

HW 01 - Solutions

4 Basic Set Theory

In proper set notation, provide the result of each of the following set operations.

SHOW YOUR WORK!

Given:

$$A = \{2, 4, 6, 8, 10\}$$

$$B = \{1, 2, 3, 4, 5\}$$

$$C = \{3, 5, 7, 9\}$$

$$D = \{0, 2, 4, 6\}$$

$$E = \{4, 5, 6, 7, 8\}$$

1. What is the result of the following operations? [3 points each]

4.1 $(A \cup C) - (B \cap D)$

$$(A \cup C) = \{2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

$$(B \cap D) = \{2, 4\}$$

$$(A \cup C) - (B \cap D) = \{3, 5, 6, 7, 8, 9, 10\}$$

4.2 $[(B \cup D) - E] \cap A$

$$(B \cup D) = \{0, 1, 2, 3, 4, 5, 6\}$$

$$(B \cup D) - E = \{0, 1, 2, 3\}$$

$$[(B \cup D) - E] \cap A = \{2\}$$

4.3 $(B \cap A) \times (E - C)$

$$(B \cap A) = \{2, 4\}$$

$$(E - C) = \{4, 6, 8\}$$

$$(B \cap A) \times (E - C) = [(2, 4), (2, 6), (2, 8), (4, 4), (4, 6), (4, 8)]$$

4.4 $[(A - D) \cup (C \cap E)] \cap B$

$$(A - D) = \{8, 10\}$$

$$(C \cap E) = \{5, 7\}$$

$$(A - D) \cup (C \cap E) = \{5, 7, 8, 10\}$$

$$[(A - D) \cup (C \cap E)] \cap B = \{5\}$$

$$4.5 \ (B \cup E) - [(A \cap D) \cup (C - A)]$$

$$(A \cap D) = \{2, 4, 6\}$$

$$(C - A) = \{3, 5, 7, 9\}$$

$$(A \cap D) \cup (C - A) = \{2, 3, 4, 5, 6, 7, 9\}$$

$$(B \cup E) = \{1, 2, 3, 4, 5, 6, 7, 8\}$$

$$(B \cup E) - [(A \cap D) \cup (C - A)] = \{1, 8\}$$

Relational Algebra

Use these tables for question 5.

Dorms

<u>dormID</u>	dormName
10	McElvaney
20	Loyd
30	Shuttles

Residents

<u>residentID</u>	name	dormID
111	Winston	10
243	Kev	20
348	Ella	30
417	Sally	10

MaintenanceRequests

<u>reqID</u>	residentID	description	status
95	111	plumbing issue	open
96	243	wall damage	closed
97	417	vermin spotted	open
98	111	wifi is nofi	open

DormEvents

<u>eventID</u>	dormID	eventName	eventDate
2112	10	movie night	2025-09-15
2116	20	spikeball	2025-10-01
2128	10	pumpkin carving	2025-10-30
2153	30	snack time	2025-12-02

2. Determine the resulting relation instance for each of the following relational algebra expressions. Your solution to each of these will be a table of data. The order of rows or columns doesn't matter.

[5 points each]

$$5.1 \sigma_{(status='open')}(MaintenanceRequests)$$

<u>reqID</u>	residentID	description	status
95	111	plumbing issue	open
97	417	vermin spotted	open
98	111	wifi is nofi	open

$$5.2. \pi_{(dormName)}(Dorms)$$

dormName
McElvaney
Loyd
Shuttles

$$5.3 \pi_{(name, dormName)}(Dorms \bowtie Residents)$$

<u>name</u>	dormName
Winston	McElvaney
Sally	McElvaney
Kev	Loyd
Ella	Shuttles

$$5.4 \pi_{(name)}(Residents) - \pi_{(name)}(Residents \bowtie MaintenanceRequests)$$

name
Ella

$$5.5 \pi_{(eventName)}(\sigma_{(dormName='McElvaney')}(Dorms \bowtie DormEvents))$$

eventName
movie night
pumpkin carving

3. Using the previous relations (Dorms, Residents, etc.), provide relational algebra queries for each of the following prompts and then provide the resulting relation instance from evaluating your query.

[9 points each]

6.1 Give the names of all students that have open maintenance requests.

$$\pi_{(name)}(\sigma_{(status='open')}(Residents \bowtie MaintenanceRequests))$$

name
Winston
Sally

6.2 Which dorm events happen in October of 2025? Give the name of the dorm and the name of the event.

$$\pi_{(dormName, eventName)}(\sigma_{(eventName \geq '10-1-2025' \wedge eventName < '11-1-2025')}(Dorms \bowtie DormEvents))$$

eventName	dormName
spikeball	Loyd
pumpkin carving	McElvaney

6.3 Only students that live in a given dorm can participate in events for that dorm. Give the names of all students eligible to attend the *movie night* event.

$$\pi_{(name)}(Residents \bowtie [\sigma_{(eventName='movie\ night')}(DormEvents)])$$

name
Winston
Sally

6.4. Create a report that lists every student's name along with the events that they can participate in (adhering to the constraint that a student must live in a dorm to participate in its events). If a student is eligible for more than one event, there would be two tuples in the resulting relation containing that student's name.

$$\pi_{(name, eventName)}(Residents \bowtie DormEvents)$$

name	eventName
Winston	movie night
Winston	pumpkin carving
Kev	spikeball
Sally	movie night
Sally	pumpkin carving
Ella	snack time

4. Rewrite query 5.5 WITHOUT using a join operator. [9 points]

$$\pi_{(eventName)}(\sigma_{(dormName='McElvaney' \wedge Dorms.dormID = DormEvents.dormID)}(Dorms \times DormEvents))$$