Assignment No.: 1
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Excercise 1

Task 1:

Important Notations Used:
-$\rho_{*\to *1}(A)$: rename all attributes in table A to its attrute name with 1 appended to the end
eg: $\rho_{*\to *1}[A(name, date, time)] \implies A(name1, date1, time1)$
-$R \leftarrow$ (RA Expression): R is the final result for the question, assume it is the finished query for the question
-Number beside each RA expression corrosponds to the comment below

Q1)

$$A \leftarrow \Pi_{PID,CID}(\rho_{playerA,court\to PID,CID}(Event)) \cup \Pi_{PID,CID}(\rho_{playerB,court\to PID,CID}(Event)) \quad (1)$$
$$B \leftarrow \Pi_{CID}(Court) \quad (2)$$
$$C \leftarrow \Pi_{PID}(A) - \Pi_{PID}((\Pi_{PID}(A) \times B) - A) \quad (3)$$
$$R \leftarrow \Pi_{fname,lname}(\sigma_{name=Canada}(\rho_{country\to CTRYID}(C \bowtie Player) \bowtie Country)) \quad (4)$$

(1) Renaming the court attribute to CID, and rename PlayerA and playerB to a common attribute Consolidates PLayerA and PlayerB into a single attribute
(2) Get the CID attribute from Court
(3) Preform the equivelant of a A/B to get PIDs who played on all courts
(4) Join with Player and Country and get only Player from canada then get their names

Q2)

$$A \leftarrow \rho_{event\to EID}(\Pi_{dateIssued,event}(Voucher)) \quad (5)$$
$$R \leftarrow \Pi_{dateIssued,date}(A \bowtie Event) \quad (6)$$

(5) Get the dateIssued out of each voucher and the event it belongs to rename The event attribute to join with Event Table
(6) Join with Event to get the date of the event and project

Q3)

Not Representable

Q4)

$$A \leftarrow \Pi_{PID}(\rho_{playerA\to PID}(Event)) \cup \Pi_{PID}(\rho_{playerB\to PID}(Event)) \quad (7)$$
$$B \leftarrow [Player - (A \bowtie Player)] \quad (8)$$
$$R \leftarrow \Pi_{name}(\rho_{country\to CTRYID}(B) \bowtie Country) \quad (9)$$

(7) Get consolidated players from playerA and playerB attributes. This relation contains players who participated in at least 1 event
(8) Join A (Players who have 1 event) with Player to get full tuple and subtract from Player to get Players who didn't play in an event
(9) Join with Country and project the country name

Q5)

$$A \leftarrow \sigma_{court=court1 \wedge EID \neq EID1}(Events \times (\rho_{* \rightarrow *1}(Events))) \tag{10}$$
$$R \leftarrow \Pi_{name,CID}((\rho_{court \rightarrow CID}(\Pi_{court}(Events) - \Pi_{court}(A))) \bowtie Court) \tag{11}$$

(10) A contains all the Events where A court is used for more than 1 event (Different EID's but Same CID)
(11) Subtract A from all events will return Courts with only 1 Event played on them. Join with court and project its CID and name

Q6)

define:

$$d = |setswonA - setswonB|$$
$$d1 = |setswonA1 - setswonB1|$$

$$A \leftarrow \Pi_{setswonA,setswonB}(Event) - \Pi_{setswonA,setswonB}[\sigma_{d1>d}(Event \times \rho_{* \rightarrow *1}(Event))] \tag{12}$$
$$B \leftarrow A \bowtie Events \tag{13}$$
$$C \leftarrow \Pi_{PID}(\rho_{playerA \rightarrow PID}(B)) \cup \Pi_{PID}(\rho_{playerB \rightarrow PID}(B)) \tag{14}$$
$$R \leftarrow \Pi_{name}(C \bowtie Player \bowtie \rho_{CTRYID \rightarrow country}(Country)) \tag{15}$$

