CMSC 424 – Database design
Lecture 8
SQL, constraints

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Next:

Integrity constraints

??

Prevent semantic inconsistencies

IC's

Predicates on the database

Must always be true (checked whenever db gets updated)

There are the following 4 types of IC's:

Key constraints (1 table)

e.g., 2 accts can't share the same acct_no

Attribute constraints (1 table)

e.g., accts must have nonnegative balance

Referential Integrity constraints (2 tables)

E.g. *bnames* associated w/ *loans* must be names of real branches

Global Constraints (n tables)

E.g., all *loans* must be carried by at least 1 *customer* with a svngs acct

Key Constraints

Idea: specifies that a relation is a set, not a bag

SQL examples:

1. Primary Key:

```
CREATE TABLE branch(
        bname  CHAR(15)  PRIMARY KEY,
        bcity      CHAR(20),
        assets     INT);
```

or

```
CREATE TABLE depositor(
        cname   CHAR(15),
        acct_no  CHAR(5),
        PRIMARY KEY(cname, acct_no));
```

2. Candidate Keys:

```
CREATE TABLE customer (
        ssn     CHAR(9)    PRIMARY KEY,
        cname  CHAR(15),
        address CHAR(30),
        city          CHAR(10),
        UNIQUE (cname, address, city));
```

Key Constraints

Effect of SQL Key declarations

PRIMARY (A1, A2, .., An) or
UNIQUE (A1, A2, ..., An)

Insertions: check if any tuple has same values for A1, A2, .., An as any inserted tuple. If found, **reject insertion**

Updates to any of A1, A2, ..., An: treat as insertion of entire tuple

Primary vs Unique (candidate)

1. 1 primary key per table, several unique keys allowed.
2. Only primary key can be referenced by “foreign key” (ref integrity)
3. DBMS may treat primary key differently
   (e.g.: create an index on PK)

How would you implement something like this ?

Attribute Constraints

Idea:

Attach constraints to values of attributes

Enhances types system (e.g.: >= 0 rather than integer)

In SQL:

1. NOT NULL

```
e.g.:   CREATE TABLE branch(
                bname   CHAR(15)  NOT NULL,
                ....
                )
```

Note: declaring bname as primary key also prevents null values

2. CHECK

```
e.g.:   CREATE TABLE depositor(
                ....
                balance int NOT NULL,
                CHECK(  balance >= 0),
                ....
                )
```

affect insertions, update in affected columns

Attribute Constraints

Domains: can associate constraints with DOMAINS rather than attributes

e.g: instead of:

```
CREATE TABLE depositor(
        ....
        balance INT NOT NULL,
        CHECK  (balance >= 0)
         )
```

One can write:

```
CREATE DOMAIN  bank-balance INT (
    CONSTRAINT not-overdrawn CHECK (value >= 0),
    CONSTRAINT not-null-value CHECK( value NOT NULL));
```

```
CREATE TABLE depositor (
    .....
    balance    bank-balance,
    )
```

Advantages?

Attribute Constraints

Advantage of associating constraints with domains:

1. can avoid repeating specification of same constraint
   for multiple columns

2. can name constraints

   e.g.:
```
CREATE DOMAIN bank-balance INT (
    CONSTRAINT not-overdrawn
        CHECK (value >= 0),
    CONSTRAINT not-null-value
        CHECK( value NOT NULL));
```

   allows one to:

   1. add or remove:

```
ALTER DOMAIN bank-balance
ADD CONSTRAINT capped
    CHECK( value <= 10000)
```

   2. report better errors (know which constraint violated)

Joins

Natural (inner) join

Outer joins (left, right)

account

name	acc_no
Bob	101
Bob	102
Jane	107
Janice	109

loan

name	loan_no
Bob	L1
Jane	L3
Harry	L4
Tom	L7

SQL Query Examples

- Movie(*title, year*, length, inColor, studioName, producerC#)
- StarsIn(movieTitle, movieYear, starName)
- MovieStar(*name*, address, gender, birthdate)
- MovieExec(name, address, *cert#,* netWorth)
- Studio(*name*, address, presC#)
- Queries:
  - Producer with maximum average length of movies
  - Find producer of Star Wars.
  - All producers of movies in which harrison ford stars

SQL Query Examples

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- Studio(*name*, address, presC#)
- Queries:
  - Find movie titles that appear more than once
  - Find number of people 3 hops away from Kevin Bacon