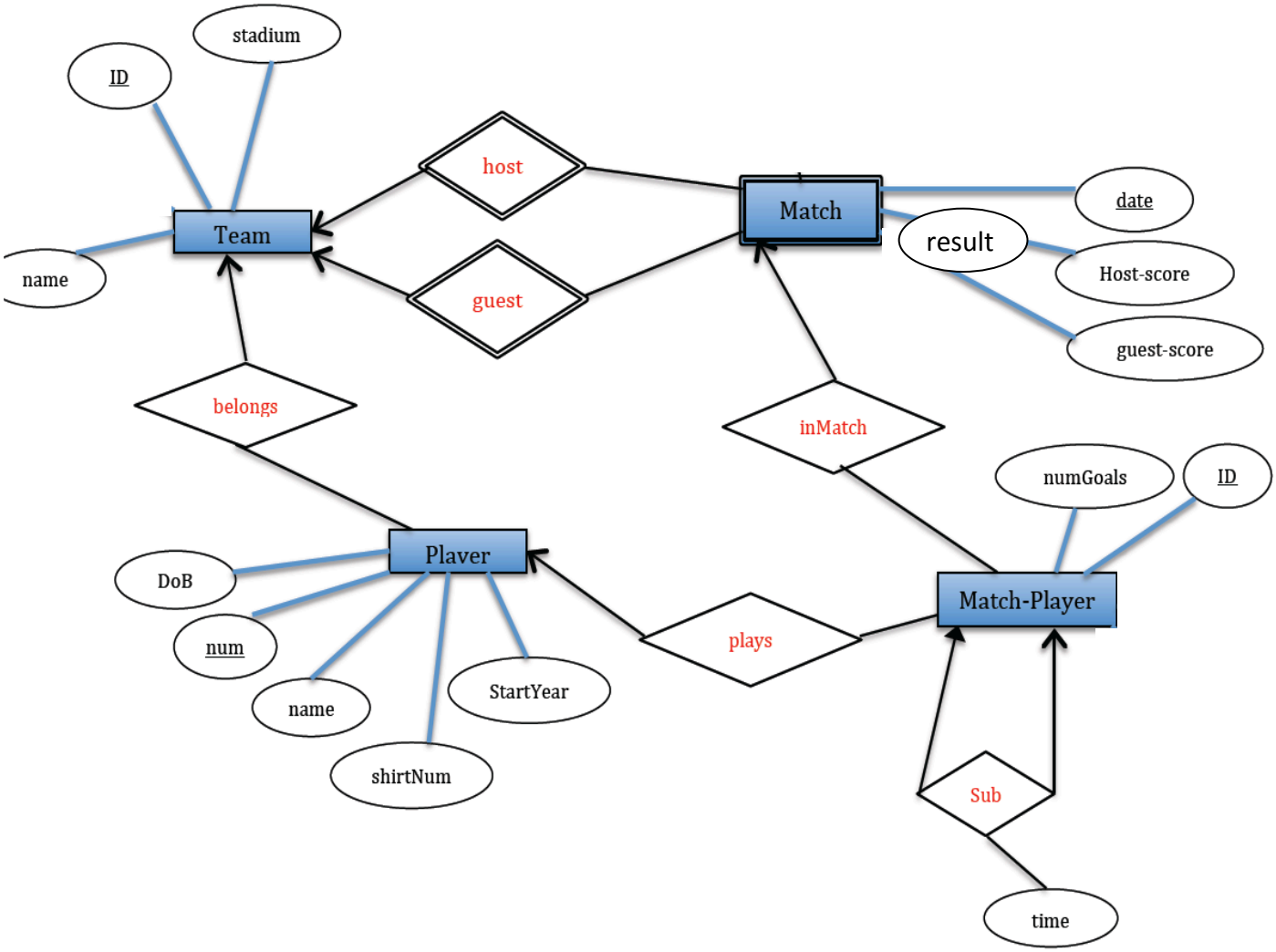
Midterm Solution

Question 1



- This ERD assumes a Match is a weak entity set. But another option is to give it a unique ID and make it a strong entity set.
- "Sub" relationship refers to two players who played in the match. This is a better design than making the relationship to reference the "Player" entity set, because now you allow for referencing players who did not play in the match.

