CPCS241-Database I-Spring2020-Project

[Hajj services System]

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PART I: Analysis

1 Problem Definition and Data Requirements

1.1 Problem Description

Planning a trip to the sacred city of Mecca to perform an Islamic religious duty such as hajj can be a long hard process especially for foreign guests. Obstacles can be overcome by contracting with an intermediate company to help pilgrims realize their dream.

The company's work with all the Islamic countries and focuses only on organizing Hajj for foreign guests outside Saudi Arabia. The guest first need to go to one of the travel agency in their country approved by The Ministry of Hajj and Umrah and the Saudi Ministry of Foreign Affairs, then they can apply for a visa application and travel to the Kingdom of Saudi Arabia.

The company must keep track of all guests' information and have a record of the services that are provided to them such as transportation and the hotel they are staying in.

Companies that offer such services usually have different categories to guests, cost depend upon the chosen class. The company has a high-cost classes which includes class A+/A and B also, for guests with low budget the company offers them a low-cost classes which are B and C. Those classes are distinguished from each other by the place of residence, transportation, meals and other features.

1.2 Data Requirements

1- Employee's requirement:

- Each Employee has a name, SSN (P.K), address, salary, bonuses, vacations, workingHours, gender and dateOfBirth.

2- Company's requirement:

- Each Department has a name, departmentID(P.K), managerID(unique), manager start date and department location.
- Each External Agent has nameOfCompany, portfolio, locationOfExternalAgent, Email (unique), permitNumber (P.K), phoneNumber(unique) and contractDate.
- Each Volunteer Companies has nameOfCompany, companyID (P.K), domain for volunteer and numberOfVolunteers.

3- Guest's requirement:

- Each Guest has a name, guestID(P.K), gender, nationality, dateOfBirth, Email, phoneNumber(unique), medicalRecord(unique), barcode(unique), passport(unique), VISA(unique) and the chosen class.
- The VISA include visaNumber (P.K), guestID, Date, Validity and duration of stay.
- Each Disappeared Guests from the campaign will have disappearedName(partial key), disappearedID (F.K), {disappearedName , disappearedID} (P.K) and dateOfDisappearance .

4- Company's services requirement

- There will be 4 Classes for hajj every Class has classNumber (P.K), className (unique), food, density, capacity and the placeOfClass.
- Transportation for hajj must have vehicleID (P.K), nameOfCompany, capacityOfVehicle, dateOfTrip, numberOfAvailableVehicles and typeOfVehicle.
- The hotels belongs to Classes and it has {hotelName , roomNumbe}(P.K) ,price and rating.

1.3 Business Rules

Department Policies:

1- The company contains multiple departments each one is responsible for different tasks a department responsible for handling all the external agents, a department for booking hotels, a department for organizing transportation and a department that handles the volunteers.
2- The company keep a list of a specific hotels and transportation companies.
3- An electronic platform is used through which hotels and transportation are reserved for incoming visitors.

External Agent Policies:

1- Each Hajj company in Saudi Arabia have five external accredited agents in each country, and there must be a contract between the two parties and confirm their agency through the Ministry of Hajj.
2- A financial portfolio must be open for each external agent to deduct the total cost of the services provided by the company.

Guest's Policies:

1- There will be no Hajj without a valid visa.
2- Passports should be valid for at least 6 months from the date of submission of the application form.
3- When Guest's disappears from the campaign, a letter must be sent to the Ministry of Hajj and Umrah.
4- The company keeps a record of information for each disappeared guest.
5- For each guest, an electronic bracelet that contains a unique barcode linked to their information is provided.

Employee Policies:

1- An employee should only work for one department and has a specific job regarding that department.
2- A group of employees have one supervisor.
3- A department contain several employees.
4- A department should have only one manager.

- **Volunteer Policies:**

1- The "Kun Awnan" program was established to contributes to organizing the Hajj. The program assigns volunteers to different locations based on their domain, skills and experience.
2- A volunteer can be working in more than one department in the same month.
3- The volunteer unit counted by hours.
4- Every volunteer in the Hajj has tasks in specific domains such as: mentoring, helping translate, provide traffic control, health care, receiving and bidding farewell to guests in all parts of the Saudi Arabia.

- **Class Categories & Policies:**

The housing services provided in these categories are very convenient. They include sofa beds/blankets/sheets. And buffet meals, 24 hours hot/cold drinks.

High-cost Hajj category:

- **Class A+:** In Mona Real Estate Towers the towers are close to the Jamarat Bridge and they are 6 towers distributed among six companies for the pilgrims inside and the capacity has about 11,872 thousand pilgrims. Class A+ is the most expensive it costs about 10000sr.
- **Class A:** The tents contain exclusive VIP tents in Mina very close to the Jamarat in a private tents and contains 30 tents. The walk to the Jamarat takes about 20 minutes. Class A costs about 8000sr.

Low-cost Hajj category:

The housing services provided in the dormitory (mattress type, pillow, quilts, and blankets) and meal items are below the high cost category.

- **Class B:** contains 17 tents and long distance from Jamarat compared to A + and A. Costs about 6000sr.
- **Class C:** contains 19 tents at Muzdalifah border. Class C costs about 3000sr and it considers the cheapest.

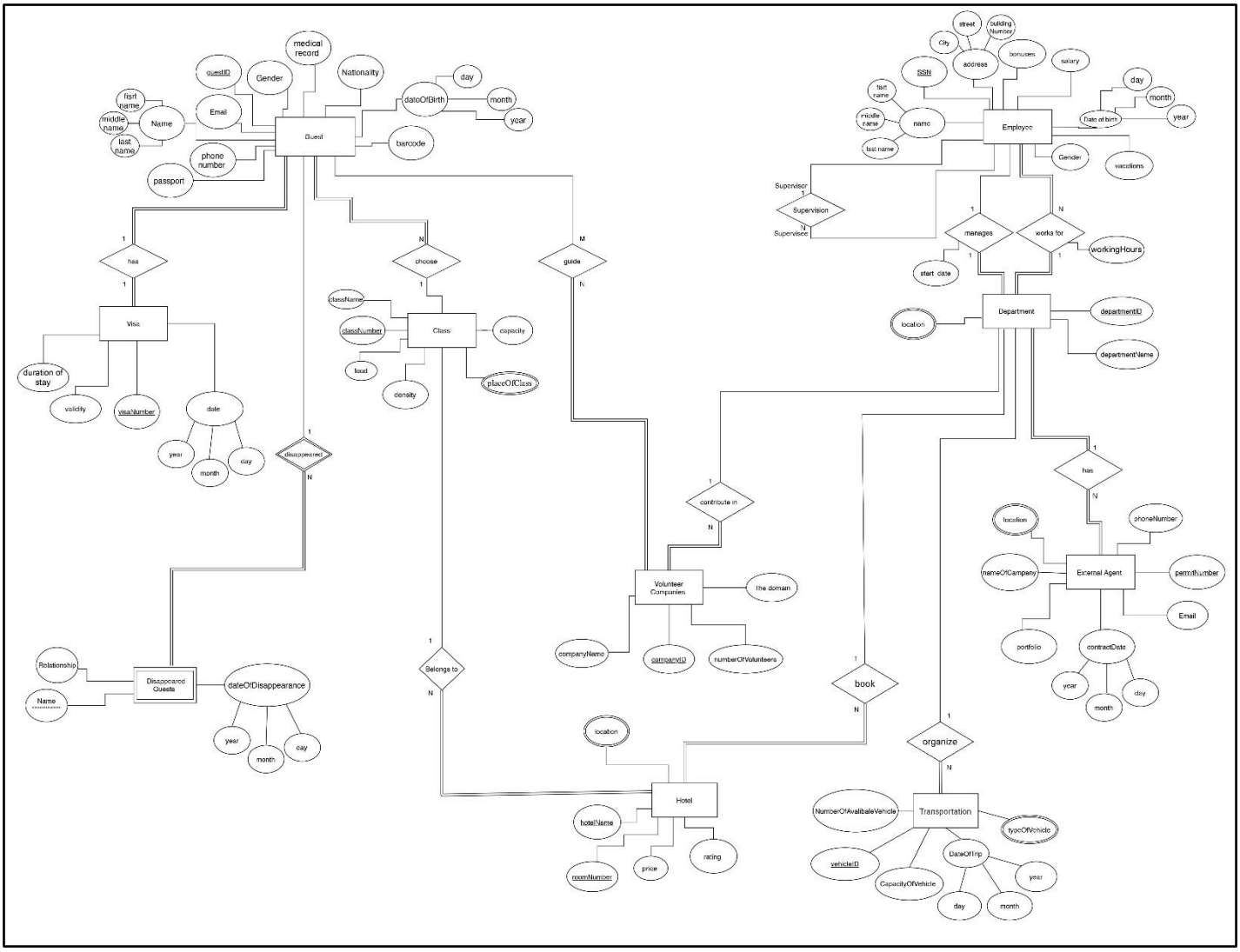
1.4 Intended Output of the system

1- Stores all the Guests information
2- Have a record of the hotels, transportations company associated
3- List all guests for hajj in every year
4- Calculate the company's annual percentage rate
5- Statistics over the last 5 years to maintain the quality

PART II: DB DEISGN

2 ER Diagram Design

2.1 ER diagram



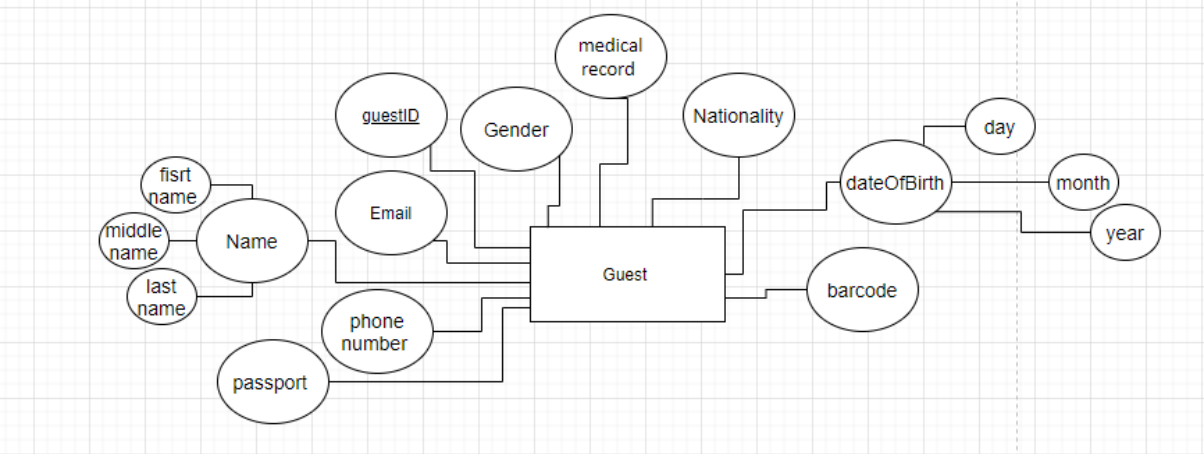
2.2 Design of Business Rules

Business Rule	Design Decisions	Justification (if any)
The company has different department and each department should have a one manager	1-1 relationship between employee and department	One employee can be assigned as a manager to one department
Every guest needs a visa for hajj	1-1 relationship between guest and visa	Guest can have one visa for hajj, and each visa belong to one guest only
Each employee should work for a specific department	1-N relationship between employee and department	A department can have multiple employees, but an employee should only work for one department
Each employee has a supervisor	1-N relationship between employees	One employee supervises many employees
Department has external agents	1-N relationship between department and external agents	A department can have several external agents, each external agent assigned to one department
A department is responsible for booking hotels.	1-N relationship between department and hotel	One department is responsible for booking many hotels for guests
Each guest will choose one Hajj class	1-N relationship between guest and class	A guest cannot be in more than one class
In case of disappearing, the company must keep the disappeared guest information	1-N weak relationship between guests and disappeared guests	
Volunteers contribute in department	1-N relationship between department and volunteer	A department can have many volunteers, and each volunteer contribute in one department
Hotels belong to one Hajj class	1-N relationship between class and hotel	The group of hotels in the same region belongs to one class.
A department is responsible for organizing transportation	1-N relationship between department and Transportation.	One department is responsible for organizing several transportations for the guests
Volunteers provide guidance and help for pilgrims	N-M relationship between volunteers and guests	Many volunteers guide more than one pilgrim and each pilgrim receive the help from different volunteers

