

Hand in a hardcopy of your answers (printed or handwritten). Include your name, and be sure to clearly identify which problems you are answering and which homework the problems are from since problems from multiple homeworks will be collected at the same time. These problems will be collected on Monday 10/12 and Monday 10/26.

Notation note: When ER/EER diagrams are drawn with PlantUML, bold lines are substituted for double lines. Red highlights have been added to make the bold lines easier to see. PlantUML also doesn't have a dashed underline, so weak keys are shown fully underlined.

For each of questions 1–4, identify which of the proposed mappings is the best and label each of the others as “worse” (can store all valid data but has drawbacks compared to the best mapping) or “wrong” (cannot store some valid data). Explain your choices — for the “worse” and “wrong” mappings, explain what the drawbacks are or what makes the mapping wrong; for the “best” case, explain why it beats the alternatives and identify any drawbacks it still has.

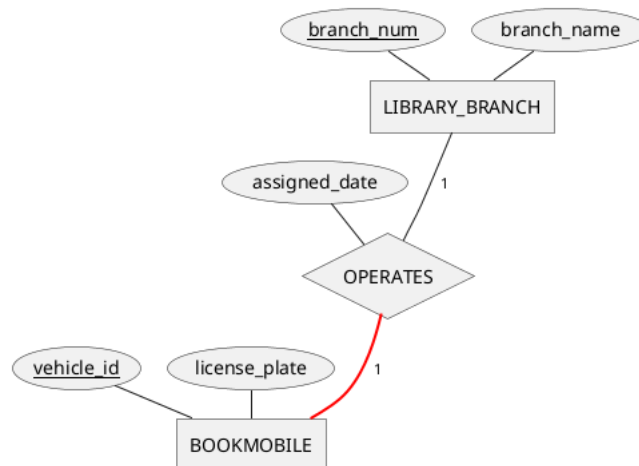


Figure 1: ER diagram for question 1.

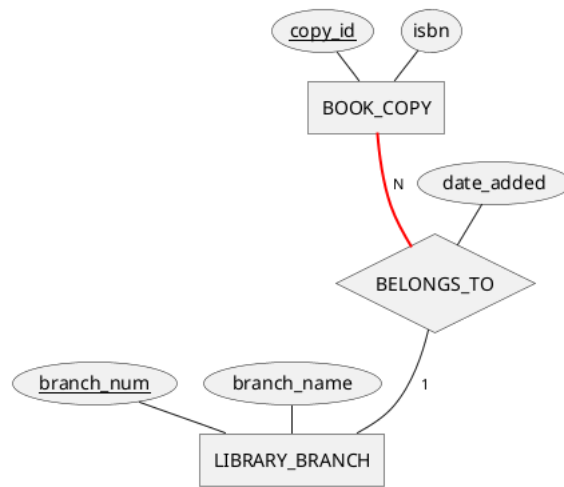


Figure 2: ER diagram for question 2.

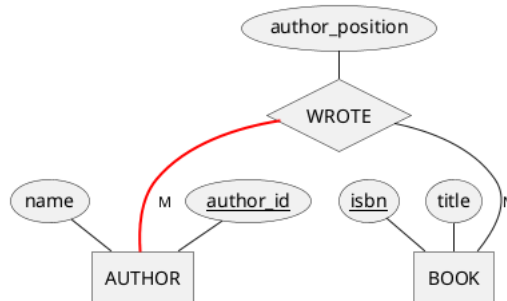


Figure 3: ER diagram for question 3.

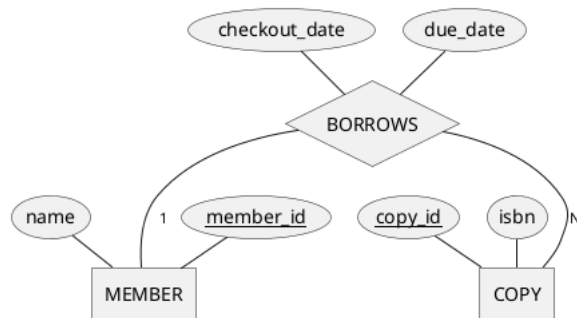


Figure 4: ER diagram for question 4.

