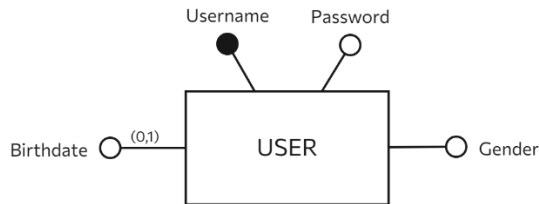


Restructuring the E-R Model

Translation to the relational model

Exercise 1

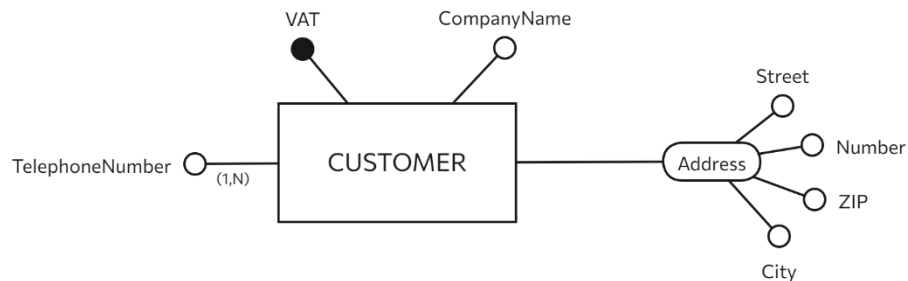
You are requested to model an entity describing the users of a mobile application. Each user is characterized by username, password, gender and date of birth (if available).



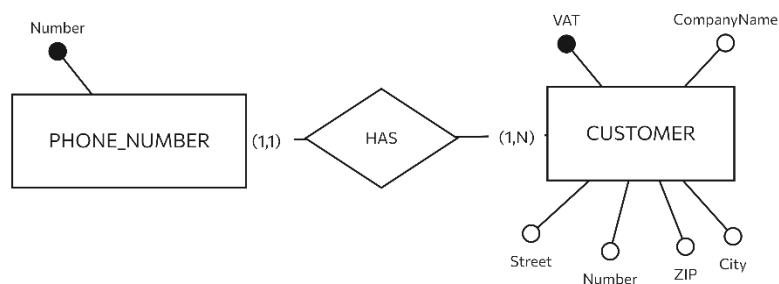
USER(Username, Password, Gender, Birthdate*)

Exercise 2

You are requested to register all customers of an office supply company. Each customer is characterized by a company name, address, VAT number and a list of telephone number.



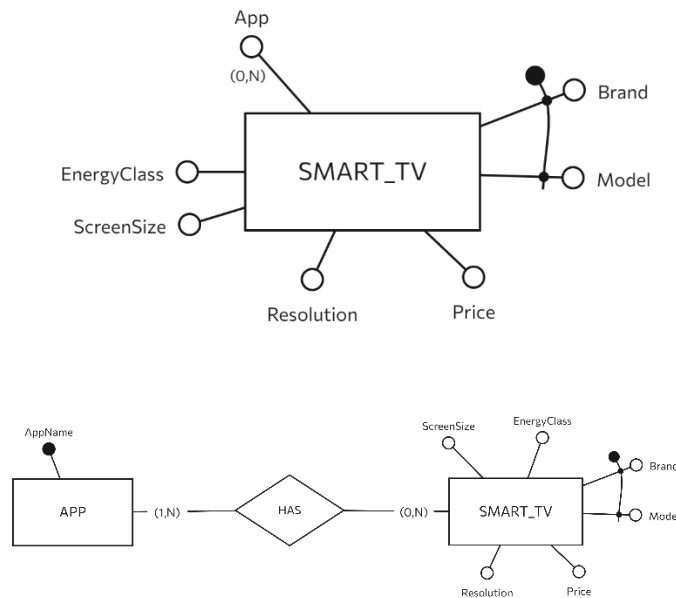
Restructured ER:



CUSTOMER(VAT, CompanyName, Street, Number, ZIP, City)
HAS_TELEPHONE(TelephoneNumber, VAT)

Exercise 3

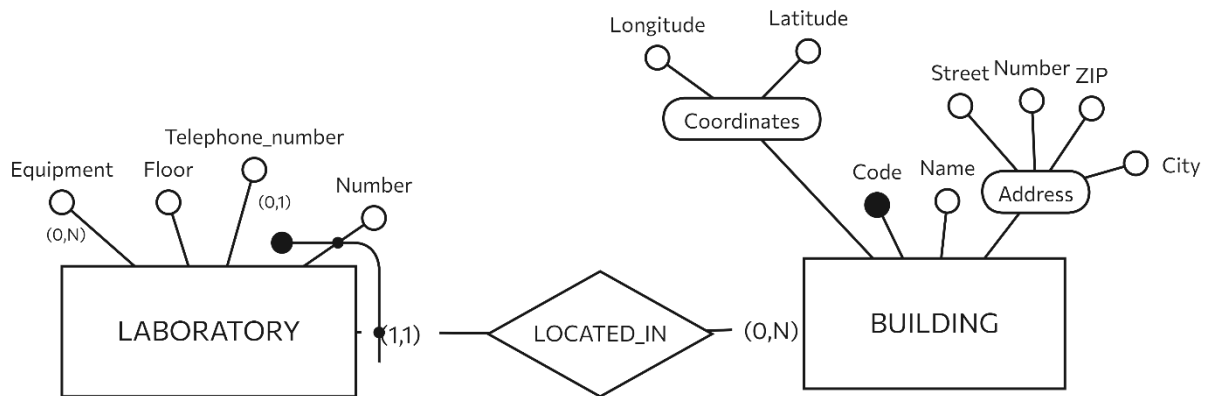
An e-commerce company must keep track of all the smart TV models available at the store. Each smart TV is uniquely identified by the brand and model. The list price, the screen size (measured in inches), the screen resolution, the list of apps installed and the energy class are also known.