3 ER-to-logical schema mapping

3.1 Mapping of Regular Entity Types

- **1- Guest Entity**



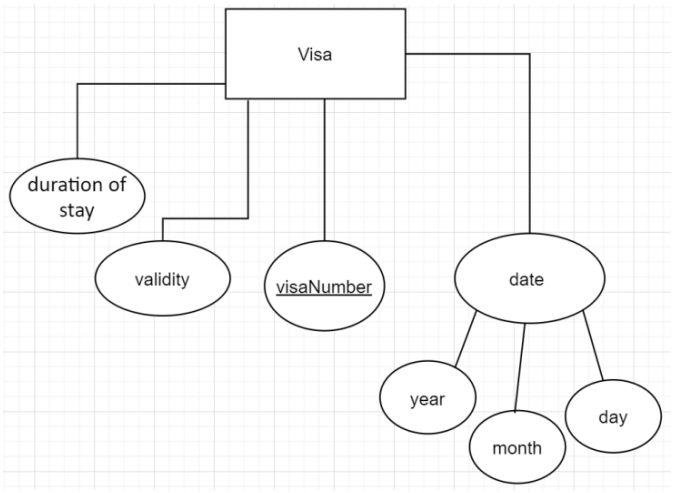
Guest

guestID	guestFname	guestMname	guestLname	Phone Number	Passpcort	Nationality	medical Record	Email	Gender	yearGBrith	monthGBrith	DayGBrith	barcode

Description:

- We create the relation GUEST in the relational schema corresponding to the regular entity GUEST in the ER diagram.
- (guestID) is the primary key for the relation GUEST as shown and it is used to uniquely identify each tuple in the GUEST relation.

- **2- Visa Entity**



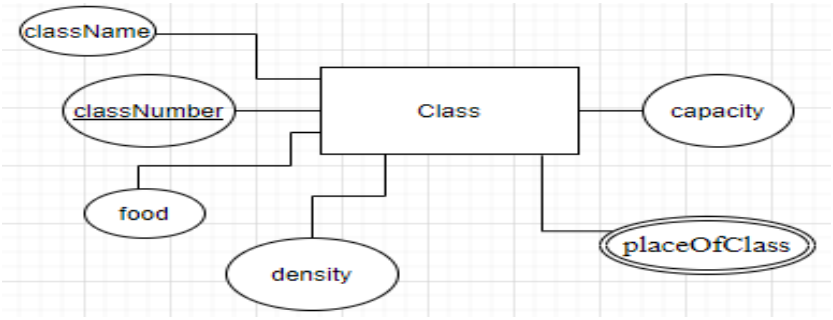
Visa

visaNumber	Validity	DurationOfStay	Yeardate	Monthdate	Daydate

Description:

- We create the relation VISA in the relational schema corresponding to the regular entity VISA in the ER diagram.
- (visaNumber) is the primary key for the relation VISA as shown and it is used to uniquely identify each tuple in the VISA relation.

- **3- Class Entity**



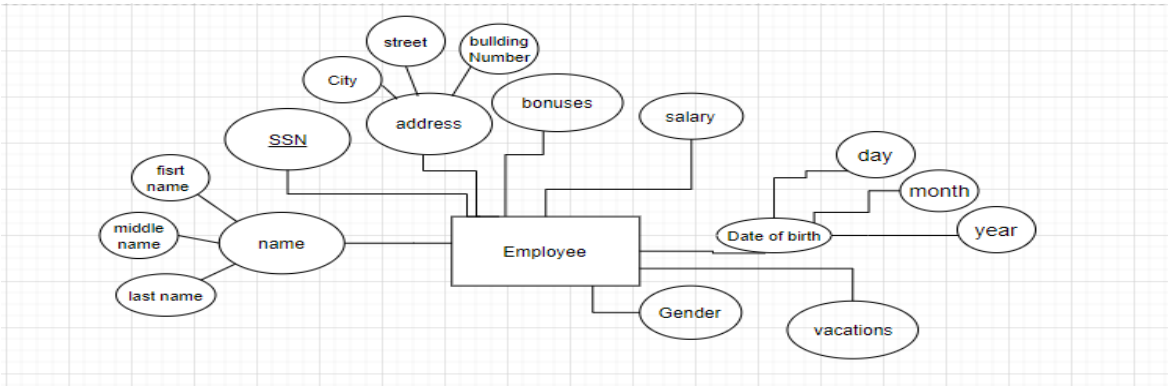
Class

classNumber	className	Density	Capacity	Food

Description:

- We create the relation CLASS in the relational schema corresponding to the regular entity CLASS in the ER diagram.
- (classNumber) is the primary key for the relation CLASS as shown and it is used to uniquely identify each tuple in the CLASS relation .

- **4- Employee Entity**



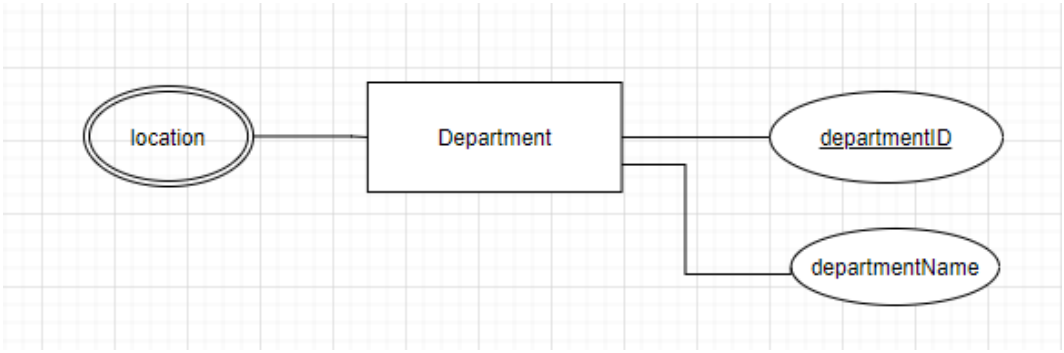
Employee

EmployeeFname	EmployeeMname	EmployeeLname	city	Building number	street	bonuses	salary	Year EBrith	monthEBrith	dayEBrith	vacation	gender	SSN

Description:

- We create the relation EMPLOYEE in the relational schema corresponding to the regular entity EMPLOYEE in the ER diagram.
- (SSN) is the primary key for the relation EMPLOYEE as shown and it is used to uniquely identify each tuple in the EMPLOYEE relation.

- **5- Department Entity**



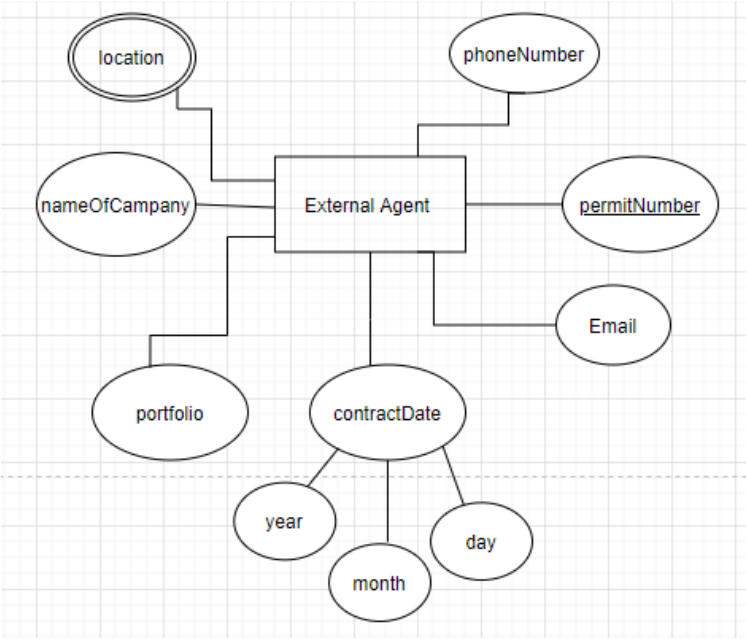
Department

departmentID	departmentName

Description:

- We create the relation DEPARTMENT in the relational schema corresponding to the regular entity DEPARTMENT in the ER diagram.
- (departmentID) is the primary key for the relation DEPARTMENT as shown and it is used to uniquely identify each tuple in the DEPARTMENT relation.

- **6- External Agent Entity**



External Agent

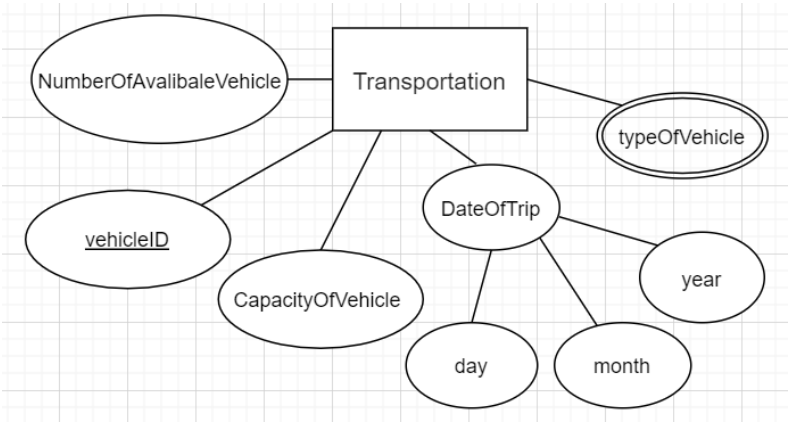
nameOfCompany	Portfolio	ContractD year	ContractD month	ContractD day	Email	permitNumber	phoneNumber

Description:

- We create the relation EXTERNAL AGENT in the relational schema corresponding to the regular entity EXTERNAL AGENT in the ER diagram.

- (permitNumber) is the primary key for the relation EXTERNAL AGENT as shown and it is used to uniquely identify each tuple in the EXTERNAL AGENT relation.

- **7- Transportation Entity**



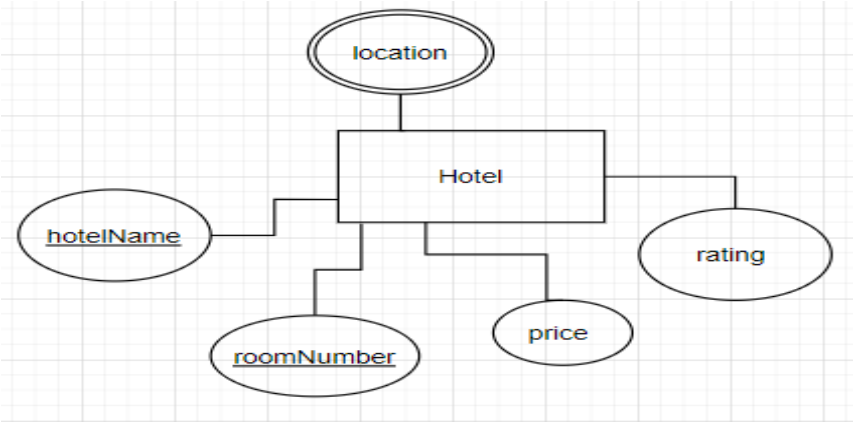
Transportation

numberOfAvailableVehicles	vehicleID	capacityOfVehicle	dayTrip	monthTrip	yearTrip

Description:

- We create the relation TRANSPORTATION in the relational schema corresponding to the regular entity TRANSPORTATION in the ER diagram.
- (vehicleID) is the primary key for the relation TRANSPORTATION as shown and it is used to uniquely identify each tuple in the TRANSPORTATION relation.

