EECS 484 Database Management Systems
Homework 1
Due on Wednesday, May 15th @ 11:55 PM Eastern time

Please read the following instructions before starting the homework:

There are two parts to this homework.

The first part consists of short response questions.

The second part requires you to draw out some ER diagrams. Please use a high quality camera or a scanner and scan your answers into one PDF file or use a computer tool to draw the diagrams. Be sure to check your PDF submission to ensure that your ER diagrams are readable.

This homework should be completed in a group of two and can be submitted on Gradescope. Use entry code **YD34X5** to self-enroll if you don't have access to the Gradescope course page.

No late days for homework! *If you miss the due date, you get 0 points. If your PDF gets modified after the due date, you get 0 points. No exceptions on this.*

Honor Code

By submitting this homework, you are agreeing to abide by the Honor Code:
I have neither given nor received unauthorized aid on this assignment, nor have I concealed any violations of the Honor Code.

PART 1 – Short Responses

Question 1 (3 points)

Determine if the following statements describe a conceptual/logical, physical, or external representation/schema of data.

a) Schools can see name, major, GPA, and gender for each student, but not their social security number and Wolverine Access Password
    a. conceptual/logical
    b. physical
    c. external

b) The table “Items” has ID, Name, Category, Price and Maker fields. ID is unique for each item.
    a. conceptual/logical
    b. physical
    c. external

c) All data is stored in tables sorted by category represented as bytes within a server hosted by AWS.
    a. conceptual/logical
    b. physical
    c. external

Question 2 (6 points)

For the given *instances* (i.e. snapshot/subset) of a student relation, identify the following attributes (set) as *might be a key* or *definitely not a key* for the **entire** student relation, and provide explanations.

1. name

2. sid

3. gpa

4. {name, login}

Answer the following questions:
Hint: Recall the definition of a candidate key and that this is simply a snapshot of the relation and may not include all records.

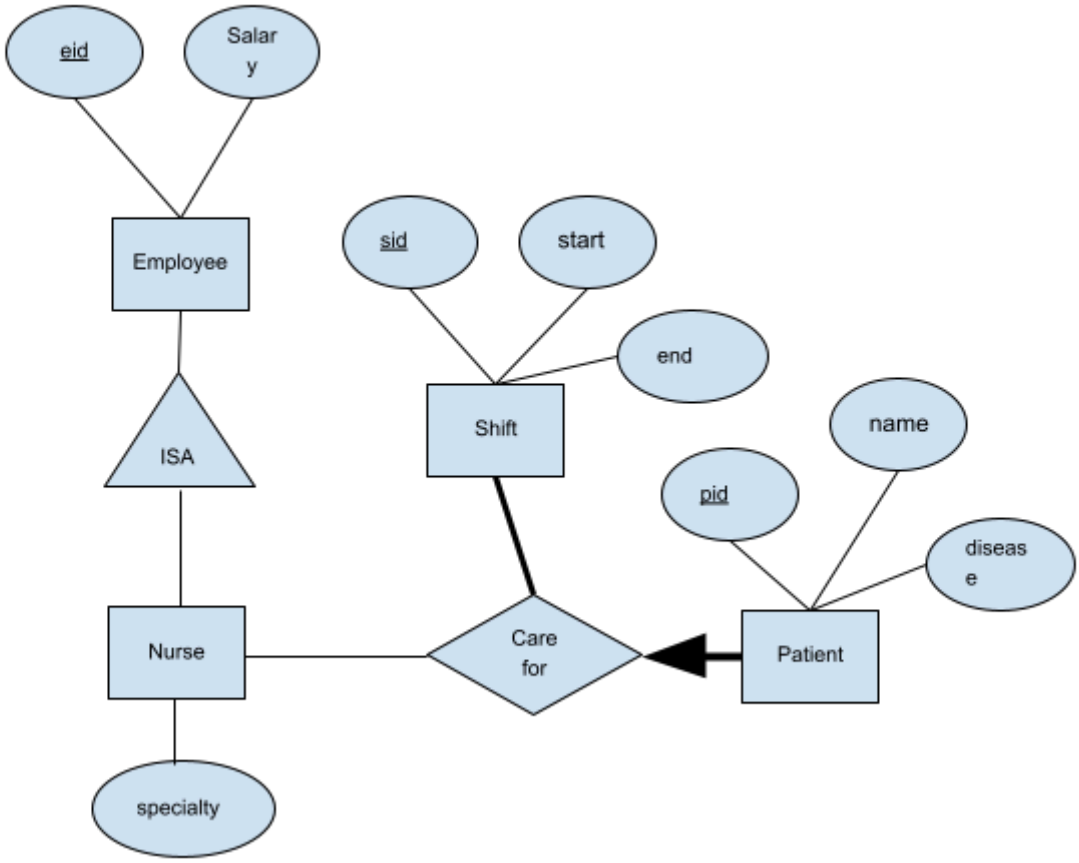
5) List all single attributes that are **definitely not** candidate keys. Why are these attributes definitely not candidate keys? If all attributes could be candidate keys, explain why.

6) Which single attribute is **definitely** a candidate key? Why? If there are no candidate keys, explain why.

sid	*name*	*login*	*age*	*gpa*
23300	Amber	amber@cs	19	3.3
13434	Joanna	joanna@cs	18	3.4
5312	Smith	smith@ee	18	3.2
5360	Smith	smith@math	19	3.8
53231	Madayan	mad@music	23	2.8
43232	Guldu	guldu@ee	21	2.0

Question 3 (14 points)

The following ER diagram shows the relationships between hospital employees and patients:



Determine whether each of the following is true or false, given the constraints reflected by the above ER diagram. No justification is required. (2 points each)

a) A patient, Dave (pid=23), can be taken care of by two different nurses in two different shifts.
True / False

b) A nurse, Alice (eid=30), in a given shift, 12pm-8pm (sid=3), can care for more than one patient.
True / False

Questions continue onto the next page.

c) A patient, Dave (pid=23) cannot be “cared for” during multiple shifts by nurse Alice (eid=30).
True / False

d) The Nurse entity does not have a primary key.
True / False

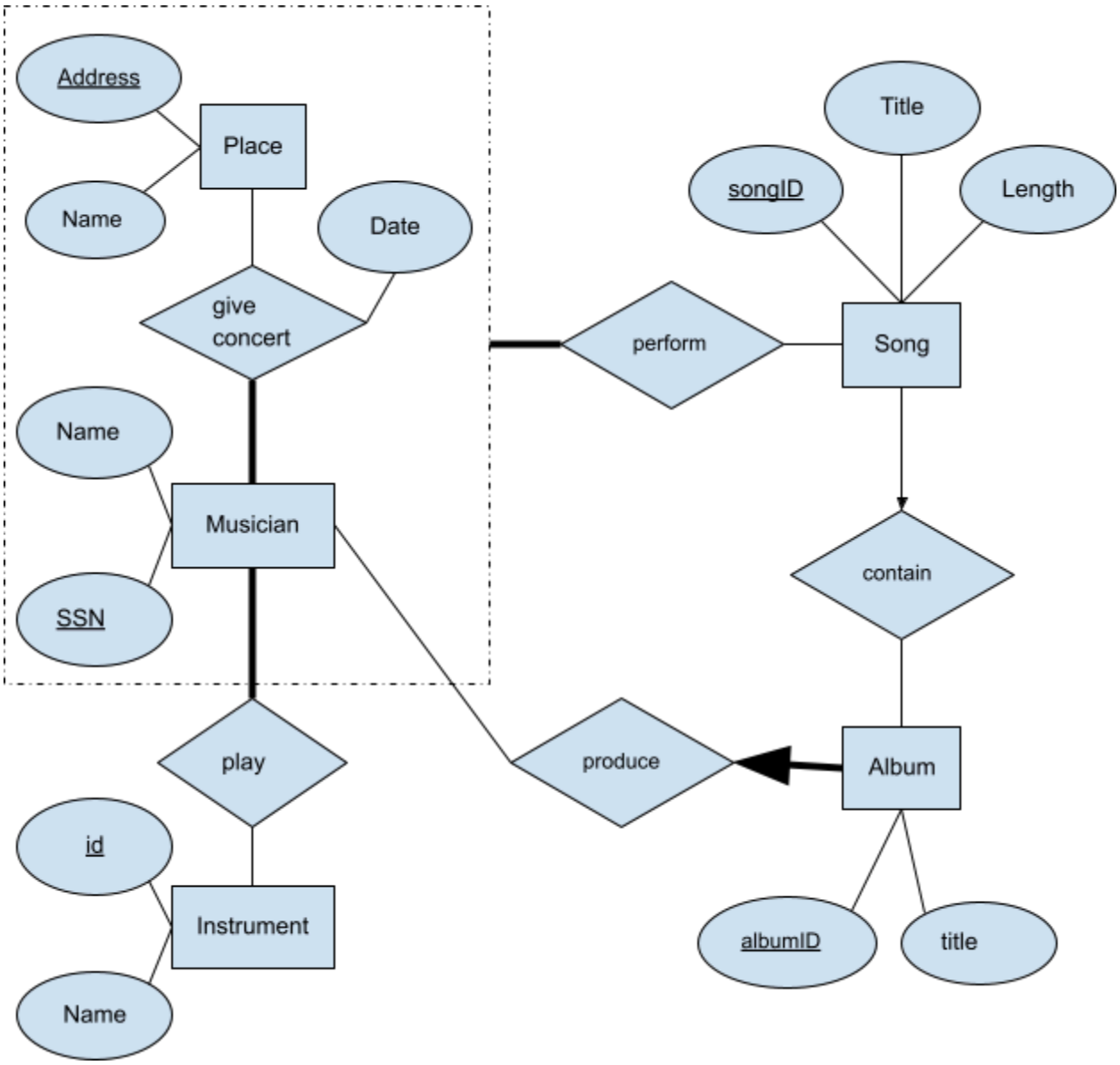
e) This design enforces that every patient is taken care of in each shift.
True / False

f) This design allows a patient that is not taken care of by any nurse.
True / False

g) This design enforces that in each shift, at least one nurse is taking care of some patients.
True / False

Question 4 (20 points)

Consider the following ER diagram that represents one way a music database could be designed and answer the questions on the next page.



Answer all of the following yes/no questions referring to the previous ER diagram. No justification is required. (2 points each)

a) Does this design allow multiple musicians to give concerts in the same place and date?
   Yes / No

b) Does this design allow a musician to give multiple concerts in the same place on different dates?
   Yes / No

c) Does this design allow for a song that is not in any album?
   Yes / No

d) Does this design allow multiple musicians to collaborate on an album?
   Yes / No

e) Does this design allow a musician to perform songs produced by another musician, in a concert?
   Yes / No

f) Does this design allow musicians to collaborate with other musicians to perform a song? Musicians collaborate when they perform the same song, in the same place, on the same date.
   Yes / No

g) Does this design allow for a musician who only sings (i.e. does not play an instrument)?
   Yes / No

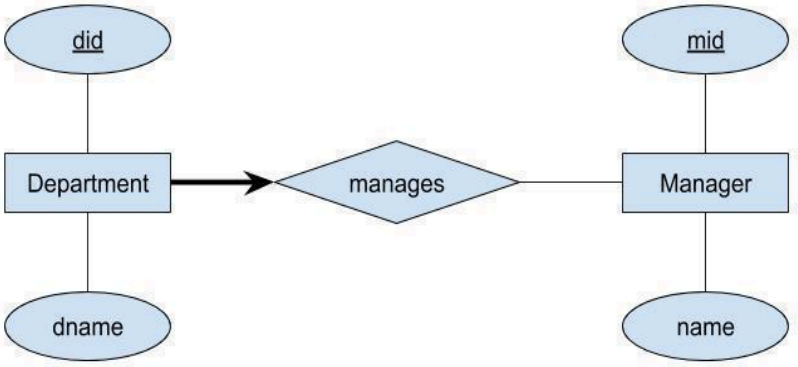
h) Does this design allow a musician to give a concert without performing any songs?
   Yes / No

i) Does this design allow a musician to produce an album that contains no songs?
   Yes / No

j) Does this design allow a musician to produce many albums?
   Yes / No

Question 5 (14 points)

Answer the following true/false questions about keys:



The following questions are about table representation of the above diagram. Assume that only two tables are used to represent this ER diagram.

a) A candidate key for the relation ‘manages’ in the above ER Diagram is {mid, did} (2 points)
True / False

b) A candidate key for the relation ‘manages’ in the above ER Diagram is {did} (2 points)
True / False

c) The fewest number of tables that can be used to represent this ER diagram *without redundancy* is 2 (i.e We need at least 2 tables to represent this ER diagram). (2 points)
True / False

d) In the least redundant design, ‘did’ is a foreign key in the Manager table (2 points)
True / False

e) In the least redundant design, ‘mid’ is a foreign key in the Department table (2 points)
True / False

Part f is on the next page.

Create a table for **Department** by SQL statement with regards to *all* integrity constraints shown by the above ER Diagram (4 points)

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f) CREATE TABLE Department (

    );
```

PART 2 – ER Diagrams

Question 6 (36 points)

As a football lover and an EECS484 enthusiast, you want to design a database to model national football teams. This includes the teams themselves, the games they play, the players and the referees.

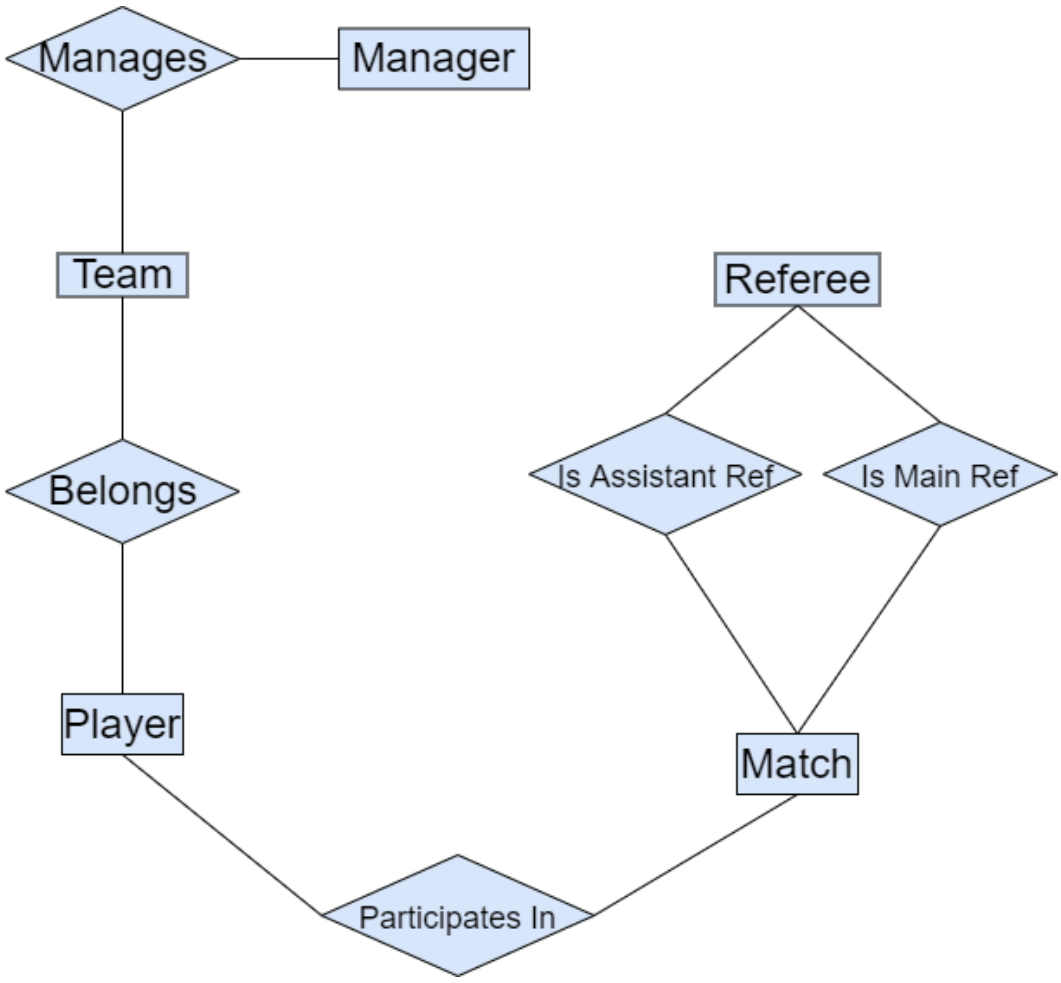
In the design, you want to capture the following:

- For each football team, you want to store their unique team ID, name, main stadium and the state to which the team belongs.
- Each player on each team will have a unique ID, name, date of birth (DoB), and shirt number.
    - Each team has at least one player and each player can belong to only one team. *It is possible that a player does not belong to any team.*
- Each manager on each team will have a name and date of birth (DoB). Each manager manages only one team and each manager's name identifies them uniquely from among the team's administrators. If a team is deleted, you need not keep track of its manager any longer.
- You want to store data on all the football matches:
    - Each match has one host team and one guest team
    - Each match has a match ID, match date, and a final result. Match ID is unique to each different match.
    - The players that participated in a match (each match must have more than one player) must be stored, as well as:
        - The number of points the player scored, and their total time playing in that match
    - Players can substitute for other players during each match, which should be recorded as well:
        - In one match, one player may substitute in or out.
        - In one match, the same substitution can occur only once.
        - At least one substitution is made per match.
- You believe who referees a match makes a big difference, so you'd also like to capture the following:
    - Each match has multiple referees. Each referee should have an ID, name, DoB, and years of experience. The IDs for different referees are unique.
    - There is exactly one main referee and one or more assistant referees per match.
    - Each referee works as an assistant referee in at least one match.
    - A referee in one match works as either main referee or assistant referee but not both.

1) Design an ER diagram that best reflects the constraints described above. You can start with the ER diagram below. Always follow the constraints described in the questions, even if you don't think they make sense in the real world. Try to reflect as many constraints as possible. Some constraints may not be possible to express in an ER diagram. Do not make any arbitrary assumptions or modify the constraints given in the problem statement.

Make sure that all your entities, attributes and constraints are drawn (again, state assumptions clearly if they are not stated in the question). Please do not modify any given entities and attributes. (32 points)

HINT: To complete this question, you may want to add more entities, relations and attributes. You may want to add constraints in the given diagram as well.



2) It is possible that some constraints mentioned above cannot be enforced by the ER diagram features we learned in lecture. State these constraints. (4 points)