Introduction to Databases

Data organized yields information

What is a Database

- A collection of pieces of information (data) which is stored in a specific structure in such a way that there is minimum repetition of data and normally serving multiple purposes
- Database software allows data to be stored, updated, organized, rearranged, and retrieved
  - Ability to query & generate reports
  - Ensure data validity through reduced redundancy, relationships, and access controls.
  - Customized to allow easy to use interfaces.
    - A person using doesn't need to know how to set up databases, reports or forms.

Data → Information

- Data alone provides little information
  - Example data: Keoki, Leilani, Emma, Jeremy
- Data which is organized yields information.
  - Example information: ICS101 students scoring 100% on test are Keoki,Leilani, Emma, Jeremy
- Database programs allow data to be organized in numerous different ways which provides different types of information.

In the next software assignment you will be asked to enter a code for this lesson. The code is **Information**. Make note of it.

Have you ever used a database?

They're Everywhere!

Uses of Databases

- Course listings
- Student records
- Mailing lists
- Movie Listing
- Online Stores
- iTunes
- And much, much more

Building Blocks of a database

- Field - the smallest piece of meaningful data
  - Each field is named and defined.
  - Example of fields: first name, last name, address.
- Record - group of fields relating to one entity
  - Example: A student record with above fields
- Table - a group of similar records containing information about a number of entities

Database vs Information base

- A database has a specific structure with fields, records, tables.
- An information base does not store information in a specific structure.
  - Search engines can be considered an information base because they search entire websites and not specific fields

Building Blocks of a Database

Field

Students Table

Record

Student ID	First Name	Last Name	Phone	Address
12345	Sam	Ho	987-6543	123 Fourth St.
67890	Leilani	Kealoha	266-1234	222 Tutu Lane
98765	Wes	Suzuki	274-6758	10 Decade Ave.
54321	David	Rodrigues	259-0000	369 Twelfth Ave.

Table

Building Blocks-Related Records

Students (Primary)

Key field

Student ID	First Name	Last Name	Phone	Address
12345	Sam	Ho	987-6543	123 Fourth St.
67890	Leilani	Kealoha	266-1234	222 Tutu Lane
98765	Wes	Suzuki	274-6758	10 Decade Ave.
54321	David	Rodrigues	259-0000	369 Twelfth Ave.

Courses Completed (Secondary)

Student ID	Course	Grade	Semester
12345	ICS101	A	F2011
67890	ICS100	B	F2011
98765	PSY100	B	F2011
54321	ICS101	A	F2011
12345	ICS107	C	F2011
12345	ENG100	A	F2011
54321	MATH200	A	F2011
67890	MATH100	A	F2011
98765	ICS101	C	F2011

Defining Fields

- Fields can be defined with
  - Name
  - Type
  - Size
    - Text – number of characters.
    - Numbers – type integer, byte,
  - Formats
  - Other options
- Field types:
  - Text – store text and numbers which don't need to be calculated
    - Name, address, phone number
  - Numbers – store as numbers only numbers that are calculated.
    - Salary, quantity, credits, grade points,
  - Date and Time
    - Birthday, sales date, enrollment date
  - Yes/No (Logic) – Any field which only has yes or no (true or false)
    - Represented by a check box
  - Memo – long text fields
    - Comments, reviews
  - More types are available

Tables Store Data

- Tables store data in records which are made up of fields
  - All records in a table have the same fields defined
  - Each record in a table refers to one entity
  - A group of records is called a table
- Databases allow us to see the data in any number of different ways but these views of the data do not store the data. Data exists only in the tables.
  - Update the data in a form and the data in the table is updated

Views

- Views allow data to be seen in different ways, but don't store data
- Views do not STORE data, but display the data that is already stored in a defined manner
- Types of views
  - Query – displays particular information from a data base.
  - Form generally designed as an input device for a database. Information is shown on screen.
    - ❑May be based on a query
  - Report – Presents data in an organized manner
    - ❑ May be based on a query

What are Queries?

