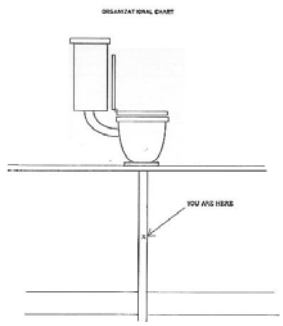
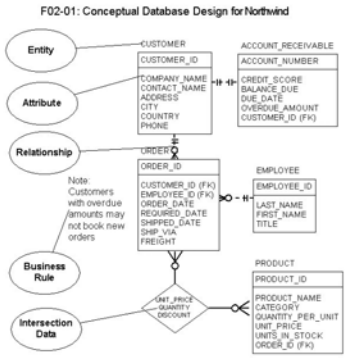
Relational Database Components

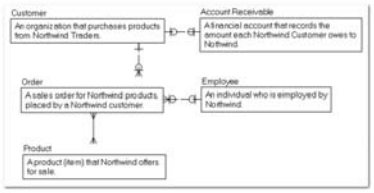
Chapter 2



Conceptual Database Design Components



High-level Conceptual Model



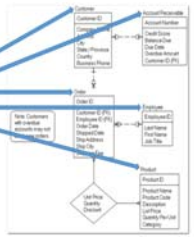
- ERD shows only entities, definitions and relationships
- This form is more common in large enterprises

Entities

- ***Entity***: a person, place, thing or event of importance to the organization.
- "Real World" things about which the organization collects data.

Entities

Entity - A person, place, thing or event of importance to the organization.



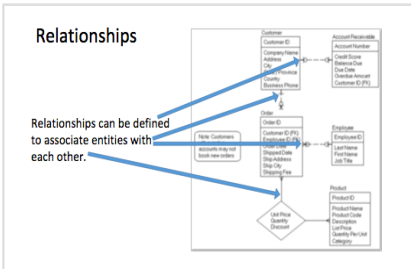
Attributes

- ***Attribute***: a unit fact that characterizes or describes an entity in some way
- Should be "atomic" (cannot be broken down into meaningful sub-parts)

Relationships

- Established through the use of primary and foreign keys
- Separating data into parent and child tables reduces data redundancy
- *Normalization*: the process of designing databases that meet certain characteristics, including reduced redundancy

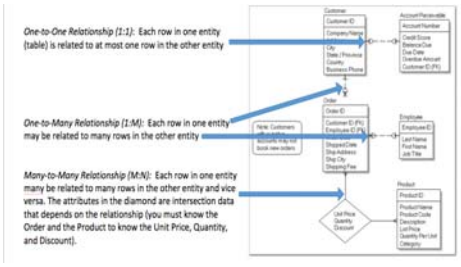
Relationships



Relationships

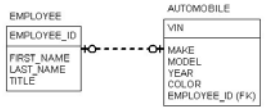
- Three Types:
  - *One-to-One (1:1)*: Each row in one entity (table) is related to at most one row in the other entity
  - *One-to-Many (1:N):* Each row in one entity may be related to many rows in the other entity
  - *Many-to-Many (M:N):* Each row in one entity many be related to many rows in the other entity and vice versa

Types of Relationships



One-to-One Relationships

F02-02: Employee - Automobile Relationship



- A given employee can have <u>one</u> automobile assigned (or no automobile assigned)
- A given automobile can be assigned to only <u>one</u> employee (or no employees)
- The <u>relationship</u> between employees and automobiles can be called *one-to-one* (conditional)

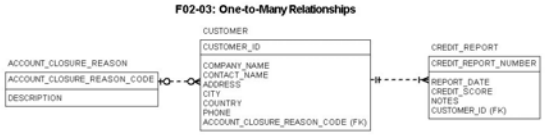
Evaluating Relationships

- **<u>Important tip</u>**: Pay careful attention to how you evaluate relationships. You need to ask yourself two questions, and you may find them easier to answer if you visualize tables with rows of data in them.
  - At any single point in time, a given row in the Employee table can be associated with how many rows in the Vehicle table? (An employee is assigned at most one vehicle at a time.)
  - At any single point in time, a given row in the Vehicle table can be associated with how many rows in the Employee table? (A vehicle is assigned to either one employee or no employees at any point in time.)

