CS4.301 Data and Applications - Project Phase 1

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Introduction to the Mini-World

This database project delves into a simplified representation of a hospital's world. It explores the various components of a hospital, such as doctors, patients, medicines, departments, and their interconnected relationships. This includes family connections like doctors' and patients' dependents, along with the equipment allocated to different hospital departments.

Purpose of the Database

This database is designed to efficiently manage the wealth of information within a hospital, with a focus on streamlining operations, enhancing patient care through centralized data access, enabling informed decision-making, ensuring regulatory compliance, optimizing resource management, and improving the overall patient experience. It also handles information about dependents of doctors and patients, aiding in staff and patient care decisions.

Users of the Database

The main users of this database encompass a wide spectrum, including healthcare professionals for patient care, hospital administrators for decision-making, pharmacists for medication management, patients for accessing their health records, family members and dependents, regulatory officers for compliance, and the hospital's board of directors for strategic planning and budgeting. This versatile system supports diverse roles, enhancing overall hospital operations and patient care.

Applications of the Database

The database's primary applications include patient management, clinical decision support, resource allocation, medication management, regulatory compliance, patient engagement, and strategic planning, enhancing patient care, operational efficiency, and informed decision-making within the hospital.

Database Requirements

The database includes 5 strong entities - Doctor, Director, Patient, Department and Attendant, and 3 weak entities - Dependent, Equipment and Treatment.

1 Entities

1.1 Doctor: Strong Entity

A Doctor is a medical professional responsible for diagnosing and treating patients. They play a crucial role in the hospital's healthcare system.

Attribute Name	Attribute Type	Data type	Example
Name	Composite (First Name, Last Name)	String	Naresh Trehan
Date of Birth	Simple	String	31/12/1966
Age	Derived (from DOB)	Integer	57
Gender	Simple	String	Male
Mobile Number	Multi-Valued	Integer	8965745200, 8226400012
Address	Composite (Building number,Street Number, City, State)	String	425, AanadVillas, Hyderabad, Telangana
Degree	Multi-valued	String	MBBS,MD,DM
Doctor ID	Primary	Integer	7
Availability	Composite (Day, Time)	String	MON-FRI, 9 AM - 5 PM
Salary	Simple	Integer	750000
Experience	Simple	Integer	15
Expertise	Multi-Valued	String	Cardiothoracic Surgeon, Cardiovascular Surgeon
Former Employers	Multi Valued	String	Medanta, Care Hospitals

1.2 Director: Strong Entity

The Director is a key administrative figure in the hospital responsible for overseeing and managing various aspects of hospital operations.

Attribute Name	Attribute Type	Data type	Example
Name	Composite (First Name, Last Name)	String	Kabir Kashyap
Date of Birth	Simple	String	05/05/1984
Age	Derived (from DOB)	Integer	39
Gender	Simple	String	Male
Mobile Number	Multi-Valued	Integer	8567452789, 7009236011
Address	Composite (Flat number,Street Number, City, State)	String	624, Amaryllis, Hyderabad, Telangana
Qualification	Multi-valued	String	B.COM,MBA
Employee ID	Primary	Integer	5
Salary	Simple	Integer	1050000
Equity	Simple	Integer	10
Incumbent	Simple	Integer	2015
Position	Simple	String	Vice-President
Former Employers	Multi Valued	String	MAX, Kokilaben Hospitals

1.3 Patient: Strong Entity

Patients are individuals who seek medical care and treatment at the hospital. They are at the core of the hospital's services.

Attribute Name	Attribute Type	Data type	Example
Name	Composite (First Name, Last Name)	String	Aryan Rathore
Date of Birth	Simple	String	05/07/1997
Age	Derived (from DOB)	Integer	26
Mobile Number	Multi-Valued	Integer	9856745209, 9236700011
Gender	Simple	String	Male
Address	Composite (Flat number,Street Number, City, State)	String	34, DLF Apartments, Hyderabad, Telangana
Medic	Multi-valued	String	Naresh Trehan, Vishal Garg
Patient ID	Primary	Integer	564
Bill Status	Simple (Paid-True, Pending- False)	Boolean	False
Freshman	Simple (Yes-True, No-False)	Boolean	True
Room Number	Simple	Integer	478
Ailment	Multi-Valued	String	Swelling Leg, Dengue
Occupation	Simple	String	Sportsperson

1.4 Department: Strong Entity

Hospital Departments are functional units responsible for specific medical services such as cardiology, radiology or surgery.

