1. Express the following queries in Relational Algebra. Both the correctness and the simplicity count.

List items available in both "red" and "blue".

$$\pi_{item} \left(\sigma_{colors = red} \left(Types \right) \cap \sigma_{colors = blue} \left(Types \right) \right)$$

List the name of the employees making at least as much as "Jane". If there are several employees named" Jane", which Jane's salary is used in this comparison in your answer?

$$JS = \sigma_{name = \text{'Jane'}} \left(Employees \right)$$
$$\pi_{name} \left(\sigma_{salary >= JS} \right)$$

In this comparison, if there were multiple Janes in the Employee relation, the selection operation would return multiple rows for Jane in JS. The salary used for comparison would be ambiguous.

Find the largest salary paid to any employees.

$$\pi_{salary} - \pi_{salary} \left(\sigma_{salary < salary2} \left(Employee \times \rho_{salary \rightarrow salary2} \left(Employee \right) \right) \right)$$

What departments sell every item with a red color?

itemsRed = $\pi_{items.} \left(\sigma_{color = red} \left(Types \right) \right)$
deptRedProd = Sales x itemsRed
deptWithMissingRedItems = Sales – deptRedProd
deptsWithAllRedItems = π_{dept} (Sales – deptWithMissingRedItems)

What departments sell only items with a red color, in other words, what departments do not sell any item with a non-red color?

nonRed = $\pi_{items} \left(\sigma_{color \neq red} \left(Types \right) \right)$
result = π_{dept} (Sales) - π_{dept} (Sales / nonRed)

2. Express the queries in Question 1 in SQL.
   List items available in both "red" and "blue".

```
SELECT item
FROM types
WHERE color = "red"
INTERSECT
SELECT item
FROM types
WHERE color = "blue"
```

List the name of the employees making at least as much as "Jane". If there are several employees named" Jane", which Jane's salary is used in this comparison in your answer?

SELECT name
FROM employee
WHERE salary >= (SELECT salary FROM employee WHERE name = "Jane")

Find the largest salary paid to any employees.

SELECT MAX(salary)
FROM employee

What departments sell every item with a red color.

    SELECT dept
    FROM sales
    JOIN types ON sales.item = types.item
    WHERE types.color = "Red"
    GROUP BY sales.dept
    HAVING
    COUNT(DISTINCT sales.item = (SELECT COUNT * FROM types WHERE color = "red")

What departments sell only items with a red color, in other words, what departments do not sell any item with a non-red color.

SELECT dept FROM sales
EXCEPT
(SELECT sales.dept FROM sales JOIN types on sales.item = types.item
WHERE types.color != "red")

3. This question refers to the queries in Question:

Express query 1 in SQL without using INTERSECT

SELECT item
FROM types
WHERE color = "red"
AND IN (SELECT(item FROM types WHERE color = "blue"))

Express query 2 in SQL using nested query

SELECT name
FROM employee
WHERE salary >= (SELECT salary FROM employee WHERE name = "Jane")

Express query 3 without using EXCEPT

SELECT MAX(salary)
FROM employee

Express query 5 without using EXCEPT

SELECT DISTINCT dept
FROM sales
WHERE dept NOT IN (
        SELECT DISTINCT sales.dept
        FROM sales
        JOIN types ON sales.item = types.item
        WHERE types.color != "red"
)