



Evolution of database

Flat File Database

Hierarchical Database

Network Database

2020

Relational Database

Non-Relational Database

Combination of both is used!

SQL → structured Query language.



Information System Management

(MIS)

Relational database: Data is stored in tables.

NonRelational data base

Key value
Document
Groups
Wide column
Search engine
Time series

Chapter Five: Part 1 - Database Concepts

Database: is the heart of any Info sys!

every data stored will be assigned to a key!

Dr. Baha'eddin Alhaj Hasan

Department of Industrial Engineering

المادة الأساسية لأي Info sys هو ال Database

كينا بأي Info sys العنصر الأساسي هو ال skilled worker

Base: يتبع من
of the data collected.

The collected data →

تجوز كاستة بيانات
موجودة في ال Database

Why DATABASE

Info: processed data

عشان نعرف كذا لازم يكون كل
شيء مرتبط بقاعدة
بيانات

<https://www.youtube.com/watch?v=j09EQ-xlh88>

Learn what is Database / Types of Database DBMS

Success of a Company comes from how well do they access their data?

You need a database to store data.

What is Data? Can be anything & everything.

Any info or fact can be considered as data!

A video audio or a text can be considered as data. data can be in any form.

What is database?

Can be considered as a container filled w/ data or info, which is electronically stored in a system.

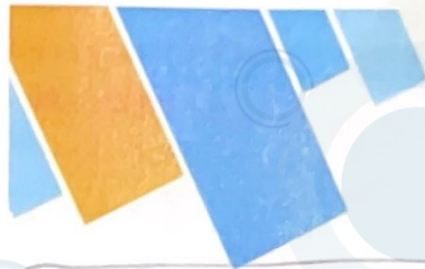
أقرب ترجمة لكلمة
Data → بيانات

Purpose of storing data in the database so it can be easily accessed, modified, protected & Analyzed.

DBMS ≠ Database?

Software to manage your database.

بالكورتس رح نركز على ال
Relational
Database



WHY DATABASES?

أنت كل يوم بتسوي
عملية database access
خلال ال Internet أو البرامج
م تستخدمها وال mobile
apps.

Databases are everywhere!

- » Databases are accessed every time you go to an Internet site, buy something online, use a search engine, send messages/emails online, play online games, and much much more!
- » Discord, Google, Facebook, Amazon, Twitter, OWL, Student Center, all use databases!

Exlearning, - - - etc.

نعمو على الذكاء الاصطناعي



WHY DATABASES?

But why do I need to know about them?

- » Need to understand the technology your business is using to make correct decisions.

» Business use databases to:

- Organize and keep track of things
- Automate data tracking and retrieval
- Allow multiple users to access data concurrently.
- Keep track of multiple themes

بإستخدام
برامج ال SQL

أي Business
حاليا لا ي
يعتمد على
ال Database
حجم ال Data
بأخذ Overview
كيف ال Data
بترتب
شوا Concept
الأساس تبعد
الاندريس عن مفهوم
ال Database
من ال Data
أهمية ال Data

MULTIPLE THEMES

General rule:

» **Single theme:** can store data in a spreadsheet

» **Multiple themes:** require a database

What's a theme?

♦ Ex: student grades, student emails, student office visits.

يمكن أن يكون كل واحد من Themes مختلف
من خلال Database

واحد Theme
يمكن أن يكون
في Excel أو
Spreadsheet

Customer Contact Log					
Contact Date	Contact Time	Customer	Purpose	Contact Method	Notes
2023-12-04	10:30:00 PM	Brown, Emmett	Product Support	Phone	Had an issue with his flux capacitor, fixed by turning it on and off again.
2025-11-22	1:34:00 AM	Brown, Emmett	Sales	Live Chat	Wanted to buy a delorean.
2024-01-26	6:23:00 PM	Smith, John	Product Support	Email	Police box had a broken chameleon circuit, customer did not want to fix.
2029-05-17	11:42:00 AM	Brown, Emmett	Follow Up	Phone	Follow up sales call about delorean.
2025-09-16	4:52:00 PM	Okabe, Rintaro	Product Support	Phone	Crazy ramblings about some kind of gate. Prank call?
2020-05-24	7:21:00 AM	Smith, John	Follow Up	Email	Follow up customer service call. Customer's screw driver was out of batteries.

