CS3010301 Database Systems

Midterm

Spring 2010

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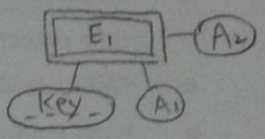
1. (24%) Explain the following terms briefly. Use an example if necessary.

- (3%) Domain (of an attribute).

  一個 attribute 資料的定義域

- (3%) Weak entity type (in ER model).

  Entity 的 key 是 partial key



- (3%) Relation state (in relational model).

  Relation 在一個時間點的資料狀態

- (3%) Atomic attribute.

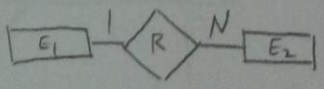
  一個 attribute 不可再分割

- (3%) Entity integrity constraint (in relational model).

  Entity 裡面的 key 不可以為 NULL

- (3%) Cardinality ratio constrain (in ER model).

  兩個 entity 之間參與的比例

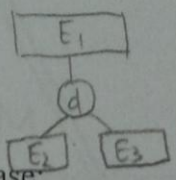


- (3%) Unsafe query (in relational calculus).

  Query 出來的結果可能是無限集合 {e| NOT EMPLOYE

- (3%) Hierarchical data model.

  Entity 之間有階層的關連

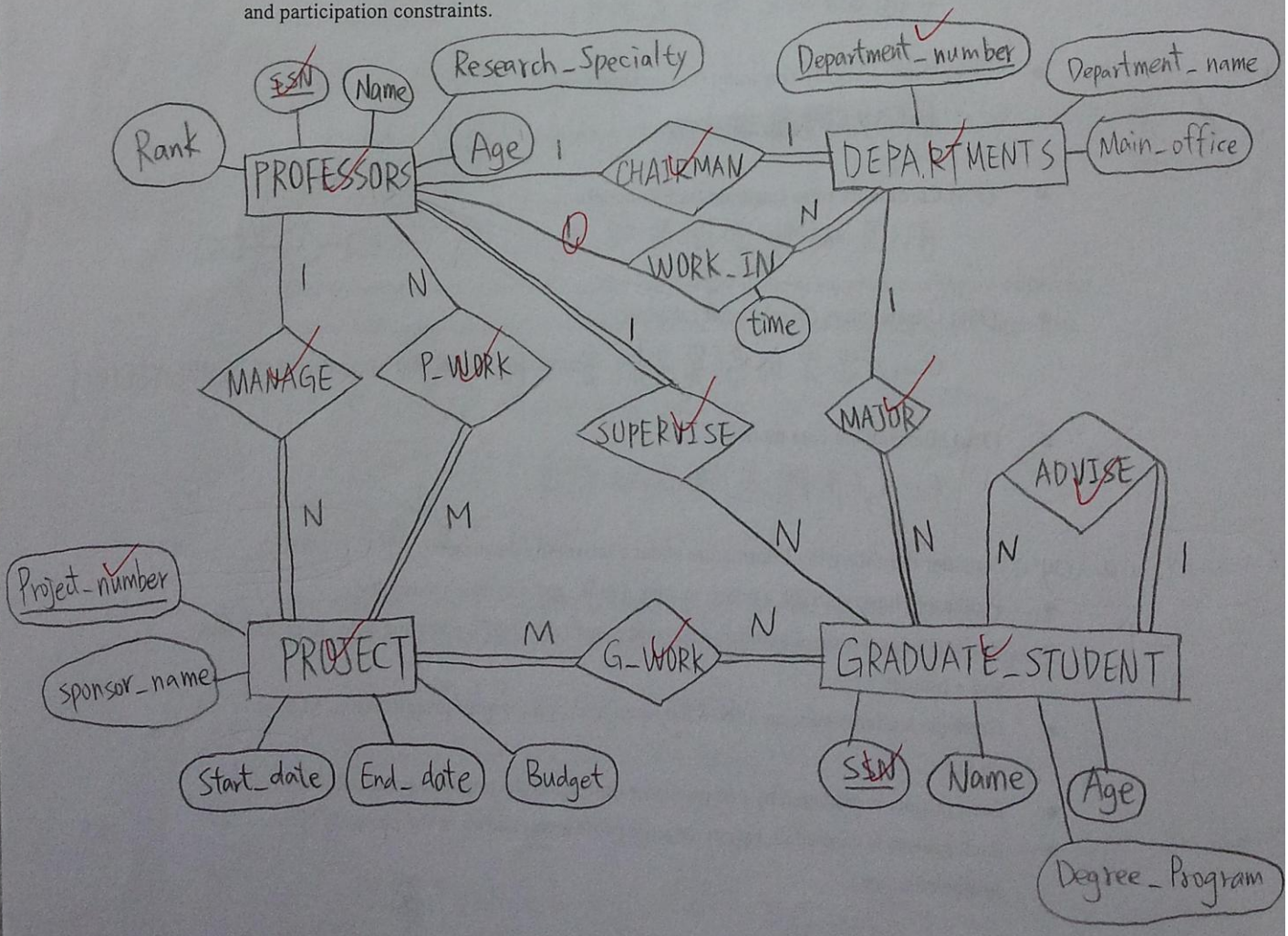


(30%) Consider the following information about a university database:

- Professors have an SSN, a name, an age, a rank, and a research specialty.
- Projects have a project number, a sponsor name (e.g., NSF), a starting date, an ending date, and a budget.
- Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D.).
- Each project is managed by one professor (known as the project's principal investigator).
- Each project is worked on by one or more professors (known as the project's co-investigators).