(12) Get setswonA and setsWonB where the absolute difference between the 2 is the maximum
(13) Get the events where these sets were recorded
(14) Consolidate PlayerA and PlayerB attributes and Extract their PID info
(15) Join PID with Player and Country and report the name of the country

Q7)

$$A \leftarrow \Pi_{capacity}(Court) - \Pi_{capacity}(\sigma_{capacity1>capacity}(Court \times \rho_{* \rightarrow *1}(Court))) \tag{16}$$
$$B \leftarrow [A \bowtie Court] \bowtie (\rho_{court \rightarrow CID}(Event)) \tag{17}$$
$$R \leftarrow \Pi_{PID}(\rho_{playerA \rightarrow PID}(B)) \cup \Pi_{PID}(\rho_{playerB \rightarrow PID}(B)) \tag{18}$$

(16) Get the court with the largest capacity
(17) Get the events that were played in the largest court
(18) Consolidate PlayerA and PlayerB attributes and Extract their PID info

Q8)

$$A \leftarrow \Pi_{dateIssued}(Voucher) - \Pi_{dateIssued}(\sigma_{dateIssued1<dateIssued}(Voucher \times \rho_{* \rightarrow *1}(Voucher))) \tag{19}$$
$$B \leftarrow (\rho_{event \rightarrow EID}(A \bowtie Voucher)) \bowtie Event \tag{20}$$
$$C \leftarrow \rho_{playerA \rightarrow PID}(\Pi_{playerA}[\sigma_{SetswonA>SetswonB}(B)]) \cup \rho_{playerB \rightarrow PID}(\Pi_{playerB}[\sigma_{SetswonA<SetswonB}(B)]) \tag{21}$$
$$R \leftarrow \Pi_{name}(C \bowtie Player \bowtie \rho_{CTRYID \rightarrow country}(Country)) \tag{22}$$

(19) Get the minimum dateIssued value implying the earliest purchased voucher
(20) Get the Event that Voucher was related to
(21) Get the winning player of that event. The select is Mutually Exclusive, one set is always empty (as it selects the losing Attribute in the event)
(22) Get the country of the winning player

Q9)

Not Representable

Q10)

$$A \leftarrow \Pi_{EID,dateIssued,date,VID}(\rho_{event \to EID}(Voucher) \bowtie Event) \tag{23}$$
$$B \leftarrow \sigma_{dateIssued=date}(A) \bowtie \sigma_{dateIssued1=date1}(\rho_{dateIssued,VID,date \to dateIssued1,VID1,date1}(A)) \tag{24}$$
$$R \leftarrow \Pi_{EID}(\sigma_{VID1 \neq VID}(B)) \tag{25}$$

(23) Join Voucher and Event together and project date and dateIssued for comparision, EID as the final output of the query, and VID as a Key
(24) Find at least 2 instances where dateIssued = date
(25) Use VID to remove the duplicate (Where the 2 joined Together have the same VID) and project the EID

Q11)

$$A \leftarrow \Pi_{wins}(Player) - \Pi_{wins}(\sigma_{wins1 > wins \wedge country1 = country}(Player \times \rho_{* \to *1}(Player))) \tag{26}$$
$$B \leftarrow (\sigma_{wins \neq 0}(A)) \bowtie Player \tag{27}$$
$$R \leftarrow \Pi_{fname,lname,name}(B \bowtie \rho_{CTRYID \to country}(Country)) \tag{28}$$

(26) Get the Max number of wins for each country (comparisons where countries are not matching will not be valid)
(27) Remove all entries with 0 wins (since 0 can be a max if all players of that country did not win). Join to get player data again
(28) Join with country and report the first name, last name and name of country