UNES Chapter 5 Student Grades.xlsx - Excel

File Home Insert Layout References Developer Tell me what you want to do

Clipboard Font Paragraph Alignment Number Styles Cells Editing

Q14

	A	B	C	D	E	F	G	H
1	Student Name	Student Number	HW1	HW2	MidTerm	HW3	HW4	Final
2								
3	BAKER, ANDREA	1325	88	100	78			
4	FISCHER, MAYAN	3007	95	100	74			
5	LAU, SWEE	1644	75	90	90			
6	NELSON, STUART	2881	100	90	98			
7	ROGERS, SHELLY	8009	95	100	98			
8	TAM, JEFFREY	3559		100	88			
9	VALDEZ, MARIE	5265	80	90	85			
10	VERBERRA, ADAM	4867	70	90	92			
11								
12								

Sheet1 Sheet2 Sheet3

Ready

بیرفایز زنی الی کلاس

Can be updated at the same time.

MULTIPLE THEMES

STUDENT

Student Name: BAKER, ANDREA

Student Number: 1325

HW1: 88

HW2: 100

MidTerm: 78

EMAIL

Date	Message
2/1/2020	For homework 1, do you want us to provide notes on our re
3/15/2020	My group consists of Swee Lau and Stuart Nelson.
4/15/2017	

Records: 1 of 2

OFFICE VISITS

Date	Notes
2/13/2020	Andrea had questions about using IS for raising barriers to entry.

Records: 1 of 1

Records: 1 of 8

storing & keeping track of data
 retrieval of data
 updating of data
 efficiency
 data consistency
 data integrity
 speed / security

MULTIPLE THEMES

extensive analysis

↑
 Spreadsheets:-

↓ 1 million rows max!

every person must update their own spreadsheet w/ new data.

Relational databases
 ↳ > 1 million rows → no duplicate info.
 ↳ Provide a stable structure, controlling access permissions & user restrictions.

▪ <https://www.youtube.com/watch?v=x4Xt0M1mHbc>

Database vs. Spreadsheets - Adv & Disadv.

Spreadsheets: An electronic ledger, an electronic version of paper accounting worksheets. (Possible to create tables)
 ↳ different cells can contain calculations. (Functions & formulas)

↓
 Cell = single entity.

Both: can contain large amount of tabular data
 can use existing data to make calculations.

Relational databases are used by many users
 only contain raw data

You must preset the type of data contained in a certain field.

data storage

data integrity.

record of data ≠ calculation.

all calculations & operations based on existing data & are done after data retrieval
 you can do calculations in "views!"

WHAT IS CONTENT?

شيء ذو قيمة = على الأغلب يكون Data

Content: Something of value, which can be considered an asset

- Can be stored as data, documents, spreadsheets, presentations, websites, text from blogs, Twitter, or discussion boards, graphics, video files and video logs, audio files, etc.

HOW CAN CONTENT BE ORGANIZED?

Management of content

- Indexing, cataloguing, processing, storing bytes

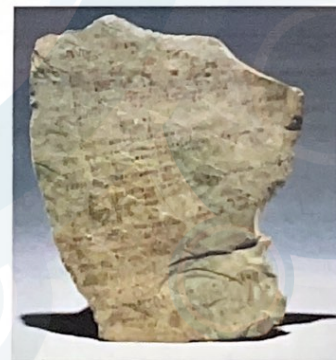
Presentation of content

- Distributing to the right person, right format
- Usually handled by content management system (CMS)



CMS: Information systems whose primary purpose is to provide an easy way to manage and present information, for example a popular blog post content Management system is wordpress. Wordpress makes it easy for blog authors to create edit format and display content without having any understanding of HTML (Hypertext Markup Language) or the database that being used under the hood.

HOW CAN CONTENT BE ORGANIZED?



Data stored in the past in filing cabinets. Card catalogs and ledger books
More in past data was saved on rocks.

Chained (2012) dollars
Seasonally adjusted at annual rates
Canada (map)

