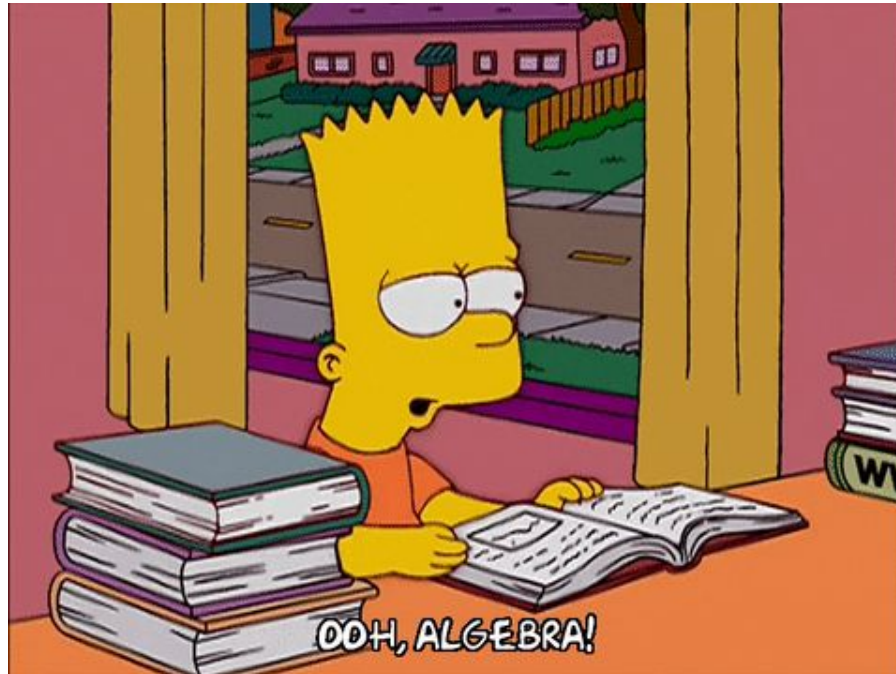


CS-GY 6083 A: *Principles of Database Systems*

Lab 4: Relational Algebra and SQL



Bakery

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

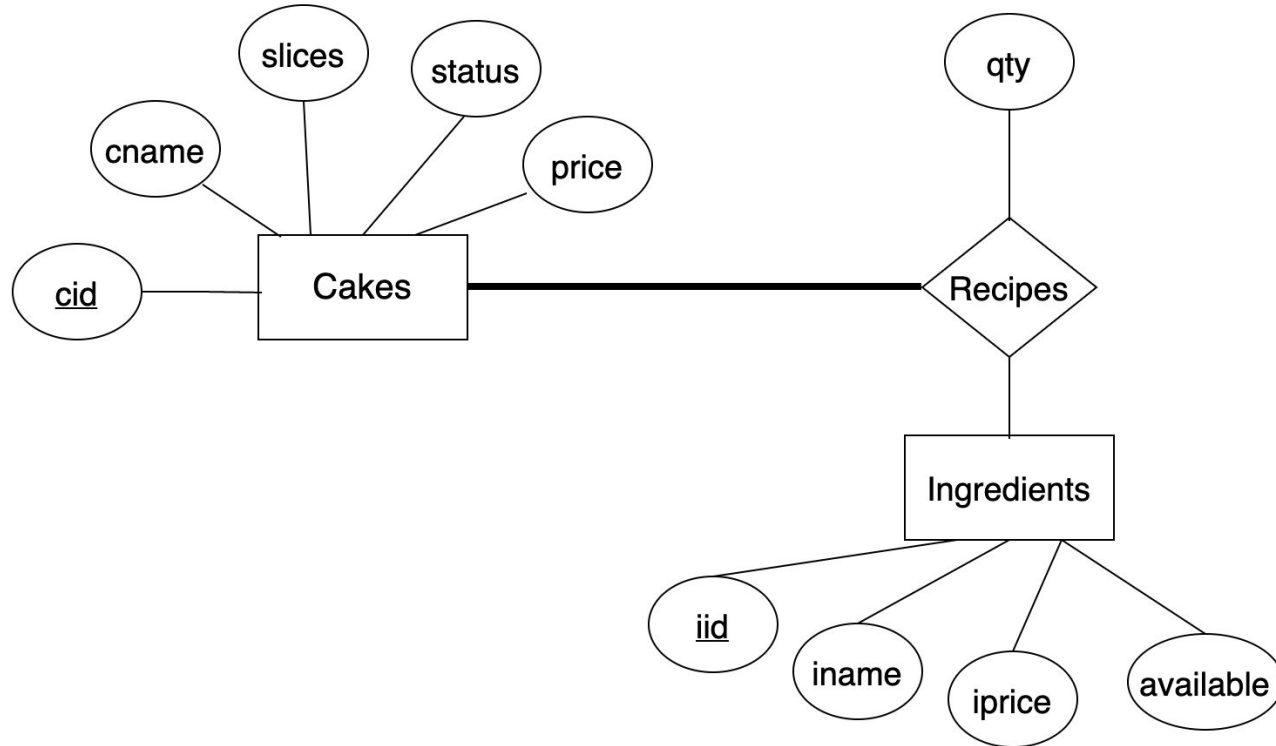
Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

Cakes are made of known ingredients and by specific quantities. Some ingredients may be unused.