- **8- Hotel Entity**



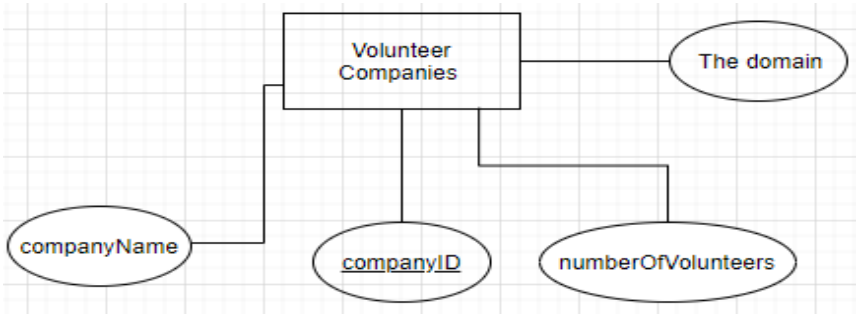
Hotel

hotelName	roomNumber	price	rating

Description:

- We create the relation HOTEL in the relational schema corresponding to the regular entity HOTEL in the ER diagram.
- The combination of {hotelName, roomNumber} is the primary key for the relation HOTEL as shown and it is used to uniquely identify each tuple in the HOTEL relation.

- **9- Volunteer Companies Entity**



Volunteer Companies

companyName	companyID	numberOfVolunteers	The domain

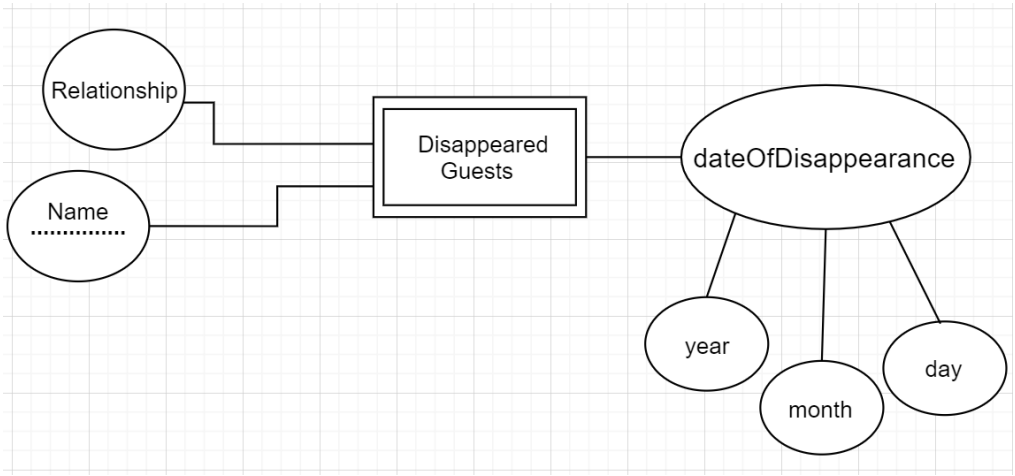
Description:

- We create the relation VOLUNTEER COMPANIES in the relational schema corresponding to the regular entity VOLUNTEER COMPANIES in the ER diagram.

- (companyID) is the primary key for the relation VOLUNTEER COMPANIES as shown and it is used to uniquely identify each tuple in the VOLUNTEER COMPANIES relation .

3.2 Mapping of Weak Entity Types

- **10-Disappeared Guests Entity**



Disappeared Guests

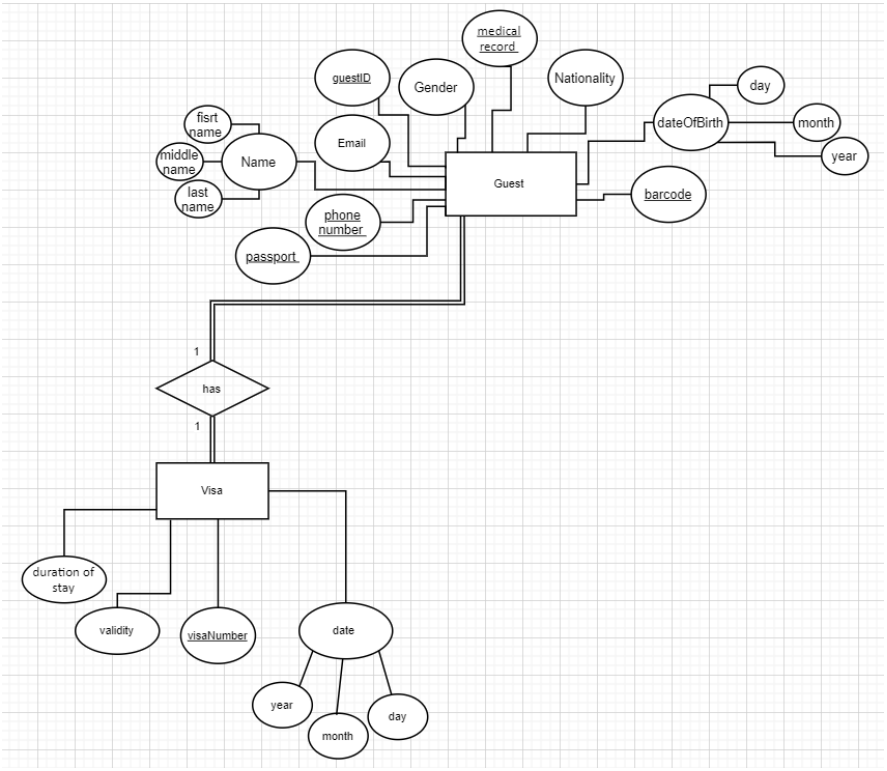
disappearedName	dissappearedID	yearDisap	monthDisap	dayDisap	Relationship

Description:

- We create the relation DISAPPEARED GUESTS in the relational schema corresponding to the weak entity type DISAPPEARED GUESTS in the ER diagram.
- Include the primary key (guestID) of the GUEST relation as a foreign key attribute in DISAPPEARED GUESTS (renamed to disappearedID) .
- The primary key of the DISAPPEARED GUESTS relation is the combination {disappearedName, disappearedID}, where disappearedName is the partial key of DISAPPEARED GUESTS.
- The GUEST entity is an identifying entity type via the identifying relationship type DISAPPEARED.

3.3 Mapping of binary 1-1 relationship types

- **1- Guest and Visa relationship (has)**



Guest

guestID	guestFname	guestMname	guestLname	Phone Number	Passpcort	Nationality	medical Record	Email	Gender	yearGBrith	monthGBrith	DayGBrith	barcode

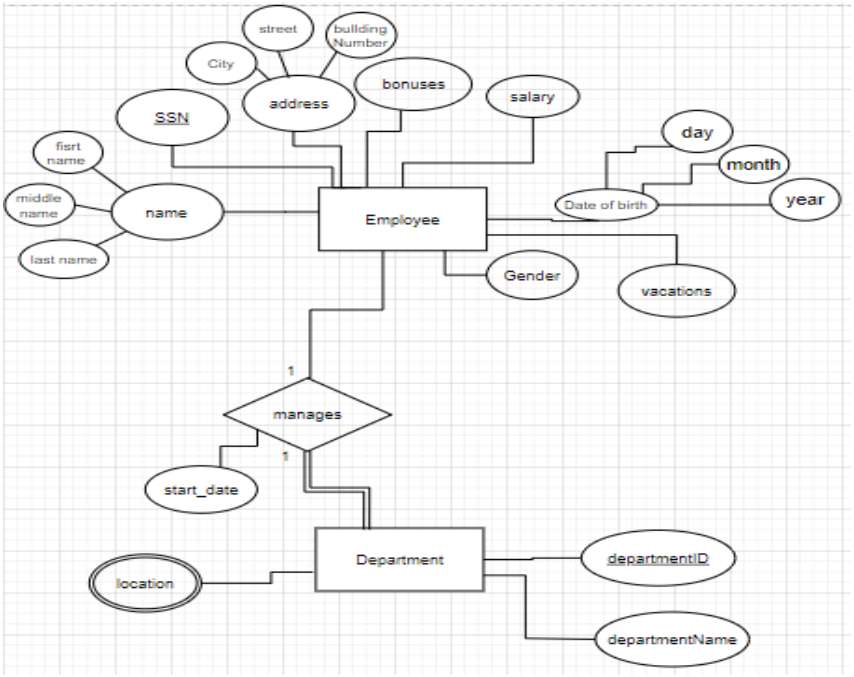
Visa

visaNumber	Validity	DurationOfStay	Yeardate	Monthdate	Daydate	guestID

Description:

- Foreign Key (2 relations) approach.
- 1:1 relation HAS is mapped by choosing the participating entity type VISA, both relations have total participation in the HAS relationship, so we can choose any one of them.

- **2- Employee and Department relationship (manages)**



Employee

Employee Fname	Employee Mname	Employee Lname	city	Building number	street	bonuses	salary	YearE Brith	monthE Brith	dayE Brith	vacation	gender	SSN

Department

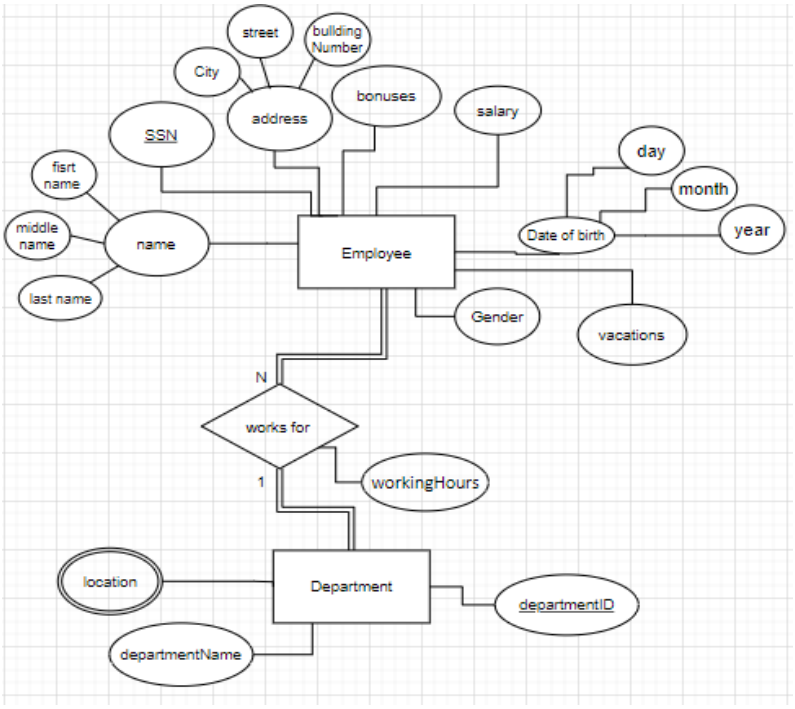
Mgr_SSN	departmentName	departmentID	Mgr_start_date

Description:

- Foreign Key (2 relations) approach.
- 1:1 relation MANAGES is mapped by choosing the participating entity type DEPARTMENT, because its participation in the MANAGES relationship is total.
- We also include the simple attribute Start-date of the MANAGES relationship type.