Estimates	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021
Final consumption expenditure	1,589,953	1,602,008	1,612,396	1,620,793	1,623,998	1,630,417	1,634,348	1,640,360	1,652,127	1,623,818	1,441,854	1,592,983	1,604,927	1,619,101	1,615,021	1,668,656	1,674,543
Household final consumption expenditure	1,151,676	1,159,463	1,165,460	1,172,344	1,172,238	1,177,374	1,180,001	1,184,106	1,192,898	1,166,164	1,003,922	1,132,979	1,136,311	1,141,610	1,138,821	1,182,886	1,195,840
Government consumption expenditure	518,528	523,136	525,335	528,569	527,820	529,172	531,092	530,511	531,041	515,597	475,615	553,877	554,940	557,697	543,946	556,117	555,178
Durable goods	154,525	156,302	157,398	157,174	157,504	157,369	157,629	156,507	156,411	140,181	121,670	166,351	166,081	165,482	160,385	156,825	157,180
Semi-durable goods	85,195	86,200	86,243	87,162	87,112	87,624	88,663	88,329	88,231	80,577	68,950	90,394	87,763	89,395	86,736	99,638	99,011
Non-durable goods	278,854	280,636	281,736	284,283	283,261	284,246	284,901	285,754	286,466	294,577	284,583	296,744	300,608	302,377	296,369	300,247	299,528
Services	633,260	636,482	640,262	643,918	644,533	648,274	649,015	653,190	661,694	650,283	529,885	581,928	584,176	586,739	597,225	638,819	642,672
Non-profit institutions serving households final consumption expenditure	20,896	30,234	30,688	30,548	30,844	31,100	31,356	31,668	31,800	32,348	28,360	30,448	31,320	30,544	30,640	31,056	31,516
Gross regional product	408,714	412,730	416,819	418,296	421,250	422,292	423,336	424,927	427,721	425,432	407,626	429,072	436,527	445,828	444,456	444,530	446,939

Good information has to be presented in good way so it will be useful!

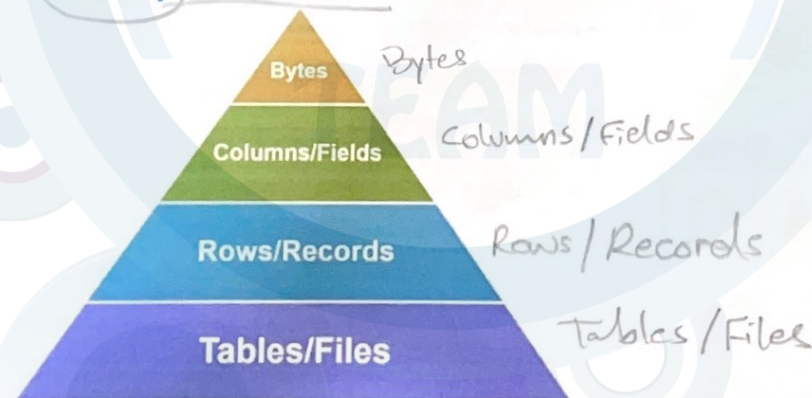
Canada's GDP digs out of COVID-sized hole

After falling off a cliff in March 2020, Canada's economy has clawed its way back to where it was before the pandemic.



WHAT DOES A DATABASE CONTAIN?

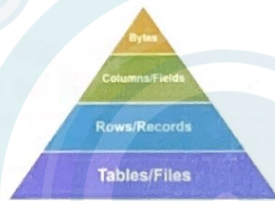
- Database: a self-describing collection of integrated records
- Hierarchy of data elements:



Integrity
very good!
efficient
I can update
easily & so

First Name	Last Name	Address	Phone #	Age	Sex	Email
Daniel	Servos	123 Fake St.	555-555-5555	37	Male	dservos5@uwo.ca
Jane	Doe	42 Long Rd.	555-123-4567	56	Female	jdoe@uwo.ca
Joe	Bloggs	135 Short St.	555-765-4321	14	Male	jbloggs@uwo.ca

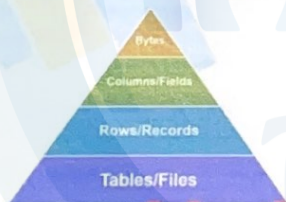
WHAT DOES A DATABASE CONTAIN?



هذا ليس بتعريف Database مجموعة Tables

改善

WHAT DOES A DATABASE CONTAIN?

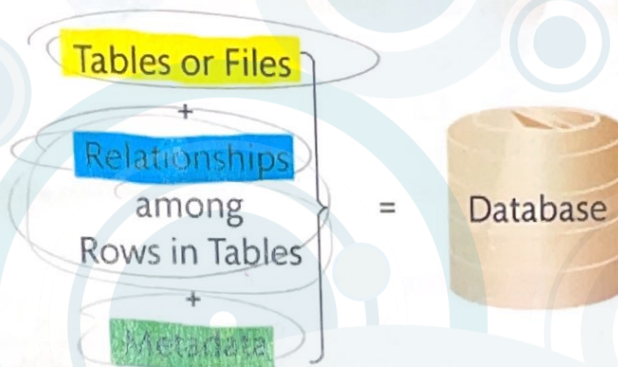


No!



