Unit 8

Joint Data and Functional Analysis

本單元目的

交替改善 D-Schema 與 F-Schema 以得出一組完整的資料分析與功能分析的結果

- D-Schema 即 conceptual schema, 是用 ER model 繪出之資料分析結果.
- F-Schema 即功能分析的結果, 是用 DFD 繪出的結果.
- 在同一應用系統中表現資料的 ER diagram 和 表現功能的 DFD 要相互參照.
  - 在 DFD 中的 data store, 在 ER diagram 應進一步描述之.
  - ER diagram 中出現的資料, 在 DFD 內某些 process 必處理之.

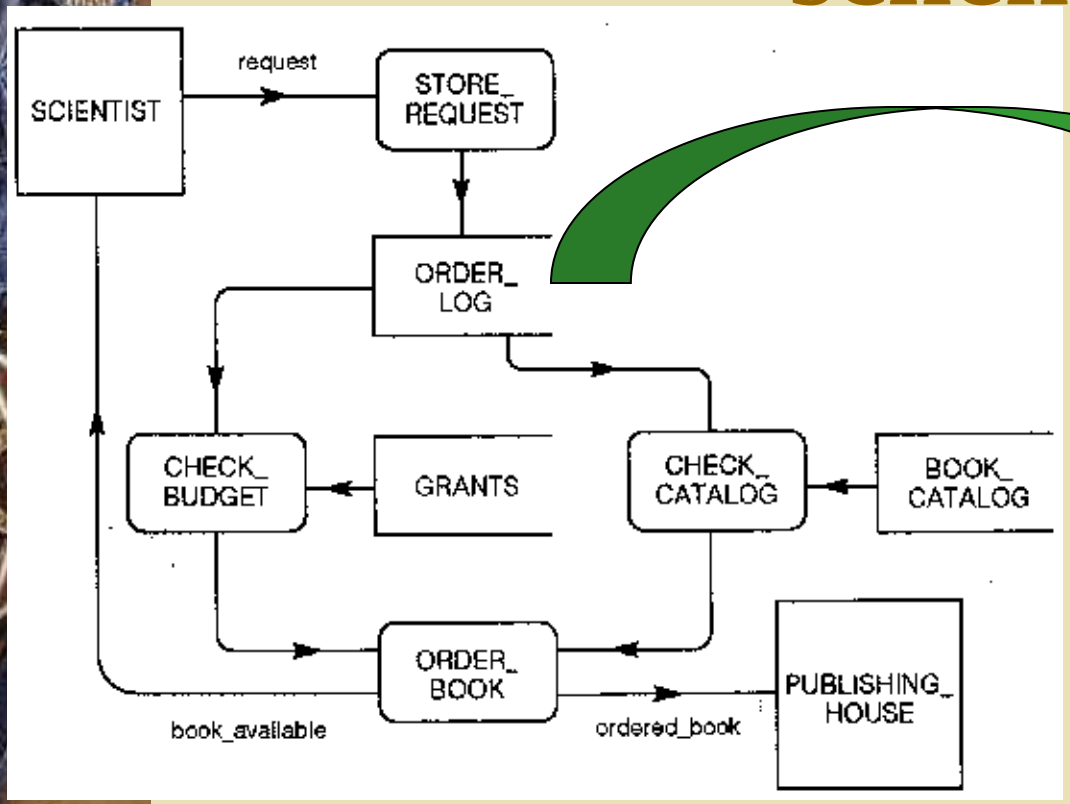
Outline

- External Schema for Dataflow Diagram
- A Methodology for Joint Data and Functional Analysis
- Navigation Schemas for Database Operations

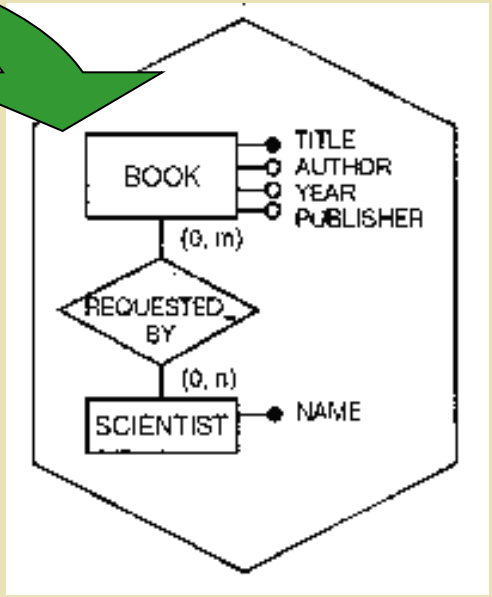
External Schema for DFD

- External schema 是指某使用者看到的部分資料庫之資料架構圖, 也就是 conceptual schema 的 一部份.
- 每個 application program 有不同的 external schema.