Q12)

$$PA' \leftarrow \Pi_{PID,CID,TID}(\rho_{playerA,court,tournament \to PID,CID,TID}(Event)) \tag{29}$$
$$PB' \leftarrow \Pi_{PID,CID,TID}(\rho_{playerB,court,tournament \to PID,CID,TID}(Event)) \tag{30}$$
$$A' \leftarrow (PA') \cup (PB') \tag{31}$$
$$A \leftarrow \Pi_{PID,CID}(A') \tag{32}$$
$$B \leftarrow \Pi_{CID}(Court) \tag{33}$$
$$C \leftarrow \Pi_{PID}(A) - \Pi_{PID}((\Pi_{PID}(A) \times B) - A) \tag{34}$$
$$D \leftarrow \Pi_{slam,PID}((C \bowtie A') \bowtie Tournament) \tag{35}$$
$$E \leftarrow \Pi_{slam}(Tournament) \tag{36}$$
$$F \leftarrow \Pi_{PID}(D) - \Pi_{PID}((\Pi_{PID}(D) \times E) - D) \tag{37}$$
$$R \leftarrow \Pi_{globalRank}(F \bowtie Player) \tag{38}$$

(29) Rename playerA court and tournament
(30) Rename playerB court and tournament
(31) Consolidates PlayerA and PlayerB into a single attribute Along with CID and TID added to the relation. Represents which player has played on what court and is in which tournament.
(32) To Set up for division We only need PID, CID
(33) Get the CID attribute from Court
(34) Preform the equivelant of a A/B to get PIDs who played on all courts
(35) Join C back with A' and join with tournament to get slam info. Relation represents which player has played in which slam that is confirmed to play in all courts

(36) Get the slam attribute from Tournament
(37) Preform the equivelant of a D/E to get PIDs who played on all slams
(38) Join with Player and report the global rank

Task 2:

Q1) $\sigma_{playerA=playerB}(Event) = \emptyset$

Q2) $A \leftarrow \Pi_{PID,date}(\rho_{playerA \to PID}(Event)) \cup \Pi_{PID,date}(\rho_{playerB \to PID}(Event))$
$\sigma_{date<activeSince}(A \bowtie Player) = \emptyset$ Q3) $\sigma_{eventdate-dateissued<10000}(\rho_{event \to EID}(Voucher) \bowtie (Event)) = \emptyset$

Q4) Cannot be expressed

Q5) $\sigma_{slam \neq AO \wedge slam \neq FO \wedge slam \neq UO \wedge slam \neq W}(Tournament) = \emptyset$

Q6) $A \leftarrow \Pi_{PID,tournament}(\rho_{playerA \to PID}(Event)) \cup \Pi_{PID,tournament}(\rho_{playerB \to PID}(Event))$
$\sigma_{gender \neq discipline}(\rho_{tournament \to TID}(A) \bowtie Tournament \bowtie Player) = \emptyset$

Relation A represents which player has played in each event and the additional information related to that event.

Excercise 2:

Task 1:

a) Min Basis = $AB \to D, C \to E, D \to C, E \to A$
b) Min Basis = $A \to D, BD \to E, AC \to E, DE \to B$
c) Min Basis = $AB \to D, AC \to E, BC \to D, D \to A, E \to B$

Task 2:

Note: the *** represents a violation
a)
$AB^+ = ABCD$
$^{***}C^+ = CDA$
$^{***}D^+ = DA$
$R_1 = CDA$
$R_2 = CB$

FD's in $R_1 = C \to D, D \to A, C \to A$
$C^+ = CDA$
$^{***}D^+ = DA$
$R_3 = DA$
$R_4 = DC$
Final Relations:
$R_2 = CB$
$R_3 = DA$
$R_4 = DC$

b)
$AB^+ = ABCD$
$BC^+ = BCDA$
$CD^+ = CDAB$
$AD^+ = ADBC$
No Violations, Final Relation: $R = ABCD$

