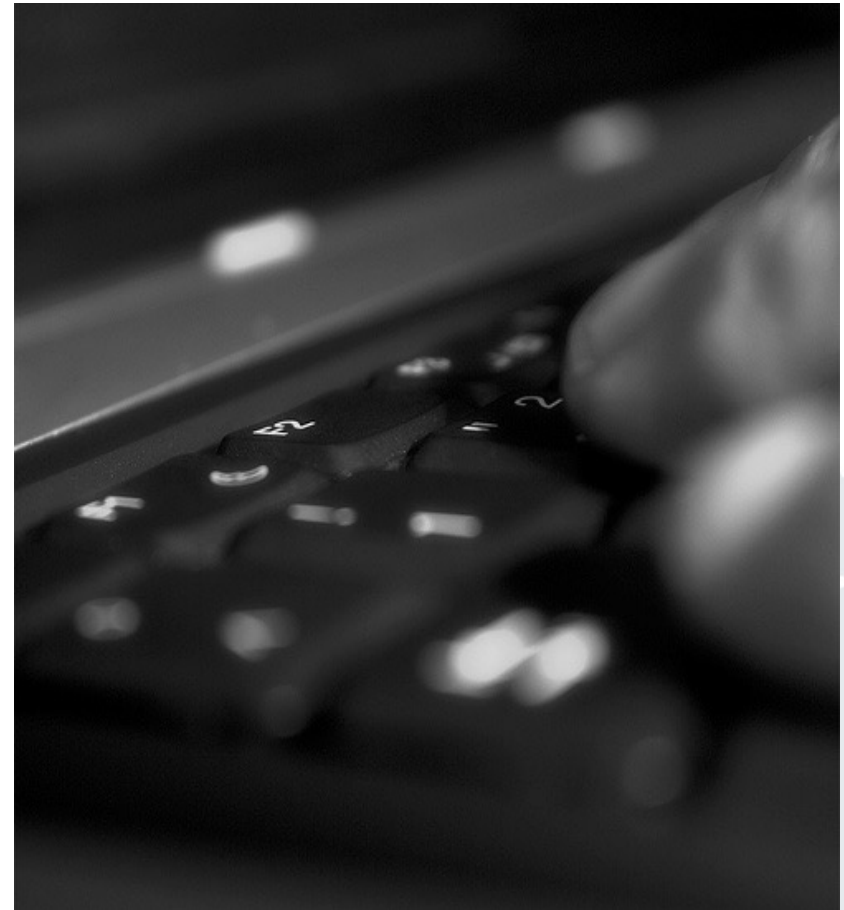mobile business

Exercise 6
Business Informatics 2 (PWIN)

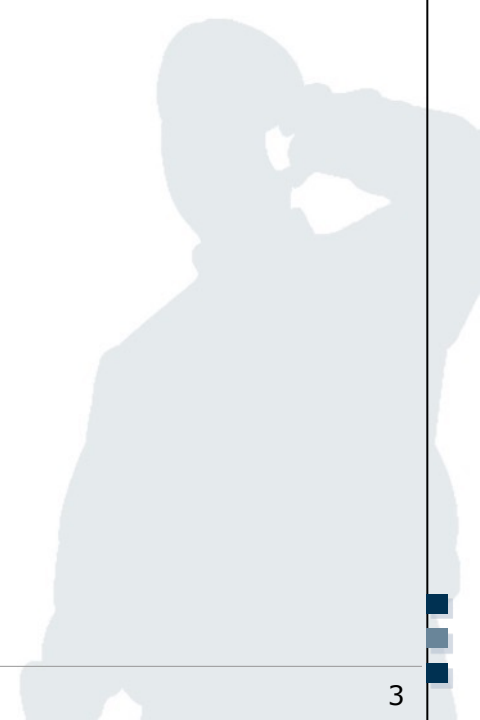Databases & Data-oriented
Modelling

SQL

Sascha Löbner, M.Sc.
www.m-chair.de

Jenser (Flickr.com)

- Exercise 1: Entity Relationship Model

- Exercise 2: Deriving Relations from an ERM
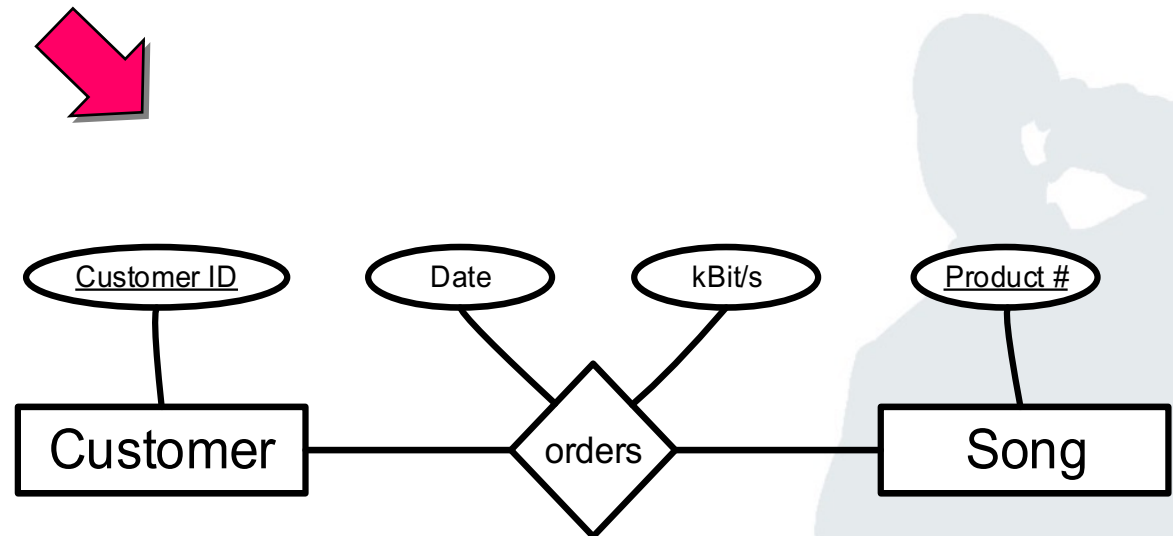
- Exercise 3: SQL

Exercise 1: Entity Relationship Model

- Modelling of the problem statement from functional perspective
- Abstraction from technical aspects and implementations
- Different modelling concepts (e.g. ERM, SERM, …) available
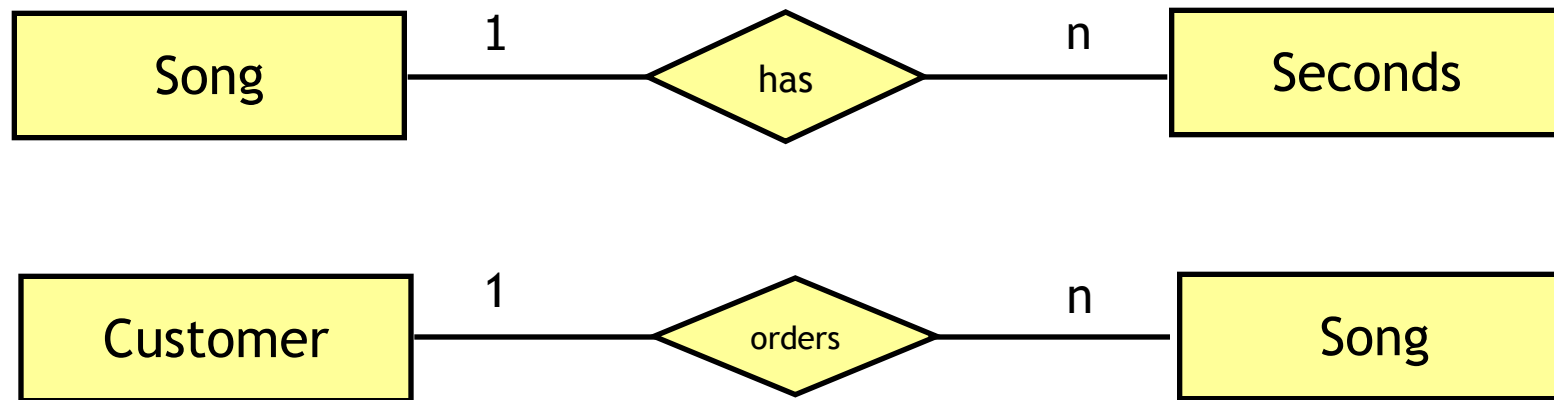
Customer orders a song.