An example of external schema



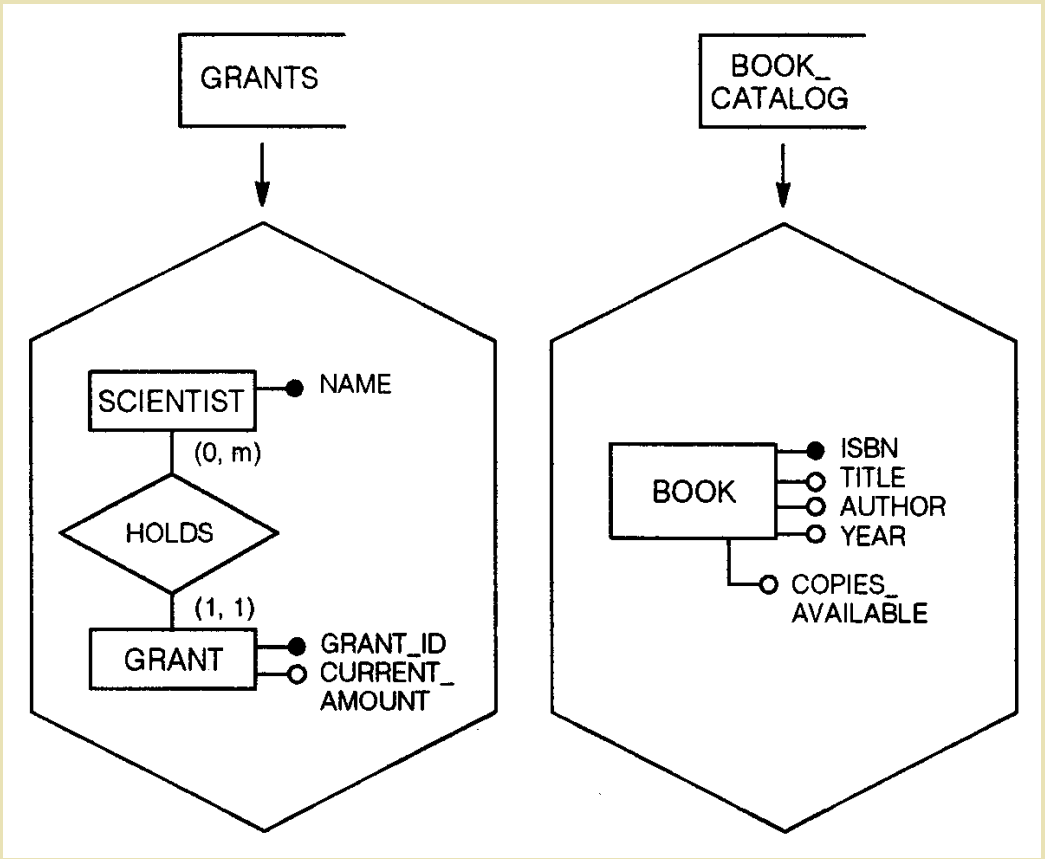
圖書館圖書採購 DFD



ORDER 對應的 external schema 即採用 ER diagram 所表現出該資料儲存檔的資料概念

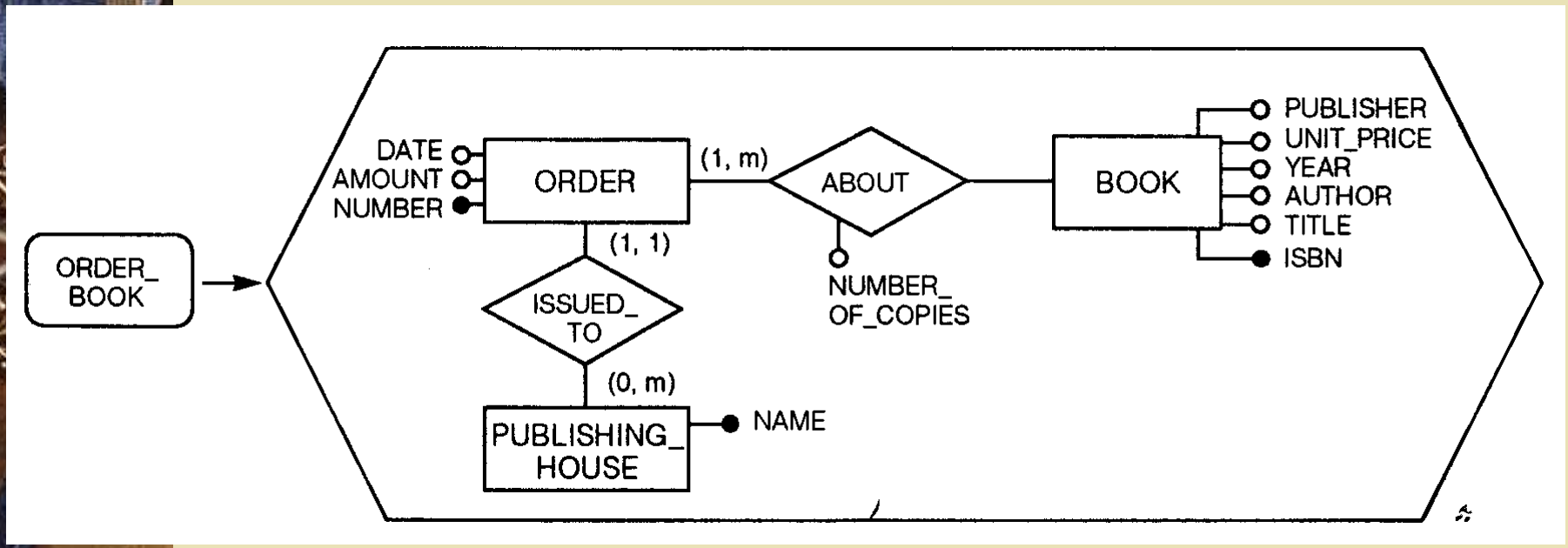
An example of external schema

在 DFD 中的另外兩個 data_store 所對應的 external schema



An example of external schema

External schema of ORDER_BOOK



A Methodology for Joint Data and Functional Analysis

Step 1 繪出 context diagram

Step 2 繪出 D-Schema 及 F-Schema 的初步架構圖

Step 3 重複相互參照改善工作, 直到充分表達需求

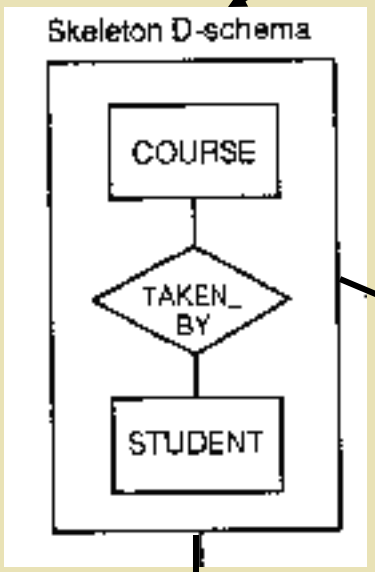
- Step 3.1 參照 F-Schema, 改進前一版的 D-Schema
- Step 3.2 參照 D-Schema, 改進前一版的 F-Schema
- Step 3.3 檢查 D-Schema 與 F-Schema 的相互一致性

Step 4 檢查 F-Schema 及 D-Schema 的品質

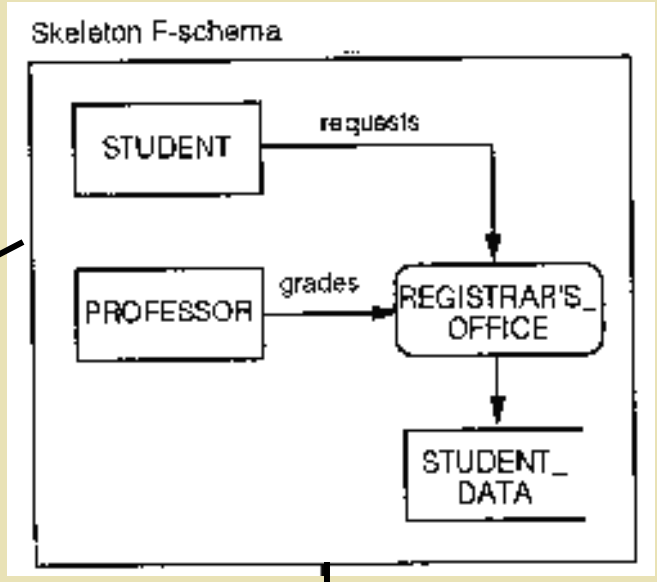
An Example: Student Information System

- Requirements:

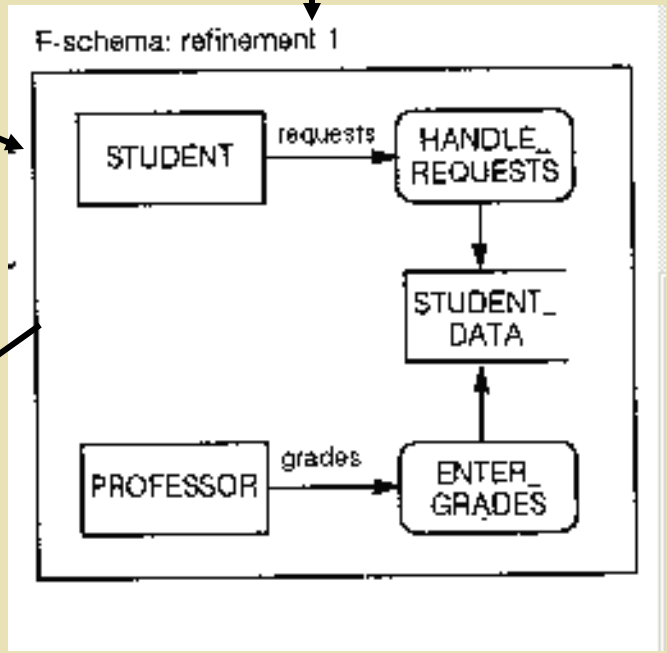
  The register's office of a university maintains information concerning each student's study plan, indicating the courses that students have taken or will take; when each course is completed, the information about the final grade and the date of completion is also recorded. For Ph.D. students, the department maintains the names of advisors and the title and date of the qualifying examination. This information is modified when the student presents the study plan for the subsequent term, when professors return the grades at the end of the term, and when Ph.D. students select their advisors or define their Ph.D. qualifying examinations. Students may request reports concerning their grades or Ph.D. progress.