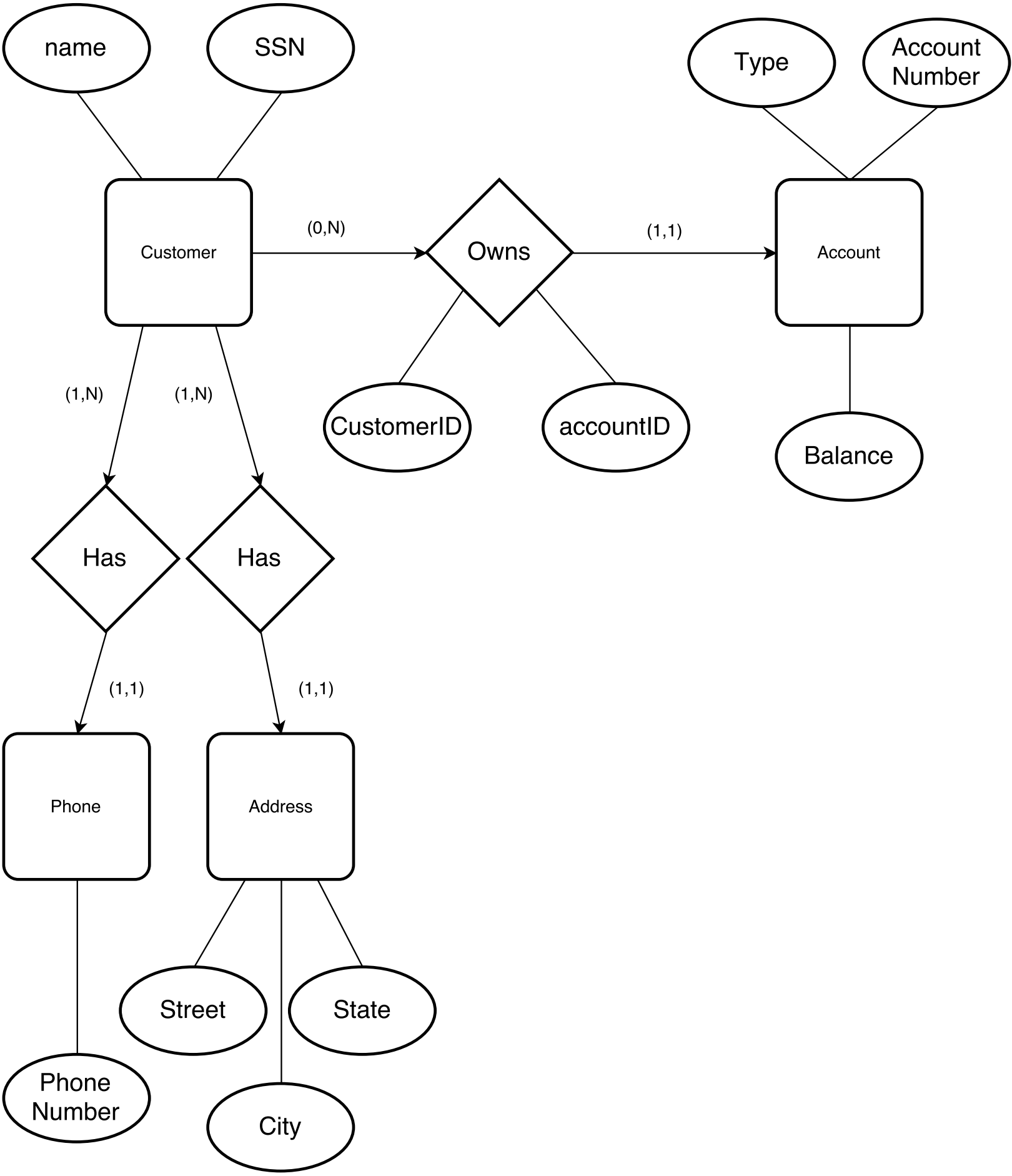
c)