Attribute Name	Attribute Type	Data type	Example
Name	Primary	String	Cardiology
Location	Simple (Floor)	Integer	4
Head	Simple	String	Naresh Trehan
Medic Count	Simple	Integer	12
Patient Count	Simple	Integer	47
Establishment	Simple	Integer	2002
Revenue	Simple	Integer	2500000

1.5 Attendant: Strong Entity

Attendants are support staff members who assist in patient care and hospital operations, contributing to the smooth functioning of the hospital.

Attribute Name	Attribute Type	Data type	Example
Name	Composite (First Name, Last Name)	String	Priya Shukla
Date of Birth	Simple	String	16/02/1990
Age	Derived (from DOB)	Integer	33
Gender	Simple	String	Female
Mobile Number	Multi-Valued	Integer	6798305509, 9578934103
Address	Composite (Flat number,Street Number, City, State)	String	12, Radhe Apartments, Hyderabad, Telangana
Degree	Multi-valued	String	BSN,ADN
Staff ID	Primary	Integer	124
Shift	Composite (Day, Time)	String	MON-SUN, 9 PM - 6 AM
Salary	Simple	Integer	50000
Experience	Simple	Integer	5
Former Employers	Multi Valued	String	Himagiri Hospitals, Apollo

1.6 Dependents: Weak Entity

Identifying Entity - Patient

Dependents are individuals related to Patients and their information is linked to the Patient entity, aiding in family and medical decision-making for the patient's care.

Attribute Name	Attribute Type	Data type	Example
Name	Composite (First Name, Last Name)	String	Shweta Rathore
Date of Birth	Simple	String	15/08/1998
Age	Derived (from DOB)	Integer	25
Gender	Simple	String	Female
Mobile Number	Multi-Valued	Integer	9867553009, 8939574103
Address	Composite (Flat number,Street Number, City, State)	String	34, DLF Apartments, Hyderabad, Telangana
Relationship	Simple	String	Wife

1.7 Equipment: Weak Entity

Identifying Entity - Department

Equipment refers to the medical tools and devices used within hospital departments, facilitating medical procedures and patient care.

Attribute Name	Attribute Type	Data type	Example
Name	Composite (Generic Name, Model)	String	Stethoscope HR-9845
Procurement Date	Simple	String	05/07/2018
Quantity	Simple	Integer	12
Purpose	Multi-Valued	String	Checking Heartbeat, Checking Blood Pressure
Price	Simple	Integer	1369
Requirement	Simple	Integer	1
Handler	Multi-Valued	String	Ram Singh, Abhishek Rawat
Condition	Simple (True-Good, False-Replacement Required)	Boolean	True

1.8 Treatment: Weak Entity

Identifying Entity - Doctor & Patient

Treatment records capture the medical procedures and therapies provided to patients, with links to both doctors and patients, ensuring comprehensive medical history management.

Attribute Name	Attribute Type	Data type	Example
Treatment Id	Partial-Key (Doctor Id '+' Patient Id)	Integer	$10_900(10' +' 900)$
Department Name	Simple	String	Orthopedics
Visit Date	Simple	String	06/10/2023
Visit Time	Simple	String	3:00 PM
First Treatment	Simple (Yes-True, No-False)	Boolean	Yes
Treatment Fee	Simple	Integer	35000

2 Relationships

2.1 Doctor - Treatment - Patient

- **Brief**: Doctors are responsible for the administering treatment to patient.
- **Type**: Ternary
- **Degree**: 3
- **Cardinality**: 1:N:1
- **Participation Constraint**
  - **Doctor**: (1,N)
  - **Treatment**: (1,1)

  - **Patient**: (1,N)

2.2 Doctor - Equipment - Treatment

- **Brief**: Doctors uses equipment to decide and administrate treatment to patient.
- **Type**: Ternary
- **Degree**: 3
- **Cardinality**: 1:N:1 (Check This)
- **Participation Constraint**
  - **Doctor**: (1,N)
  - **Treatment**: (0,N)
  - **Patient**: (1,N)

2.3 Doctor - Doctor

- **Brief**: Doctors supervise other doctors and or doctors work as sub-ordinate to other doctors based on experience.
- **Type**: Binary (Recursive Relation)
- **Degree**: 2
- **Cardinality**: 1:N
- **Participation Constraint**
  - **Doctor**: (0,N)

2.4 Doctor - Department

- **Brief**: Doctor works in a particular department based on his field of expertise.
- **Type**: Binary
- **Degree**: 2
- **Cardinality**: N:1
- **Participation Constraint**
  - **Doctor**: (1,1)
  - **Department**: (1,N)

2.5 Doctor - Attendant

- **Brief**: Doctor provides guidance and oversees the attendant's work.
- **Type**: Binary
- **Degree**: 2
- **Cardinality**: 1:N
- **Participation Constraint**
  - **Doctor**: (0,N)
  - **Attendant**: (0,1)

2.6 Director - Department

- **Brief**: Directors assess the departments once in a while to ensure smooth functionality and to maximise profit.
- **Type**: Binary
- **Degree**: 2
- **Cardinality**: 1:1
- **Participation Constraint**
  - **Director**: (0,1)
  - **Department**: (1,1)

2.7 Patient - Dependent

- **Brief**: Patient supports and take care of their dependents.
- **Type**: Binary (Identifying Relation)
- **Degree**: 2
- **Cardinality**: 1:N
- **Participation Constraint**
  - **Patient**: (0,N)
  - **Dependent**: (1,1)

2.8 Attendant - Patient

- **Brief**: Attendants overlook after the pateint in absence of doctors or post treatment.
- **Type**: Binary
- **Degree**: 2
- **Cardinality**: N:M

- **Participation Constraint**
  - **Attendant**: (1,N)
  - **Patient**: (1,M)

2.9 Attendant - Department

- **Brief**: Attendants works together under one department.
- **Type**: Binary
- **Degree**: 2
- **Cardinality**: N:M
- **Participation Constraint**
  - **Attendant**: (1,M)
  - **Department**: (1,N)

2.10 Department - Doctor

- **Brief**: Department manages and co-ordinate work of all the doctors.
- **Type**: Binary
- **Degree**: 2
- **Cardinality**: 1:N
- **Participation Constraint**
  - **Doctor**: (1,N)
  - **Department**: (1,1)

2.11 Department - Equipment

- **Brief**: Department procures multiple equipment for accurate and faster diagnosis.
- **Type**: Binary (Identifying Relation)
- **Degree**: 2
- **Cardinality**: 1:N
- **Participation Constraint**
  - **Department**: (1,1)
  - **Equipment**: (1,N)

3 Functional Requirements

3.1 Modifications

- Insert
  - Insert newly joining medical staff including doctors and directors on recruitment.
  - Insert new patients on their admission in hospital.
  - Insert new equipment procured by hospital.
  - Insert treatment after every consultation.
- Update
  - Update the personal details of hospital personnel (doctors, directors and attendants).
  - Update salary of hospital personnel (doctors, directors and attendants) to incorporate annual increment.
  - Update the department head in event of any changes.
- Delete
  - Delete an equipment from the hospital's records following its discard
  - Delete records of a nurse or doctor from the hospital's records after their departure in accordance with a formal process

3.2 Retrievals

- Aggregates
  - Average number of doctors consulted by a patient - average
  - Total amount of equipment with a department - sum
  - Max/min profit of a department - max/min
  - Average cost of treatment for a particular disease – average
- Search
  - List of patients cared or treated by a doctor.
  - List of treatments administered to a patient.
  - Conduct a search to identify patients under the age of 10 and above the age of 60.
  - Which all doctors are available on a particular day, during a particular time slot.(Don't include as hard to implement)
- Projection
  - An inventory of equipment categorized by their respective departments.
  - Comprehensive schedule displaying the availability timings for all doctors.
- Analysis
  - Generate a list of patients who have made visits to the hospital exceeding 'k' times.

- Determine the month of the year or day of the week that records the highest/lowest patient visits, possibly influenced by a special offer provided by the hospital.
- Compile a list of treatments administered between a specified start date/time and an end date/time.
- Identify the predominant age group in a specific department or category of ailments, such as the prevalence of dengue/malaria in children or bone/joint pain in senior citizens.

Summary

This hospital database project is designed to efficiently manage and streamline hospital operations, enhance patient care, and support data-driven decisions. It serves a diverse range of users and includes strong and weak entities. The primary applications encompass patient management, clinical decision support, resource allocation, and medication management. The project outlines the essential database requirements, relationships, and functional features needed to achieve these goals. Ultimately, the project aims to improve healthcare service delivery and the overall healthcare experience for patients and professionals within the hospital's dynamic setting.

Assumptions

1. The DOB format is dd/mm/yyyy.
2. The salary provided for each person is monthly salary.
3. Equity is % (percent) of the company.
4. One doctor can be part of only one Department.
5. Attendant can work in any number of department.
6. Only one dependent per person, will be contacted in case of emergency.
7. Director and Head are two different persons for same department. Director watches over publicity, profits, logistics or other mattters where as head is concerned only with medical matters (like for surgery we have head as chief of surgery looks over each surgery).
8. Attendant consist of all the staff excluding doctors and management. This may include nurses, compounders, Ambulance Rider etc.