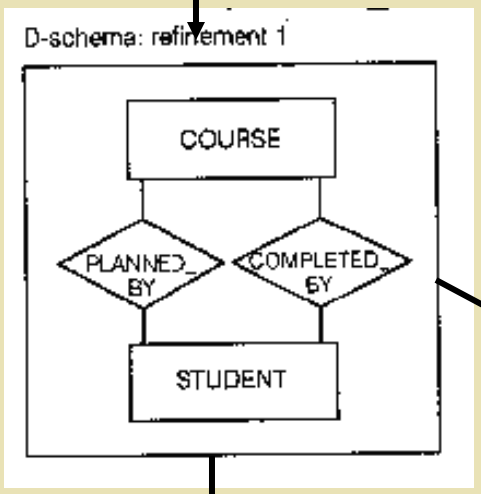
Step 1



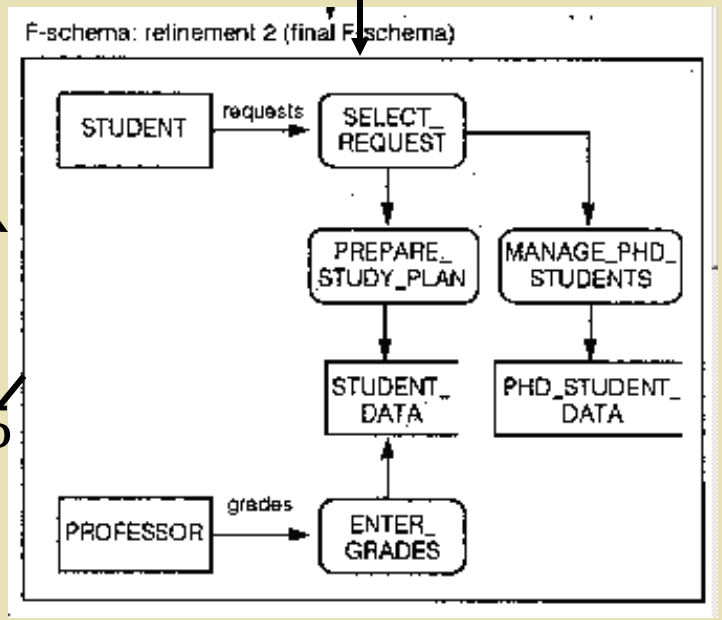
Step 2



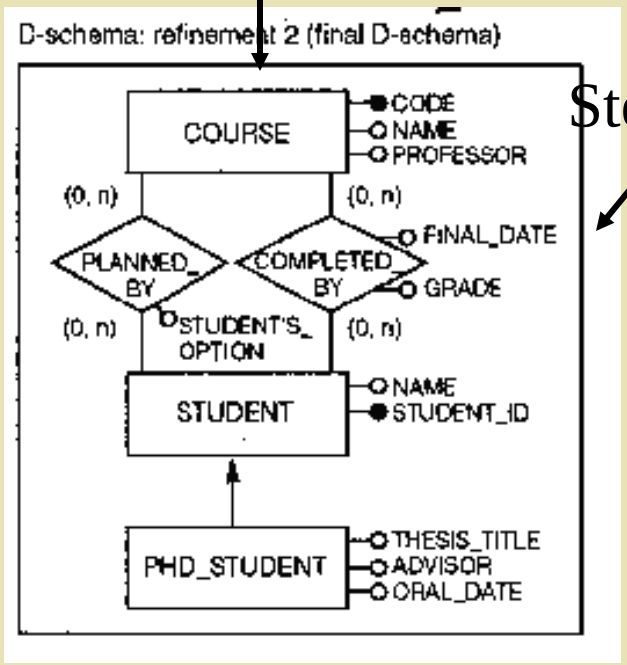
Step 3


D-schema: refinement 1
COURSE
PLANNED_BY
COMPLETED_BY
STUDENT

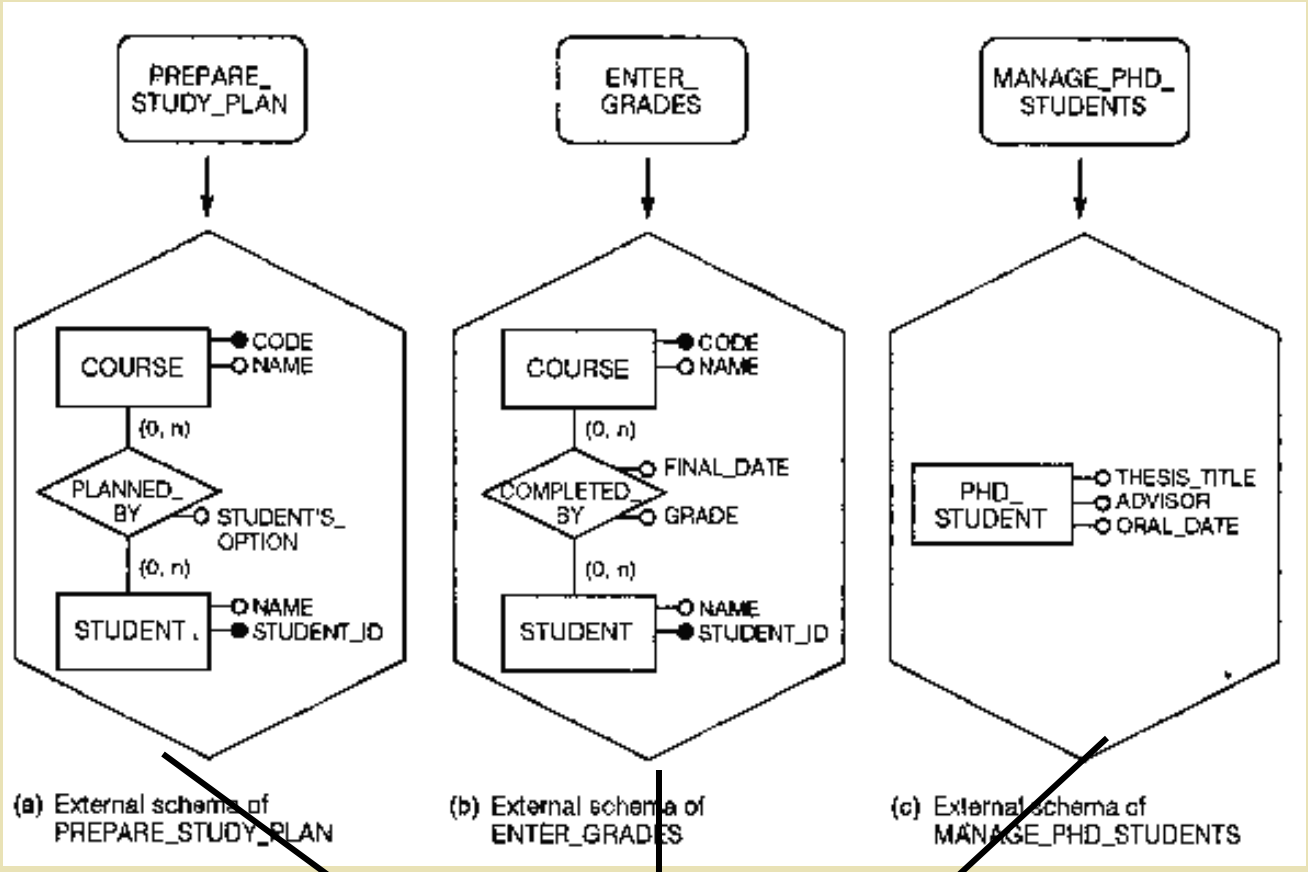
Step 4


F-schema: refinement 2 (final F-schema)
STUDENT
requests
SELECT_REQUEST
PREPARE_STUDY_PLAN