أكيد لا

WHAT DOES A DATABASE CONTAIN?



Here we're talking about Relational Databases

Database بتكون أكثر من جداول

* All tables have a Primary key.

Email Table

Date	Message	Student Number
2/1/2007	For homework 1, do you want us to provide notes on our references?	1325
3/15/2007	My group consists of Sweet Lau and Stuart Nelson.	1325
3/15/2007	Could you please assign me to a group?	1644

Student Table

Student Number	Student Name	HW1	HW2	MidTerm
1325	BAKER, ANDREA	88	100	78
1644	LAU, SWEE	75	90	90
2881	NELSON, STUART	100	90	98
3007	FISCHER, MAYAN	95	100	74
3559	TAM, JEFFREY		100	88
4867	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLEY	95	100	98

Office Visit Table

Date	Notes	Student Number
2/13/2007	Andrea had questions about using IS for raising barriers to entry.	1325
2/17/2007	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
2/17/2007	Will miss class Friday due to job conflict.	4867

RELATIONSHIPS

Primary key: عبارة عن Identifier
يجمع جميع العناوين
التي عندهم نفس
حتى لو كان الاسم
مختلف Related



Primary Keys:

- Fields Column(s) that uniquely identify a row in a table.
- All tables have a primary key.

Q1: What Is the Purpose of a Database?

- Purpose: To organize and keep track of things
- Spreadsheets do that too
 - Keeping lists of only a single theme per worksheet
 - Example: Student test scores in a course
 - Linking and managing multiple worksheets is a real pain
- Databases
 - Keep lists that involve multiple themes
 - Examples: Student grades, grades for all courses in a department, courses offered in all departments, faculty records, and so on

Based on rows
not cells

改善

Q2: What Does a Database Contain?

- A self-describing collection of integrated records
- Hierarchy of data elements
 - Bytes/data are grouped into columns/fields
 - Columns grouped into rows/records
 - Rows are grouped into tables/files
- Collection of tables plus relationships among rows
 - Also includes “metadata”
 - Describes the structure of the database and its data
- A database is a structured collection of records stored in a computer system so that a computer program or person using a query language can consult it to answer queries.

Student Table (a.k.a., File)

Columns, also called fields

Student Number	Student Name	HW1	HW2	MidTerm
1325	BAKER, ANDREA	88	100	78
1644	LAU, SWEE	75	90	90
2881	NELSON, STUART	100	90	98
3007	FISCHER, MAYAN	95	100	74
3559	TAM, JEFFREY		100	88
4867	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLY	95	100	98

Rows,
also called
records

Characters, also called bytes

Database
قائمة
على
Records
بالدرجة
الأولى

Foreign Key ← Database, Primary Key
لما افتر ال Primary Key

Relationships Among Records

- Database have multiple tables (one for each theme)
- Values in one table may relate to rows/records in other tables
- Keys
 - A column(s) that identify unique row in table
 - Each table has a key
- Foreign keys
 - Are keys of a different table than the one in which they reside
- Relational databases
 - Databases use tables, keys, and foreign keys to create relationships

Example of Relationships Among Three Tables

Email Table

EmailNum	Date	Message	Student Number
1	2/1/2004	For homework 1, do you want us to provide notes on our references?	1325
2	3/15/2004	My group consists of Swee Lau and Stuart Nelson.	1325
3	3/15/2004	Could you please assign me to a group?	1644

Student Table

Student Number	Student Name	HW1	HW2	MidTerm
1325	BAKER, ANDREA	88	100	78
1644	WU, JEFFREY	75	90	90
2891	WILLIAMS, STUART	100	90	98
3559	FISCHER, RYAN	95	100	74
3559	WU, JEFFREY		100	88
4867	WU, JEFFREY	70	90	92
5265	WU, JEFFREY	85	90	85
8009	WU, JEFFREY	55	100	98

Office_Visit Table

VisitID	Date	Notes	Student Number
2	2/1/2004	Andrea had questions about the barriers to entry.	1325
3	2/1/2004	Jeffrey is considering a new major. Wanted to talk about career opportunities.	3559
4	2/1/2004	Will has a conflict due to job conflict.	4867

د طالب له
Unique Student
number
و صحبت دایکون دای
- Duplicanté.

改善

Example of Relationships Among Three Tables

- These lines are not stored in the database, they are just for illustrative purposes.
- Databases define these relationships through primary and foreign key fields and the values they contain in records.