1. A city library system runs a few bookmobiles out of its branches.

(a) OPERATES(branch_num, branch_name, vehicle_id, license_plate,
 assigned_date)

- OPERATES.vehicle_id is unique

(b) LIBRARY_BRANCH(branch_num, branch_name, vehicle_id,
 assigned_date)
 BOOKMOBILE(vehicle_id, license_plate)

- LIBRARY_BRANCH.vehicle_id $\rightarrow$ BOOKMOBILE.vehicle_id
- LIBRARY_BRANCH.vehicle_id is unique

(c) LIBRARY_BRANCH(branch_num, branch_name)
 BOOKMOBILE(vehicle_id, license_plate, home_branch,
 assigned_date)

- BOOKMOBILE.home_branch $\rightarrow$ LIBRARY_BRANCH.branch_num
- BOOKMOBILE.home_branch is unique and NOT NULL

(d) LIBRARY_BRANCH(branch_num, branch_name)
 BOOKMOBILE(vehicle_id, license_plate, home_branch,
 assigned_date)

- BOOKMOBILE.home_branch $\rightarrow$ LIBRARY_BRANCH.branch_num
- BOOKMOBILE.home_branch is NOT NULL

(e) LIBRARY_BRANCH(branch_num, branch_name)
 BOOKMOBILE(vehicle_id, license_plate)
 OPERATES(vehicle_id, branch_num, assigned_date)

- OPERATES.vehicle_id $\rightarrow$ BOOKMOBILE.vehicle_id
- OPERATES.branch_num $\rightarrow$ LIBRARY_BRANCH.branch_num
- OPERATES.branch_num is NOT NULL, unique

2. Every copy in the collection belongs to a home branch, where it is shelved and returned after loans.

- (a) LIBRARY_BRANCH(branch_num, branch_name)
 BOOK_COPY(copy_id, isbn)
 BELONGS_TO(copy_id, branch_num, date_added)
- BELONGS_TO.copy_id → BOOK_COPY.copy_id
 - BELONGS_TO.branch_num → LIBRARY_BRANCH.branch_num
- (b) LIBRARY_BRANCH(branch_num, branch_name)
 BOOK_COPY(copy_id, isbn, home_branch, date_added)
- BOOK_COPY.home_branch → LIBRARY_BRANCH.branch_num
 - BOOK_COPY.home_branch is NOT NULL
- (c) LIBRARY_BRANCH(branch_num, branch_name, copy_id, date_added)
 BOOK_COPY(copy_id, isbn)
- LIBRARY_BRANCH.copy_id → BOOK_COPY.copy_id
 - LIBRARY_BRANCH.copy_id is unique
- (d) LIBRARY_BRANCH(branch_num, branch_name)
 BOOK_COPY(copy_id, isbn, home_branch, date_added)
- BOOK_COPY.home_branch → LIBRARY_BRANCH.branch_num
- (e) LIBRARY_BRANCH(branch_num, branch_name)
 BOOK_COPY(copy_id, isbn)
 BELONGS_TO(copy_id, branch_num, date_added)
- BELONGS_TO.copy_id → BOOK_COPY.copy_id
 - BELONGS_TO.branch_num → LIBRARY_BRANCH.branch_num
 - BELONGS_TO.branch_num is NOT NULL

3. The library's catalog records who wrote each book.

(a) AUTHOR(author_id,author_name)
 BOOK(isbn,title)
 WROTE(author_id,isbn,author_position)

- WROTE.author_id → AUTHOR.author_id
- WROTE.isbn → BOOK.isbn

(b) AUTHOR(author_id,author_name)
 BOOK(isbn,title)
 WROTE(author_id,isbn,author_position)

- WROTE.author_id → AUTHOR.author_id
- WROTE.isbn → BOOK.isbn
- WROTE.isbn is NOT NULL

(c) AUTHOR(author_id,author_name,isbn,author_position)
 BOOK(isbn,title)

- AUTHOR.isbn → BOOK.isbn
- AUTHOR.isbn is NOT NULL

(d) AUTHOR(author_id,author_name)
 BOOK(isbn,title,author_id,author_position)

- BOOK.author_id → AUTHOR.author_id

(e) AUTHOR_BOOK(author_id,author_name,isbn,title,author_position)