One-to-One Relationships

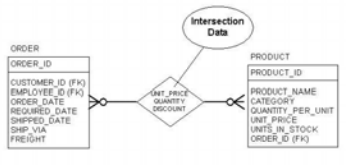
- Sets of entities with one-to-one relationships are most often consolidated into a single entity class
- When participation is mandatory in both directions, and non-transferrable, one-to-one relationships should <u>always</u> be consolidated if at all feasible

One-to-Many Relationships



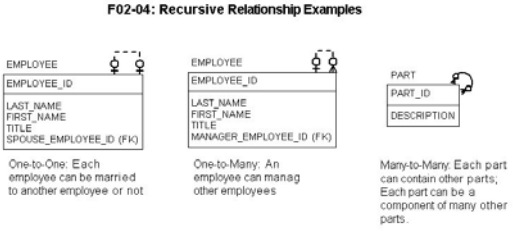
- A given customer may have many credit reports
- A given credit report belongs to only one customer
- The relationship between customers and credit reports can be called *one-to-many*

Many-to-Many Relationships



- A given order can contain many products
- A given product can appear on many products
- The relationship between orders and products can be called *many-to-many*
- *Intersection Data:* data that belongs to both entities

Recursive Relationships



- Relationships between entity instances (records) of the same entity type
- All types of relationships can be recursive (one-to-one, one-to-many, many-to-many)

Business Rules

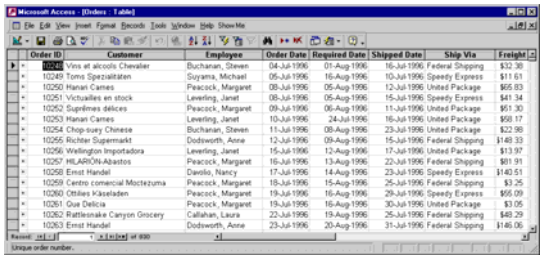
- *Business Rule:* a policy, procedure, or standard that an organization has adopted
- Important because they dictate controls (*constraints*) that must be placed upon the data
- The database is the last line of defense in preserving data integrity

Logical/Physical Database Design Components

Tables

- *Table:* the primary unit of storage for data in a relational database
  - Logically stores data
  - Relationships might exist between tables
  - May have constraints attached
  - Comprised of rows and columns
    - Each column holds data for one attribute
    - Each row holds all related data for a single occurrence of an entity

Table Example: Orders



Order ID	Customer	Employee	Order Date	Required Date	Shipped Date	Ship Via	Freight
10248	Vins et alcools Chevalier	Buchanan, Steven	04-Jul-1996	01-Aug-1996	16-Jul-1996	Federal Shipping	$32.38
10249	Toms Spezialitäten	Suyama, Michael	05-Jul-1996	16-Aug-1996	10-Jul-1996	Speedy Express	$11.61
10250	Hanari Carnes	Peacock, Margaret	08-Jul-1996	05-Aug-1996	12-Jul-1996	United Package	$65.83
10251	Victuailles en stock	Leverling, Janet	08-Jul-1996	05-Aug-1996	15-Jul-1996	Speedy Express	$41.34
10252	Suprêmes délices	Peacock, Margaret	09-Jul-1996	06-Aug-1996	11-Jul-1996	United Package	$51.30
10253	Hanari Carnes	Leverling, Janet	10-Jul-1996	24-Jul-1996	16-Jul-1996	United Package	$58.17
10254	Chop-suey Chinese	Buchanan, Steven	11-Jul-1996	08-Aug-1996	23-Jul-1996	United Package	$22.98
10255	Richter Supermarkt	Dodsworth, Anne	12-Jul-1996	09-Aug-1996	15-Jul-1996	Federal Shipping	$148.33
10256	Wellington Importadora	Leverling, Janet	15-Jul-1996	12-Aug-1996	17-Jul-1996	United Package	$13.97
10257	HILARIÓN-Abastos	Peacock, Margaret	16-Jul-1996	13-Aug-1996	22-Jul-1996	Federal Shipping	$81.91
10258	Ernst Handel	Davolio, Nancy	17-Jul-1996	14-Aug-1996	23-Jul-1996	Speedy Express	$140.51
10259	Centro comercial Moctezuma	Peacock, Margaret	18-Jul-1996	15-Aug-1996	25-Jul-1996	Federal Shipping	$3.25
10260	Ottilies Käseladen	Peacock, Margaret	19-Jul-1996	16-Aug-1996	29-Jul-1996	Speedy Express	$55.09
10261	Que Delícia	Peacock, Margaret	19-Jul-1996	16-Aug-1996	30-Jul-1996	United Package	$3.05
10262	Rattlesnake Canyon Grocery	Callahan, Laura	22-Jul-1996	19-Aug-1996	25-Jul-1996	Federal Shipping	$48.29
10263	Ernst Handel	Dodsworth, Anne	23-Jul-1996	20-Aug-1996	31-Jul-1996	Federal Shipping	$146.06

