Introduction to Databases with Access 2010

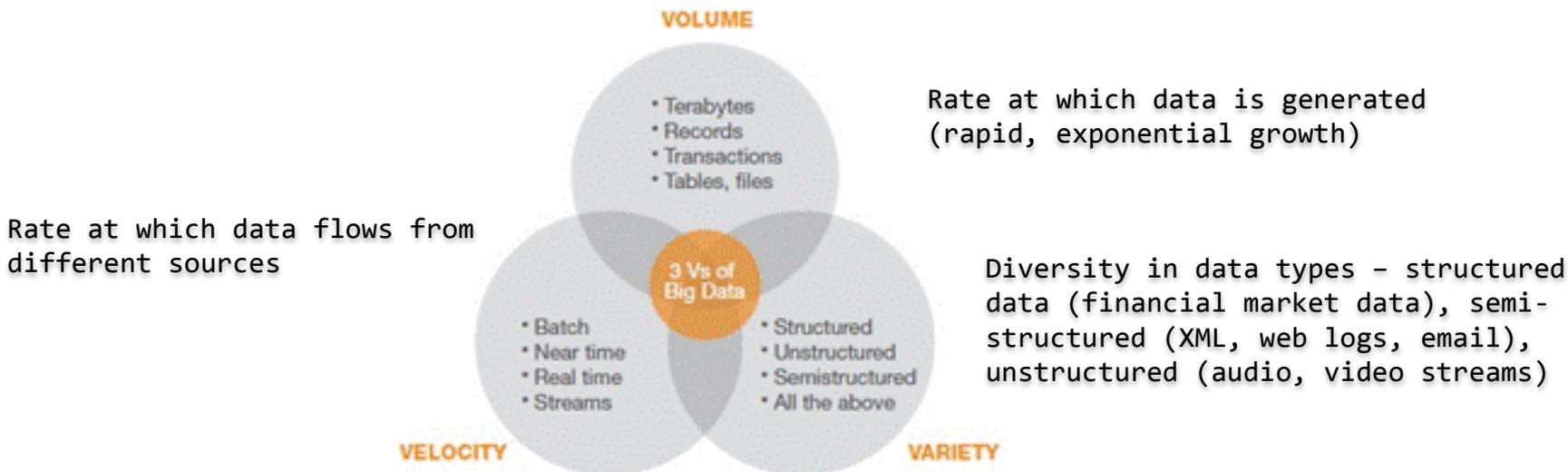**Instructor: Aarthi Natarajan**

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Based on slides by
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Objectives

- What are databases, and how do they differ from Excel tables, or table-structured spreadsheets?
- Relational databases
- Keys, tables, foreign keys
- Navigate among objects in Access database
- Practice good database file management
- Back up, compact, and repair Access files
- Create filters
- Sort table data on one or more fields
- Know when to use Access or Excel to manage data

What is data?

- Data – facts that can be recorded and have implicit meaning (Elmasri & Navathe)
- Today data is being generated at an exponential rate
  - Financial market data, posts to social media sites, growing logs of web transactions, computation physics…BIG Data

VOLUME
- Terabytes
- Records
- Transactions
- Tables, files

Rate at which data is generated (rapid, exponential growth)

Rate at which data flows from different sources

3 Vs of Big Data

VELOCITY
- Batch
- Near time
- Real time
- Streams

- Structured
- Unstructured
- Semistructured
- All the above

VARIETY

Diversity in data types – structured data (financial market data), semi-structured (XML, web logs, email), unstructured (audio, video streams)

What is a database?

- Data by itself is not very useful.

- Give a context to data to transform data into information e.g., the numbers 45,55,67 do not mean much, but given a context such as these are the marks of students in COMP 1000, this is now information

  DATA -> INFORMATION -> DECISION

- A database is collection of related data, which is organised such it can be easily accessed to produce useful information, can be managed and updated.

- Databases are everywhere...

  - The Internet uses databases extensively.

  - Every time you are asked to input data, you're accessing a database e.g., Google, Ebay, Amazon, Book Depository, Medicare, Tax Office, credit card, debit card, iTunes shop, Facebook, Twitter, WebCMS, UNSW Library card, ...

