COSC 304 - Introduction to Databases - September 2023

Instructor

Dr. Ramon Lawrence, ramon.lawrence@ubc.ca, 250-807-9390

Live Classroom Schedule: 11:00 a.m. to 12:30 p.m Tuesday/Thursday

Mode of Delivery: FIP 204 and live-stream on Zoom

Office Hours: Thursdays 2 to 4 p.m. (in-person and online)

Office Location: ASC 349

Calendar Course Description from the UBCO Calendar: http://www.calendar.ubc.ca/okanagan/courses.cfm?go=name&code=COSC (https://okanagan.calendar.ubc.ca/course-descriptions/subject/cosc)

Virtual Drop-in Session Hours

Day/Time	TA/Instructor
Monday 9 to 11 a.m.	Eranga Desaa / Omar Abdelaziz
Monday 2 to 4 p.m.	Justin Schoenit / Kevin Wang
Tuesday 11 a.m. to 12:30 p.m. (class time)	Justin Schoenit
Tuesday 2 to 4 p.m.	Eranga Desaa / Omar Abdelaziz
Wednesday 2 to 4 p.m.	Eranga Desaa / Omar Abdelaziz
Thursday 11 a.m. to 12:30 p.m. (class time)	Omar Abdelazi
Thursday 2 to 4 p.m.	Dr. Ramon Lawrence (virtual and in-person)
Friday 1 to 3 p.m.	Justin Schoenit
Friday 3 to 5 p.m.	Kevin Wang

For support, create a ticket on HelpMe system at: https://help.cosc304.ok.ubc.ca/ (https://help.cosc304.ok.ubc.ca/)

User id: **your student number** Password: **your student number**

PrairieLearn online system (Connect with your CWL): https://plcanary.ok.ubc.ca/ (https://plcanary.ok.ubc.ca/)

Course Description

Official Calendar: Databases from a user's perspective: querying with SQL, designing with UML, and using programs to analyze data. Construction of database-driven applications and websites and experience with current database technologies. Completion of COSC 121 is recommended. **Prerequisite:** One of COSC 111, COSC 123, COSC 210. Third-year standing.

Specific description: This course provides an introduction to database systems including database querying, design, and programming. The course consists of three major components. The first component explains databases from a user perspective including how to query using SQL and relational algebra. The second component involves designing relational databases using Entity-Relationship (ER) diagrams and UML. The last component involves experiential learning on real-world use cases of databases for software development and data analytics. Technologies used include Java, JDBC, JSP, Python, and PHP. Students completing the course have experience with current database technologies, and the ability to use databases, analyze the contained data, and develop programs to automate data analysis and presentation.

Course Objectives

Course Format: Interactive classes consist of topic introduction, understanding evaluation using quick questions, and concept mastery with larger exercises. Practical skills and applications of topics are covered in assignments as well as practice using industrial database systems and software.

Learning Outcomes:

- Describe how databases provide data abstraction and simplify writing programs to store and manipulate data.
- Create relational algebra queries on relational databases using selection, projection, join, and set operators.
- Construct SQL CREATE TABLE, INSERT, UPDATE, DELETE, and SELECT statements including queries with multiple joins, aggregation, grouping, and subqueries. Explain the translation of a SQL query into relational algebra operators.
- Analyze and understand existing database designs, design new databases using ER/UML modeling, and convert designs to the relational model including proper modeling of primary and foreign keys.

- Develop programs and web sites that access a database to read data, perform analysis, and display output.
- Perform data analysis, reporting, and visualization using data extracted from databases.
- Use JSON and XML for data exchange and representation.
- Execute and deploy databases on a computer using virtualization/containerization technology such as Docker.
- Implement database security using user accounts/passwords and SQL privileges using GRANT and REVOKE.

Marking and Evaluation

Item	Weighting	Description
Quizzes and Exercises	10%	Online and during class time activities
Assignments	20%	Weekly assignments
Midterm #1	15%	October 10th in class
Midterm #2	15%	November 2nd in class
Final Exam	40%	Cumulative, 2.5 hours, **exams require a laptop**

A student must receive a combined grade of at least 50% on the exams (midterms and final) to pass the course. Otherwise, the student receives a maximum overall grade of 45.