SMART_TV(Brand, Model, EnergyClass, ScreenSize, Resolution, Price)
 HAS_APPLICATION(App, Brand, Model)

Exercise 4

You are requested to keep track of which laboratories are located in buildings owned by a medical research organization. Each building is characterized by a unique code, a name, address and geographical coordinates (latitude and longitude). Inside each building there are several laboratories. Each laboratory is identified by a unique number within the building and is characterized by the floor on which it is located, the telephone number (if available) and the list of available equipment (e.g. PC, freezer, etc.).



BUILDING(Code, Name, Street, Number, ZIP, City, Longitude, Latitude)

LABORATORY(Number, BuildingCode, Telephone_number*, Floor)

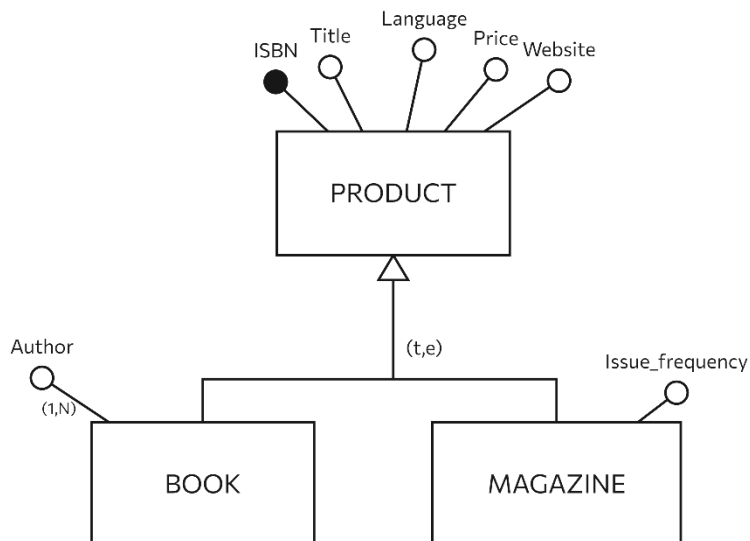
HAS_EQUIPMENT(Number, BuildingCode, Equipment)

LABORATORY (BuildingCode) REFERENCES BUILDING (Code)

HAS_EQUIPMENT(BuildingCode, Number) REFERENCES LABORATORY (BuildingCode, Number)

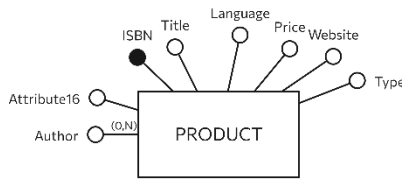
Exercise 5

You are requested to track the products of a publishing house. Each product is characterized by the ISBN, the title, the language, the list price and the link to the e-commerce page where to buy it. The products are divided into books and magazines. The books are characterized by the list of authors. Otherwise, for magazines the frequency of issues (e.g. weekly, monthly) is known.

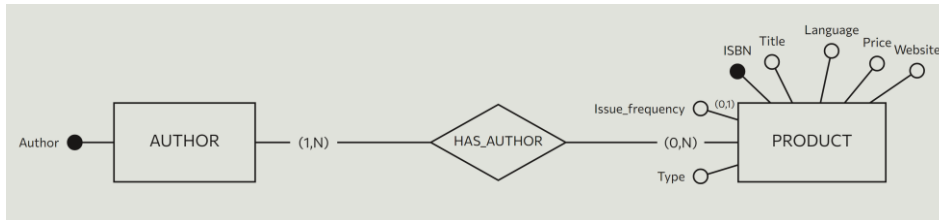


Possible solution: child -> parent

First the generalization is removed



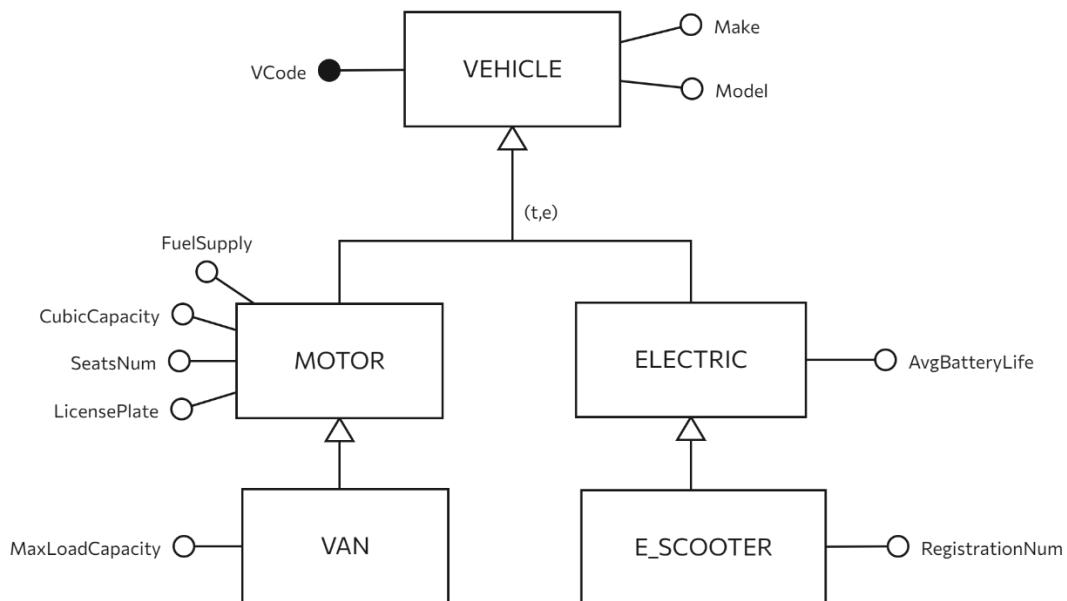
Then, the multi-valued attribute is removed