  - Every time you use a loyalty card, you're inputting information about your buying habits into the database of the company in question.

Database concepts

- A database is a coherent collection of related data

- A Database Management System (DBMS) is an application or collection of programs that allows users to create and maintain a database

- A database and DBMS are collectively referred to as a Database System

- A Relational Database Management System (RDBMS) is a special type of DBMS that:
  - Stores data as tables
  - Allows the user to create relationships between tables

- Applications access the database through the DBMS by:
  - Defining queries that causes data to be retrieved
  - Through transactions that cause some data to be written or deleted from the database

More database concepts

- A data model describes how the data is structured in the database

- A database schema adheres to a data model and provides a logical view of the database, defining how the data is organised and the relationships between them and is typically set up at the beginning

- A database instance is the state of the database at a particular instance of time

Data Models

- There are several types of data models
  - Relational model
    - a data structure where data is stored as a set of records known as tables
    - a table consists of rows of information (also called a tuple)
    - each row contains fields known as columns

StudentId	FirstName	LastName
213899	Joe	Bloggs
321456	Sam	Hunt
456789	John	Smith

  - Document model
    - data is stored in a hierarchical fashion e.g., XML
  - Object-oriented model
    - a data structure where data is stored as a collection of objects
  - Object-Relational model
    - a hybrid model that combines the relational and the object-oriented database models

Creating a database

- Choose a data model for the database
- Set up the structure of the database by defining a database schema for the database (e.g., for a relational data model, define the tables, rows and columns or field names and types of fields, constraints and relationships)
- Create the initial state of the data by loading data into the database
- After this, typically schema doesn't change much, but data changes rapidly as new data is loaded or existing data is updated

Microsoft Access

- An application in Microsoft Office that is used to store and maintain data in a database

- Access is a RDBMS, using which you can:
  - Create a database
  - Create and edit tables in the database
  - Create relationships between tables
  - Build forms and reports that use these tables)

Objects

- Objects – The main components in Microsoft Access RDBMS that are created and used to make the database function

- Four most commonly used object types
  - Tables (data)
  - Queries (extract information from data)
  - Forms (enter data into tables)
  - Reports (meaningful output)

- Two less commonly used object types
  - Macros
  - Modules

Navigating Access Interface

- ## Navigation Pane

  - Organizes and lists the database *objects* in an Access database. Objects can be tables, queries, forms, reports, macros or modules

- ## Access Ribbon

 - Contains the icons that enable you to perform functions to maintain your database
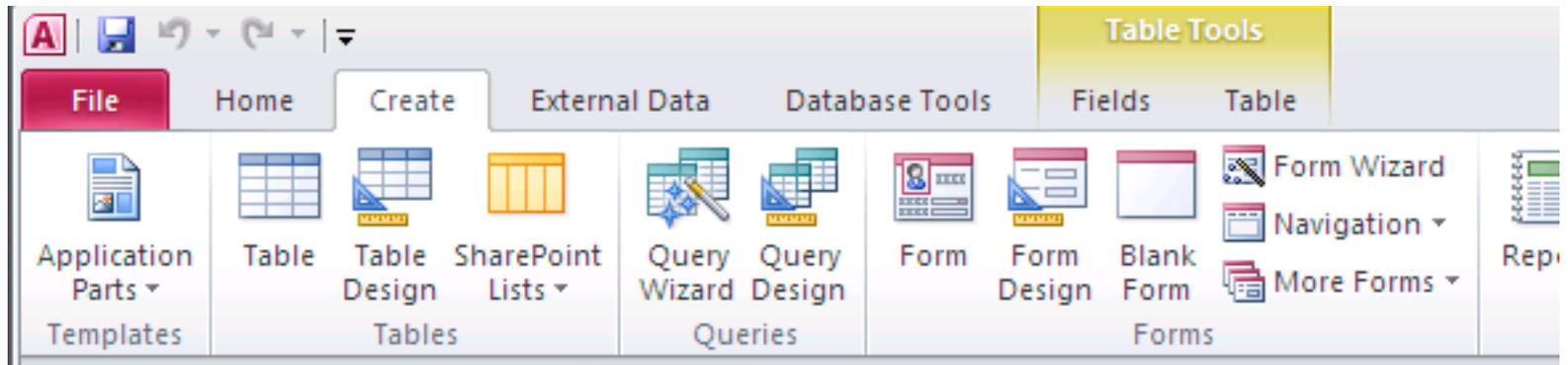
Working with Table Views

