

CSIE30600/CSIEB0290 Database Systems

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Course Objectives

- First course in database systems
- Cover the **fundamental concepts**
- Using **Database Management System (DBMS)**.
- Learning state-of-the-art **open source DBMS**
- Study how a DBMS is **implemented**
- **Advanced topics:** Cloud DBs and NoSQL for Big Data (topics for Big Data Systems course)*
- **Advanced topics:** XML DB, OODB, mobile, etc. (topics of Advanced DB course)*

Course Information

- Instructor's Office: Eng Building CSIE Office
- Office Hours: Tue 17:00 - 18:00
- Phone Number: (03) 8634011, 8634020
- Email Address: showyang@gms.ndhu.edu.tw
- Grading Policy: (may change if necessary)
 - Assignments 25%
 - Midterm 25%
 - Final Exam 25%
 - Term project 25%

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Web Pages

- Course webpage:
<http://web.csie.ndhu.edu.tw/showyang/DB2017f/index.html>
- Not on “東華e學苑” !!
- Instructor's homepage:
<http://web.csie.ndhu.edu.tw/showyang>

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Textbook

- Ramez Elmasri and Shamkant B. Navathe.
Fundamentals of Database Systems, 7th Edition.
Pearson, 2015-2016.
- Recommended but not required.

References



- Thomas Connolly and Carolyn Begg. ***Database Systems- A Practical Approach to Design, Implementation, and Management, 6th Edition.*** Pearson, 2015.
- Abraham Silberschatz, Henry F. Korth, and S. Sudarshan. ***Database System Concepts, 6th Edition.*** McGraw-Hill, 2011.
- Garcia-Molina, J. D. Ullman, and J. Widom. ***Database Systems: The Complete Book, 2nd Edition,*** Prentice Hall, 2008.
- Jeffrey D. Ullman and Jennifer Widom. ***A First Course in Database Systems, 3rd Edition,*** Prentice Hall, 2007.

SQL References

- Andrew Johansen. *SQL: The Ultimate Beginner's Guide!* CreateSpace Independent Publishing Platform, Nov 2015.
- John Viescas and Michael J. Hernandez. *SQL Queries for Mere Mortals: A Hands-On Guide to Data Manipulation in SQL (3rd Edition)*. Addison-Wesley Professional, Jun 2014.
- Joe Celko. *Joe Celko's SQL for Smarties, 5th Edition: Advanced SQL Programming*. Morgan Kaufmann, Dec 2014.
- Stephane Faroult. *SQL Success – Database Programming Proficiency*. RoughSea Ltd, 2013.
- Ben Forta. *SQL in 10 Minutes, Sams Teach Yourself, 4th Edition*. Sam Publishing, Nov 2012.
- Mike McGrath. *SQL in Easy Steps, 3rd Edition*. In Easy Steps Ltd. 2012.

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SQL References (cont.)

- Alan Beaulieu. *Learning SQL, 2nd Edition*. O'Reilly Media, Inc. 2009.
- James R. Groff, Paul N. Weinberg, Paul Weinberg, James Groff. *SQL: The Complete Reference, 3rd Edition*. McGraw-Hill, 2009.
- Kevin Kline, Daniel Kline and Brand Hunt. *SQL In A Nutshell, 3rd Edition*. O'Reilly Media, Inc. 2008.
- Alex Kriegel and Boris M. Trukhnov. *SQL Bible, 2nd Edition*. Wiley, 2008.

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PHP and MySQL References

- Luke Welling and Laura Thomson. *PHP and MySQL Web Development, 5th Edition*, Addison-Wesley Professional, 2016.
- W. J. Gilmore. *Beginning PHP and MySQL: From Novice to Professional, 5th Edition*, Apress, 2016.
- Mr Andrew Comeau and Stephen Burge. *MySQL Explained: Your Step By Step Guide*, CreateSpace Independent Publishing Platform, Nov 2015.
- Paul DuBois. *MySQL, 5th Edition (Developer's Library)*. Addison-Wesley Professional, 2013.
- Alan Forbes. *The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications with PHP and mySQL, 2nd Edition*, Plum Island Publishing LLC, 2013.
- Larry Ullman. *PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide, 4th Edition*, Peachpit Press, 2011.