MANAGE_PHD_STUDENTS
STUDENT_DATA
PHD_STUDENT_DATA
PROFESSOR
grades
ENTER_GRADES

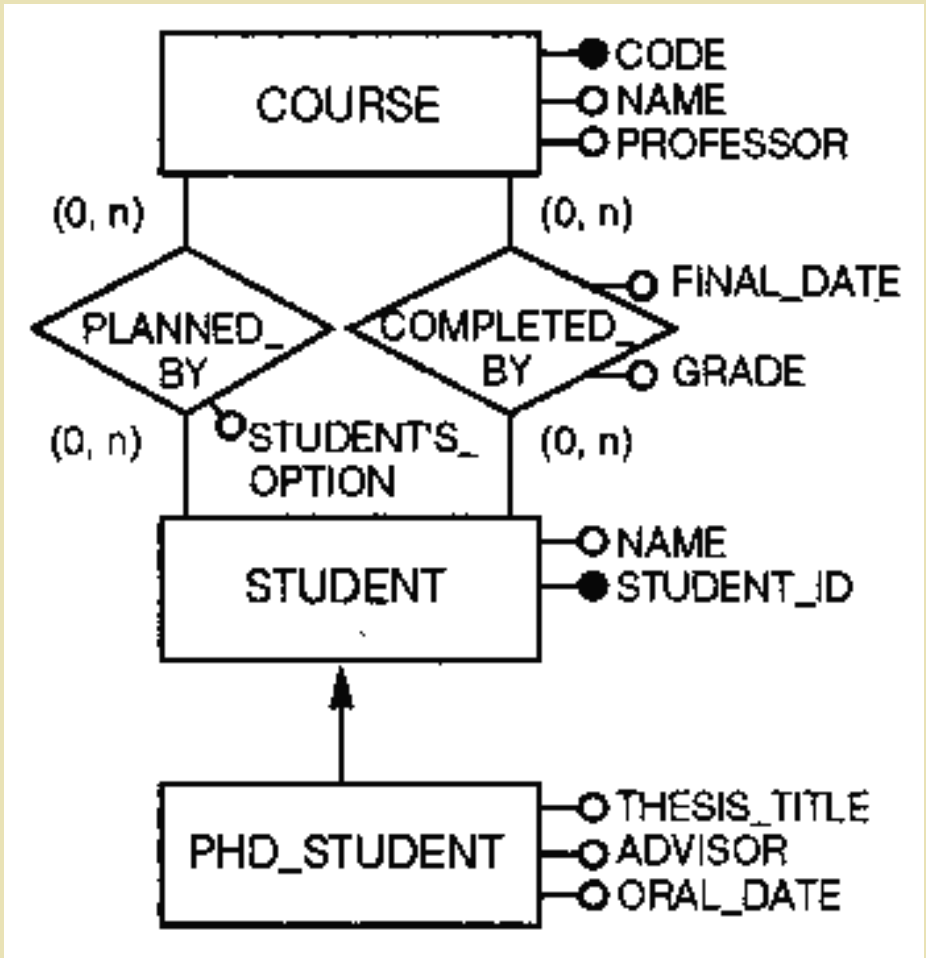
Step 5


D-schema: refinement 2 (final D-schema)
COURSE
CODE
NAME
PROFESSOR
(0, n)
(0, n)
PLANNED_BY
COMPLETED_BY
FINAL_DATE
GRADE
(0, n)
STUDENT'S_OPTION
(0, n)
STUDENT
NAME
STUDENT_ID
PHD_STUDENT
THESIS_TITLE
ADVISOR
ORAL_DATE