3.4 Mapping of binary 1-N relationship types

- **1- Employee and Department relationship (works for)**



Employee

Employee Fname	Employee Mname	Employee Lname	city	Building number	street	bonuses	salary	Year EBrith	monthE Brith	dayE Brith	vacation	gender	SSN	department ID

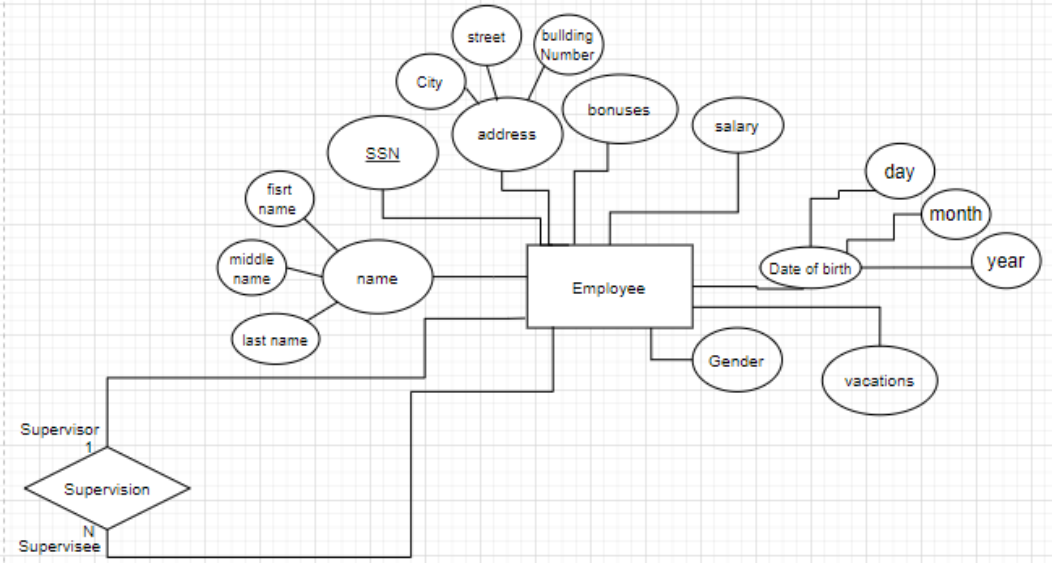
Department

departmentName	departmentID

Description:

- 1:N relationship type WORKS FOR.
- We include the primary key (departmentID) of the DEPARTMENT relation as foreign key in the EMPLOYEE relation and named it (departmentID), because EMPLOYEE entity is in the N-side of the relationship.

- **2- Employee and Employee relationship (Supervision)**



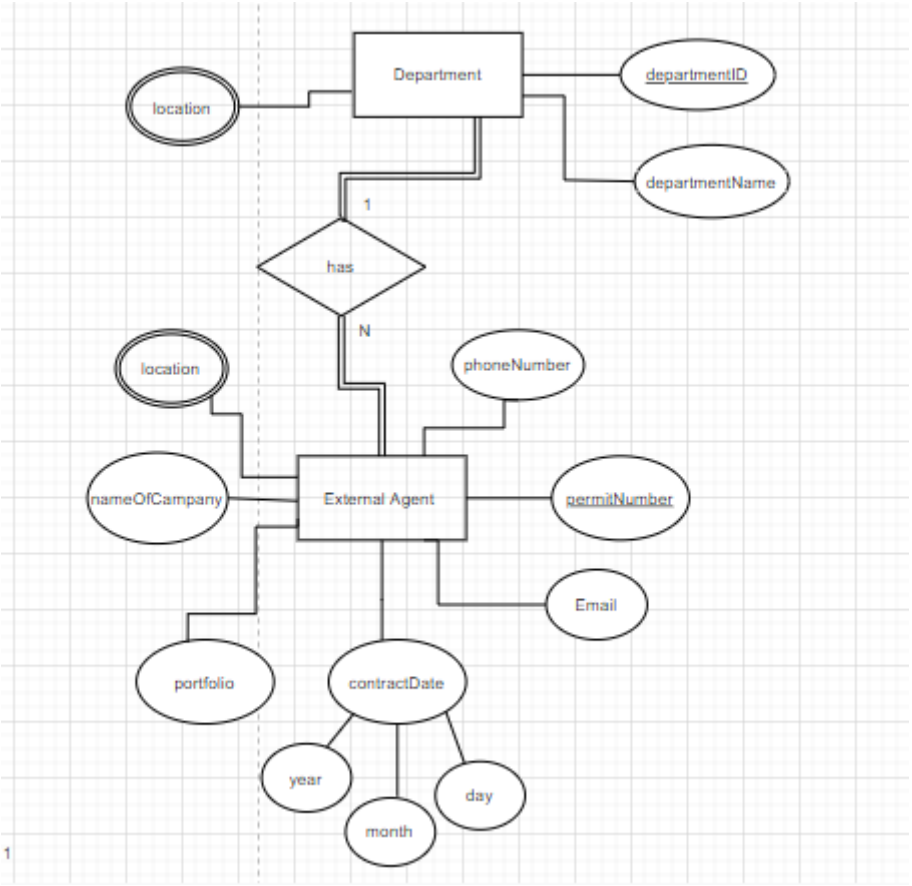
Employee

Employee Fname	Employee Mname	Employee Lname	city	Building number	street	bonuses	salary	YearE Brith	monthE Brith	dayE Brith	vacation	gender	Supervisor_ SSN	SSN

Description:

- 1:N relationship type SUPERVISION .
- The SUPERVISION relationship between the same entity (recursive relationship), so we include the primary key (SSN) of the EMPLOYEE relation as foreign key in the EMPLOYEE relation and named it (Supervisor_SSN).

- **3- Department and External Agent relationship (has)**



Department

departmentName	departmentID

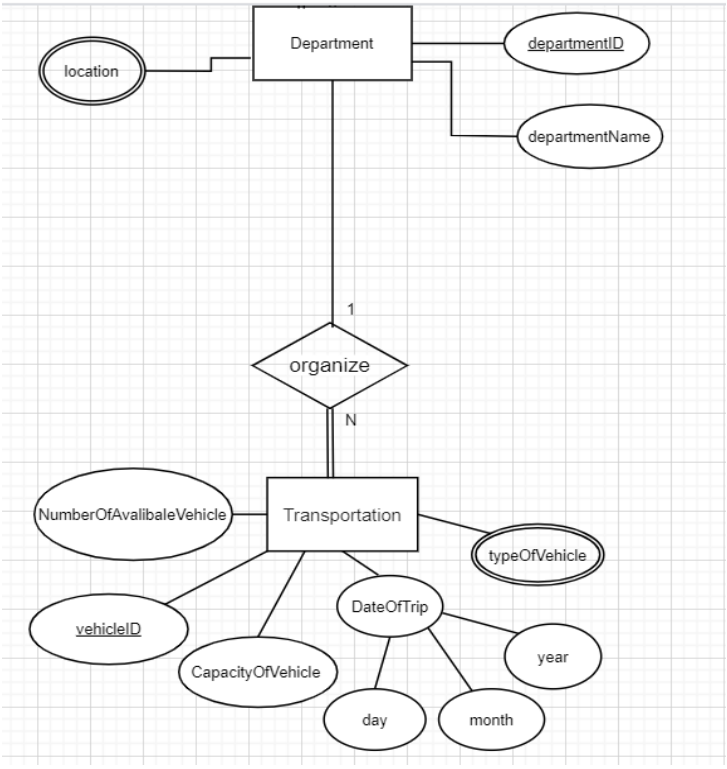
External Agent

nameOfCompany	Portfolio	contractDyear	contractD month	contract Dday	Email	permit Number	Phone Number	departmentID

Description:

- 1:N relationship type HAS.
- we include the primary key (departmentID) of the DEPARTMENT relation as foreign key in the EXTERNAL AGENT relation and named it (departmentID), because EXTERNAL AGENT entity is in the N-side of the relationship.

- **4- Department and Transportation relationship (organize)**



Department

departmentName	departmentID

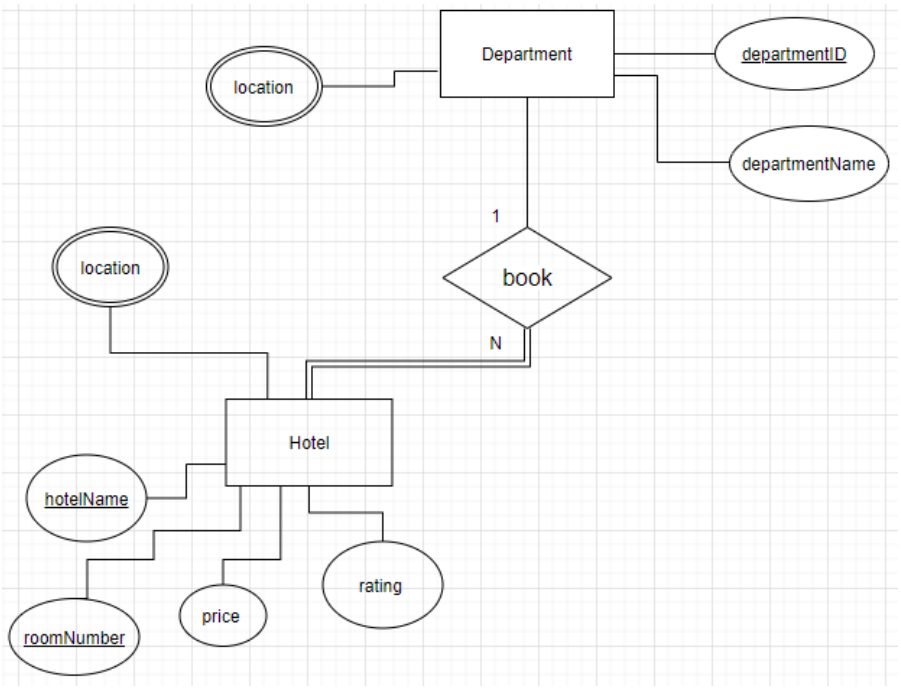
Transportation

numberOfAvailableVehicles	vehicleID	capacityOfVehicle	dayTrip	monthTrip	yearTrip	departmentID

Description:

- 1:N relationship type ORGANIZE.
- we include the primary key (departmentID) of the DEPARTMENT relation as foreign key in the TRANSPORTATION relation and named it (departmentID), because the TRANSPORTATION entity is in the N-side of the relationship.

- **5- Department and Hotel relationship (book)**



Department

departmentName	departmentID

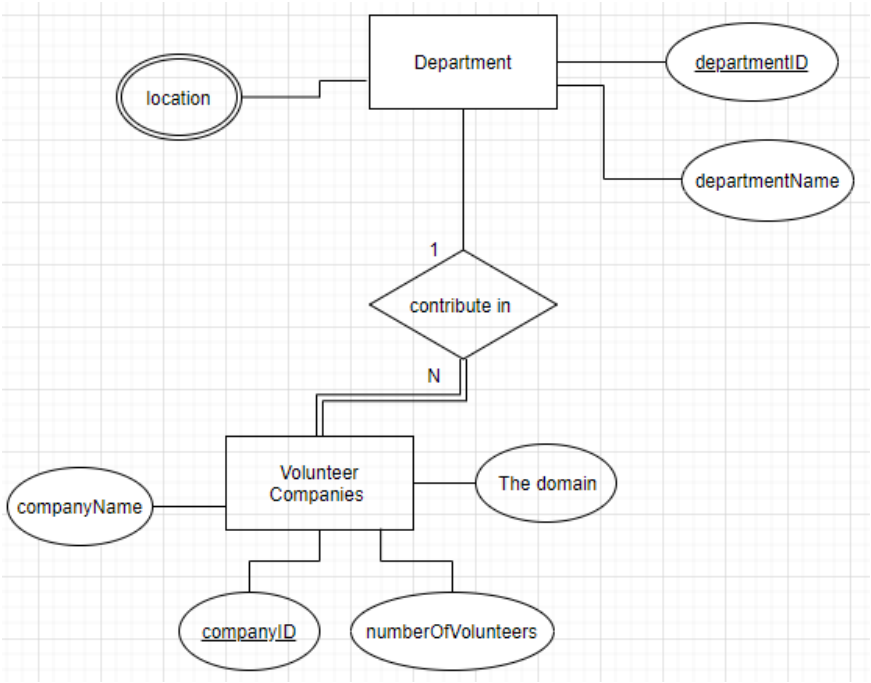
Hotel

hotelName	roomNumber	price	rating	departmentID

Description:

- 1:N relationship type BOOK.
- we include the primary key (departmentID) of the DEPARTMENT relation as foreign key in the HOTEL relation and named it (departmentID), because the HOTEL entity is in the N-side of the relationship.

