

**COMP 4900 & 5900 Knowledge Representation for
AI
Fall 2023 Assignment 1**

Instructions: (for this assignments and the following ones)

1. **For your solution use the template file that was posted on the course news, and follow the instructions in it, and those here below.**

In particular: (a) Include at the top of the first page: full name, student number, and email address. (b) Assignments have to be created with Latex, and submitted in pdf format. (c) Every problem solution **MUST** include the problem statement as found below in this assignment. The source file for this assignment is provided. (d) Latex has to be used as such, not as a simple text editor, such as Notepad. Latex is much more than that. In particular, formulas have to be written using Latex's mathematical features, and then compiled. Keep your Latex source files, you may be requested to show them.

2. **Only a single pdf file will be accepted as submission.** No tar or zip files.
3. Assignments can be solved in groups of at most two. For future assignments you cannot change partner, but you can decide to continue on your own. No new partnerships will be allowed.
4. Submit by email to the instructor (bertossi@scs.carleton.ca), with the subject: "Assignment "Number" KR4AI. **Include your last name(s) in the file name!** For example: Subject: "Assig. 1 KR4AI", attaching the file: "bertossi-1.pdf".
5. Explain your solution very carefully, but still be succinct in your answers. No unnecessary verbose arguments, please. Go to the point. Make explicit all your assumptions.
6. **Not following the instructions above or the solution template file will make you lose points.**

Exercise 2.4.3: This exercise builds upon Exercise 2.3.2 concerning World War II capital ships. Recall it involves the following relations:

```
Classes(class, type, country, numGuns, bore, displacement)
Ships(name, class, launched)
Battles(name, date)
Outcomes(ship, battle, result)
```

Figures 2.22 and 2.23 give some sample data for these four relations.⁴ Note

<i>class</i>	<i>type</i>	<i>country</i>	<i>numGuns</i>	<i>bore</i>	<i>displacement</i>
Bismarck	bb	Germany	8	15	42000
Iowa	bb	USA	9	16	46000
Kongo	bc	Japan	8	14	32000
North Carolina	bb	USA	9	16	37000
Renown	bc	Gt. Britain	6	15	32000
Revenge	bb	Gt. Britain	8	15	29000
Tennessee	bb	USA	12	14	32000
Yamato	bb	Japan	9	18	65000

(a) Sample data for relation Classes

<i>name</i>	<i>date</i>
Denmark Strait	5/24-27/41
Guadalcanal	11/15/42
North Cape	12/26/43
Surigao Strait	10/25/44

(b) Sample data for relation Battles

<i>ship</i>	<i>battle</i>	<i>result</i>
Arizona	Pearl Harbor	sunk
Bismarck	Denmark Strait	sunk
California	Surigao Strait	ok
Duke of York	North Cape	ok
Fuso	Surigao Strait	sunk
Hood	Denmark Strait	sunk
King George V	Denmark Strait	ok
Kirishima	Guadalcanal	sunk
Prince of Wales	Denmark Strait	damaged
Rodney	Denmark Strait	ok
Scharnhorst	North Cape	sunk
South Dakota	Guadalcanal	damaged
Tennessee	Surigao Strait	ok
Washington	Guadalcanal	ok
West Virginia	Surigao Strait	ok
Yamashiro	Surigao Strait	sunk

(c) Sample data for relation Outcomes

<i>name</i>	<i>class</i>	<i>launched</i>
California	Tennessee	1921
Haruna	Kongo	1915
Hiei	Kongo	1914
Iowa	Iowa	1943
Kirishima	Kongo	1915
Kongo	Kongo	1913
Missouri	Iowa	1944
Musashi	Yamato	1942
New Jersey	Iowa	1943
North Carolina	North Carolina	1941
Ramillies	Revenge	1917
Renown	Renown	1916
Repulse	Renown	1916
Resolution	Revenge	1916
Revenge	Revenge	1916
Royal Oak	Revenge	1916
Royal Sovereign	Revenge	1916
Tennessee	Tennessee	1920
Washington	North Carolina	1941
Wisconsin	Iowa	1944
Yamato	Yamato	1941

Figure 2.23: Sample data for relation Ships

- a) Give the class names and countries of the classes that carried guns of at least 16-inch bore.
- b) Find the ships launched prior to 1921.
- c) Find the ships sunk in the battle of the Denmark Strait.
- d) The treaty of Washington in 1921 prohibited capital ships heavier than 35,000 tons. List the ships that violated the treaty of Washington.
- e) List the name, displacement, and number of guns of the ships engaged in the battle of Guadalcanal.
- f) List all the capital ships mentioned in the database. (Remember that all these ships may not appear in the Ships relation.)
- ! g) Find the classes that had only one ship as a member of that class.
- ! h) Find those countries that had both battleships and battlecruisers.
- ! i) Find those ships that “lived to fight another day”; they were damaged in one battle, but later fought in another.

1. Consider the database schema and the associated data in the figure. Using the language of safe FOPL (or safe Relational Calculus) based on the four given predicates (plus possibly built-in predicates) exactly as presented in class (nothing else counts), express all the queries (a)-(i), more precisely:

1. Introduce for each of them a query-answer predicate, and define it by means of a FOPL formula.
2. Carefully explain your formula, and explain why it is safe or domain-independent.
3. The query should work for every instance for the database schema, not only for the given instance.
4. Evaluate the query, i.e. compute its answers, using the definition of formula satisfaction given and illustrated in class. Explain.

2. Do exactly the same as in the previous problem, but now using Datalog or Datalog^{s,not}. To answer the queries use the minimal or standard model.

Note: In the next assignment you will have to use the DLV system to evaluate these Datalog queries. You will **not** receive solutions for part 2 before that assignment. So, make sure to start carefully solving this problem already at this stage.

Deadline: Nov. 5, at 23:55