- Queries essentially provide answers to questions. Queries allow data to be selected, displaying only the data that is needed subset of total records
- parts of a record
- Select Queries select data according to specified criteria

Forms & Reports

- Input of data.
  - Forms are designed for input of data
  - Reports do not allow input
- Primary record views
  - Forms generally display one primary record at a time
    - ❑sometimes with multiple related records
  - Reports generally display multiple records

Databases vs Spreadsheets

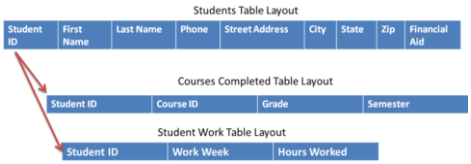
- Databases
  - allow better report generation with updated data.
  - help ensure data validity through reduced redundancy, relationships, and access controls.
  - can be customized to allow user friendly interfaces.
    - ❑End user doesn't necessarily need to know how to set up databases, reports or forms.
- Spreadsheets allow for easier numeric calculations

Relational Databases

Linking Tables

What Are Relational Databases

- A relational database allows us to tie together (or relate) the tables within our database allowing us to create queries, reports and forms from multiple tables.



Reducing redundancy

- Relational databases store data in a format that reduces redundancy.
  - We want to reduce redundancy because it affects the integrity of a database.
  - EXAMPLE: If a person's address is stored in 3 or 4 tables and the person moves, there is an integrity problem if not all tables are updated.
    - ❑In relational databases, the address is stored once and related to other tables, so changes need to be updated in only one place
- Access is an example of a relational database

Why Use Table Relationships?

- Reduces redundancy
- Ensures integrity of data
- Allows more flexibility in data use
  - Reports and forms based on from various related tables
    - ❑Looks like one record even though it is stored in separate records.
  - Information can be pulled from various tables to meet different applications or uses of the database.

Types of Relationships

- One-to-one
  - For one entity, there is only one possible piece of data for a given attribute
    - ❑Person to first name
    - ❑Book to title
  - Usually defined in one table
- One-to-many
  - For one entity, there are more than one possible pieces of data for a given attribute
    - ❑Student to courses
    - ❑Book title to copies in library
  - Usually define in separate tables

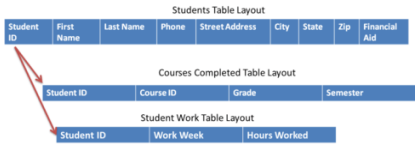
One-to-One Relationships

Students Table Layout

Student ID	First Name	Last Name	Phone	Street Address	City	State	Zip	Financial Aid

- For each student there is only one possible data for each of these fields
  - Student ID
  - First Name
  - Last Name
  - Home Phone
  - Street Address
  - City
  - State
  - Zip
  - Financial aid status

One-to-Many Relationships



- For each student, there are any number of Courses Completed - One student may have 0, 1, 2,.. 100 or more courses
- One student may have any number of student work hours. Some students have no work records as they are not employed as a student worker.

How Do Relationships Work?

- Use of key fields - All tables containing the key can be related
  - For one table the key is primary and a unique key is assigned to each record.
  - For other tables the key is secondary and is used as a link to the table where the key is primary.
    - ❑Table with secondary keys may also have a primary key that uniquely identifies that table's record.
  - Sometimes a table is created to establish links between two tables (linking table)

What is Database Integrity?

- Integrity in data bases means that the information is accurate and consistent.
- Relational databases help insure integrity by having data stored once and tying the data together
- Good forms help insure integrity
  - If data coming in is accurate, information being output will be accurate.

Reports & Forms

- Can pull information from various related tables
  - Information looks like it is all one record even though it is stored in separate records.
  - Information can be pulled from various tables to meet different applications or uses of the database
- Queries can also have multiple tables and can assist with creation of reports and forms.

Relationships in Access

- Defining Key
  - Primary table must have primary key defined.
    - Define key by selecting field then click on the key icon.
  - In the secondary table the secondary key is defined exactly the same as in the primary table But does not as primary key
    - Don't click on the key icon
- Establish relationships
- Database Tools - Relationships
- Add tables
- Drag key field from primary table to key in secondary table.
- Enforce referential integrity

Access Wizards

Recommendations from teacher about Access Wizards

- Queries – don't use the query wizard – does not allow criteria to be input
- Do Use Wizards in Access to create Forms & Reports

Database Queries

Finding the information needed

What is a query

- Queries assist with finding the right data for the task - Display only the data needed
  - only certain records
  - only particular fields
  - or both
- Queries generally need a criteria to select the correct data
- Queries can also
  - Create calculated fields
  - temporary data generated from a calculation
- Allow certain ACTION on the database

Queries into Reports & Queries

- Reports generally need only certain data rather than all the data
  - Base reports on the queries
  - Only the data from the query will show in the report.
- Queries can be used to create more sophisticated reports and forms
  - Calculated fields
  - Data from multiple tables
  - Data meeting certain criteria.
- Create a query first, then base the form or report on the query.

