國立東華大學

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	115/1
課程名稱(英文) Course Name in English	Database Systems				
科目代碼 Course Code	DS__10160	系級 Department & Year	學四	開課單位 Course-Offering Department	大數據科學國際學士班
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 and Internet of Things(IoT), data processing and analysis technologies are considered key indicators of competitiveness for any organization, enterprise, or even country. In the Artificial Intelligence (AI) era, database systems technologies are even more important not only for data storage/retrieval and information management, but also for model learning, deep analysis and active reasoning to facilitate data intelligence. 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。在大數據和物聯網應用盛行的當前，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。隨著人工智慧時代的來臨，資料庫系統技術更從傳統的資料存取和資訊管理，演進到支援模型學習、深度分析和主動推理，以促成資料智慧升級。 本課程介紹資料庫系統的理論基礎與實務應用，同時討論當前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)
. Vector databases (向量資料庫)
. Database technologies for Artificial Intelligence and Machine Learning (支援人工智慧和機器學習之資料庫技術)
. Data management for Internet of Things (支援物聯網之資料庫技術)
. 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。)

課程目標　Course Objectives

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	具備基本資料科學知識及邏輯推理能力。have well-founded background in data science and logical reasoning,	●
B	具備機率、統計、資料科學及相關領域的知識與應用能力。have the knowledge of probability , statistics , data science and the related fields, and their applications,	●
C	具備資料科學應用技能與團隊合作，解決問題能力。be able to utilize data scientific skills for problem solving through cooperation and teamworking.	○

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) . 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) . 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) . 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 (關聯式代數) . Relational calculus (關聯式計算)**	
4	Relational models and languages II (關聯式模型和語言2) . 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) . 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: Python/PHP + SQLite/MySQL/PostgreSQL（資料庫應用設計: Python/PHP + SQLiteMySQL/PostgreSQL）	
11	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）	
12	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）	
13	Transaction management（交易管理） . Transaction concepts and system architecture（交易概念與系統架構） . Transaction processing（交易處理） . Concurrency control（並行控制） . Recovery（交易回復）	
14	Big data and analytics（大數據與資料分析） . 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） . 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）	
15	Vector Databases & AI Applications . Introduction to vector database . Vector embeddings and similarity search . ANN (Approximate Nearest Neighbor) . AI applications in . Semantic search . Recommendation systems . Retrival-Augmented Generation (RAG)	
16	Advanced topics(進階議題)** . 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）	
17	期末考試週 Final Exam	

彈性教學規劃 Flexible Teaching Plan	請勾選(至少需勾選1 個項目)： Please tick the box(es). (At least one item is required.): ☑ 問題討論 Problem-based Discussion ☐ 翻轉教學 Flipped Classroom ☑ 展演實作 Performance / Practical Presentation ☐ 校外參訪Off-campus Visit ☐ 講座活動 Lecture / Seminar ☐ 線上作業 Online Assignments ☐ 自主學習 Self-directed Learning ☐ 課業輔導Academic Support ☐ 實驗操作 Experiment Operation ☐ 遠距教學(同步) Distance Learning (Synchronous) ☐ 遠距教學(非同步) Distance Learning (Asynchronous) ☐ 其他(請填寫) Others (Please specify.): 備註: 本校學期週數自115 學年度起調整為17 週，為符合1學分18 小時之原則，請教師規劃安排彈性教學。 Note: From the 115th academic year, the semester will be 17 weeks. Please include flexible teaching activities to meet the required 18 hours per credit.

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 Industy-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(含出缺席) General Performance (Attendance Record)									
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 and turn in the term project to pass(必須執行和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.)

Textbook:
Carlos Coronel and Steven Morris. Database Systems: Design, Implementation & Management, 14th Edition. Cengage Learning, Inc., 2023. (DSDIM14) (https://www.cengageasia.com/title/default/detail?isbn=9780357673034)

Main Regerences:
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): on e-Learning

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

其他補充說明 (Supplemental instructions)