

CS 2300 – Homework 4

Submit a digital copy (of PDF) to Canvas

Total possible points: 100 points

Homework Guidelines

No Handwritten Answers

This homework will require some written responses and some diagrams. For the written responses, use a standard word processor like Microsoft Word, LibreOffice Writer, Google Docs, or LaTeX. Drawings can be made using Microsoft PowerPoint or Google Drawings¹, among others (e.g. draw.io, lucidchart). You can explore other tools as well, just search around and verify the tool you are considering is compliant with the design aspects that are presented in class.

Please create your answers in a digital format, export to a PDF, and upload that PDF to Canvas. No need to turn a printed copy. For those of you considering LaTeX, ShareLaTeX and Overleaf are good online editors.

One Problem per Page

In the past, many students turned in a single piece of paper with all answered questions smooshed onto it. This did not leave my grader or I with adequate room to provide suggestions on how a design could be improved nor explanations on errors. The process of design work is to work in iterative stages: the first stage will be rather messy (and can be hand-written), the second stage will have things cleaned up, and so on. The final stage is what you should turn in, and it should be free of scratched-out work and high-density drawings. Only answer one problem on *at least* one page, and refrain from super-compact answers that leaves more than 1/2 of the page empty. Ideally, leave somewhere between 1/4 to 1/2 of a page empty so that we can make annotations.

¹ <https://docs.google.com/drawings/>

Problem 1 [80 pts; 10 pts each]

Using the database schema in Figure 1, create *relational algebra expressions* using the relational operators discussed in class.

- Retrieve the names of all employees in department 5 who work more than 10 hours per week on the ProductX project.
- List the names of all employees who have a dependent with the same first name as themselves.
- Find the names of all employees who are directly supervised by 'Franklin Wong'.
- For each project, list the project name and the total hours per week (by all employees) spent on that project.
- Retrieve the names of all employees who work on every project.
- Retrieve the names of all employees who do not work on any project.
- For each department, retrieve the department name and the average salary of all employees working in that department.
- Retrieve the average salary of all female employees.

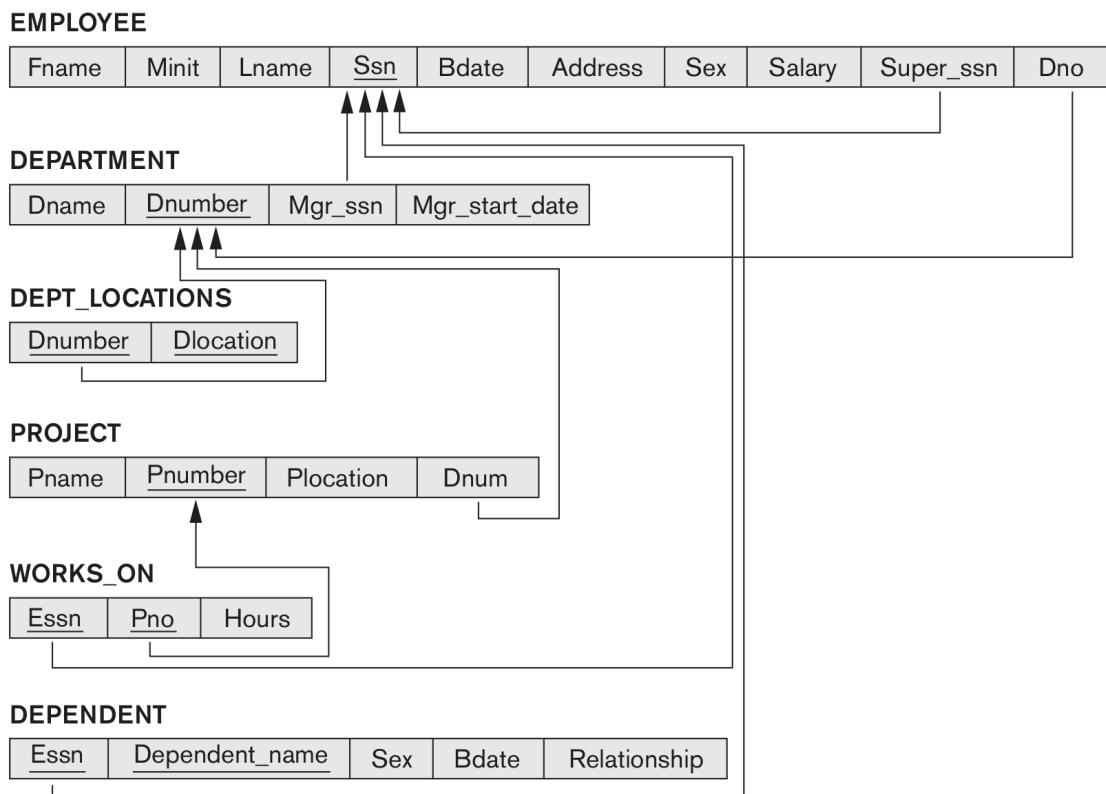
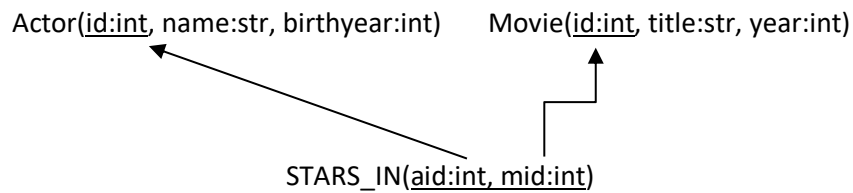


Figure 1

Problem 2 [20 pts]

Given the following relations,



write a *relational algebra expression* that will produce a resulting relation of each actor's latest film and their age when they starred in it—i.e. a relation of the following scheme:

ActorLatestMovie(actor_name:str, age_during_movie:int, latest_movie_title:str, movie_year:int)

Assume there exists some actors who haven't starred in any movies. They ought to appear in the relation.

Hint: When using the generalized projection, an operation on attributes with a NULL value results in NULL. For example:

R		$\pi_{x-y}(R)$
<u>x:int</u>	<u>y:int</u>	<u>x-y:int</u>
3	4	-1
5	NULL	NULL

Please separate out your answers using assignment statements. Example:

$$R_1 \leftarrow \pi_{x-y}(R)$$

$$Answer \leftarrow \rho_{(xy)}(R_1)$$