- **6- Department and Volunteer Companies relationship (contribute in)**



Department

departmentName	departmentID

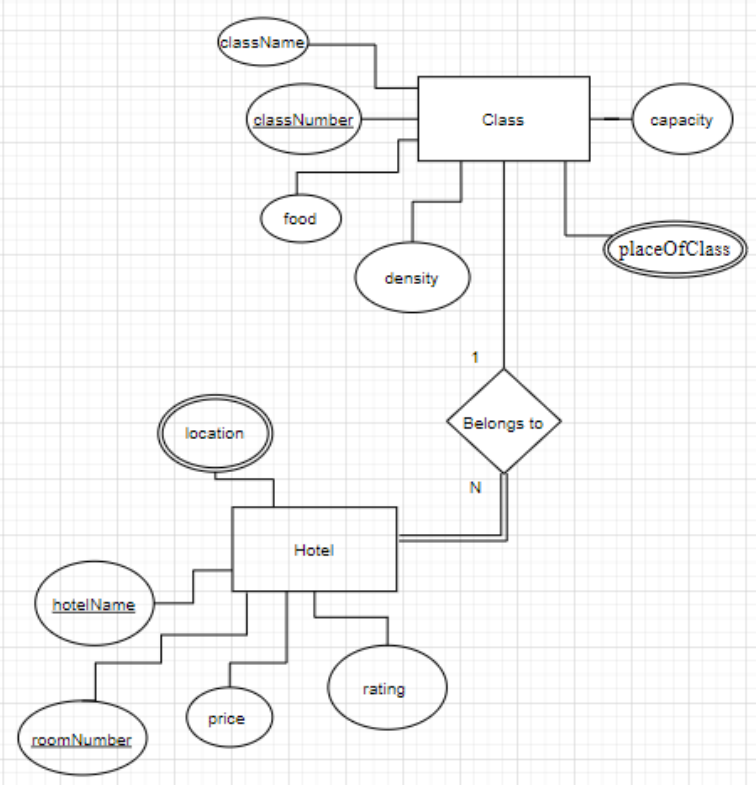
Volunteer Companies

companyName	companyID	numberOfVolunteers	The domain	departmentID

Description:

- 1:N relationship type CONTRIBUTE IN.
- we include the primary key (departmentID) of the DEPARTMENT relation as foreign key in the VOLUNTEER COMPANIES relation and named it (departmentID), because the VOLUNTEER COMPANIES entity is in the N-side of the relationship.

- **7- Class and Hotel relationship (belong to)**



Class

classNumber	className	Density	Capacity	Food

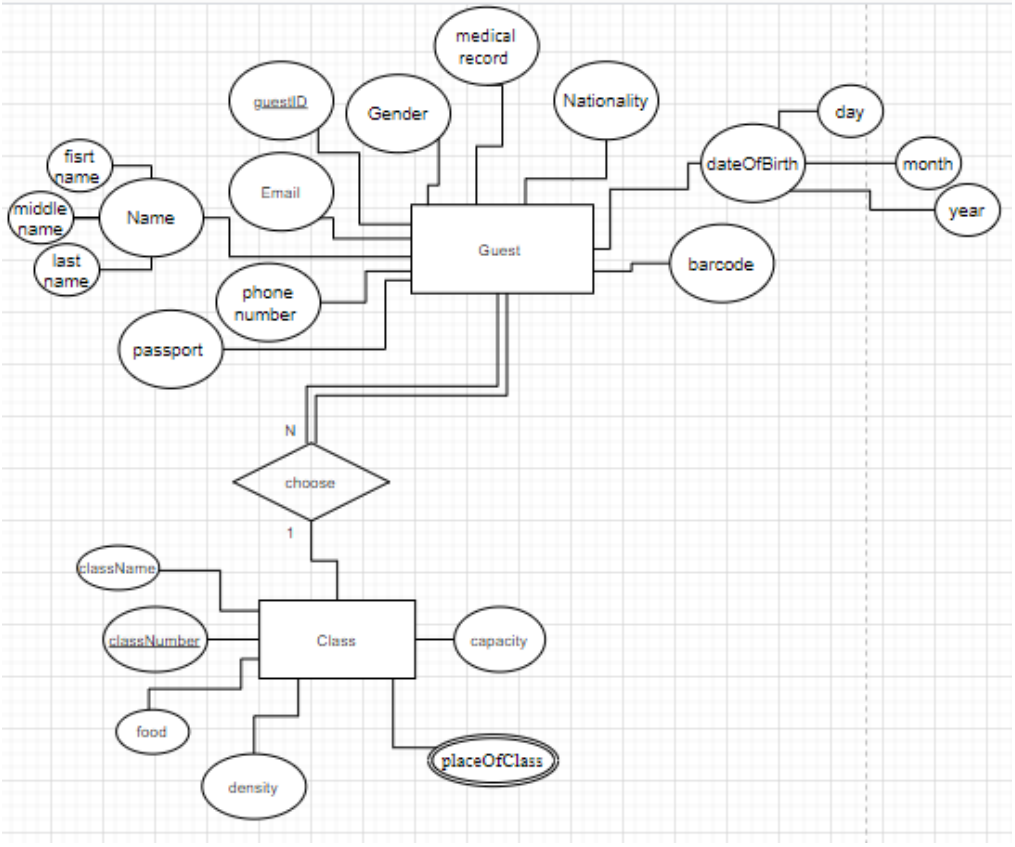
Hotel

hotelName	roomNumber	price	rating	classNumber

Description:

- 1:N relationship type BELONGS TO.
- we include the primary key (classNumber) of the CLASS relation as foreign key in the HOTEL relation and named it (classNumber), because the HOTEL entity is in the N-side of the relationship.

- **8- Guest and Class relationship (choose)**



Class

classNumber	className	Density	Capacity	Food

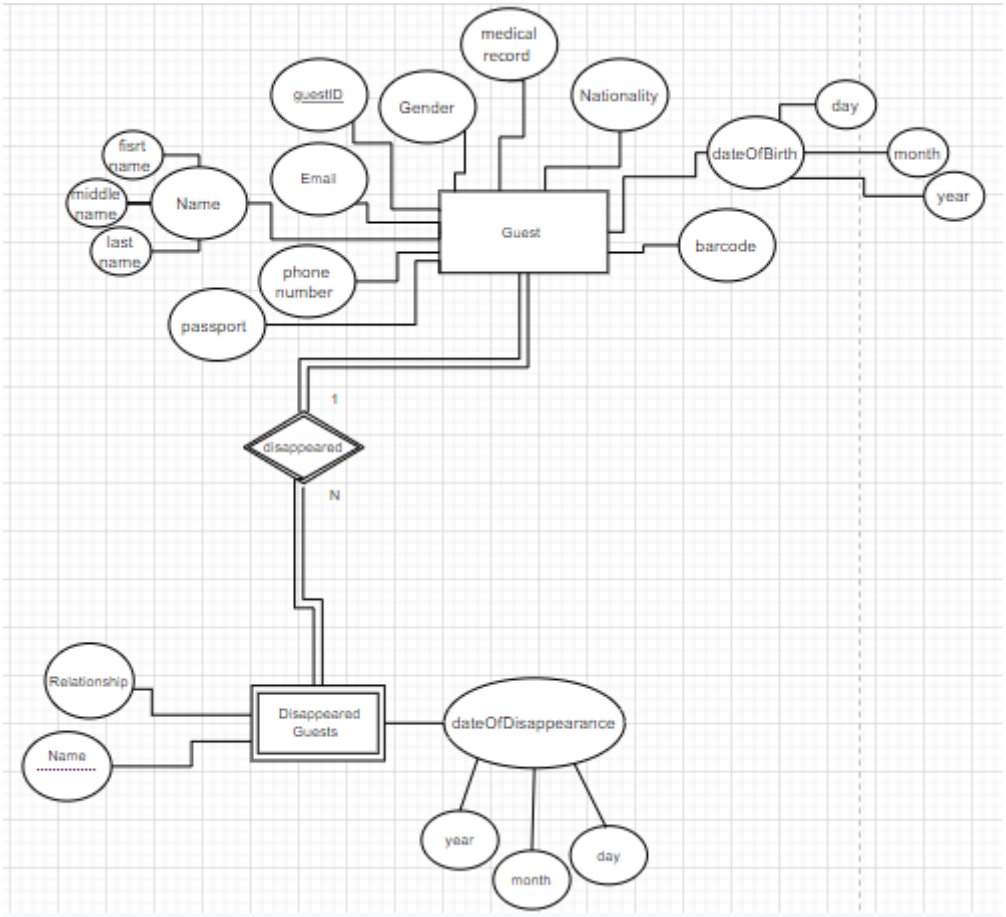
Guest

guestID	Guest fname	guest Mname	Guest Lname	Phone Number	Passport	Nationality	Medical Record	Email	Gender	Year GBrith	monthG Brith	dayG Brith	barcode	Class Number

Description:

- 1:N relationship type CHOOSE.
- we include the primary key (classNumber) of the CLASS relation as foreign key in the GUEST relation and named it (classNumber), because the GUEST entity is in the N-side of the relationship.

- **9- Guest and Disappeared Guest relationship (disappeared)**



Guest

guest ID	guestF name	guestM name	guestL name	Phone Number	Passport	Nationality	medical Record	Email	Gender	yearG Brith	monthG Brith	day G Brith	barcode

Disappeared Guest

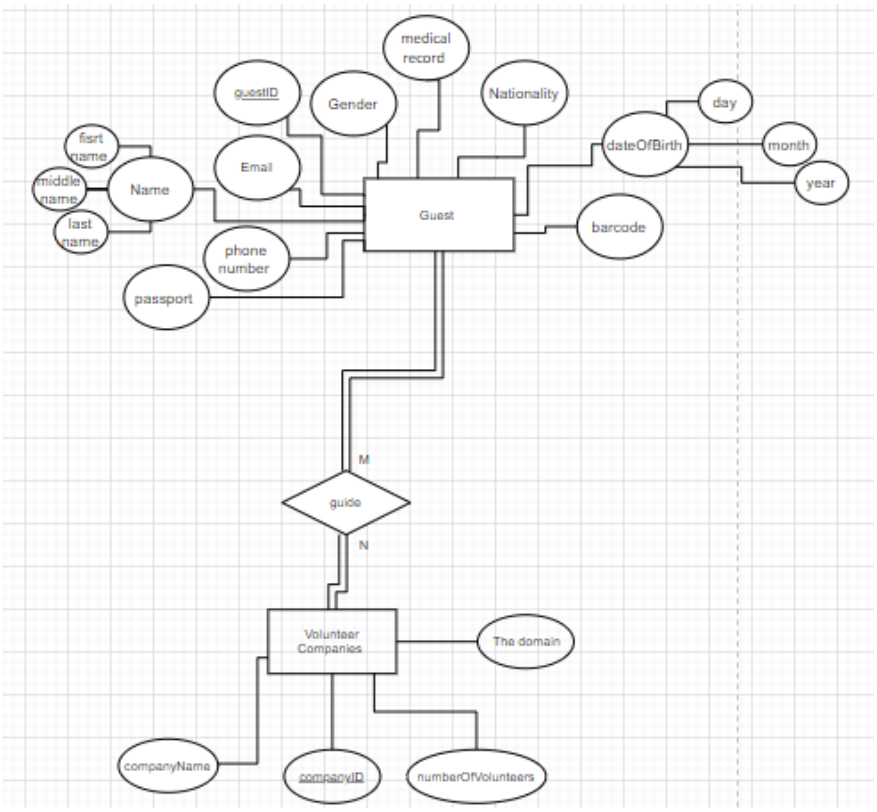
disappearedName	dissappearedID	yearDisap	monthDisap	dayDisap	Relationship

Description:

- 1:N relationship type DISAPPEARED.
- we include the primary key (guestID) of the GUEST relation as foreign key in the DISAPPEARED GUEST relation and named it (dissappearedID), because the DISAPPEARED GUEST entity is in the N-side of the relationship.
- GUEST relation is the identifying entity type via the identifying relationship type DISAPPEARED.

