CpSc 4620/6620: Database Management Systems (DBMS) (TEXNH Approach)

Relational Schema and SQL Queries

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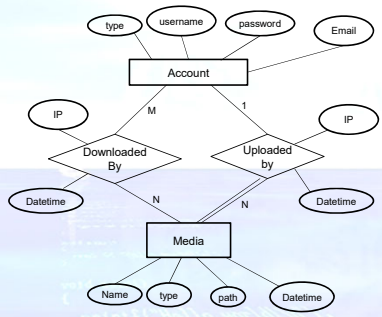
Partial ER Diagram for MeTube



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Create Table

- **Create the Account table:**

```
CREATE TABLE ACCOUNT (
   type INTEGER,
   username varchar(100),
   password varchar(100),
   email varchar(2048) primary key
  );
```

- **Is it good to use email as the primary key for ACCOUNT?**
  - Email sometimes is very long.
  - String comparison is more expensive.
  - Be better create an artificial integer key.
  - Some DBMS systems do not allow long key.

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The use of artificial key

- **Create the Account table:**

```
CREATE TABLE ACCOUNT (
   AccountID INTEGER AUTO_INCREMENT PRIMARY KEY ,
   email VARCHAR(1024) NOT NULL,
   username VARCHAR(100) NOT NULL,
   password VARCHAR(100) NOT NULL,
   type TINYINT NOT NULL
  );
```

- **Create the Media table:**

```
CREATE TABLE MEDIA (
   MediaID INTEGER AUTO_INCREMENT PRIMARY KEY,
   type INTEGER NOT NULL,
   name varchar(100) NOT NULL,
   path varchar(4096) NOT NULL,
   lastaccess DATETIME NOT NULL
  );
```

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Create Associative Table

- **It is easy to represent an M:N relationship in ER diagram.**
- **However, in the relational model, an associative relation must be used to represent the M:N relationship**
- **Create the Downloads table:**

```
CREATE TABLE DOWNLOADS (
   DownloadID INTEGER AUTO_INCREMENT PRIMARY KEY,
   AccountID INTEGER REFERENCES ACCOUNT(AccountID),
   MediaID INTEGER NOT NULL REFERENCES MEDIA(MediaID),
   ip varchar(128) NOT NULL,
   downloadtime DATETIME NOT NULL,
   FOREIGN KEY(AccountID) REFERENCES ACCOUNT(AccountID),
   FOREIGN KEY(MediaID) REFERENCES MEDIA(MediaID)
  );
```

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Deal with 1:N relationship

- **We don't need to create a table for uploadedby relationship because it is a 1:N relationship.**
- **In the relational model, relationships are represented through foreign keys.**

```
ALTER TABLE MEDIA ADD COLUMN AccountID INTEGER NOT NULL;
ALTER TABLE MEDIA ADD COLUMN uploadtime DATETIME;
ALTER TABLE MEDIA ADD FOREIGN KEY(AccountID) REFERENCES
ACCOUNT(AccountID);
```

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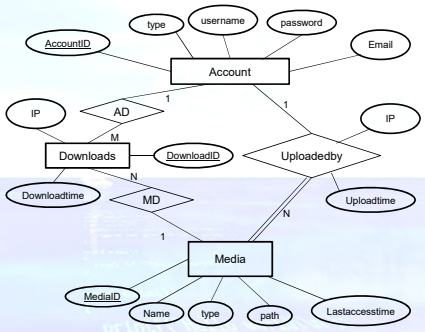
A Improved Version of ER Diagram



SQL Queries

- **List all media files in the MeTube system:**
  SELECT * FROM MEDIA WHERE 1;
- **Show media name and path that were uploaded before 09/20/20007.**
  SELECT name, path FROM MEDIA
  WHERE uploadTime < '2007-09-20';
- **List the image files (type = 1) uploaded by User #1.**
  SELECT * FROM MEDIA
  WHERE type = 1 AND AccountID = 1;

SQL Queries (more)

- **List all media files downloaded by user "xyz" in the MeTube system:**
  SELECT username, name, path, ip
  FROM ACCOUNT, MEDIA, DOWNLOADS
  WHERE username ='xyz' AND
  ACCOUNT.AccountID = DOWNLOADS.AccountID AND
  DOWNLOADS.MediaID = MEDIA.MediaID;
- **Find the name of the most recently downloaded media.**
  SELECT name, downloadtime
  FROM MEDIA, DOWNLOADS
  WHERE MEDIA.MediaID = DOWNLOADS.MediaID
  ORDER BY downloadtime DESC
  LIMIT 1 ;