d)
$AB^+ = ABCDE$
$^{***}C^+ = CDBE$
$R_1 = CDBE$
$R_2 = CA$

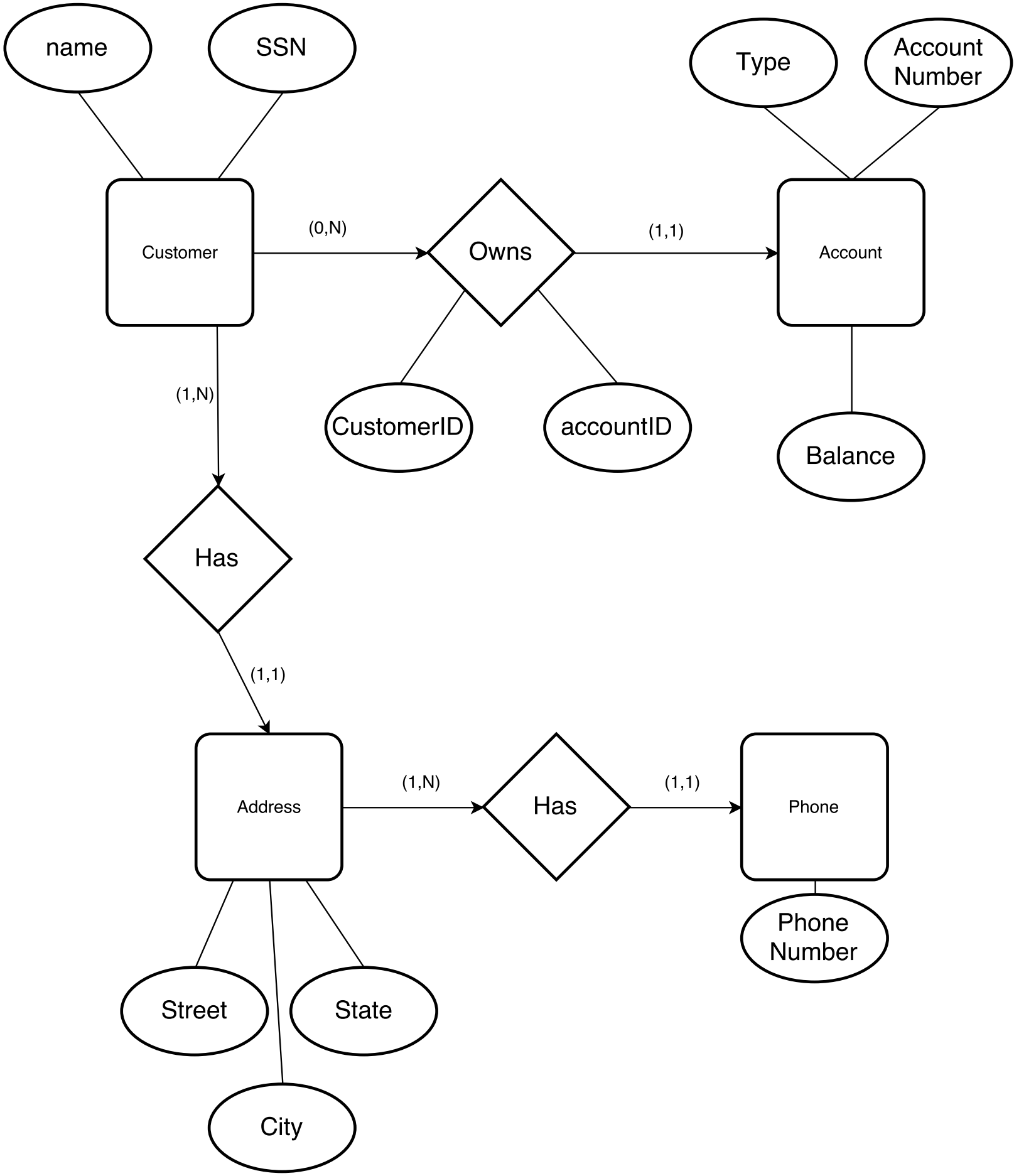
FD's in $R_1 = C \to D, D \to B, D \to E, C \to B, C \to E$
$C^+ = CDBE$
$^{***}D^+ = DBE$
$R_3 = DBE$
$R_4 = DC$
Final Relations:
$R_4 = DC$
$R_3 = DBE$
$R_2 = CA$

