

CS430/630 – Homework 3

Released Nov 10, Due Nov 26

100 points (10/100 of final grade)

Instructions: The homework is due BEFORE CLASS (19:00) on Wed Nov 26th. Submit a file called HW3.pdf in your course folder with the solution (**which must be typeset, not handwritten**).

Question 1 (20 points)

A university database contains information about professors (identified by social security number *SSN*) and courses (identified by *courseid*). Professors also have a name, an address and a phone number. Courses have a name and a number of credits. Professors teach courses. For each of the following situations, draw an ER diagram that describes it (assuming no further constraints hold).

- (a) Every professor must teach some course.
- (b) Every professor teaches exactly one course (no more, no less).
- (c) Every professor teaches exactly one course (no more, no less), and every course must be taught by some professor.
- (d) [630 students only] Modify the diagram from (a) such that a professor can have a set of addresses (which are street-city-state triples) and a set of phones. Recall that in the E/R model there can be only primitive data types (no sets).
- (e) [630 students only] Modify the diagram from (d) such that professors can have a set of addresses, and at each address there is a set of phones.

Question 2 (10 points)

Let *a* and *b* be integer-valued attributes that may be NULL in some tuples. For each of the following conditions that may appear in a WHERE clause, describe exactly the value space of (*a*, *b*) tuples that satisfy the condition, including the case where *a* and/or *b* is NULL.

- (a) $a=10 \text{ OR } b=20$
- (b) $a=10 \text{ AND } b=20$
- (c) $a<10 \text{ OR } a\geq 10$
- (d) [630 students only] $a=b$

Question 3 (10 points)

Consider a database schema with three relations:

```
Movies (movie_id, title,      year,          studio)
Actors (actor_id, name,      nationality)
StarsIn(actor_id, movie_id, character)
```

Provide SQL statements for the following:

- (a) Create a view `CharactersPlayed` that lists actor names, their nationality and the characters they interpreted together with the year they interpreted it in. The view will have four columns with headings: `ActorName`, `ActorNationality`, `CharacterName` and `Year`.

- (b) Query the view above to retrieve the set of distinct nationalities for actors that interpreted character “Winston Smith”.
- (c) Query the view above to find for each year the count of distinct nationalities of actors who starred in some role for that year.

Question 4 (20 points)

Suppose you are given a relation R with four attributes ABCD and the following set of FDs: $AB \rightarrow C$, $BC \rightarrow D$.

- a. Identify the candidate key(s) for R (recall that keys must be *minimal*)
- b. Determine if R is in BCNF, 3NF, or none of the above. If it is not in BCNF, decompose it into a set of BCNF relations.

Question 5 (20 points)

Suppose you are given a relation R with four attributes ABCD and the following set of FDs: $BC \rightarrow A$, $AB \rightarrow C$, $C \rightarrow DA$.

- a. Identify the key(s) for R (recall that keys must be *minimal*)
- b. Determine if R is in BCNF, 3NF, or none of the above. If it is not in BCNF, decompose it into a set of BCNF relations.

Question 6 (20 points)

Show the grant diagrams after steps 7 and 8 of the sequence of actions below, where A owns the relation on which the privilege p is assigned. Can C still exercise privilege p after step 8? What about E?

Step	Executed by	Action
1	A	GRANT p TO B
2	A	GRANT p TO C WITH GRANT OPTION
3	C	GRANT p TO D WITH GRANT OPTION
4	A	GRANT p TO D WITH GRANT OPTION
5	D	GRANT p TO B WITH GRANT OPTION
6	B	GRANT p TO C
7	D	GRANT p TO E
8	A	REVOKE p FROM C CASCADE