CS2102 Database Systems

LECTURE 04 (SUPPLEMENTARY)

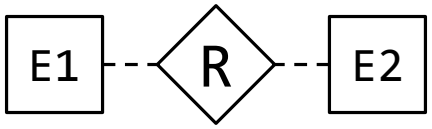
N-ARY RELATIONSHIP

Relationship constraints

Ignore the terminology!

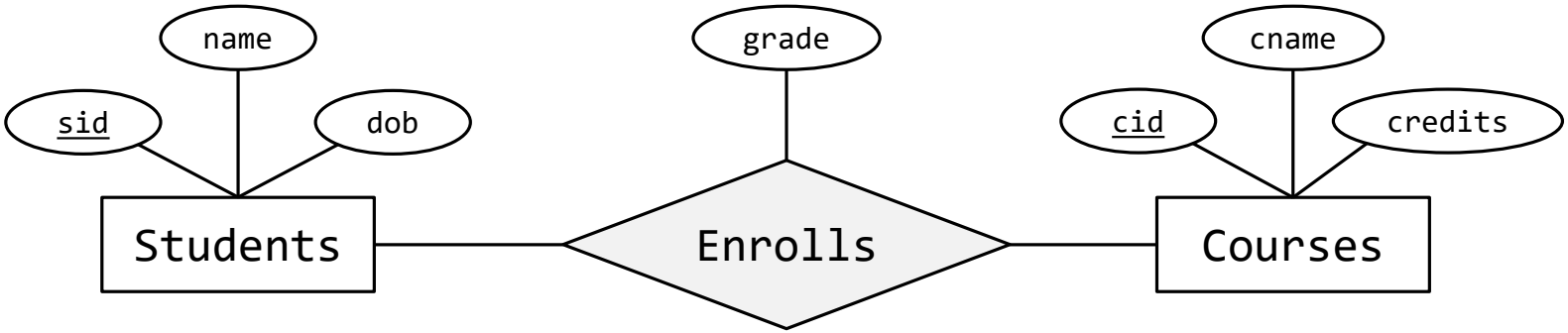
- Terminology such as many-to-many; one-to-many; many-to-one may cause confusion
- The best advice I can give is to *ignore* them and replace them with $\geq$ and $\leq$ constraints

Simply ask yourself these questions



- We abstract away the lines; it can be any types of line
  1. Can E1 *NOT be involved* in R?
  2. Can E2 *NOT be involved* in R?
  3. Can the same E1 be involved in R with *the same* E2 multiple times?
  4. Can the same E1 be involved in R with *different* E2 multiple times?
  5. Can the same E2 be involved in R with *different* E1 multiple times?

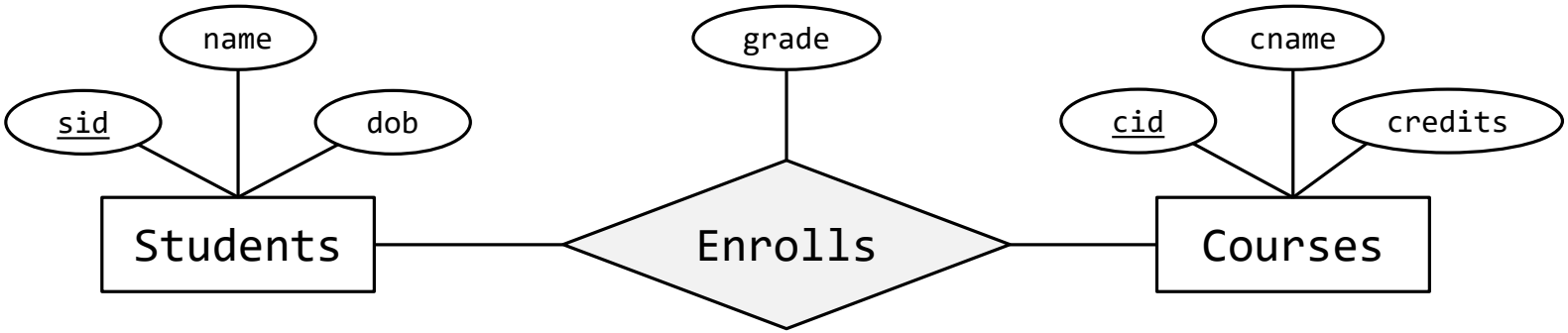
Relationship constraints



Example

- Each student can enroll in *0 or more* courses
- Each course can be enrolled by *0 or more* students
- Constraints gathered
  - $\texttt{Students} -\{\geq 0\}- \texttt{Enrolls} -\{\geq 0\}- \texttt{Courses}$
- Explanation:
  - Every students can appear ≥ 0 times in Enrolls
  - Every courses can appear ≥ 0 times in Enrolls
  - Each pair (students, courses) can appear exactly once in Enrolls