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On-line Resources

- Wikibooks, **Structured Query Language**.
(http://en.wikibooks.org/wiki/Structured_Query_Language) (SQL:2011)
- Wikibooks, **MySQL**.
(<http://en.wikibooks.org/wiki/MySQL>)



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Individual Term Project

- An on-line database application (details will be announced in class)
- Use MySQL as backend database
- Use browser as user interface
- Can use any technique to connect the database.
- We will discuss PHP + MySQL.
- Demonstration and report due: Jan 22 ~ 26, 2018.

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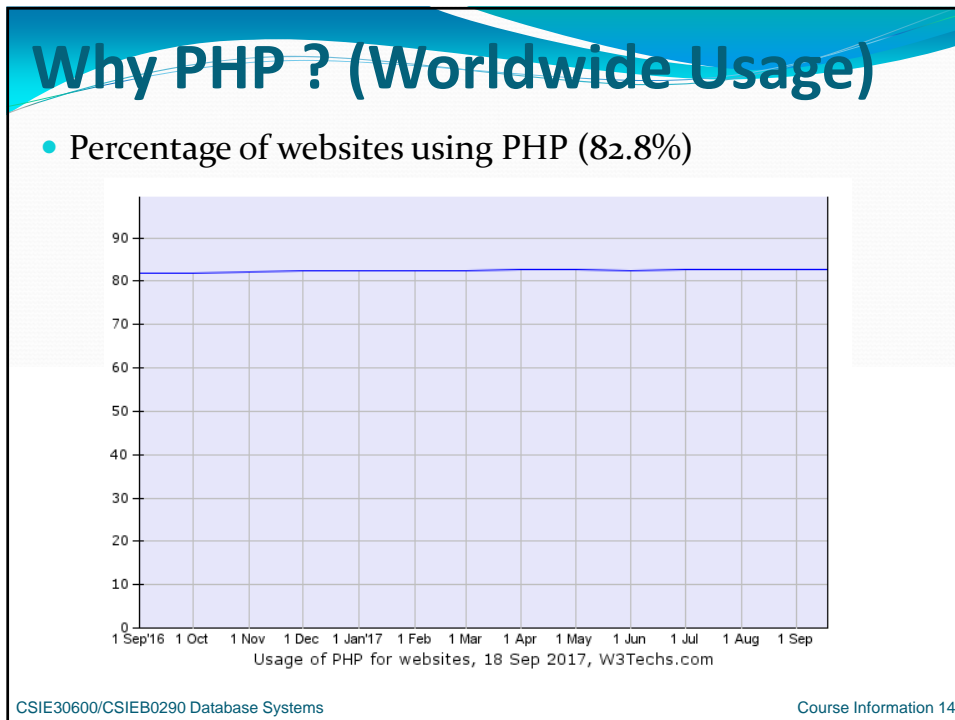
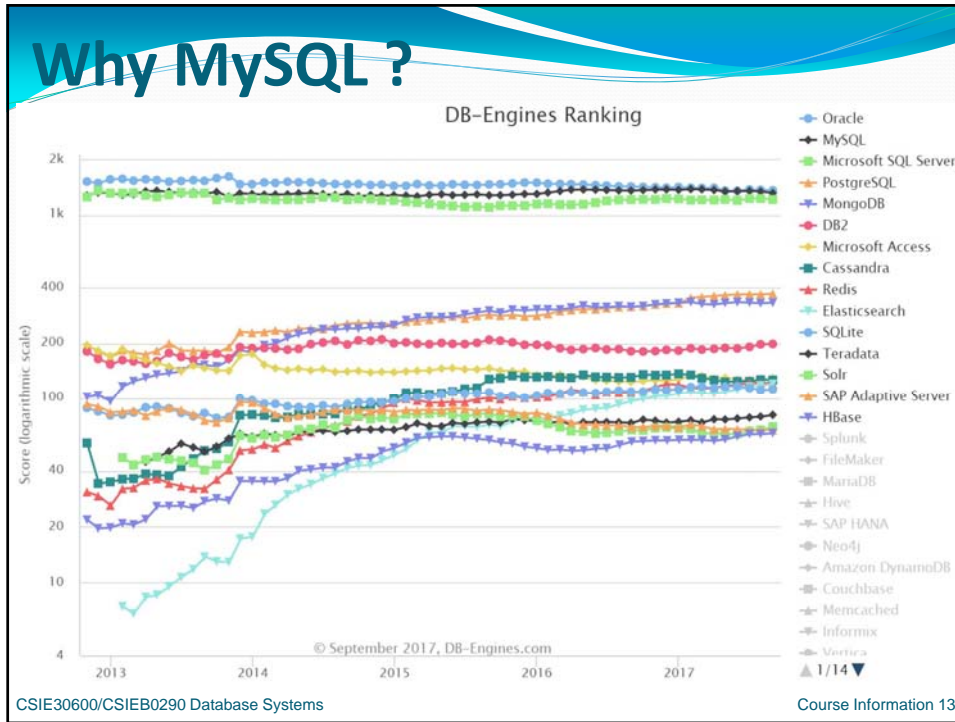
Why MySQL ?

