Grading Information

- Warmup problems will be graded as one of (✓+, ✓, ✓-)
- All other problems will be graded in detail and will be given a score.

Solutions for the warmup problems will be provided along with your graded work.

Collaboration Policy

Please submit your signed collaboration policy to the CS127 handin bin before the first assignment is due. The collaboration policy can be found under the DOCS section in the course website.

Warmup #1  (Textbook Problem 2.7)

Solution:

2.7 Consider the relational database of Figure ??. Give an expression in the relational algebra to express each of the following queries:

a. Find the names of all employees who live in city “Miami”.

b. Find the names of all employees whose salary is greater than $100,000.

c. Find the names of all employees who live in “Miami” and whose salary is greater than $100,000.

Answer:

a. $\Pi_{name} \left( \sigma_{\text{city}=\text{"Miami"}} \left( \text{employee} \right) \right)$

b. $\Pi_{name} \left( \sigma_{\text{salary} > 100000} \left( \text{works} \right) \right)$

c. $\Pi_{name} \left( \sigma_{\text{city}=\text{"Miami"} \land \text{salary}>100000} \left( \text{works} \natural \text{employee} \right) \right)$

Figure 1: Warmup 1

Warmup #2  (Textbook Problem 2.10)

Solution:
2.10 Consider the *advisor* relation shown in Figure 2.8, with *s.id* as the primary key of *advisor*. Suppose a student can have more than one advisor. Then, would *s.id* still be a primary key of the *advisor* relation? If not, what should the primary key of *advisor* be?

**Answer:** No, *s.id* would not be a primary key, since there may be two (or more) tuples for a single student, corresponding to two (or more) advisors. The primary key should then be *s.id, i.id*.

---

**Warmup #3 (Textbook Problem 2.13)**

Solution:

**2.13** Consider the bank database of Figure 2.15. Give an expression in the relational algebra for each of the following queries:

a. Find all loan numbers with a loan value greater than $10,000.

b. Find the names of all depositors who have an account with a value greater than $6,000.

c. Find the names of all depositors who have an account with a value greater than $6,000 at the “Uptown” branch.

**Answer:**

a. \( \Pi_{\text{loan\_number}} (\sigma_{\text{amount} > 10000}(\text{loan})) \)

b. \( \Pi_{\text{customer\_name}} (\sigma_{\text{balance} > 6000} (\text{depositor} \bowtie \text{account})) \)

c. \( \Pi_{\text{customer\_name}} (\sigma_{\text{balance} > 6000 \land \text{branch\_name} = "Uptown"} (\text{depositor} \bowtie \text{account})) \)
Warmup #4  (Textbook Problem 6.2)

Solution:

6.2 Consider the relational database of Figure 6.22, where the primary keys are underlined. Give an expression in the relational algebra to express each of the following queries:

a. Find the names of all employees who live in the same city and on the same street as do their managers.

b. Find the names of all employees in this database who do not work for “First Bank Corporation”.

Answer:

a. \( \Pi_{\text{person.name}} ( (\text{employee} \bowtie \text{manages}) \bowtie (\text{manager.name} = \text{employee2.person.name} \land \text{employee.street} = \text{employee2.street} \land \text{employee.city} = \text{employee2.city}) \bowtie \text{employee2 (employee)}) ) \)

b. The following solutions assume that all people work for exactly one company. If one allows people to appear in the database (e.g. in employee) but not appear in works, the problem is more complicated. We give solutions for this more realistic case later.

\( \Pi_{\text{person.name}} (\sigma_{\text{company.name} \neq \text{"First Bank Corporation"}} (\text{works})) \)

If people may not work for any company:

\( \Pi_{\text{person.name}} (\text{employee}) - \Pi_{\text{person.name}} (\sigma_{\text{company.name} = \text{"First Bank Corporation"}} (\text{works})) \)

Problem 5 (To Be Graded)

You work as a Data Analyst for a research hospital. Your database contains comprehensive clinical data from Intensive Care Unit (ICU) patients. You were asked to write a impartial report driven by the insights you get from the data. As part of your report you have to query the database for some data. Below is a sample of the database. Underlined column name represents the primary key for the given table.
Give expressions in relational algebra to answer the following questions.

1. Which patients treated by Warfarin have a history of Abnormal Blood Pressure?
   \[ \Pi_{Patient}(\sigma_{Drug = \text{Warfarin}} \land \sigma_{Test = \text{Blood Pressure}} \land \sigma_{Status = \text{Abnormal}}(TREATMENTS \bowtie TESTRESULTS)) \]

2. Which patients above the age of 50 are treated with Warfarin and have glucose in their urine?
   \[ \Pi_{Patient}(\sigma_{Age > 50} \land \sigma_{Drug = \text{Warfarin}} \land \sigma_{Test = \text{Urinalysis: Glucose}} \land \sigma_{Reading > 0}(PATIENT \bowtie TREATMENTS \bowtie TESTRESULTS)) \]

3. Which state has the most diagnoses of Cardiac Arrest?
   \[ x < \text{State} \overline{G \text{COUNT}(Patient)AScount(\sigma_{Disease = \text{Cardiac Arrest}}(PATIENTS \bowtie DIAGNOSES))} \]
   \[ y < \text{G MAX}(count)AScount(x) \]
   \[ \Pi_{State}(x \bowtie y) \]

4. Which patients have not received a Red Blood Cell test?
   \[ \Pi_{Patient}(PATIENTS) - \Pi_{Patient}(\sigma_{Test = \text{Red Blood Cell}}(PATIENTS \bowtie TESTRESULTS)) \]

5. Which patient received the highest total dosage of Ferrous Sulfate?
   \[ x < -\Pi_{Patient, sum}(\sigma_{Drug = \text{Ferrous Sulfate}}(TREATMENTS), \sum_{Dosage}(sum)ASsum) \]
   \[ y < \text{G MAX}(sum)ASsum(x) \]
   \[ \Pi_{Patient}(x \bowtie y) \]

6. Which specialty diagnosed the highest number of unique patients?
   \[ x < -\Pi_{Specialty, count}(\sigma_{Specialty}(G \text{COUNT}(Patient)AScount(\Pi_{Patient, Specialty}(DIAGNOSES)))) \]
   \[ y < \text{G MAX}(count)AScount(x) \]
   \[ \Pi_{Specialty}(x \bowtie y) \]