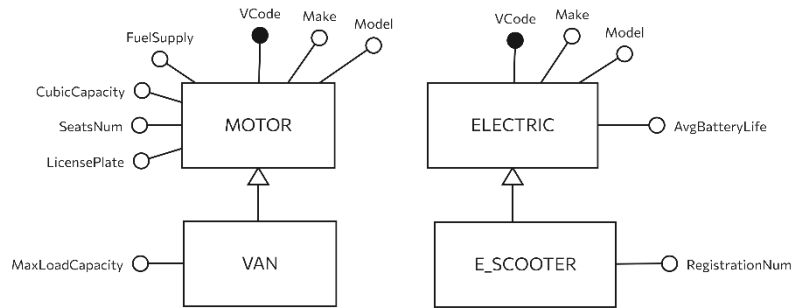
PRODUCT(ISBN, Title, Language, Price, Website, Type, Issue_frequency*)
 HAS_AUTHOR(ISBN, Author)

Exercise 6

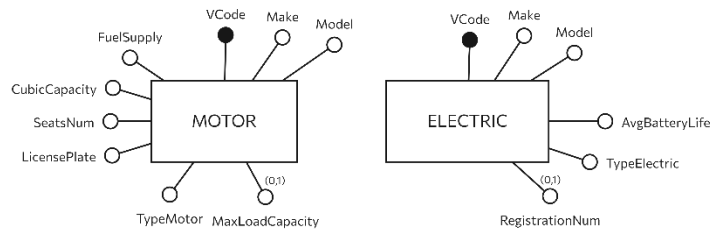
A rental business wants to keep track of the vehicles in its fleet. The vehicles available are cars, vans, bicycles, electric mopeds, and e-scooters. All vehicles are identified by an alphanumeric code and characterized by make and model. For motor vehicles (cars and vans), the license plate, engine capacity, number of seats and fuel supply (petrol, LPG, Diesel) are known. For vans, the maximum load capacity is also known. For electric vehicles (mopeds and e-scooters) the average battery life is known. Only for e-scooters the vehicle registration number is also known.



Possible solution: parent -> child (possible because higher-level generalization is total AND exclusive)



Then, remove children

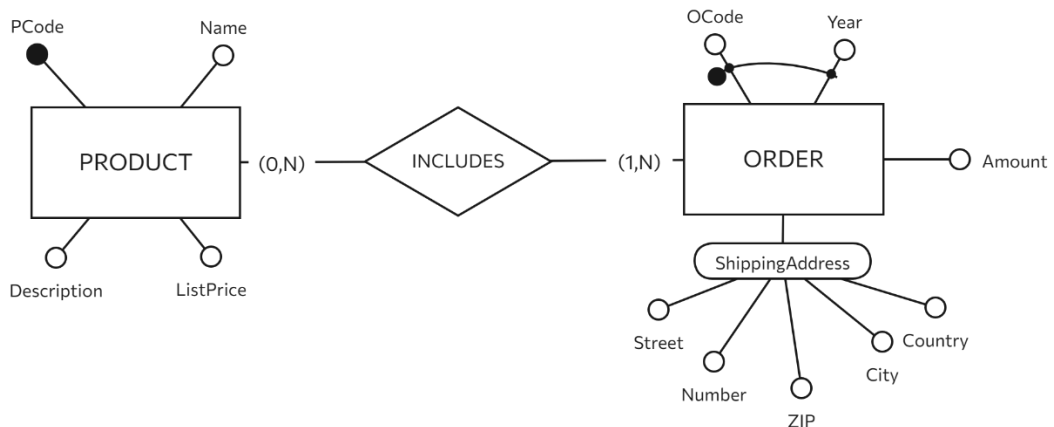


MOTOR(VCode, Make, Model, FuelSupply, CubicCapacity, SeatsNum, LicensePlate, TypeMotor, MaxLoadCapacity*)

ELECTRIC (VCode, Make, Model, AvgBatteryLife, TypeElectric, RegistrationNum*)

Exercise 7

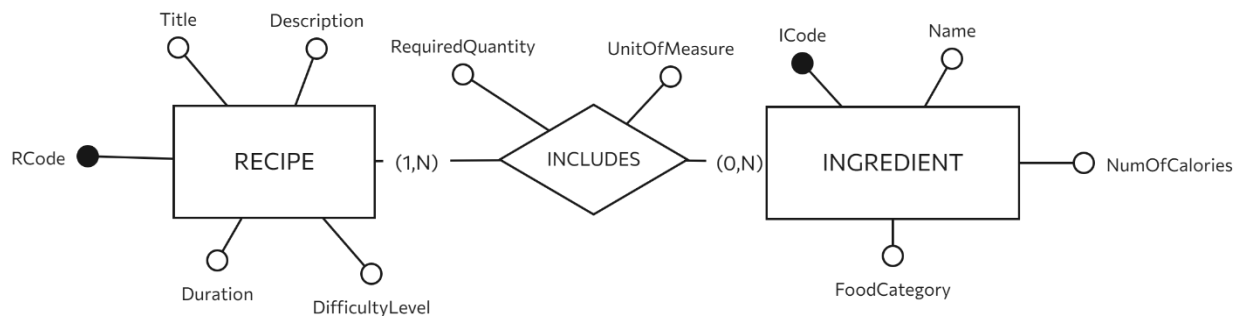
You are requested to track the orders of an e-commerce. Each order is identified by an alphanumeric code with respect to the year of issue and is characterized by the shipping address (street, house number, zip code, city, country), by the total amount (including any promotional discounts) and the list of products. The products are identified by an alphanumeric code and are characterized by name, description, and list price.



PRODUCT(PCode, Name, Description, ListPrice)
 ORDER(OCode, Year, Amount, Street, Number, ZIP, City, Country)
 INCLUDES(Pcode, OCode, Year)

Exercise 8

You are requested to model a recipe book. Each recipe is characterized by the title, a text description, the level of difficulty (low, medium, high), the duration (expressed in minutes) and the list of ingredients. For each ingredient in a given recipe, the required quantity and corresponding unit of measurement is known. Each ingredient is characterized by the name, the food category (vegetables, meat, dairy products) and the number of calories.