- Professors can manage and/or work on multiple projects.
- Each project is worked on by one or more graduate students (known as the Project's research assistants).
- When graduate students work on a project, a professor must supervise their work on the project. Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one.
- Departments have a department number, a department name, and a main office.
- Departments have a professor (known as the chairman) who runs the department.
- Professors work in one or more departments, and for each department that they work in, a time percentage is associated with their job.
- Graduate students have one major department in which they are working on their degree.
- Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take.

Design and draw an ER diagram that captures the information about the university. Use only the basic ER model here; that is, entities, relationships, and attributes. Be sure to indicate any key and participation constraints.



3. (10%) Consider the following instance of the Student relation.

Sid	Name	Login	Age	GPA 平均成績
50000	Dave	dave@yahoo	19	3.3
53666	Jones	jones@cs	18	3.4
53688	Smith	smith@ee	18	3.2
53650	Smith	smith@math	19	3.8
53831	Maya	maya@stat	11	1.8
53833	Gulda	gulda@music	12	2.0

- (5%) Give an example of an attribute (or set of attributes) that can deduce is NOT a candidate key, based on the above instance being legal. Explain why.

Name 不可以為 candidate key；因為學生的名字可能會重覆。

- (5%) Give an example of an attribute (or set of attributes) that can deduce IS a candidate key, based on the above instance being legal. Explain why.

Sid 可以為 candidate key；因為學生的 id 是用來區分每一個學生，所以 sid 不可以重覆。

4. (36%) Consider the following schema:

```
suppliers (sid, sname, address)
parts (pid, pname, color)
catalog (sid, pid, cost)
```

The key fields are underlined. The Catalog relation lists the prices charged for parts by Suppliers.

a. (6%) Write the query "*Find the names of all blue parts*" in **domain** relational calculus.

$\{b \mid (\exists a)(\exists c)(parts(abc) \text{ AND } c.color = 'blue')\}$

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b. (6%) Write the query "*Find the addresses of suppliers whose name is GlobalInc or supply some orange parts.*" in relational algebra.

$S\_Globe \leftarrow \pi_{sid}(\sigma_{sname='GlobalInc'}(suppliers))$

$S\_Green \leftarrow \pi_{sid}(\sigma_{color='orange'}(parts * catalog))$

$RESULT \leftarrow \pi_{address}((S\_Globe \cup S\_Green) * suppliers)$

c. (6%) Write the query "*Find the names and addresses of suppliers who supply **some** green parts that are less than $10*" in relational algebra.

$P\_Green \leftarrow \pi_{pid}(\sigma_{color='green'}(parts))$

$P\_Green\_Less \leftarrow \sigma_{cost<10}(P\_Green * catalog)$

$RESULT \leftarrow \pi_{sname, address}(P\_Green\_Less * suppliers)$

d. (6%) Write the query "*Find the ids of suppliers who supply every blue parts*" in **tuple** relational calculus.

$\{S.sid \mid suppliers(S) \text{ AND } (\exists p)(\exists c)(parts(p) \text{ AND } catalog(c) \text{ AND } S.sid = C.sid \text{ AND } P.pid = C.pid \text{ AND } P.color = 'blue')\}$

e. (6%) Write the query "*For each supplier, retrieve the name of supplier, and the average cost of parts sold by the supplier*" in relational algebra. You may use grouping and/or aggregate functions for the query, if necessary.

$S\_cost \leftarrow suppliers * catalog$

$TEMP \leftarrow {}_{sid}\mathcal{F}_{AVERAGE\ cost}(S\_cost)$

$RESULT \leftarrow \pi_{sname, AVERAGE\ cost}(TEMP)$

f. (6%) Write the query "*Find pairs of supplier ids such that the supplier with the first sid charges more for some parts than the supplier with the second sid*" in relational algebra.

$First\_S \leftarrow suppliers * catalog$

$Second\_S \leftarrow suppliers * catalog$

$Supply\_Part \leftarrow First\_S \bowtie_{First\_S.sid \neq Second\_sid \text{ AND } First\_S.pid = Second\_S.pid} Second\_S$

$RESULT(first\ sid, second\ sid) \leftarrow \pi_{sid, sid}(\sigma_{cost > cost}(Supply\_Part))$