Metadata

- Database is self-describing
 - Contains descriptions of its data
- Metadata
 - Data that describe data
 - Makes databases more useful
 - Makes databases easier to use
- Describes data by:
 - Data type – text, number, date, etc.
 - Field name
 - Field properties

data is self describing
- file

Student #
↳ metadata

لأنه يفسر معلوماتنا

Access Metadata Report

C:\Users\Joys\Courses\CS330\data sets\Exercise 2 Skills.accdb
Table: Annual Sales

Wednesday, September 30, 2009
Page: 1

Properties			
DateCreated:	12/10/2006 11:00:18 PM	DefaultView:	2
GUID:	{GUID {1C07FCAB-2C95-4A0F-82F1-9D1C3B6778A}}	LastUpdated:	12/13/2006 12:06:14 AM
NameMap:	Long binary data	OrderByOn:	False
Orientation:	Left-to-Right	RecordCount:	44
Updatable:	True		

Columns

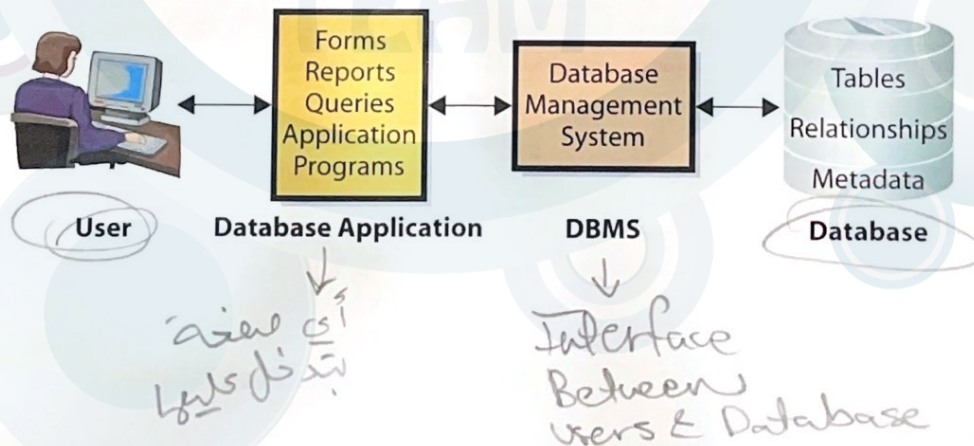
Name	Type	Size
Last Name	Text	20
AllowZeroLength:	True	
AppendOnly:	False	
Attributes:	Variable Length	
CollatingOrder:	General	
ColumnHidden:	False	
ColumnOrder:	Default	
ColumnWidth:	Default	
DataUpdatable:	False	
DisplayControl:	Text Box	
GUID:	{GUID {6BDC3986-D798-4384-A970-F6C20A520D4C}}	
IMEMode:	0	
IMESentenceMode:	3	
OrdinalPosition:	0	
Required:	False	
SourceField:	Last Name	
SourceTable:	Annual Sales	
UnicodeCompression:	True	
First Name	Text	20
AllowZeroLength:	True	
AppendOnly:	False	
Attributes:	Variable Length	
CollatingOrder:	General	
ColumnHidden:	False	
ColumnOrder:	Default	
ColumnWidth:	Default	
DataUpdatable:	False	
DisplayControl:	Text Box	
GUID:	{GUID {19A28BAD-5358-4E10-8DE4-7FE86DB7A758}}	
IMEMode:	0	
IMESentenceMode:	3	

Metadata Report

Q3: What Is a DBMS and What Does It Do?

- Database management system (DBMS)
 - Program that creates, processes, and administers databases
 - Usually licensed from vendors
 - Examples: Microsoft Access, Oracle, MySQL, DB2
- DBMS and database are two different things
 - Database is a structured collection of records or data stored in a computer system so a computer program or person using a query language can consult it to answer queries.
 - Database management system (DBMS) is a computer program used to manage and query a database

Components of a Database Application System



Database Management Systems

- DBMS is used to create tables, relationships in databases
- Applications use a DBMS to read, insert, modify, and delete data
 - Structured Query Language (SQL)
 - International standard language for querying databases
 - Allows users to interactively interrogate the database, analyze its data and update it according to the users privileges on data
 - Also controls the security of the database

interrogate
بخطاب أو استجواب
Database

Creating the Database and Its Structure

Field Name	Data Type	Description
EmailNum	AutoNumber	Primary key — values provided by Access
Date	Date/Time	Date the message is recorded into the database
Message	Memo	Text of the email
Student Number	Number	Foreign key to row in the Student Table
Response?	Yes/No	True / false value to indicate if prof has responded

Field Properties	
General	Lookup
Format	Yes/No
Caption	
Default Value	False
Validation Rule	
Validation Text	
Required	Yes
Indexed	No

A field name can be up to 64 characters long, including spaces. Press F1 for help on field names.

