Curriculum Development Centers Program

Awardee of The Office of the National Coordinator for Health Information Technology

# Component 4: Introduction to Information and Computer Science

Unit 6:
Databases and SQL
Lecture 2

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## Topic II Relational Databases

- Keys and relationships
- Data modeling
- Database acquisition
- Database Management System (DBMS)
- Database development



## Connecting Data

- Relationships
- Candidate keys
- Primary keys
  - Natural keys
  - Surrogate keys
- Foreign keys

## Data Modeling: Database Design

- Entities
- Entity-Relation Diagram (ERD)


- Maximum cardinality of the relationship
- Attributes
- Crow's foot diagrams




## Database Acquisition

- Data is stored in and retrieved from a database by using Structured Query Language (SQL)




## The Database Management System (DBMS)

- Metadata
- Administration of the database
- Carries out SQL statements and procedures
- Stored procedures
- Triggers
- Security (permissions)
- Handles processing problems
- Carries out backup & restore/recovery

## Database Development

- From scratch
  - Existing data
  - Data model eventually becomes DB design
  - Merge existing databases
- Modification of existing database
  - Most databases have already been developed



## Phases of Database Development

1. Gathering specifications
2. Design
   - Data modeling to database design
3. Testing
4. Implementation
5. Maintenance
6. Modification (starts process all over again)



## Gathering Specifications

- Attribute domains
  - Data type, length, legitimate values
- Business rules
- Input from users
- Forms and reports
- Existing files
- Outcome of this phase is a beginning data model

## Design

- More definitive specifications are gathered
- The data model is perfected toward the database design
- Entities become tables
- Attributes are added subtracted as needed
- Candidate keys are identified and finally primary keys are chosen
- Relationships are indicated with the addition of foreign keys



## Multiple Views of the Database

- Each user will have a different need/view of the database
- Forms, files and reports will all be of different views of the database
- All views of the database need to be resolved into the data model. The data model will not look like any one of the views.



## Testing

- First evaluate design
- Confirm that data model contains all the information that users will need
  - Converse with users
  - Show them data model
  - Express “known” facts to users
    - Users can make objections

## Implementation

- Database is created
- Tables are created with attributes, primary and foreign keys
- Business rules are carried out
  - Stored procedures
  - Triggers
  - Built-in DBMS features



## DBMS Restrictions

- The database design may have to be adjusted to meet with any DBMS or computer system restrictions.



## Testing Again

- The database is populated with real and/or test data
- SQL is written that accommodates what the users have requested and the SQL is run against the database
- Bad results means that the database must be changed. This can mean going all the way back to the design phase or it could be something more elementary.

## Entity-Relationship Model

- ER model (Peter Chen, 1976)
- Extended ER model
- Information Engineering (IE)(James Martin, 1990) or Crow's foot version of ER Model
- Integrated Definition 1, Extended Version (IDEF1X) – government standard
- National Institute of STDs and Technology (NIST) 1993
- Unified Modeling Language (UML)



## Entities

- Potential table
- Things that the user needs to keep track of
  - People, places, things, activities, documents
- Object Classes (idea)
  - An occurrence or individual is an instance of an entity class

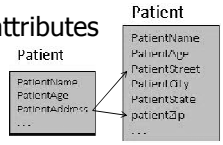


## Attributes

- Descriptors of entities
- Have to have a direct relationship with the entity.
  - Customer entity might have customer name as an attribute
- Can be shown in entity relationship model as balloons or be listed under the entity name.

# Attributes Continued

- Composite attributes

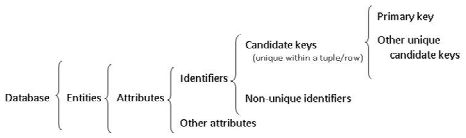



- Multi-value attributes
- Attribute domains




# Attributes Continued

- Identifiers

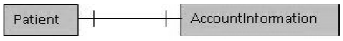



# Primary Keys

- Primary key uniquely defines a record:
  - It must be unique within the table column
  - Composite keys consist of two or more columns
  - It's more efficient if it's short and numeric
  - Value should never change
- Natural vs. surrogate primary keys
  - A natural primary key is something that the user is familiar with and/or is readily available.

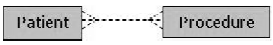
# Relationship Classes

- One-to-one




- One-to-many


- Many-to-many

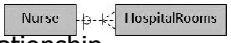




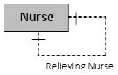

# Relationships

- Maximum cardinality
- Parent-Child

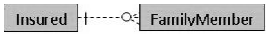

- Minimum cardinality




- Recursive relationship



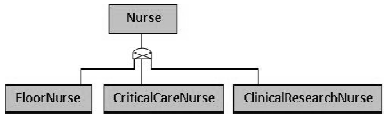

- Weak and strong entities
- ID shared relationship






# Relationships Continued

- Subtype and super type entities
  - Inheritance
  - Discriminator
  - Exclusive Vs Inclusive (Crow's Foot)
  - Complete Vs Incomplete (IDEF1X)



# Relationships Continued

- Naming a relationship
  - Used to distinguish two relationships between the same two entities
  - Used to help clarify the relationship
  - Can be made up of a short phrase that describes the parent to child relationship followed by a short phrase that describes the child to parent relationship.