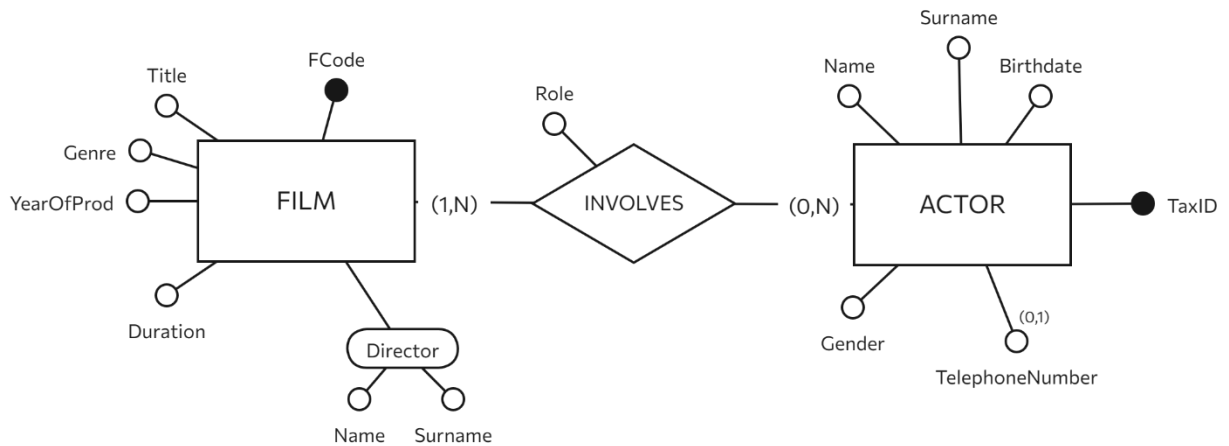


RECIPE(RCode, Title, Description, Duration, DifficultyLevel)
 INGREDIENT(ICode, Name, NumOfCalories, FoodCategory)
 INCLUDES(RCode, ICode, RequiredQuantity, UnitOfMeasure)

INCLUDES (RCode) REFERENCES RECIPE (RCode)
 INCLUDES (ICode) REFERENCES INGREDIENT (ICode)

Exercise 9

You are requested to keep track of the cast of films produced by a film production company. Each film is characterized by the title, the genre, the year of production, the name and surname of the director and the duration of the film. The actors are identified by their tax ID code and characterized by name, surname, date of birth, gender and telephone number (if available). For each film, the list of actors involved and their role is known.

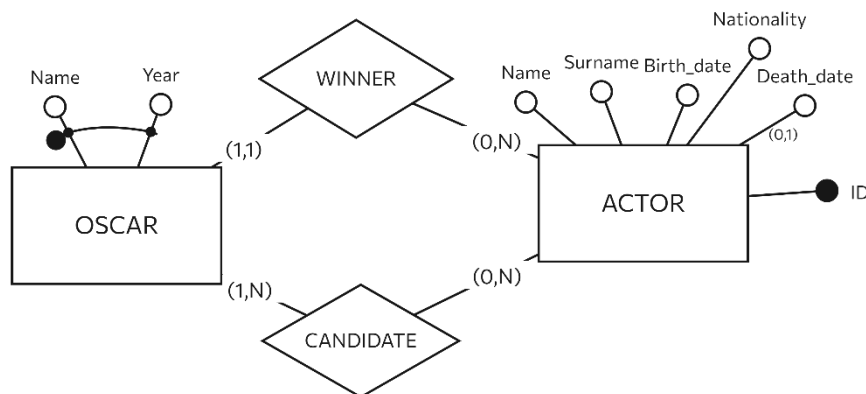


FILM(FCode, Title, Genre, YearOfProd, Duration, Director_Name, Director_Surname)
 ACTOR(TaxID, Name, Surname, Birthdate, TelephoneNumber*, Gender)
 INVOLVES(FCode, TaxID, Role)

INVOLVES(FCode) REFERENCES FILM(FCode)
 INVOLVES(TaxID) REFERENCES ACTOR(TaxID)

Exercise 10

You are requested to create a database to store the Oscar awards for the different actor categories. Each award is identified by name and year of award and is characterized by the list of candidates and the winner. Candidates and winners are characterized by name, surname, date of birth, nationality and date of death, if any.

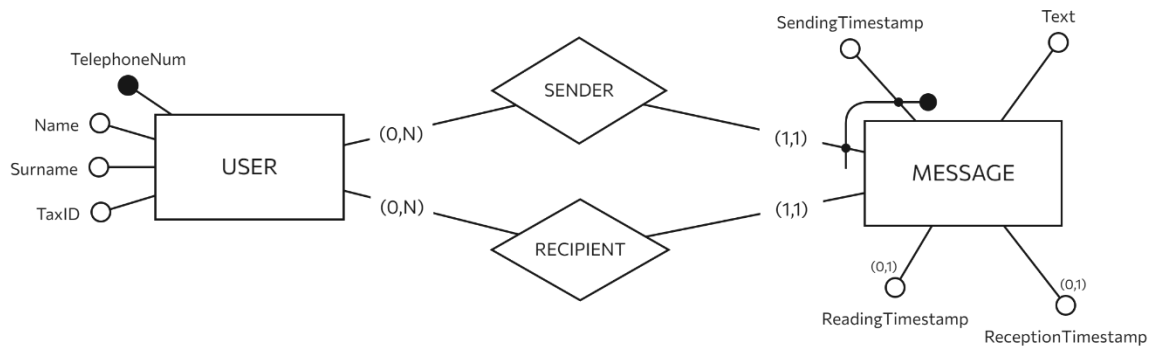


OSCAR(Name, Year, WinnerID)
 ACTOR(ID, Name, Surname, Birth_date, Nationality, Death_date*)
 CANDIDATE(OscarName, OscarYear, ActorID)

OSCAR(WinnerActorID) REFERENCES ACTOR(ID)
 CANDIDATE(ActorID) REFERENCES ACTOR(ID)
 CANDIDATE(OscarName, OscarYear) REFERENCES OSCAR(Name, Year)

Exercise 11

You are requested to model a messaging service. Platform users are identified by the telephone number and are characterized by name, surname and tax ID code. The messages sent on the platform are characterized by the sending timestamp, the reception timestamp, the reading timestamp, the text of the message, the sender and the recipient.