Types of Queries

- Select queries
  - Select data based on a criteria
  - Create calculated fields
- Parameter queries
  - Same as a select query, but the criteria is entered whenever the query is run
  - Different criteria can be entered each time
- Cross-tab queries
  - Cross-tabluates using multiple criteria
- Action queries
  - Update queries
    - Update records quickly.
    - Sometimes using a calculation
    - Global updates based on criteria
  - Deletion queries
    - Delete sets of records based on criteria
  - Append queries
    - Add records from one table into another table

Criteria

- Queries select data based on a specified criteria.
- Criteria are specified for particular fields
- Criteria specified must match the type of field.
  - Text field must have text criteria (numbers can be part of a text field, too.
  - Number fields must have number criteria
    - Leave off formatting such as dollar signs and commas.
  - Date fields must have date criteria

Criteria Qualifiers

To specify	Use Symbols
Equal to (same as)	=
Greater than (after)	>
Less than (before)	<
Greater than or equal to (on or after)	>=
Less than or equal to (on or before)	<=
Not equal to	<>

Boolean Criteria

- Boolean logic can also be used
  - AND
  - OR
  - NOT

In the next software assignment you will be asked to enter a code for this lesson. The code is Criteria. Make note of it.

Example Criteria

- Find all records where location is Kailua
  =Kailua
- Find all records where location is not Kailua
  <>Kailua
- Find all records where salary is equal to or over $20,000
  >20000
- Logic Criteria
  - Yes - finds all records where this field is checked
  - No - finds all records which are not checked

Multiple Criteria

- Multiple Criteria can be used with Boolean Logic
  - Find all records where location is Kailua OR Kaneohe OR Waimanalo
  - Find all records were locations is Kailua AND salary is over $20,000
    - Location field criteria: Kailua
    - Salary field criteria : >20000
    - Criteria must be placed on the same line or becomes an OR and returns more items
      - all records where location is Kailua and
      - All records where salary is >20000
        - no matter where the location is

Date Criteria

- Dates are stored as whole numbers that counts the days from 1/1/1900.
  - Dates before a specified date are considered less than
  - Dates after a specified date are considered greater than
- Example find people who are less than 30 on January 1, 2011.
  - Birthday is GREATER THAN 1/1/1981

    >1/1/1981

Logical Thinking Required

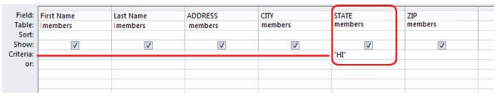
- To specify correct criteria, you need to THINK!
  - Which field is needed
  - What information is stored in that field
  - Which qualifier is needed.

Logical Thinking Example

- Example: Find everyone in the database who lives in Hawaii.
  - Which field would this information be stored?
    - ❑ State (or some other similarly named field)
  - What information is stored in that field?
    - ❑Two letter abbreviation -- for Hawaii we query for HI
  - What qualifier?
    - ❑= (equal is the default, so you don't need to enter it)

Example cont.

- Be sure to enter criteria on the criteria line under the correct field.



More Critical Thinking

- Find people who are less than 30 on January 31, 2013.
  - What field is needed?
    - ❑ Birthdate
  - What type of information is stored there?
    - ❑dates
    - ❑Query must match the type of data so do not use <30 as that is not a date!
    - ❑THINK! What birthday do people have who are less than 30 on January 31, 2013?
    - ❑ Born after 1/31/1983. For dates AFTER use >
    - ❑ >1/31/1983

More Critical Thinking

- Find everyone from out of state
  - Can list all of the other states, but that would be too tedious
  - Critical thinking, if someone is from out of state then they are not in Hawaii
  - Use the Not Criteria
  - <>"HI“
- USE CRITICAL THINKING!!!! You have to translate the request into something the database can compute.

