

Assumptions:

For this model, we are assuming the following:

- Each Owner cannot have multiple Pets with the same name
- A Pet can receive multiple Examinations in one day, but cannot be examined by a single Staff Member more than once in one day
- Staff phone is unique for each staff member, clinic phone is unique for each clinic, owner phone is unique for each owner, can

1. Derive Relations from Conceptual Model

- a. Staff Member- **staffNo**, sName, sAddress, sPhone, sDOB, position, salary, clinicNo
  - i. Primary key: staffNo
  - ii. Foreign key: clinicNo- references Clinic (clinicNo) to determine which Clinic each Staff Member works at (1:\* relationship)
  - iii. Alternate/Candidate key: sPhone
- b. Clinic- **clinicNo**, cName, cAddress, cPhone, managerNo
  - i. Primary key: clinicNo
  - ii. Foreign key: managerNo- references Staff Member (staffNo) to determine the manager of the Clinic (1:1 relationship, optionality - not all staff members manage clinics (Manages is optional for Staff))
  - iii. Alternate/Candidate key: cPhone
- c. Owner- **ownerNo**, oName, oAddress, oPhone
  - i. Primary key: ownerNo
  - ii. Alternate/Candidate key: oPhone
- d. Pet- **petNo**, pName, pDOB, species, breed, color, clinicNo, ownerNo
  - i. Primary key: petNo
  - ii. Foreign keys: clinicNo- references Clinic (clinicNo) to determine which Clinic each Pet is registered (1:\* relationship); ownerNo- references Owner (ownerNo) to determine the Owner of the Pet (1:\* relationship)
  - iii. Alternate/Candidate key: pName + ownerNo
- e. Examination- **examNo**, chiefComplaint, description, date, actionsTaken, staffNo, petNo
  - i. Primary key: examNo
  - ii. Foreign keys: staffNo- references Staff (staffNo) to determine which Staff Member conducted the Examination (1:\* relationship); petNo- references Pet (petNo) to determine which Pet received the Examination (1:\* relationship)
  - iii. Alternate/Candidate key: date + staffNo + petNo

2. Validate Logical Model Using Normalization to 3NF

- a. Staff Member- no partial dependencies, no transitive dependencies
- b. Clinic- no partial dependencies, no transitive dependencies
- c. Owner- no partial dependencies, no transitive dependencies
- d. Pet- no partial dependencies, no transitive dependencies

e. Examination- no partial dependencies, no transitive dependencies

- **1NF (Flattening UNF tables)**

- The relations are in 1NF form.
- Functional Dependencies:
  - clinicNo  $\rightarrow$  cName, cAddress, cPhone
  - staffNo  $\rightarrow$  sName, sAddress, sPhone, sDOB, position, salary, clinicNo
  - ownerNo  $\rightarrow$  oName, oAddress, oPhone
  - petNo  $\rightarrow$  pName, pDOB, species, breed, color, clinicNo, ownerNo
  - examNo  $\rightarrow$  chiefComplaint, description, date, actionsTaken, staffNo, petNo

- **2NF (Remove partial dependencies)**

- There are no partial dependencies from the 1NF relations because all primary keys are single attributes. The tables remain the same:
  - Clinic(clinicNo, cName, cAddress, cPhone)
  - Staff(staffNo, sName, sAddress, sPhone, sDOB, position, salary, clinicNo)
  - Owner(ownerNo, oName, oAddress, oPhone)
  - Pet(petNo, pName, pDOB, species, breed, color, clinicNo, ownerNo)
  - Examination(examNo, date, chiefComplaint, description, actionsTaken, petNo, staffNo)

- **3NF (Remove Transitive Dependencies)**

- There are no transitive dependencies from the 1NF/2NF relations because all non-key attributes depend directly on their respective primary keys. The tables remain the same:
  - Clinic(clinicNo, cName, cAddress, cPhone)
  - Staff(staffNo, sName, sAddress, sPhone, sDOB, position, salary, clinicNo)
  - Owner(ownerNo, oName, oAddress, oPhone)
  - Pet(petNo, pName, pDOB, species, breed, color, clinicNo, ownerNo)
  - Examination(examNo, date, chiefComplaint, description, actionsTaken, petNo, staffNo)