- Access provides two different views to view a table
  - Datasheet View : A grid containing rows and columns similar to Excel and allows user to add, edit, delete records in a table
  - Design View : allows user to create tables, add/delete fields, modify field data types and associated properties
    - Data types define the type of data stored in a field such as text, number, currency, etc., e.g, to store the salary of an employee, create a field called "salary" and select the data type as currency
    - Field properties define additional characteristics of fields e.g., pay rate to be >= $25 (defined using a validation rule)

Design View

Customers table in design view. Field names along left side. Each field has a Data Type.
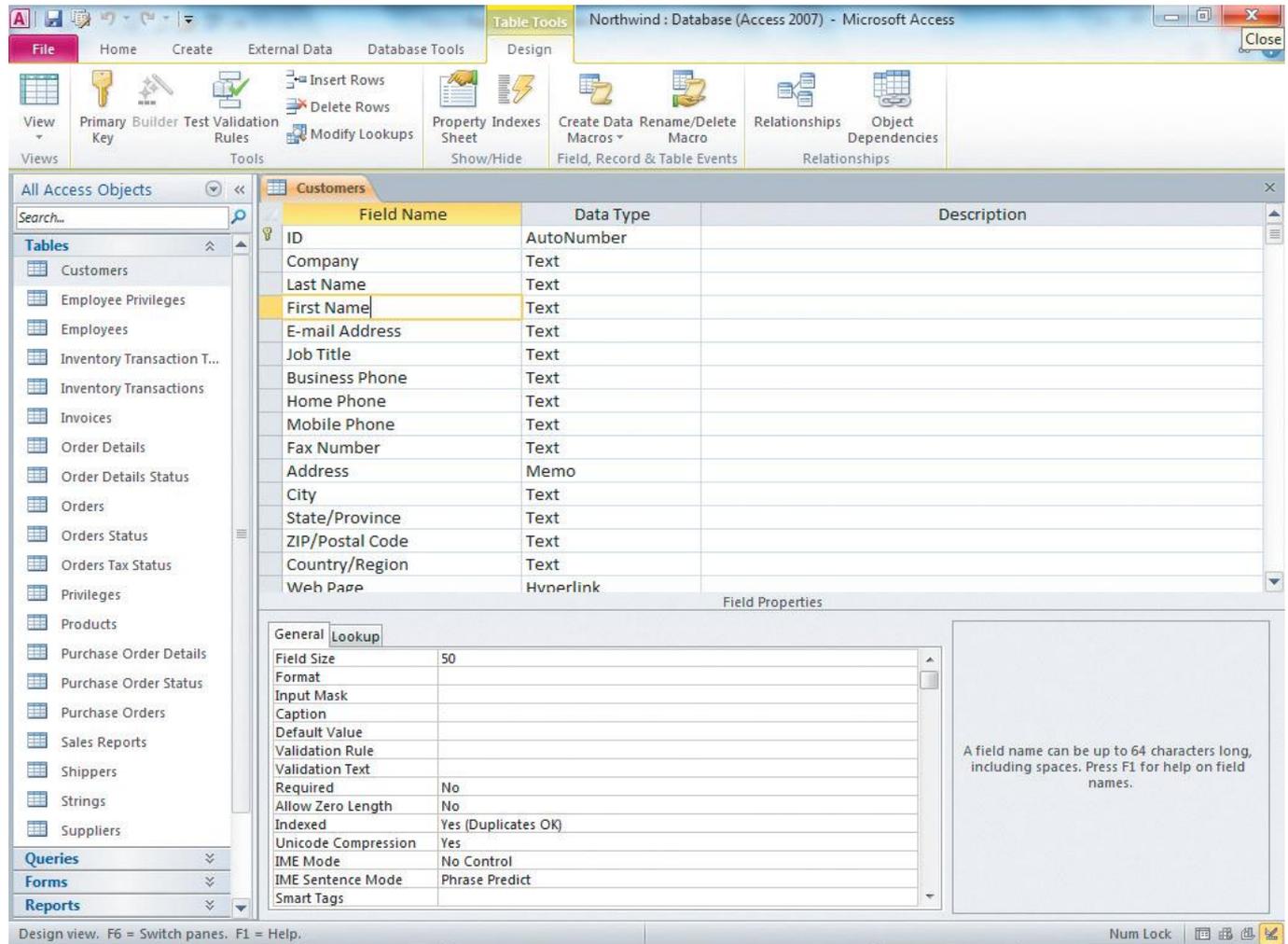
Datasheet View

