**CS 353 Fall 2023**
**Homework 1**
**Due:** September 29, Friday till midnight
**You will use the Moodle course page for submission of this assignment**

**Q.1 [82 pts]** Given the following relational schema for a movie database:

Movie(m-id, title, year, genre, dName, rating)
dName is a foreign key to Director
Director(dName, dCountry)
MovieStar(s-id, name, sCountry, gender, birthYear)
StarIn(m-id, s-id)
m-id is a foreign key to Movie, s-id is a foreign key to MovieStar

For each of the following queries, give an expression in **Relational Algebra**.

**(a) [6 pts]** Find the movies (m-id and title) directed last year (2022) by the Turkish directors.
**(b) [6 pts]** Find the id and name of the movie stars who acted in a movie directed by "Alfred Hitchcock" in the 60s.
**(c) [6 pts]** Find the name, birth year, and country of the movie stars over the age of 40 who acted in the movies of the last year with a rating higher than 6.0.
**(d) [6 pts]** Find the Turkish directors whose movies have never been rated below 6.0.
**(e) [6 pts]** Find the name and country of the movie stars younger than 25 who acted in the "horror" movies of the last year directed by the directors from USA.
**(f) [6 pts]** Find the average rating of the "horror" movies directed by "Alfred Hitchcock".
**(g) [6 pts]** For each year, find the number of "comedy" movies whose rating is higher than 9.0.
**(h) [8 pts]** Find the directors who have directed at least 3 "action" movies after 2010 with a rating higher than 6.0.
**(i) [8 pts]** Find the director who got the highest rating for "drama" movies of the last year.
**(j) [8 pts]** For each country, find the director who got the highest rating for "drama" movies of the last year.
**(k) [8 pts]** For each year, find the director from each country who got the highest rating for "drama" movies.
**(l) [8 pts]** Find the name of the directors from USA who directed "western" movies in the last year, that received a rating value higher than the average rating value of the "western" movies directed by "Clint Eastwood".

**Q.2 [18 pts, 6 pts each]** Given relations R, S, and T having the same schema, determine whether each of the following equivalence rules holds or not. If not, provide a counter example (instance for each of R, S, T).

**(a)** $S \bowtie (R \cap T) \equiv (T \cap S) \bowtie R$

**(b)** $(T - S) \cup (T - R) \equiv T - (S \cup R)$

**(c)** $\prod_L(\sigma_\Theta((R \cup S) - S) \equiv \sigma_\Theta(\prod_L (R \cup S) - \prod_L(S))$, where L is any set of attributes from the given relations that are mentioned in $\Theta$.