Chapter 1
SQL and Data

What is SQL?

- Structured Query Language
- An industry-standard language used to access & manipulate data stored in a relational database
- E. F. Codd, 1970's IBM

What is Oracle?

- A relational database management system (DBMS)
  - software that allows the creation, retrieval, and manipulation of data
- We will
  - retrieve data to answer questions
  - add records
  - delete records
  - change field values so they're up-to-date
  - create new tables
  - define relationships between tables
  - define constraints to ensure data integrity
  - create views, sequences, indexes
  - control user access to database objects

Overview of SQL Language Commands

- Data Manipulation Language (DML) (Chapters 2-11)
  - commands to retrieve or modify the contents of a table
  - SELECT, INSERT, UPDATE, DELETE
- Data Definition Language (DDL) (Chapters 12, 13)
  - commands to create or modify database objects
    - tables, views, sequences, indexes, stored procedures
  - CREATE, ALTER, DROP
- Data Control Language (DCL) (Chapter 15)
  - commands to control user privileges (access to database objects)
  - GRANT, REVOKE

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Primary and Foreign Keys

- How do we connect (join) related data that has been stored in separate tables?
- Primary Key
  - 3 properties of
    -
    -
    -
  - how indicated on schema diagram?
- Foreign key
  - how indicated on schema diagram?

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Additional Primary Key Topics

- Candidate key
- Composite (concatenated) primary key
- Natural primary key
- Synthetic primary key

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Columns and Datatypes

- When a table is created, each column is declared to contain data of a particular type
- Example datatypes:
  - varchar2(10)
  - char(10)
  - number(6,2)
  - date
- Domain
  - the set of permissible values from which a column draws its actual values

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Schema

- A collection of objects owned by a database user and having the same name as the user
  - egs: tables, views, indexes, sequences, synonyms, stored procedures, functions, triggers, packages
- Schema Diagram
  - a pictorial representation of a database's tables and its inter-table relationships
  - Student Schema (Appendix D)
  - Issue25 Schema

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Data Redundancy

- What is it?
- Three main problems it causes:
  -
  -
  -
- Issue25 handout

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One-to-Many Relationships (1:M)

- The most common type of inter-table relationship
- Each row in Table A can have many (zero or more) matching rows in Table B but each row in Table B has only one matching row in Table A.
  - each ZipCode can have many Students but each Student has only one ZipCode
  - each Course can be associated with many Sections but each Section covers only one Course
- Implementation
  - include the primary key of the one table as a foreign key in the many table
- How depicted in a schema diagram?
  - join line: crows feet and single line

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Many:Many Relationships (M:M)

- Each row in Table A can have many matching rows in Table B & each row in Table B can have many matching rows in Table A.
  - each Pitcher can pitch in many Games and each Game can use many Pitchers
  - each Author can write many Books and each Book can be written by many Authors
- Figure 1.16, pg 18
- Implementation
  - create a third table (intersection table, junction table) and include each table's primary key as foreign keys
  - doing so breaks the Many:Many relationship into two separate 1:Many relationships
- How depicted in a schema diagram?
  - junction table and 2 join lines

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One-to-One Relationships (1:1)

- Each row in one table has at most one matching row in the other table
- Implementation
  - Two tables whose primary keys are the same and also serve as foreign keys to the other table
- Columns in one table are additional attributes for the other table
- Figure 1.14, pg 17
- Commonly used to
  - avoid nulls
  - control field access

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Join Lines

- Each join line runs between two tables and can be read in two directions
- Cardinality
  - indicates whether a table can have 0, 1, or Many matching rows in the related table
  - single line or crow's feet
- Optional/Mandatory Relationships
  - circle indicates optional relationship
  - vertical bar indicates mandatory relationship
- Figure 1.17, pg 19
  - each PUBLISHER may publish 0, 1, or many BOOKs
    - there can be publishers with no matching books
  - each BOOK must be published by 1 PUBLISHER
    - each book's PUBLISHER_ID must have a value (NOT NULL)

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Database Development

- Requirements Analysis
  - identify user needs, data elements
- Conceptual Data Model
  - group attributes (data elements) into entities; unique identifiers
- Logical Data Model
  - normalization process; ERD; primary & foreign keys identified
  - general data type for each attribute
  - M:M relationships resolved
- Physical Data Model
  - is platform specific
  - column names, datatypes, relationships, schema diagram
- Implementation
  - use SQL statements to create the tables and other objects

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Referential Integrity

- Each foreign key value must match a primary key value in the related table
  - if a row in one table references a row in another, the referenced row must exist
- Rules to ensure that data stored in related tables stays "in synch" with each other
  - prevents orphan records in a related table
- How can we prevent null foreign keys?

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Referential Integrity

- When INSERT a new record to a child table and specify a value for a foreign key field, a matching record must already exist in the primary table
  - e.g.: when add a new Article, the WriterID you enter must match an existing WriterID in the Writer table
- Can't UPDATE an existing record's primary key value in the primary table when there are matching records the child table
  - e.g.: change a Writer's WriterID
- Can't DELETE an existing record from a primary table when matching records exist in a child table (unless cascade the delete)
  - e.g.: delete a Writer

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Recursive Relationship

- A.k.a. Self-Referencing relationship
- A table containing a foreign key that relates to its own primary key
- How depicted in a schema diagram?
- Which table has a recursive relationship in the
  - Student schema?
  - Issue25 schema?

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