3. Validate Logical Model Against 5 User Transactions

1. Clinic registers a Pet that belongs to an existing Owner

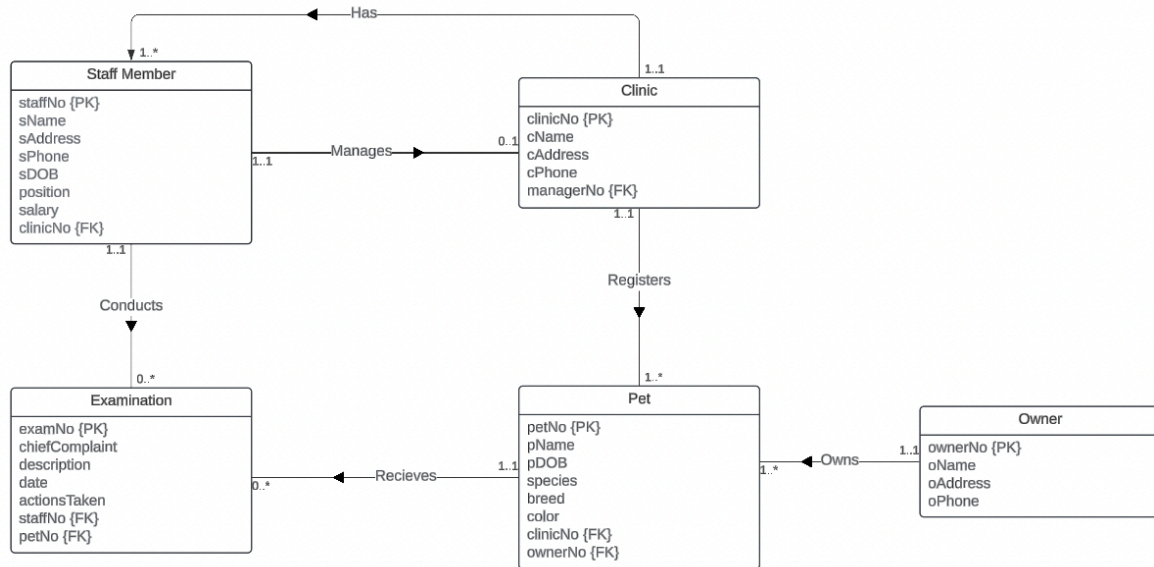
- Insert a new record into the Pet table with a valid value for each attribute: petNo, petName, petDOB, petSpecies, petBreed, petColor, and the associated clinicNo and ownerNo.
- The Pet is registered to the appropriate Clinic through the foreign key clinicNo in the Pet table referencing clinicNo from the Clinic table.
- The Owner of the Pet is associated through the foreign key ownerNo in the Pet table referencing ownerNo from the Owner table.
- Validate that petNo is unique in the Pet table
- Validate that clinicNo exists in the Clinic table
- Validate that ownerNo exists in the Owner table
- Insert the record, if constraints are met

2. Staff Member conducts an Examination

- Retrieve petNo:
    - Use the Pet table to retrieve the pet's details (petNo).
  - Retrieve staffNo:
    - Use the Staff table to retrieve the staff member's details (staffNo).
  - Insert a new record into the Examination table with the details corresponding to the table's attributes: examNo, examDate, chiefComplaint, examDescription, actionsTaken, and the associated staffNo and petNo.
  - Validate that staffNo exists in the Staff Member table
  - Validate that the petNo exists in the Pet table
  - Validate that the examNo is unique in the Examination table
  - If all constraints are met, insert record
  - 3. List all details of all Pets registered to a Clinic, given name
    - Query/Filter the Clinic table to get all records that match a desired clinic name; get clinicNo
    - Use the clinicNo to query the Pet table:
      - Retrieve all pet details (petNo, petName, petDOB, petSpecies, petBreed, petColor, clinicNo) where clinicNo matches the selected Clinic.
    - Retrieve and return the list of Pet records
  - 4. List all Pets owned by an Owner, given owner number
    - Filter by ownerNo:
      - Use the ownerNo in the Owner table to identify the desired owner.
    - Query the Pet table
      - Retrieve all pet details (petNo, petName, petDOB, petSpecies, petBreed, petColor) where ownerNo matches the selected owner.
    - Validate the ownerNo exists in the database
    - Retrieve and return the list of pets
  - 5. Show all examinations conducted by a Staff Member
    - Filter by staffNo:
      - Use the staffNo in the Staff table to identify the desired staff member.
    - Query the Examination table:
      - Retrieve all examination details (examNo, examDate, chiefComplaint, examDescription, actionsTaken) where staffNo matches the selected staff member.
    - Validate that the staffNo exists in the database
    - Retrieve and return the list of examinations
  - 6. Update the oAddress of an Owner
    - Select the correct record from the Owner table by using the ownerNo primary key.
    - Update the current oAddress to the new oAddress
  - 7. Find how many Examinations a Pet has received
    - Validate that the petNo of the desired Pet exists in the Pet table
    - Query the Examination table and count the number of records that contain this specific petNo
    - Return the count/number of records found
4. Define Integrity Constraints
- a. Primary Key Constraints
    - i. Each relation must have a unique primary key.
    - ii. The primary key cannot be null for each entity.
  - b. Referential Integrity/Foreign Key Constraints

- i. Each FK attribute must reference a valid entry in the table that it references.
  - ii. If the value of a PK is updated, the value of the FK must also be updated anywhere it is referenced.
  - iii. If an entry is deleted, any FK that references it must be updated to a valid entry or the entry that references it must also be deleted.
- c. Alternate Key Constraints
  - i. Staff Member-sPhone- all phone numbers are unique
  - ii. Clinic-cPhone- all phone numbers are unique
  - iii. Owner-oPhone- all phone numbers are unique
  - iv. Pet-pName+ownerNo- the pName for each Pet registered to one Owner must be unique
  - v. Examination-date+staffNo+petNo- each Pet can only be examined by each Staff Member once per day
- d. Required Data
  - i. The following for each relation cannot be null.
  - ii. Staff Member- staffNo, clinicNo
    - 1. sName, sAddress, sPhone, sDOB, position, salary
  - iii. Clinic- clinicNo, managerNo
    - 1. cName, cAddress, cPhone
  - iv. Owner- ownerNo
    - 1. oName, oAddress, oPhone
  - v. Pet- petNo, ownerNo
    - 1. pName, pDOB, species, breed, color
  - vi. Examination- examNo, staffNo, petNo
    - 1. chiefComplaint, description, date, actionsTaken
- e. Attribute Domain Constraints
  - i. clinicNo, staffNo, petNo, ownerNo, examNo, and managerNo must all be unique, positive integers
  - ii. sName, cName, pName, and oName are strings, max 100 characters
  - iii. sAddress, cAddress, and oAddress are strings, max 250 characters
  - iv. sPhone, cPhone and oPhone must be in valid 10-digit phone number format
  - v. sDOB, pDOB, and date must be in valid date format (YYYY-MM-DD)
    - 1. Cannot be later than current date
  - vi. position (Staff Member) must be a valid string from the set of possible positions that each Staff Member can work
  - vii. salary (Staff Member) is a decimal, must be positive
  - viii. species (Pet) must be a valid string from the set of species that the Clinic treats
  - ix. breed and color (Pet) are strings, max 75 characters
  - x. chiefComplaint, description, and actionsTaken (Examination) are strings, max 1000 characters
- f. General Constraints
  - i. The Staff Member must work at the Clinic that they manage
    - 1. Staff Member-clinicNo = Clinic-clinicNo AND Clinic-managerNo = Staff Member-staffNo
  - ii. Each Examination must be performed by a Staff Member that works at the Clinic that the Pet is registered to
    - 1. Examination-petNo = Pet-petNo AND Examination-staffNo = Staff Member-staffNo AND Pet-clinicNo = Staff Member-clinicNo

- iii. All Pets that belong to one Owner must be registered to the same Clinic  
 1. All Pets with the same ownerNo must have the same clinicNo  
 5. Generate the E-R Diagram for the Logical Level (Contains FKs as Attributes)



Staff Member:

staffNo	sName	sAddress	sPhone	sDOB	position	salary	clinicNo

Clinic:

clinicNo	cName	cAddress	cPhone	managerNo

Owner:

ownerNo	oName	oAddress	oPhone

Pet:

petNo	pName	pDOB	species	breed	color	clinicNo	ownerNo

Examination:

examNo	chiefComplaint	description	date	actionsTaken	staffNo	petNo