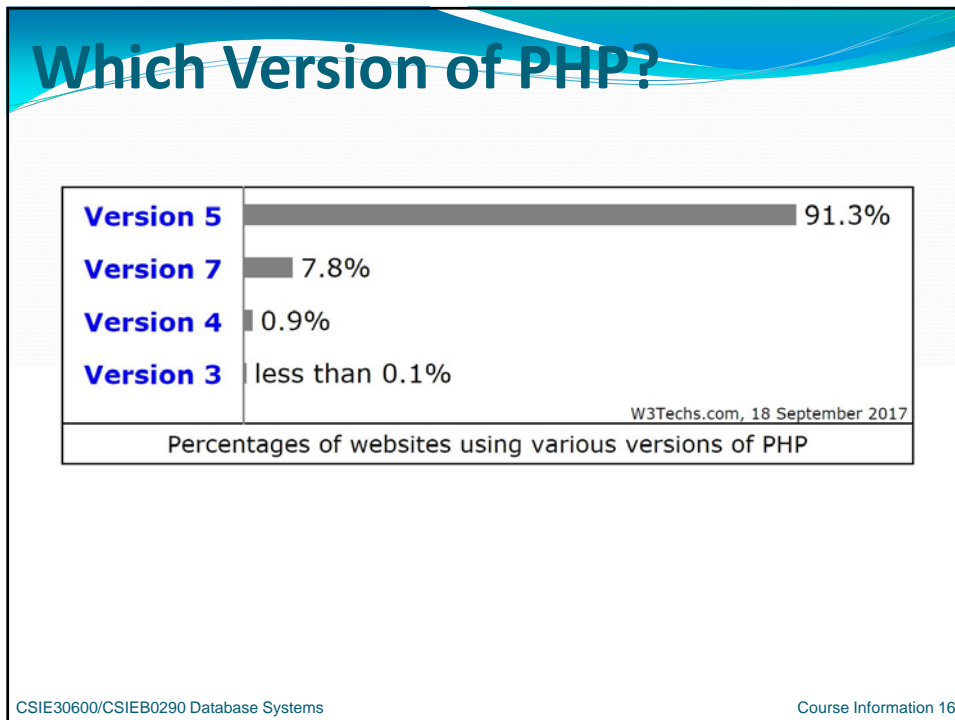
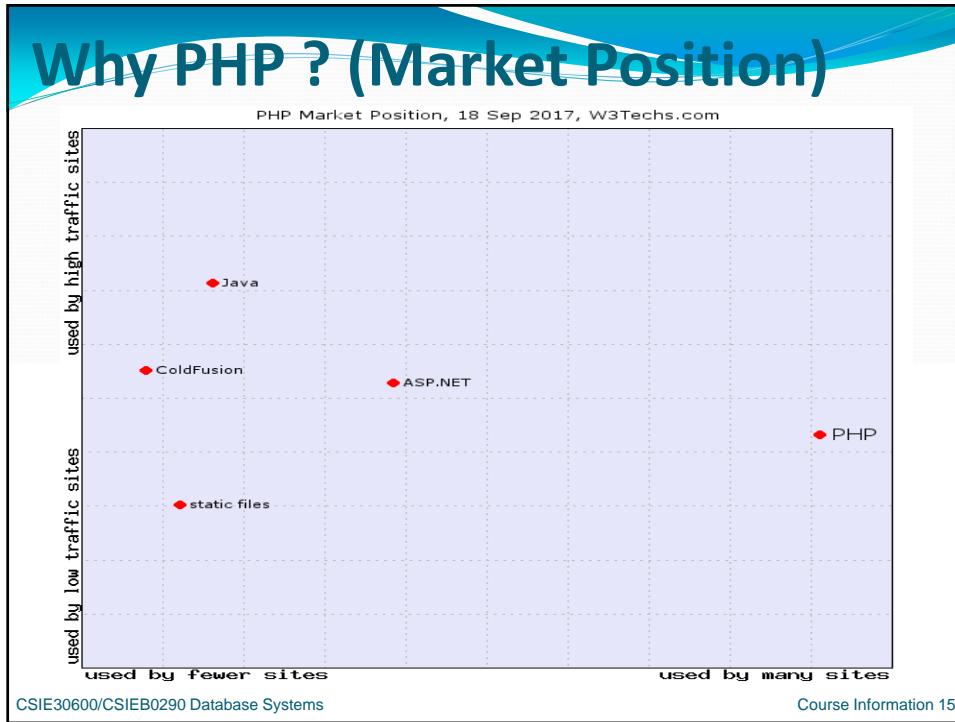
334 systems in ranking, September 2017