Textbook and Reference Material

- All notes are online.
- A textbook is not required. Students can get supplemental material from any database textbook.
- The course uses iClicker Cloud (free). Setup instructions for iClicker Cloud Student Account (https://lthub.ubc.ca/guides/iclicker-cloud-student-guide/). iClicker Cloud Login (https://student.iclicker.com/#/login)

Expectations

- Attend all classes and prepare before attending class.
- Read the notes before the class time. **Expect to spend about five hours per week in out-of-class preparation.**
- Learn the material in the course by completing all assignments. **No late assignments are accepted.**
- Enjoy attending class activities and participating according to your personality. Ask questions by posting on chat or raising your hand.
- Please actively participate in class discussions, questions, and problem solving exercises.
- **I want all students to pass the course, receive a good grade, and feel the course was beneficial.**

Schedule

Date	Topic	Reading and Resources
Sept. 5 (T)	**First day of classes. Introduction to course** (topics/1_introduction) Introduction to databases (topics/2_database_introduction)	SQL for Web Nerds: SQL Introduction (https://philip.greenspun.com/sql/introduction.html)
Sept. 7 (TH)	Relational Model - Schemas, Keys, Constraints, Integrity (topics/3_relational_model)	
Sept. 12 (T)	Relational Algebra - Select, Project, Set Ops, Outer Joins (topics/4_relational_algebra)	Online Relational Algebra Tool (https://dbis-uibk.github.io/relax/), WorksOn Data Set (https://gist.github.com/rlawrenc/5a7eb3f69cbea033c04c3cdf680a2e39), Bank Data Set (https://gist.github.com/rlawrenc/51721bd35f05ce3ef7391ff826f8f81a)
Sept. 14 (TH)	SQL DDL – Create table/index, Insert/Delete/Update (topics/5_sql_ddl)	
Sept. 19 (T)	SQL - Queries, LIKE operator, Set Operations, Order By (topics/6_sql)	SQL for Web Nerds: SQL Queries (https://philip.greenspun.com/sql/queries.html)
Sept. 21 (TH)	SQL - Group By, Aggregate Functions (topics/7_sql_aggregation)	SQL for Web Nerds: SQL Complex Queries (https://philip.greenspun.com/sql/complex-queries.html)
Sept. 26 (T)	SQL - Subqueries, Outer joins (topics/7_sql_aggregation)	
Sept. 28 (TH)	Database Design – General Approach (topics/8_db_design) ER and UML Modeling (topics/9_er_design)	