Completeness check



整合之後和上面 refined D-schema 相同

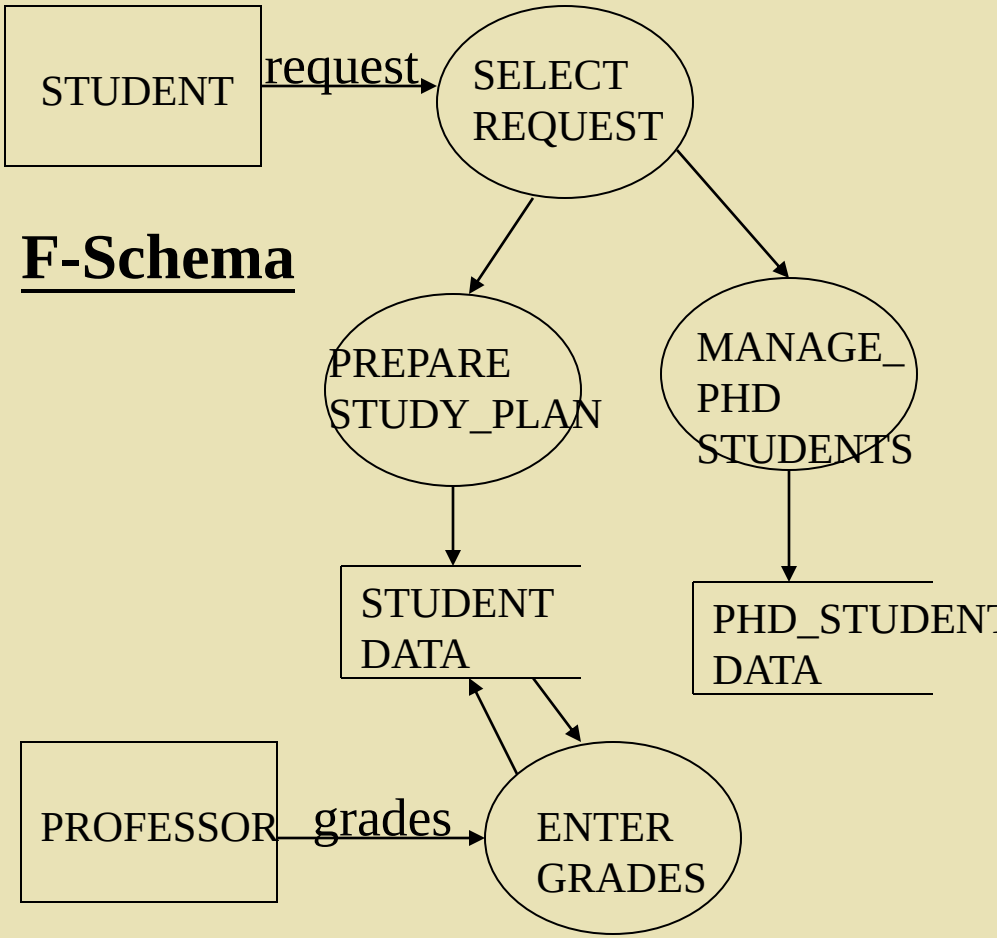

COURSE
CODE
NAME
PROFESSOR
(0, n)
(0, n)
PLANNED_BY
COMPLETED_BY
FINAL_DATE
GRADE
(0, n)
STUDENT'S_OPTION
(0, n)
STUDENT
NAME
STUDENT_ID
PHD_STUDENT
THESIS_TITLE
ADVISOR
ORAL_DATE

Navigation Schemas for Database Operations

- Database operations
  - 指對資料庫存取資料或更新資料的動作,是和資料庫交談的基本單元, 是 process 動作的一部份.
  - 例如一個 SQL 查詢, 即為一個Database Operation.
- Navigation Schema
  - 指引一個 database operation 搜尋資料時所經過的路徑
  - 在 logical database design 時用到
  - 每個 database operation 可以繪出一個 navigation schema

Example of DB operations

- For process: ENTER_GRADES
  - O1: 輸入學生某課程成績
  - O2: 改變學生成績
  - O3: 計算分數分布狀況
- For process: PREPARE_STUDY_PLAN
  - O4: 插入或刪除某學生資料
  - O5: 輸入學生新學期修課資料
  - O6: 改變學生加退選資料

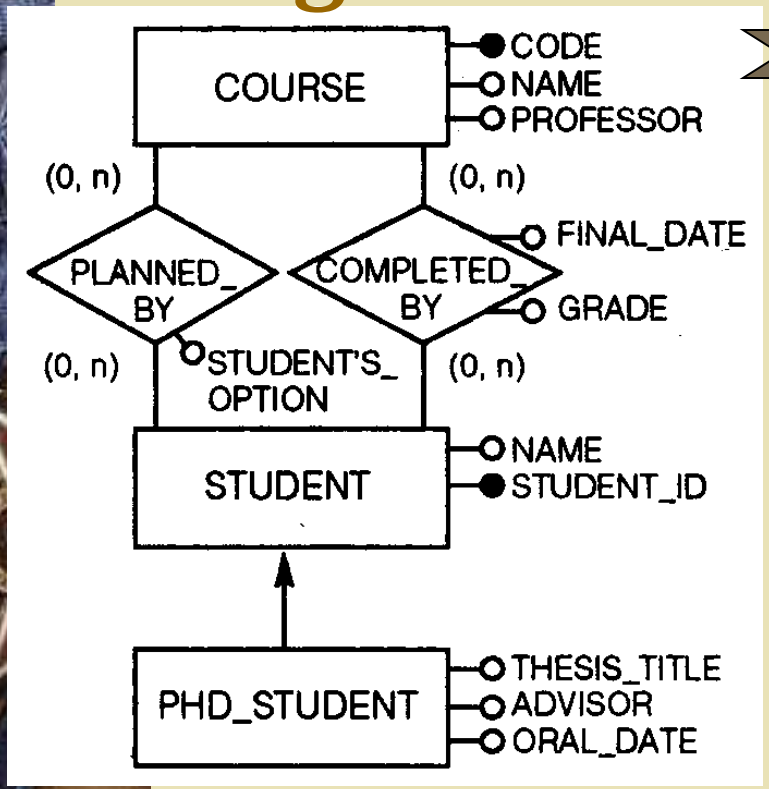


產生 navigation schema 的步驟

- 每個 process 連到 data store 的資料流, 即存在一 database operation.
- 對每個 database operation
  - Step 1: 繪出 operation schema
    - 把已有的 schema 取下該 operation 相關的資料項 (包括 attributes, entity, relationship or generalization)
  - Step 2: 繪出 navigation schema
    - 由 operation schema 加上箭頭, 指出選擇條件的 attribute, 指出走過的 relationship, 在經過的entity & relationship上加上 R, M, I or D 等記號, 代表