4. The library tracks which members currently have which copies checked out.

- (a) `MEMBER(member_id,member_name)`
 `BOOK_COPY(copy_id,isbn,member_id,checkout_date,due_date)`
- `BOOK_COPY.member_id` → `MEMBER.member_id`
 - `BOOK_COPY.member_id` is NOT NULL
- (b) `MEMBER(member_id,member_name)`
 `BOOK_COPY(copy_id,isbn,member_id,checkout_date,due_date)`
- `BOOK_COPY.member_id` → `MEMBER.member_id`
- (c) `MEMBER(member_id,member_name)`
 `BOOK_COPY(copy_id,isbn)`
 `LOAN(copy_id,member_id,checkout_date,due_date)`
- `LOAN.copy_id` → `BOOK_COPY.copy_id`
 - `LOAN.member_id` → `MEMBER.member_id`
 - `LOAN.checkout_date` and `LOAN.due_date` are NOT NULL
- (d) `MEMBER(member_id,member_name)`
 `BOOK_COPY(copy_id,isbn)`
 `LOAN(copy_id,member_id,checkout_date,due_date)`
- `LOAN.copy_id` → `BOOK_COPY.copy_id`
 - `LOAN.member_id` → `MEMBER.member_id`
 - `LOAN.member_id`, `LOAN.checkout_date` and `LOAN.due_date` are NOT NULL
- (e) `MEMBER(member_id,member_name,copy_id,checkout_date,due_date)`
 `BOOK_COPY(copy_id,isbn)`
- `MEMBER.copy_id` → `BOOK_COPY.copy_id`
 - `MEMBER.copy_id` is unique

5. (a) Map the ER/EER diagram below into a relational schema using the *multiple relations (superclass and subclasses)* approach.
- (b) Map the ER/EER diagram below into a relational schema using the *multiple relations (subclasses only)* approach.
- (c) Map the ER/EER diagram below into a relational schema using the *single relation (single type attribute)* approach.
- (d) Map the ER/EER diagram below into a relational schema using the *single relation (multiple type attributes)* approach.
- (e) Compare the four approaches for handling the specialization — which approach do you think is best for this situation? Explain.