Date	Topic	Reading and Resources
Oct. 3 (T)	ER and UML Modeling examples and questions (topics/9_er_design)	
Oct. 5 (TH)	EER Design - Specialization, Generalization, Aggregation (topics/10_eer_design) ER/EER Mapping to Relational model (topics/11_er_to_relational)	
Oct. 10 (T)	**Midterm Exam #1 In-Class**	
Oct. 12 (TH)	Database Programming using Java/JDBC (topics/12_db_programming)	Sample Java Code (topics/12_db_programming/code), JDBC Tutorial (https://docs.oracle.com/javase/tutorial/jdbc/index.html)
Oct. 17 (T)	Database Programming using Python and R (topics/13_db_python_programming)	Sample Python Code (topics/13_db_python_programming/code), SQL Server and pyodbc (https://docs.microsoft.com/en-us/sql/connect/python/pyodbc/python-sql-driver-pyodbc), pyodbc (https://github.com/mkleehammer/pyodbc/wiki) pyodbc Getting Started (https://github.com/mkleehammer/pyodbc/wiki/Getting-started), Python Database API (https://www.python.org/dev/peps/pep-0249), Python sqlite3 (https://docs.python.org/3/library/sqlite3.html)
Oct. 19 (TH)	Assignment and database programming practice class	
Oct. 24 (T)	Database Web Programming – Web servers, JSP/PHP (topics/14_web_programming)	Sample JSP/PHP Code (topics/14_web_programming/code) Comic - Why validation is important (https://xkcd.com/327/) SQL Injection Attack (https://cwe.mitre.org/data/definitions/89.html)
Oct. 26 (TH)	Advanced SQL DDL – Triggers (topics/15_triggers) Advanced SQL DDL – Views (topics/16_views)	SQL for Web Nerds: SQL Triggers (https://philip.greenspun.com/sql/triggers.html)
Oct. 31 (T)	Advanced SQL – Security (topics/17_security) Advanced SQL – Transactions, Recursion (topics/18_transactions)	MySQL Recursive Query (https://www.mysqltutorial.org/mysql-recursive-cte/)
Nov. 2 (TH)	**Midterm Exam #2 In-Class**	
Nov. 7 (T)	Project Work Class	
Nov. 9 (TH)	XML and XPath (topics/19_xml)	Sample XML Code (topics/19_xml/code), Intro to XML/XML Reference (https://www.w3schools.com/xml/xml_whatis.asp) XMLSchema Reference (https://www.w3schools.com/xml/schema_intro.asp) XML Validator (https://www.freeformatter.com/xml-validator-xsd.html), Test XPath (https://cosc304.ok.ubc.ca/rlawrenc/tomcat/xml/xmlquery.html)
Nov. 14 (T)	**No class for Term 1 midterm break**	
Nov. 16 (TH)	**No class for Term 1 midterm break**	
Nov. 21 (T)	JSON (topics/20_json) NoSQL Databases (topics/21_nosql)	
Nov. 23 (TH)	Normalization and Design Verification (topics/22_normalization)	
Nov. 28 (T)	Database hosting and data cleansing/wrangling (topics/23_hosting)	Sample D3 Code (topics/23_hosting/code)
Nov. 30 (TH)	Data warehousing and Data Mining (topics/24_data_warehousing) 304 Course Summary and Preview of COSC 404 (topics/25_course_summary)	10 Rules for Data Storage (https://people.ok.ubc.ca/rlawrenc/teaching/304/Notes/refs/rulesfordatastorage.pdf)
Dec. 5 (T)	Project completion - Work Class	
Dec. 7 (TH)	**Project presentations Final Exam Review**	

Date	Topic	Reading and Resources
Dec. 16 (Sa)	**Final Exam at 8:30 AM in COM 201.** **Cumulative, 2.5 hours, requires a laptop.**	

Labs

Lab	Date	Topic
	September 4 – 8	**No Lab during First Week of Class**
1 (labs/lab1)	September 11 – 15	Lab 1: Querying using Relational Algebra
2 (labs/lab2)	September 18 – 22	Lab 2: SQL DDL: CREATE, INSERT, UPDATE, and DELETE
3 (labs/lab3)	September 25 – 29	Lab 3: Writing SQL queries
4 (labs/lab4)	October 2 – 6	Lab 4: Database Design using UML Modeling
5 (labs/lab5)	October 9 – 20	Lab 5: Converting UML Diagrams into the Relational Model
6 (labs/lab6)	October 23 – 27	Lab 6: Programming with Java/Python using MySQL and SQL Server

Development Stream

Lab	Date	Topic
7 (labs/lab7)	Oct. 30 – Nov. 3	Lab 7: Building a Database-enabled Web Site using JSP/PHP/Node
8 (labs/lab8)	November 6 – 10	Lab 8: Images, Security, and Transactions
	November 13 - 17	**No Lab during Midterm Break**
9 (labs/lab9)	November 20 - 24	Lab 9: XML, JSON, Views, and Triggers
10 (labs/lab10)	Nov. 27 - Dec. 7	Lab 10: Project Completion

Analysis Stream

Lab	Date	Topic
7 (labs/lab7)	Oct. 30 – Nov. 3	Lab 7: Using Databases with Analysis Software (Excel)
8 (labs/lab8)	November 6 – 10	Lab 8: Data Prediction, Forecasting, and Visualization
	November 13 - 17	**No Lab during Midterm Break**
9 (labs/lab9)	November 20 - 24	Lab 9: Handling Data Formats (CSV, XML, JSON)
10 (labs/lab10)	Nov. 27 - Dec. 7	Lab 10: Project Completion

Missing an Exam

Only students who miss the final exam for a reason that corresponds to the University of British Columbia Okanagan's policy on excused absences from examinations will be permitted to take the final exam at a later time. A make-up exam may have a question format different from the regular exam. There will be no make-up midterm exams. If the reason for absence is satisfactory, the student's final exam will be worth more of the final grade. Further information on Academic Concession is in the Academic Calendar http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0 (http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0).

