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## Project Part 2

### a. Derive relations from conceptual model

From the conceptual model, we can identify 5 distinct relations/tables

- Clinic: **clinicNo (PK)**, name, address, phone, staffNo (FK)
- Staff: **staffNo (PK)**, name, address, phone, DOB, position, salary, clinicNo (FK)
- Pet: **petNo (PK)**, name, DOB, species, breed, color, clinicNo (FK), ownerNo (FK)
- Owner: **ownerNo (PK)**, name, address, phone
- Examination: **examNo (PK)**, complaint, description, date, action, staffNo (FK), petNo (FK)

### b. Validate the logical model using normalization to 3NF

First, we verify the tables are in 1NF by satisfying the property of atomicity (i.e. no multivalued columns). From the relations above, it is true that each column in every relation may only hold one value. These relations are in 1NF.

To move from 1NF to 2NF, we must remove all partial dependencies (i.e. every non-key attribute of a relation depends on the entire PK of the relation). For our tables:

Clinic: all non-key attributes depend on **clinicNo**

Staff: all non-key attributes depend on **staffNo**

Pet: all non-key attributes depend on **petNo**

Owner: all non-key attributes depend on **clinicNo**

Examination: all non-key attributes depend on **examNo**

These relations satisfy the conditions to be 2NF.

To move from 2NF to 3NF, we must remove all transitive dependencies (i.e. every non-prime attribute must solely depend on PK). For our tables:

Clinic: all non-prime attributes SOLELY depend on **clinicNo**

Staff: all non-prime attributes SOLELY depend on **staffNo**

Pet: all non-prime attributes SOLELY depend on **petNo**

Owner: all non-prime attributes SOLELY depend on **clinicNo**

Examination: all non-prime attributes SOLELY depend on **examNo**

These relations satisfy the conditions for 3NF.

c. Validate the logical model against 5 user transactions.

Transaction 1: Opening a new Clinic

Opening a new clinic involves creating a record in the Clinic table with details such as clinic name, address, and phone number. No staff is required initially, so the staffNo foreign key may be NULL for now. This operation is valid because the clinicNo is the primary key and will be auto-generated and the transaction doesn't violate any constraints, as the staffNo can be NULL until a staff member is assigned.

Transaction 2: Registering a new Pet for an Owner

When a new pet is registered, the system must create a new entry in the Pet table, linking the pet to an owner from the Owner table using the ownerNo foreign key. The pet's details are entered along with the clinic it is registered to (clinicNo foreign key). The pet must be linked to a valid clinic, and the owner must exist in the database. This operation is valid because the ownerNo foreign key in the Pet table ensures that the pet is linked to an existing owner and the clinicNo foreign key ensures that the pet is associated with a valid clinic. Along with this, since each pet is unique, there are no issues with duplicate entries for the same pet.

Transaction 3: Retrieve all Staff members working at a certain Clinic

This transaction involves querying the Staff table for all staff members who work at a particular clinic. The staff members are identified using the clinicNo foreign key in the Staff table. This operation is valid. The clinicNo foreign key in the Staff table links staff to a specific clinic and the transaction will return all staff assigned to the clinic. If there are no staff members for a given clinicNo, it will simply return an empty result.

Transaction 4: Generate a report of all Examinations for one Pet

To generate a report for a pet, we need to retrieve all related Examination records from the Examination table, filtering by the pet's petNo. Each examination will include the complaint, description, date, and actions taken, as well as the associated staff member and pet. This operation is valid. The petNo foreign key in the Examination table ensures that we can filter the examinations related to a specific pet. Since

the examNo is unique for each examination, there won't be any conflicts, and the report will only return the examinations associated with that particular pet.

Transaction 5: Get a list of all Managers for every Clinic

This transaction involves generating a list of staff members who are assigned as managers for all clinics. Staff members with the position attribute set to "Manager" will be identified. This requires a query that checks for staff members whose position matches "Manager" and retrieves the clinics they manage.

This operation is valid. The Staff table has the position attribute, which can be queried to filter for staff members with the "Manager" role and the clinicNo foreign key in the Staff table ensures that the list of managers will be tied to the appropriate clinic.