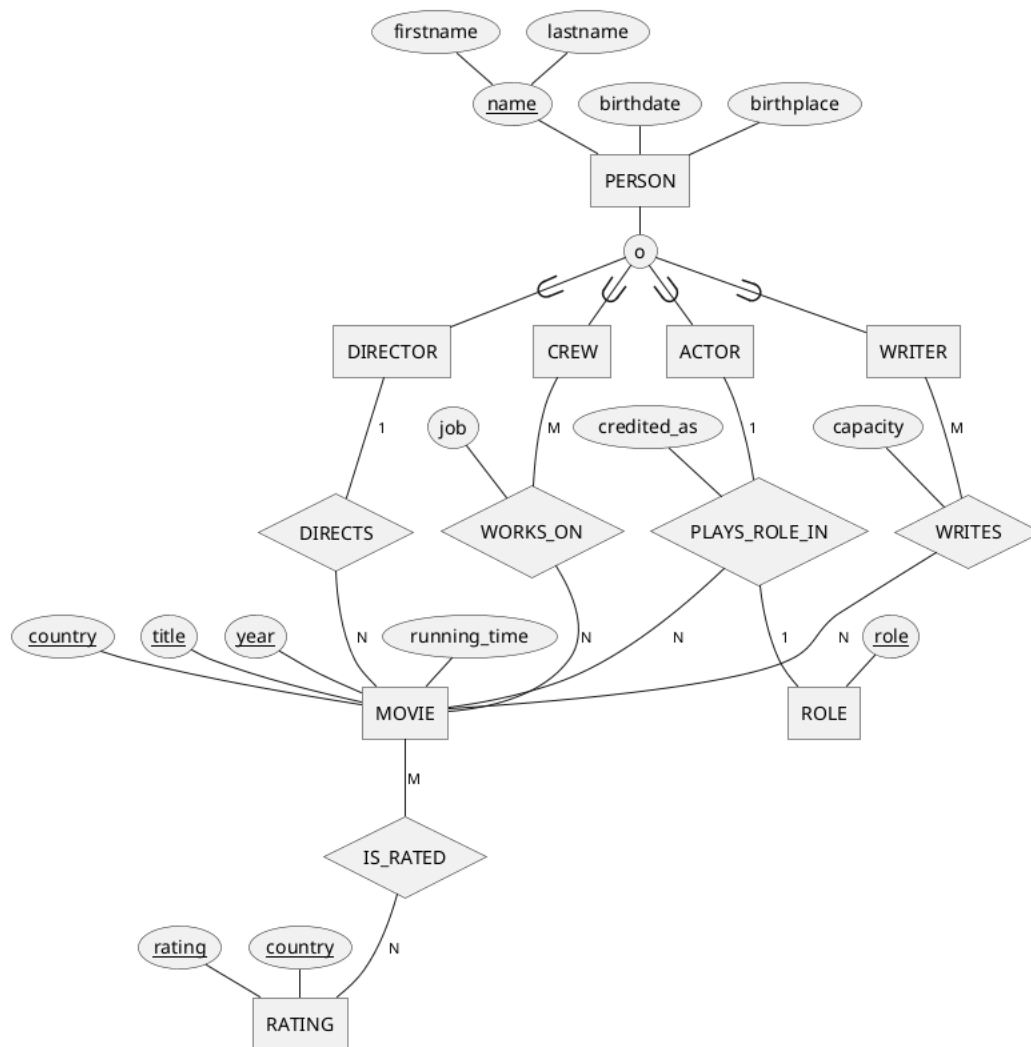


Figure 5: ER diagram for question 5.

6. Map the ER/EER diagram below into a relational schema. Be sure to specify all primary key, referential integrity (foreign key), and NOT NULL constraints.

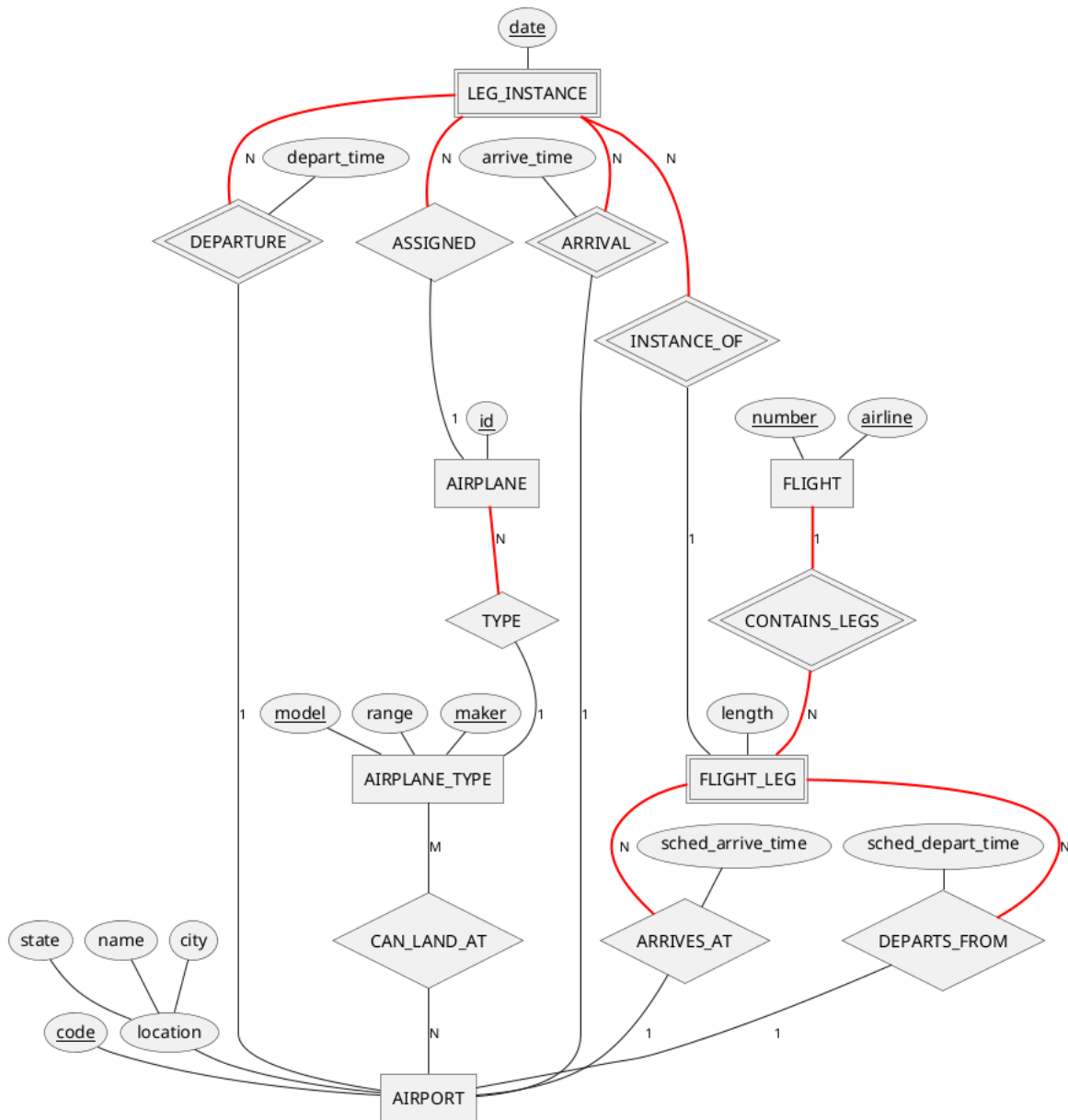


Figure 6: ER diagram for question 6.