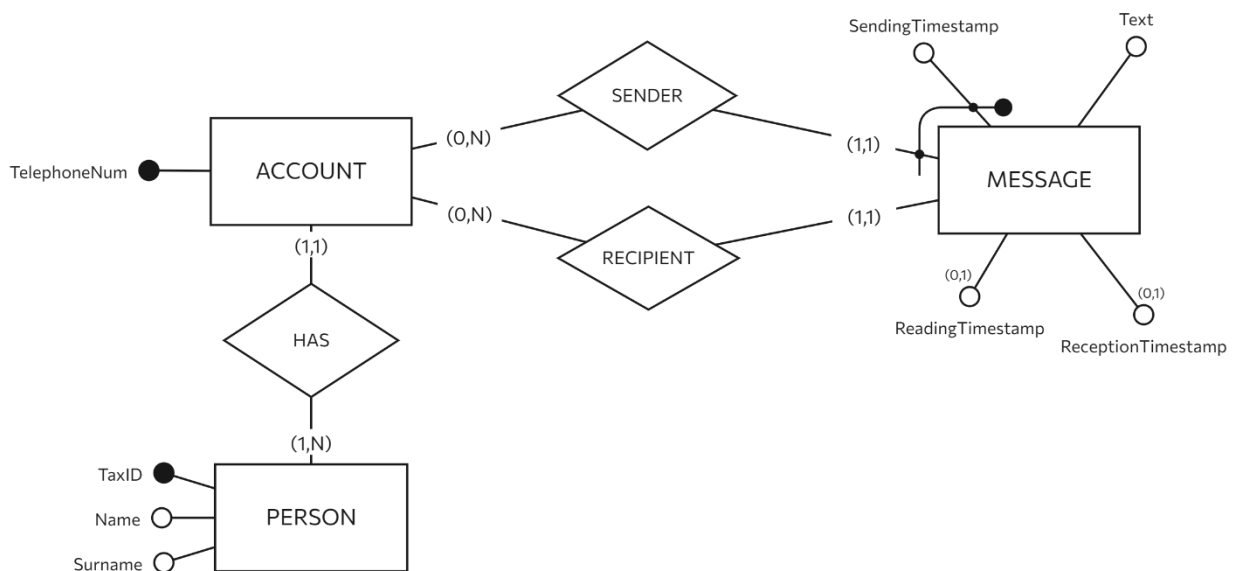
USER(TelephoneNum, Name, Surname, TaxID)

MESSAGE(SenderTelephoneNumber, SendingTimestamp, Text, RecipientTelephoneNumber, ReadingTimestamp*, ReceptionTimestamp*)

MESSAGE(SenderTelephoneNumber) REFERENCES USER(TelephoneNum)

MESSAGE (RecipientTelephoneNumber) REFERENCES USER(TelephoneNum)

To avoid a redundancy of the user's information, as well as to guarantee data integrity, the USER entity can be modeled by an entity ACCOUNT (i.e., the telephone number) in a one-to-many relation with the PERSON entity, as reported in the following figure.

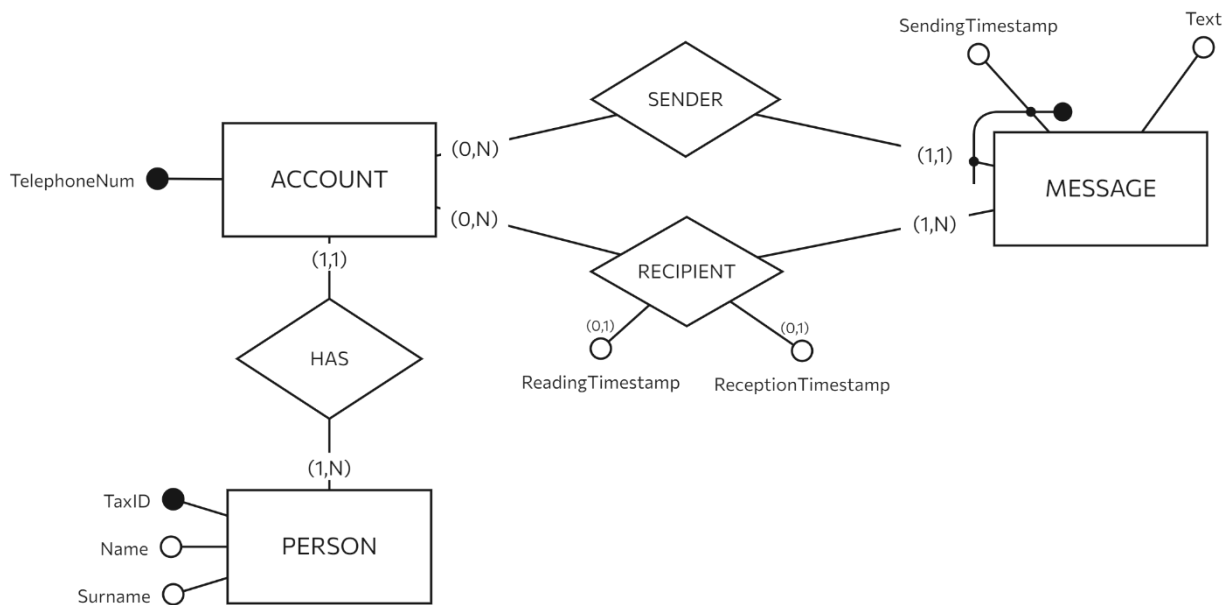


ACCOUNT(TelephoneNum, TaxID)

PERSON(TaxID, Name, Surname)
 MESSAGE(SenderTelephoneNumber, SendingTimestamp, Text, RecipientTelephoneNumber ,
 ReadingTimestamp*, ReceptionTimestamp*)

MESSAGE(SenderTelephoneNumber) REFERENCES ACCOUNT (TelephoneNum)
 MESSAGE (SenderTelephoneNumber) REFERENCES ACCOUNT (TelephoneNum)
 MESSAGE (RecipientTelephoneNumber) REFERENCES MESSAGE(SenderTelephoneNumber)

Moreover, in case you want to model the sending of the same message to more than one recipient, the conceptual model would be the following one.