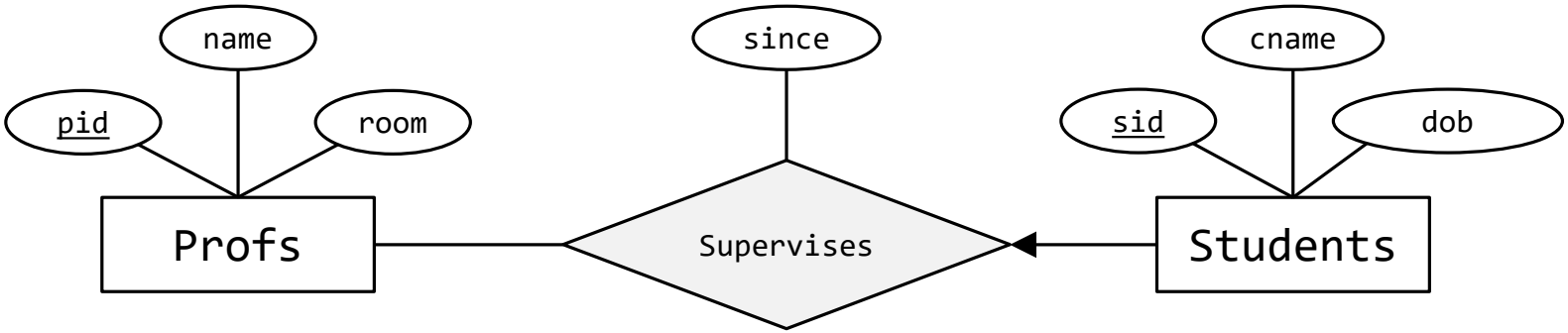
Relationship constraints



Example

- Each student can enroll in *0 or more* courses
- Each course can be enrolled by *0 or more* students
- Constraints gathered
  - $\texttt{Students} -\{\geq 0\}- \texttt{Enrolls} -\{\geq 0\}- \texttt{Courses}$
- Questions:
  - Can you have a student not enrolling? YES
  - Can you have a course not having student? YES
  - Can the same student enrolls in the same course multiple times? NO
  - Can the same student enrolls in multiple different courses? YES
  - Can the same courses have multiple different students? YES

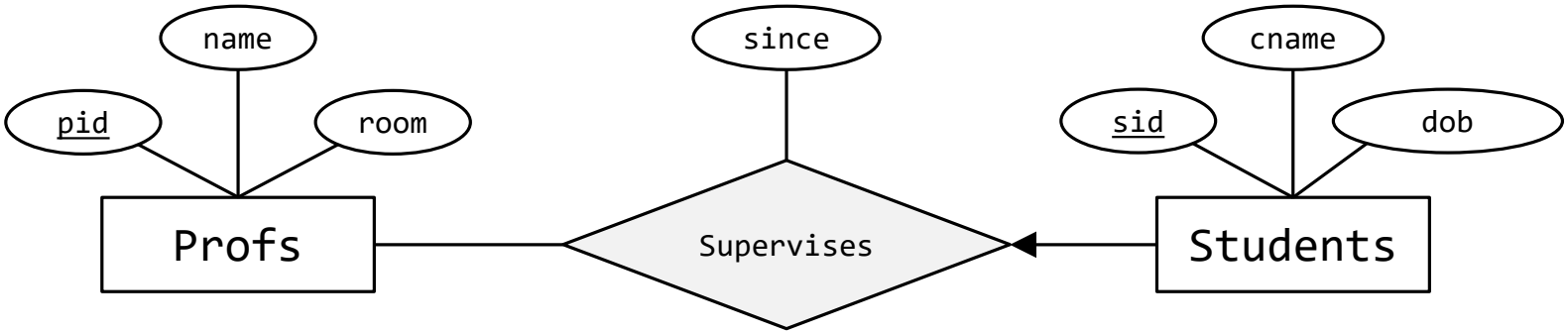
Relationship constraints



Example

- Each professor can supervise *0 or more* students
- Each student can be supervised by *at most one* professor
- Constraints gathered
  - $\texttt{Profs} -\{\geq 0\}- \texttt{Supervises} -\{\leq 1\}- \texttt{Students}$
- Explanation
  - Every profs can appear ≥ 0 times in Supervises
  - Every students can appear ≤ 1 times in Supervises
  - Each pair (students, courses) can appear exactly once in Enrolls

