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Pawsome Pets: Design, Development, and Implementation of a Relational Database Pt. 1

I. INTRODUCTION

As part of the University of Miami's Fall 2022 CSC 423 Database Systems course with Dr. Vanessa Aguiar-Pulido, students are tasked with designing and creating a relational database for the case study provided:

Case Study: Pawsome Pets

A company called Pawsome Pets runs multiple clinics. The company would like for their data to be stored in a database. The following description was obtained during the analysis phase:

"Each of the Pawsome Pets clinics has several staff members and a member of staff manages at most one clinic (not all staff manage clinics). Each clinic has a unique clinic number (clinicNo) and each member of staff has a unique staff number (staffNo). Additionally, the company would like to store each clinic's name, address and telephone number, as well as the staff's name, address, telephone number, DOB, position and salary.

When a pet owner contacts a clinic, the owner's pet is registered with the clinic. An owner can own one or more pets, but a pet can only be registered at one clinic. Each owner has a unique owner number (ownerNo), a name, an address, and a telephone number. Each pet has a unique pet number (petNo), name, DOB, animal species, breed, and color.

When the pet comes to the clinic, it undergoes an examination by a member of the consulting staff. The database should store the following information for each examination: chief complaint (i.e., the main cause for the visit), description (i.e., what was done during the examination), date seen, and actions taken (e.g., a treatment was prescribed, tests were ordered). A unique examination number (examNo) is assigned to each examination."

The project is divided into three parts, each constituting a piece of the overall design, development, and implementation process for creating the relational database. The following report is the first part of this project: developing a conceptual data model of the case study.

II. CONCEPTUAL DATA MODEL DEVELOPMENT: E-R DIAGRAM

An Entity-Relationship (E-R) diagram shows the relationships between entities in a system, such as people, objects, or concepts. This is the first step in the design of the database to understand how all entities are interconnected and relate to one another. The entities, relationships, and constraints that will be illustrated in the E-R diagram are determined through the following steps:

a. Identify the main entity types.
    a. **Clinic**.
    b. **Staff**.
    c. **Owner**.
    d. **Pet**.
    e. **Examination**.

b. Identify the main relationship types between the entity types identified in "a".
    a. **Clinic** *Employs* **Staff**.

       This is a one-to-many relationship as one clinic employs many staff members and staff members work at one clinic.

    b. **Clinic** *Registers* **Pet**.

       This is a one-to-many relationship as a clinic registers many pets, but a pet can only be registered at one clinic.

    c. **Staff** *Manages* **Clinic**.

       This is a one-to-one relationship as one manager can only manage one clinic and each clinic has only one manager.

    d. **Staff** *Performs* **Examination**.

This is a one-to-one relationship as a staff member performs one examination and each examination is performed by one staff member.

e. **Owner** *Owns* **Pet**.

This is a one-to-many relationship as one owner can own many pets, but a pet belongs to one owner.

f. **Pet** *Undergoes* **Examination**.

This is a one-to-one relationship as a pet undergoes one examination and each examination is undergone by one pet.

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

Multiplicity involves the participation and cardinality of a relationship, where the participation tells whether an entity can or must have an occurrence in a relationship and the cardinality is the maximum number of possible relationship occurrences.

a. **Clinic** *Employs* **Staff**.

From **Clinic** to **Staff**: each staff member works in a clinic (participation: 1) and a clinic employs multiple staff members (cardinality: *). Then, the multiplicity is 1..*.

From **Staff** to **Clinic**: each staff member is employed at a minimum and maximum of one clinic (participation and cardinality: 1). Then, the multiplicity is 1..1.

b. **Clinic** *Registers* **Pet**.

From **Clinic** to **Pet**: a clinic (participation: 1) can have multiple pets registered (cardinality: *). Then, the multiplicity is 1..*.

From **Pet** to **Clinic**: all pets are registered at a clinic (participation: 1) and a pet can only be registered at one clinic (cardinality: 1). Then, the multiplicity is 1..1.

c. **Staff** *Manages* **Clinic**.

From **Staff** to **Clinic**: only one staff member can manage a clinic (cardinality: 1) but not all staff members manage a clinic (participation: 0). Then, the multiplicity is 0..1.

From **Clinic** to **Staff**: all clinics are managed by a staff member (participation: 1) and one branch is managed by one staff member (cardinality: 1). Then, the multiplicity is 1..1.

d. **Staff** *Performs* **Examination**.

From **Staff** to **Examination**: not all staff members perform examinations (participation: 0) but those that do can perform many examinations over time (cardinality: *). Then, the multiplicity is 0..*.

From **Examination** to **Staff**: an examination is performed by a minimum and maximum of one staff member (participation and cardinality: 1). Then, the multiplicity is 1..1.

e. **Owner** *Owns* **Pet**.

From **Owner** to **Pet**: an owner (participation: 1) can own multiple pets (cardinality: *). Then, the multiplicity is 1..*.

From **Pet** to **Owner**: each pet is owned by a minimum and maximum of one owner (participation and cardinality: 1). Then, the multiplicity is 1..1.

f. **Pet** *Undergoes* **Examination**.

From **Pet** to **Examination**: a pet (participation: 1) undergoes many examinations over time (cardinality: *). Then, the multiplicity is 1..*.

From **Examination** to **Pet**: an examination is undergone by a minimum and maximum of one pet at a time (participation and cardinality: 1). Then, the multiplicity is 1..1.

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

a. **Clinic**
   clinicNo
   name
   address
   telephoneNumber

b. **Staff**
   staffNo
   name
   address
   telephoneNumber
   DOB
   position
   salary

c. **Owner**
   ownerNo
   name
   address
   telephoneNumber

d. **Pet**
   petNo
   name

DOB
species
breed
color

e. **Examination**
   examNo
   chiefComplaint
   description
   dateSeen
   actionsTaken

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

Strong entity types are those that are independent of other entities in a system, and, as such, can exist on their own. In this case, all entities are strong.

Candidate keys are attributes or a set of attributes that can uniquely identify a row in a relation. They are irreducible, meaning no proper subset of them can be unique. Primary keys are the candidate keys that are selected to uniquely identify rows in a relation. Note that the following assumption is made: each clinic, staff member, and pet owner has a unique telephone number.

a. **Clinic** has candidate keys {clinicNo} and {telephoneNumber}.

   The primary key is {clinicNo}.

b. **Staff** has candidate keys {staffNo} and {telephoneNumber}.

   The primary key is {staffNo}.

c. **Owner** has candidate keys {ownerNo} and {telephoneNumber}.

   The primary key is {ownerNo}.

d. **Pet** has candidate and primary key {petNo}.

e. **Examination** has candidate and primary key {examNo}.

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

III. E-R DIAGRAM

Below is the conceptual E-R diagram for the Pawsome Pets case study, illustrating the details outlined in the previous section.