Copyright Disclaimer

Grievances and Complaints Procedures

A student who has a complaint related to this course should follow the procedures summarized below:

- The student should attempt to resolve the matter with the instructor first. Students may talk first to someone other than the instructor if they do not feel, for whatever reason, that they can directly approach the instructor.
- If the complaint is not resolved to the student's satisfaction, the student should e-mail the Department Head, Dr. Sylvie Desjardins, sylvie.desjardins@ubc.ca.

Your Responsibilities

Your responsibilities to this class and to your education as a whole include attendance and participation. You have a responsibility to help create a classroom environment where all may learn. At the most basic level, this means you will respect the other members of the class and the instructor and treat them with the courtesy you hope to receive in return. Inappropriate classroom behavior may include: disruption of the classroom atmosphere, engaging in non-class activities, talking on a cell-phone, inappropriate use of profanity in classroom discussion, use of abusive or disrespectful language toward the instructor, a student in the class, or about other individuals or groups.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences. A more detailed description of academic integrity, including the policies and procedures, may be found: http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0 (http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0) If you have any questions about how academic integrity applies to this course, please consult with your professor.

The use of artificial intelligence (AI) assistance, such as ChatGPT or GitHub Copilot, for any assessed portions of this course is not permitted unless explicitly specified by the instructor.

Academic Integrity Course Policies

Academic integrity is critical to being a professional developer and a respected person. This is a guide to what is and is not acceptable behaviors in this course.

In-Class Participation and Quizzes and Teamwork Collaboration

Allowed

- Collaboration in groups of up to 4 on Canvas quizzes and in-class exercises

Not Allowed

- One person providing all answers for a quiz/exercise to a group of people of any size
- Sharing, posting, or distributing answers to other students or websites for quizzes/exercises
- Answering questions for another student or submitting answers on their behalf
- Requesting help from previous students in the course or other individuals outside of the course
- Relying on others to do work for me or not contributing reasonable effort to group activities
- Dividing up the work for a quiz or exercise between members of an approved group (*Not Recommended*)

Assignments

Allowed

- Collaborating with your approved group members (usually two) and submitting a shared answer to the assignment
- Request help from the TA or instructor and use the answer/code that they provide
- Answer general questions about assignments in chat or discussion forums (*Allowed with care*)

Not Allowed

- Working on an individual assignment with a group of people and submitting minor variations of work developed together
- For group assignment, completing all work independently and providing answer to rest of group
- Sharing solutions to assignments with other students or on the Internet
- Receiving solutions to assignments from other sources (students, web, tutors, AI)

Exams

Allowed

- Using approved material for the given exam format:

- **open book:** all course material including assignments, notes, and quizzes. No online/AI resources. No use of Google Docs. No secondary devices.
  - **closed book:** one page (two sides) personal notes on paper

Not Allowed

- Using any non-approved resource (people, AI, web, etc.) for exams **(severe)**
- Allowing another person to write or complete any part of any exam **(severe)**
- Posting or providing answers to students who have not yet completed the exam
- Requesting help from other people or web services for open book exams
- Posting or providing exam questions and answers after exam has been completed

Grading Practices

Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections and conformity to University, faculty, department, or school norms. Students should therefore note that an unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not official until they appear on a student's academic record. http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014 (http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014) If you have any questions about how academic integrity applies to this course, please consult with your professor.

Disability Resource Centre

The Disability Resource Centre (DRC) facilitates disability-related accommodations and programming initiatives that ameliorate barriers for students with disabilities and/or ongoing medical conditions. If you require academic accommodations to achieve the objectives of a course, please contact the DRC at: University Centre building (UNC 215). Ph: 250.807.8053 Email: drc.questions@ubc.ca Web: https://students.ok.ubc.ca/drc (https://students.ok.ubc.ca/academic-success/disability-resources/)

Equity and Inclusion Office

Through leadership, vision, and collaborative action, the Equity & Inclusion Office (EIO) develops action strategies in support of efforts to embed equity and inclusion in the daily operations across the campus. The EIO provides education and training from cultivating respectful, inclusive spaces and communities to understanding unconscious/implicit bias and its operation within in campus environments. UBC Policy 3 prohibits discrimination and harassment on the basis of BC's Human Rights Code. If you require assistance related to an issue of equity, educational programs, discrimination or harassment please contact the EIO. Office: UNC 325H Ph: 250.807.9291 Email: equity.ubco@ubc.ca Web: https://equity.ok.ubc.ca (https://equity.ok.ubc.ca)