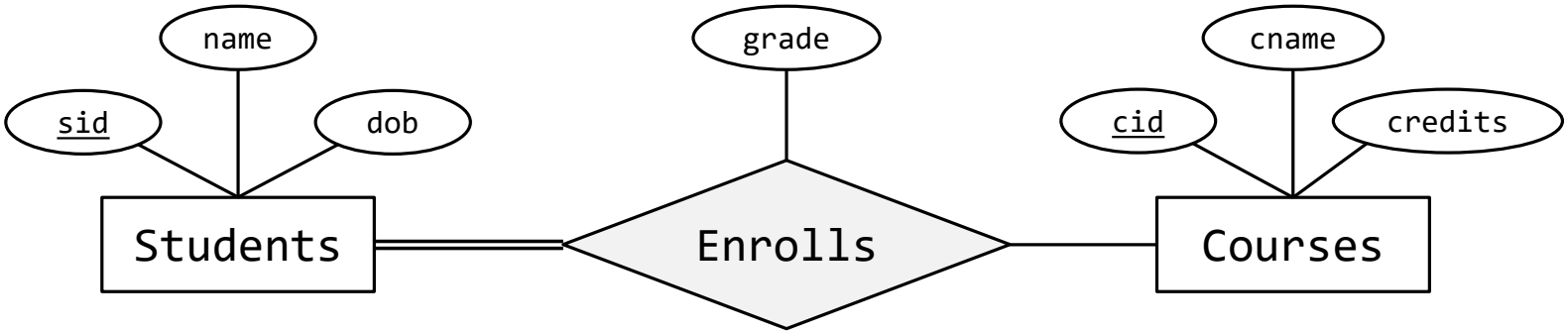
Relationship constraints



Example

- Each professor can supervise *0 or more* students
- Each student can be supervised by *at most one* professor
- Constraints gathered
  - $\texttt{Profs} -\{\geq 0\}- \texttt{Supervises} -\{\leq 1\}- \texttt{Students}$
- Questions:
  - Can you have a student not supervised? YES
  - Can you have a prof not supervising? YES
  - Can the same student be supervised by the same prof multiple times? NO
  - Can the same **student** be supervised by different profs? NO
  - Can the same prof be supervising different students? YES