Excercise 3 diagrams below

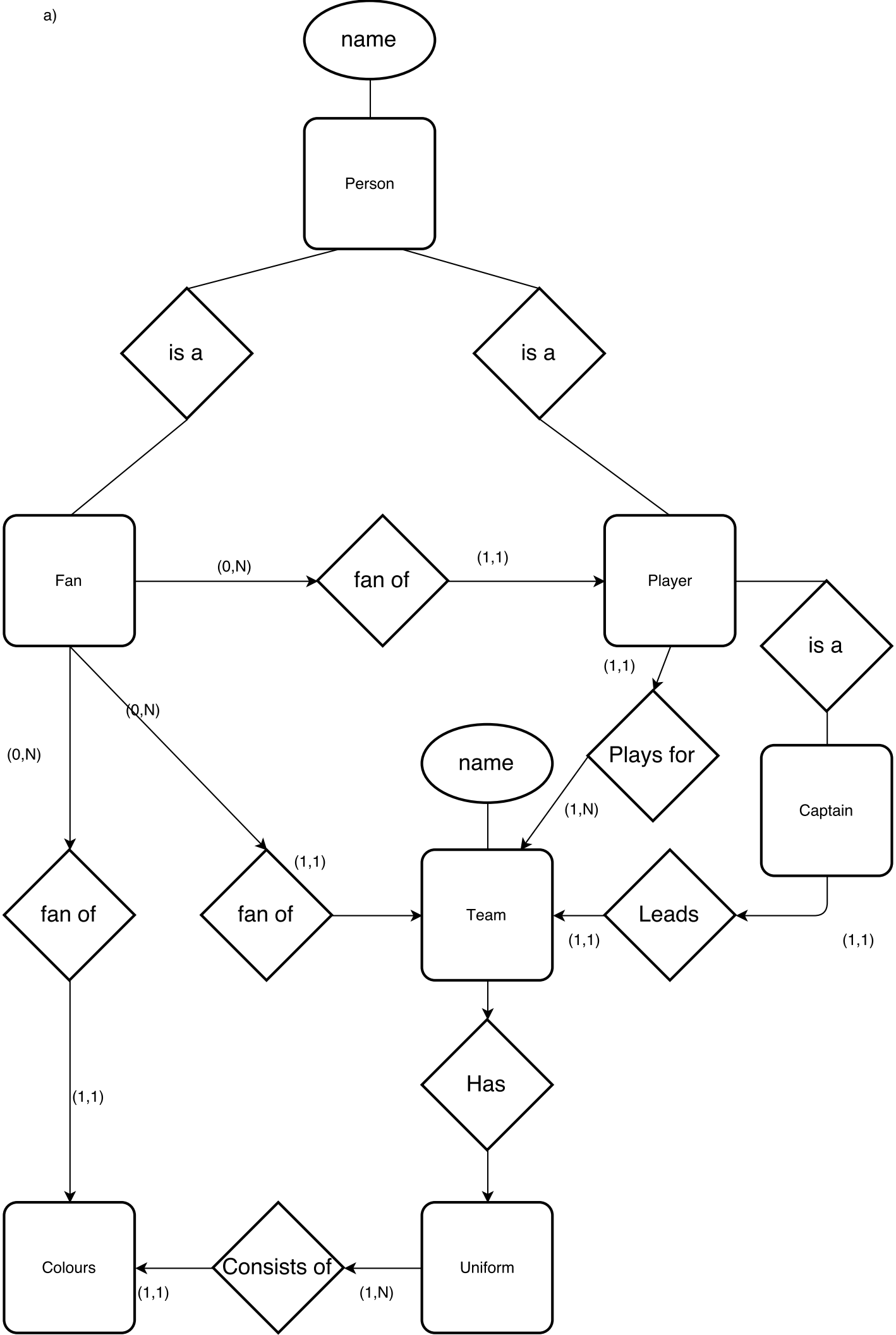
a)


name
SSN
Type
Account Number
Customer
(0,N)
Owns
(1,1)
Account
(1,N)
(1,N)
CustomerID
accountID
Balance
Has
Has
(1,1)
(1,1)
Phone
Address
Street
State
Phone Number
City