Customers table in datasheet view. Field names along top. Data for first 27 records below.

Tables

- Objects
  - Tables
- Fields (Columns)
- Records (Rows)

School Database				
Student Table			Course Table	
S-ID	S-FN	S-LN	C-ID	C-Name
S01	Bob	Woods	C01	Intro to Microcomputer Applications
S02	Ted	Trees	C02	Computer Applications for Business
S03	Carol	Rose	C03	Introduction to Computer Science
S04	Alice	Lilies	C04	Introduction to Programming

Tables in More Detail

Records
(one per line)

Field Names

ISBN Number	Title	Author	Year	List Price	Publisher
0-13-503393-4	Exploring PowerPoint	Grauer/Barber	1996	$28.95	Prentice Hall
0-13-503362-2	Exploring Access	Patel/Rao	1995	$35.50	Prentice Hall
0-13-504016-9	Exploring Excel	Flanagan	1997	$18.00	Addison Wesley
0-13-503982-2	Exploring Word	Cornell/Arnol	1996	$42.25	Prentice Hall
0-13-502344-1	Introduction to Win95	Shepherd	1997	$58.00	Addison Wesley

- Data is stored in a database in the form of tables, a collection of related *records*
- Each row represents a *record*. We can add, remove and alter records.
  - A record is a complete set of all data elements (*fields*) about one person, place or concept e.g., first name, last name, email address of a student
  - Some times, records are also known as *tuples*.
- Each column represents a *field*.
  - A field is the smallest data element contained in a table
  - A field stores a specific type of data, i.e. number or character string or dollar value
- The field (or combination of fields) that is unique for each record is also known as *primary key*

Primary Keys

- A **primary key** is a field (or combination of fields) that is used to uniquely identify records.

- The Autonumber data type is often used to create unique values by automatically incrementing the value each time a new record is created.

- An example of a primary key would be a student's ID number or a driver's license number.

Query

- A query is an Access object that allows a user to ask questions about the data in the tables and the answer is shown in the query results

- A query displays records that meet a certain criterion

- A criterion is a number, text phrase or an expression that allows records to be searched and filtered based on their field values

  e.g., the following criteria lists all records where

  Publisher = "**Prentice Hall**" , and   *Year* > = *1996*

ISBN Number	Title	Author	Year	List Price	Publisher
0-13-503393-4	Exploring PowerPoint	Grauer/Barber	1996	$28.95	Prentice Hall
0-13-503982-2	Exploring Word	Cornell/Arnol	1996	$42.25	Prentice Hall

- New records can be added or records can be modified based on a search criteria. For example, the following adds $10 to all the books published in 1997

ISBN Number	Title	Author	Year	List Price	Publisher
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0-13-503362-2	Exploring Access	Patel/Rao	1995	$35.50	Prentice Hall
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0-13-503982-2	Exploring Word	Cornell/Arnol	1996	$42.25	Prentice Hall
0-13-502344-1	Introduction to Win95	Shepherd	1997	$68.00	Addison Wesley

Working in Storage and Memory

- Access works primarily from storage (hard-disk), unlike other MS Office applications such as Word, Excel and PowerPoint

- When you change the content of a field (e.g., phone number), Access saves the change as you soon shift focus to another record

- Changes to the design of a table, query, report or form must be saved

- Multiple users can work on an Access database simultaneously as long as they are not working on the same record. One person can be adding records to the Employees table, while another queries the table.