Processing the Database

- DBMS perform four basic operations

1. Read data
2. Insert data
3. Modify data
4. Delete data

- Structured Query Language (Example)

```
INSERT INTO Student  
([Student Number], [Student Name], HW1, HW2, MidTerm)  
VALUES  
(1000, 'Franklin, Benjamin', 90, 95, 100).
```

Administering the Database

- DBMS security features are used to set up user accounts, passwords, permissions, processing limits

– Permissions – data access rights for specific users or groups of users

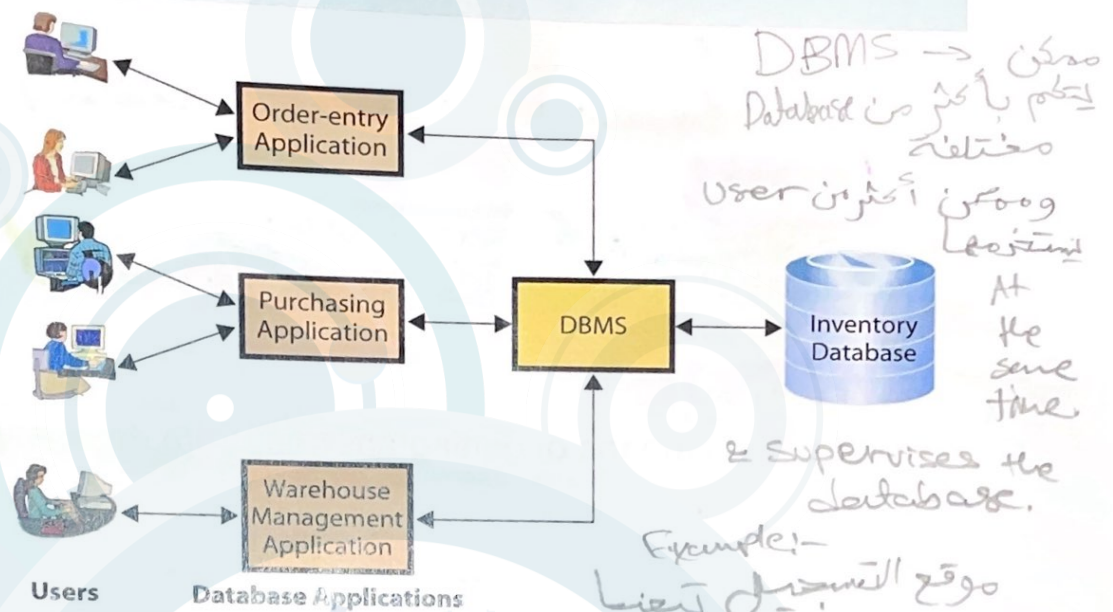
- Database backup and replication, adding structures, removing unneeded data

Permissions
وإعدادات
Backup

مش كل ال users الهم نفس الصلاحيات
فيهم لاخاوا

كل ال
Database

Use of Multiple Database Applications



Q4: What Is a Database Application?

- Database application is the software we create that actually utilizes our database.
- Collection of forms, reports, queries, and application programs that process a database
- Databases can have multiple applications
- Applications can have multiple users

Forms, Reports, and Queries

- Forms
 - Used to read, insert, modify, and delete data
- Reports
 - Show data in structured context
 - May compute values such as Totals, within a report
- Queries
 - Are a means of getting answers from database data

بتورجيني
Data
اي عندي

Specific questions or specific data.

Forms, Reports, and Queries

The screenshot shows a web-based form titled "Student Registration" for Western University. The form includes fields for Student Num (SN1), Student Name (Jane Smith), Registration Date (May 4, 2020), Date of Birth (February 11, 2020), and Phone Number ((345) 345-3453). There is a section for "Can This Student Graduate?" with radio buttons for Yes and No. A dropdown menu for "Faculty" is set to "Arts". At the bottom, there are navigation buttons (back, save, cancel, forward) and a status bar showing "Record: 1 of 10". The word "Form" is circled in pink below the screenshot.