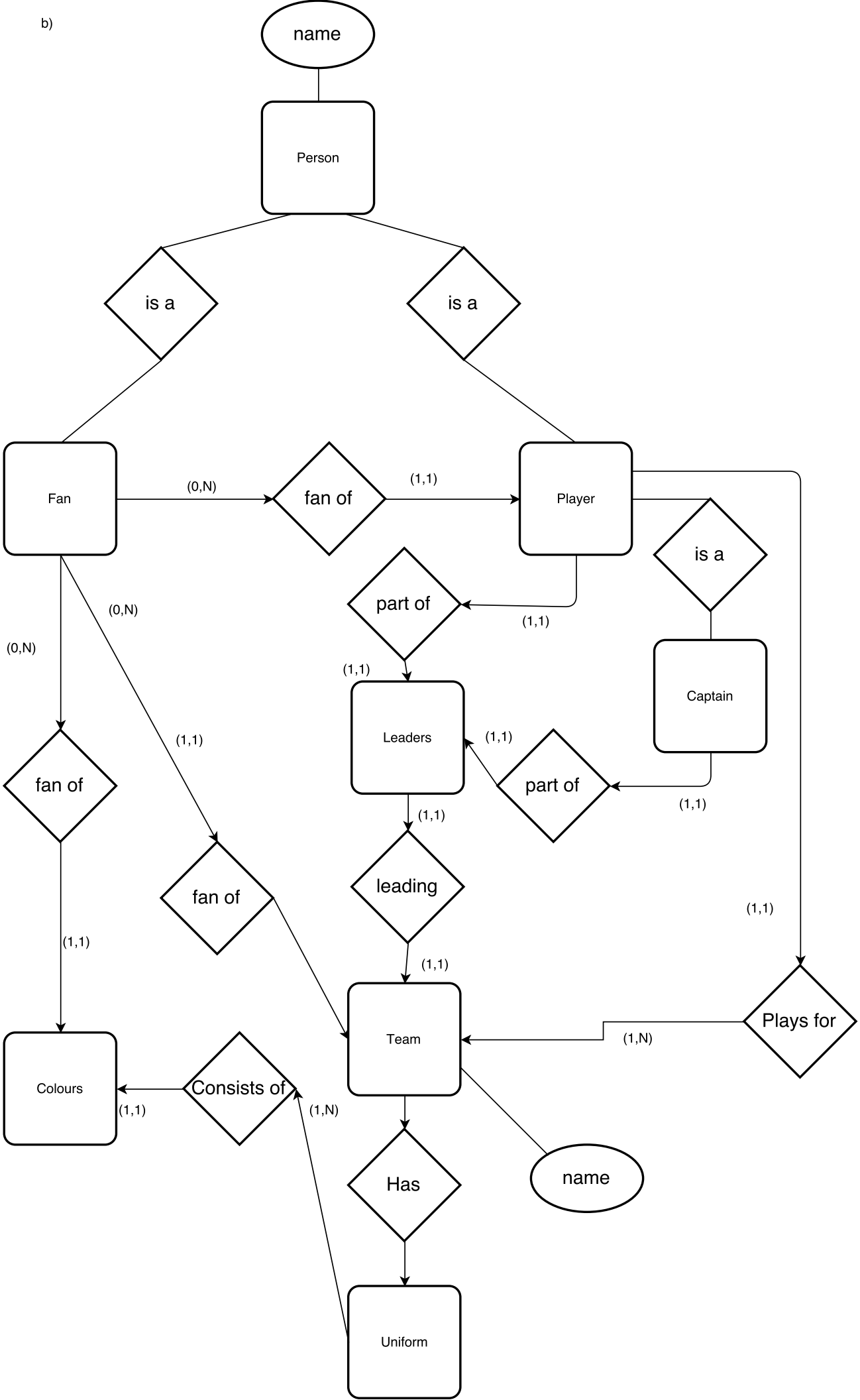
b)


name
SSN
Type
Account Number
Customer
(0,N)
Owns
(1,1)
Account
(1,N)
CustomerID
accountID
Balance
Has
(1,1)
Address
(1,N)
Has
(1,1)
Phone
Phone Number
Street
State
City

