

1. Develop a conceptual data model reflecting the following requirements: (11/01/22)

a. Identify the main entity types.

- Staff
- Clinic
- Pet owner
- Pet
- Examination

b. Identify the main relationship types between the entity types identified in "a".

- Staff → Clinic: manages
- Clinic → staff: employs
- Pet owner → Pet: owns
- Clinic → Pet: registers
- Pet → Examination: undergoes
- Staff → Examination: performs

c. Determine the multiplicity constraints for each relationship identified in "b".

- Staff → Clinic: many to one
- Clinic → staff: one to many
- Pet owner → Pet: one to many
- Clinic → pet: one to many
- Pet → examination: one to zero
- Staff → Examination: one to zero

d. Identify attributes and associate them with entity or relationship types.

- Staff
  - **staffNo**
  - Staff name
  - Address
  - Telephone number
  - DOB
  - Position
  - salary
- Clinic
  - **clinicNo**
  - Name
  - Address

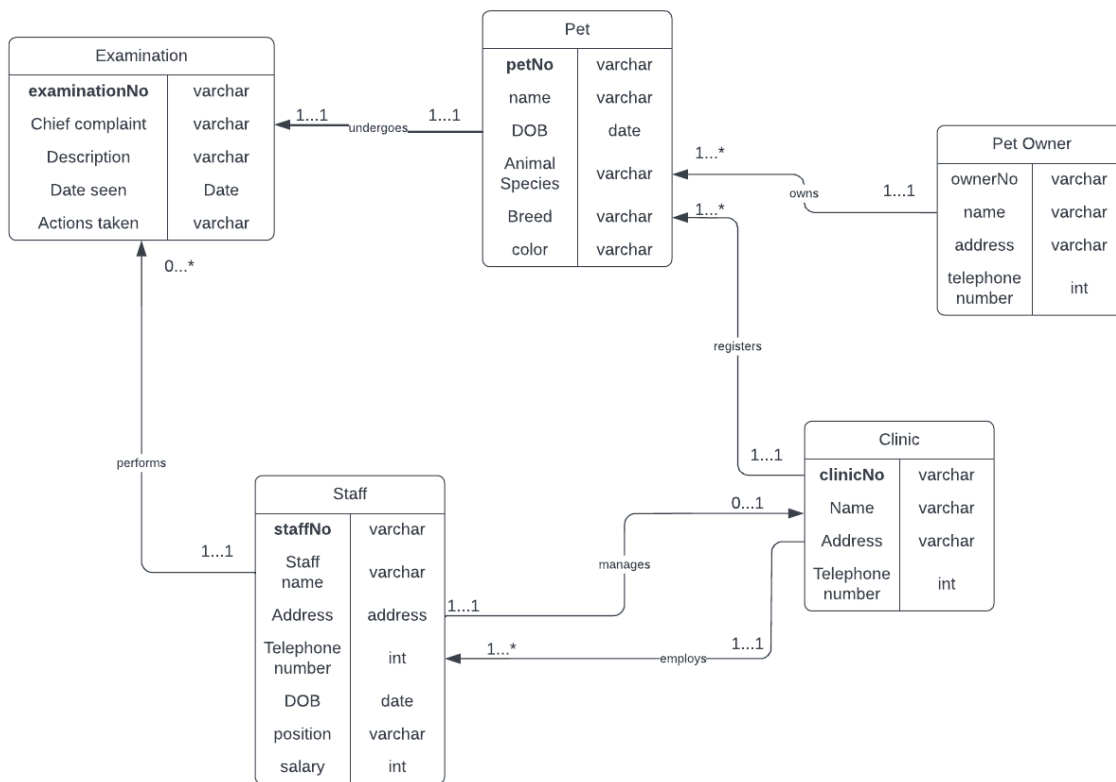
- Telephone number
- Pet owner
  - **ownerNo**
  - name
  - address
  - Telephone number
- Pet
  - **petNo**
  - Name
  - DOB
  - Animal species
  - Breed
  - color
- Examination
  - **examinationNo**
  - Chief complaint
  - Description
  - Date seen
  - Actions taken

e. Determine candidate and primary key attributes for each (strong) entity type.

Primary keys: **Bolded**

Candidate keys: underlined

f. Generate the E-R diagram for the conceptual level (no FKs as attributes).



2. Develop a logical data model based on the following requirements:

a. Derive relations from the conceptual model.