7. Map the ER/EER diagram below into a relational schema. Be sure to specify all primary key, referential integrity (foreign key), and NOT NULL constraints.

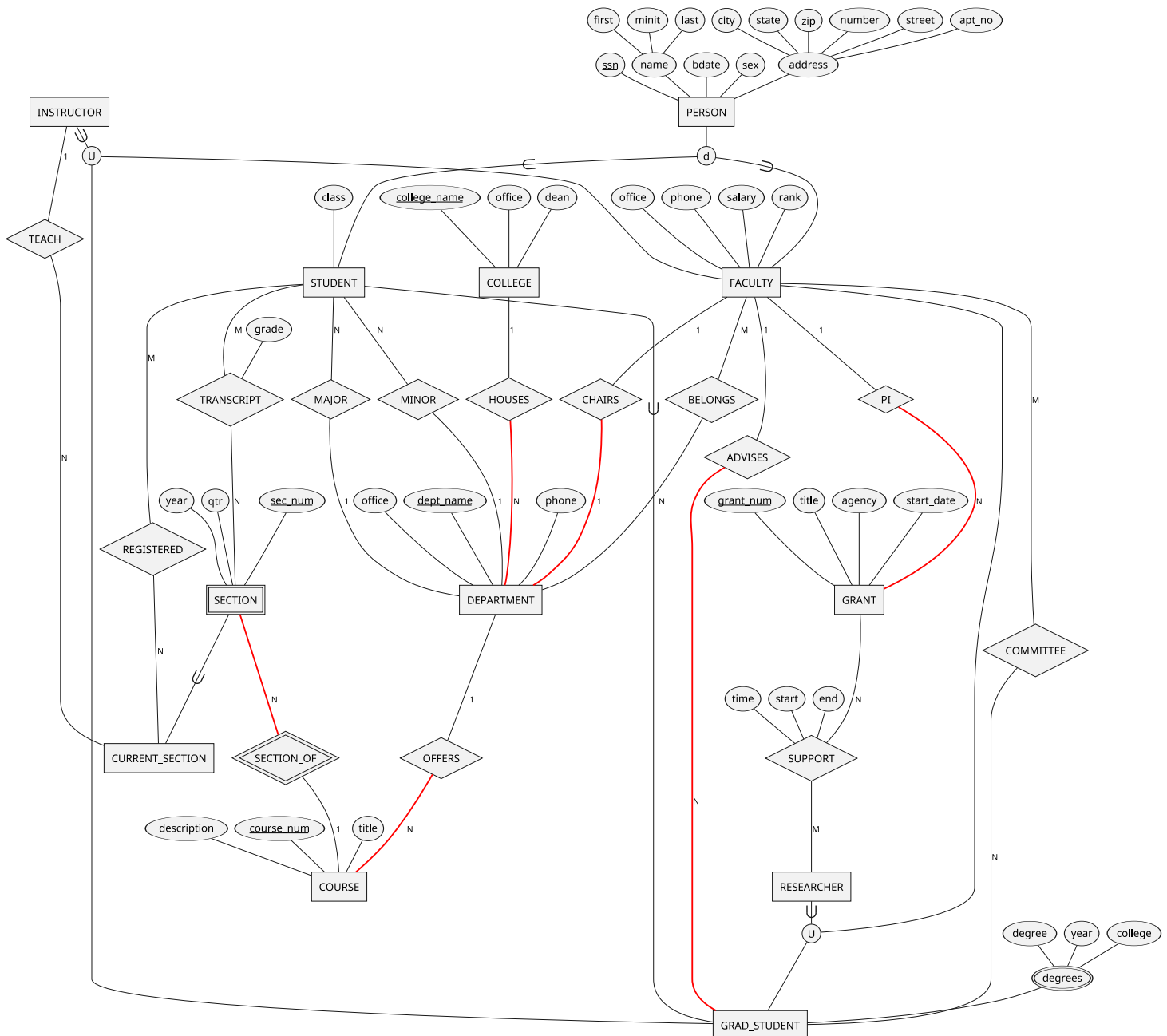


Figure 7: ER diagram for question 7. Adapted from Elmasri and Navathe.