Metadata: Data About Data

Database Integrity

- *Database Integrity:* the insurance of accurate data in the database
- *Constraints* validate or restrict the data values placed in the database
  - Can be implemented at column or table level
  - Can be used to enforce business rules
- *Referential Integrity:* ensures that data is consistent between related tables

Constraints

- *Constraint:* a rule placed on a database object (typically a table or column) that restricts the allowable data values for that database object in some way

Primary Key Constraints

- *Primary Key:* a column or set of columns that uniquely identifies each row in a table
- Unique identifier in conceptual design is implemented as a primary key in logical design
- Usually implemented using an index
- For multi-column primary keys, it is the *combination* of values for *all* the columns that must be unique among all rows in the table

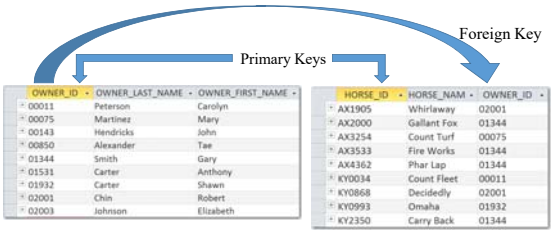
Foreign Keys

- *Foreign Key:* the combination of one or more columns in a table that reference (match) the primary key in another table
  - Foreign keys in child tables establish the relationship with the parent table
  - Fundamental building block of the Relational database

Referential Constraints

- One-to-many relationships implemented in tables by storing the primary key from the "parent" (one side) table in the "child" (many side) table as a *foreign key*
- A *referential constraint* is defined in the DBMS to insure that each *foreign key* value refers to a valid (existing) *primary key* value

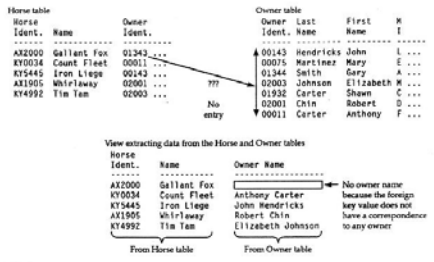
Primary and Foreign Keys



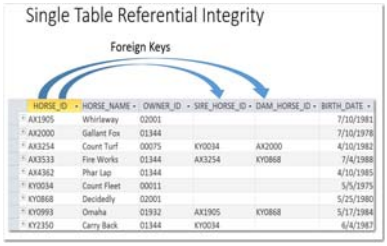
OWNER_ID	OWNER_LAST_NAME	OWNER_FIRST_NAME
00011	Peterson	Carolyn
00075	Martinez	Mary
00143	Hendricks	John
00850	Alexander	Tae
01344	Smith	Gary
01531	Carter	Anthony
01932	Carter	Shawn
02001	Chin	Robert
02003	Johnson	Elizabeth

HORSE_ID	HORSE_NAM	OWNER_ID
AX1905	Whirlaway	02001
AX2000	Gallant Fox	01344
AX3254	Count Turf	00075
AX3533	Fire Works	01344
AX4362	Phar Lap	01344
KY0034	Count Fleet	00011
KY0868	Decidedly	02001
KY0993	Omaha	01932
KY2350	Carry Back	01344

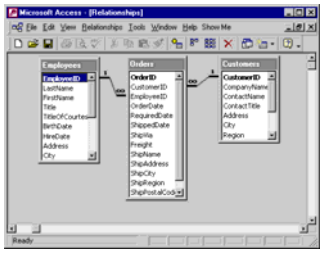
The Need for Referential Integrity



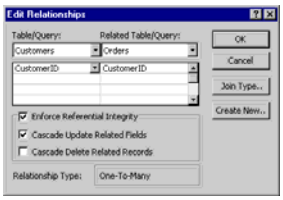
Single Table Referential Integrity



Referential Constraints Defined in Microsoft Access



Microsoft Access Edit Relationships Panel



Intersection Table

- *Intersection Table*: resolves a many-to-many relationship between two other entities.
- Appears on the "many" side of two one-to-many relationships.
- Why do this? Relational databases don't directly support many-to-many relationships

Integrity Constraints

- *NOT NULL Constraint*: Prevents a database column value from being NULL (a way of handling "missing" data values)
- *CHECK Constraint:* A simple logic statement that validates ("checks") a column value
- Triggers may be used for complicated constraint logic

Constraints in Access