Tips on Database Management

- Database files should be named using meaningful names

- Database files should be stored in meaningful folders and subfolders

- Back up your files!

Compacting & Repairing a Database (1)

- Access databases increase in size over time

- Compacting
  - Avoids loss of data
  - Recovers unclaimed space
  - Defragments fragmented databases
  - Repairs corrupt databases
  - Should compact your database daily

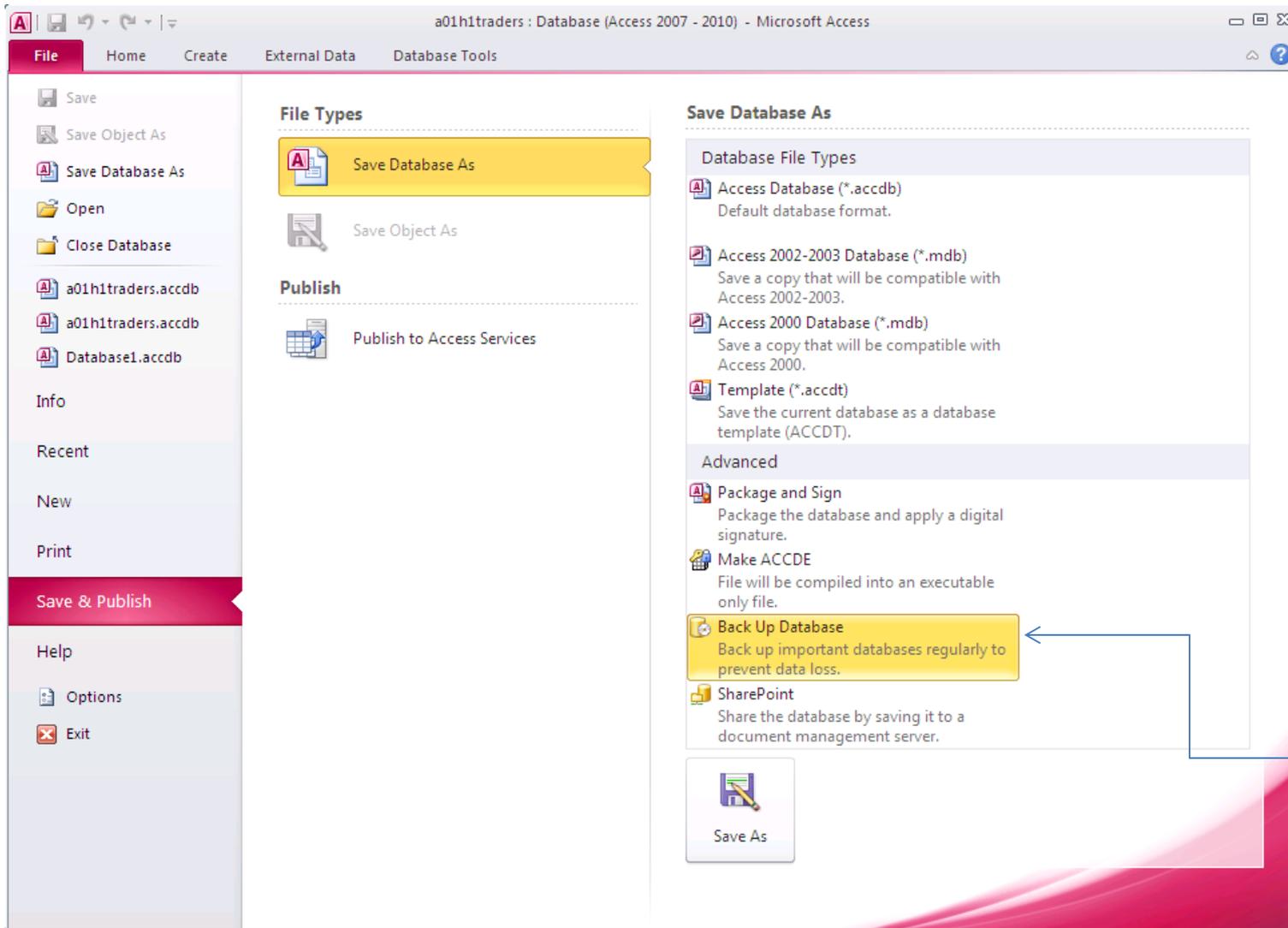# Compacting & Repairing a Database (2)
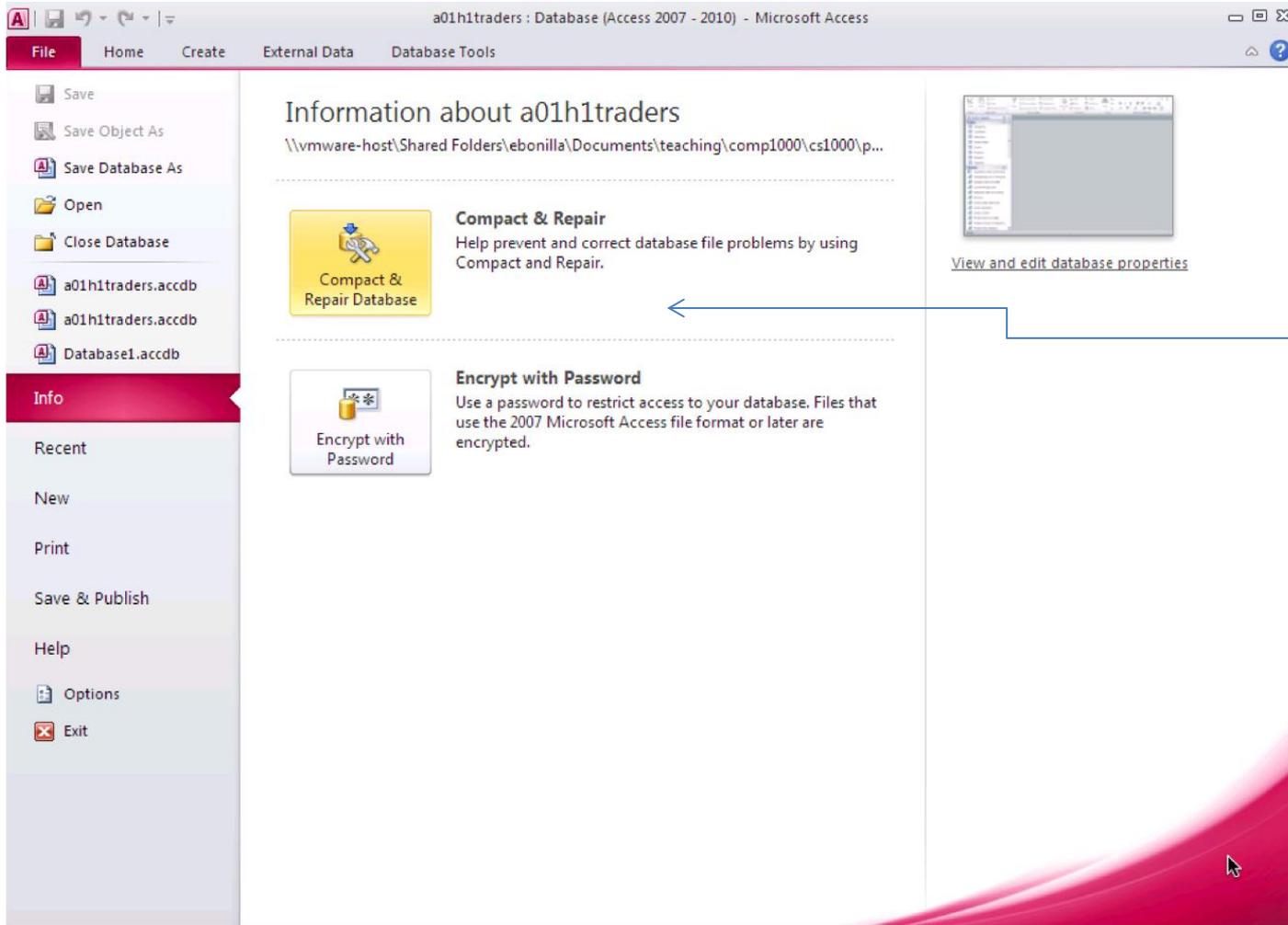
Compact & Repair option