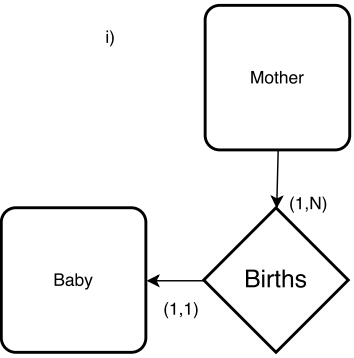
a)


name
Person
is a
is a
Fan
(0,N)
fan of
(1,1)
Player
(1,1)
is a
(0,N)
(0,N)
name
Plays for
(1,N)
Captain
fan of
fan of
(1,1)
Team
Leads
(1,1)
(1,1)
(1,1)
Has
Colours
Consists of
(1,1)
(1,N)
Uniform

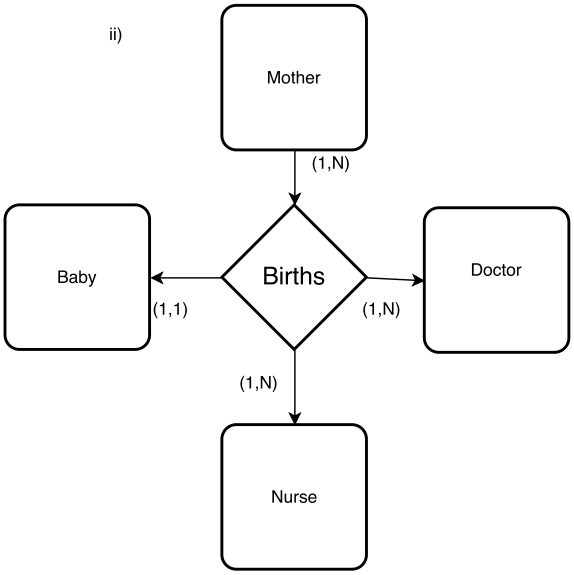
b)


name
Person
is a
is a
Fan
(0,N)
fan of
(1,1)
Player
is a
part of
(1,1)
(0,N)
(0,N)
(1,1)
Captain
(1,1)
Leaders
(1,1)
fan of
part of
(1,1)
(1,1)
fan of
leading
(1,1)
(1,1)
(1,1)
Plays for
Team
(1,N)
Colours
Consists of
(1,1)
(1,N)
Has
name
Uniform

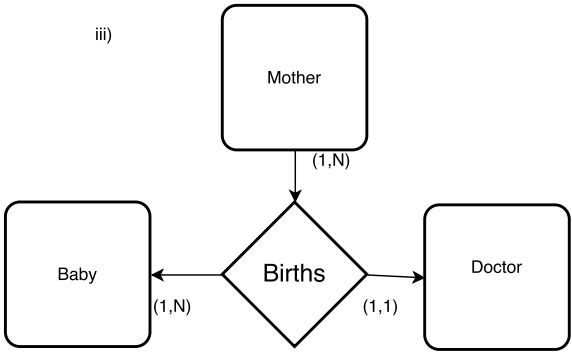
i)


Mother
(1,N)
Baby
Births
(1,1)

ii)


Mother
(1,N)
Baby
Births
Doctor
(1,1)
(1,N)
(1,N)
Nurse

iii)


Mother
(1,N)
Baby
Births
Doctor
(1,N)
(1,1)

b)