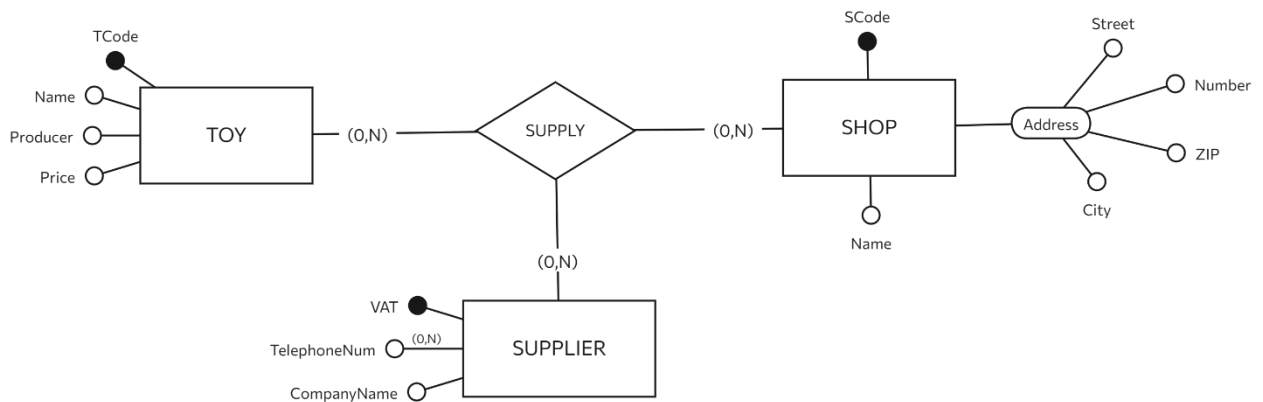
ACCOUNT(TelephoneNum, TaxID)
 PERSON(TaxID, Name, Surname)
 MESSAGE(SenderTelephoneNumber, SendingTimestamp, Text)
 RECIPIENT(RecipientTelephoneNumber, SenderTelephoneNumber, SendingTimestamp, ReadingTimestamp*,
 ReceptionTimestamp*)

MESSAGE(SenderTelephoneNumber) REFERENCES ACCOUNT (TelephoneNum)
 RECIPIENT(RecipientTelephoneNumber) REFERENCES ACCOUNT (TelephoneNum)
 RECIPIENT(SenderTelephoneNumber) REFERENCES MESSAGE(SenderTelephoneNumber)
 RECIPIENT(SendingTimestamp) REFERENCES MESSAGE(SendingTimestamp)

Exercise 12

A chain of toy stores wants to track the supply of different products in various stores. The toys are characterized by a name, the manufacturer and the list price. For shops, the name and address are known (street, house number, zip code, city). Each toy can be supplied to a shop by different suppliers. Each supplier is identified by the VAT number

and characterized by the company name and the list of telephone numbers (if available). A vendor may distribute several toys to the same store and to different stores.

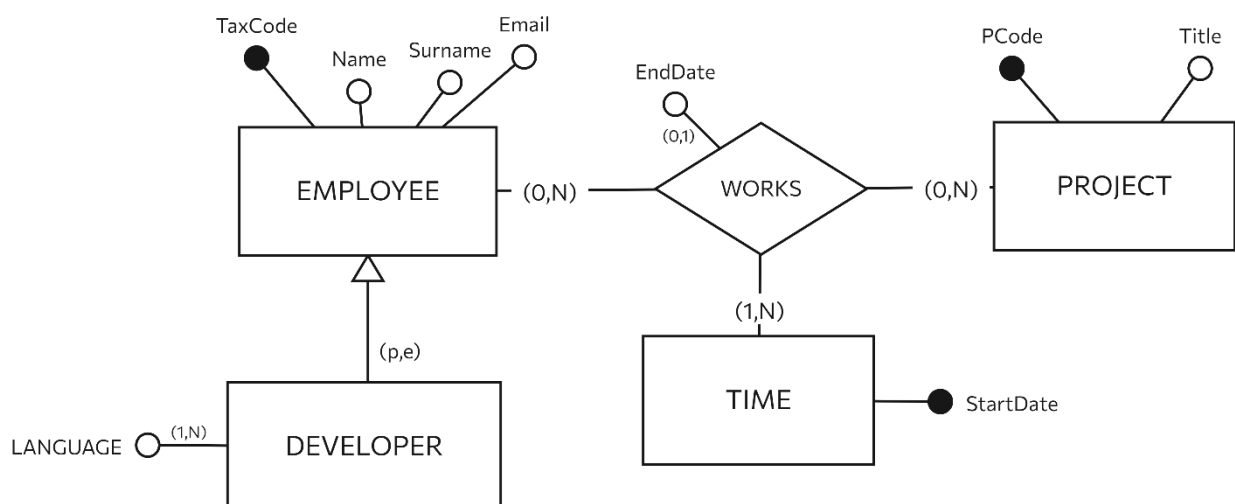


TOY(TCode, Name, Producer, Price)
 SHOP(SCode, Name, Street, Number, ZIP, City)
 SUPPLIER(VAT, CompanyName)
 HAS_PHONE_NUMBER(PhoneNumber, VAT)
 SUPPLY(TCode, SCode, VAT)

Referential integrity constraints: (to do)

Exercise 13

A company that provides IT consultancy services wants to store the deliverables produced by its employees for each project. A project is characterized by an alphanumeric code and a title. Employees who work at the company are characterized by their tax code, name, surname and email. Employees are divided into developers and systems engineers. For developers, the list of programming languages they use is known. You are requested to store the time periods (start date and end date) for which each employee works on a project. Multiple employees can work on the same project at the same time.