Calculated Fields

- Calculated fields allow for calculation of information.
  - For example for a sales order, a calculated field can multiply the quantity times the price to come up with a total for a given item.
  - Instead of storing the total, which would be redundant, we store just the quantity and price, then use a calculated field to provide the total when needed.
- Many functions, such as used in Excel, are also available to help calculate information.

More on calculated fields

- Some functions help us deal with text such as displaying a first and last name together.
- In Access, use the Builder tool to create a calculated field within a query 
  - Click on fields to refer to these fields
  - Use functions and mathematical formulas to create calculated field

Design Mode & Wizards

- Wizards allow quick generation of tables, queries, forms and reports.
- Design mode allows individual customization of tables, queries, forms and reports.
- Forms and reports generated by wizard can be customized in design mode.
- Instructor recommends
  - Using Wizards for reports and forms
  - Using Design mode for queries The wizard does not ask for criteria and criteria is the backbone of queries!

Database Integrity

Through Easing Database Use

What is Database Integrity

- Integrity in data bases means that the information is accurate and consistent.
  - Relational databases help insure integrity by having data stored once and tying the data together
  - Being consistent in spelling, word choice help insure integrity also.
    - ❑For instance using Hawaii and the abbreviation HI in the same field in different records causes inconsistency.
    - ❑If we do a query for “Hawaii” we may miss records with the abbreviation HI

Accurate Information

- Remember the computer saying "Garbage in - Garbage out"
  - If data is not accurately entered, the information coming out will not be accurate.
- Accuracy in input can be increased by
  - Data field properties
  - Form design
  - Action queries
- Accuracy in output can be increased by
  - Report design
  - Query design

Action Queries

- Append queries
  - Eliminates reentry of data
  - Allows records from other sources to be added to the database
- Update queries
  - Updates records based on a criteria
    - ❑Example: For all records that show dues have not been paid, set member status to inactive
  - Quicker to do and more accurate
    - ❑No records meeting criteria are missed

Data Field Properties

- Lookup fields
  - Species a limited number of input choices
  - Input can be made through a list of choices
- Input Masks
  - Specifies data must be in a certain layout
  - Phone number (999)999-9999
  - Input must be numbers.
  - Parenthesis and dash already included for input
- Validation
  - Data must meet certain rules
    - ❑ Example <1000

More Field Properties

- Default Values
  - Use with caution
  - Use only when the initial input data is the same for all records
  - All new members are ranked as Novice
  - or when data changes rarely
  - Year joining an organization only changes once a year
  - Be sure to change default in the new year

Forms Design

- Create forms using Form Wizards, but use Design View to customize.
- Clearly label forms
- Include instructions to clarify how to fill out form
- Input aids: Dropdown list, checkbox, radio buttons
- Keep layout organized in a familiar way
  - Addresses laid out in the same way one would normally see an address
  - If based off a paper form arrange similarly

Action Queries

- Append queries
  - Eliminates reentry of data
  - Allows records from other sources to be added to the database
- Update queries
  - Updates records based on a criteria
    - ❑Example: For all records that show dues have not been paid, set member status to inactive
  - Quicker to do and more accurate
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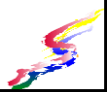
More Action Queries

- Deletion queries
  - Deletes records based on a criteria
  - Verify correct records are being selected before running as a deletion query
  - Example: For all members who have been inactive for 5 years, delete the records
  - Use with caution.
  - Be sure you will never need the data again.
- Before running update or deletion query, enter criteria as a select query to ensure the correct records are found.

Reports Generation

- Usually based on query to have just the information needed
  - Correct query design
  - Test to see if works
- Design reports for ease of use and reading
  - Clearly identify information
    - ❑ Appropriate titles, headings, etc.
    - ❑Use new page designation to keep only desired information on each page
  - Use report wizards to ease creation of reports
  - Customize reports in design view



Database Integrity Insured

- If data coming in is accurate, information being output will be accurate.
- User error is always possible
  - Relational databases insure data is input once
  - Ease input to decrease user error
- Design errors can be present
  - Create appropriate queries to derive information
  - Base reports on queries
  - Design both reports and forms using Wizards, but be sure to customize for ease of use