3.5 Mapping of binary M-N relationship types

- **Guest and Volunteer Companies relationship (guide)**



Guest

guest ID	guestF name	guestM name	guestL name	Phone Number	Passport	Nationality	Medicl Record	Email	Gender	yearG Brith	monthG Brith	dayG Brith	barcode

Volunteer Companies

companyName	companyID	numberOfVolunteers	The domain

Guide

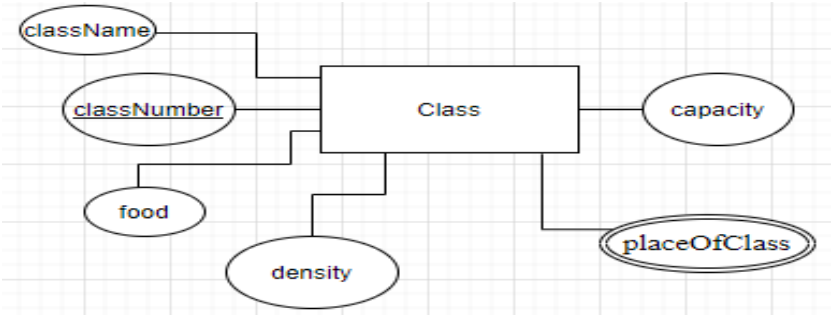
guestID	companyID

Description:

- The M-N relationship type GUIDE from the ER diagram is mapped by creating a new relation GUIDE in the relational database schema.
- The primary keys of the GUEST and VOLUNTEER COMPANIES relations are included as foreign keys in GUIDE and call it (guestID and companyID), respectively.
- The Primary Key of GUIDE relation is combination of {guestID, companyID}.

3.6 Mapping of multivalued attributes

- **1- PlaceOfClass multivalued at Class Entity**



Class

classNumber	className	Density	Capacity	Food

Class_place

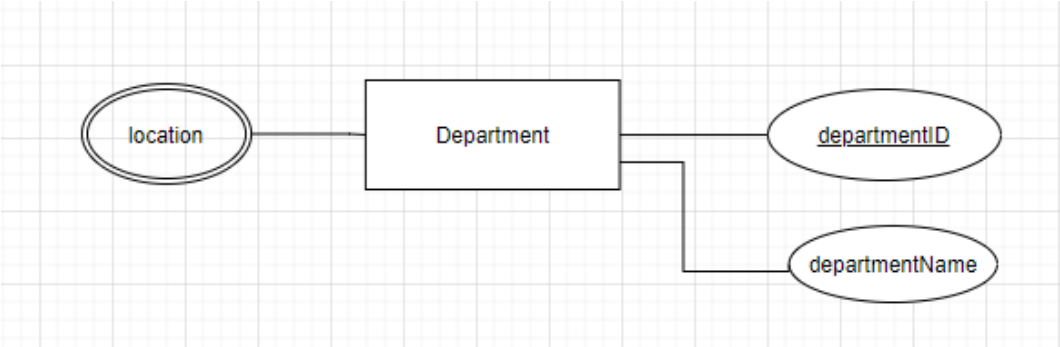
classNumber	placeOfClass

Description:

- The multivalued placeOfClass from the ER diagram is mapped by creating a CLASS_PLACE relation in the relational database schema.

- The relation CLASS_PLACE PK is the combination (classNumber, placeOfClass) Where classNumber is a FK from CLASS entity.

- **2- Location multivalued at Department Entity**



Department

departmentName	departmentID

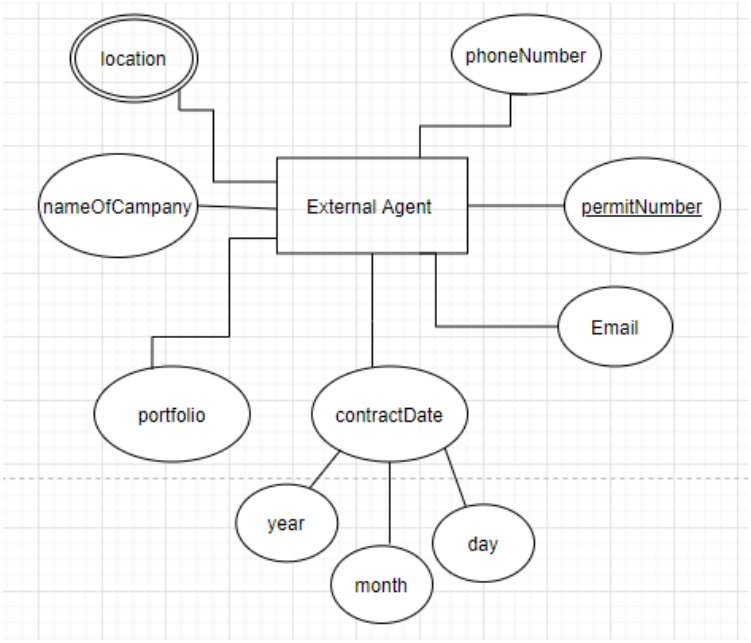
Location_dept

departmentID	departmentLocation

Description:

- The multivalued departmentLocation from the ER diagram is mapped by creating a Location_dept relation in the relational database schema.
- The relation Location_dept PK is the combination (departmentID,departmentLocation), Where departmentID is a FK from DEPARTMENT entity.

3- Location multivalued at External Agent Entity



External Agent

nameOfCompany	Portfolio	contractD year	contractD month	contractD day	Email	Permit Number	Phone Number

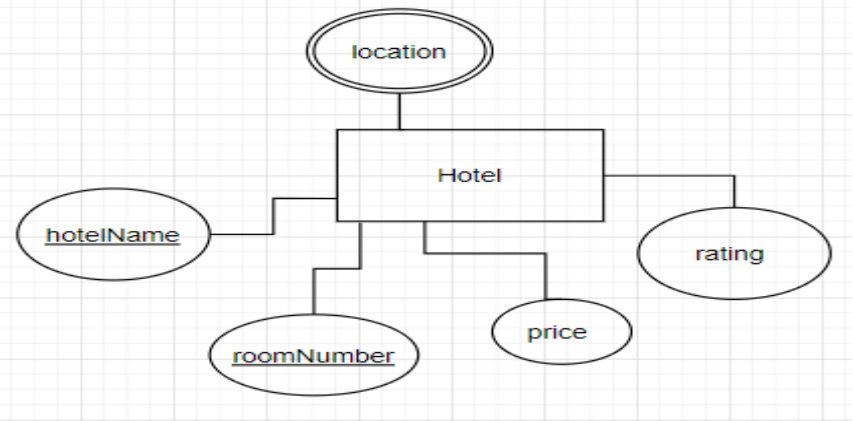
Location_external

LocationOfExternalAgent	PermitNumber

Description:

- The multivalued LocationOfExternalAgent from the ER diagram is mapped by creating a Location_external relation in the relational database schema.
- The relation Location_external PK is the combination of (LocationOfExternalAgent, PermitNumber), Where PermitNumber is a FK from External Agent entity.

- **4- location multivalued at Hotel Entity**



Hotel

hotelName	roomNumber	price	rating

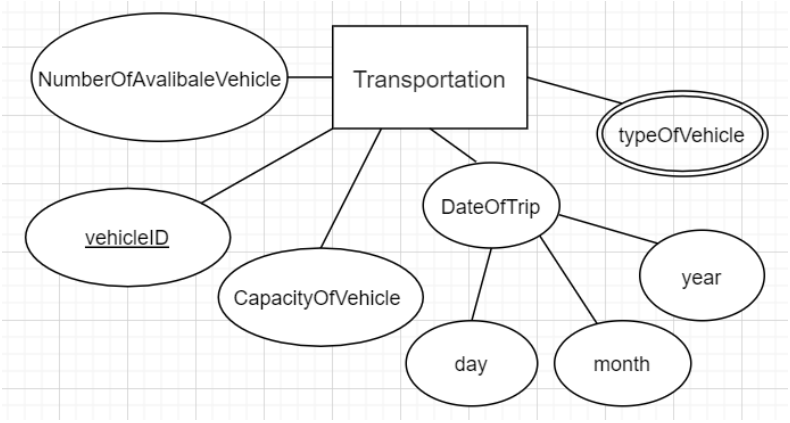
Hotel_location

hotelName	roomNumber	hotelLocation

Description:

- The multivalued hotelLocation from the ER diagram is mapped by creating a Hotel_location relation in the relational database schema.
- The relation Hotel_location PK is the combination of (hotelName, roomNumber, hotelLocation),Where (hotelName, roomNumber) is a FK from Hotel entity.

- **5- typeOfVehicle multivalued at Transportation Entity**



Transportation

numberOfAvailableVehicles	vehicleID	capacityOfVehicle	dayTrip	monthTrip	yearTrip

Vehicle_type

typeOfVehicle	vehicleID

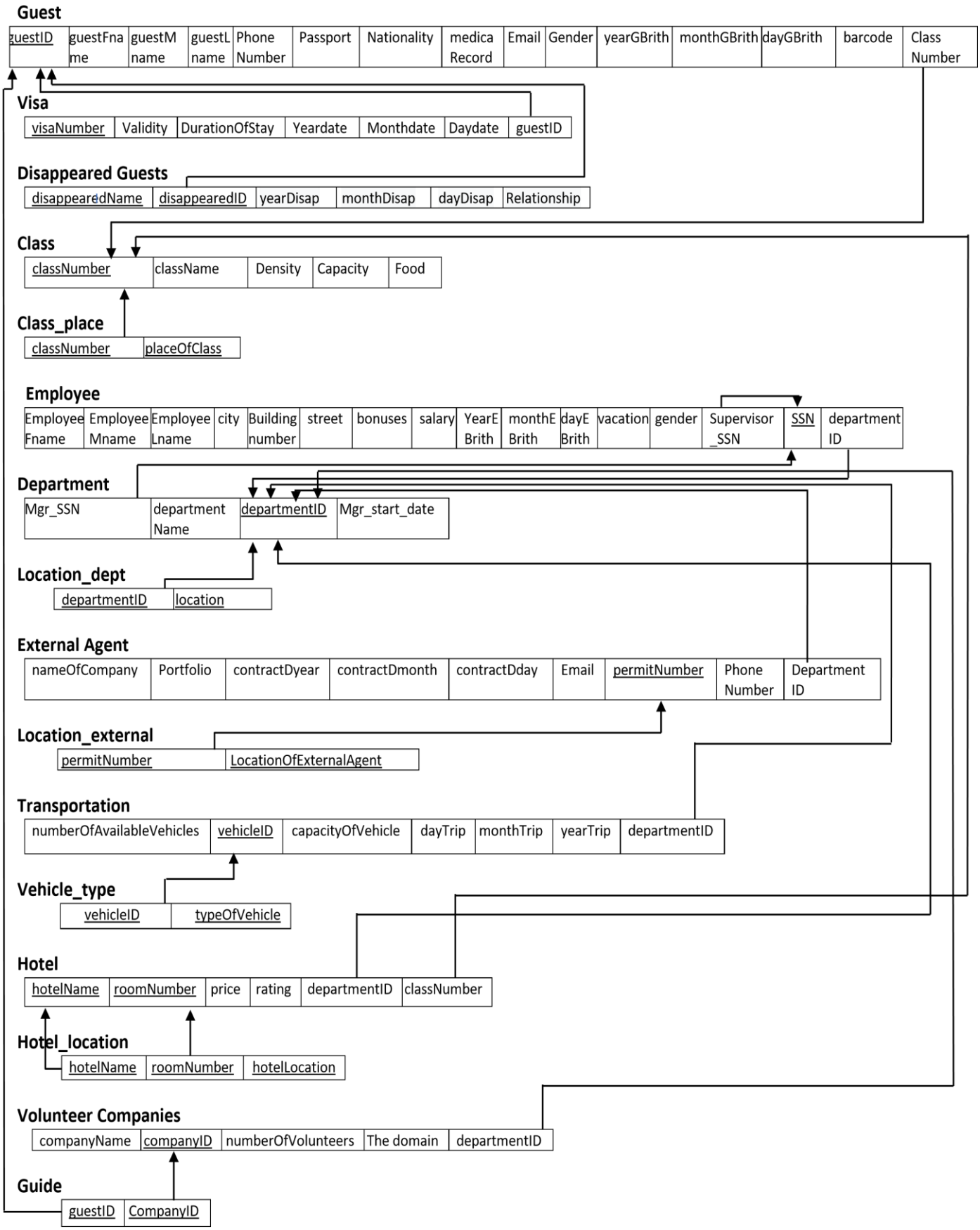
Description:

- The multivalued typeOfVehicle from the ER diagram is mapped by creating a Vehicle_type relation in the relational database schema.
- The relation Vehicle_type PK is the combination (typeOfVehicle,vehicleID), Where vehicleID is a FK from Transportation entity .

3.7 Mapping of n-ary relationship types

We don't have n-ary relationship

3.8 Schema Diagram



4 Normalization

4.1 First Normal Form

Guest

guestID	Guest Fname	Guest Mname	Guest Lname	Phone Number	Passport	Nationality	Medical Record	Email	Gender	yearG Brith	monthG Brith	dayG Brith	barcode	Class Number

- **This relation has composite attribute** dateOfBirth (year , month , day) **the relation is in 1NF because, we added the single attributes** (year , month , day) **in the Guest relation.**

- **This relation has composite attribute** Name (fisrt name, middle name, last name) **the relation is in 1NF because we added the single attributes** (fisrt name, middle name, last name) **in the Guest relation.**

Visa

visaNumber	Validity	DurationOfStay	Yeardate	Monthdate	Daydate	guestID

- **The relation has composite attributes** date(year, month, day) **this relation is in 1NF because we added the single attributes** (year , month , day) **in the Visa relation.**

Disappeared Guests

disappearedName	disappearedID	yearDisap	monthDisap	dayDisap	Relationship

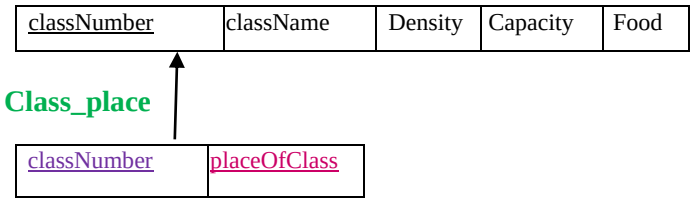
- **The relation has composite attribute** dateOfDisappearance (year, month, day) **this relation is in 1NF because we added the single attributes** (year , month , day) **in the Disappeared Guests relation.**

Employee

Employee Fname	Employee Mname	Employee Lname	city	Building number	street	bonuses	salary	YearE Brith	month EBrith	dayE Brith	vacation	gender	Supervisor _SSN	SSN	Department ID

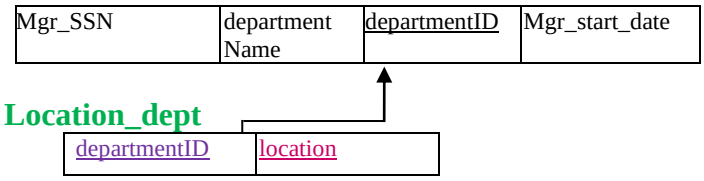
- **This relation has composite attribute** dateOfBirth (year , month , day) **the relation is in 1NF because we added the single attributes** (year, month, day) **in the Employee relation.**
- **This relation has composite attribute** Name (fisrt name, middle name, last name) **the relation is in 1NF because we added the single attributes** (fisrt name, middle name, last name) **in the Employee relation.**

Class



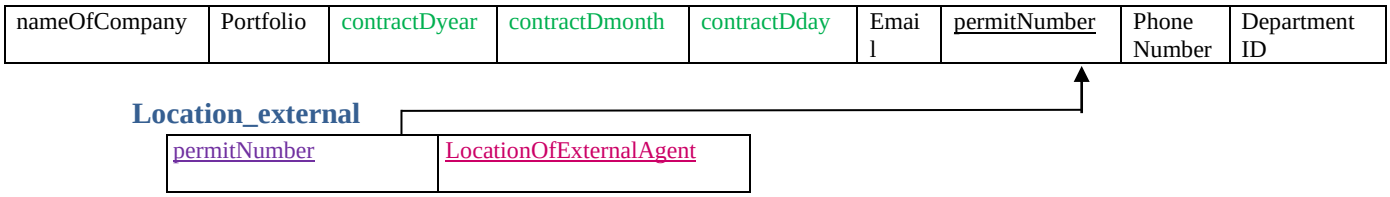
- **This relation has multivalued attribute** placeOfClass **the relation is in 1NF because we removed** placeOfClass in Class relation **and we created a separate relation** Class_place **which has a** primary key classNumber **and** placeOfClass **attribute**.

Department



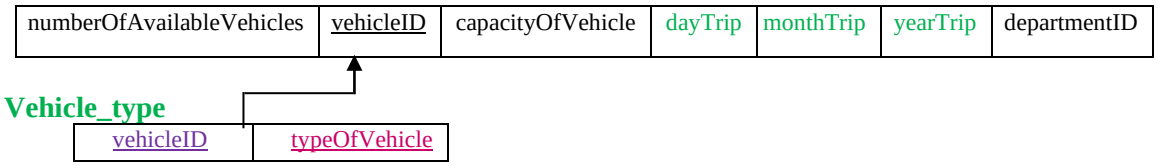
- **This relation has multivalued attribute** location**. The relation is in 1NF because we removed** location in Department relation **and we created a separate relation** Location_dept **which has** a primary key departmentID **and** location **attribute**.

External Agent



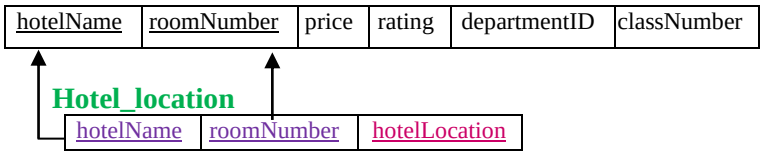
- **This relation has composite attribute** contractDate (year, month, day)**. The relation is in 1NF because we added the single attributes** (year, month, day) **in the External Agent relation.**
- **This relation has multivalued attribute** location**. The relation is in 1NF because we removed** location attribute in **External Agent relation and we created a separate relation** Location_external **which has** a primary key permitNumber **and** locationOfExternalAgent **attribute.**

Transportation



- **This relation has composite attribute** DateOfTrip (year, month, day)**. The relation is in 1NF because we added the single attributes** (year, month, day) **in the Transportation relation.**
- **This relation has multivalued attribute** typeOfVehicle**. The relation is in 1NF because we removed** typeOfVehicle in **Transportation relation and we created a separate relation** Vehicle_type **which has** a primary key vehicleID and typeOfVehicle **attribute.**

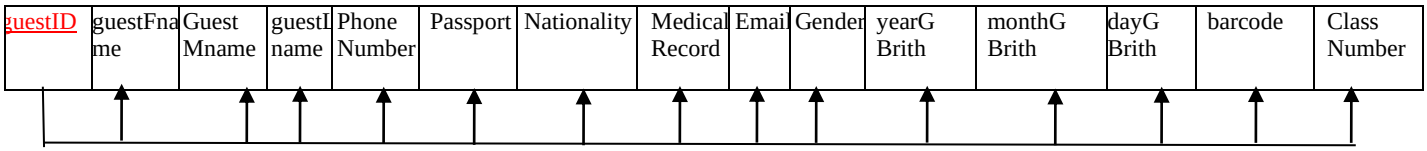
Hotel



- **This relation has multivalued attribute** location. **The relation is in 1NF because we removed** location in **Hotel relation and we created a separate relation** Hotel_location **which has a** primary key hotelName, roomNumber **and** hotelLocation **attribute.**

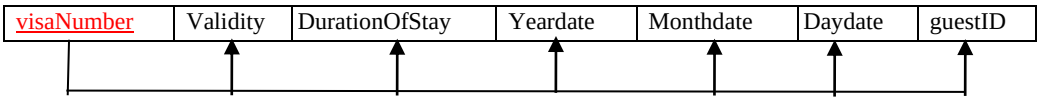
4.2 Second Normal Form

Guest



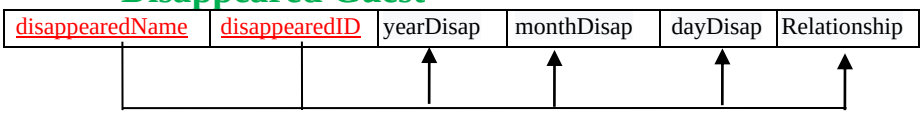
- **This relation in the 2NF**
- Reason: because it has only atomic primary key (guestID), So there's no partial functional dependency on PK. That means every non-prime attributes in GUEST relation is fully functionally dependent on the PK.

Visa



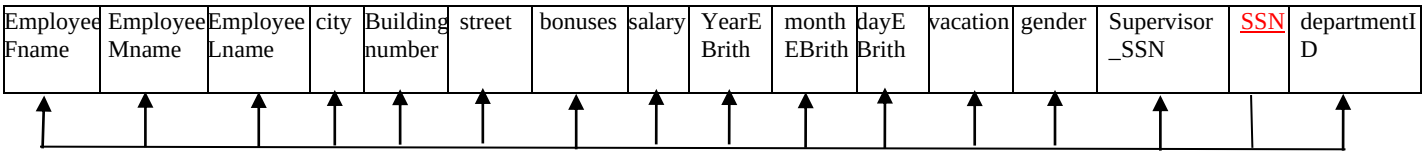
- **This relation in the 2NF**
- Reason: because it has only atomic primary key (visaNumber), So there's no partial functional dependency on PK. That means every non-prime attributes in VISA relation is fully functionally dependent on the PK.

Disappeared Guest



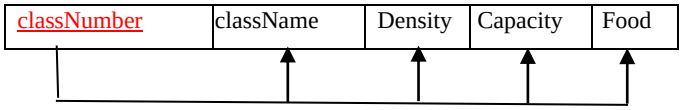
- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute disappearedName disappearedID) with one nonprimary attribute.
- So, there's no partial functional dependency on PK. That means every non-prime attributes in Disappeared Guest relation is fully functionally dependent on the PK.

Employee



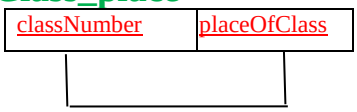
- **This relation in the 2NF**
- Reason: because it has only atomic primary key (SSN), So there's no partial functional dependency on PK. That means every non-prime attributes in Employee relation is fully functionally dependent on the PK.