EMPLOYEE(TaxCode, Name, Surname, Email, Type)

KNOWS_LANGUAGE(TaxCode, Language)

PROJECT(PCode, Title)

~~TIME(StartDate)~~

WORKS(TaxCode, PCode, StartDate, EndDate*)

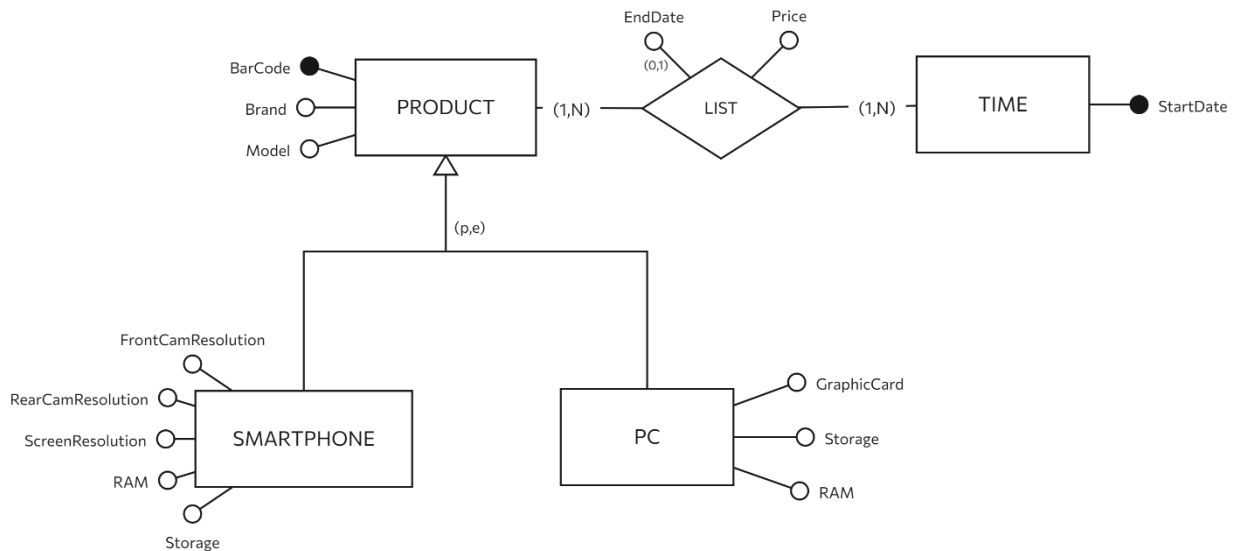
WORKS(TaxCode) REFERENCES EMPLOYEE(TaxCode)

WORKS(PCode) REFERENCES PROJECT(PCode)

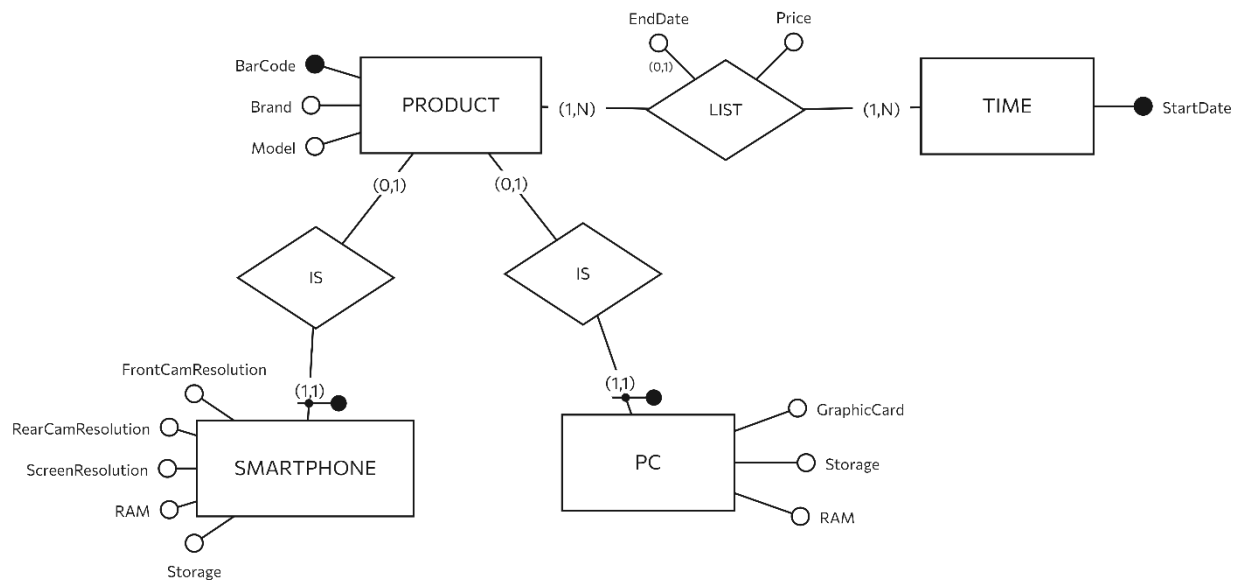
KNOWS_LANGUAGE(TaxCode) REFERENCES EMPLOYEE(TaxCode)

Exercise 14

A technology product store wants to memorize the price list. Each product is marked with a barcode, brand and model. The products are divided into different categories (cameras, smartphones, PCs). For smartphones, we know the screen resolution (in inches), the resolution of the front and rear cameras (in megapixels), the storage capacity (in GB) and the size of the RAM (in GB). PCs are characterized by the storage capacity (in GB), the size of the RAM (in GB), the model of the graphics card. The price list keeps track of the prices at which each product was sold over time.



