**CS 360: Database Systems**

Department of Computer Science

University of Idaho

***Course Syllabus***

**Instructor**: Hasan Jamil **Semester**: Fall 2023

**Office**: JEB 224 **Prerequisites**: CS 121 and CS 150

**Office hours**: 10:30-12:30 WF Via Zoom **Classrooms**: EP 204, and BL 107

**E-mail**: [jamil@uidaho.edu](mailto:jamil@uidaho.edu) **Class Time**: 14:00-15:15 TR

This course will emphasize on database models, basic concepts in database management systems, and database design. Students will learn how to design, manage and query a relational database using a relational DBMS such as MySQL. A substantial database project implementation using a modern database management system is required. A substantial technical report writing and submission on the database project using the document preparation system Latex on OverLeaf is also required. This course uses pedagogies such as project-based learning, eLearning and peer programming to improve learning outcomes.

1. Database Management Systems – goals and advantages, and database system architecture.
   1. Chapter 1: Introduction
2. The Entity-Relationship Model of Data.
   1. Chapter 7: Entity-Relationship Model
3. Relational Model
   1. Relational Algebra, SQL, and Views.
      1. Chapter 2: Introduction to the Relational Model
      2. Chapter 3: Introduction to SQL
      3. Chapter 4: Intermediate SQL
      4. Chapter 5: Advanced SQL
      5. Chapter 6: Other Relational Languages. Section 6.1 (Relational Algebra)
   2. Conceptual Database Design – Data Dependencies and Normalization.
      1. Chapter 8: Relational Database Design

**Text:**

* Avi Silberschatz, Henry Korth and S. Sudarshan, Database System Concepts (Seventh Edition or later), McGraw-Hill.

**Additional References:**

1. Michael Kifer, Arthur Bernstein and Philip Lewis, *Database Systems – An Application Oriented Approach*, 2nd Edition (or later). Addison Wesley, 2005.
2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 2nd Edition (or later). McGraw Hill; 2000.

**Grading Scheme**:

1. Assignments (7 total – 2 RA, 3 SQL, 1 FD and 1 NF) – **20%**
2. Traditional Option:
   1. Implementation Project (Conceptual/ER Design 5% (Phase I), Implementation 40% (Phase II and III) and Final Report 5%) – **50%**
   2. Two Midterm Exams – **30%**
3. Advanced Learning Option:
   1. A research-based implementation project (Conceptual Design 5% (Phase I), Implementation 65% (Phase II and III), and Final report 10%) – **80%**.

**Tentative Lecture Schedule**

1. August 22, 24: Introduction. Introduction to Latex on OverLeaf, UI Calendar System, and CS 360 Lab procedures. Course and research project discussion. ***Must attend this week’s classes.***
2. August 29, 31:The basics – Database Management Systems: goals and advantages, architecture of a database management system. Data modeling using Entity Relationship Model.
3. September 5, 7: Introduction to the Project 360 – Kallol Naha.
4. September 12, 14: Relational Data Model. Discussion on tables, introduction to SQL and simple SQL SPJ queries. Database creation using SQL – Schema definitions and constraints. *Assignment #1 on SQL due on September 21.*
5. September 19, 21: Complex SQL – Set and Sub-queries, Division, Nested and advanced queries. Advanced SQL (DDL, triggers, views, and updates). *Assignment #2 on SQL due on October 10.*
6. September 26, 28: ***Phase I project report/presentation and initial demo*** *in Class on September 19.* **Submit 2-page Phase I report using OverLeaf. Tutorial I on Queries on September 28**. *Assignment #3 on SQL due on October 12.*
7. October 3, 5: SQL queries and wrap-up. *Assignment #4 on relational algebra due on October 17.*
8. October 10, 12: Relational Algebra and wrap up. *Assignment #5 on relational algebra due on October 19*.
9. October 17, 19: **Tutorial II on Queries on October 17.** **Midterm Exam I on October 19 (15%, Covers SQL and Algebra). Fall midterm grades published on October 20.**
10. October 24, 26: Introduction to functional dependencies. Axiomatization, keys, closures and covers. *Assignment #6 on FDs due on November 2*.
11. October 31, November 2: **Project working prototype presentation (Phase II).**
12. November 7, 9: Functional dependencies. Axiomatization, keys, closures and covers continued. *Assignment #7 on Covers and NFs due on November 16*.
13. November 14, 16: Introduction to conceptual database design. Design theory and normalization – First, Third and Boyce-Codd Normal Forms.
14. **November 21, 23: Fall Recess.**
15. November 28, 30: **Tutorial III on FDs and normalization on March 28.** **Midterm Exam II on November 30 (15%, Covers FDs and Database design).**
16. December 5, 7: *Project Final Demo. Project final report (****Phase III****) due 24 hours before your demo begins.* Choose your group’s final demo date from the slots below and schedule it on my calendar by November 16, 2023.

December 5: 10am-10:30am, 10:30am-11am, 11am-11:30am, 11:30am-12pm, 2pm-2:30pm, 2:30-3pm, 3pm-3:30pm.

December 7: 10am-10:30am, 10:30am-11am, 11am-11:30am, 11:30am-12pm, 2pm-2:30pm, 2:30-3pm, 3pm-3:30pm.

December 8: Spillover demos, on request.

1. December 12, 14: No Classes. (**NO FINAL EXAM**)
2. ***December 19: Final Grades Published***

**Notes**:

1. Attendance is mandatory.
2. You must open an OverLeaf account before August 29, 2023 using the link [*https://www.overleaf.com?r=895bc793&rm=d&rs=b*](https://www.overleaf.com?r=895bc793&rm=d&rs=b).
3. Please submit your project team names by August 29, 2023 on Canvas, identify team leader and contact person along with contact info. One submission per project team. You will be assessed as a team for the project.
4. This semester we have two project options. The first is a traditional option in which you complete a set of assignments, a database project and take two midterm tests. The second is the advanced learning option in which you complete a set of assignments, and implement a research-based database application, and take no tests. The complexity levels of the two projects in both options are similar, with the only difference that in the research project you will read a couple of research papers to understand what the design should be like and implement a novel idea which will require more dedication. Finally, each research project will be different while the traditional option will have a single application for all students.
5. Assignments should be handed in by the due date on Canvas. No late submissions, please.
6. To pass the course, *usually* a minimum of 50% is required in **each** of the exams, assignments and projects.
7. **There is no direct relationship between the numerical percentages and the final letter grades awarded in this course**. Performance will be assessed by ``normalizing" the marks obtained in each exam, assignment, and project separately. Typically, 90%+ is assigned an A, 80%+ is B, 70%+ is C, 60%+ is D and less than 60% is assigned F.
8. You are advised to retain a copy of all your course works till a final grade has been assigned.
9. Please back up all your computing work, computers do break down and at the worst possible time, such as a day before a project is due! It is your responsibility to be prepared for such accidents and still meet the deadlines.
10. University and departmental policies on cheating, plagiarism and academic misconduct apply to this course. Please consult departmental/university home pages regarding professional and academic conduct.
11. You may copy class materials, including lecture notes (such as project description, assignments, lecture notes, etc.) from Canvas.
12. Most exams are multiple-choice type and are designed to expedite marking and evaluation efficiency. Please consult past exams to gather some ideas about the nature of the exams. Notice the uneven distribution of the coverage of topics. There is no guarantee, however, that this year's tests will be similar.
13. *This year, we are testing an intelligent database tutoring and assessment system called Project 360. Some or all of your assignments and test may be administered through this system. Please stay tuned.*
14. Please note that there may be a couple of extra classes to make up for any missing regular classes due to travel commitments. I will announce those from time to time.
15. Students with any disability are advised to talk to me outside the class and contact disability services for help. All required accommodations for students with disability will be made in accordance with the university policies.
16. There are two zoom links:
    1. Class Zoom link is <https://uidaho.zoom.us/j/88488887865> and the PWD is CS360.
    2. Office hours, please use this zoom link which is a waiting room: <https://uidaho.zoom.us/j/8590626031>.

**CS 360 Project Related Information**

Requirements for all projects (general or research)

* + - 1. Submit your team members’ names by August 29, 2023, on Canvas. Identify the team leader and include his/her email address. All communications will go to the team leader. Each team will have a minimum of two members, and in rare cases, maximum of three.
      2. Open your OverLeaf account using the link listed in the **Notes** section before August 29, 2023. An introduction to document editing with Latex will be included in your lab schedule. You will submit your final report using Latex. **A non-Latex submission will have a 20% penalty**. You will submit your Phase I and final project reports by sharing your OverLeaf documents with jamil@acm.org. The final report must meet the following requirements.
         1. ACM Conference format/style – 10-point Roman, two column formats. The template is given below:

\documentclass[sigconf,authordraft]{acmart}

\usepackage[flushleft]{threeparttable}

\usepackage[shortlabels]{enumitem}

\usepackage{subfigure}

\usepackage{epsfig}

\usepackage{url}

\usepackage{textcase}

\AtBeginDocument{%

\providecommand\BibTeX{{%

\normalfont B\kern-0.5em{\scshape i\kern-1000.25em b}\kern-0.8em\TeX}}}

\setcopyright{acmcopyright}

\copyrightyear{2023}

\acmYear{2023}

\setcopyright{acmlicensed}

\acmConference[SAC '23]{SAC '23: 38th ACM International Symposium on Applied Computing}{March 27--31, 2022}{Tallinn, Estonia}

%\acmBooktitle{Woodstock '18: ACM Symposium on Neural Gaze Detection, June 03--05, 2018, Woodstock, NY}

\acmPrice{15.00}

\acmDOI{10.1145/1122445.1122456}

\acmISBN{978-1-4503-9999-9/18/06}

\begin{document}

\title{Title of your project}

\author{Your Name}

\affiliation{%

\institution{Department of Computer Science, University of Idaho}

% \streetaddress{875 Perimeter Drive}

% \city{Moscow}

% \state{Idaho}

\country{}

% \postcode{83843}

}

\email{your email}

\begin{abstract}

Abstract of your project.

\end{abstract}

\begin{CCSXML}

\end{CCSXML}

\keywords{five keywords}

\maketitle

\section{Introduction}

\label{intro}

%

% ---- Bibliography ----

%

\bibliographystyle{ACM-Reference-Format}

\bibliography{Refs}

\end{document}

\endinput

* + - * 1. Your Phase I report must be 2-pages long, and the final report must be at least 8 pages long, and you are allowed an unlimited number of pages for references. References and large pics do not count toward the minimum number of required pages (main text).
        2. Must include figures showing various system features and functions.
        3. Must have acceptable style, presentation, and clarity.
      1. Traditional project requirement weights are shown below (50%)
         1. ER diagram and Phase 1 report. – 10% or 5 points.
         2. You will have to host this database on the UI/Lab server. – 10% or 5 points.
         3. You will design a web-based interface for user interaction. – 10% or 5 points.
         4. All the features must function. – 60% or 30 points.
         5. Must use Faker or Mockaroo to populate the database with test data where appropriate. If not applicable, this portion will be added to item d above. – 10% or 5 points.
      2. Research project requirement weights are shown below (80%)
         1. You will have to host this database on the UI/Lab server. – 15% or 12 points.
         2. You will design a web-based interface for user interaction. – 15%, or 12 points.
         3. All the features must function. – 70% or 56 points.
      3. The lab classes will include lectures on Latex, system building tools such as Django, XAMMP, Bootstrap, PHP, MySQL, SQLite, and web design tools such as CSS templates and so on.
      4. You will demonstrate your progress in the lab at a scheduled time. Consult your lab schedule. These lab presentations are preparatory exercises for your three class presentations in your class schedule. You must schedule your final demo during one of the available final demo days listed in the schedule.
      5. You will have the option to choose from two project classes: a general course project, and a research project as described below.

**Traditional Course Project: iCare (45% total + Final Report 5%)**

**Description**: Design a home care database called iCare using which homeowners will be able to subscribe to basic home services, but in a very different way. In this service, homeowners will create a home profile for the following items:

1. Mortgages and insurances: Homeowners’ mortgage and home owners’ insurance details will be saved.
2. Lawn: They will take a satellite picture of their property and measure their lawn size, including the flower bed sizes and number of trees on the lawn using the service at <https://www.measuremylawn.com/>.
3. Interior: A floor plan will be uploaded, the number of rooms of all types will be recorded and the floor space will be saved.
4. Internet: Using sites such as <https://broadbandnow.com/bandwidth-calculator>, or <https://www.consumerreports.org/internet/how-much-internet-speed-do-you-need-a1714131782/> or <https://www.highspeedinternet.com/how-much-internet-speed-do-i-need>, homeowners will record their internet needs.
5. Phones: They will also save the number of cell phones they use.
6. They will also save the current plans, costs, and services they have. They will also maintain when their current contracts, if any, will expire or if they are looking for services for any of the above.
7. The goal is to find new services that are better in terms of price and quality.

Businesses will maintain a database of their services and costs for these items. Your system should generate a notification ONLY when the time is right, the homeowners can benefit from the offer in a demonstrable manner, and if they can do so with a click of a button.

**Deliverables:**

1. Design a homeowners’ and a business owners’ dashboard that will allow entering the information needed as described above. Make sure that you support items 2 and 4 above through an external link in a creative manner. Your dashboard should also support service needed tasks – a homeowner must be able to choose the services she is looking for regardless of the current condition of her services, e.g., still under contract.
2. Design a database notification service that a homeowner will be able to see when she logs in about the available opportunities.
3. For a business, generate a report of possible opportunities regardless of a match based on similarity of cost, and quality so that they are able to decide if they could get these businesses by adjusting their services.

**Final Report:** Submit an 8 Plus-page final report using OverLeaf as described earlier by the deadline.

**Copyright, Ownership and Co-Authorship**

You will co-own the authorship and copyright of all projects you will work on in either category (traditional or research). You are free to post or list the source codes of these projects on any public or private repositories. You are also free to sell or use them in any fashion you deem appropriate to anyone if you also mention and credit Dr Hasan Jamil and UI as the co-authors and co-owners of these projects, in most cases. Finally, as in the previous semesters, plans are in place to publish some of these projects as research papers whenever possible and if the quality of the project permits. If it so happens, you as the co-author of the project will be listed as a co-author of the article based on the level of contributions you make post completion of your course. It is often will be in the form of acknowledgement of your contributions toward to projects if your post-course completion contributions are not substantial. Dr. Hasan Jamil will make that decision and the call.

**Research Projects: (70% total + Final Report 10%)**

**CoDD**

**Description**: In this project, you will design an online ER diagramming tool similar to ERDPlus at <https://erdplus.com/>. Users of this system must be able to design an ER diagram and convert the diagram into SQL CREATE TABLE statements. For this project, there are no available documents, but the ERDPlus site is a functional example that can be used as a reference.

**NoDD**

**Description:** In this project, you will design a functional dependency tutoring engine using which students will be able to answer questions on functional dependencies. There are two articles that can be used as references that include substantial details.

**ProTrack**

**Description:** In this project, you will design a database project management system using which students and instructors will be able to design, manage and coordinate class projects to stay on track. There is a published article on ProTrack at IEEE ICALT 2023 that can be used as a reference that includes substantial details.

**EnSer**

**Description:** In this project, you will design a service learning collaboratory using which students and instructors will be able to design, manage and coordinate a socially inspired project for a student to take for credit. The available projects will be contributed by stakeholders in the community, and they will be able to grade and offer feedback on the quality of the completed projects. There is a published article on EnSer at IEEE ICALT 2023 that can be used as a reference that includes substantial details. A sample EnSer project is described below. If you have a useful project that will benefit the community, please talk to me.

