hours
Total student study effort	108 hours

Student assessment:

Final assessment will be determined on the basis of:

In-class/Lab Exercise	5%	Homework	15%	Project	20%
Mid-term	25%	Final exam	35%		

Course assessment:

The assessment of course objectives will be determined on the basis of:

- Homework, project and exams
- Course evaluation

Course outline:

Weeks	Topics	Course Work
1-2	**Query Processing** Overview of the activities that are involved in extracting data from a database, including translation of queries in high-level database languages into expressions that can be used at the physical level of the file system, a variety of query-optimizing transformations, and actual evaluation of queries.	Assignment 1
3-4	**Query Optimization** Introduce the common techniques and algorithms for selecting the most efficient query-evaluation plan from among the many strategies usually possible for processing a given query, especially if the query if complex.	Assignment 2
5-6	**Transaction Management** Describes the concept of a transaction in detail, including the properties of atomicity, durability, isolation, and other properties provided by the	

Weeks	Topics	Course Work
	transaction abstraction. In particular, serializability and recoverability will be discussed.	
7-8	**Concurrency Control** Describe several concurrency-control techniques that help implement the isolation property. Study two-phase locking and snapshot isolation schemes. Introduce lock management, locking techniques in detail, dealing with deadlocks, and the concurrency control without locking.	Assignment 3
9-10	**Crash Recovery** Describe the recovery management component of a database, which implements the atomicity and durability properties. Introduce ARIES algorithm and logging technique in detail. Study the Write-Ahead Log protocol and check-pointing, learn the procedures for recovering from a system crash.	Assignment 4
11-12	**Security and Authentication** Introduce application security that deals with several security threats and issues beyond those handled by SQL authorization. Study the role of encryption in ensuring secure access, and how is it used for certifying servers and creating digital signatures.	Assignment 5
12-13	**Distributed Databases** Presents the issues in disturbed database, including how to store data, how to ensure atomicity of transactions that execute at multiple sites, how to perform concurrency control, and how to provide high availability in the presence of failures.	
14	**Final Review**	

Contribution of course to meet the professional component:

This course primarily contributes to the Computer Science program outcomes that develop student abilities to:

(a) An ability to apply knowledge of computing and mathematics appropriate to the programme outcomes and to the discipline;

(b) An ability to apply knowledge of a computing specialisation, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models;

(c) An ability to analyse a problem, and identify and define the computing requirements appropriate to its solution;

(d) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs with appropriate consideration for public health and safety, social and environmental considerations;

(h) An ability to analyse the local and global impact of computing on individuals, organisations, and society;

Program Outcomes

(a) An ability to apply knowledge of computing and mathematics appropriate to the programme outcomes and to the discipline;
(b) An ability to apply knowledge of a computing specialisation, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models;
(c) An ability to analyse a problem, and identify and define the computing requirements appropriate to its solution;
(d) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs with appropriate consideration for public health and safety, social and environmental considerations;
(e) An ability to function effectively on teams to accomplish a common goal;
(f) An understanding of professional, ethical, legal, security and social issues and responsibilities;
(g) An ability to communicate effectively with a range of audiences;
(h) An ability to analyse the local and global impact of computing on individuals, organisations, and society;

(i) Recognition of the need for and an ability to engage in continuing professional development;
(j) An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations;

Relationship to CS program criteria:

Criterion	DS	PF	AL	AR	OS	NC	PL	HC	GV	IS	IM	SP	SE	CN
Scale: 1 (highest) to 4 (lowest)	4	3	3			4	2				1		2	4

Discrete Structures (DS), Programming Fundamentals (PF), Algorithms and Complexity (AL), Architecture and Organization (AR), Operating Systems (OS), Net-Centric Computing (NC), Programming Languages (PL), Human-Computer Interaction (HC), Graphics and Visual Computing (GV), Intelligent Systems (IS), Information Management (IM), Social and Professional Issues (SP), Software Engineering (SE), Computational Science (CN).

Course content distribution:

Percentage content for			
Mathematics	Science and engineering subjects	Complementary electives	**Total**
0%	100%	0%	100%

Persons who prepared this description:

Dr. Sam Chao

Part B General Course Information and Policies

1st Semester 2014/2015

Instructor:	Dr. Sam Chao	Office:	E11-4008
Office Hour:	Tue 11:00 am – 12:30 pm, Thu 3:00 pm – 4:30 pm, Fri 10:00 am – 12:00 pm, or by appointment	Phone:	8822 8051
Email:	lidiasc@umac.mo		

Time/Venue: Tue 2:00 pm – 4:00 pm, CTB – E6 – 2095 (lecture)
Thu 11:00 am – 1:00 pm, FST – E11 – 1027 (tutor/laboratory)

Grading distribution:

Percentage Grade	Final Grade	Percentage Grade	Final Grade
100 - 93	A	92 - 88	A–
87 - 83	B+	82 - 78	B
77 - 73	B–	72 - 68	C+
67 - 63	C	62 - 58	C–
57 - 53	D+	52 - 50	D
below 50	F		

Comment:
The objectives of the lectures are to explain and to supplement the text material. Students are responsible for the assigned material whether or not it is covered in the lecture. Students who wish to succeed in this course should read the materials prior to the lecture and should work all homework and lab assignments. You are encouraged to look at other sources (other texts, etc.) to complement the lectures and text.

Homework Policy:
The completion of homework is a powerful learning experience; therefore:
- There will be approximately 4-6 homework assignments.
- Homework is due one week after assignment unless otherwise noted, no late homework is accepted.
- There will be occasional in-class assignments during the class.
- The course grade will be based on the average of the HW grades.

Course project:
The project is probably the most exciting part of this course and provides students with meaningful experience to design and implement an application system with topics covered in the course:
- The project is either individual or in a group of 2.
- The application domain will be discussed further in class.
- The project will be presented by the groups at the end of the semester.

Exam:
- One 2-hour mid-term exam, one 3-hour final exam and 3-4 quizzes will be held during the semester. All exams are closed book examinations.

Note:
- Laboratory session is important part of this course and attendance is strongly recommended.
- Check course web pages for announcement, homework and lectures. Report any mistake on your grades within one week after posting.
- No make-up exam is given except for CLEAR medical proof.
- Cheating is absolutely prohibited by the university.