

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.

A: primary key 為 *person_name*

因為一個人只對應到一間公司，且人名不重複。

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

A: primary key 為 (*person_name*, *company_name*)

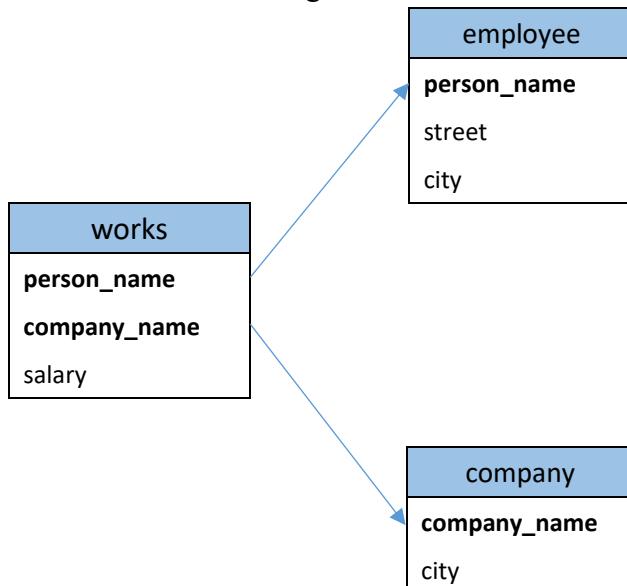
因為 *person_name* 會對應到多個 *company_name*，而 *company_name* 會對應到多個 *person_name* 所以(*person_name*, *company_name*) 才唯一。

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.

A: *person_name* in *works* --> *person_name* in *employee*,
company_name in *works* -->*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”.

A: $\prod_{\text{person_name}} (\sigma_{\text{city}=\text{"Miami"}}(\text{employee}))$

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

A: $\prod_{\text{person_name}} (\sigma_{\text{city}=\text{"Miami"} \wedge \text{salary}>100000} \wedge \text{employee.person_name} = \text{works.person_name} (\text{employee} \times \text{works}))$

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

A: $\prod_{\text{person_name}, \text{city}} (\sigma_{\text{company_name}=\text{"FirstBank"} \wedge \text{employee.person_name} = \text{works.person_name} \wedge \text{company.company_name} = \text{works.company_name}} (\text{employee} \times \text{works} \times \text{company}))$

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

A: $\prod_{\text{person_name}} (\text{employee}) - \prod_{\text{person_name}} (\sigma_{\text{company_name}=\text{"FirstBank"}}(\text{works}))$

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)。

A: 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。

A: T-SQL

<https://learn.microsoft.com/zh-tw/sql/t-sql/lesson-1-creating-database-objects?view=sql-server-ver16>

(b) Oracle專用的SQL語言名稱。

A: 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.