Form

Forms, Reports, and Queries

Doctor's Patients

Daniel's Patient Report

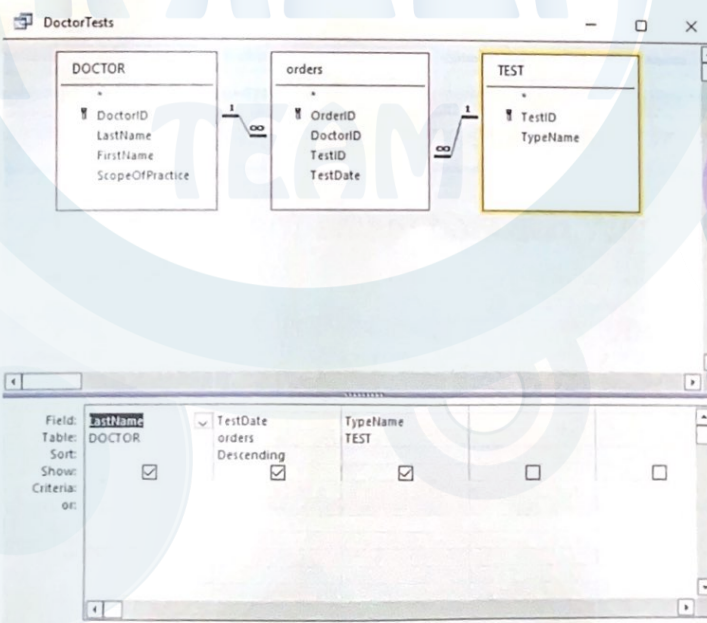
Doctor:	Smith				
Last Name	First Name	Phone Number	Address	Account Balance	
Davis	Dave	4165557777	54 Blarney Rd., London, ON	\$5.00	
Doe	Jack	5195550000	99 Fake St., London, ON	\$35.00	
				Doctor Total:	\$40.00
Doctor:	Bloggs				
Last Name	First Name	Phone Number	Address	Account Balance	
Jones	Alice	5195552323	876 Richmond St, London, ON	\$0.00	
Jones	Bob	1235558321	444 Limberlost St, London, ON	\$600.00	
				Doctor Total:	\$600.00
Doctor:	Wilson				
Last Name	First Name	Phone Number	Address	Account Balance	
Bloggs	Joe	1235550011	123 fake St., London, ON	\$0.00	
Doe	Jane	4165558473	1151 Richmond St, London, ON	\$1,000.00	
				Doctor Total:	\$1,000.00
Doctor:	Jones				
Last Name	First Name	Phone Number	Address	Account Balance	
O'Brian	Patty	5195552583	36 Blarney Rd., London, ON	\$20.00	
				Doctor Total:	\$20.00
				Total:	\$1,660.00

May 27, 2022

Page 1 of 1

Report

Forms, Reports, and Queries



Query in Access DBMS

Forms, Reports, and Queries

DoctorTests

```
SELECT DOCTOR.LastName, orders.TestDate, TEST.TypeName  
FROM TEST INNER JOIN (DOCTOR INNER JOIN orders ON DOCTOR.DoctorID = orders.DoctorID) ON TEST.TestID = orders.TestID  
ORDER BY orders.TestDate DESC;
```

Query
on a specific question

أول اسم الطبيب

First name

Last name

改善

Forms, Reports, and Queries

DoctorTests

LastName	TestDate	TypeName
Bloggs	2020-05-13	MRI
Smith	2020-05-12	CAT Scan
Bloggs	2020-05-05	CAT Scan

أول اسم
الطبيب

Database Application Programs

- » Forms, reports, and queries work for standard functions
- » Application programs provide more robust information
 - ◊ Process logic specific to business need
 - ◊ Enables database processing over Internet
 - ◊ Serves as intermediary between Web server and database
 - ◊ Responds to events
 - ◊ Reads, inserts, modifies, deletes data

تتفاعل التطبيقات
Applications

لكن طبعاً جدير بالذكر يتم التحكم فيها
من خلال ال servers التي يتحكم فيها ال Database
management systems.