Rank			DBMS	Database Model	Score		
Sep 2017	Aug 2017	Sep 2016			Sep 2017	Aug 2017	Sep 2016
1.	1.	1.	Oracle 🏆 🏆	Relational DBMS	1359.09	-8.78	-66.47
2.	2.	2.	MySQL 🏆 🏆	Relational DBMS	1312.61	-27.69	-41.41
3.	3.	3.	Microsoft SQL Server 🏆 🏆	Relational DBMS	1212.54	-12.93	+0.99
4.	4.	4.	PostgreSQL 🏆 🏆	Relational DBMS	372.36	+2.60	+56.01
5.	5.	5.	MongoDB 🏆 🏆	Document store	332.73	+2.24	+16.74
6.	6.	6.	DB2 🏆	Relational DBMS	198.34	+0.87	+17.15
7.	7.	📈 8.	Microsoft Access	Relational DBMS	128.81	+1.78	+5.50
8.	8.	📉 7.	Cassandra 🏆	Wide column store	126.20	-0.52	-4.29
9.	9.	📈 10.	Redis 🏆	Key-value store	120.41	-1.49	+12.61
10.	10.	📈 11.	Elasticsearch 🏆	Search engine	120.00	+2.35	+23.52
11.	11.	📉 9.	SQLite	Relational DBMS	112.04	+1.19	+3.41
12.	12.	12.	Teradata	Relational DBMS	80.91	+1.67	+7.84
13.	13.	📈 14.	Solr	Search engine	69.91	+2.95	+2.95
14.	14.	📉 13.	SAP Adaptive Server	Relational DBMS	66.75	-0.16	-2.41
15.	15.	15.	HBase	Wide column store	64.34	+0.82	+6.53
16.	16.	📈 17.	Splunk	Search engine	62.57	+1.11	+11.28
17.	17.	📈 16.	FileMaker	Relational DBMS	61.00	+1.35	+5.64
18.	18.	📈 20.	MariaDB 🏆	Relational DBMS	55.47	+0.78	+16.94
19.	📈 20.	📉 18.	Hive 🏆	Relational DBMS	48.62	+1.31	-0.21
20.	📉 19.	📉 19.	SAP HANA 🏆	Relational DBMS	48.33	+0.36	+4.91

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Why Study Databases?