R: Read I: Insert M: Modify D: Delete

Example of navigation schema



D_Schema

根據 O10 取子集合

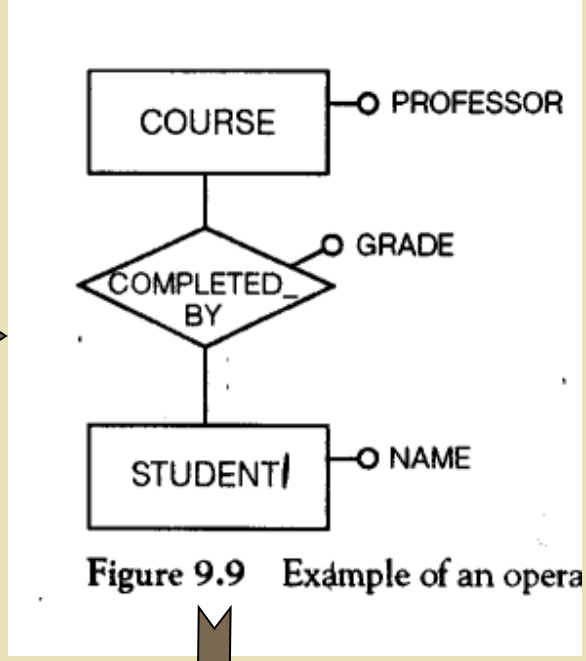
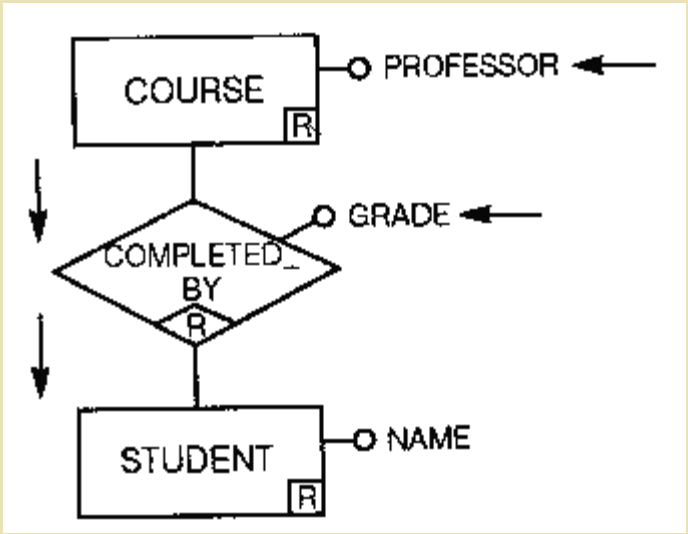