Backing Up a Database (1)

- Backups are critical to a database

- Access provides a default file name, including the original file name and adds on the current date

- Default extension for Access databases is *accdb*

Backing-up Your Database (2)

Back Up Database option

Demonstration 1 – Open and Edit

- Start Access, open *a01h1traders.accdb* and save a copy as *a01h1traders_demo*

- Click Enable Content

- Click Tables group in Navigation pane if necessary

- Double-click **Employees** table to open it

- Click Last Name field in row 4 (Peacock), double-click, replace with another name. Press Tab. Change name. Note pencil icon at left (means changed, not saved).

- Click in row 3. Pencil symbol vanishes – change saved.

- Experiment with changing and undoing.

- Click Close (x at top right) or right-click Employees tab and click Close.

Demo 2 – use Access form, add records

- Click Tables group to collapse it, click Forms group to expand it.

- Double-click **Products form** to open it.

- Move between records using navigation buttons, bottom of window.

- Click Home / Find / Find. Type "Grandma" in Find What box, click Match arrow, select Any Part of Field. Click Find Next.

- Close Find dialogue box. Click New Blank Record on navigation bar.

- Enter BillW's Pecan Pie / Grandma Kelly's Homestead (click arrow) / Confections (click arrow) / 1 / 25.00 / 18 / 50 / 20 / No (check box not checked). (Product ID automatically assigned.)

- Click in this record. Click File / Print / Print Preview.

- Click Last Page in navigation bar, then Previous, to view record just entered.

- Click Close Print Preview. Close Products form.

Demo 3 – table/ form connection, delete record

- Click Forms group to collapse it, click Tables group to expand it.

- Double-click Products table to open it.

- Click Last Record in navigation bar. Navigate to 5th record, Chef Anton's Gumbo Mix

- Click Home / Find / Find. Type "Grandma" in Find What box, click Match arrow, select Any Part of Field. Click Find Next.

- Scroll right to Discontinued field.

- Click row selector box for 5th record. (Highlights with gold border.)

- Click Delete in Records group. Read error message. Click OK.

- Navigate to last record. Click row selector box. Click Delete. Read *warning* message. Click No.

Demo 4 – Compact & Repair, Backup database

- Click File tab.

- Click Compact & Repair Database

  Defragments and eliminates waste space.

- Click File / Save & Publish.

- Double-click Back Up Database.

  You do not want to lose your data if the original becomes corrupted.

- Click Save to accept default backup name with today's date.

Filters

- A filter displays a subset of records based on specified criteria

- Will always display the entire record selected based on criteria selected

- All data extracted must be contained within a single table

- Hides unwanted records i.e., records that do not match the selection criteria, but does not delete them

Types of Filters

- Filter by Selection
- Filter by Form

Filter by Selection

- Displays only records that match selected criteria
- To implement a Filter by Selection
  - Click in any cell field that contains the criterion on which you want to filter
  - Click Filter by Selection in the Sort & Filter group
  - Select Equals "criterion" from the list of options
- Only the records that match the selected criterion will be displayed
  - 'find records like this one'

Filter by Form

- Displays table records based on multiple criteria.

- Allows the use of AND and OR conditions

- Allows the use of comparison operators
  - Comparison operators include:

Greater than	>	Less than	<
Greater than or equal to	>=	Less than or equal to	<=

Filter using ANDs and ORs

- ANDs restrict selection criteria

- ORs expand selection criteria

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Filtering & Sorting Demo 1

- Open *a01h1traders_demo* again

- Open Customers table, go to record 4, replace Contact Name field with COMP1000 Student

- Find & click City field in this record ("London")

- Click Sort&Filter>Selection>Equals "London"

- Click Sort&Filter>Toggle Filter

- Click Sort&Filter>Toggle Filter again

- Find & click a Contact Title of Sales Representative

- Click Sort&Filter>Selection>Contains "Sales Repre…"

- Check results, Toggle Filter, close Customers table (say No to "Save design changes?")