Bakery - ER Diagram



Bakery - Relational Model

create table Cakes (

cid	integer	primary key,
cname	varchar(30)	not null,
slices	integer	not null,
status	varchar(30)	not null,
cprice	decimal	not null

);

create table Ingredients (

iid	serial	primary key,
iname	varchar(30)	not null,
iprice	integer	not null,
available	integer	not null

);

create table Recipes (

cid	integer,
iid	integer,
qty	integer not null,

primary key (cid, iid),

foreign key (cid)

foreign key (iid)

);

references Cakes (cid) on delete cascade on update cascade,

references Ingredients (iid)



Bakery - Instance

Cakes

cid	cname	slices	status	cprice
1	Apple Pie	6	available	15
2	Brownie	8	available	32
3	Chocolate Delight	3	available	50
4	Red bean cake	5	available	20
5	Italian	7	discontinued	60
6	Lemon cake	4	available	23
7	Vanilla cake	10	available	30
8	Strawberry cake	5	available	42

Ingredients

iid	iname	iprice	available
1	flour	3	40
2	eggs	4	53
3	sugar	2	16
4	milk	5	25
5	peanuts	4	16

Recipes

cid	iid	qty
1	1	2
1	3	1
1	4	1
2	2	2
2	3	4
3	1	2
3	4	2
3	5	2
4	2	2
4	3	1
5	1	2
5	2	3
5	4	2
6	1	3
6	2	1
6	3	1
6	5	1
7	1	1
7	2	2
7	3	2
7	4	2
8	1	2
8	2	2
8	3	3

Example 1

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List the names and prices of all cakes that are available.

Write a Relational Algebra expression

Example 1

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List the names and prices of all cakes that are available.

Write a Relational Algebra expression

$$\pi_{cname, cprice} (\sigma_{status='available'} C)$$

Example 2

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List all ingredients with their id & names with stock greater than 40.

Write a Relational Algebra expression

Example 2

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List all ingredients, with their id and name, with stock greater than 40.

Write a Relational Algebra expression

$$\pi_{iid, iname} (\sigma_{available > 40} I)$$

Example 3

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List the id, names of available cakes that contain ingredient 2 (iid=2).

Example 3

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List the id, names of available cakes that contain ingredient 2 (iid=2).

$$\pi_{cid, cname}((\sigma_{status='available'} C) \bowtie (\sigma_{iid=2} R))$$

$$\pi_{cid, cname}(\sigma_{status='available' \wedge iid=2} (C \bowtie R))$$

Example 4

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List the ingredients, present in discontinued cakes with their cname and quantity.

Write a Relational Algebra expression

Example 4

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List the ingredients of discontinued cakes, with their cname and quantity.

Write a Relational Algebra expression

$$\pi_{C.cname, I.iname, R.qty} \left((I \bowtie (\sigma_{status='discontinued'} C)) \bowtie R \right)$$

Example 5

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List all ingredients that are not used in any cakes.

Write a Relational Algebra expression

Example 5

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List ids of ingredients that are not used in any cakes.

Write a Relational Algebra expression

$$\pi_{iid} I - \pi_{iid} R$$

Example 5a

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List names of ingredients that are not used in any cakes.

$$\pi_{iname}(I \bowtie (\pi_{iid}I - \pi_{iid}R))$$

Example 6

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List ids of flourless cakes.

Write a Relational Algebra expression

Example 6

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List ids of flourless cakes.

Write a Relational Algebra expression

$$\pi_{cid} C - \pi_{cid} (R \bowtie (\sigma_{iname='flour'} I))$$

Example 7

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List names of all cakes that cost < \$20 or use flour.

Example 7

Cakes (cid:integer, cname: string, slices:integer, status:string, cprice:integer)

Ingredients (iid:integer, iname: string, iprice: integer, available: integer)

Recipes (cid: integer, iid: integer, qty, integer)

List names of all cakes that cost < \$20 or use flour.

$$\pi_{cname}(\sigma_{cprice < 20} C) \cup \pi_{cname}(C \bowtie (R \bowtie (\sigma_{iname='flour'} I)))$$