Key Points

- the components of a database system
- the advantages of databases over files
- types of database systems
- relational databases

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Components of a Database System

- database
 - the data a structured collection of information
- database management system (DBMS)
 - the system providing all the services governing access to the data – efficient querying, integrity constraints, access control, concurrency, backups and recovery, ...
- application programs
 - programs that use the data via interactions with the DBMS

Components of a Database System

- database
 - the data a structured collection of information
- structured data is highly organized and easily searchable
 - fits neatly into data tables with rows and columns
 - conforms to a defined data model or schema which specifies the format and types of data for each column
- unstructured data lacks a defined data model or schema
 - does not fit neatly into data tables
 - e.g. text, images, videos, documents

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Advantages of Databases Over Files

- centralized storage of data avoids redundancy and inconsistency across different files
- data isn't isolated in an obscure file
- self-describing
 - contains both data and metadata defining and describing the data
- program-data independence
 - refers to separation between application program and the data
 - application programs work with a conceptual model of the data provided by the DBMS instead of directly with the underlying files storing the data
 - allows the storage details to change without affecting the application program

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Advantages of Databases Over Files

- added value
 - integrity and consistency constraints are part of the database and enforced by the DBMS
 - security, concurrency, transactions, backup and recovery are provided by the DBMS
 - transactions refer to bundling a multi-step operation into a single unit that either fully completes or doesn't happen at all
 - ...though these services do incur overhead (disk space, time)

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Types of Database Systems

- centralized vs distributed
 - centralized exists on a single server, distributed involves multiple servers (for mirroring or different parts of the database)
 - distributed can be further classified as homogeneous or heterogeneous depending on whether the same DBMS software is used at all of the sites
 - heterogeneous can occur when different organizations maintain databases that are integrated into a single package
 - e.g. a library catalog that includes the holdings of many different libraries
 - e.g. data clearinghouses

Types of Database Systems

- single-user vs multiuser
 - single-user systems are typically limited to personal computers
 - e.g. a back end for another program such as Microsoft Outlook
 - still useful because DBMS provides other features besides concurrency control (efficient querying, backup and crash recovery, etc)

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Types of Database Systems

- data model relational vs other things
 - relational model is based on tables (with rows and columns)
 - most common
 - general purpose
 - object-oriented database stores objects (instance variables and methods)

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Relational Databases

- a relational database consists of tables
- each row in a table groups together data values about a particular thing
 - duplicate rows are not allowed (must differ by at least one value)
 - order of the rows doesn't matter
 - order of the columns doesn't matter
 - data values are atomic
- foreign keys link tables together
 - e.g. DEPARTMENT.Mgr_ssn → EMPLOYEE.Ssn

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John			123456789		1965-01-09 7		731 Fondren, Houston, TX		хм	30000 33		3334	45555	5 5	
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Relational Databases

notation for relational schemas

EMPLOYEE(Fname,Minit,Lname,<u>Ssn</u>,Bdate, Address,Sex,Salary,Super_ssn, Dno) DEPARTMENT(Dname,<u>Dnumber</u>,Mgr_ssn, Mgr_start_date) WORKS_ON(<u>Essn</u>,<u>Pno</u>,Hours)

...

- underline denotes the primary key – two rows cannot have the same values for all the fields of the PK
- PK uniquely identifies each row
- foreign keys might be shown with arrows or listed separately
 - DEPARTMENT.Mgr_ssn → EMPLOYEE.Ssn
 - EMPLOYEE.Super_ssn → EMPLOYEE.Ssn
 - WORKS_ON.Essn → EMPLOYEE.Ssn
 - EMPLOYEE.Dno → DEPARTMENT.Dnumber

Fname	Minit	Lname	S	San		Bdate		Address		Sex	Salary	Su	00r_88	Dno
John	В	Smith	1234	123456789		1965-01-09		731 Fondren, Houston, TX		M	30000	333	44555	5 5
Franklin	Т	Wong 33		333445555 1		1955-12-08 63		538 Voss, Houston, TX		м	40000	888	66555	5 5
Alicia	J	Zelaya	9998	87777	1968-01-19		3321	3321 Castle, Spring, TX		F	25000 98		65432	1 4
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Relational Databases

terminology

theoretical	SQL	DBMS internals
relation	table	file
tuple	row	record
attribute	column	field

- domain is the data type for a column
- a view is a subset of rows and columns from one or more tables
- a database schema defines the tables, columns, and constraints

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Ramesh	K	Nara	an 6	666884444		1962-09-15		975 Fire Oak, Humble, TX		м	38000 333		3334	33445555		
Joyce	A	Engli	h 4	453453453		1972-07-31		5631 Rice, Houston, TX		F	25000 333		3334	333445555		
Ahmad	٧	Jabb	r 9	987987987		1969-03-29		980 Dallas, Houston, TX		м	25000 983		987654321		4	
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