Database Application Programs

- Application programs
 - Process logic specific to a business need
 - May enable database processing over Internet to:
 - Serve as intermediary between Web server and database
 - Respond to events,
 - Asks DBMS to read, insert, modify, delete data

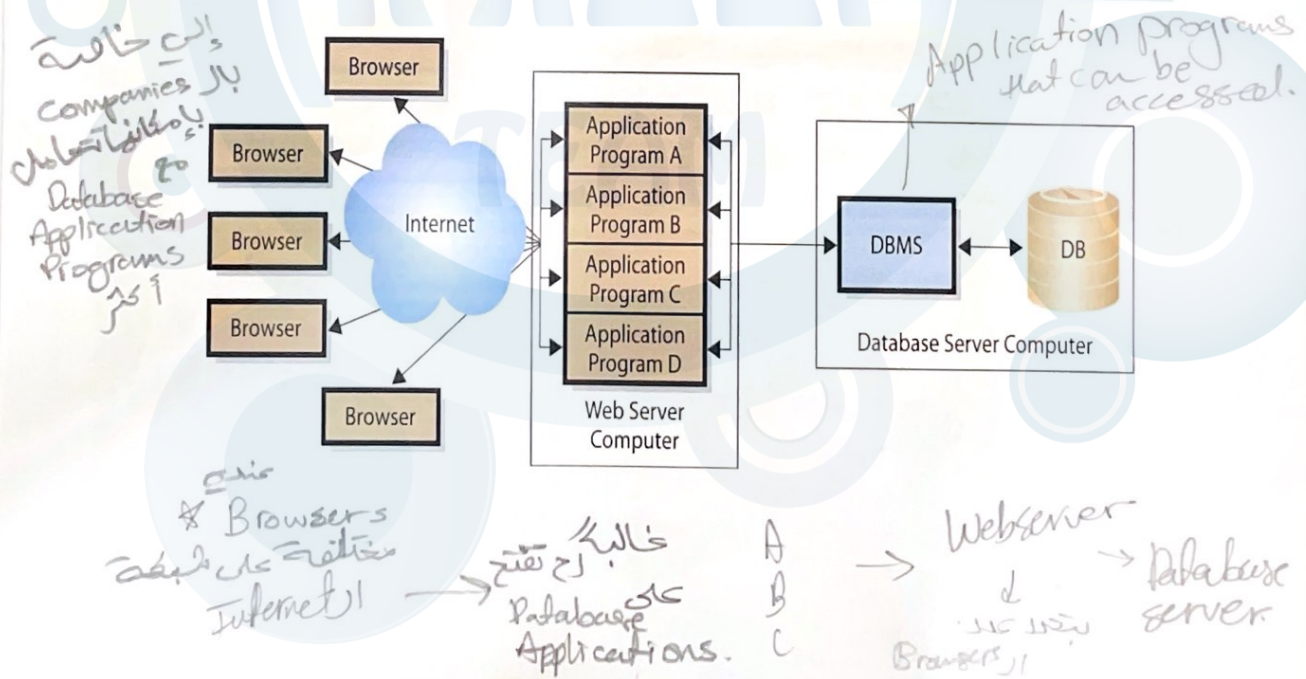
Repeated.

Example of a Query

a. Form used to enter phrase for search

b. Results of query operation

Four Application Programs on a Web Server Computer



Multiuser Processing Considerations

- Lost-update problem

- Occurs when an update made by one transaction is lost due to an update made by another transaction.

1. Process A reads a customer record from a file containing account information, including customer's account balance and phone number.
2. Process B now reads same record from same file, now B has its own copy.
3. Process A changes account balance in its copy of customer record and writes record back to the file.
4. Process B—which still has the original value of account balance in its copy of the customer record—updates customer's phone number and writes customer record back to the file.
5. Process B has now written the old account balance value to the file, causing the changes made by process A to be written over or lost.

ما هي المشاكل التي يمكن حلها من خلال الأنظمة المختلفة
إلى كسبي Database Management Systems.

Multiuser Processing Considerations (cont'd)

- Preventing Lost Update problems using:
- Locking

- Used to ensure that a transaction does not interfere with any other transaction. Locking prevents the problem of lost update, uncommitted data, and inconsistent data.
- By preventing another user or process to open a record that is currently being used by another user or process.

بفتح الـ Record
لو في حالة تاني
عمر يستعمله

without to manage
your database.

Q5: What Is the Difference Between an Enterprise DBMS and a Personal DBMS?

Enterprise DBMS

- Processes large organizational and workgroup databases
- Supports many users (thousands plus)
- Examples: DB2, SQL Server, Oracle, DB2

Supports

1,000 + users

Personal DBMS

- Designed for smaller, simpler database applications
- Supports fewer than 100 users (mostly 1-10 users)
- Examples: Access, dBase, FoxPro, Paradox, R-Base

Supports

1 - 10 users

Microsoft Access
شخصي
(Personal DBMS)

Database

Personal Database System

Database Application & DBMS → Program