Office of the Ombudsperson for Students

The Office of the Ombudsperson for Students is an independent, confidential and impartial resource to ensure students are treated fairly. The Ombuds Office helps students navigate campus-related fairness concerns. They work with UBC community members individually and at the systemic level to ensure students are treated fairly and can learn, work and live in a fair, equitable and respectful environment. Ombuds helps students gain clarity on UBC policies and procedures, explore options, identify next steps, recommend resources, plan strategies and receive objective feedback to promote constructive problem solving. If you require assistance, please feel free to reach out for more information or to arrange an appointment. Office: UNC 217 Ph: 250.807.9818 Email: ombuds.office.ok@ubc.ca Web: https://ombudsoffice.ubc.ca (https://ombudsoffice.ubc.ca)

Sexual Violence Prevention and Response Office (SVPRO)

A safe and confidential place for UBC students, staff and faculty who have experienced sexual violence regardless of when or where it took place. Just want to talk? We are here to listen and help you explore your options. We can help you find a safe place to stay, explain your reporting options (UBC or police), accompany you to the hospital, or support you with academic accommodations. You have the right to choose what happens next. We support your decision, whatever you decide. Visit svpro.ok.ubc.ca or call us at 250.807.9640.

Independent Investigations Office (IIO)

If you or someone you know has experienced sexual assault or some other form of sexual misconduct by a UBC community member and you want the Independent Investigations Office (IIO) at UBC to investigate, please contact the IIO. Investigations are conducted in a trauma informed, confidential and respectful manner in accordance with the principles of procedural fairness. You can report your experience directly to the IIO by calling 604-827-2060. Web: https://investigationsoffice.ubc.ca (https://investigationsoffice.ubc.ca) E-mail: director.of.investigations@ubc.ca

Student Learning Hub

The Student Learning Hub is your go-to resource for free math, science, writing, and language learning support. The Hub welcomes undergraduate students from all disciplines and year levels to access a range of supports that include tutoring in math, sciences, languages, and writing, as well as help with academic integrity, study skills and learning strategies. Students are encouraged to visit often and early to build the skills, strategies and behaviours that are essential to being a confident and independent learner. For more information, please visit the Hub's website. LIB 237. Ph: 250.807.8491 Email: learning.hub@ubc.ca https://students.ok.ubc.ca/student-learning-hub (https://students.ok.ubc.ca/academic-success/learning-hub/)

Student Wellness

At UBC Okanagan health services to students are provided by Student Wellness. Nurses, physicians and counsellors provide health care and counselling related to physical health, emotional/mental health and sexual/reproductive health concerns. As well, health promotion, education and research activities are provided to the campus community. If you require assistance with your health, please contact Student Wellness for more information or to book an appointment.

UNC 337 250.807.9270 Email: healthwellness.okanagan@ubc.ca Web: https://students.ok.ubc.ca/health-wellness (https://students.ok.ubc.ca/health-wellness)

SAFEWALK

Don't want to walk alone at night? Not too sure how to get somewhere on campus? Call Safewalk at 250-807-8076. For more information: https://security.ok.ubc.ca/safewalk (https://security.ok.ubc.ca/safewalk) or download the UBC SAFE – Okanagan app.

Reference Material

- SQL for Web Nerds (https://philip.greenspun.com/sql/index.html)
- SQL Tutorial by Software Carpentry (https://swcarpentry.github.io/sql-novice-survey/) - uses SQLite and demonstrates using databases with Python/R
- Codecademy SQL course (https://www.codecademy.com/learn/learn-sql)
- Amazon Database Blog (https://aws.amazon.com/blogs/database/)
- Sample databases WorksOn (SQL Notes): WorksOn (https://people.ok.ubc.ca/rlawrenc/teaching/304/Notes/DB/WorksOn.accdb), WorksOn DDL (https://people.ok.ubc.ca/rlawrenc/teaching/304/Notes/DB/MySQL_WorksOn_DDL.sql)