**Service-Learning Project**

**Description**: Design a database using which students will be able to find and rent on- or off-campus accommodations in Moscow, ID. You should anticipate three types of users – students, university housing agents from UI and local rental company agents. Students should also be able to find roommates based on multiple preferences, and housing based on their rental priorities. Both university and rental agents will list their homes or apartments, rental conditions, availability, rent and contract details. Students will list their needs and preferences. A weekly match day algorithm will decide who gets which ***binding*** accommodation based on their preferences. If a student declines to accept the match, he/she will be taken out of the list and placed in a waiting list and will be given a chance after all accommodations are assigned and some are still left unassigned. The contract forms will be auto filled, co-signed by the UI housing agent (when needed, for freshly arriving international students) and the student applicants, and finalized fully automatically. A $50 fee will be assessed for the service, and a security deposit and first month’s rent will be collected by the system using card payment. A 5% credit card transaction fee will be charged if paid using a credit card. You will make the system and the site pleasant, innovative, and useful. UI’s IPO plans to recommend using it by the incoming international students at the start of the Spring 2024 semester and will be developed in collaboration with the International Program Office of UI and SmartTech to which *you will surrender the copyright of this system*.

**CS 360: Lab Syllabus**

Lab Instructor: Kallol Naha Email: knaha@uidaho.edu

Lab Points (CS 360 Lab): Pass/Fail – Passing requires scoring 75% overall in lab (Attendance – 15% (no unexcused absences), Assignments (7) – 35%, Project Demo Presentation – 50%)

**Zoom Links**: **all sections (same as the class link) (**<https://uidaho.zoom.us/j/88488887865>).

1. **August 30**: Introduction to Latex on OverLeaf.
2. **September 6:** Full Stack Web Development, Client Software, Server Software, Popular stacks, Introduction to XAMPP, introduction to PhpMyAdmin. Introduction to HTML, First html code, HTML – Tags, Elements, Attributes, Headings, Paragraphs, Image, Links, Tables, Forms. Project planning.
3. **September 13**:CSS Introduction, Inserting CSS into html, CSS – Selectors, Id’s and Classes, Common Styling Properties.

**Lab Assignment 1: Due before September 13 (Based on Previous Lecture)**

1. **September 20:** Introduction to Bootstrap 5, Containers, Grid, Colors, Alerts, Buttons, Cards, Badges, Navs, Modal, Tooltip, etc.

**Lab Assignment 2: Due before September 20 (Based on Previous Lecture)**

1. **September 27:** Introduction to Php, Php – Syntax, Comments, Variables, Array, Echo/Print, Data Types, Loop, Function etc.

**Lab Assignment 3: Due before September 27 (Based on Previous Lecture)**

1. **October 4:** Introduction to Php Frameworks, Laravel, Laravel – MVC, Laravel – Routing, Middleware, .htaccess file.

**Lab Assignment 4: Due before October 04 (Based on Previous Lecture)**

1. **October 11:** Database design and adding data to DBs, connecting to the database using PHP and Laravel.

**Lab Assignment 5: Due before October 11 (Based on Previous Lecture**

1. **October 18:** **Project Demo 1 Presentation– 30% weight (100% complete interface design with database design)**
2. **October 25:** User registration and Login using Laravel, basic page development – home page, terms of use page etc.

**Lab Assignment 6: Due before October 25 (Based on Previous Lecture)**

1. **November 1:** Introduction to JavaScript, JavaScript – Syntax, Comments, Variables, Loop, Functions etc.

**Lab Assignment 7: Due before November 1 (Based on Previous Lecture)**

1. **November 8:** **Project Demo 2 Presentation – 30% weight (75% functional project.)**
2. **November 15:** Introduction to Version Control, GIT, SourceTree, GitHub.

**Lab Assignment 8 (Bonus): Due before November 15**

1. **November 22:** Fall Recess.
2. November 29: Introduction to Project management tool and their uses, project deployment into server
3. **December 6: Project Demo 3 Presentation – 40% weight (100% functional project)**