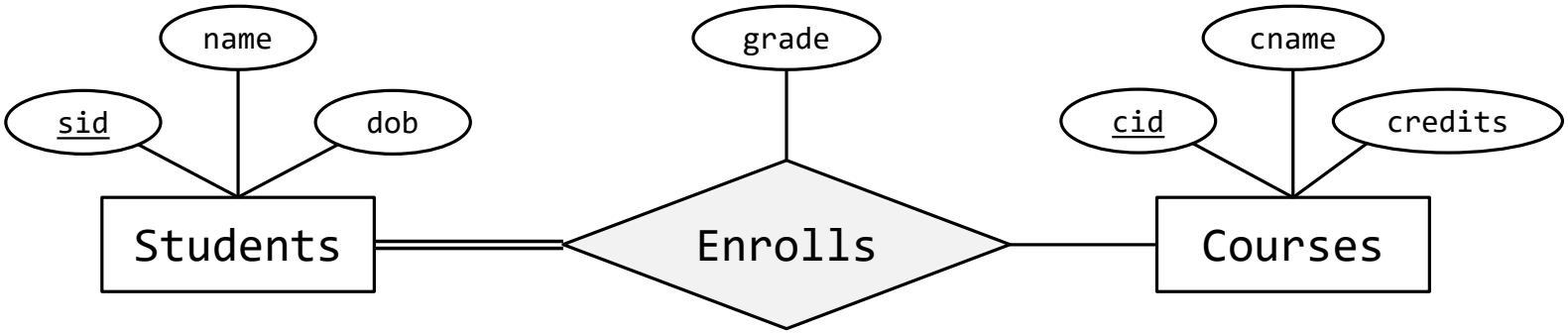
Relationship constraints



Example

- Each student can enroll in *0 or more* courses
- Each course can be enrolled by *0 or more* students
- Constraints gathered
  - $\texttt{Students} - \{\geq 1\} - \texttt{Enrolls} - \{\geq 0\} - \texttt{Courses}$
- Explanation
  - Every students can appear ≥ 1 times in Enrolls
  - Every courses can appear ≥ 0 times in Enrolls
  - Each pair (profs, students) can appear exactly once in Supervises

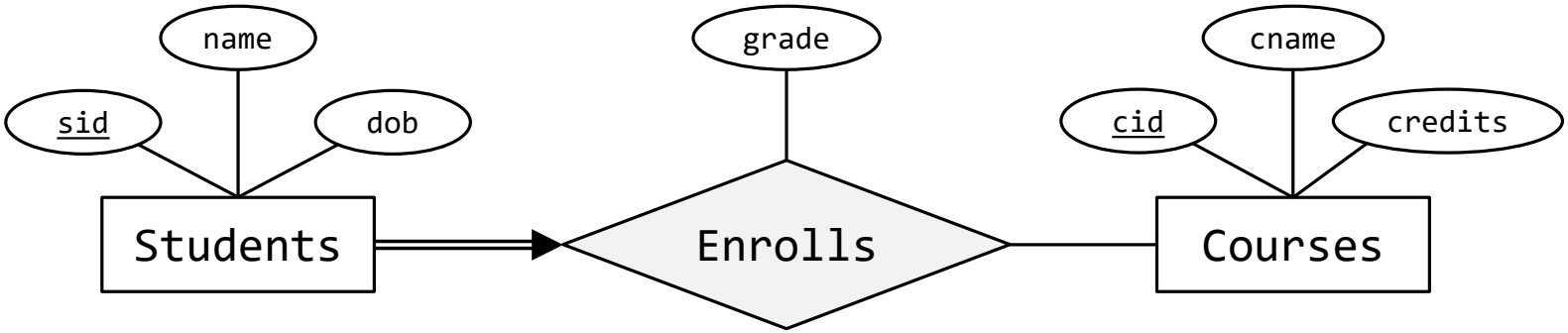
Relationship constraints



Example

- Each student can enroll in *0 or more* courses
- Each course can be enrolled by *0 or more* students
- Constraints gathered
  - $\texttt{Students} - \{\geq 1\} - \texttt{Enrolls} - \{\geq 0\} - \texttt{Courses}$
- Questions:
  - Can you have a **student** not enrolling? NO
  - Can you have a course not having student? YES
  - Can the same student enrolls in the same course multiple times? NO
  - Can the same student enrolls in multiple different courses? YES
  - Can the same courses have multiple different students? YES

