Exercise 1:
Data models provide a conceptual framework that provides a formal definition of the overall application structure using model-specific semantics.
Data models enable a rapid implementation of a prototype and serve as documentation tool. The maintenance and further development of the system is also simplified.
Mainly in the design phase

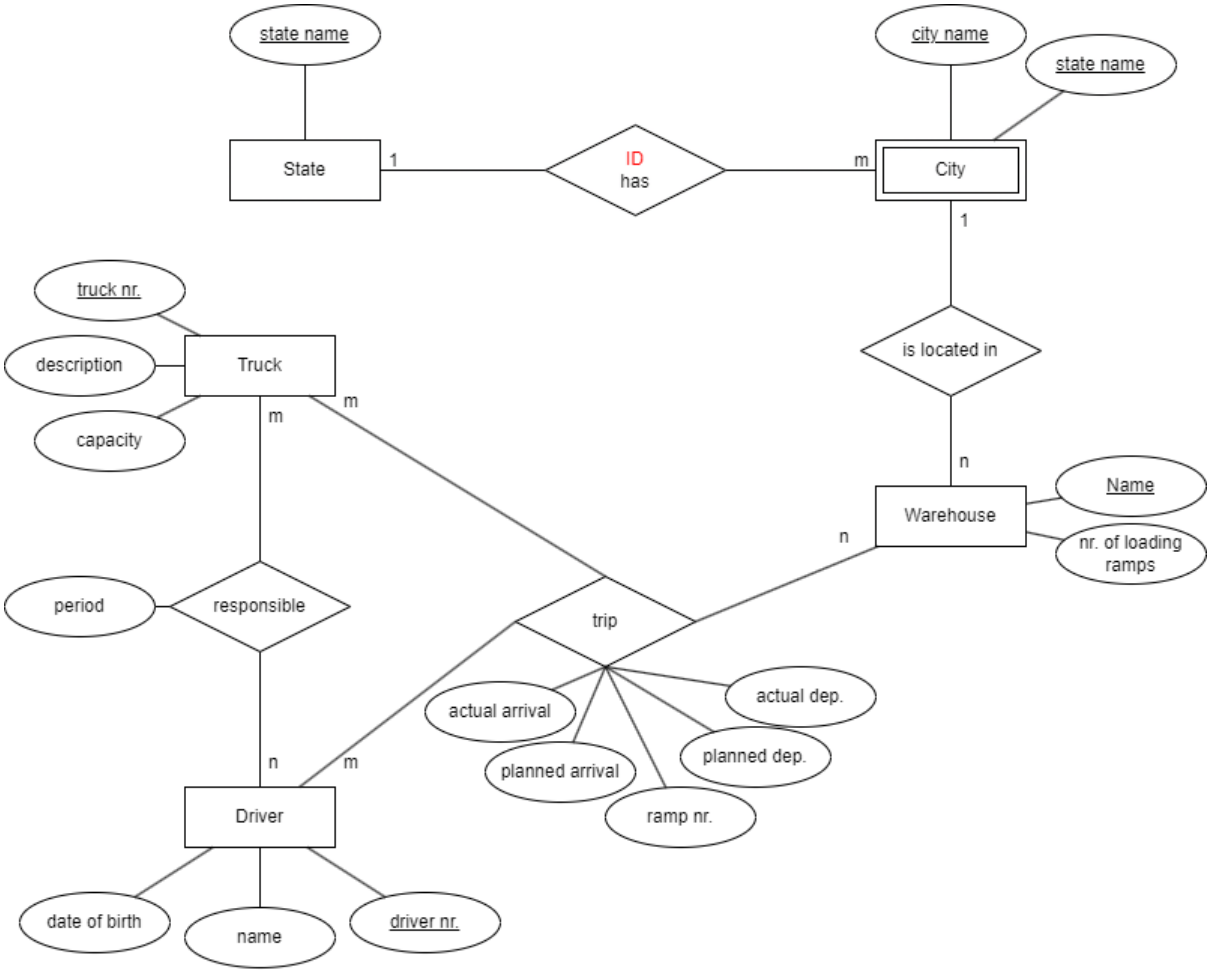
Exercise 2:
Complete/incomplete needs to be assigned to indicate whether there might be the need to add extra subtypes in the future and if the supertype exists on its own and the subtype only have additional attributes.

Disjoint/overlapping needs to be assigned to indicate whether a further relation for the generalization is required and whether several sub relations have to be joined.

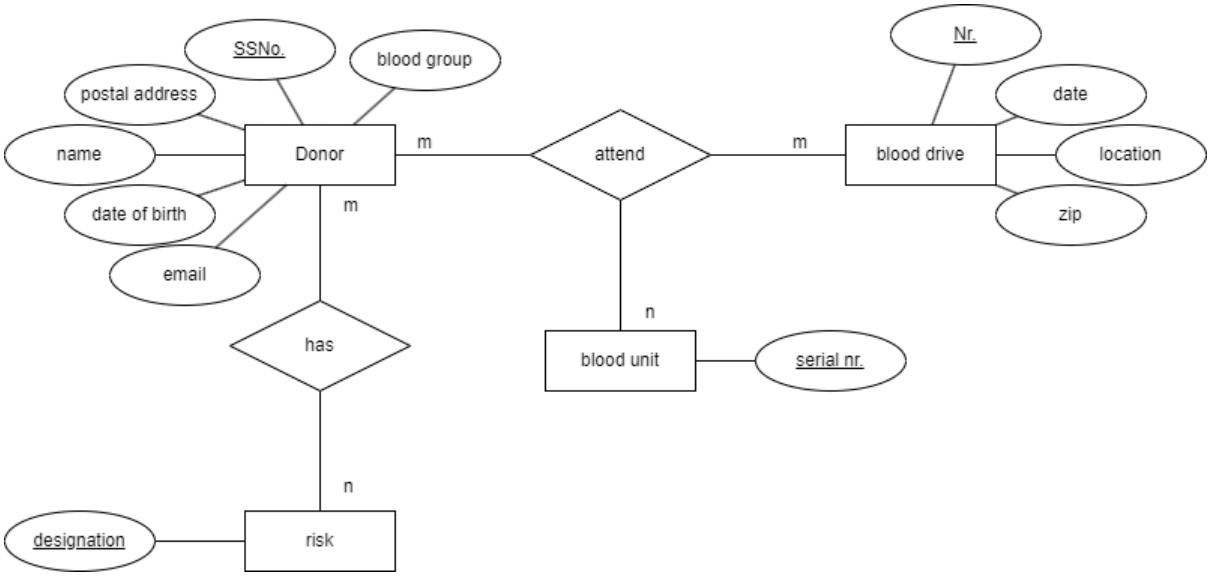
Exercise 3:

1. A Bank branch can not exist without a Bank!
2. A Bank branch can not be identified with only the bank_branch_number, but needs the BIC (Business Identifier Code) in addition to it.
3. If the Bank is closed, all of its Branches will be closed too!

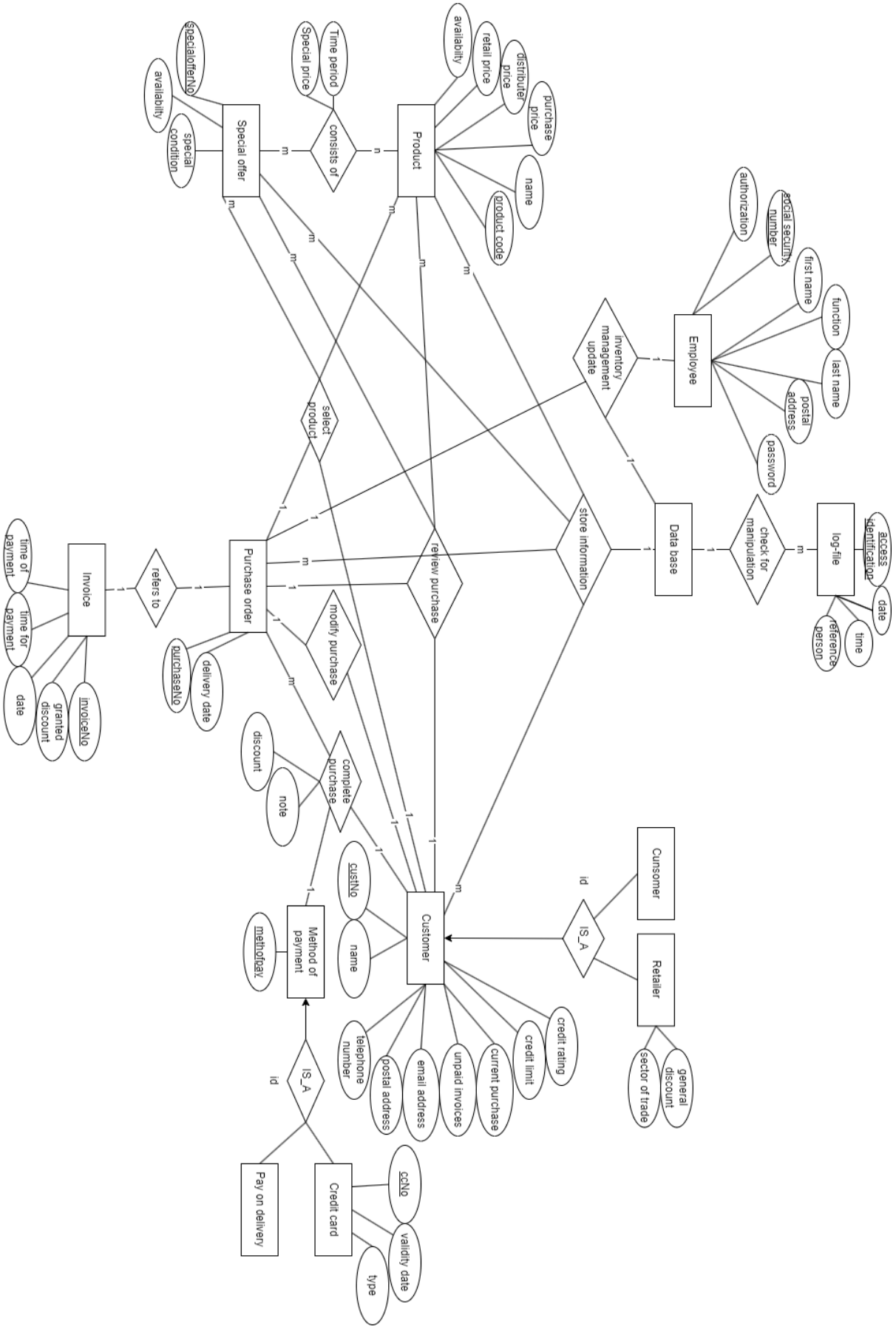
Exercise 4:



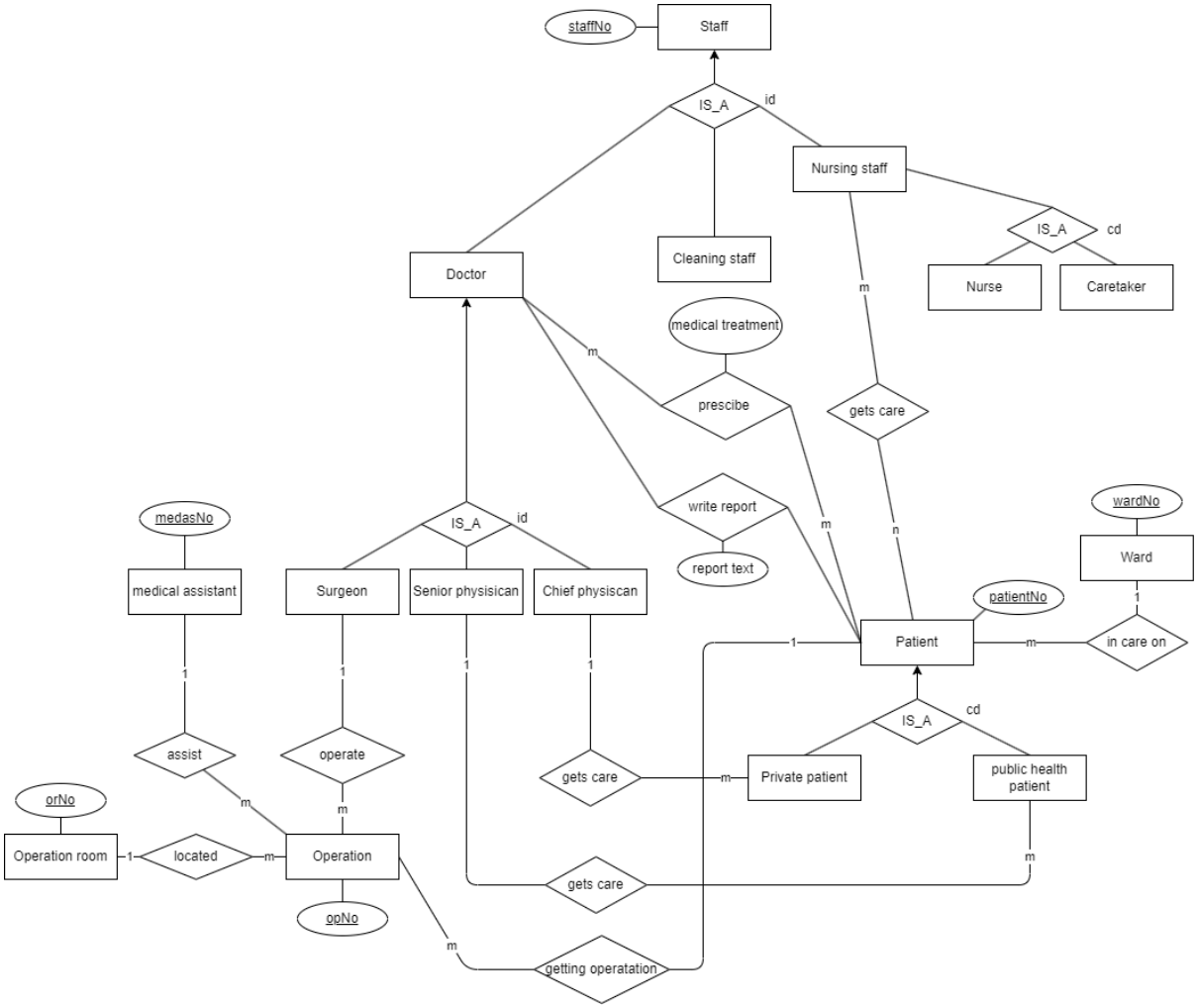
Exercise 5:



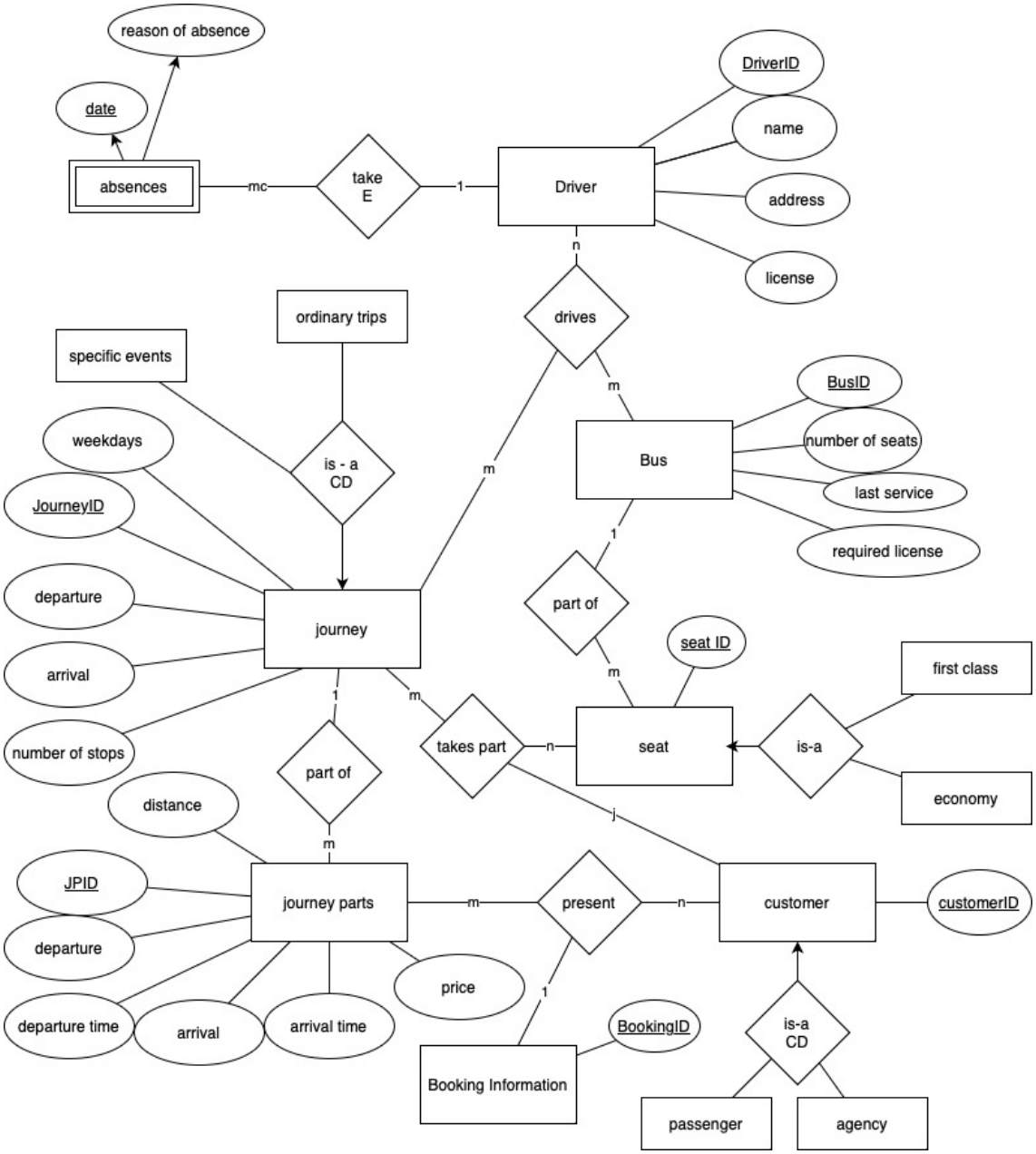
Exercise 6:


Special offer
specialofferNo
availability
special condition
consists of
Special price
Time period
Product
availability
retail price
distributer price
purchase price
name
product code
Employee
authorization
social security number
first name
function
last name
postal address
password
inventory management update
select product
store information
check for manipulation
Data base
log-file
access identification
date
time
reference person
Purchase order
purchaseNo
delivery date
refers to
Invoice
time of payment
time for payment
date
granted discount
invoiceNo
modify purchase
review purchase
complete purchase
discount
note
Customer
custNo
name
telephone number
postal address
email address
unpaid invoices
current purchase
credit limit
credit rating
Method of payment
methodpay
IS_A
id
Pay on delivery
Credit card
ccNo
validity date
type
Cunsomer
Retailer
sector of trade
general discount
m
n
1

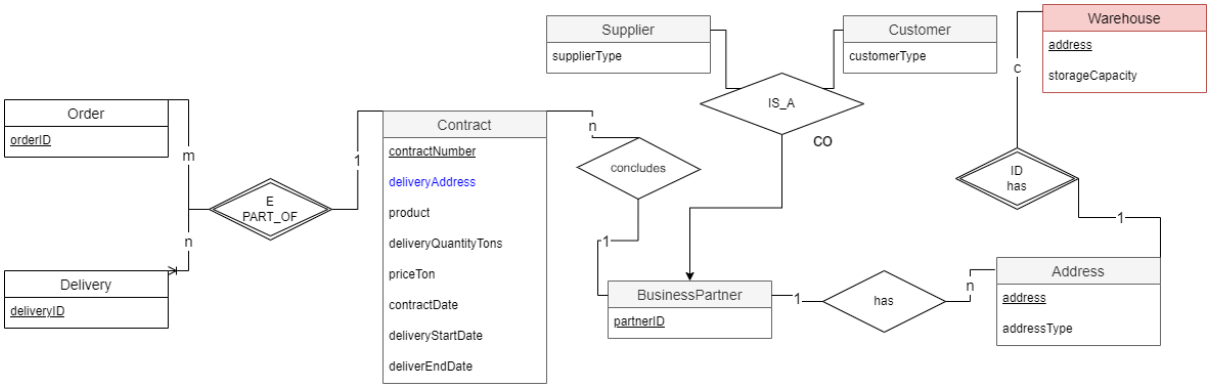
Exercise 7:



Exercise 8:


reason of absence
date
absences
mc
take
E
1
Driver
DriverID
name
address
license
n
drives
m
ordinary trips
specific events
weekdays
JourneyID
is - a
CD
m
Bus
BusID
number of seats
last service
required license
1
part of
m
departure
arrival
number of stops
journey
1
m
part of
takes part
n
seat
seat ID
first class
is-a
economy
distance
m
JPID
departure
departure time
arrival
arrival time
journey parts
m
present
n
customer
customerID
price
1
BookingID
Booking Information
is-a
CD
passenger
agency

