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Data Modeling and Database Design

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Week 2

One Table SQL

Answers to the Quiz

```
select id, name
from spare_parts
where number_in_stock<=0;

select number_in_stock
from spare_parts
where
 name="Type 2 Holoprojector";
```

Relational Algebra

persona

name	occupation	species
Obi-Wan Kenobi	Jedi Master	Human
Yoda	Jedi Master	NULL
Jabba	crime lord	Hutt
Chewbacca	co-pilot	Wookiee
Luke Skywalker	Jedi Knight	Human
Padmé Amidala	queen	Human

Projection

persona

name	occupation	species
Obi-Wan Kenobi	Jedi Master	Human
Yoda	Jedi Master	NULL
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(AKA “restriction”.)

Selection

persona

name	occupation	species
Obi-Wan Kenobi	Jedi Master	Human
Luke Skywalker	Jedi Knight	Human
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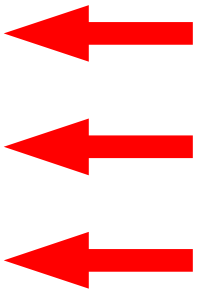


(AKA “restriction”.)

Columns vs Rows

Projection:

choosing columns (fields)
by name

Selection:

choosing rows with a condition

Back to SQL

```
use starwars;
select name, occupation
from persona
where species="Wookiee";
```

projection

selection

selection followed by **projection**

Skipping Projection

```
select
*
from «table»
where «condition»;
```

```
select *
from persona
where species="Human";
```

Skipping Projection

```
select
*
from «table»
where «condition»;
```

to be substituted

the new parts

general pattern

```
select *
from persona
where species="Human";
```

specific example

Skipping Selection

```
select
*
from «table»;
```

```
select *
from persona;
```

LIMIT

```
select ... from ... limit «N»;
```

```
select name from persona
limit 5;
```

Sorting the Results

```
select ... from ... where ...
order by «expression»;
```

```
select name from persona
order by size;
```

Descending Sort

```
select ... from ... where ...
order by «expression» desc;
```

```
select name from persona
order by size desc;
```

Putting It Together

Who are the 3 tallest human characters (species="Human")?

```
select name, size
from persona
where species="Human"
order by size desc
limit 3;
```

Putting It Together

Who are the 3 **shortest** human characters?

```
select name, size
from persona
where species="Human"
order by size desc
limit 3;
```

Putting It Together

What is the species of the shortest character?

```
select species
from persona
order by size
limit 1;
```

Putting It Together

What which Jedi Master character comes first alphabetically?

```
select name
from persona
where occupation="Jedi Master"
order by name
limit 1;
```

Moving On

What is the name of the world that Humans are originally from?

Hmm. Where is this information?

Browsing

```
show tables;
describe «table»;
```

```
describe species;
```

Complex Conditions

```
select «fields» from «table»
where «condition1» and
«condition2»;
```

```
use menagerie;
select name, weight from pet
where owner="Harold"
and species="dog";
```

```
+-------+--------+
| name  | weight |
+-------+--------+
| Buffy |    2.3 |
+-------+--------+
1 row in set (0.00 sec)
```

Or We Can Use "OR"

```
select «fields» from «table»
where «condition1» or
«condition2»;
```

```
select name, owner, species
from pet
where owner="Harold"
or species="dog";
```

```
+--------+--------+---------+
| name   | owner  | species |
+--------+--------+---------+
| Fluffy | Harold | cat     |
| Buffy  | Harold | dog     |
| Fang   | Benny  | dog     |
| Bowser | Diane  | dog     |
+--------+--------+---------+
4 rows in set (0.00 sec)
```

And Why Not "NOT"?

```
select «fields» from «table»
where not «condition»;
```

```
select name, owner from pet
where not owner="Harold";
```

```
+----------+-------+
| name     | owner |
+----------+-------+
| Claws    | Gwen  |
| Fang     | Benny |
| Bowser   | Diane |
| Chirpy   | Gwen  |
| Whistler | Gwen  |
| Slim     | Benny |
| Puffball | Diane |
+----------+-------+
7 rows in set (0.00 sec)
```

Combinations

```
«condition1» and
not («condition2» or
«condition3»)
```

```
select name from pet
where species="dog" and
not (owner="Harold" or
owner="Gwen");
```

```
+---------+
| name    |
+---------+
| Fang    |
| Bowser  |
+---------+
2 rows in set (0.00 sec)
```

Things to Compare

```
«field» = «constant»
  where name="Harald";
```

vs.

```
«field1» = «field2»
  where name=owner;
```

Combinations

```
where «field1» = «field2»
```

```
select name from pet
where name=owner;
```

```
+--------+--------+
| name   | owner  |
+--------+--------+
| Margie | Margie |
+--------+--------+
1 row in set (0.00 sec)
```

