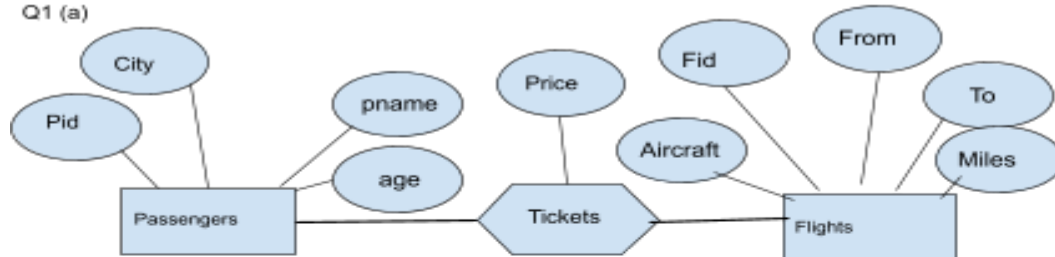


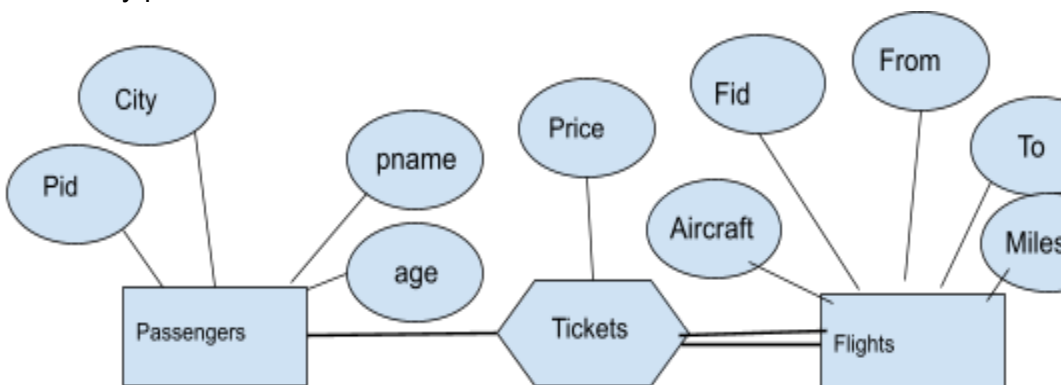
Question 1 (5 points)

a. Draw an ER diagram for the schema given above, assuming no constraints hold other than results from the schema definition

Q1 (a)

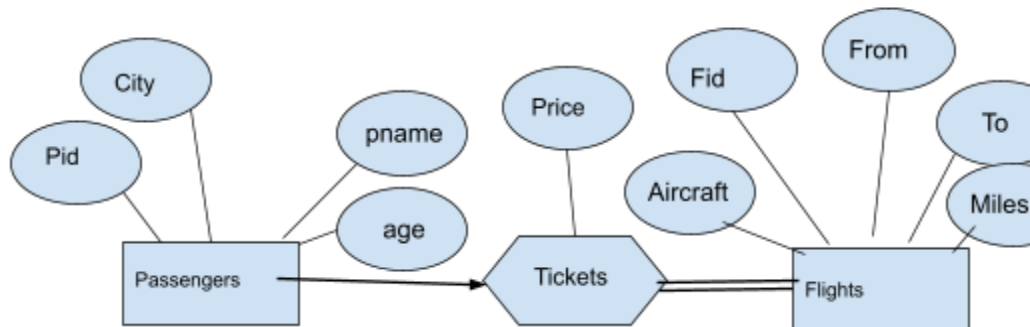


b. Update the ER diagram in 1.a to account for the constraint that a flight cannot take off without any pass



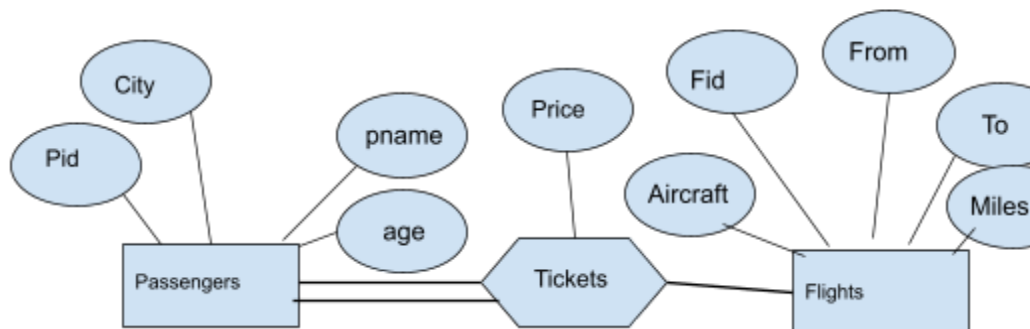
c. Update the ER diagram to account for the constraint in 1.b as well as that no passenger should have multiple flights in the same day

