**​​[1DV503] Database Technology and Modeling**

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### **Task 1. The Hospital database (25 points)**

* 1. ***Identify all entities and their attributes from the description of database requirements using the following Table template:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Entity** | **Attribute** | **Attribute Type** | **Key Attribute** | **Value type of attribute** |
| Department | DepartmentID | Simple | true | Integer, not null, unique |
| Department | Name | Simple | false | String, not null |
| Department | HeadPhysician | Simple | false | String, null |
| Physician | PhysicianID | Simple | true | Integer, not null, unique |
| Physician | Name | Simple | false | String, not null |
| Physician | PhoneNumber | Simple | false | String, null |
| Physician | Address | Simple | false | String, null |
| Patient | PatientID | Simple | true | Integer, not null, unique |
| Patient | Name | Composite | false | String, not null |
| Patient | Address | Simple | false | String, null |
| Patient | PhoneNumber | Simple | false | String, null |
| Patient | InsuranceCode | Simple | false | String, null |
| Test | TestID | Simple | true | Integer, not null, unique |
| Test | Date | Simple | false | Date, not null |
| Test | Type | Simple | false | String, null |
| Test | Result | Simple | false | String, null |
| Appointment | AppointmentID | Simple | true | Integer, not null, unique |
| Appointment | StartDate | Simple | false | Date, not null |
| Appointment | EndDate | Simple | false | Date, not null |
| Room | RoomNumber | Simple | true | Integer, not null, unique |
| Room | Type | Simple | false | String, null |
| Room | Availability | Simple | false | String not null |
| Nurse | NurseID | Simple | true | Integer, not null, unique |
| Nurse | Name | Simple | false | String, not null |
| Nurse | PhoneNumber | Simple | false | String, null |
| Nurse | Specialization | Simple | false | String, null |
| Medication | MedicationID | Simple | true | Integer, not null, unique |
| Medication | ATCCode | Simple | false | String, null |
| Medication | Name | Simple | false | String, null |
| Medication | Type | Simple | false | String, null |
| Medication | Description | Composite | false | String, null |
| Procedure | ProcedureID | Simple | true | Integer, not null, unique |
| Procedure | Name | Simple | false | String, null |
| Procedure | Cost | Simple | false | Integer, null |

***1.2 Identifying the relationship between entity sets using the following table template:***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Entity A** | **Relationship Name** | **Entity B** | **Cardinality Ratio** | **Attribute of Relationship** | **Justify your decision** |
| Physician | Makes | Appointment | 1:N | None | A physician makes appointments with many patients, but a patient has appointments with one physician. |
| Physician | Prescribes | Procedure,  Medication | 1:N | None | Each prescription is associated with exactly one physician, but a physician can prescribe many procedures and medications. |
| Patient | Receives | Appointment | 1:N | None | Each appointment is associated with exactly one patient, but a patient can have many appointments. |
| Patient | Takes | Test | 1:N | None | Each test is associated with exactly one patient, but a patient can take many tests. |
| Room | AssignedTo | Appointment | 1:N | None | Each appointment is assigned to exactly one room, but a room can be assigned to many appointments |
| Nurse | AssignedTo | Appointment | 1:N | StartTime, EndTime | Each nurse can be on call for many rooms, but a room can have at most one nurse on call. |
| Nurse | OnCall | Room | 1:N | StartTime, EndTime | Each nurse can be on call for many rooms, but a room can have at most one nurse on call. |

***1.3 Design an ER schema for hospital database based on information provided in task 1, and entities defined in 1.2 with relationships defined in 1.3.***

The ER schema should contain entities with their corresponding attributes, key attributes of each entity, relationship types, and their corresponding cardinality ratio.

A diagram of a company

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### **Task 2 Conference Review Database (25 points)**

***2.1******Identify all entities and their attributes from the description of Conference review database requirements using the following Table template:***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Entity** | **Attribute** | **Attribute Type** | **Key Attribute** | **Value type of attribute** |
| Author | Email | Simple | true | String, not null, unique |
| Author | Name | Composite | false | String, not null |
| Author | Affiliation | Simple | false | String, not null |
| Author | Country | Simple | false | String, not null |
| Paper | PaperID | Simple | true | Integer, not null, unique |
| Paper | Title | Simple | false | String, not null |
| Paper | Abstract | Simple | false | String, not null |
| Paper | Keywords | Multivalued | false | String, not null |
| Paper | Year | Simple | false | Integer, not null |
| Paper | FileName | Simple | false | String, not null |
| Reviewer | Email | Simple | true | String, not null, unique |
| Reviewer | FirstName | Simple | false | String, not null |
| Reviewer | LastName | Simple | false | String, not null |
| Reviewer | PhoneNumber | Simple | false | , null |
| Reviewer | Affiliation | Simple | false | String, not null |
| Reviewer | Topics | Multivalued | false | String, null |
| Dependent | DependentID | Simple | true | Integer, not null, unique |
| Dependent | Name | Simple | false | Integer, not null |
| Dependent | Gender | Simple | false | Integer, not null |
| Dependent | Birthdate | Simple | false | Date, not null |

***2.2 Identifying the relationship between entity sets using the following table template:***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Entity A** | **Relationship Name** | **Entity B** | **Cardinality Ratio** | **Attribute of Relationship** | **Justify your answer** |
| Author | Writes | Paper | 1:N | - | An author can write 0 or more papers, and each paper is written by at least one author. |
| Paper | Writes | Author | N:1 | CorrespondingAuthor | A paper can have multiple authors, but only one is marked as the corresponding author. |
| Reviewer | Review | Paper | N:M | Rating, ReviewComments | A reviewer can review 0 or more papers, and a paper can be reviewed by 2 to 4 reviewers. |
| Reviewer | HasDependent | Dependent | 1:N | - | A reviewer can have 0 or more dependents. |

***2.3 Design an ER schema for review database based on information provided in task 2, and entities defined in 2.1 with relationships defined in 2.2.*** You are free to make additional assumptions if you feel that some information is missing. Make sure to **document** **all assumptions** that you make. Please justify your assumptions.

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### **Assumptions and Justifications:**

1. In the **AUTHOR** entity, the **Email** attribute is chosen as the primary key (**PK**) since it is expected to be unique for each author.
2. The **WRITES** relationship is established between **AUTHOR** and **PAPER** with a many-to-many (M:N) cardinality, as a paper can have multiple authors, and an author can write multiple papers.
3. The **CorrespondingAuthor** relationship is introduced to identify the corresponding author for a paper. It is assumed that only one author is marked as the corresponding author for simplicity.
4. The **REVIEWER** entity has a **TopicsOfInterest** attribute to capture the areas of interest for each reviewer.
5. The **REVIEWS** relationship is formed between **REVIEWER** and **PAPER** with a many-to-many (M:N) cardinality, as a reviewer can review multiple papers, and a paper can be reviewed by multiple reviewers.
6. The **HAS\_DEPENDENT** relationship links **REVIEWER** with **DEPENDENT** to represent the dependents associated with each reviewer. It is assumed that a reviewer can have multiple dependents.
7. In the **DEPENDENT** entity, **Birthdate** is considered as a **Date** attribute for simplicity.

### **Task 3. Bank database (25 points)**

1. List all strong (non-weak) entities in the ER diagram:
   * Bank
   * Customer
   * Account
   * Loan
2. Is there a weak entity? If so, give its name, partial key, and identifying relationship (owner entity):
   * Yes, the weak entity is "Bank\_Branch."
   * Partial key: Branch\_no
   * Identifying relationship: Has\_Brances (with owner entity "Bank")
3. What constraints do the partial key and the identifying relationship (owner) of the weak entity have in this diagram:
   * The partial key "Branch\_no" is unique within each account.
   * The identifying relationship "Has\_Branches" indicates that each customer is identified within the scope of an account.
4. List the names of all relations (entities) and specify the (min, max) constraint using total/partial participation of an entity in a relationship (on both sides of the relation: left and right). Justify your answer:

|  |  |  |  |
| --- | --- | --- | --- |
| **Entity name** | **Relationship**  **name** | **(min,max)** | **Justify your answer** |
| Bank | Has\_Branches | (1,N) | This indicates that a bank must have at least one branch, and it can have multiple branches (total participation). |
| Bank\_Branch | Has\_Branches | (1,1) | Each branch must be associated with exactly one bank (total participation). |
| Account | Has\_Accounts | (0,N) | An account may or may not be associated with a bank branch (partial participation). |
| Bank\_Branch | Has\_Accounts | (0,N) | A bank branch may or may not have accounts (partial participation). |
| Account | A\_C | (1,N) | An account must be associated with at least one customer (total participation). |
| Customer | A\_C | (1,N) | A customer must have at least one account (total participation). |
| Customer | L\_C | (0,N) | A customer may or may not have a loan (partial participation). |
| Loan | L\_C | (1,N) | A loan must be associated with at least one customer (total participation). |
| Loan | Loan | (0,N) | A loan may or may not be associated with a bank branch (partial participation). |
| Bank\_Branch | Loan | (1,N) | A bank branch must have at least one loan (total participation). |

### **Task 4. Airport Management database (25 points)**

***4.1******Given the constraints shown in the ER schema below, respond to the following statements with True, False, or Maybe.***

|  |  |  |  |
| --- | --- | --- | --- |
| **N** | **Statement** | **True/False/Maybe** | **Justify your answer** |
| 1 | Every pilot has been a passenger in some flight. | True | Pilot entity has a relation “is a” with Passenger entity |
| 2 | Every flight has at least one deadheading pilot. | True | Pilot entity has a relation “Deadheading” with Flight entity with 1:N |
| 3 | Every flight has at least 2 pilots. | True | There is a minimum cardinality of 2 on the "Flies" relationship between "Flight" and "Pilot" |
| 4 | Every pilot has flown at least 2 times. | Maybe | If there is a N cardinality of the "Assigned" relationship between "Flight" and "Pilot," |
| 5 | There are tickets that do not belong to any flight. | False | The "Belong to" relationship between "Ticket" and "Flight" with a minimum cardinality of (N:1) |
| 6 | Some airline does not have flights. | False | Airline entity has a Belong to relationship with Flight with 1:N so it can have N number of flights |
| 7 | Some flight does not have assigned aircraft. | False | Flight entity has 1 Aircraft entity with the Assigned relationship |
| 8 | Each flight has a departure and arrival airport assigned. | True | "Departure" and "Arrival" relationships between "Flight" and "Airport." |
| 9 | A passenger can be a pilot. | True | Between Passenger And Pilot entity there is an “is a” relationship with 1:1 |
| 10 | Passengers can buy one ticket for the flight. | Maybe | Passenger can Book N Tickets and a Ticket is Belong to 1 Flight so it can book as many Ticket as want |
| 11 | There are tickets that do not have a class type (Economy, etc.) | False | Between Ticket and Class there is a Has relationship with 1:N and the N is double line |
| 12 | There are some tickets without payment. | True | Tickets may be booked but not paid for in advance. |
| 13 | There are some flights without tickets. | False | Between Ticket and Flight there is a Belong relationship with N:1 and with double lines |
| 14 | There are some aircraft that are not assigned to a flight. | False | Between Aircraft and Flight there is an Assigned relationship with 1:N and the N is double-lined |
| 15 | Some airlines do not have any flights. | True | The Belong to relationship between Airline and Flight with a minimum cardinality of 0 |