- Examination(examNo, chiefComplaint, description, dateSeen, actions, staffNo, petNo)
- Pet(petNo, name, DOB, species, breed, color, ownerNo, clinicNo)
- Clinic(clinicNo, name, telephonenumber, address)
- Owner(ownerNo, address, telephonenumber, name)
- Staff(staffNo, address, name, telephonenumber, position, clinicNo, DOB)

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

To 3NF: remove transitive dependencies

Clinic: clinicNo → address, phoneNo, position, telephoneNumber

Staff: staffNo → staffName, address, DOB, telephoneNumber, position, salary

PetOwner: ownerNo → name, address, telephoneNumber

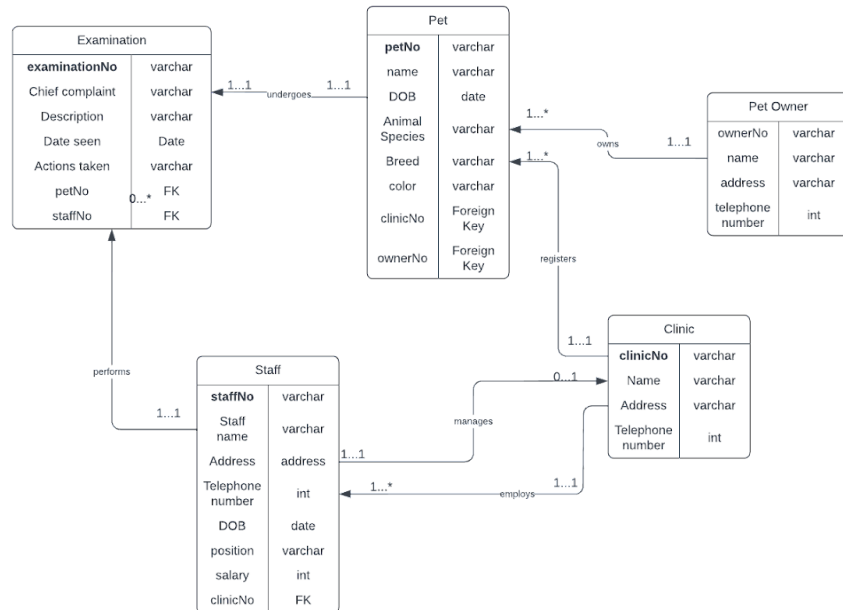
Examination: examinationNo → chiefComplaint, dateSeen, actions, staffNo, description, petNo

Pet: petNo → name, color, ownerNo, breed, species, clinicNo

- c. Validate the logical model against user transactions.
  - List all exams done on golden retrievers and the staff name for the staffNo (a23) who performed the examination
    - Join the Staff, Pet, and Staff tables to list examNo, petNo, staffNo, clinicNo, where Examination.staffNo = a23, Examination.petNo = Pet.petNo, Pet.breed = 'Golden Retriever'
  - 
  - List all the owners going to a specific clinic
    - Join Pet Owner and clinic tables and display all owners on the record.
  - List all the pets that are owned by the same person
    - Join Pet and Owner and print all pets where PetOwner is the same
  - List all clinics and all staff registered in them
    - Display all records in Clinic and staff tables
  - List all staff in 'secretary' position
    - Display all records on Staff table with position = 'vet tech'

Define integrity constraints:

- i. Primary key constraints
    - 1. Must be unique
    - 2. Can't be null
  - ii. Referential integrity/Foreign key constraints.
    - 1. All values of all foreign keys are valid
    - 2. Must reference an existing value
    - 3. Some component of the foreign key is null
  - iii. Alternate key constraints (if any). → defined using SQL constraint unique
  - iv. Required data → All required data must not be null
  - v. Attribute domain constraints. → All attributes must have a domain
  - vi. General constraints (if any) → no null constraints
- d. Generate the E-R diagram for the logical level (contains FKs as attributes)