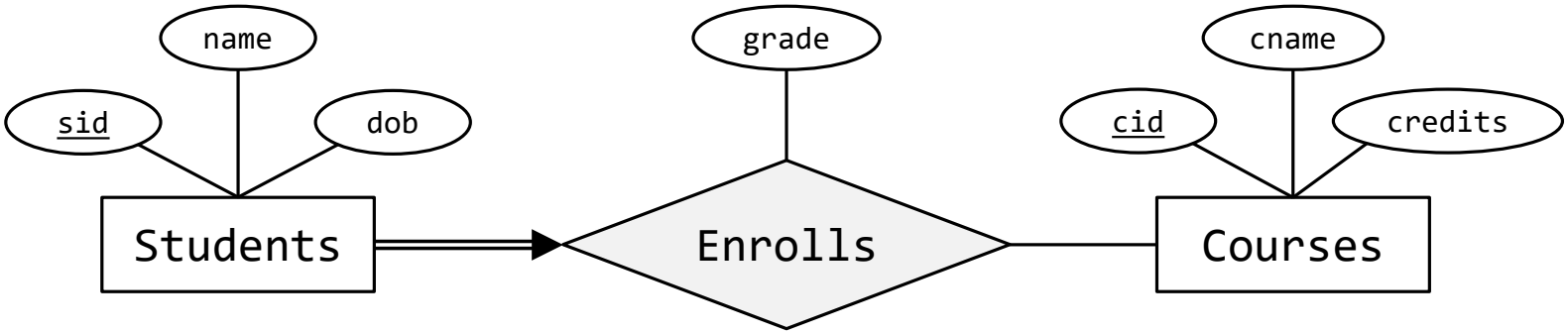
Relationship constraints



Example

- Each student can enroll in *0 or more* courses
- Each course can be enrolled by *0 or more* students
- Constraints gathered
  - $\texttt{Students} - \{\geq 1 \,\&\, \leq 1\} - \texttt{Enrolls} - \{\geq 0\} - \texttt{Courses}$
- Explanation
  - Every students can appear ≥ 1 and ≤ 1 times in Enrolls
    - Every students can appear exactly once in Enrolls
  - Every courses can appear ≥ 0 times in Enrolls
  - Each pair (profs, students) can appear exactly once in Supervises

Relationship constraints



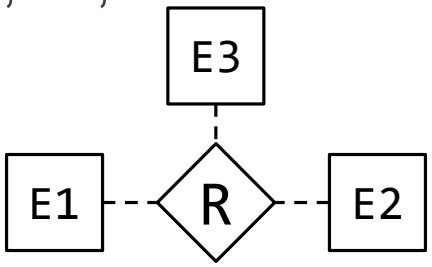
Example

- Each student can enroll in *0 or more* courses
- Each course can be enrolled by *0 or more* students
- Constraints gathered
  - $\texttt{Students} -\{\geq 1 \,\&\, \leq 1\} - \texttt{Enrolls} -\{\geq 0\} - \texttt{Courses}$
- Questions:
  - Can you have a **student** not enrolling? NO
  - Can you have a course not having student? YES
  - Can the same student enrolls in the same course multiple times? NO
  - Can the same **student** enrolls in multiple different courses? NO
  - Can the same courses have multiple different students? YES

N-ary relationship demystified

What about N-ary?

- The same technique first; ignore any terminology
- Ask more question, you need to involve all E1, E2, and E3

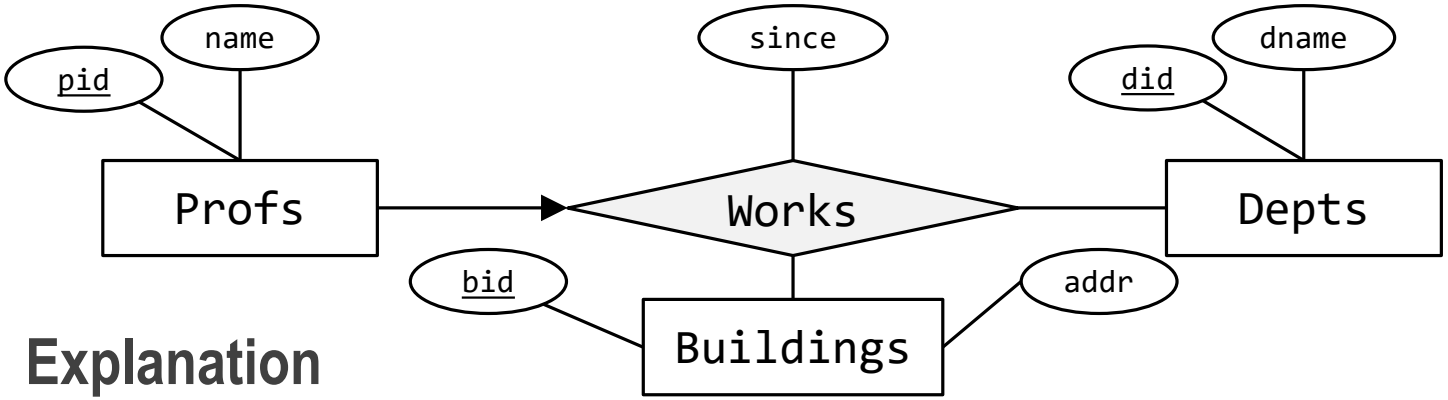


Questions

1. Can E1 *NOT be involved* in R?
2. Can E2 *NOT be involved* in R?
3. Can E3 *NOT be involved* in R?
4. Can the same E1 be involved in R with *the same* E2 *AND* E3 multiple times?
5. Can the same E1 be involved in R with *the same* E2 *BUT different* E3 multiple times?
6. Can the same E1 be involved in R with *the same* E3 *BUT different* E2 multiple times?