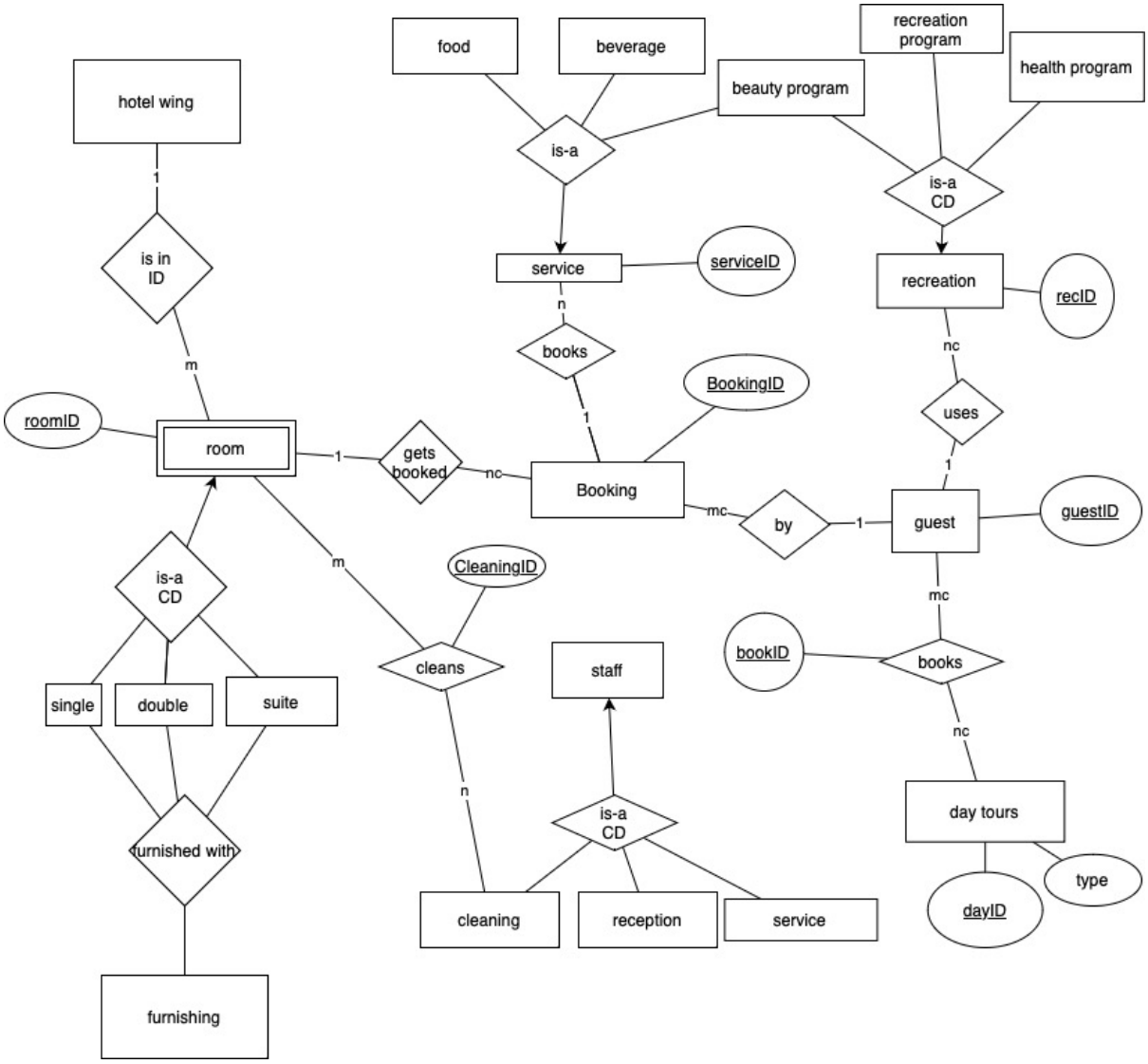
Exercise 9:


Supplier
supplierType
Customer
customerType
Warehouse
address
storageCapacity
IS_A
CO
c
Order
orderID
m
E
PART_OF
1
Contract
contractNumber
deliveryAddress
product
deliveryQuantityTons
priceTon
contractDate
deliveryStartDate
deliverEndDate
n
concludes
ID
has
1
n
Delivery
deliveryID
1
BusinessPartner
partnerID
1
has
n
Address
address
addressType

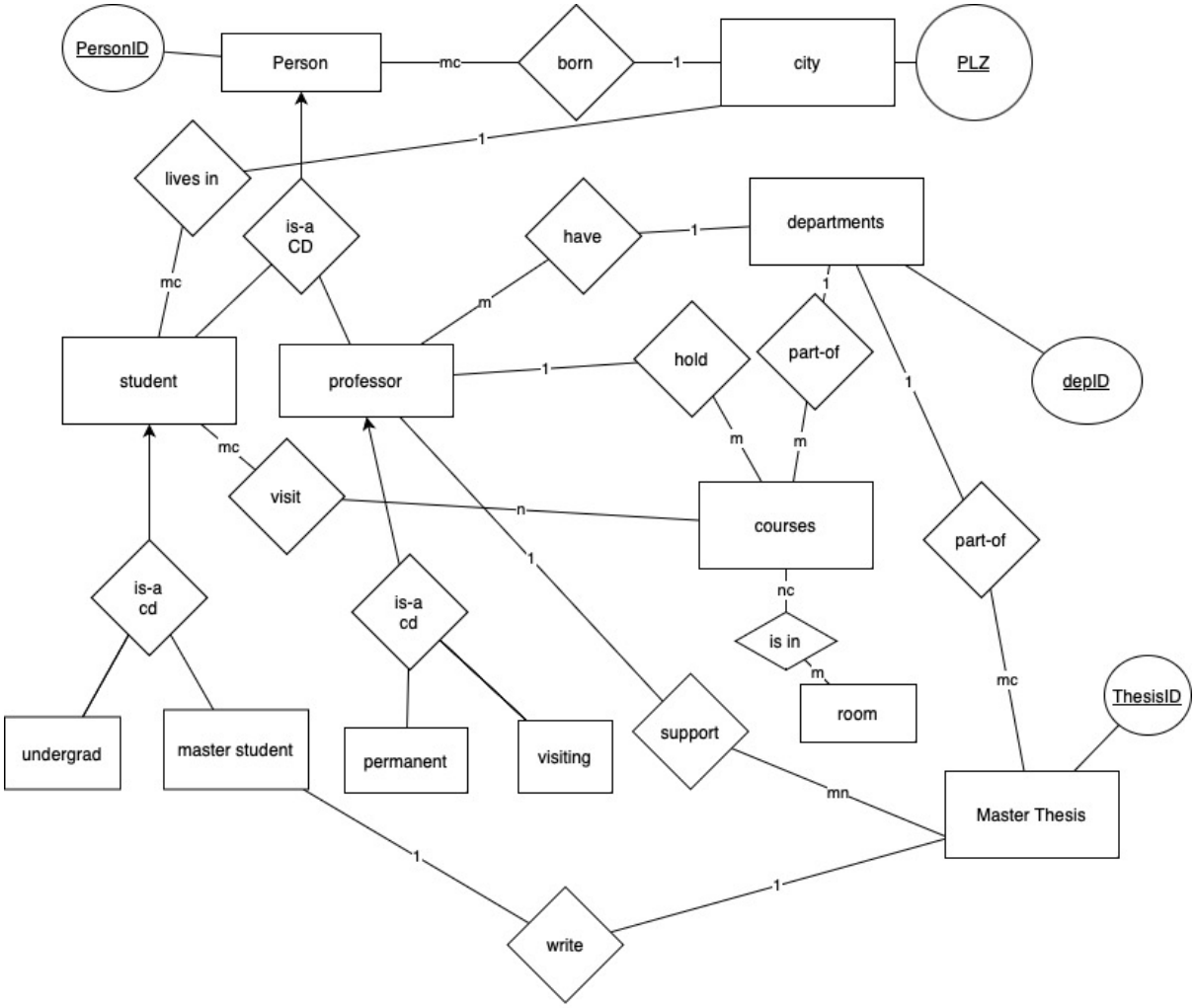
Exercise 10:

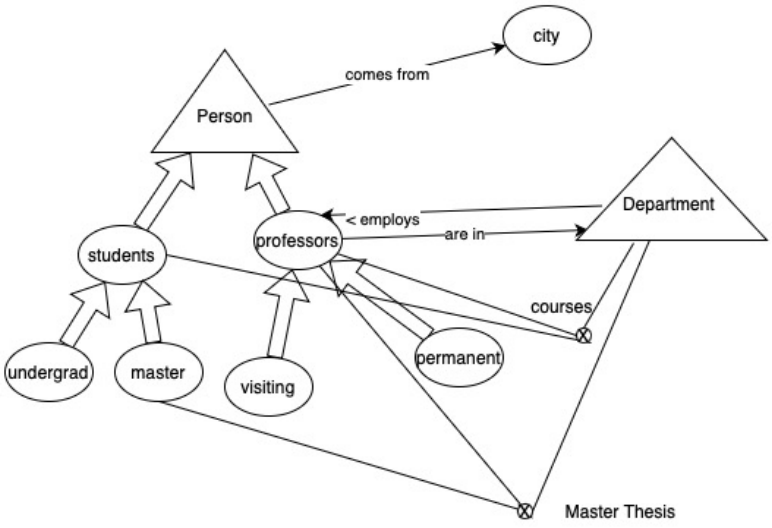
- Engagement({*from*, *to*})
- BandMember-Engagement({*bmNo*, *from*, *to*})
- BandMember({*bmNo*, name, address, salary})
- Musician({*bmNo*})
- GuestMusician({*bmNo*})
- Staff({*bmNo*})
- BandMemberCategorization({*bmNo, bmType*})
- Instrument({*instNo*})
- BandMemberAbleToPlay({*instNo, bmNo*})
- BandMemberPlays({*instNo, bmNo,* from, to})
- GuestMusicianAbleToPlay({*instNo, bmNo*})
- GuestMusicianPlays({*instNo, bmNo,* from, to})
- BandMemberEvent({*bmNo*, *eventName*, from, to, salary})
- Event({*eventName, date*, locationNo})
- Location({*locationNo*})
- MusicScheduled({*eventName, date, songNo,* No})
- MusicPlayed({*eventName, date, songNo,* No })
- PieceOfMusic({*songNo*})
- Uniform({*uniformNo*})
- WearsUniform({*bmNo, eventName, date,* uniformNo})

Exercise 11:

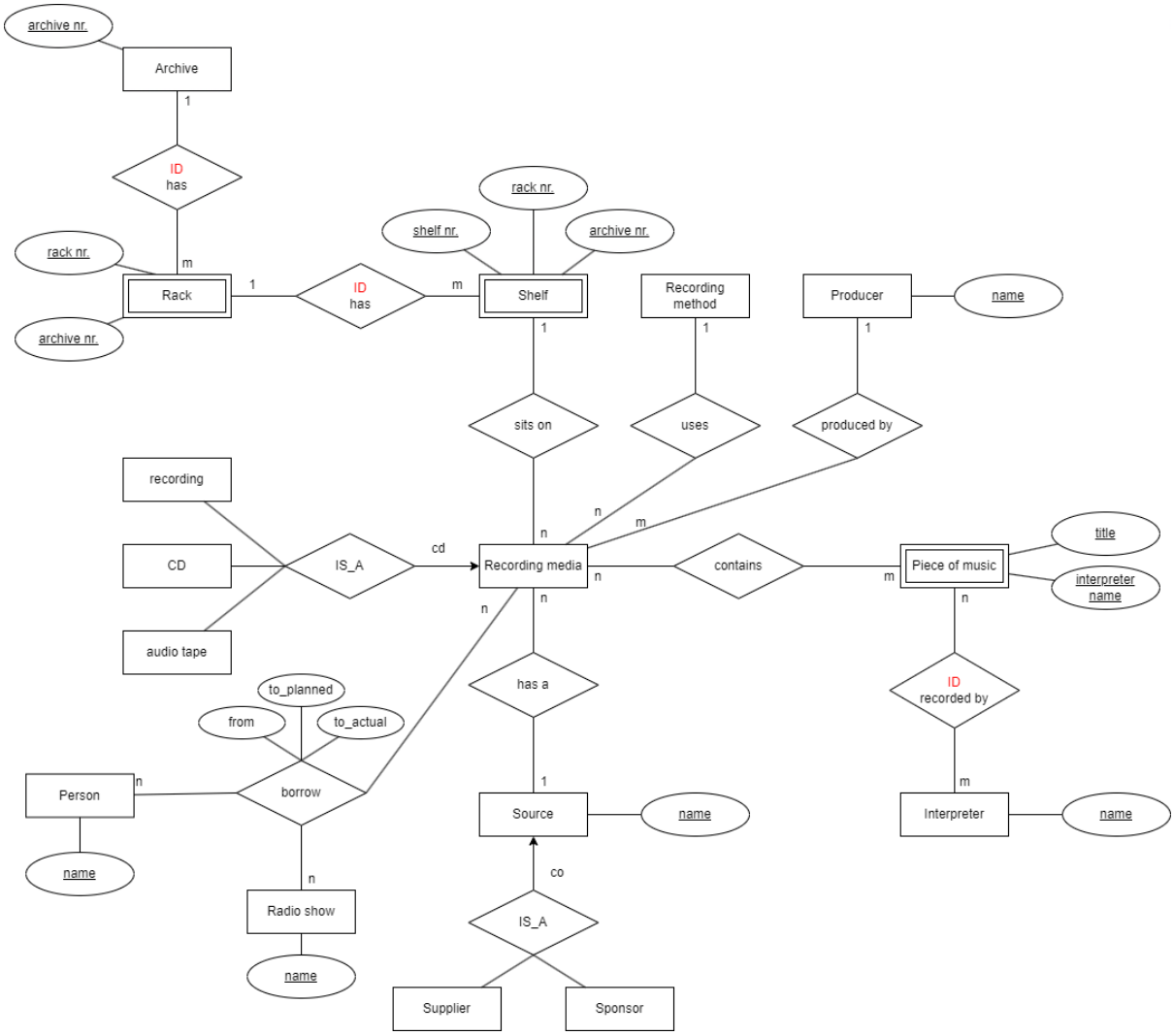

food
beverage
recreation program
health program
beauty program
hotel wing
is-a
is-a CD
1
is in ID
service
serviceID
recreation
recID
n
books
nc
BookingID
uses
roomID
m
room
1
gets booked
nc
Booking
1
mc
by
1
guest
guestID
is-a CD
m
CleaningID
mc
bookID
books
cleans
staff
single
double
suite
nc
n
is-a CD
day tours
furnished with
cleaning
reception
service
type
dayID
furnishing

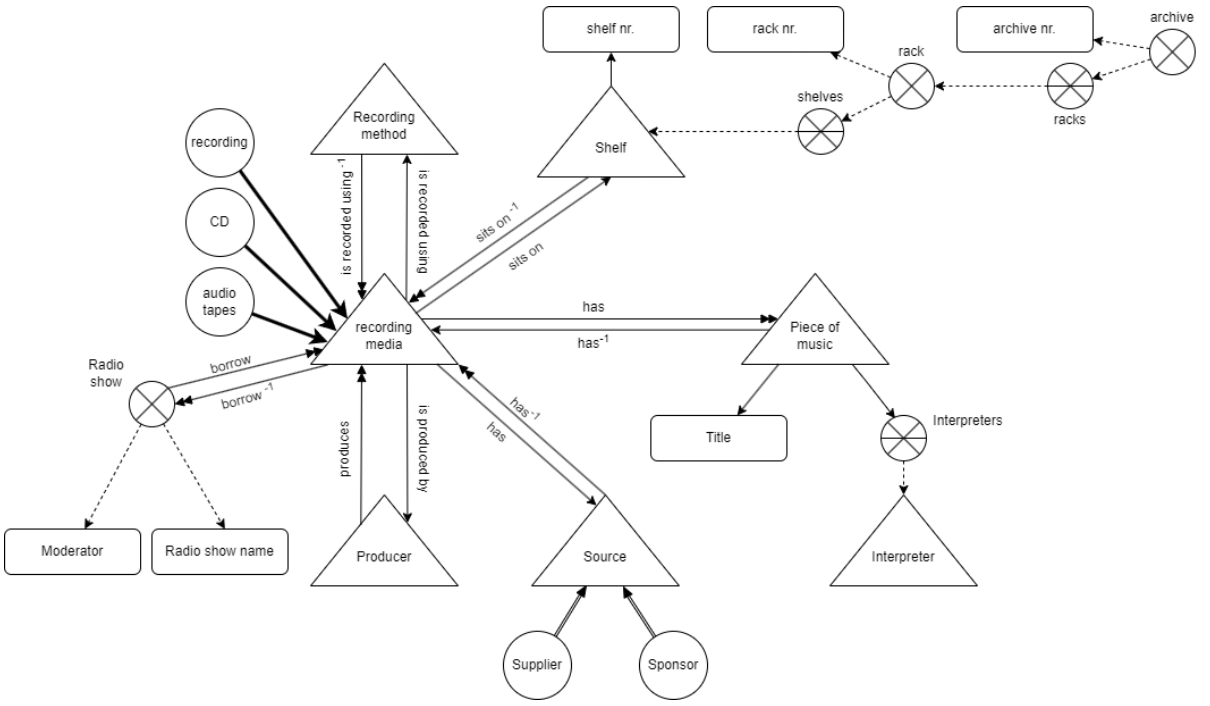
Exercise 12:


PersonID
Person
mc
born
1
city
PLZ
1
lives in
is-a
CD
have
1
departments
mc
m
1
student
professor
1
hold
part-of
deplD
1
mc
m
m
visit
n
courses
part-of
1
is-a
cd
is-a
cd
nc
is in
m
room
mc
ThesisID
undergrad
master student
permanent
visiting
support
mn
Master Thesis
1
1
write