- Databases used to be *specialized applications*, now they are a *central component* in computing environments
 - Knowledge of database concepts is essential for computer scientists
- Databases are *everywhere*, even when you don't see them
 - most activities involve *data*
 - Banking + credit cards: all transactions
 - Airlines: reservations, schedules
 - Universities: registration, grades
 - Telecommunications/networks

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Why Study Databases?

- Sales: customers, products, purchases
- Manufacturing: production, inventory, orders, supply chain
- Human resources: employee records, salaries, tax deductions
- Web sites: generated from databases; front-ends to databases
- Scientific research, e.g., studying the environment
- Your own data!
- Sky-high demand for Big data and NoSQL !
- *Data needs to be managed*

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Why Study Databases?

- **Because data is valuable:**
 - E.g., bank account records, tax records, student records...
 - It must be protected - no matter what happens whether we have machine crashes, disk crashes, hurricanes/floods;
 - It also needs to be protected from **people**

Why Study Databases?

- **Because data is often structured:**
 - Bank account records all follow the same structure
 - We can exploit this regular structure
 - To retrieve data in useful ways (that is, we can use a *query language*)
 - To store data efficiently
- Dealing with unstructured data still needs database technologies.
- Big data needs database + new techs

Why Study Databases?

- Because the database field has made significant contributions to basic computer science:
 - *Understand concepts and apply to different problems and different areas*
- Because DBMS software is highly successful as a commercial technology (Oracle, DB2, SQL Server...)
- Because DB research is highly active and VERY interesting!
 - Lots of opportunities to have practical impact

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Syllabus

- Introduction
- Databases and database users
- Database system concepts and architecture
- ER/EER models and conceptual design
- Relational model and constraints
- Basic SQL
- Relational algebra and calculus**
- ER/EER to relational mapping
- MySQL (open source RDBMS)
- Web DB applications using PHP



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Syllabus (cont.)

- Relational database design I – Functional dependencies and normalization
- Relational database design II – Further normalization and design algorithms
- Storage structure and indexing methods**
- Query processing and optimization
- Physical design and tuning**
- Transaction processing
- Concurrency control
- Recovery**



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Syllabus (cont.)

- Object and object-relational databases**
- Semi-structured data and XML**
- Web database programming with PHP and MySQL

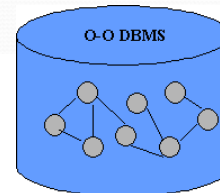


Figure 1: O-O Database Structure



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Syllabus (cont.)*

- Distributed and parallel databases
- Cloud computing and big data trends
- Big data systems and NoSQL databases
- Big data processing and analytics



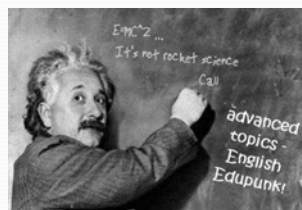
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Syllabus (Advanced Topics)*

- Database security
- Active databases
- Temporal and real-time databases
- Spatial databases
- Multimedia databases
- Deductive databases
- Information retrieval and Web search
- Data mining and data warehousing
- Mobile and pervasive data management



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Accept the DB Challenges

- A very interesting and challenging class
- Be prepared for some theoretical discussion on the principles and algorithms.
- You must keep up with the pace.
- Ask questions if you miss the point.
- Design your own examples.
- Join us with the **DB challenges** !!!