Syntax of SQL Statements

SELECT [DISTINCT] {*Select-List*}
FROM {*From-List*}
WHERE {*Qualification*}

- ***Selection-List* is in the form of T_1.*attrib*, …, T_2.*attrib*, …. They are the expected attributes for the returned results.**
- ***From-List* is a list of tables separated by comma.**
- **DISTINCT: Eliminate the redundant rows in the return results.**
- ***Qualification:* Conditions for a record to be selected.**

Expressions in SQL

- **You can apply operations on the scalars (int, float, string, datetime, etc.) in the *qualification* or in the *select-list.***
  SELECT UPPER(name), DATEDIFF(CURRENT_DATE, downloadtime)
  FROM MEDIA, DOWNLOADS
  WHERE MEDIA.MediaID = DOWNLOADS.MediaID AND
  DATEDIFF(CURRENT_DATE, downloadtime) > 2;
- ***Note on strings:***
  - Fixed (CHAR(x)) or variable length (VARCHAR(x))
  - Use single quotes: 'A string'
  - Special comparison operator: LIKE
  - Not equal: <>
- **Typecasting:** CAST(S.sid AS VARCHAR(255))

Operations on Two Queries

- **Set operations can be applied on two queries.**
  (SELECT … FROM … WHERE …)
  {op}
  (SELECT … FROM … WHERE …)
- ***{op}:* UNION, INTERSECT, MINUS/EXCEPT.**
- **Note: Not all DBMS support "MINUS/EXCEPT".**
- **Nested Queries:**
  - IN, NOT IN
  - EXISTS, NOT EXISTS
- **Where to use Nested Queries?**
  - Anywhere in *from-list* or *qualification*.

Examples of Nested Queries

- **Find users downloaded media 1 but not media 3:**

```
SELECT username FROM ACCOUNT, DOWNLOADS
WHERE ACCOUNT.AccountID = DOWNLOADS.AccountID AND
MediaID = 1 AND username NOT IN (SELECT username FROM ACCOUNT,
    DOWNLOADS WHERE ACCOUNT.AccountID = DOWNLOADS.AccountID AND
    MediaID = 3 );
```

- **Can we write a query by using EXISTS or NOT EXISTS to return the same results?**
- **How about nesting query in the *from-list*?**

```
SELECT UA.username FROM ( SELECT ACCOUNT.username,
    DOWNLOADS.MediaID FROM ACCOUNT, DOWNLOADS
WHERE ACCOUNT.AccountID = DOWNLOADS.AccountID
AND MediaID =1 ) AS UA WHERE UA.username NOT IN ( SELECT username
FROM ACCOUNT, DOWNLOADS WHERE ACCOUNT.AccountID =
    DOWNLOADS.AccountID AND MediaID =3
)
```

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Aggregation

- **GROUP BY**

```
SELECT {group-attribs}, {aggregate-operator}(attrib)
FROM {relation} T1, {relation} T2, …
WHERE {predicates}
GROUP BY {group-list}
```

- **Aggregate operators**
  - AVG, COUNT, SUM, MAX, MIN
  - DISTINCT keyword for AVG, COUNT, SUM
- **Example:**
  - Find the numbers of times that users downloaded media 1 respectively.

```
SELECT AccountID, count( AccountID ) AS cnt
FROM DOWNLOADS
WHERE MediaID =1
GROUP BY AccountID
ORDER BY cnt
```

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HAVING Clause

- **What If you want to only show some groups?**
- **The HAVING clause lets you do a selection based on an aggregate (there must be 1 value per group):**

```
SELECT AccountID, count( AccountID ) AS cnt
FROM DOWNLOADS
WHERE MediaID =1
GROUP BY AccountID
HAVING cnt > 1
```

- **Sometimes, we combine a nested GROUP BY query in the from-list to aggregate twice.**

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JOIN

- **INNER JOIN:**
  - Regular JOIN will return results only when the join attribute matches in both tables involved.
  - In MySQL JOIN == CROSS JOIN.
- **LEFT JOIN:**
  - Besides returning results matching the join attribute in both tables. It also returns results from left table that do not have matching rows in right table.
  - Some DBMS vendor use syntax LEFT OUTER JOIN.
- **RIGHT JOIN:**
  - Return results from right table that table that do not have matching rows in left table.
  - Some DBMS vendor use syntax RIHGT OUTER JOIN

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Beyond SELECT

- **INSERT:**

```
INSERT INTO T(C1, C2, …)
VALUES (V1, V2, …)

INSERT INTO T(C1, C2, …)
SELECT ….
```

- **DELETE:**

```
DELETE FROM tbl WHERE condition-list
```

- **UPDATE:**

```
UPDATE tbl
SET C1 = x1, C2 = x2
WHERE condition-list
```

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References

- **MySQL documentation, http://dev.mysql.com/doc/**
- **PHP MySQL Tutorial, http://www.php-mysql-tutorial.com/**
- **https://dev.mysql.com/doc/refman/8.0/en/sql-statements.html**

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