Let's remove the generalization



PRODUCT(BarCode, Brand, Model)

SMARTPHONE(BarCode, FrontCamResolution, RearCamResolution, ScreenResolution, RAM, Storage)

PC(BarCode, GraphicCard, Storage, RAM)

LIST(BarCode, StartDate, EndDate*, Price)

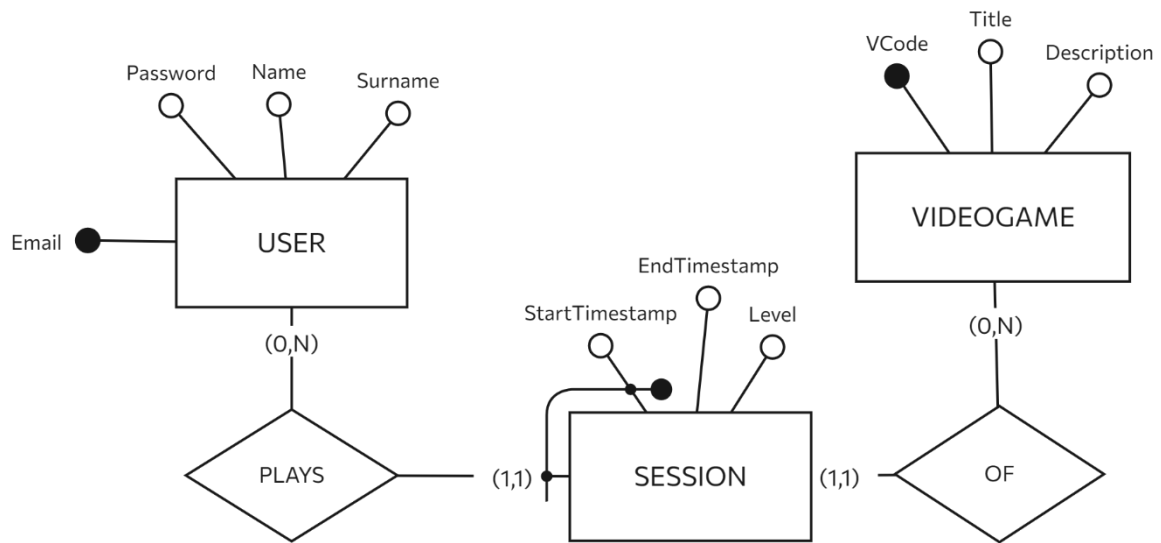
SMARTPHONE(BarCode) REFERENCES PRODUCT(BarCode)

PC(BarCode) REFERENCES PRODUCT(BarCode)

LIST(BarCode) REFERENCES PRODUCT(BarCode)

Exercise 15

A gaming platform wants to keep track of when its users play. Each video game is characterized by a unique code, a title and a description. Platform users are described by email, password, name and surname. Note that a user cannot play multiple video games at the same time. Finally, the level reached in the game session is also saved.

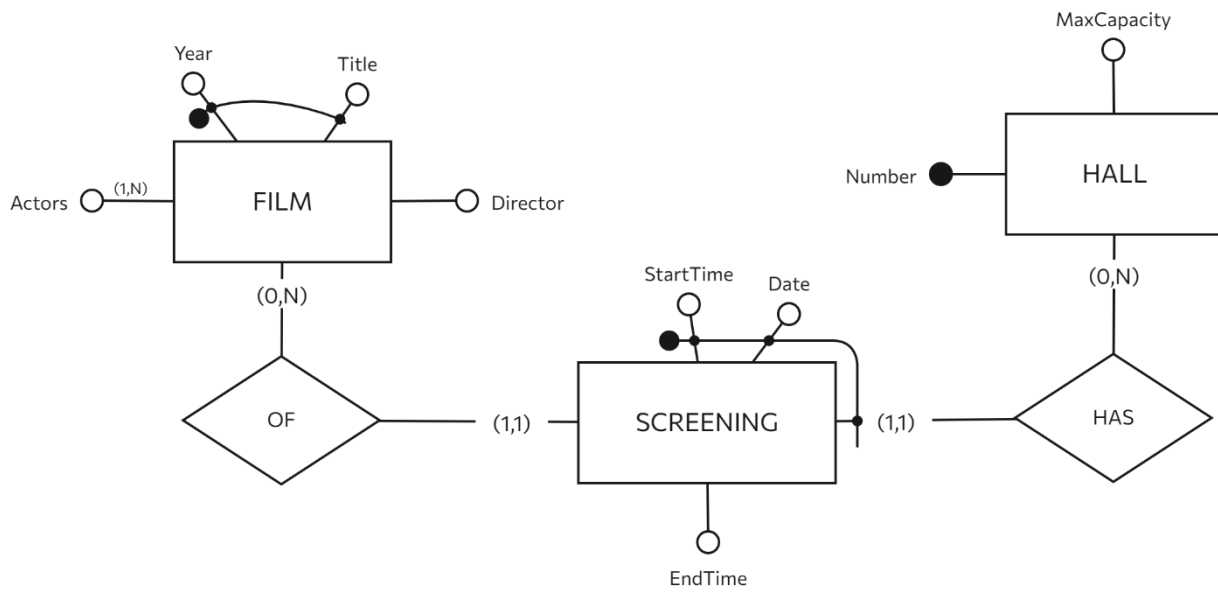


USER(Email, Name, Surname, Password)
 VIDEOGAME(VCode, Title, Description)
 SESSION(Email, StartTimestamp, EndTimestamp, Level, VCode)

SESSION (Email) REFERENCES USER(Email)
 SESSION(VCode) REFERENCES VIDEOGAME(VCode)

Exercise 16

A movie theater wants to keep track of movie showings at various theaters. The films are characterized by a title, the year of production, the director and the list of actors. The halls of the cinema are described by a number and by the maximum capacity. A film can be screened in several cinemas even at the same time, but only one film is shown in a hall at a given time.



FILM(Year, Title, Director)
 HAS_ACTOR(Year, Title, Actor)
 HALL(Number, MaxCapacity)
 SCREENING(Number, Date, StartTime, EndTime, Title, Year)

This is what the restructured and translated E-R would look like in DesignER:

