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教學計劃表 Syllabus

| | | | | | |
|------------------------------------|------------------|-----------------------------|---------------------------------|---------------------------------------|--------|
| 課程名稱(中文) Course Name in Chinese | 資料庫系統 | | 學年/學期 Academic Year/Semester | 112/2 | |
| 課程名稱(英文) Course Name in English | Database Systems | | | | |
| 科目代碼 Course Code | CSIEB0290 | 系級 Department & Year | 學三 | 開課單位 Course-Offering Department | 資訊工程學系 |
| 修別 Type | 學程 Program | 學分數/時間 Credit(s)/Hour(s) | 3.0/3.0 | | |
| 授課教師 Instructor | /吳秀陽 | | | | |
| 先修課程 Prerequisite | | | | | |
| 課程描述 Course Description | | | | | |

Database systems are at the heart of almost all modern information systems. Any organization/company with a need to process large volume of data can't survive without databases. It is now one of the essential capabilities for computer science students to learn and practice. At the age of big data, Internet of Things(IoT) and Artificial Intelligence(AI), data processing and analysis technologies are considered key indicators of competitiveness for any organization, enterprise, or even country. The main purposes of this course are to introduce the core concepts and key technologies of database systems, as well as current trends in data science. Students will learn how to construct effective database systems for any domain of interest. Students will also learn how to build software systems for supporting the efficient manipulation of data in database systems. More specifically, we will discuss the following topics during the semester. (資料庫系統技術經過多年的發展，已經廣泛應用在絕大多數現代資訊系統中。隨著大數據、物聯網、和人工智慧時代的來臨，各種類型的資料不斷產生與累積，資料庫系統和智慧分析技術已經成為現代企業、機關組織、甚至整個國家維繫競爭力所不可或缺的重要能力。本課程介紹資料庫系統的理論基礎與實務應用，同時討論在大數據時代的最新資料庫技術趨勢。內容可以分為基礎部分和進階議題討論(依時間允許)，分別敘述如下。)

Fundamentals(基礎部分):

- . Database system concepts and history(資料庫系統基本概念與發展歷史回顧)
- . Conceptual data modeling(概念資料模型)、Entity Relationship(ER)/Enhanced Entity Relationship(EER) data model(ER/EER資料模型)and database design(資料庫設計)
- . Relational data model(關聯式資料模型)、Structured Query Language SQL(結構查詢語言SQL)、relational algebra/calculus(關聯式代數與計算) and relational database design(關聯式資料庫設計)
- . Open source DBMS and application design: PHP/MySQL, Python/PostgreSQL(開源資料庫管理系統與應用設計: PHP/MySQL, Python/PostgreSQL)
- . Database design theory(資料庫設計理論)、functional dependencies(函數相依) and normalization(正規劃)
- . Database management system DBMS design(資料庫管理系統設計)、storage structure(儲存架構)、indexing methods(索引方法)
- . Query processing(查詢處理)、query optimization(查詢最佳化)
- . Transaction processing(交易處理)、concurrency control(並行控制)、and recovery(回復)
- . Big data processing(大數據處理)、NoSQL/NewSQL databases(NoSQL/NewSQL資料庫) and cloud data management(雲端資料管理)

Advanced topics(進階部分): will be covered if time permits(依時間允許)

- . Database technologies for AI/ML
- . IoT data management
- . Object-oriented databases(物件導向資料庫)、XML and semi-structure data processing(XML與半結構資料處理)
- . Parallel and distributed databases(平行與分散式資料庫)
- . Active databases(主動式資料庫)
- . Temporal databases(時間資料庫)
- . Spatial databases(空間資料庫)
- . Multimedia databases(多媒體資料庫)
- . Logic and deductive databases(邏輯與推導式資料庫)
- . Data mining(資料探勘) and data warehousing(資料倉儲)
- . Mobile data management(行動資料管理)
- . Streaming data management(串流資料管理)

We will use open source DBMS such as MySQL, PostgreSQL as examples to practice database application design. (在實務練習方面，我們將採用開放式資料庫管理系統像是MySQL、PostgreSQL等，同時討論如何設計建構資料庫應用程式。) If time permits, we will also cover NoSQL and NewSQL databases such as HBase and MongoDB for big data processing. (如果時間允許，我們將介紹大數據處理之NoSQL與NewSQL資料庫如HBase與MongoDB等。)

資料庫系統技術經過多年的發展，已經廣泛應用在絕大多數現代資訊系統中。隨著各種類型大數據資料(Big Data)不斷的產生與累積，資料庫系統和資料分析技術已經成為現代企業或機關組織維繫競爭力所不可或缺的重要能力。本課程介紹資料庫系統的理論基礎與實務應用，同時討論在大數據時代的最新資料庫技術趨勢。內容可以分為基礎部分和進階議題討論(依時間允許)。我們將選擇廣受歡迎的開放軟體資料庫管理系統和工具來進行實驗和學期計畫，讓同學具備透過網路提供資料庫相關應用服務的設計和實作能力。

Database systems are at the heart of almost all modern information systems. Any area with a need to process large volume of data can't survive without database technologies. It is now one of the essential capabilities for computer science students to learn and practice. At the age of big data, data processing and analysis technologies are considered key indicators of competitiveness for any organization or enterprise. The main purposes of this course are to introduce the core concepts and key technologies of database systems, as well as current trends in data science. Students will learn how to construct effective database systems for intended domains. Students will also learn how to build online services with database systems for effective data management in the background.

| 系專業能力 Basic Learning Outcomes | | 課程目標與系專業能力相關性 Correlation between Course Objectives and Dept.'s Education Objectives |
|----------------------------------|---|---|
| A | 資訊專業終身學習能力Ability of lifetime learning in information profession | ● |
| B | 實驗驗證資訊科學能力Ability of validate experimental result validation in information science field | ● |
| C | 資訊工具整合運用能力Ability of integrated applications of information technology | ● |
| D | 資訊系統應用設計開發能力Ability of information application system design and development | ○ |
| E | 團隊合作溝通協調能力Ability of teamwork, communication, and coordination | ○ |
| F | 資通訊科技問題解決能力Ability of problem solving regarding information and communication technology | ○ |
| G | 瞭解資訊科技多元影響能力Ability to understand information technology's multiple influences | |
| H | 肩負資訊人社會責任能力Ability of bearing the social responsibilities being among information professionals | |

圖示說明Illustration：● 高度相關 Highly correlated ○ 中度相關 Moderately correlated

授課進度表 Teaching Schedule & Content

| 週次Week | 內容 Subject/Topics | 備註Remarks |
|--------|---|-----------|
| 1 | Course introduction(課程介紹) <ul style="list-style-type: none"> . Course description and learning objectives(課程描述與學習目標) . Textbooks and resources(教科書與參考資源) . Course syllabus(課程大綱) . Course requirements(課程要求) . Grading policy(評量策略) | |
| 2 | Introduction(資料庫系統簡介) <ul style="list-style-type: none"> . Basic concepts(資料庫系統基本概念) . History of database systems(資料庫系統發展歷史回顧) . Applications of database systems(資料庫系統應用) | |
| 3 | Relational models and languages I (關聯式模型和語言1) <ul style="list-style-type: none"> . Relational data model and constraints(關聯式資料模型與約束條件) . Relational database architecture(關聯式資料庫架構) . Relational algebra and calculus(關聯式代數與關聯式計算)** | |
| 4 | Relational models and languages II (關聯式模型和語言2) <ul style="list-style-type: none"> . Basic SQL(關聯式查詢語言SQL基礎) . Intermediate SQL(中級SQL) . Advanced SQL(進階SQL)** | |
| 5 | Conceptual modeling and database design I (概念模式化與資料庫設計1) <ul style="list-style-type: none"> . Conceptual modeling(概念模式化) . Database design process(資料庫設計程序) . Entity Relationship data modeling(ER資料模型) | |

| | | |
|----|---|--|
| 6 | Conceptual modeling and database design II (概念模式化與資料庫設計2) . Enhanced Entity Relationship data modeling(EER資料模型) . ER/EER to relational database mapping(從ER/EER模型到關聯式資料庫設計) | |
| 7 | Relational database design I (關聯式資料庫設計1) . RDB design concepts(關聯式資料庫設計概念) . Functional dependencies(函數相依) . Normalization(正規畫) | |
| 8 | Relational database design II (關聯式資料庫設計2) . Further normalization(進階正規畫) . Design algorithms(設計演算法) . Application design(關聯式資料庫應用設計) | |
| 9 | Midterm Exam 期中考試週 | |
| 10 | Database application design(資料庫應用設計) . Database application architecture(資料庫應用架構) . Introduction to open source DBMS: MySQL and PostgreSQL(開放式資料庫管理系統簡介: MySQL 與 PostgreSQL) . Database application design: PHP/MySQL, Python/PostgreSQL(資料庫應用設計: PHP/MySQL, Python/PostgreSQL) | |
| 11 | Big data and analytics I (大數據與資料分析1) . Introduction to big data(大數據簡介) . Big data storage(大數據儲存系統) . NoSQL, NewSQL and Distributed SQL databases(NoSQL, NewSQL與Distributed SQL資料庫) | |
| 12 | Big data and analytics II (大數據與資料分析2) . Big data processing and cloud database(大數據處理與雲端資料庫) . Big data analytics(大數據分析) | |
| 13 | DBMS technologies I (資料庫管理系統技術1) . DBMS architecture(資料庫管理系統架構) . Storage structure and system(儲存架構與系統) . Indexing methods(索引方法) | |
| 14 | DBMS technologies II (資料庫管理系統技術2) . Query processing(查詢處理) . Query optimization(查詢最佳化) | |
| 15 | Transaction management I (交易管理1) . Transaction concepts and system architecture(交易概念與系統架構) . Transaction processing(交易處理) | |
| 16 | Transaction management II (交易管理2) . Concurrency control(並行控制) . Recovery(交易回復) | |
| 17 | Advanced topics(進階議題)** . Database technologies for AI/ML(資料庫技術在人工智慧與機器學習上的應用) . Internet of Things(IoT) and streaming data processing(物聯網與串流資料處理) . Parallel and distributed databases(平行與分散式資料庫) . Object-oriented databases(物件導向資料庫) . Semi-structured data and XML(半結構化資料與XML) . Mobile data management(行動資料管理) . Multimedia databases(多媒體資料庫) . Blockchain databases(區塊鏈資料庫) | |
| 18 | Final Exam 期末考試週 | |

教學策略 Teaching Strategies

- 課堂講授 Lecture 分組討論 Group Discussion 參觀實習 Field Trip
- 其他 Miscellaneous: Term Project (學期計畫)

教學創新自評 Teaching Self-Evaluation

創新教學 (Innovative Teaching)

- 問題導向學習 (PBL) 團體合作學習 (TBL) 解決導向學習 (SBL)
- 翻轉教室 Flipped Classroom 磨課師 Moocs

社會責任 (Social Responsibility)

- 在地實踐 Community Practice 產學合作 Industry-Academia Cooperation

跨域合作 (Transdisciplinary Projects)

- 跨界教學 Transdisciplinary Teaching 跨院系教學 Inter-collegiate Teaching
- 業師合授 Courses Co-taught with Industry Practitioners

其它 other:

學期成績計算及多元評量方式 Grading & Assessments

| 配分項目 Items | 配分比例 Percentage | 多元評量方式 Assessments | | | | | | | |
|--|--------------------|--------------------|----------|----------|----------|----------|----------|----------|----|
| | | 測驗 會考 | 實作 觀察 | 口頭 發表 | 專題 研究 | 創作 展演 | 卷宗 評量 | 證照 檢定 | 其他 |
| 平時成績 General Performance | | | | | | | | | |
| 期中考成績 Midterm Exam | 25% | ✓ | | | | | | | |
| 期末考成績 Final Exam | 25% | ✓ | | | | | | | |
| 作業成績 Homework and/or Assignments | 25% | | ✓ | | | | ✓ | | |
| 其他 Miscellaneous (學期計畫(Term Project)) | 25% | | ✓ | | | ✓ | | | |

評量方式補充說明

Grading & Assessments Supplemental instructions

Must carry out, demo, and turn in the term project to pass(必須執行、演示、繳交學期計畫才能及格)!!

教科書與參考書目(書名、作者、書局、代理商、說明)

Textbook & Other References (Title, Author, Publisher, Agents, Remarks, etc.)

Avi Silberschatz, Henry F. Korth and S. Sudarshan. Database System Concepts, 7th Edition. McGraw-Hill, 2019/2020. (<https://www.db-book.com/db7/>)

Ramez Elmasri and Shamkant B. Navathe. Fundamentals of Database Systems, 7th Edition. Pearson, 2016. (<https://www.pearson.com/us/higher-education/program/Elmasri-Fundamentals-of-Database-Systems-7th-Edition/PGM189052.html>)

Recommended but not required.(建議但非必要)

課程教材網址(含線上教學資訊, 教師個人網址請列位於本校內之網址)

Teaching Aids & Teacher's Website(Including online teaching information.
Personal website can be listed here.)

Course web page(課程網頁): <http://web.csie.ndhu.edu.tw/showyang/DB2024s/index.html>

Instructor's homepage(教師網頁): <http://web.csie.ndhu.edu.tw/showyang>

其他補充說明 (Supplemental instructions)