

*employee (person\_name, street, city)*  
*company (company\_name, city)*  
*works (person\_name, company\_name, salary)*

Figure 1. An Employee database.

A simple Employee database is shown in Figure 1. Please answer Questions 1-3 based on this schema.

1. (20%) The attribute *person\_name* is defined as the primary key of the *employee* relation for simplicity (假設沒有兩個人同名), and the attribute *company\_name* is defined as the primary key of the *company* relation. The *works* relation describes which company(s) a person works for and the associated salary(s). Please determine what the **best** primary key of the *works* relation should be based on the following two assumptions, respectively. Note that you need to explain your answer.

- (a) An employee can work for only one company in this database.

Ans: *person\_name*, 因為*person\_name*已經是unique了, 只需要一個*person\_name*就可以得到work

- (b) An employee might work for many companies in this database.

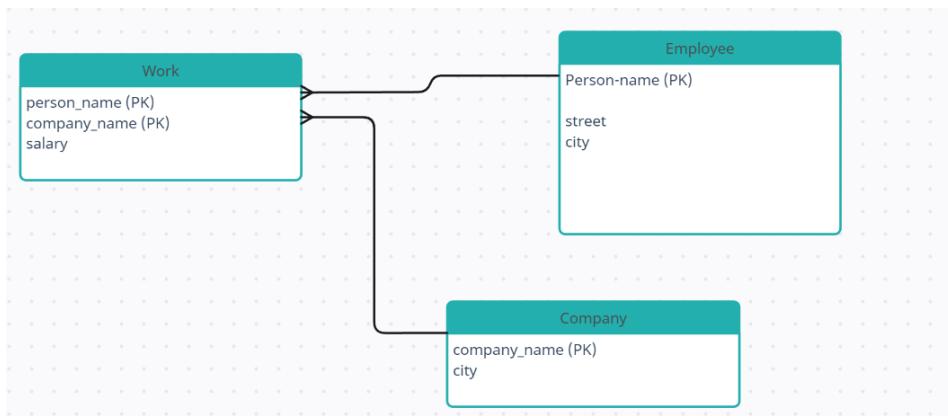
Ans: (*person\_name, company\_name*), 只有*person\_name*並不是unique, 只用*person\_name*會得到多個work

2. (20%) Suppose that the primary key of the *works* relation is (*person\_name, company\_name*).

- (a) Identify the two appropriate foreign keys of the *works* relation.

Ans: *person\_name* in *works*  $\rightarrow$  *person\_name* in *employee*, *company\_name* in *works*  $\rightarrow$  *company\_name* in *company*

- (b) Construct a schema diagram for this database.



3. (40%) Suppose that the primary key of the *works* relation is the attribute *person\_name*. Give an expression in the relational algebra for each of the following queries, respectively.
- (a) Find the name of each employee who lives in the city “Miami”.

Ans:  $\Pi_{\text{person\_name}}(\sigma_{\text{city}=\text{"Miami"}}(\text{employee}))$

- (b) Find the name of each employee who lives in the city “Miami” and whose salary is greater than \$100000.

Ans:  $\Pi_{\text{person\_name}}(\sigma_{\text{city}=\text{"Miami"} \wedge \text{salary} > 100000}(\text{employee} \times \text{works}))$

Find the name and the city of residence of each employee who works for “FirstBank”.

Ans:  $\Pi_{\text{person\_name}, \text{city}}(\text{employee} \times (\sigma_{\text{company\_name}=\text{"FirstBank"}}(\text{works})))$

- (c) Find the name of each employee who does NOT work for “FirstBank”.

Ans:  $\Pi_{\text{person\_name}}(\sigma_{\text{company\_name} \neq \text{"FirstBank"}}(\text{works}))$

4. (20%) 請回答下述有關SQL的問題。You need to list the references (e.g., URLs) you used.

- (a) ISO最新通過的SQL標準版本為何? (答案的格式應該是SQL:XXXX，其中XXXX代表年分。)並請列出至少兩項新增之處 (與上一標準版本相比)。

Ans: SQL:2023 (1) UNIQUE null treatment (F292) (2) ORDER BY in grouped table (F868)

<https://peter.eisentraut.org/blog/2023/04/04/sql-2023-is-finished-here-is-whats-new>

- (b) Microsoft SQL Server專用的SQL語言名稱。

Ans: T-SQL

<https://zh.wikipedia.org/zh-tw/Transact-SQL>

- (c) Oracle專用的SQL語言名稱。

Ans: PL-SQL

<https://zh.wikipedia.org/zh-tw/PL-SQL>

Note: Please submit your homework in a single PDF file to Tronclass before **2023/10/8 23:59**.