Filtering & Sorting Demo 2

- Click Tables group in Navigation pane, then Queries group

- Locate & double-click **Order Details Extended query**

- Sort&Filter>Advanced>Filter by Form

- Click row 1 under First Name field, click First Name arrow

- Select our first name from the list. Ditto for Last Name.

- Find Extended Price field, click row 1, type "<50".

- Click Sort&Filter>Toggle Filter

- File>Print>Print Preview

- Click Print Preview>Close Print Preview.

- Close Order Details Extended query (don't Save changes)

Filtering & <u>Sorting</u> Demo 3

- Navigation pane>Queries group to close it
- Open **Tables** group, then double-click **Customers**
- Click a value in the Customer ID field, then Home>Sort&Filter>Descending.
- Find Country and City fields, click Country column heading
- Left click and hold Country column heading, note blue bar, drag till line between City and Region fields, release.
- Click a city, click Sort&Filter>Ascending
- Click a country, click Sort&Filter>Ascending
- Close Customers table (don't save changes)

Filtering & Sorting Demo 4

- Open **Products table**
- Sort&Filter>Advanced>Filter by Form
- Supplier row 1, Supplier arrow, scroll, select "Grandma Kelly's Homestead"
- Click Or (bottom of window), Category row 1, Category arrow, Confections
- Click Sort&Filter>Toggle Filter
- Close Products, don't save changes
- File>Compact&Repair Database
- File>Save&Publish>double-click Back Up Database>Save

When to use a Database

- Databases are ideal for maintaining data related to objects (e.g., student records, inventories, etc.)

- This data can be queried, sorted, etc. and the relationship between the objects and their attributes is maintained.

- While they can be used to perform numeric calculations, they are not usually optimised for this task.

Databases

- One important feature of a database is that the stored information is organised and structured in a particular way

- Usually databases try to allow for fast retrieval of information (via queries) even when they contain vast amounts of data

- It is important to pay careful attention to the design so as to structure the storage of data appropriately

Differences Between Spreadsheets and Databases

- In a spreadsheet, **changes** to elements may affect other elements however the elements are not related in any other way.

- A database groups the **attributes of an object together** and treats them as "belonging" to that object.

- In a database, elements have a "type" (e.g., text, number, date, yes/no, etc.)

Problems that Databases Try to Deal With

- **Redundancy** and **inconsistency** of data
  - Different copies of information may exist (redundancy) and some attributes may differ (inconsistency)
- **Access**
  - May need to **allow/restrict access** to different portions of data
  - Multiple users accessing/modifying data at the same time
- **Integrity**
  - Constraints on data that can be stored (e.g., only Gold status members entitled to a discount)

When to Use a Database Rather than a Spreadsheet?

- Database stores information in a structured way as relations: attribute values of a single object

- Different attributes have a data type

- Spreadsheet doesn't maintain information in this way (only formula dependencies) and has only a few data types

- Use **DBMS** when it is important to maintain attributes of objects as single entities, and **relationships** between objects

- **Spreadsheet** is normally useful for calculations and visualisation of information

Excel or Access?

It is better to use Excel, if you:

- Are more comfortable with its ease of use
- Only need one worksheet to handle all of your data
- Have mostly numeric data
  - Flat (non-relational) data
- Require subtotals and totals for a worksheet
- Want to use "what if" scenarios on data
- Need to create complex charts and/or graphs

Access or Excel? (continued)

It is better to use Access when you:

- Need multiple related tables to store data
- Have a large amount of data
- Need to connect to and retrieve data from external databases (such as Microsoft SQL Server)
- Need to group, sort, and total data based on criteria
- Need multiple users to have access to application simultaneously
- Need built-in tools to help organize data
  - Ability to create relationships between tables

Summary

- Access works best for large amounts of data stored in multiple related tables using relationships between tables
- Access allows you to sort and filter data
- Access allows you to compact and repair and back up your data
- Practicing good database file management will improve the quality of your database