Cardinalities

- Cardinalities describe the number of relationship instances that an entity can participate in:
    - 1:1 (one-to-one), e.g. student – student card (theoretically)
    - 1:n (one-to-many), e.g. university – student (theoretically)
    - n:m (many-to-many), e.g. professor – student (theoretically)

Intervals (min/max notation)

- Intervals allow specifying cardinalities more accurately.
- They specify that each entity participates in at least *min* and at most *max* relationship instances.

Song —1— has —n— Seconds

Customer —1— orders —n— Song

- Intervals allow specifying cardinalities more accurately.

| Song | — (0,600) — has — (1,1) — | Seconds |

| Customer | — (0,*) — orders — (1,1) — | Song |

$$(n,m)$$

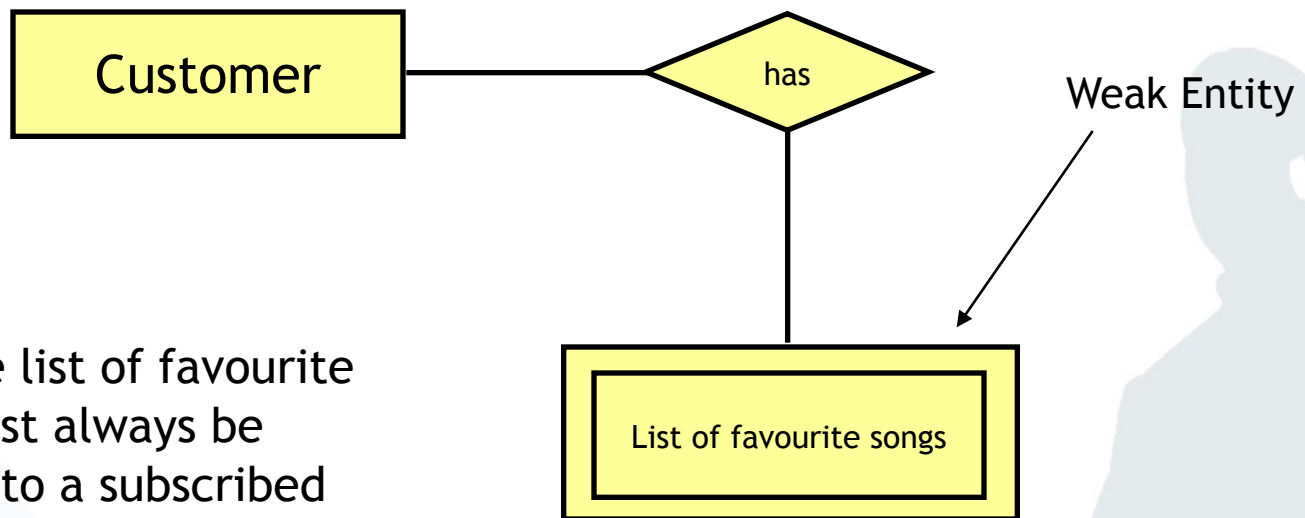any number → (0,*)

Minimum → n

Maximum → m

Create an ER model which represents the structure of a university:

- Identify and mark the **primary key** for each entity and avoid as far as possible artificial keys (e.g. ID).
- Define the relations, using the **interval notation**.
- Make explicitly use of **weak entities**.

The ER model should be based on the following information:

- A university consists of different **departments**. Each of them has a name and a unique number.
- Departments are structured into **chairs** with unique names. They offer at least one lecture.
- Each chair offers a number of **lectures** which are described with course number, title and description.
- **Exams** can be distinguished by its type. For each lecture two exams are offered: One normal exam and one repeat exam. The number of participants for an exam is not limited.
- A **student** can register for any number of exams. Furthermore, a student is assigned to one department and has a matriculation number and a name.

Weak entities depend on at least one entity and consequently cannot exist without them.

An active list of favourite songs must always be assigned to a subscribed customer.

1.) Define entities
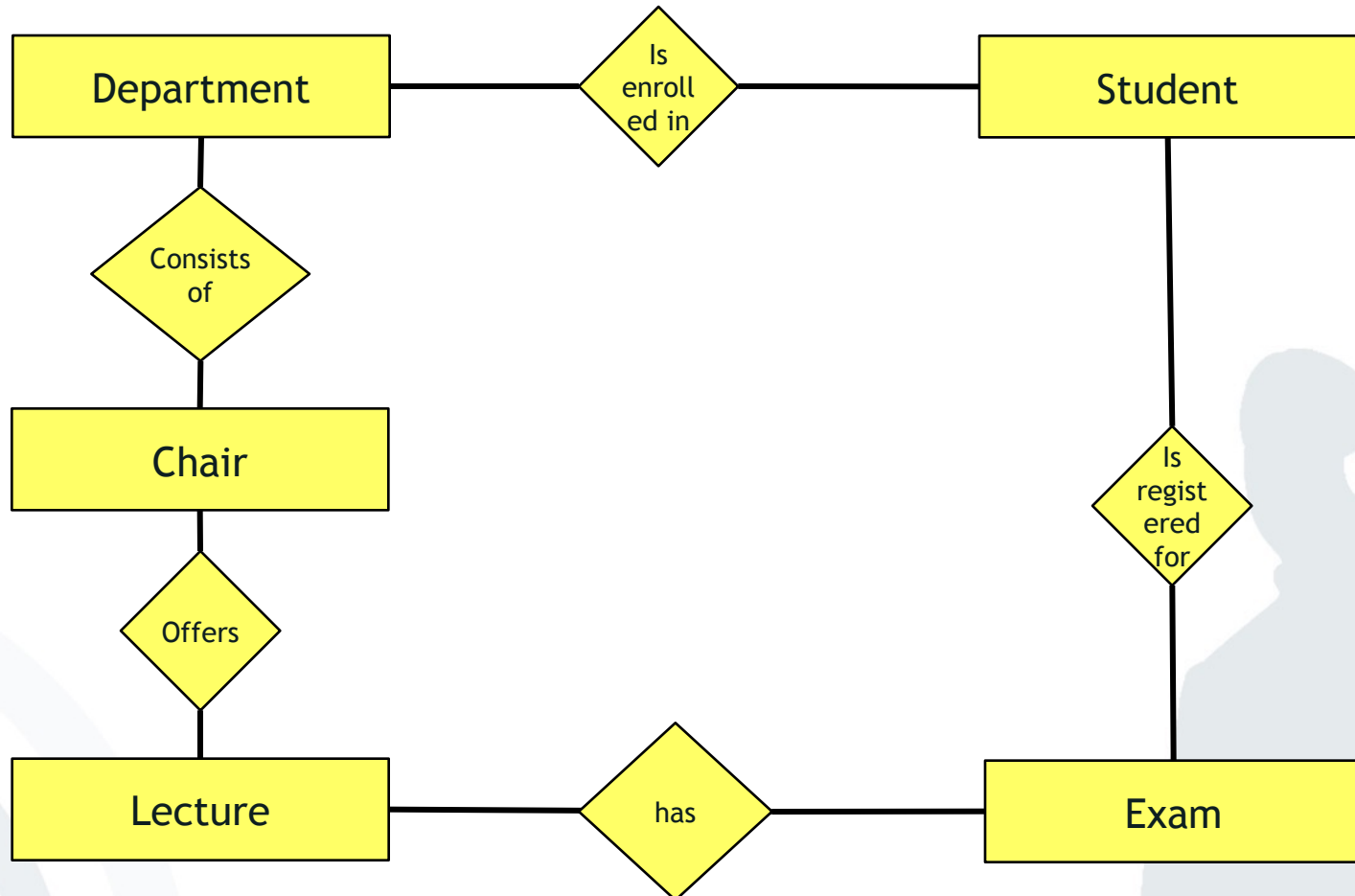
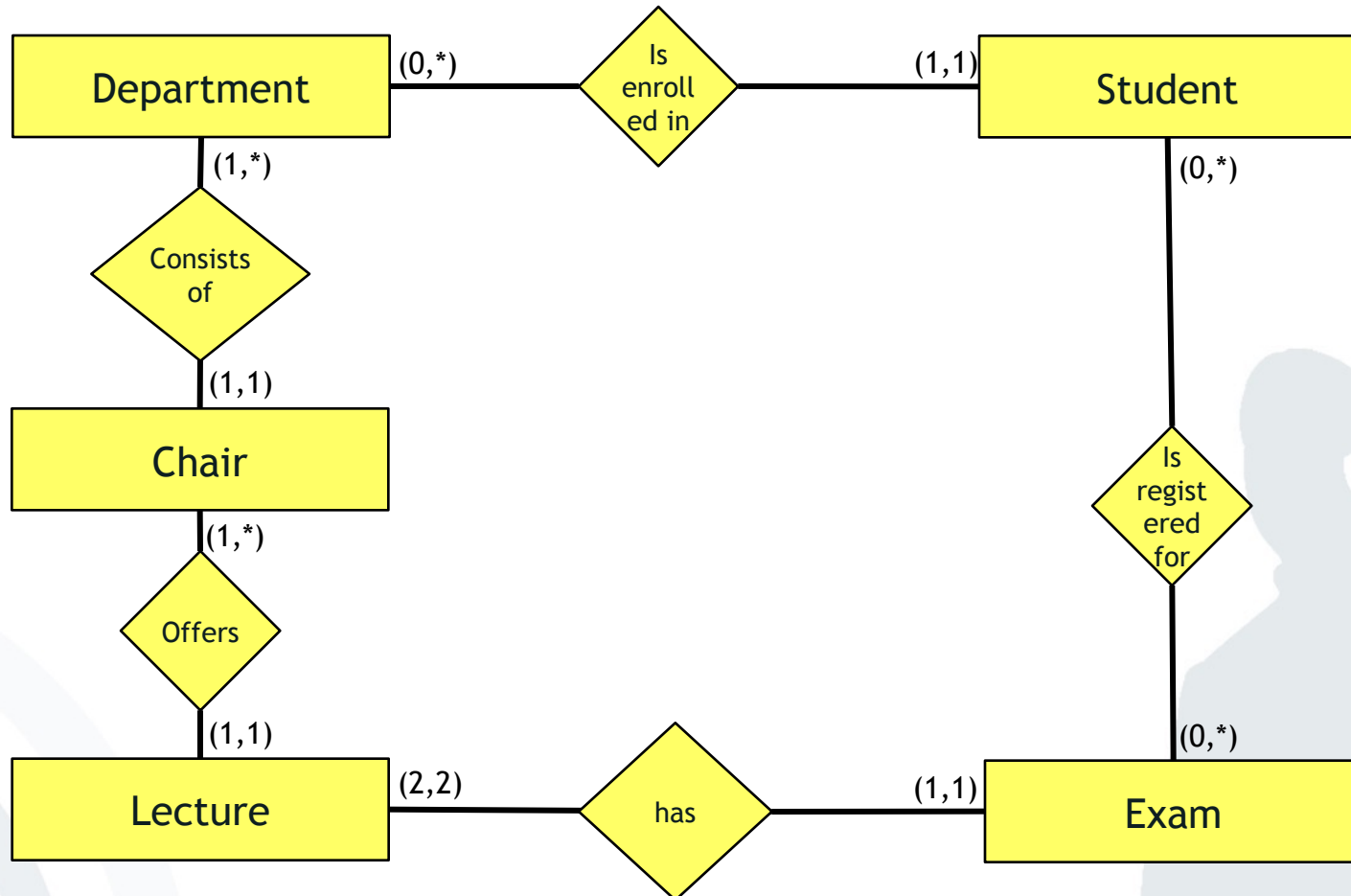|	
Department	Student
Chair	
Lecture	Exam

2.) Define relationships between entities

3.) Define cardinalities (using the interval notation)

**Create an ER model which represents the structure of a university:**

- Identify and mark the **primary key** for each entity and avoid as far as possible artificial keys (e.g. ID).
- Define the relations, using the **interval notation**.
- Make explicitly use of **weak entities**.

The ER model should be based on the following information:

- A university consists of different **departments**. Each of them has a name and a unique number.
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- **Exams** can be distinguished by its type. For each lecture two exams are offered: One normal exam and one repeat exam. The number of participants for an exam is not limited.
- A **student** can register for any number of exams. Furthermore, a student is assigned to one department and has a matriculation number and a name.

4.) Add attributes to entities
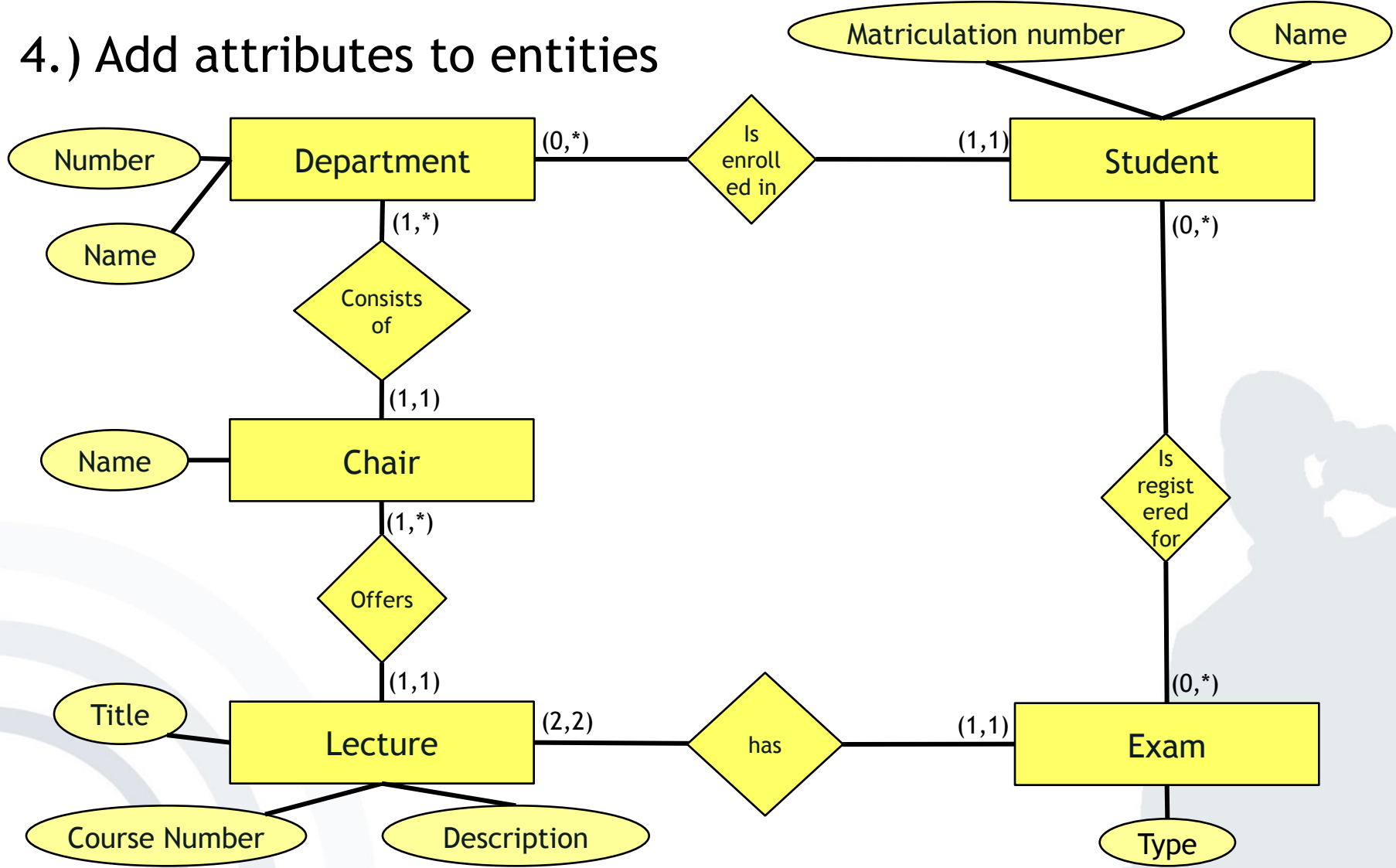
5.) Define weak entities

Cardinalities

Sprudel-Kiste — 1 / (0,12) — contains — n / (1,1) — Sprudel-Flasche
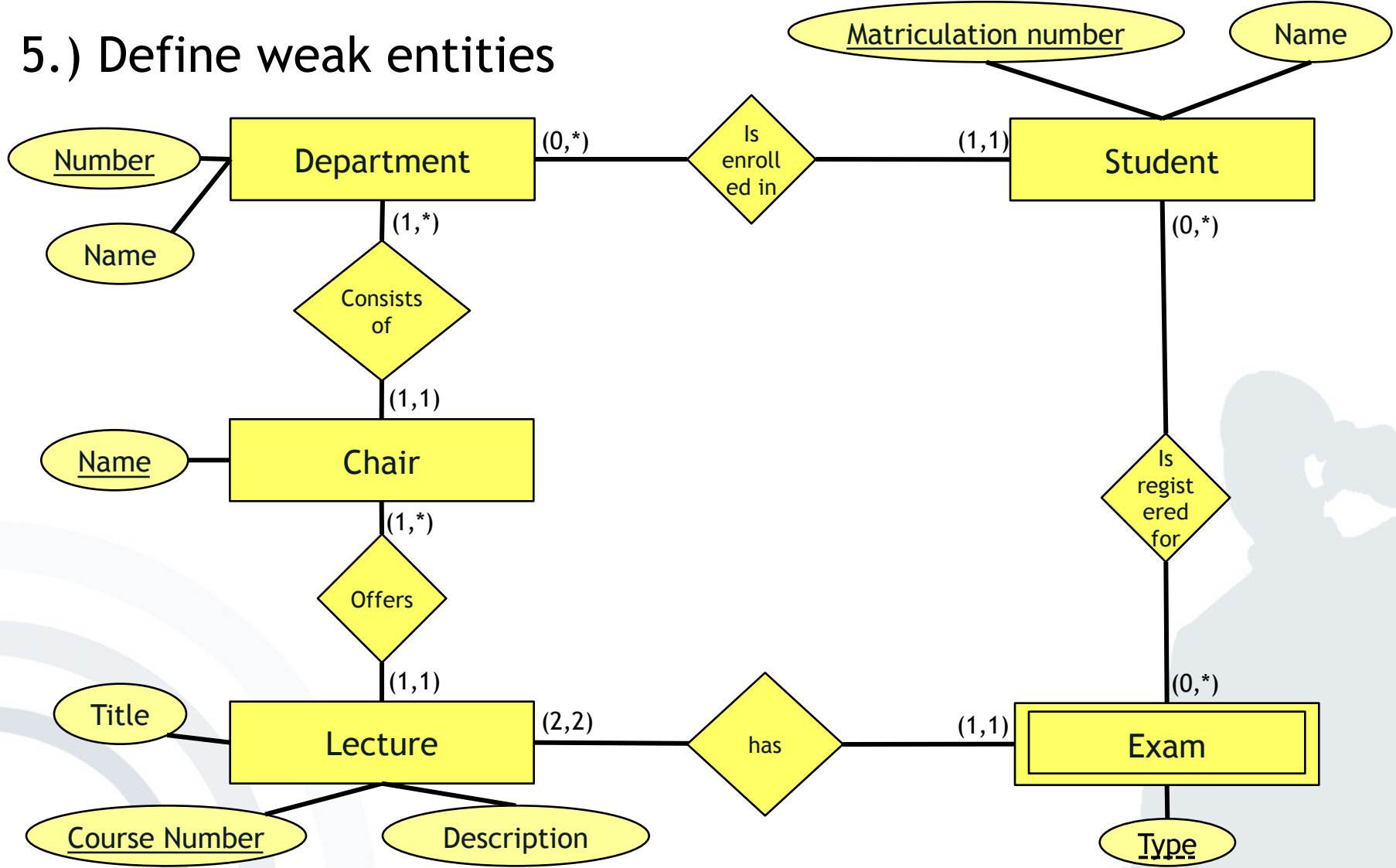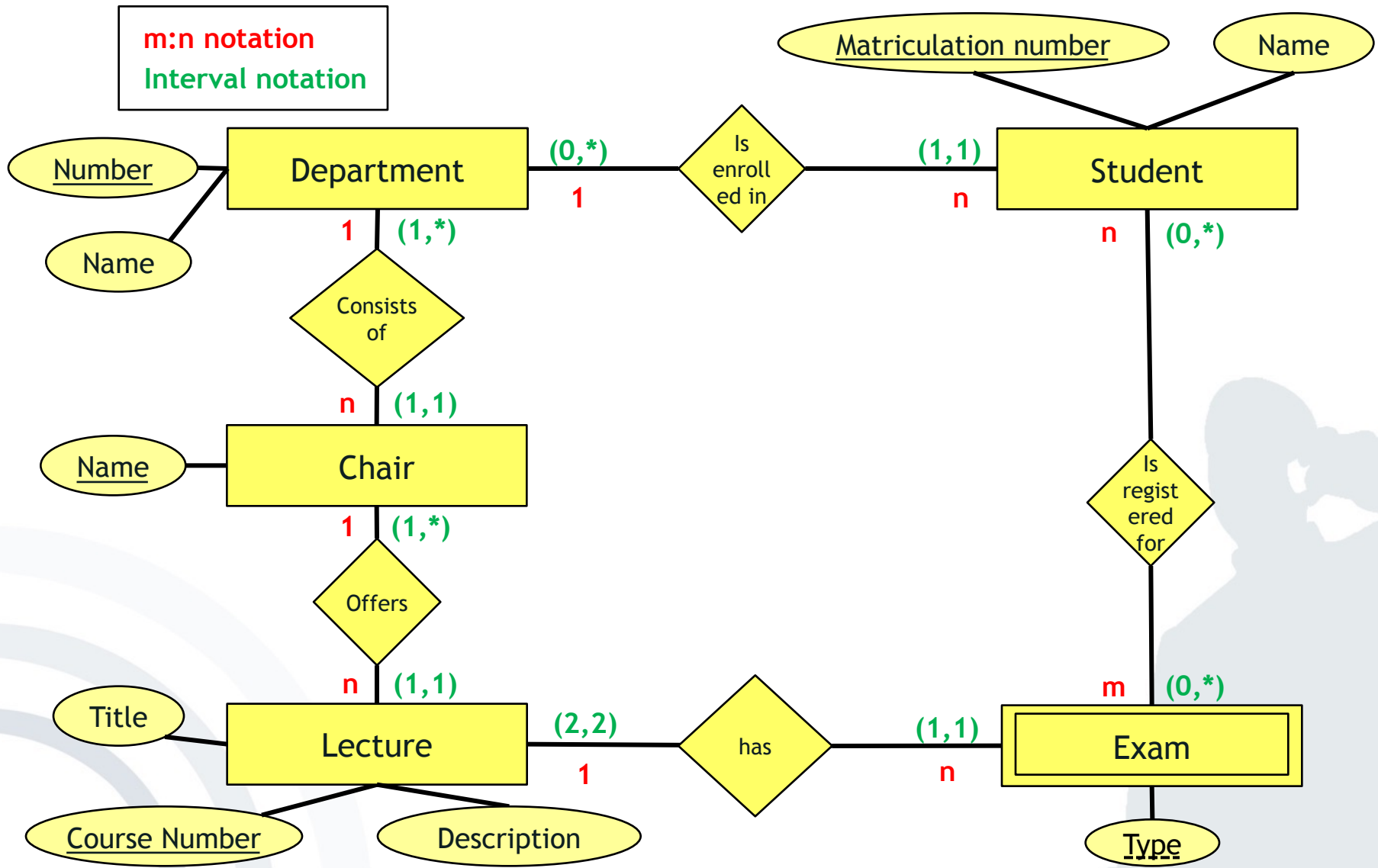
Intervals (according to Ferstl/Sinz, 2001)

- **Exercise 1: Entity Relationship Model**

- **Exercise 2: Deriving Relations from an ERM**

- **Exercise 3: SQL**

Repetition: Deriving Relations from an ERM
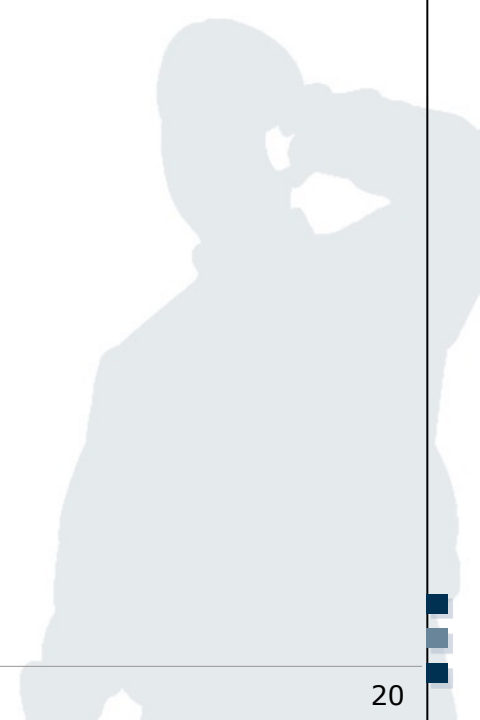
- The relation type with its corresponding attributes is derived from the entity type.

Example:
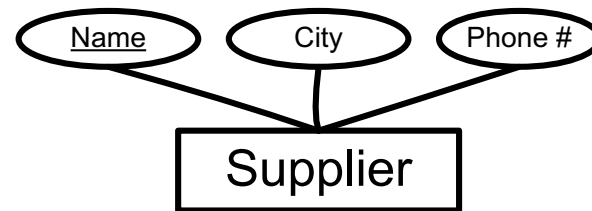
Name	City	Phone#

- A 1:1 relationship type does NOT become a relation on its own.
- The information is to be 'attached' to one of the involved entity types.
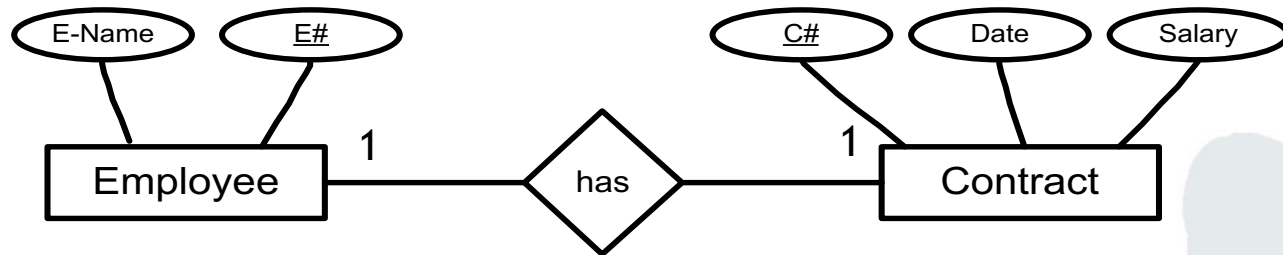
Example:

- A 1:1 relationship type does NOT become a relation on its own.
- The information is to be 'attached' to one of the involved entity types.
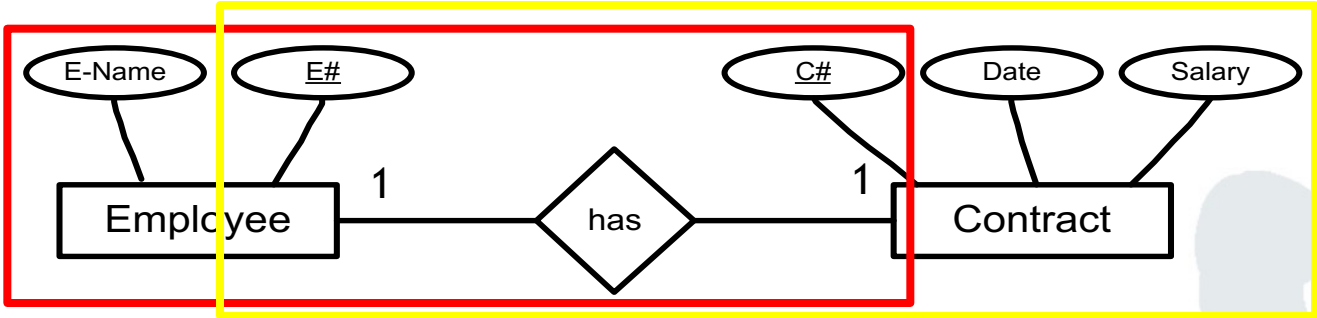
Example:

E#	E-Name	C#

Alternative 1:

C#	Date	Salary	E#

Alternative 2:

- A 1:n relationship type does NOT become a relation on its own.

- The information is to be 'attached' to that relation that corresponds to the entity type with the n-signed edge.

Example:
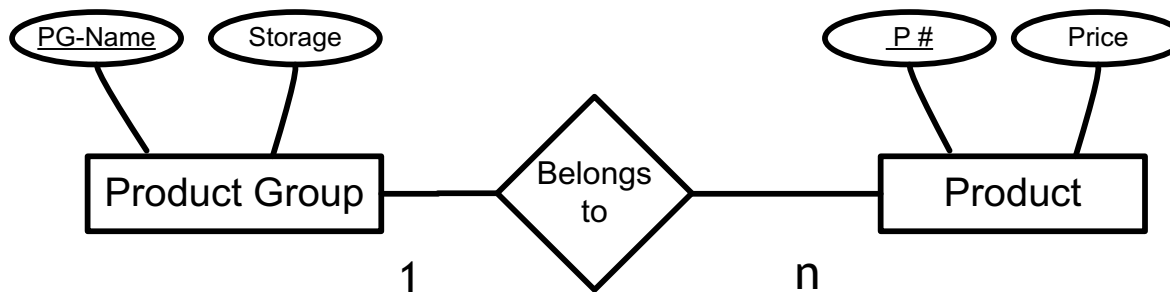
P #	Price	PG-Name

- An n:m-relationship type induces an additional relation-type.
- The relation contains
    - primary keys of involved entity types as attributes
    - and additional attributes of the relation types

Example:

- An n:m-relationship type induces an additional relation-type.
- The relation contains
    - primary keys of involved entity types as attributes
    - and additional attributes of the relation types

Example:

Matriculation Number	Course Number	Exam Result	…
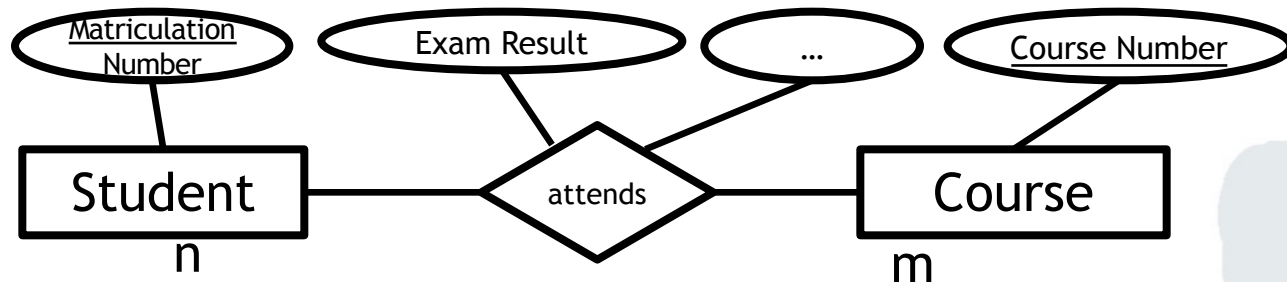
Attributes   Additional attributes
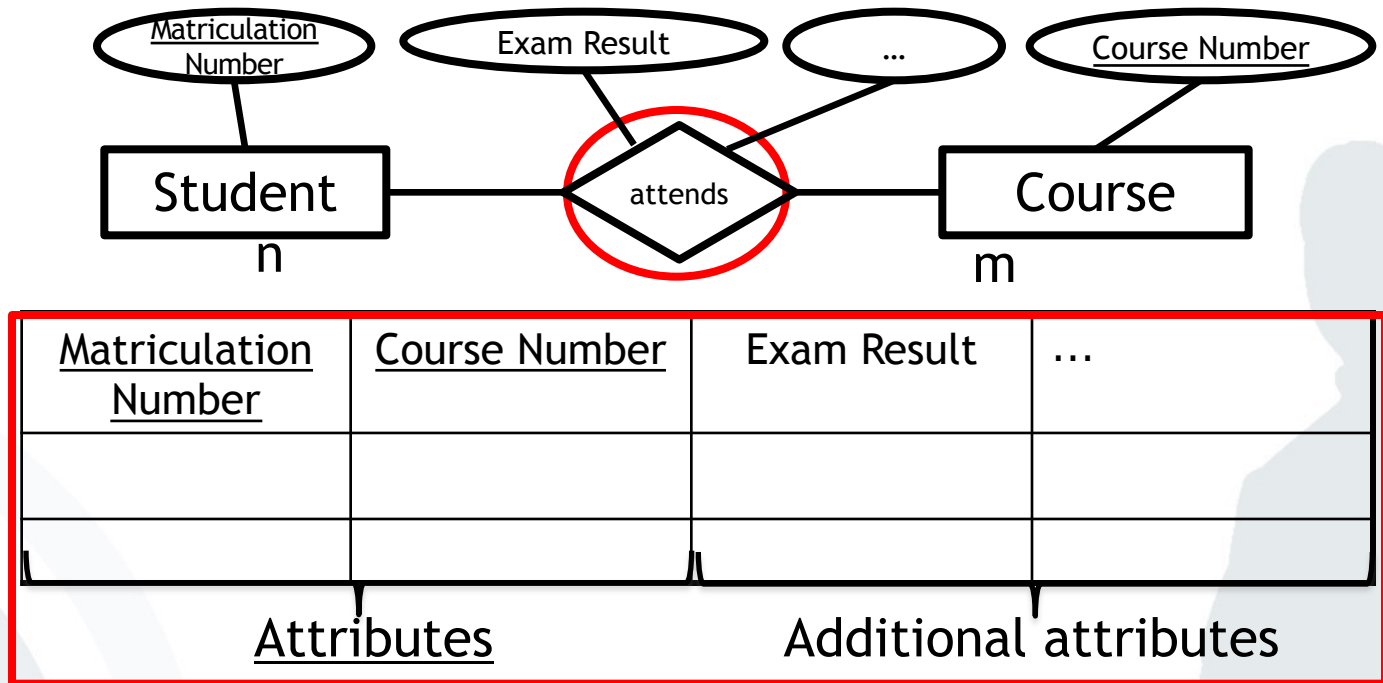
Note: In order to reflect the complete ER Model above, two more relations (Student(Matriculation Number) and Course (Course Number)) are required. The relation above connects both Student and Course entities.

Exercise 2: Deriving Relations from an ERM
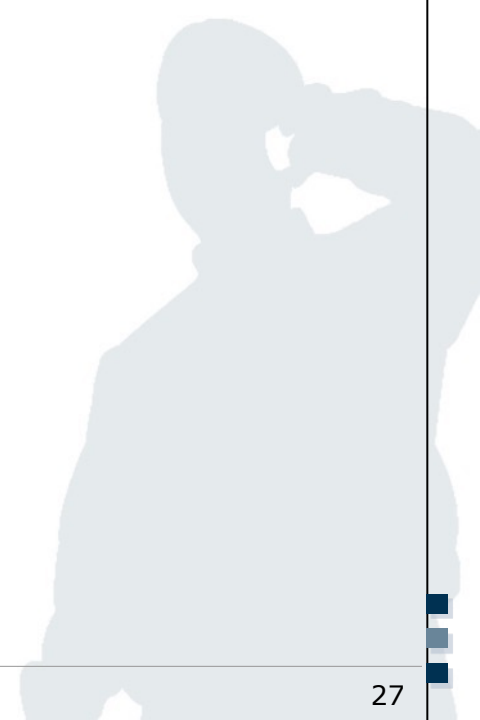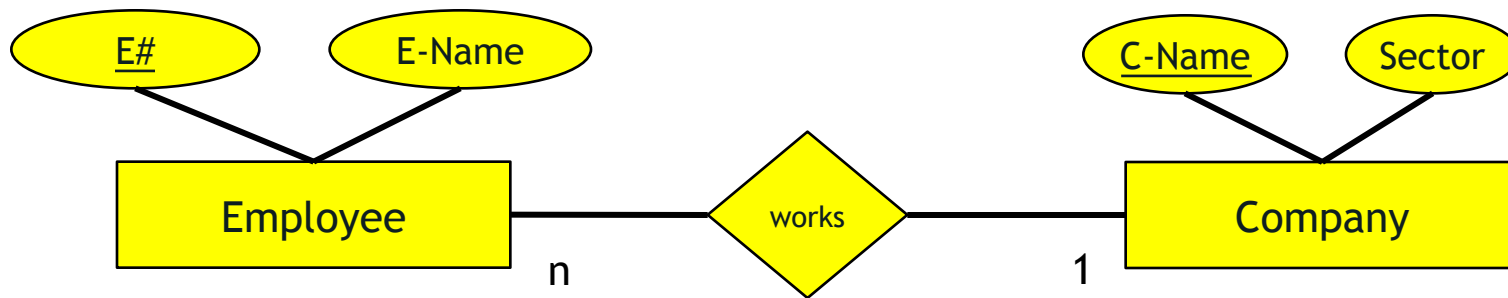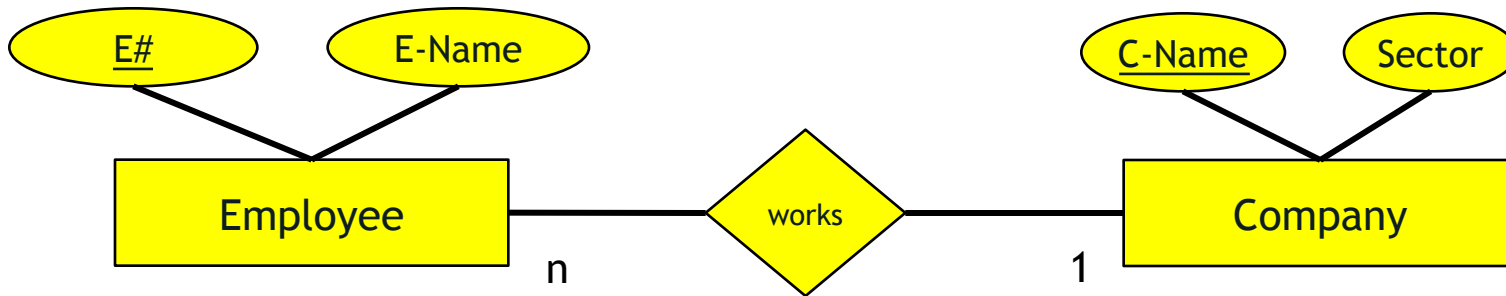
Employee:

E#	E-Name	C-Name
...	...	...

Company:

C-Name	Sector
...	...

E# Name Inventory# Number

Employee — has — Company Mobile Phone

1   1
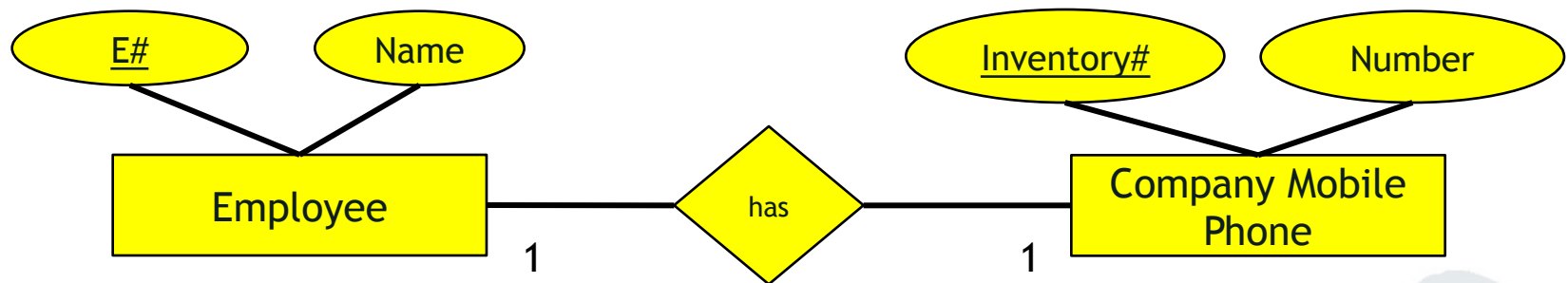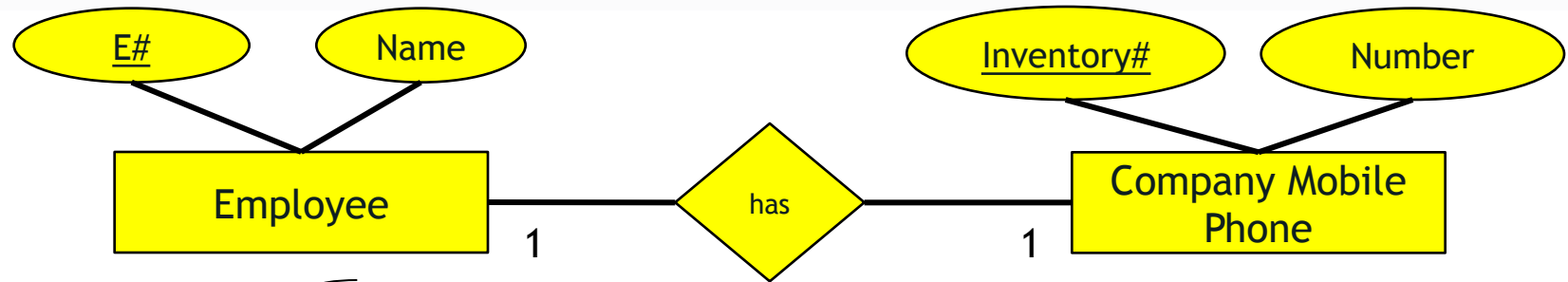
Alternative 1

Company Mobile Phone:

Inventory#	Number	E#
...	...	...

Employee:

E#	Name
...	...

or

Alternative 2

Employee:

E#	Name	Inventory#
...	...	...

Company Mobile Phone:

Inventory#	Number
...	...
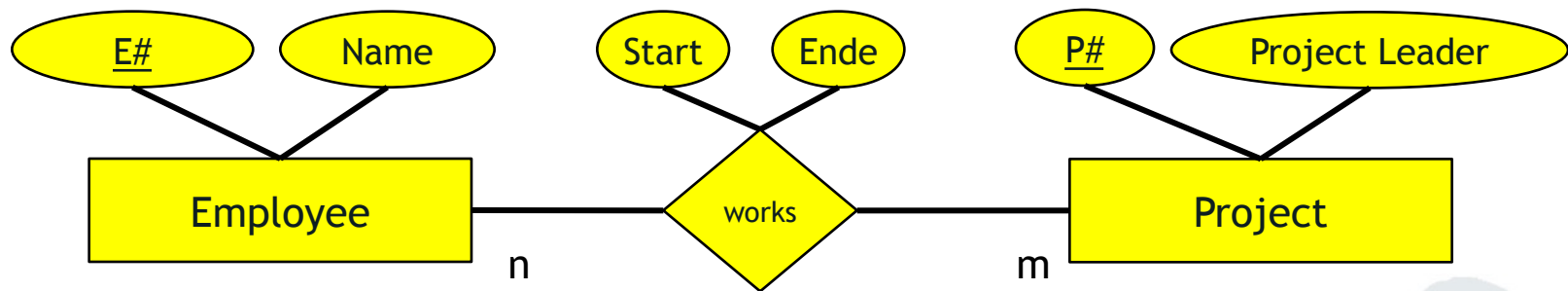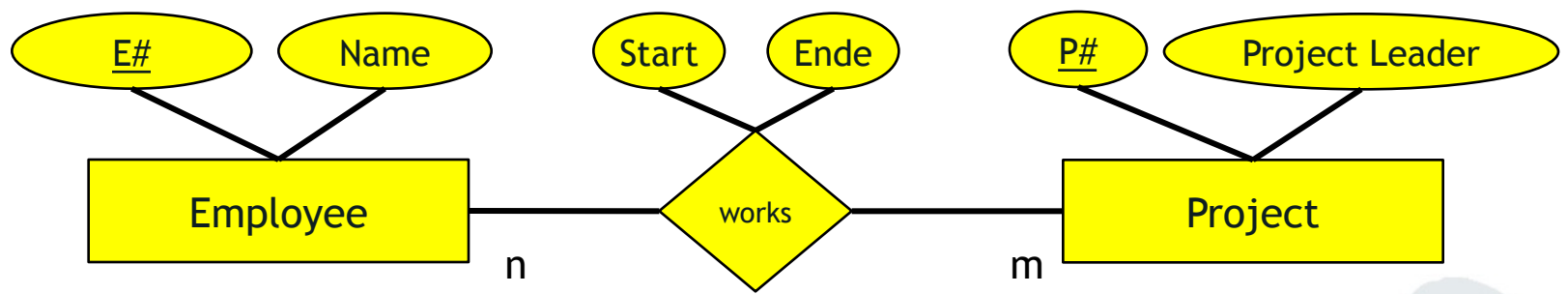
Employee:

E#	Name
...	...

Project:

P#	Project Leader
...	...

works:

E#	P#	Start	End
...	...	...	...
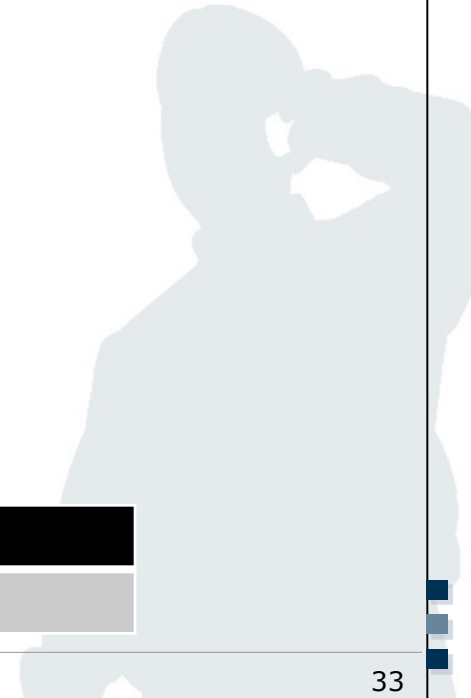
- Exercise 1: Entity Relationship Model

- Exercise 2: Deriving Relations from an ERM

- Exercise 3: SQL

Write the appropriate SQL statements to answer the following questions and draw the table which will be returned as a result.
The Fortune Bank database consists of the four tables branch, customer, loan and borrower.
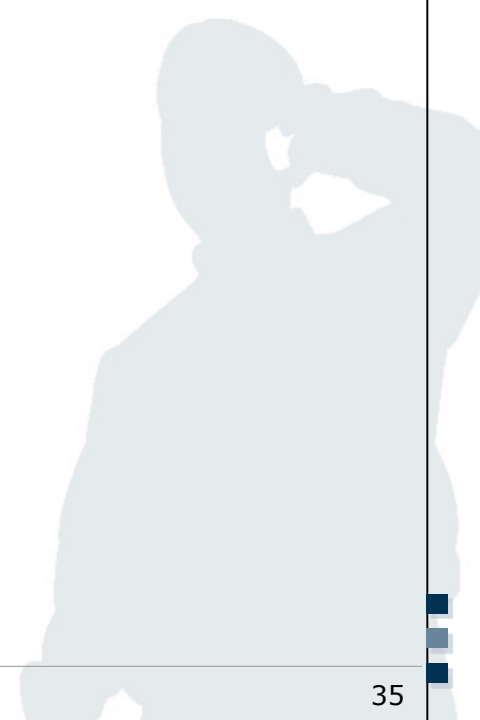
Database: Fortune Bank

Table: branch

branch_name	branch_city	assets
Brighton	Brooklyn	7100000.00
Downtown	Brooklyn	9000000.00
Mianus	Horseneck	400000.00
North Town	Rye	3700000.00
Perryridge	Horseneck	1700000.00
Pownal	Bennington	300000.00
Redwood	Palo Alto	2100000.00
Round Hill	Horseneck	8000000.00

Table: customer

customer_name	customer_street	customer_city
Adams	Spring	Pittsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sand Hill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Jackson	University	Salt Lake
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	Main	Rye
Turner	Putnam	Stamford
Williams	Nassau	Princeton

Database: Fortune Bank

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

Table: borrower

customer_name	loan_number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14
Jones	L-17
Smith	L-11
Smith	L-23
Williams	L-17

a) What is the average amount of loans over all branches?

```
SELECT AVG(amount)
FROM loan
```

```
_____
   1242.857142
_____
```

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

b) What is the total amount of loans granted by the Fortune Bank?

```
SELECT SUM(amount)
FROM loan
```

    ―――――――
    8700.00
    ―――――――

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

c) How many branches does the Fortune Bank have?

```
SELECT COUNT(branch_name)
FROM branch
```

8

Table: branch

branch_name	branch_city	assets
Brighton	Brooklyn	7100000.00
Downtown	Brooklyn	9000000.00
Mianus	Horseneck	400000.00
North Town	Rye	3700000.00
Perryridge	Horseneck	1700000.00
Pownal	Bennington	300000.00
Redwood	Palo Alto	2100000.00
Round Hill	Horseneck	8000000.00

d) How many loans were granted exceeding $1000 ?

```
SELECT COUNT(loan_number)
FROM loan
WHERE amount>1000
```

4

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

e) How many borrowers are serviced by the branch 'Downtown' and live in Princeton?

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

Table: customer

customer_name	customer_street	customer_city
Adams	Spring	Pittsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sand Hill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Jackson	University	Salt Lake
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	Main	Rye
Turner	Putnam	Stamford
Williams	Nassau	Princeton

Table: borrower

customer_name	loan_number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14
Jones	L-17
Smith	L-11
Smith	L-23
Williams	L-17

e) How many **borrowers** are serviced by the **branch** 'Downtown' and **live** in Princeton?

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

Table: borrower

customer_name	loan_number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14
Jones	L-17
Smith	L-11
Smith	L-23
Williams	L-17

Table: customer

customer_name	customer_street	customer_city
Adams	Spring	Pittsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sand Hill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Jackson	University	Salt Lake
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	Main	Rye
Turner	Putnam	Stamford
Williams	Nassau	Princeton

e) How many borrowers are serviced by the branch 'Downtown' and live in Princeton?

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

Table: borrower

customer_name	loan_number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14
Jones	L-17
Smith	L-11
Smith	L-23
Williams	L-17

Table: customer

customer_name	customer_street	customer_city
Adams	Spring	Pittsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sand Hill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Jackson	University	Salt Lake
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	Main	Rye
Turner	Putnam	Stamford
Williams	Nassau	Princeton

How many borrowers are serviced by the branch 'Downtown" and live in Princeton?

Table: loan

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

+

Table: borrower

customer_name	loan_number
Adams	L-16
Curry	L-93
Hayes	L-15
Jackson	L-14
Jones	L-17
Smith	L-11
Smith	L-23
Williams	L-17

=

loan_number	branch_name	amount	customer_name
L-16	Perryridge	1300.00	Adams
L-93	Mianus	500.00	Curry
L-15	Perryridge	1500.00	Hayes
L-14	Downtown	1500.00	Jackson
L-17	Downtown	1000.00	Jones
L-11	Round Hill	900.00	Smith
L-23	Redwood	2000.00	Smith
L-17	Downtown	1000.00	Williams

```
loan INNER JOIN borrower ON loan.loan_number=borrower.loan_number
```

How many **borrowers** are serviced by the branch 'Downtown" and **live in Princeton**?

Table: customer

loan_number	branch_name	amount	customer_name
L-16	Perryridge	1300.00	Adams
L-93	Mianus	500.00	Curry
L-15	Perryridge	1500.00	Hayes
L-14	Downtown	1500.00	Jackson
L-17	Downtown	1000.00	Jones
L-11	Round Hill	900.00	Smith
L-23	Redwood	2000.00	Smith
L-17	Downtown	1000.00	Williams

+

customer_name	customer_street	customer_city
Adams	Spring	Pittsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sand Hill	Woodside
Green	Walnut	Stamford
Hayes	Main	Harrison
Jackson	University	Salt Lake
Johnson	Alma	Palo Alto
Jones	Main	Harrison
Lindsay	Park	Pittsfield
Smith	Main	Rye
Turner	Putnam	Stamford
Williams	Nassau	Princeton

=

loan_number	branch_name	amount	customer_name	customer_street	customer_city
L-16	Perryridge	1300.00	Adams	Spring	Pittsfield
L-93	Mianus	500.00	Curry	North	Rye
L-15	Perryridge	1500.00	Hayes	Main	Harrison
L-14	Downtown	1500.00	Jackson	University	Salt Lake
L-17	Downtown	1000.00	Jones	Main	Harrison
L-11	Round Hill	900.00	Smith	Main	Rye
L-23	Redwood	2000.00	Smith	Main	Rye
L-17	Downtown	1000.00	Williams	Nassau	Princeton

```
(loan INNER JOIN borrower ON loan.loan_number=borrower.loan_number)
INNER JOIN customer ON borrower.customer_name = customer.customer_name
```

How many borrowers are serviced by the branch 'Downtown' and live in Princeton?

```sql
SELECT COUNT(customer.customer_name)
FROM (loan INNER JOIN borrower ON
    loan.loan_number=borrower.loan_number) INNER JOIN customer ON
    borrower.customer_name = customer.customer_name
WHERE branch_name='Downtown' AND customer_city='Princeton'
```

1

f) Insert a new loan in the table 'loan'.

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

→

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00
L-94	Downtown	4000.00

```sql
INSERT INTO loan (loan_number, branch_name, amount)
VALUES ('L-94', 'Downtown', 4000)
```

g) Delete the previously inserted entry from the table 'loan'.

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00
L-94	Downtown	4000.00

→

loan_number	branch_name	amount
L-11	Round Hill	900.00
L-14	Downtown	1500.00
L-15	Perryridge	1500.00
L-16	Perryridge	1300.00
L-17	Downtown	1000.00
L-23	Redwood	2000.00
L-93	Mianus	500.00

```
DELETE FROM loan
WHERE loan_number='L-94'
```

- **W3Schools.com** provides databases, exercises and explanations
  - → Will be used in the mentoriums

- **Mystery.knightlab.com** provides a murder mystery game to learn SQL
  - → Find the murder in several police databases, using SQL

Open Questions?