(c)



d. Update the ER diagram in 1.a to account for the constraint that each passenger must be on at least one flight

(d)



Question 2 (10 points) Write relational algebra expressions for the following queries given the schema above

(a) Find the ages of passengers who traveled only on flights with aircraft B777 (assumes that they were on at least one flight)

$\pi_{age}(\sigma_{aircraft = 'B777'}(Flights) \bowtie (Tickets) \bowtie (Passengers))$

(b) Find the ages of passengers who traveled on a flight from airport ORD, and who never paid more than \$300 for a ticket on any flight.

$\pi_{age}(Passengers \bowtie (\sigma_{From = 'ORD'}(Flights) \bowtie (\sigma_{price \leq 300}(Tickets))))$

(c) Find the origin of flights that had both passengers who reside in Boston and passengers who reside in Chicago.

$\pi_{from}(\sigma_{city = 'Boston'}(Passengers) \cap \sigma_{city = 'Chicago'}(Passengers \bowtie (Tickets \bowtie (Flights))))$

(d) Find the names of passengers who traveled on a A380 aircraft and paid at most \$100 for that ticket.

$\pi_{name}(Passengers \bowtie (\sigma_{aircraft = 'A380'}(Flights) \bowtie (\sigma_{price \leq 100}(Tickets))))$

Question 3 (15 points) Write SQL queries for the following:

(a) Find the name of passengers who traveled on all aircraft types.

3. a) Select P.pname FROM Passengers P Where Not Exists(Select F.aircraft From Flights F Minus Select F1.aircraft From Flights F1, Tickets T Where F2.fid = T.fid & T.pid = P.pid))

(b) Find for each flight with at least 50 passengers the average price paid by passengers who are 18 or older. List the fid in the output to identify the flight.

Select T.fid, Avg(T.price) AS average_price From Ticket T, Passengers P Where P.pid = T.fid & P.age >= 18 Group by T.fid (Select Count * From Tickets T1 Where T1.fid = T.fid) >= 50);

(c) Find the city of residence of passengers who traveled only on A380 aircraft (assumes they were on at least one flight).

Select P.city From Passengers P, Tickets T Where P.pid = T.pid & P.pid not (Select T1.pid From Tickets T1, Flights F Where F.aircraft <> "A380" & F.fid = T1.fid));

(d) Calculate the revenue earned by the airline from tickets on the flight(s) with the longest distance.

Select sum(price) as Revenue From tickets flights(fid) group fid having max(miles);

e) Create a view OriginSummary that lists for every origin airport the total number of passengers that departed from that airport, the total dollar amount earned by the airline for tickets on flights that depart from that airport, and the average distance for flights departing from that airport. The view will have four columns with headings: Airport, PsgCount, Revenue and AvgDistance

Question 4 (10 points) Suppose you are given a relation R with four attributes ABCD and the following set of FDs: $A \rightarrow D$, $AB \rightarrow C$, $C \rightarrow B$.

a. Identify the key(s) for R (4p)

X	X ⁺
A	A, D
B	B
C	B, C
D	D
AB	A, B, C, D
AC	A, C, B, D
AD	A, D
BC	B, C
BD	B, D
CD	C, D, B
ABC	SK
ABD	A, B, C, D
ACD	A, C, D, B
BCD	B, C, D

K = AB AC minimal keys

F⁺ = { $A \rightarrow D$, $AB \rightarrow C$, $C \rightarrow B$ }

b. Determine if R is in BCNF, 3NF, or none of the above. If it is not in BCNF, decompose it into a set

BCNF	BCNF Violation?	3NF Violation?
A → D	YES	YES
AB → C	NO	NO
C → B	YES	NO

Not in BCNF or 3NF