3. Translate the logical data model for the Oracle Enterprise DBMS. (12/08/22)

a. Develop SQL code to create the entire database schema, reflecting the constraints identified in previous steps.

```

import sqlite3
import pandas as pd

db_connect = sqlite3.connect('test.db')
cursor = db_connect.cursor()

# -- Create the clinic table
create_clinic = """
CREATE TABLE Clinic (
    clinicNo INT PRIMARY KEY,
    clinicName VARCHAR(255),
    clinicAddress VARCHAR(255) UNIQUE,
    managerNo VARCHAR(255) NOT NULL,
    clinicPhone VARCHAR(255),
    FOREIGN KEY (managerNo) REFERENCES Staff
);"""

create_staff = """
CREATE TABLE Staff (
    staffNo INT PRIMARY KEY,
    clinicNo INT,
    staffName VARCHAR(255),
    staffAddress VARCHAR(255),
    staffPhone VARCHAR(255),
    staffDOB DATE,
    staffPosition VARCHAR(255),
    staffSalary INT,
    FOREIGN KEY (clinicNo) REFERENCES Clinic
);
"""

```

```

create_owner = ""
CREATE TABLE Owner (
    ownerNo INT NOT NULL PRIMARY KEY,
    ownerName VARCHAR(255),
    ownerAddress VARCHAR(255),
    ownerPhone VARCHAR(255) NOT NULL
);
""

create_pet = ""
CREATE TABLE Pet (
    petNo INT PRIMARY KEY,
    ownerNo INT,
    clinicNo INT,
    petName VARCHAR(255),
    petDOB DATE,
    petSpecies VARCHAR(255),
    petBreed VARCHAR(255),
    petColor VARCHAR(255),
    FOREIGN KEY (ownerNo) REFERENCES Owner,
    FOREIGN KEY (clinicNo) REFERENCES Clinic
);
""

create_exam = ""
CREATE TABLE Examination (
    examNo INT NOT NULL PRIMARY KEY,
    petNo INT NOT NULL,
    staffNo INT NOT NULL,
    chiefComplaint VARCHAR(255) NOT NULL,
    description VARCHAR(255),
    dateSeen DATE NOT NULL,
    actionsTaken VARCHAR(255),
    FOREIGN KEY (petNo) REFERENCES Pet,
    FOREIGN KEY (staffNo) REFERENCES Staff
);
""

cursor.execute(create_clinic)
cursor.execute(create_staff)
cursor.execute(create_owner)
cursor.execute(create_pet)
cursor.execute(create_exam)

```

b. Create at least 5 tuples for each relation in your database.

```
# -- Insert 5 tuples into the Clinic relation
clinic_info = """
INSERT INTO Clinic VALUES
(1, 'Pawsome Pets Clinic 1', '123 Main St, Anytown USA', 1, '123-456-7890'),
(2, 'Pawsome Pets Clinic 2', '456 Park Ave, Anytown USA', 2, '234-567-8901'),
(3, 'Pawsome Pets Clinic 3', '789 Hill St, Anytown USA', 4, '345-678-9012'),
(4, 'Pawsome Pets Clinic 4', '321 River Rd, Anytown USA', 5, '456-789-0123'),
(5, 'Pawsome Pets Clinic 5', '654 Mountain Ave, Anytown USA', 3, '567-890-1234');
"""

# -- Insert 5 tuples into the Staff relation
staff_info = """
INSERT INTO Staff VALUES
(1, 2, 'John Green', '123 Main St, Anytown USA', '123-456-7890', '1990-01-01', 'Veterinarian', 80000),
(2, 2, 'Jane Doe', '456 Park Ave, Anytown USA', '234-567-8901', '1995-04-15', 'Receptionist', 40000),
(3, 4, 'Barb Johnson', '789 Hill St, Anytown USA', '345-678-9012', '1980-07-05', 'Veterinarian', 80000),
(4, 5, 'Star Williams', '321 River Rd, Anytown USA', '456-789-0123', '1985-10-20', 'Technician', 50000),
(5, 2, 'Stella Brown', '654 Mountain Ave, Anytown USA', '567-890-1234', '1988-12-31', 'Receptionist', 40000);
"""

# -- Insert 5 tuples into the Owner relation
owner_info = """
INSERT INTO Owner VALUES
(1, 'Alice Smith', '123 Main St, Anytown USA', '123-456-7890'),
(2, 'Bob Jones', '456 Park Ave, Anytown USA', '234-567-8901'),
(3, 'Carol Johnson', '789 Hill St, Anytown USA', '345-678-9012'),
(4, 'David Williams', '321 River Rd, Anytown USA', '456-789-0123'),
(5, 'Emily Brown', '654 Mountain Ave, Anytown USA', '567-890-1234');
"""

# -- Insert 5 tuples into the Pet relation
pet_info = """
INSERT INTO Pet VALUES
(1, 1, 2, 'Fluffy', '2010-01-01', 'Dog', 'Labrador Retriever', 'Yellow'),
(2, 2, 4, 'Buddy', '2012-03-15', 'Dog', 'Golden Retriever', 'Golden'),
(3, 3, 5, 'Sasha', '2011-05-07', 'Cat', 'Siamese', 'Gray'),
(4, 2, 3, 'Max', '2009-09-21', 'Dog', 'German Shepherd', 'Black'),
(5, 2, 1, 'Kitty', '2008-12-31', 'Cat', 'Domestic Shorthair', 'Tuxedo');
"""
```



```

examination_info = """
INSERT OR IGNORE INTO Examination
VALUES
    ('1423', 2, 2, 'Check Up', 'Monthly appointment', '2008-12-31', 'N/A'),
    ('1534', 1, 2, 'Teeth checkup', 'Looked at teeth', '2009-09-21', 'Given meds'),
    ('1523', 2, 4, 'Dentist', 'Took teeth out', '2010-08-11', 'treats'),
    ('1827', 5, 3, 'Femur tumor', 'remove tumor', '2000-10-08', 'Treats'),
    ('1827', 2, 3, 'Surgery', 'Had broken ribs', '2004-04-23', 'N/A');
"""

cursor.execute(clinic_info)
cursor.execute(staff_info)
cursor.execute(owner_info)
cursor.execute(pet_info)
cursor.execute(examination_info)

# --
q1 = """
SELECT *
FROM Clinic;
"""

q2 = """
SELECT *
FROM Staff;
"""

q3 = """
SELECT *
FROM Owner;
"""

q4 = """
SELECT *
FROM Pet;
"""

```

```

q4 = """
SELECT *
FROM Pet;
"""

q5 = """
SELECT *
FROM Examination;
"""

queries = [q1, q2, q3, q4, q5]

print("Database")

for query in queries:
    cursor.execute(query)
    column_names = [row[0] for row in cursor.description]
    table_data = cursor.fetchall()
    df = pd.DataFrame(table_data, columns = column_names)
    print("...")
    print(df)
    print("...")

# --
# -- Query 1: Get the clinic number, name, and address for all clinics
q1 = """
SELECT clinicNo, clinicName, clinicAddress
FROM Clinic;
"""

# -- Query 2: Get the staff number, name, and position for all staff members who are veterinarians
q2 = """
SELECT staffNo, staffName, staffPosition
FROM Staff
WHERE staffPosition = 'Veterinarian';
"""

```

```

# -- Query 3: Get the owner number, name, and telephone number for all owners who have pets registered at Clinic 1
q3 = """
SELECT o.ownerNo, o.ownerName, o.ownerPhone
FROM Owner o
JOIN Pet p ON o.ownerNo = p.ownerNo
JOIN Clinic c ON p.clinicNo = c.clinicNo
WHERE c.clinicNo = 1;
"""

# -- Query 4: Get the pet number, name, species, and breed for all pets registered at Clinic 2
q4 = """
SELECT p.petNo, p.petName, petSpecies, petBreed
FROM Pet p
JOIN Clinic c ON p.clinicNo = c.clinicNo
WHERE c.clinicNo = 2;
"""

# -- Query 5: Get the examination number, chief complaint, and actions taken for all examinations performed by Staff 2
q5 = """
SELECT e.examNo, e.chiefComplaint, e.actionsTaken
FROM Examination e
JOIN Staff s ON e.staffNo = s.staffNo
WHERE s.staffNo = 2;
"""

# -- Query 5: Get the examination number, chief complaint, and actions taken for all examinations performed by Staff 2
q5 = """
SELECT e.examNo, e.chiefComplaint, e.actionsTaken
FROM Examination e
JOIN Staff s ON e.staffNo = s.staffNo
WHERE s.staffNo = 2;
"""

print("Queries")
queries = [q1, q2, q3, q4, q5]
for query in queries:
    cursor.execute(query)
    column_names = [row[0] for row in cursor.description]
    table_data = cursor.fetchall()
    df = pd.DataFrame(table_data, columns = column_names)
    print("...")
    print(df)
    print("...")

# commit changes
db_connect.close()

```

c. Develop 5 SQL queries using embedded SQL (see Python tutorial).

## Database

```
...
clinicNo      clinicName      clinicAddress managerNo  clinicPhone
0      1  Pawsome Pets Clinic 1    123 Main St, Anytown USA    1  123-456-7890
1      2  Pawsome Pets Clinic 2    456 Park Ave, Anytown USA   2  234-567-8901
2      3  Pawsome Pets Clinic 3    789 Hill St, Anytown USA    4  345-678-9012
3      4  Pawsome Pets Clinic 4    321 River Rd, Anytown USA   5  456-789-0123
4      5  Pawsome Pets Clinic 5    654 Mountain Ave, Anytown USA 3  567-890-1234
...
...
staffNo  clinicNo  staffName      staffAddress      staffPhone      staffDOB  staffPosition  staffSalary
0      1      2      John Green      123 Main St, Anytown USA 123-456-7890 1990-01-01 Veterinarian    80000
1      2      2      Jane Doe        456 Park Ave, Anytown USA 234-567-8901 1995-04-15 Receptionist    40000
2      3      4      Barb Johnson    789 Hill St, Anytown USA 345-678-9012 1980-07-05 Veterinarian    80000
3      4      5      Star Williams   321 River Rd, Anytown USA 456-789-0123 1985-10-20 Technician      50000
4      5      2      Stella Brown    654 Mountain Ave, Anytown USA 567-890-1234 1988-12-31 Receptionist    40000
...
...
ownerNo      ownerName      ownerAddress      ownerPhone
0      1      Alice Smith      123 Main St, Anytown USA 123-456-7890
1      2      Bob Jones        456 Park Ave, Anytown USA 234-567-8901
2      3      Carol Johnson    789 Hill St, Anytown USA 345-678-9012
3      4      David Williams   321 River Rd, Anytown USA 456-789-0123
4      5      Emily Brown      654 Mountain Ave, Anytown USA 567-890-1234
...
...
petNo  ownerNo  clinicNo  petName      petDOB  petSpecies      petBreed  petColor
0      1      1      Fluffy      2010-01-01 Dog      Labrador Retriever Yellow
1      2      2      Buddy      2012-03-15 Dog      Golden Retriever Golden
2      3      3      Sasha      2011-05-07 Cat      Siamese      Gray
3      4      2      Max        2009-09-21 Dog      German Shepherd Black
4      5      2      Kitty      2008-12-31 Cat      Domestic Shorthair Tuxedo
...
...
examNo  petNo  staffNo  chiefComplaint      description      dateSeen  actionsTaken
0      1423  2      2      Check Up      Monthly appointment 2008-12-31 N/A
1      1534  1      2      Teeth checkup  Looked at teeth 2009-09-21 Given meds
2      1523  2      4      Dentist      Took teeth out 2010-08-11 treats
3      1827  5      3      Femur tumor    remove tumor 2000-10-08 Treats
...
Queries
...
clinicNo      clinicName      clinicAddress
0      1  Pawsome Pets Clinic 1    123 Main St, Anytown USA
1      2  Pawsome Pets Clinic 2    456 Park Ave, Anytown USA
2      3  Pawsome Pets Clinic 3    789 Hill St, Anytown USA
3      4  Pawsome Pets Clinic 4    321 River Rd, Anytown USA
4      5  Pawsome Pets Clinic 5    654 Mountain Ave, Anytown USA
...
```

```

...
Queries
...
    clinicNo      clinicName      clinicAddress
0      1  Pawsome Pets Clinic 1      123 Main St, Anytown USA
1      2  Pawsome Pets Clinic 2      456 Park Ave, Anytown USA
2      3  Pawsome Pets Clinic 3      789 Hill St, Anytown USA
3      4  Pawsome Pets Clinic 4      321 River Rd, Anytown USA
4      5  Pawsome Pets Clinic 5  654 Mountain Ave, Anytown USA
...
...
    staffNo      staffName staffPosition
0      1      John Green  Veterinarian
1      3  Barb Johnson  Veterinarian
...
...
    ownerNo  ownerName  ownerPhone
0      2  Bob Jones  234-567-8901
...
...
    petNo petName petSpecies      petBreed
0      1  Fluffy      Dog  Labrador Retriever
...
...
    examNo chiefComplaint actionsTaken
0      1423      Check Up      N/A
1      1534  Teeth checkup  Given meds

```