- d. Define integrity constraints:
  - i. Primary key constraints.
    - 1. We Must ensure that our primary keys are unique and not Null we can do this through primary key constraints on:
      - a. clinicNo for the Clinic table
      - b. staffNo for the Staff table
      - c. petNo for the Pet table
      - d. ownerNo for the Owner table
      - e. examNo for the Examination table
  - ii. Referential integrity/Foreign key constraints.
    - 1. Each staffNo(FK) in Clinic table must match a staffNo in Staff
    - 2. Each clinicNo(FK) in Staff must match a clinicNo in Clinic
    - 3. Each clinicNo(FK) in Pet must match a clinicNo in Clinic
    - 4. Each ownerNo(FK) in Pet must match an ownerNo in Owner
    - 5. Each staffNo(FK) in Examination must match a staffNo in Staff
    - 6. Each petNo(FK) in Examination must match a petNo in Pet
  - iii. Alternate key constraints (if any).
    - 1. There are no alternate key constraints for this case study
  - iv. Required data.
    - 1. Not Null constraints should be placed on the following attributes
      - a. Clinic
        - i. clinicNo (primary key constraint will ensure this)
        - ii. name
        - iii. address

- iv. phone
    - v. staffNo (FK)
  - b. Staff
    - i. staffNo (PK)
    - ii. name
    - iii. position
    - iv. clinicNo (FK)
  - c. Owner
    - i. ownerNo (PK)
    - ii. name
  - d. Pet
    - i. petNo (PK)
    - ii. name
    - iii. species
    - iv. breed
    - v. ownerNo (FK)
  - e. Examination
    - i. examNo (PK)
    - ii. date
    - iii. staffNo (FK)
    - iv. petNo (FK)
- v. Attribute domain constraints.
- 1. Clinic
    - a. clinicNo: integer, positive, unique, auto increment
    - b. name: VARCHAR(100), not null
    - c. address: VARCHAR(200), not null
    - d. phone: VARCHAR(11), not null, valid phone number
    - e. staffNo: Integer, not null, must match a value in Staff table
  - 2. Staff
    - a. staffNo: Integer, positive, unique, auto increment
    - b. name: VARCHAR(100), not null
    - c. position: VARCHAR(50), not null, allowable values: {"Manager", "employee"}
    - d. address: VARCHAR(200), not null
    - e. phone: VARCHAR(11), not null, valid phone number
    - f. DOB: DATE, not null, must be a past date
    - g. salary: DECIMAL(10,2), not null, non negative
    - h. clinicNo: integer, positive, unique, auto increment

3. Owner

- a. ownerNo: integer, positive, unique, auto increment
- b. name: VARCHAR(100), not null
- c. address: VARCHAR(200), not null
- d. phone: VARCHAR(11), not null, valid phone number

4. Pet

- a. petNo: integer, positive, unique, auto increment
- b. name: VARCHAR(100), not null
- c. DOB: DATE, not null, past date
- d. species: VARCHAR(50), not null
- e. breed: VARCHAR(50), not null
- f. color: VARCHAR(30), not null
- g. clinicNo: integer, not null, must exist in Clinic
- h. ownerNo: integer, not null, must exist in Owner

5. Examination

- a. examNo: integer, positive, unique, auto increment
- b. complaint: TEXT, not null
- c. description: TEXT, not null
- d. date: DATE, not null, on or before current date
- e. action: TEXT, not null
- f. staffNo: integer, not null, must exist in Staff
- g. petNo: integer, not null, must exist in Pet

vi. General constraints (if any).

- 1. Each clinic must have exactly one manager
- 2. A staff member manages at most one clinic
- 3. Staff must work at one clinic
- 4. Owner owns at least one pet
- 5. Pet must be registered at one clinic
- 6. Pet must be owned by one owner
- 7. Examination date must not be in the future
- 8. Staff member doing an examination must work at pet's clinic
- 9. Salary must be non negative
- 10. Position must be a valid selection of options

e. Generate the E-R diagram for the logical level (contains FKs as attributes).

