COSC 4820, Spring 2023
Homework 3, Constraints and FD's

Constraints

Use the following alternative syntax when you type the algebra.

operation	*notation*
union	R UNION S
intersection	R INTERSECT S
difference	R DIFF S
projection	PROJECT(*attribute_list*){R}
selection	SELECT(*conditional*){S}
cartesian product	PRODUCT{R, S}
natural join	JOIN{R, S}
theta join	THETA(*conditional*){R, S}
renaming	RENAME(new_relation_name)(*attribute_list*){R}

Question 1: [**0 points**]

Express the following constraints in relational algebra. These are based on the ship data from pages 56 and 57.

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

You can express these as either containments or or by equating an expression to the empty set.

Containment example:

$\pi_{movieTitle,\ movieYear}(\text{StarsIn}) \subseteq \pi_{title,\ year}(\text{Movies})$

Equating to empty set example:

$\sigma_{MS1.name=MS2.name \text{ AND } MS1.address \neq MS2.address}\ (\text{MS1} \times \text{MS2}) = \emptyset$

Question 2: [**4 points**]

No class of ships may have guns larger than 16-inch bore.

Question 3: [**4 points**]

If a class of ships has more than 9 guns, then their bore must be no larger than 14 inches.

Question 4: [**4 points**]

No class may have more than two ships.

Question 5: [**4 points**]

No country may have both battleships and battlecruisers.

Question 6: [4 points]
No ship with more than 9 guns may be in a battle with a ship having fewer than 9 guns that was sunk.

Questions about FD Rules

Let $R(A, B, C, D, E, F)$ be a relation and let $T(K, L, M, N)$ be another.
$AB \rightarrow C$, $B \rightarrow D$, $E \rightarrow F$ are FD's which hold for relation R

$K \rightarrow M$, $L \rightarrow M$, $M \rightarrow N$ are FD's which hold for relation T

Question 7: [10 points]
Does $AB \rightarrow F$ hold for R? You must show the computed closure and explicitly answer the question.

Question 8: [5 points]
What are the *keys* for relation T?

Question 9: [5 points]
What are the *superkeys* for relation T?

Question 10: [5 points]
Does $AB \rightarrow D$ hold for relation R? Why or why not?

Question 11: [5 points]
Give a *minimal basis* for relation R.