Class



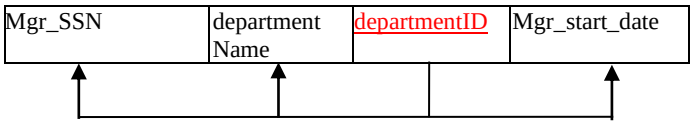
- **This relation in the 2NF**
- Reason: because it has only atomic primary key (classNumber), So there's no partial functional dependency on PK. That means every non-prime attributes in CLASS relation is fully functionally dependent on the PK.

Class_place



- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute classNumber, placeOfClass) without nonprimary attribute.

Department

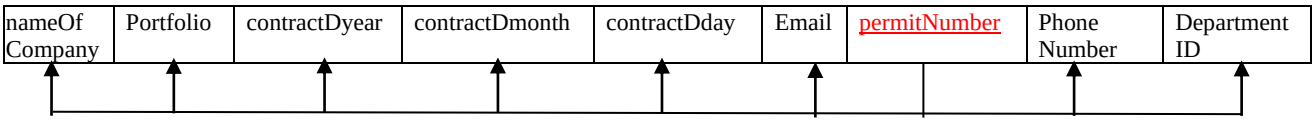


- **This relation in the 2NF**
- Reason: because it has only atomic primary key (departmentID), So there's no partial functional dependency on PK. That means every non-prime attributes in DEPARTMENT relation is fully functionally dependent on the PK.

Location_dept

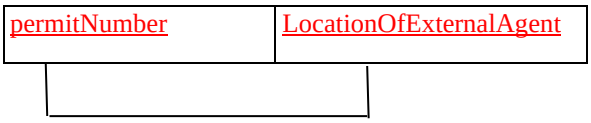
- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute departmentID, location) without nonprimary attribute .

External Agent



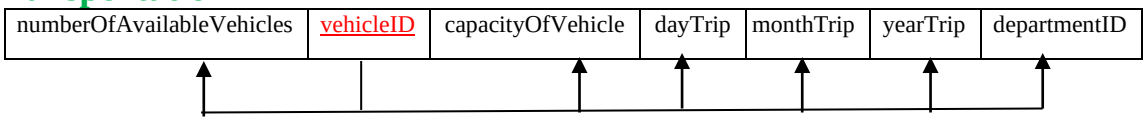
- **This relation in the 2NF**
- Reason: because it has only atomic primary key (permitNumber), So there's no partial functional dependency on PK. Thea means every non-prime attributes in EXTERNAT AGENT relation is fully functionally dependent on the PK.

Location_external



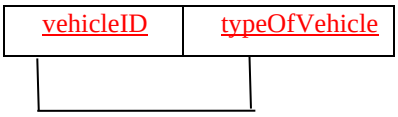
- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute permitNumber, LocationOfExternalAgent) without nonprimary attribute ..

Transportation



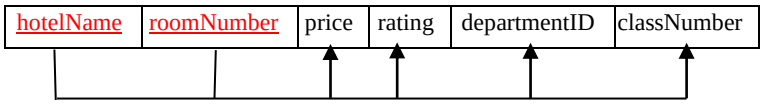
- **This relation in the 2NF**
- Reason: because it has only atomic primary key (vehicleID), So there's no partial functional dependency on PK. That means every non-prime attributes in TRANSPORTATION relation is fully functionally dependent on the PK.

Vehicle_type



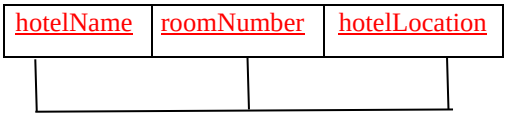
- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute vehicleID, typeOfVehicle) without nonprimary attribute .

Hotel



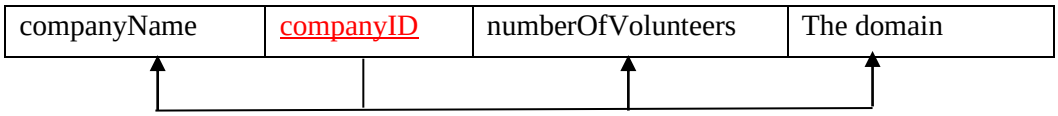
- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute hotelName roomNumber) with one nonprimary attribute.
- So, there's no partial functional dependency on PK. That means every non-prime attributes in Hotel relation is fully functionally dependent on the PK.

Hotel_location



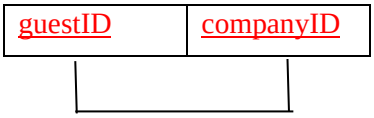
- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute hotelName, roomNumber**,** hotelLocation) without nonprimary attribute .

Volunteer Companies



- **This relation in the 2NF**
- Reason: because it has only atomic primary key (companyID), So there's no partial functional dependency on PK. That means every non-prime attributes in VOLUNTEER COMPANIES relation is fully functionally dependent on the PK.

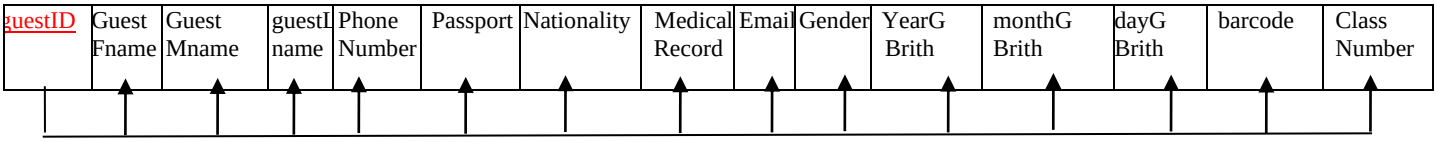
Guide



- **This relation in the 2NF**
- Reason: because they have partial functional (the primary key contains more than one attribute guestID, companyID) without nonprimary attribute .

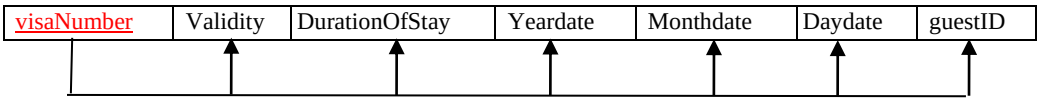
4.3 Third Normal Form

Guest



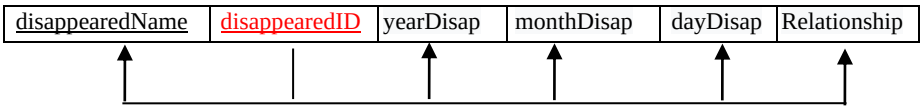
- **This relation is in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (guestID) .

Visa



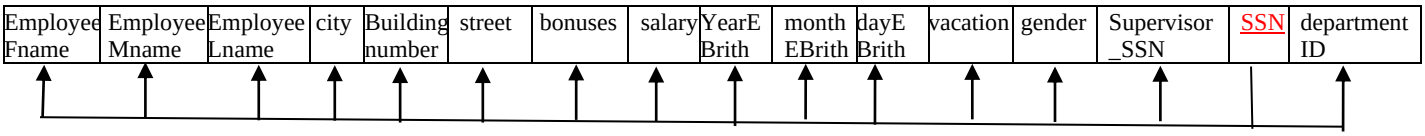
- **This relation in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (visaNumber) .

Disappeared Guests



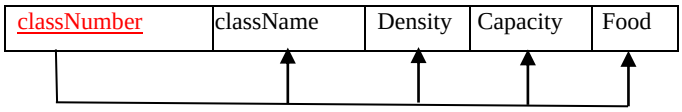
- **This relation in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (disappearedID).

Employee



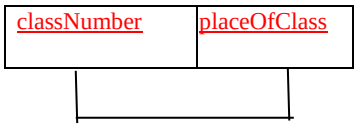
- **This relation in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (SSN).

Class



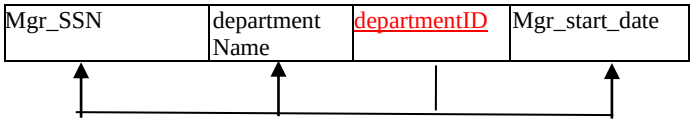
- **This relation in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (classNumber).

Class_place



- **This relation in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute is a PK

Department

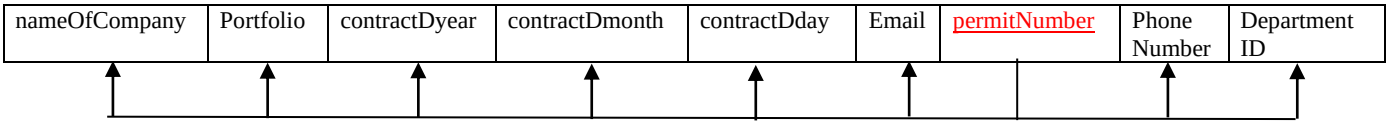


- **This relation in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (departmentID).

Location_dept

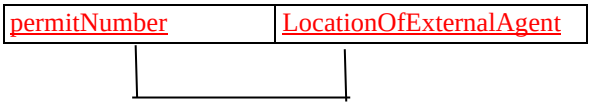
- **This relation in the 3NF**
- Reason: Because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK.

External Agent



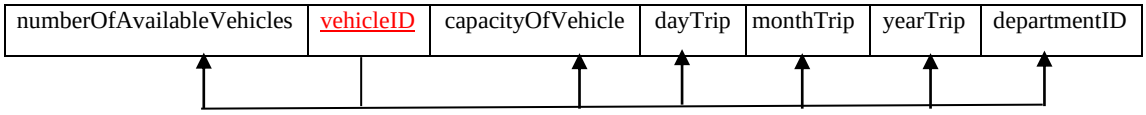
- **This relation in the 3NF**
- Reason: because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (permitNumber).

Location_external



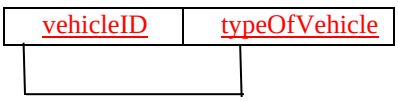
- **This relation in the 3NF**
- Reason: because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute is a PK.

Transportation



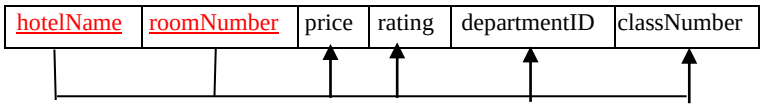
- **This relation in the 3NF**
- Reason: because there' s no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (vehicleID).

Vehicle_type



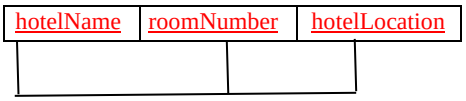
- **This relation in the 3NF**
- Reason: because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute is a PK.

Hotel



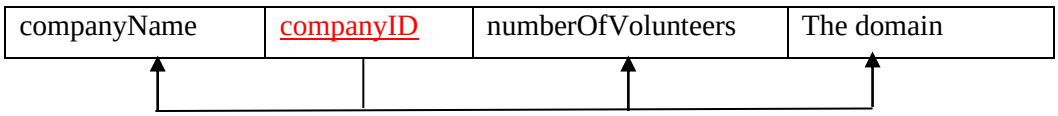
- **This relation in the 3NF**
- Reason: because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (hotelName,roomNumber) .

Hotel_location



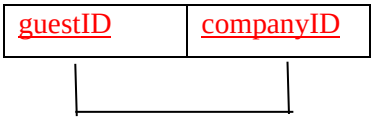
- **This relation in the 3NF**
- Reason: because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute is a PK.

Volunteer Companies



- **This relation in the 3NF**
- Reason: because there' s no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute depends on PK (companyID).

Guide



- **This relation in the 3NF**
- Reason: because there's no transitive relation. That means there's no non-prime attribute depend to another non-prime. All attribute is a PK.

5. Final DB Schema Diagram