Question 2

Team (ID, name, stadium);

Player (num, DoB, name, shirtNum, startYear, TeamID)
Player.TeamID references Team.ID

Match(hostTeamID, guestTeamID, date, host-score, guest-score)
Match.hostTeamID references Team.ID
Match.guestTeamID references Team.ID

Match-Player(ID, PlayerNum, hostTeamID, guestTeamID, date, numGoals, SubID, subTime)
Match-Player.SubID references Match-Player.ID
Match-player.(hostTeamID, guestTeamID, date) references Match. hostTeamID, guestTeamID, date

Question 3

R

A	B	C
1	10	a
2	20	a
3	30	x
4	20	x

S

A	X	Z
2	18	Mike
2	20	John
5	30	Wang
7	40	JohnSmith

Q1: $\gamma_{A,\ SumX \leftarrow sum(X)}(S)$

A	SumX
2	38
5	30
7	40

Q2: $\delta(\pi_B(R)) \ \bowtie_{B>X} \ \pi_{A,X}(S)$

B	A	X
20	2	18
30	2	18
30	2	20

Q3: $\gamma_{A,CNT \leftarrow count(*)}(\pi_A(S) \ \cup_{bag\ semantics} \ \pi_{A \leftarrow (A+1)}(R))$

A	CNT
2	3
3	1
4	1
5	2
7	1

[20 Points] Question 4 (Relational Algebra):
Given the following relations from a university registration system:

Department(ID, name, address) ---------- short name D

Faculty(ID, deptID, firstName, lastName, joinYear) ---------- short name F

Course(ID, deptID, name, numOfCredits) ---------- short name C

Student(ID, deptID, firstName, LastName, joinYear) ---------- short name S

Teaching(FacultyID, courseID, Year) ---------- short name T

Registration(studentID, courseID, Year, grade) ---------- short name R

The primary key in each relation is underlined. Each faculty member and each course belong to exactly one department (The deptID in the F and C relations). Each student also belongs to one department (The deptID in S relation). A student can take courses inside or outside his/her department (The R relation). Each faculty can teach many courses each year.

Write the *algebraic expression* for the following queries (*Use the short name for the relations*):

$$\Pi_{ID, FirstName, LastName}\left(\sigma_{joinYear = 2010}\left(F\right)\right)$$

Q2: Select the courses (name and number of credits) offered by a department named 'Computer Science'

$$\Pi_{C.name,\ C.numOfCredits}\left(C \underset{C.deptID = D.ID}{\bowtie} \sigma_{name = 'Computer\ Science'}\left(D\right)\right)$$

Department(ID, name, address) ---------- short name D

Faculty(ID, deptID, firstName, lastName, joinYear) ---------- short name F

Course(ID, deptID, name, numOfCredits) ---------- short name C

Student(ID, deptID, firstName, LastName, joinYear) ---------- short name S

Teaching(FacultyID, courseID, Year) ---------- short name T

Registration(studentID, courseID, Year, grade) ---------- short name R

Q3: Select the faculty Ids who have taught courses neither in year 2010 nor 2011 (That is, did not offer courses in 2010 and 2011).

$$\Pi_{ID}(F) - \Pi_{ID \leftarrow FacultyID}\left(\sigma_{Year=2010 \text{ or } Year=2011}(T)\right)$$

Q4: Select the student Ids who have taken in year 2010 exactly two courses outside their departments (That is, the student's deptID does not equal the course's deptID).

$$R_1 \leftarrow \sigma_{Year=2010}(R)$$

$$R_2 \leftarrow \left(R_1 \bowtie_{R_1.studentID = S.ID} S\right) \bowtie_{R_1.CourseID = C.ID} C$$

$$\sigma_{CNT=2}\left(\gamma_{studentID,\ Count(*) \rightarrow CNT}\left(\sigma_{C.deptID <> S.deptID}(R_2)\right)\right)$$