Relational Database Model

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Basic Structure

- Relation or Table
  - Named
  - NO repeating fields (no occurs clause in COBOL terminology
  - Shown as Relation-Name (A1, A2, …., An)

Relation Name

A1	A2	..	..	..	..	..	An

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Basic Structure

- Columns
  - named attributes
  - must be atomic values
  - values valid within a domain

Relation Name

A1	A2	..	..	..	..	..	An

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Basic Structure

- Rows
  - also called tuples
  - similar to record
  - must have primary key

Relation Name

A1	A2	..	..	..	..	..	An

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Basic Structure

- Keys
  - Super Key:
    - an attribute or set of attributes that uniquely identify a tuple
    - every relation has at least one superkey, the set of all attributes
    - a relation can have more than one superkey

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Basic Structure

- Keys
  - Candidate Key:
    - a minimum set of attributes that uniquely identify a tuple
    - a minimal super key
    - a relation may have more than one candidate key
  - Primary Key:
    - one and only one per relation.
    - a chosen candidate key

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Basic Structure

- Keys Example
  - Employee (Emp-ID, Emp-Name, Emp-Birthdate, Emp-Address, Emp-Salary)
    - Super key:
      - Emp-ID, Emp-Address
      - Emp-Name, Emp-Birthdate, Emp-Salary
    - Candidate key:
      - Emp-ID
      - Emp-Name, Emp-Birthdate
    - Primary key:
      - Emp-ID

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Basic Structure

- Keys Example
  - Employee-Project(Emp-ID, Project-ID, Emp-Title-Proj, Hours-Worked)
    - Super key:
      - Emp-ID, Project-ID, Emp-Title-Proj
      - Emp-ID, Project-ID, Hours-Worked
    - Candidate key:
      - Emp-ID, Project-ID
      - Project-ID, Emp-Title-Proj (assuming each employee has a different title within a project)
    - Primary key:
      - Emp-ID, Project-ID

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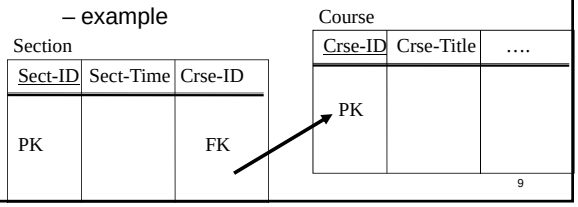
Basic Structure

- Foreign Key
  - used to reference another relation
  - attributes of FK have same domain as the primary key of the home relation
  - example



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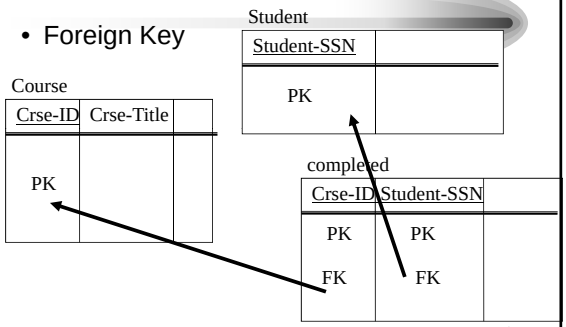
Basic Structure

- Foreign Key



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Terminology

- Domain
  - set of atomic valid values of one or more attribute
  - may be specified as a data type
- Atomic values
  - indivisible data values
- Null value
  - designates a MISSING attribute value
  - may or may not be allowed for an attribute

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Terminology

- Degree
  - number of attributes (columns) in a relation
  - does not changes dynamically
- Cardinality
  - number of tuples (rows) in a relation
  - changes dynamically with additions and deletions of tuples using DML

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Terminology

- Intention
  - a named relation and its attribute names
  - also called schema of a relation
  - the DDL is used to modify the intention
- Extension
  - the data (tuples) in a relation
  - the state of a relation
  - the DML is used to modify the extension

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Characteristics of a Relation

- Order Independence
- Two kinds
  - (1) ordering of tuples within a relation
    - do not have any particular order
    - considered an unordered set

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Characteristics of a Relation

- Order Independence
  - (2) ordering of attributes within a relation
    - do not have any particular order as long as correspondence between the attribute and its values is maintained
    - Example

Student(Stud-ID, Stud-Name, Stud-Address)

Student(Stud-Address, Stud-Name, Stud-ID)

equivalent relations

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Relational Constraints

- Domain / Integrity Constraints
  - specify the valid values of each attribute
  - editing criteria
    - salary not > 100k
    - height < 8 feet

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Relational Constraints

- Entity Integrity Constraint
  - states that no attribute of a primary key can contain a null value
    - Game (Date, Location, Time)
      - here neither Date nor Location nor both can ever contain a null value in this relation

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Relational Constraints

- Referential Integrity Constraint
  - a foreign key can
    - EITHER contain a valid value of the PK in the home relation
    - OR contain a NULL value

Sect-ID	Sect-Time	Crse-ID
S1	10:00am	C2
S2	2:00pm	C2
S3	3:00pm	C3
S4	1:00pm	null

Crse-ID	Crse-Title	. . .
C1	Course 1	
C2	Course 2	
C3	Course 3	

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Relational Constraints

Crse-ID in Section relation is the Foreign Key

Crse-ID in Course relation is the referenced Primary Key

- Referential Integrity Constraint
  - a foreign key can
    - EITHER contain a valid value of the PK in the home relation
    - OR contain a NULL valueSection

Sect-ID	Sect-Time	Crse-ID
S1	10:00am	C2
S2	2:00pm	C2
S3	3:00pm	C3
S4	1:00pm	null

Crse-ID	Crse-Title	. . .
C1	Course 1	
C2	Course 2	
C3	Course 3	

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Relational Operators

- Update operators
  - Insert
  - Delete
  - Modify
- Retrieval operators
  - Relational Algebra
  - Relational Calculus
  - SQL

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SQL

- Name derived from Structured Query Language
- Comprehensive database language
  - DDL
  - DML
  - view definition
  - transaction control
- Can be embedded in a programming language

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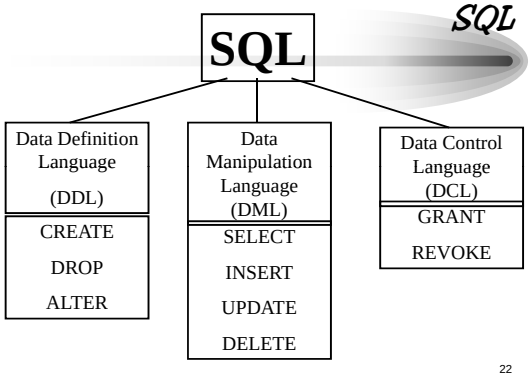
SQL



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