❖ *Repeat questions 5-6 but change the order of E1, E2, and E3*

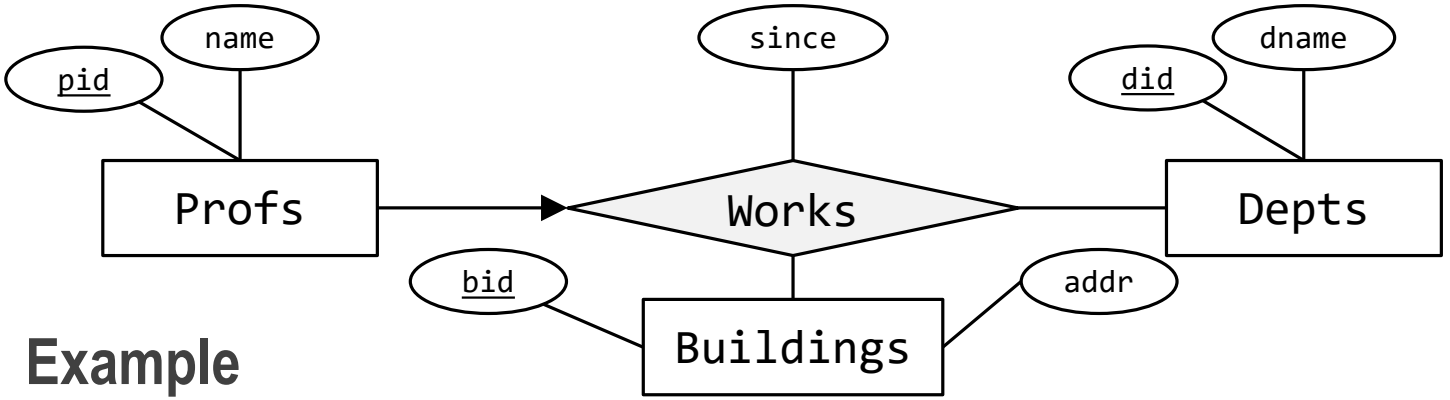
N-ary relationship demystified



Explanation

- Every profs can appear ≤ 1 times in Works
- Every depts can appear ≥ 0 times in Works
- Every buildings can appear ≥ 0 times in Works
- Each triples (profs, depts, buildings) can appear exactly once in Works

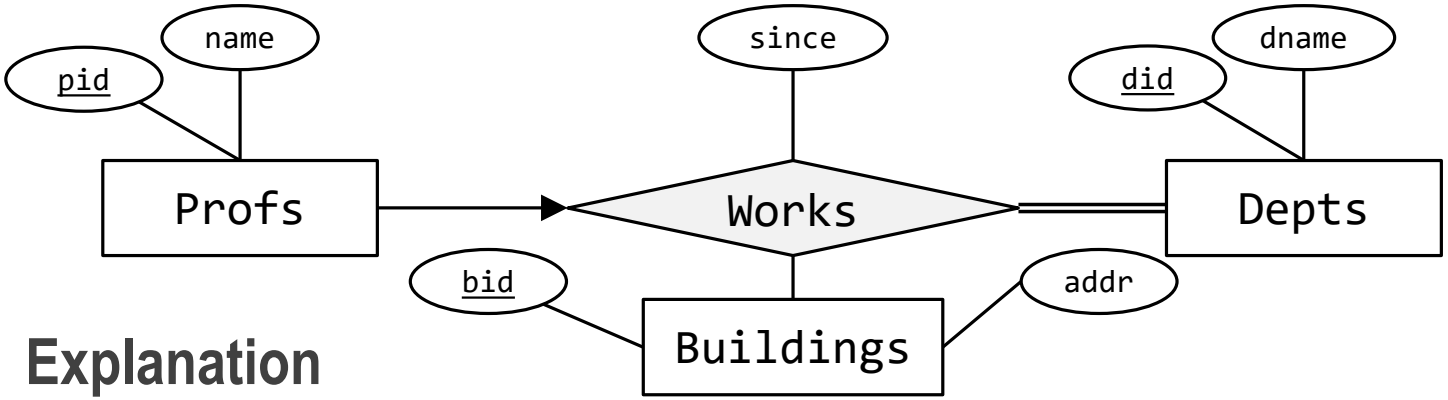
N-ary relationship demystified



Example

- Can you have a prof not working in any dept and any building? YES
- Can you have a dept not having prof and not having building? YES
- Can you have a building not belonging to a dept and have no prof working? YES
- Can the same **prof** works for the same dept in the same building? NO
- Can the same **prof** works for the same dept but in different building? NO
- Can the same **prof** works in the same building but for different dept? NO
- Can the same dept have the same **prof** working but in a different building? NO
- Can the same dept located in the same building have different profs? YES
- Can the same building have the same **prof** working but for different dept? NO
- Can the same building be in the same dept but have different profs? YES

N-ary relationship demystified



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- Every profs can appear ≤ 1 times in Works
- Every depts can appear ≥ 1 times in Works
- Every buildings can appear ≥ 0 times in Works
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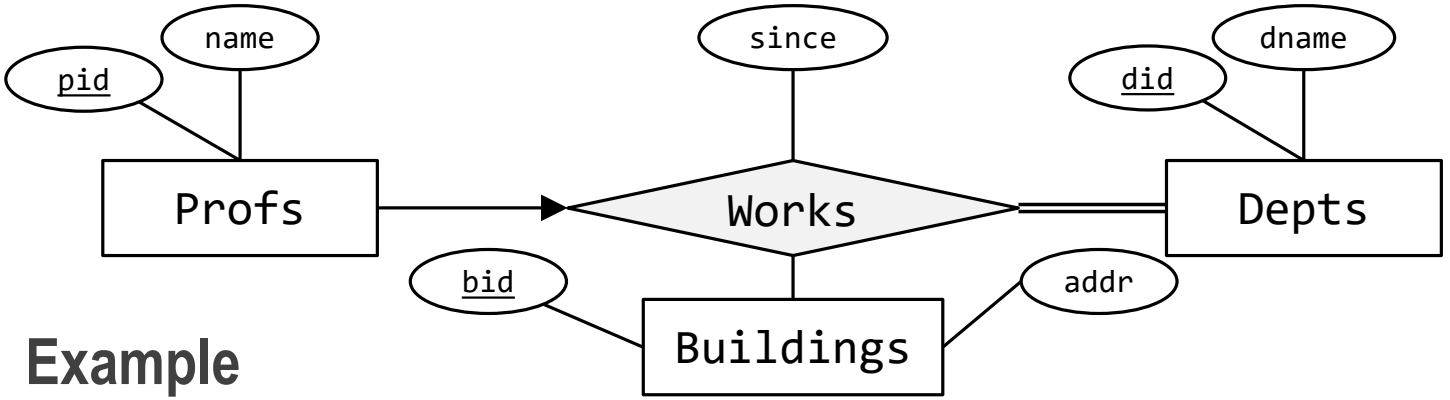
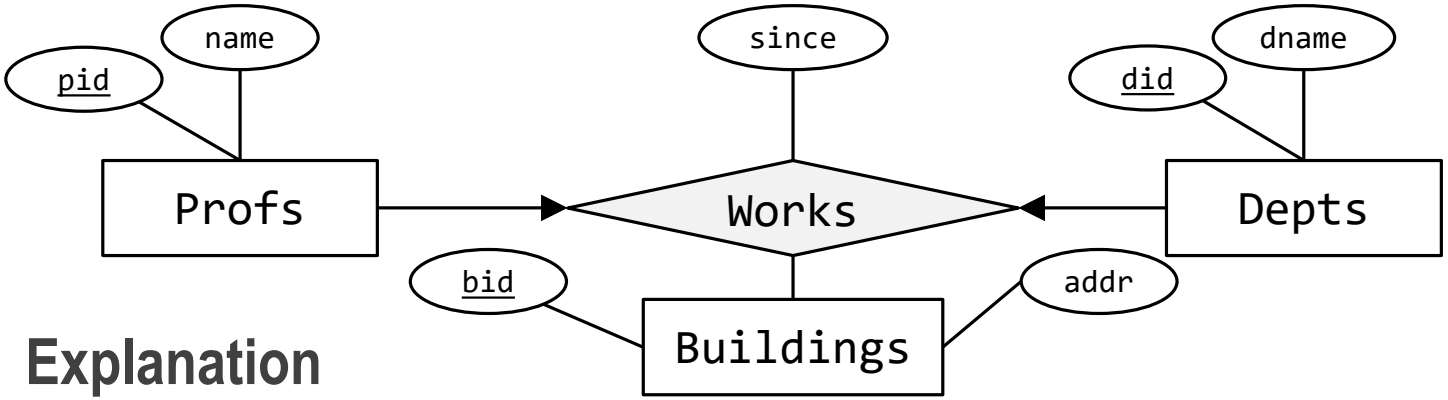
N-ary relationship demystified



Example

- Can you have a prof not working in any dept and any building? YES
- Can you have a **dept** not having prof and not having building? NO
- Can you have a building not belonging to a dept and have no prof working? YES
- Can the same **prof** works for the same dept in the same building? NO
- Can the same **prof** works for the same dept but in different building? NO
- Can the same **prof** works in the same building but for different dept? NO
- Can the same dept have the same **prof** working but in a different building? NO
- Can the same dept located in the same building have different profs? YES
- Can the same building have the same **prof** working but for different dept? NO
- Can the same building be in the same dept but have different profs? YES

This is where I was wrong



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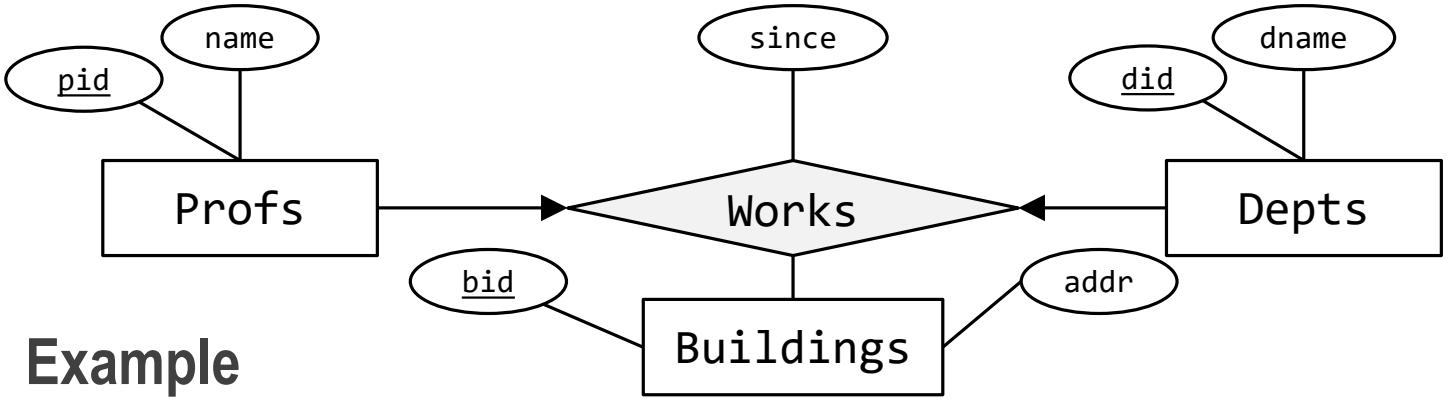

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- Can you have a dept not having prof and not having building? YES
- Can you have a building not belonging to a dept and have no prof working? YES
- Can the same **prof** works for the same **dept** in the same building? NO
- Can the same **prof** works for the same **dept** but in different building? NO
- Can the same **prof** works in the same building but for different dept? NO
- Can the same **dept** have the same **prof** working but in a different building? NO
- Can the same **dept** located in the same building have different profs? NO
- Can the same building have the same **prof** working but for different dept? NO
- Can the same building be in the same **dept** but have different profs? NO

Final note on N-ary relationship

Notes

- Is this the only interpretation of N-ary relationship?
  - No, but this is the interpretation we use
  - This is the simplest interpretation where we restrict the entity occurrences in the relationship
  - Other interpretation typically uses different notation (*such as where the arrow is going; there are notation that uses the arrow going towards entity instead of towards relationship*)
- Are we going to have N-ary relationship in assessment?
  - Yes!
  - But, to avoid unnecessary confusions and complications, there will be AT MOST one key constraint OR one total constraint
    - In other words
      - there will be NO key & total constraint for one entity
      - there will be NO key/total constraint for one entity & another key/total constraint for another entity