EECS 495
Introduction to Database Systems
Fall 2018
Instructor: Mas-ud Hussain
Homework Assignment No. 2
Due: Sunday, October 21, 2018

Problem No. 1:

Consider the following schema:

```
student (sid, sname, sex, age, year, gpa)
dept (dname, numphds)
prof (pname, dname)
course (cno, cname, dname)
major (dname, sid)
section (dname, cno, sectno, pname)
enroll (sid, grade, dname, cno, sectno)
```

For each of the following statements/queries, write the relational algebra expression. If it is not possible to write the relational algebra using the operators learned in the class (e.g., projection, selection, renaming, product, joins, division, and set operations), explain why not.

a) Print the names of professors who work in departments that have more than 12 PhD students.
b) Print the name(s) of the youngest student(s).
c) Print the course names, course numbers and section numbers of all classes with more than 3 female students enrolled in them.
d) For each Mathematics class, print the cno, sectno, and the number of enrolled students with GPAs below 3.5.
e) Print the names of students who are majoring in both Computer Science and Mechanical Engineering.
f) Print the absolute difference in average age between Computer Science majors and Mathematics majors.
g) For those departments that have no majors taking the "Programming" courses, print the department name and the number of PhD students in the department.
h) Print the names of professors in departments where those departments have one or more majors who are under 18 years old.

Problem No. 2:

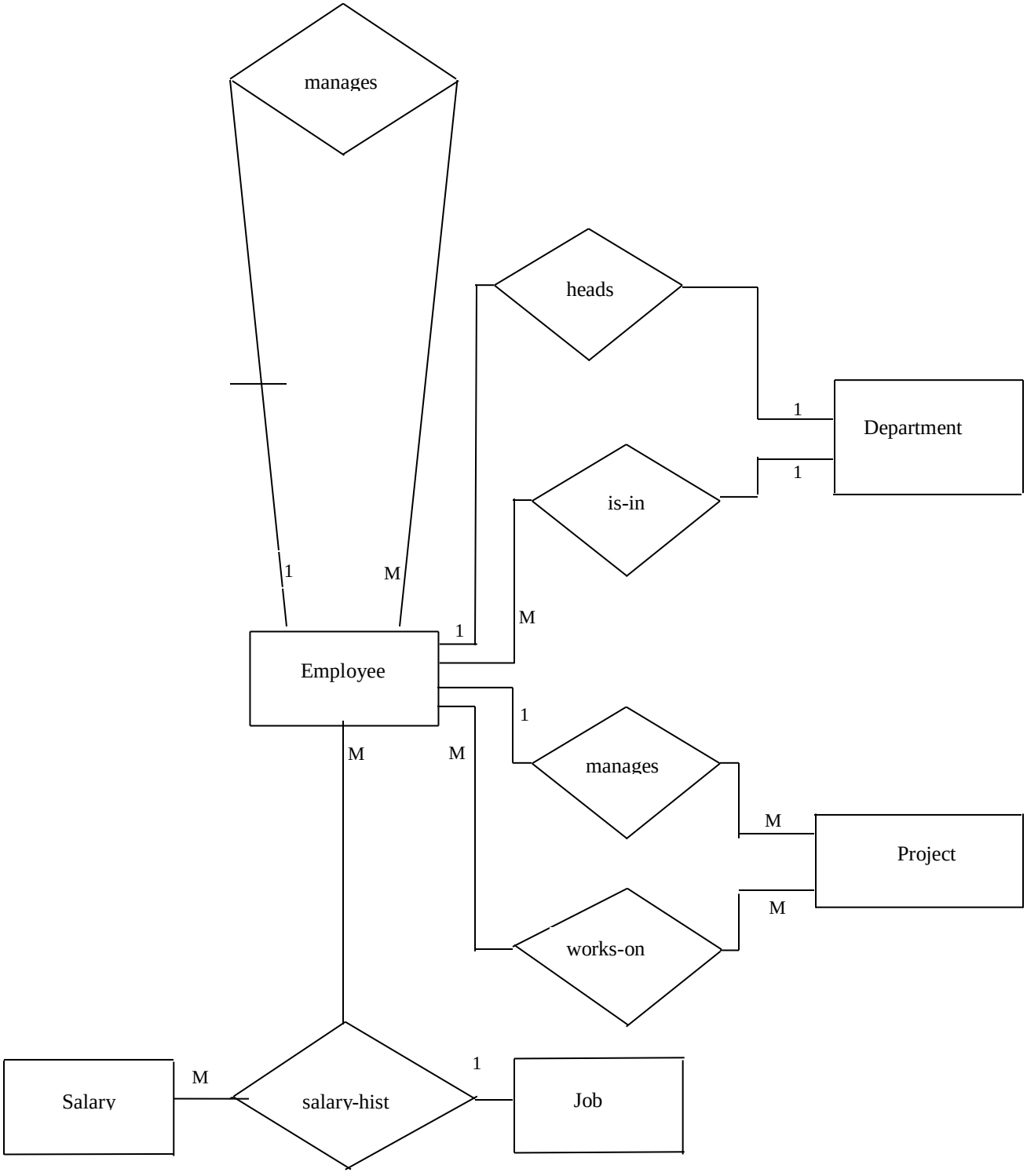
a) For queries (a), (e), and (h) from problem 1, draw appropriate expression trees of your relational algebra solution (if possible).
b) Consider the following relational schema:

```
Suppliers (sID, sname, saddress, scity)
Parts (pID, pname, color)
Catalog (sID, pID, cost)
```

Write an English statement describing what is it that the following query computes:

$$\pi_{sname}((\sigma_{color='red'}(Parts) \bowtie (\sigma_{cost<100}(Catalog) \bowtie Suppliers)) \cap \pi_{sname}((\sigma_{color='green'}(Parts) \bowtie \sigma_{cost<100}(Catalog) \bowtie Suppliers))$$

Problem No. 3: Given the following ER diagram, define the appropriate SQL Tables (i.e., write the SQL CREATE statements). Use appropriate attribute types and ensure integrity constraints (including Primary Key, Foreign Key, Not Null, Unique, etc.). Note: although you don't have to include the relational model schema in your answer, but it might be helpful for you to create one before.



Following are the known attributes for the corresponding entity sets:

Department:	Dept_no, Dept_name, Dept_head;
Employee:	Emp_no, Emp_name, Room_no;
Salary:	Salary_level, Mon_Salary;
Job:	Job_code, Job_title;
Project:	Proj_code, Proj_name, Start_date, End_date;