Figure 9.9 Example of an opera

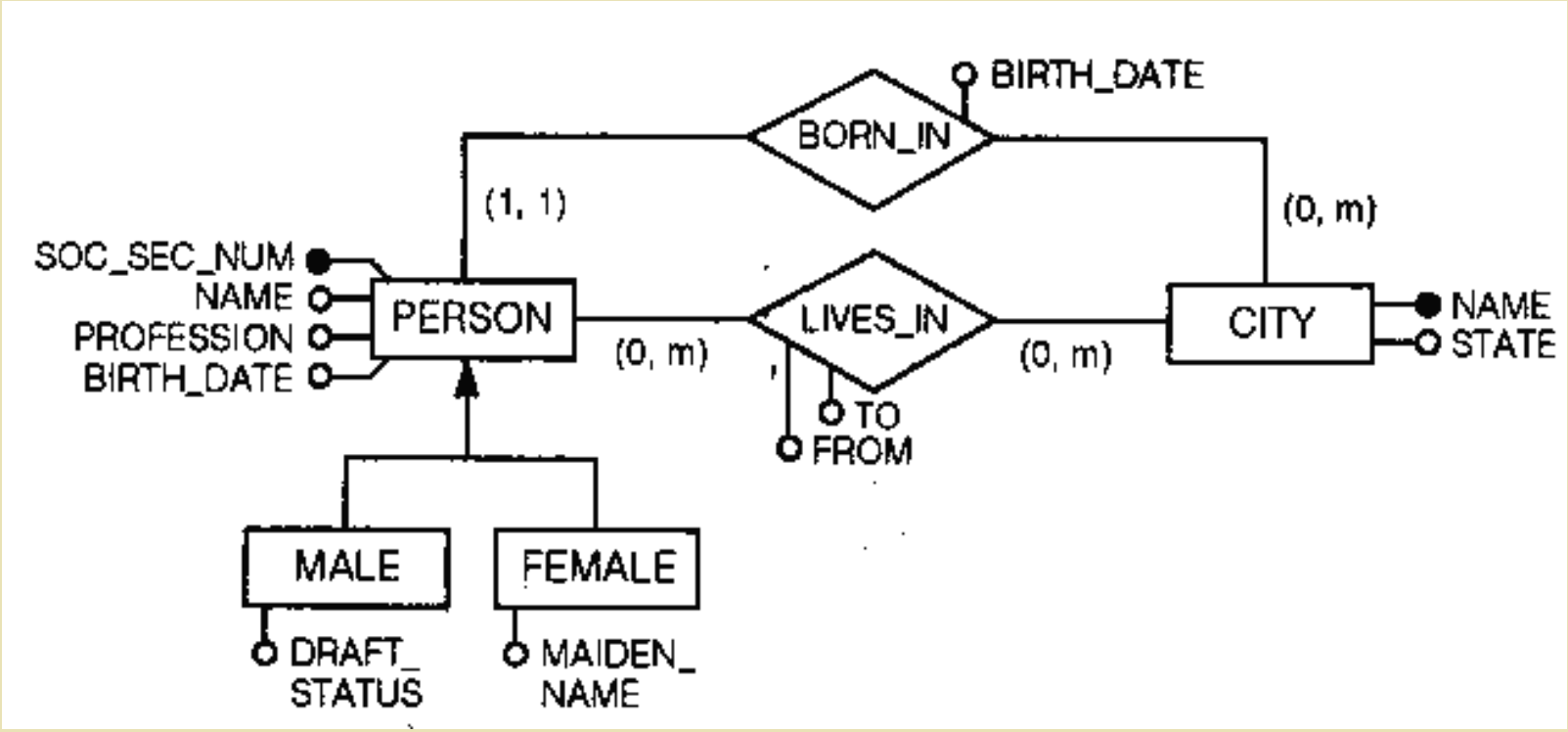
加上箭頭和存取型態



O10: 找某教授所開的課程中其 grade 是低於 ‘B’ 的所有學生姓名.

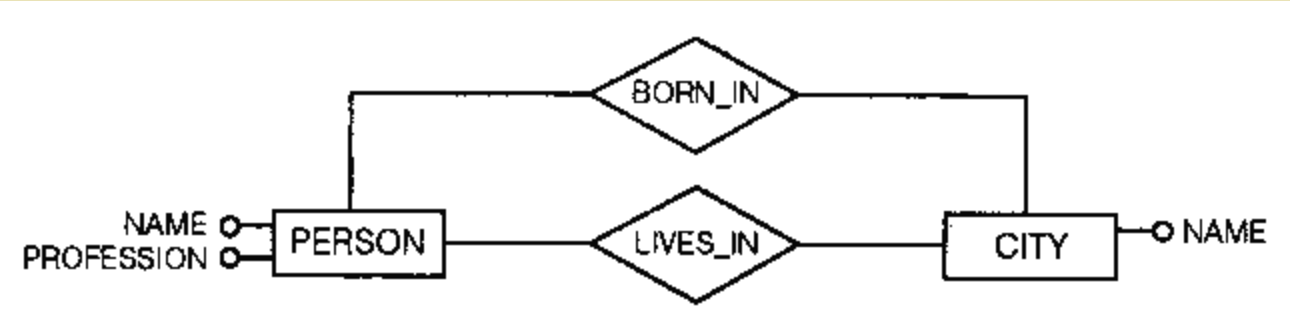
Example of navigation schema

Operation: 找出出生地和居住地相同的物理學家的姓名

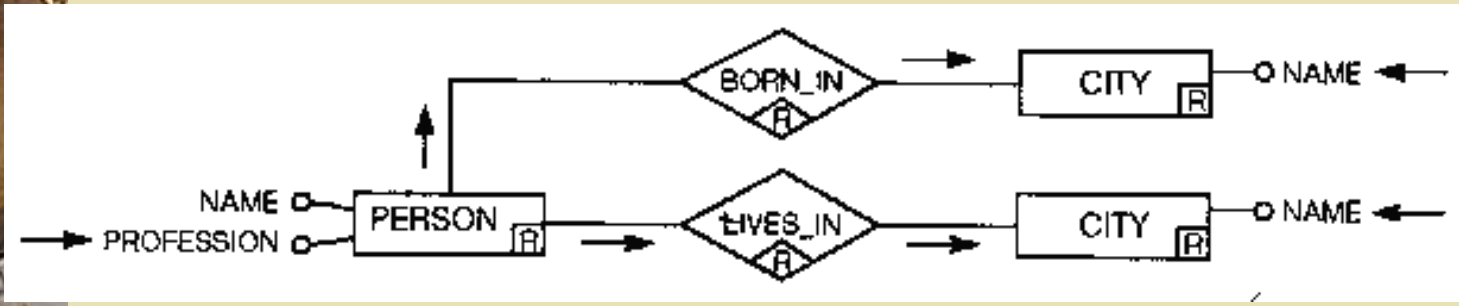


Example of navigation schema

- 取下相關的 attribute, entities & relationship



- 加上箭頭和存取型態



Exercises

1. Apply the joint data and function design methodology to the following case study.

In a large, well-connected alpine valley, all the ski lifts (滑雪電纜車) and gondolas (吊艙) are subject to a unique ticketing system, although they belong to various owners. Tickets include a magnetic part that can be read by magnetic devices when each skier lines up for the ski lift or gondola. The magnetic devices are connected to a central computer, which maintains data about the usage of ski lifts and gondolas. Each week, profits made by selling tickets are distributed to the owners, proportional to the usage. Skiers are identified by a unique number, and statistics are kept about how many times each ski lift or gondola is used by skiers who have purchased the ticket in a specific ticket office. This information is used to determine how far each skier travels in the valley, assuming that skiers purchase tickets close to their residences.

2. Translate into navigation schemas, using step-by-step transformations, the following operations over the schema of page 18 of this unit.

a. Retrieve names and addresses of all programmers who live in cities with less than 1,000 inhabitants.

b. Retrieve the names and addresses of all programmers who live in Milan and are over 50 years old.

c. Insert the fact that a given female person, with a given social security number, has a maiden name that was previously left unspecified.