An Odd Case

```
"Harold"="Harold"
```

What will we get back?

```
select name, owner
from pet
where "Harold"="Harold";
```

```
+----------+--------+
| name     | owner  |
+----------+--------+
| Fluffy   | Harold |
| Claws    | Gwen   |
| Buffy    | Harold |
| Fang     | Benny  |
| Bowser   | Diane  |
| Chirpy   | Gwen   |
| Whistler | Gwen   |
| Slim     | Benny  |
| Puffball | Diane  |
| Margie   | Margie |
+----------+--------+
10 rows in set (0.00 sec)
```

Another Odd Case

```
"Harold"="Gwen"
```

What will we get back?

```
select name, owner
from pet
where "Harold"="Gwen";
```

```
Empty set (0.00 sec)
```

Functions

```
«value» = «function»(«value»)
```

```
select name, owner
from pet
where upper(name)="buffy";
```

```
+--------+---------+
| name   | owner   |
+--------+---------+
| Buffy | Harold |
+--------+---------+
1 row in set (0.00 sec)
```

Tests: Equality

```
where «value»=«value»;
```

```
select name from pet
where owner="Harold";
```

Tests: Inequality

```
where «value»!=«value»;
```

```
select name, owner from pet
where owner!="Harold";
```

```
+----------+-------+
| name     | owner |
+----------+-------+
| Claws    | Gwen  |
| Fang     | Benny |
| Bowser   | Diane |
| Chirpy   | Gwen  |
| Whistler | Gwen  |
| Slim     | Benny |
| Puffball | Diane |
+----------+-------+
7 rows in set (0.00 sec)
```

Tests: LIKE

```
where «field» like «pattern»;
```

```
select name from pet
where name like "%uff%";
```

```
+-----------+
| name      |
+-----------+
| Fluffy    |
| Buffy     |
| Puffball  |
+-----------+
3 rows in set (0.00 sec)
```

More: >, <, <=, >=

```
where «value»<«value»;
```

```
select name, birth from pet
where birth<"1980-01-01";
```

```
+--------+------------+
| name   | birth      |
+--------+------------+
| Bowser | 1979-08-31 |
+--------+------------+
1 row in set (0.00 sec)
```

Expressions

```
«expression» > «expression»
```

```
select name from pet
where weight>birth_weight*50;
```

```
+---------+
| name    |
+---------+
| Fluffy |
| Fang    |
| Bowser |
+---------+
3 rows in set (0.01 sec)
```

Combinations

```
select name from pet
where species="dog" and
not (owner="Harold" or
owner="Gwen")
and  weight>birth_weight*50;
```

Combinations

```
select name
from pet
where
  species="dog"
  and
     not (owner="Harold"
           or owner="Gwen")
  and weight>birth_weight*50;
```

```
+---------+
| name    |
+---------+
| Fang    |
| Bowser  |
+---------+
2 rows in set (0.00 sec)
```

Complex Projection

```
select
  upper(name),
  weight/1000
from pet
where species="dog";
```

Complex Projection

```
select
  upper(name),
  round(weight/1000,3)
from pet
where species="dog";
```

```
+--------------+------------------------+
| upper(name)  | round(weight/1000,3)   |
+--------------+------------------------+
| BUFFY        |                  0.002 |
| FANG         |                  0.013 |
| BOWSER       |                  0.037 |
+--------------+------------------------+
3 rows in set (0.00 sec)
```

The 6th Column

```
mysql> describe pet;
+---------+-------------+------+-----+---------+-------+
| Field   | Type        | Null | Key | Default | Extra |
+---------+-------------+------+-----+---------+-------+
| name    | varchar(20) | YES  |     | NULL    |       |
| owner   | varchar(20) | YES  |     | NULL    |       |
| species | varchar(20) | YES  |     | NULL    |       |
| sex     | char(1)     | YES  |     | NULL    |       |
| birth   | date        | YES  |     | NULL    |       |
| death   | date        | YES  |     | NULL    |       |
| weight  | float       | YES  |     | NULL    |       |
+---------+-------------+------+-----+---------+-------+
7 rows in set (0.00 sec)
```

What's in it?

```
mysql> select name, death
    -> from pet;
+----------+------------+
| name     | death      |
+----------+------------+
| Fluffy   | NULL       |
| Claws    | NULL       |
| Buffy    | NULL       |
| Fang     | NULL       |
| Bowser   | 1995-07-29 |
| Chirpy   | NULL       |
| Whistler | NULL       |
| Slim     | NULL       |
| Puffball | NULL       |
+----------+------------+
9 rows in set (0.00 sec)
```

NULL = no value provided (unknown, does not apply, etc.)

IS NULL

```
where «field» is null;
```

```
select name, death from pet
where death is null;
```

```
+----------+--------+
| name     | death  |
+----------+--------+
| Fluffy   | NULL   |
| Claws    | NULL   |
| Buffy    | NULL   |
| Fang     | NULL   |
| Chirpy   | NULL   |
| Whistler | NULL   |
| Slim     | NULL   |
| Puffball | NULL   |
+----------+--------+
8 rows in set (0.00 sec)
```

“IS NULL” vs “= NULL”

`death="NULL"`

true if the value of death is equal to the four-letter string “NULL”

`death=NULL`

always evaluates to NULL (the condition fails)

`death is NULL`

evaluates to TRUE is death is null and to FALSE if death is not null

IS NOT NULL

```
where «field» is not null;
```

```
select name, death from pet
where death is not null;
```

```
+--------+------------+
| name   | death      |
+--------+------------+
| Bowser | 1995-07-29 |
+--------+------------+
1 row in set (0.00 sec)
```

Null with And and Or

Null and True → Null
Null and False → False
Null or True → True
Null or False → Null

Duplicates

```
select species
from pet
where owner="Gwen";
```

```
+----------+
| species  |
+----------+
| cat      |
| bird     |
| bird     |
+----------+
3 rows in set (0.00 sec)
```

Removing Duplicates

```
select distinct «fields» ...
```

```
select distinct species
from pet where owner="Gwen";
```

```
+---------+
| species |
+---------+
| cat     |
| bird    |
+---------+
2 rows in set (0.00 sec)
```

vs

```
+---------+
| species |
+---------+
| cat     |
| bird    |
| bird    |
+---------+
3 rows in set (0.00 sec)
```

Aggregation

getting back less then one row per matched record

A “Normal” Function

```
select upper(name) from pet
where birth<"1994-12-31";
```

```
+--------------+
| upper(name)  |
+--------------+
| FLUFFY       |
| CLAWS        |
| BUFFY        |
| FANG         |
| BOWSER       |
+--------------+
5 rows in set (0.00 sec)
```

Aggregating: COUNT

```
select count(<fields>)
from ...;
```

```
select count(name) from pet
where birth<"1994-12-31";
```

```
+--------------+
| count(name)  |
+--------------+
|            5 |
+--------------+
1 row in set (0.00 sec)
```

Counting Distinct

```
select count(distinct owner)
from pet
where birth<"1994-12-31";
```

```
+-------------------------+
| count(distinct owner) |
+-------------------------+
|                       4 |
+-------------------------+
1 row in set (0.00 sec)
```

Summation

```
select sum(weight) from pet
where species="cat";
```

```
+------------------+
| sum(weight)      |
+------------------+
| 13.130000114441 |
+------------------+
1 row in set (0.00 sec)
```

More Aggregation

AVG, MIN, MAX

```
select min(weight) from pet;
```

```
+--------------------+
| min(weight)        |
+--------------------+
| 0.032000001519918 |
+--------------------+
1 row in set (0.00 sec)
```

Data Modification

INSERT

add a new record

UPDATE

modify existing record

DELETE

remove a record

INSERT

```
insert into my_pet values
( "Lilly", "Margie", "pony","f",
  "2001-04-19", NULL, 72, 2);
```

here order matters!

INSERT

```
insert into my_pet values
( "Frank", "Margie", "dog", "m",
  "2011-09-21", NULL, 6, 2),
( "Zé", "Margie", "fish", NULL,
  "2011-12-17", NULL, .1, 2);
```

INSERT

```
insert into my_pet
  (name, owner)
values (
  "Minnie", "Margie"
);
```

INSERT with SELECT

```
insert into my_pet
select * from pet;
```

UPDATE

```
update my_pet
set weight=100
where name="Buffy";
```

DELETE

```
delete from my_pet
where name="Buffy";
```

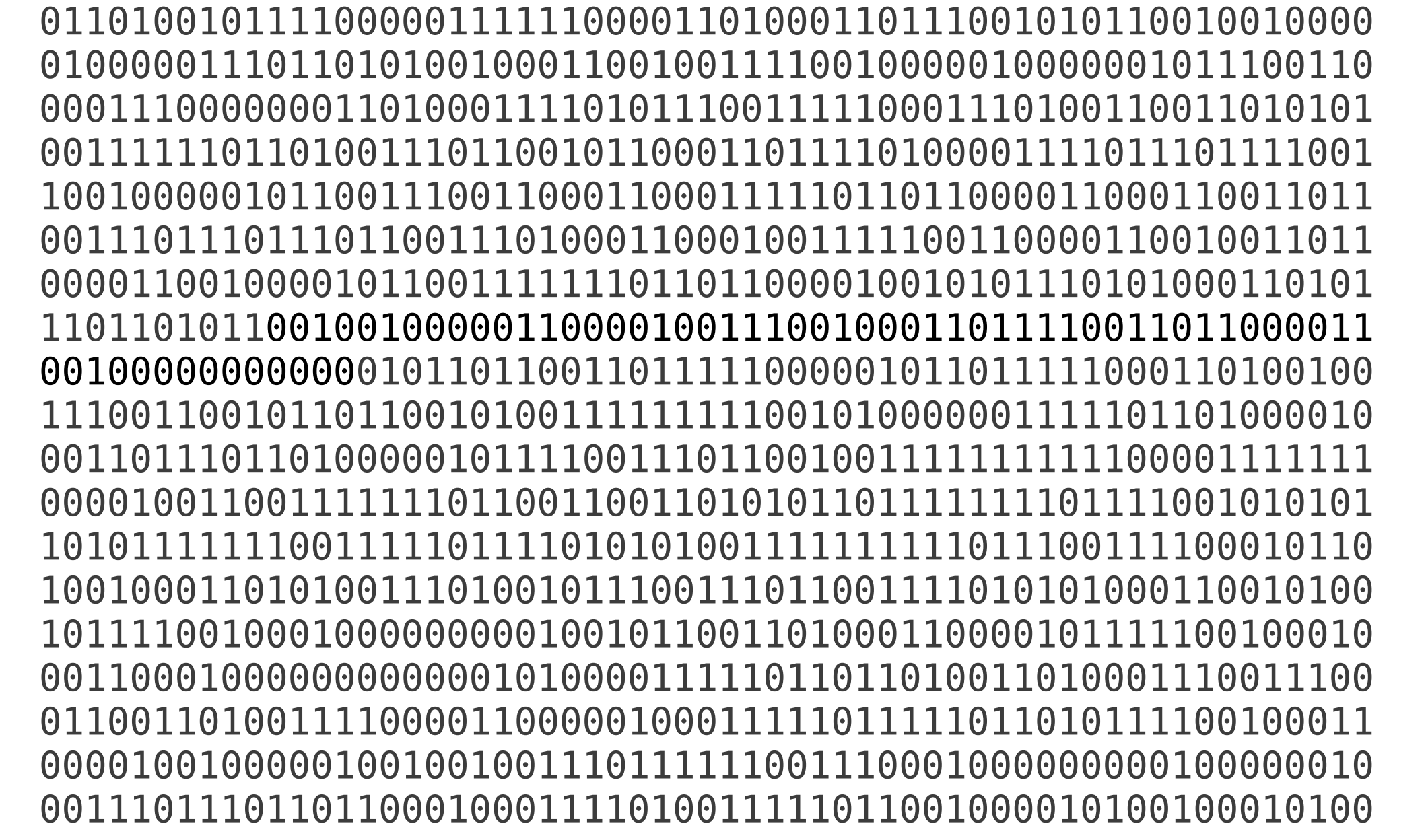
DELETE

```
delete from my_pet;
```

CREATE TABLE

```
use okenobi;
create table «name» (
   «field» «type»
);
```

Domains / Data Types



Domains / Data Types

Domains / Data Types

11011010110010010000011000010011100100011011110011011000011
00100000000000010110110011011111000001011011111000110100100

"Harold\n"?

1300457425722198016?

130045742.5722198016?

$0.523730480154 8 * 10^{-36}$?

String (Text)

CHAR(n)	BINARY(n)
VARCHAR(n)	VARBINARY(n)
TEXT	BLOB

ENUM

Numeric

INTEGER
UNSIGNED
SMALLINT
BIGINT

NUMERIC(n,m)
DECIMAL(n,m)

BOOLEAN

REAL
DOUBLE PRECISION
FLOAT(m,d)

Date and Time

DATE

TIME

DATETIME

TIMESTAMP

Extensions

Spatial:

POINT

POLYGON

LINESTRING

GEOMETRY

Choosing a Type

table student

- name
- student_no
- date_of_birth
- no_of_credits
- gpa
- amount_owed

CREATE TABLE

```
use okenobi;
create table student  (
   name varchar(100)
);
describe student;
```

DROP TABLE

```
drop table student;
describe student;
```

CREATE TABLE

```
create table student (
   name varchar(100),
   student_no integer,
   date_of_birth date,
   no_of_credits integer,
   gpa decimal(3,2),
   amount_owed decimal(10,2)
);
```

An Exercise

1. Create a table to store info about films: title, year, country, director, duration.
2. Insert several movies.
3. Find the duration of the most recent movie.