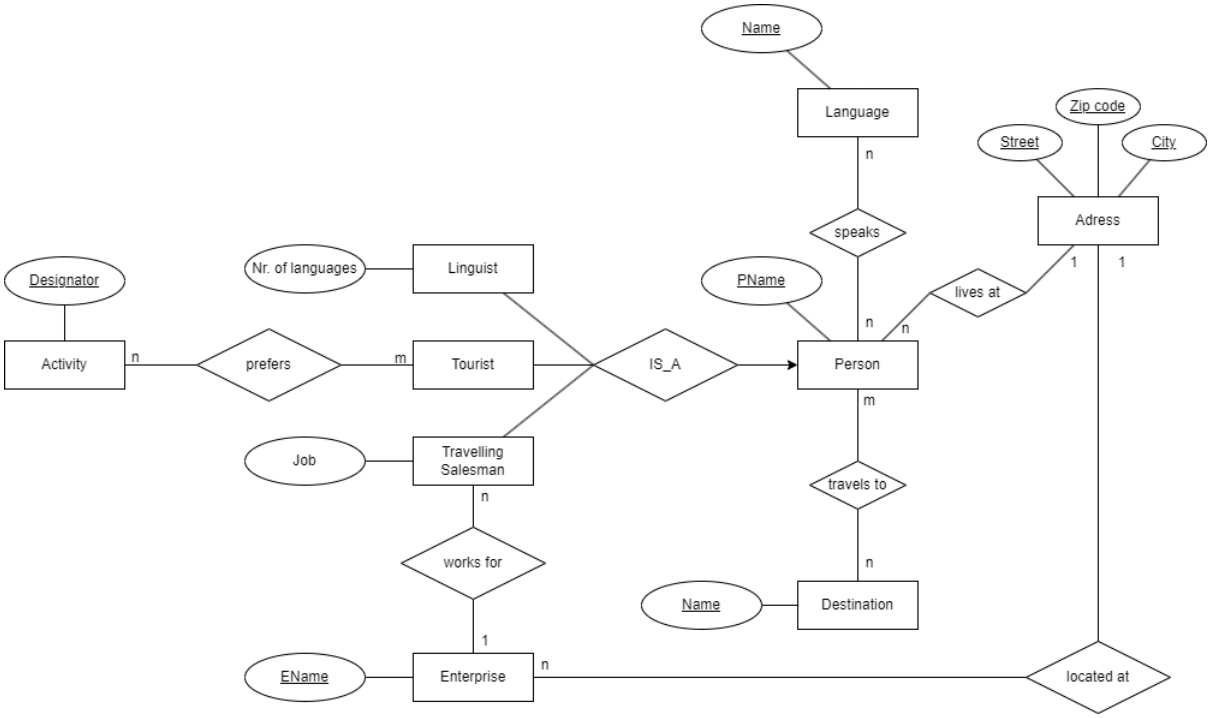

city
comes from
Person
Department
< employs
are in
professors
students
courses
undergrad
master
visiting
permanent
Master Thesis

Exercise 13:


archive nr.
Archive
1
ID
has
m
rack nr.
Rack
archive nr.
1
ID
has
m
rack nr.
shelf nr.
archive nr.
Shelf
1
Recording
method
1
Producer
1
name
sits on
uses
produced by
recording
CD
audio tape
IS_A
cd
n
m
n
Recording media
n
contains
m
Piece of music
title
interpreter
name
n
n
has a
ID
recorded by
m
to_planned
from
to_actual
borrow
Person
n
name
n
Radio show
name
1
Source
name
co
IS_A
Supplier
Sponsor
Interpreter
name

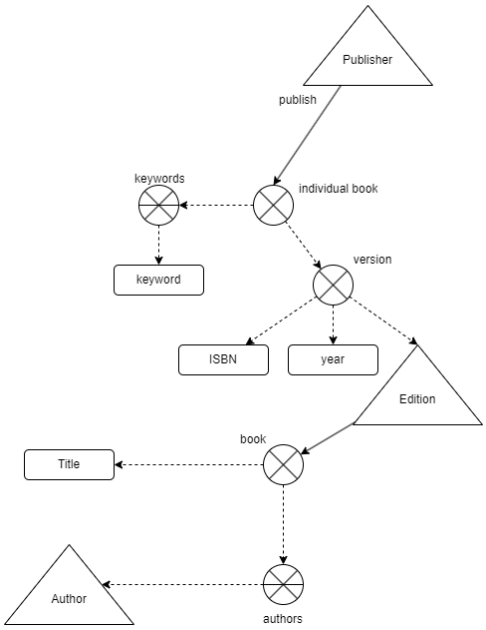

shelf nr.
rack nr.
archive nr.
archive
rack
shelves
racks
Recording
method
Shelf
recording
CD
audio
tapes
is recorded using -1
is recorded using
sits on -1
sits on
has
has-1
recording
media
Piece of
music
Radio
show
borrow
borrow -1
produces
is produced by
has-1
has
Title
Interpreters
Moderator
Radio show name
Producer
Source
Interpreter
Supplier
Sponsor

Exercise 14:



Assuming that both models are correct and complete, the only distinguishing factor I found is the readability.
Because entities in the ER model can not reference multiple objects at once, we have to introduce additional entities like Activity, Language, and Destination as well as corresponding relations which leads to the GSM model being more compact.
On the other hand, the ER model uses way less shapes and arrow types, which makes it far more readable. This is especially true for people not familiar with data modeling concepts.

Exercise 15:



Applying aggregation in this example leads to the general concept of book becoming more and more specialized until there is an individual book which can be published by the publisher.

Exercise 16: