# CSC 3300 Homework 1 – Relational Algebra

## Skills you will learn :

- Writing Relational Algebra expressions

## Tools you will use :

- The RelaX relational algebra calculator at the link
- The database named Database Systems The Complete Book – Exercise 2.4.3 from the site above

## Description

- **Introduction**

  To complete this exercise, you will use RelaX, the relational algebra algebra calculator at the following web site: [link is here]. For all the questions, you will use the database named  Database Systems The Complete Book - Exercise 2.4.3.

  For each of the questions below, you will provide an answer by entering the corresponding relational algebra into RelaX and excuting it. You will take a screenshot, and name the screenshot according to the instructions in each question below. **Save all of your screenshots into a directory called homework1**.

  For these questions, you will not use any aggregate functions, order by, group by, division, left outer join, right outer join, full outer join, theta join, or left or right semi-join. If you use any of these operators, you will either lose points or obtain zero points for the question. Also, answer each question as if you had no knowledge of what data is stored in the tables, although you can use the knowledge obtained by investigating the database's structure.

- **Problems**

  The total number of points available on this assignment is 31. The final grade will be on a 100 point scale according to the formula (points earned * 100) / (total points)

  1. For this problem, you will write two relational algebra queries that each show all information in the ships table. For the first query, use the projection operator. For the other query, do not use the projection operator. Include a Screenshot for each query. You may use any the following operators, but not necessarily all, in your expression: projection. (2 pts) Screenshot file: problem1a.png, problem1b.png
  2. Write a relational algebra query that, when executed, results in the names and dates for all Iowa class ships that that were in at least one battle in the year 1943 or later. You may use any the following operators, but not necessarily all, in your

expression: selection, projection, natural join, difference, rename. (2 pts) Screenshot file: problem2.png

3. Write a relational algebra query that, when executed, results in the names of all ships that were not in a battle. You may use any the following operators, but not necessarily all, in your expression: selection, projection, natural join, difference, rename. (2 pts) Screenshot file: problem3.png
4. Execute the following relational algebra query:

   $\sigma_{launched}$>2 and class='Iowa' ($\pi_{name}$ (Ships))

   This query gives an error. You should be able to figure out what the query is supposed to do. Fix the query by using the comment characters (/* and */). In other words, put in comments above your relational algebra expression what executing this query should return, i.e. what it returns after you fix it. In other words, your final answer should use the following format:

   /* This query results in blah, blah, blah */
   $\pi$Ships /*Fixed query goes here */ (2 pts) Screenshot file: problem4.png
5. For this question, you will write four relational algebra expressions, one for each table, which will result in four Screenshots. Each expression should show all the columns for the primary key for the particular table. Logical assumptions are that ship classes in the Classes table are unique, names are unique, and a particular ship may be in more than one battle but can only have one result as the outcome for that battle. (4 pts) Screenshot files: problem5_classes.png, problem5_battles.png, problem5_outcomes.png, problem5_ships.png
6. The database has three foreign keys based on the assumptions of the primary keys in question 5. Write three relational algebra expressions that show the values of the foreign keys. Include a comment that describes what primary key this query references. For example:
   /* References column "name" in table "Person" */ (3 pts) Screenshot files: problem6_fk1.png, problem6_fk2.png, problem6_fk3.png
7. Write a relational algebra expression that results in the names of all ships that have never been sunk. Note that a ship that has never been in a battle has never been sunk. You may use any the following operators, but not necessarily all, in your expression: selection, projection, natural join, difference. (2 pts) Screenshot file: problem7.png
8. Write a relational algebra expression that results in the name of countries that have ships that have launched before 1941 and have more than 8 guns. You may use any the following operators, but not necessarily all, in your expression: selection, projection, and natural join. (2 pts) Screenshot file: problem8.png
9. Write a relational algebra expression that results in all countries that have ships with at least three more guns than at least one ship from another country. You may use any the following operators, but not necessarily all, in your expression:

selection, projection, cross product, rename. (2 pts) Screenshot file: problem9.png

10. Write a relational algebra expression that results in the names of all countries that have ships that have launched between 1915 and 1920, inclusive. You may use any the following operators, but not necessarily all, in your expression: selection, projection, and natural join. (2 pts) Screenshot file: problem10.png
11. Write a relational algebra expression that results in, for each country, that country's name, the classes of ships that country has produced, what ships that country has launched of those listed classes, and the status (results) of those ships resulting from each of the battles in which the ship engaged. You may use any the following operators, but not necessarily all, in your expression: selection, projection, natural join, and rename. (2 pts) Screenshot file: problem11.png
12. Write a relational algebra expression that results in a table with three columns. The first column is the name of a ship, the second column is the name of a ship, and the third column is the name of a battle. The rows in the table show ships that were in the same battle as another ship. Do not include duplicates. You may use any the following operators, but not necessarily all, in your expression: selection, projection, natural join, Cartesian product, difference, and rename. (2pts) Screenshot file: problem12.png
13. Write a relational algebra expression that that results in a single column table of names. The names should be the names of all battles that start with the letter 'R' and the names of all ships that start with the letter 'R' in the database. Do not use any string manipulation functions such as concatenation or substring. You may use any the following operators, but not necessarily all, in your expression: selection, projection, rename, and union. You can use the LIKE operator in a predicate. (2 pts) Screenshot file: problem13.png
14. Write a relational algebra expression that results in a single column table. The values in the column are names of ships that have the same name as their class. For this question do not use the selection (σ) operator. If you use the selection operator, you will get no credit for the question. (2 pts) Screenshot file: problem14.png
15. This question is worth 5 points extra credit (on a 100 point scale). You must get this question completely correct to get any credit. Not attempting this question, or answering it incorrectly, will have no negative effect on your grade. Also, your total grade for this assignment cannot be over 100%. For example, if you answer all the previous questions correctly and answer this question correctly, your grade will be 100%.

    Write a relational algebra expression that shows the launch date for the ships that have the oldest launch date. You can use the following operators ONLY: projection, selection, rename, intersection, Cartesian product, and difference. Screenshot file: problem15.png