

Exercise walk-through

3.1

Relational databases: a key and a relationship

International Baccalaureate · IB Diploma · Computer Science · HL

3.1 Relational databases: a key and a relationship

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS primary key • foreign key

Objective

Relational databases: a key and a relationship. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

1 Key knowledge and worked examples

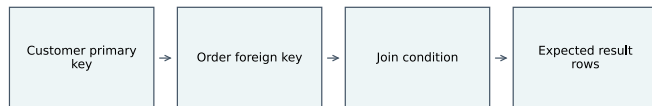
■ What would explain this observation?

- Duplicating a user address in every order can produce conflicting records when the address changes.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- A relational table contains rows and attributes. A **primary key** identifies a row; a **foreign key** links to a referenced key in another table. Normalization can reduce avoidable duplication and update anomalies while preserving meaningful relationships.
- primary key: Attribute set uniquely identifying a table row; foreign key: Attribute

set referencing a key in another table.



■ Choose evidence that can test it

- A join combines rows according to a specified condition. The result count depends on relationship cardinality and filters. A foreign key constraint enforces a relationship rule; it does not automatically encrypt personal data.
- Design a small synthetic user-order dataset with no real personal information. Declare keys, test duplicate and missing-reference inserts, then check a query result against a hand-worked expected table.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: four customers have respectively 2, 0, 3 and 1 orders. An inner join of customer to order returns $2+0+3+1 = 6$ rows. A left join also retains the customer with no order as one null-matched row, giving 7 here.

Example:

Three customers have 1, 3 and 2 orders. How many rows does the customer-order inner join return? Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- A primary key need not be a person name. A join is not a simple concatenation of tables. Use parameterized queries for untrusted input rather than building SQL from raw strings.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A foreign key automatically encrypts every row. This claim is false: A primary key need not be a person name. A join is not a simple concatenation of tables. Use parameterized

queries for untrusted input rather than building SQL from raw strings.

Key:

Relational databases: a key and a relationship: A join combines rows according to a specified condition. The result count depends on relationship cardinality and filters. A foreign key constraint enforces a relationship rule; it does not automatically encrypt

personal data.

■ Runnable trace and boundary

```
import sqlite3
db = sqlite3.connect(":memory:")
db.executescript("""CREATE TABLE c(id INTEGER PRIMARY KEY);
CREATE TABLE o(id INTEGER PRIMARY KEY, cid INTEGER);
INSERT INTO c VALUES(1),(2),(3);
INSERT INTO o VALUES(10,1),(11,1),(12,3);""")
for kind in ["INNER", "LEFT"]:
    sql = f"SELECT COUNT(*),COUNT(o.id) FROM c {kind} JOIN o ON c.id=o.cid"
    print(kind, db.execute(sql).fetchone())
db.close()
```

Expected output:

```
INNER (3, 3)
LEFT (4, 3)
```

The left join retains customer 2 with null order fields. COUNT(*) includes that row, while COUNT(o.id) excludes null. Primary keys distinguish records; customer count is not order count. The interpolated join keyword comes from a fixed internal list, not user input.

Exercises 2.1-2.3

2.1 Which design helps avoid duplicated customer-address updates? Choose one answer.

- **A** Separate customers and orders linked by keys
- **B** Repeat the address in every order without a rule
- **C** Use names as guaranteed unique identifiers

[1]

2.2 Three customers have 1, 3 and 2 orders. How many rows does the customer-order inner join return? Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: A foreign key automatically encrypts every row.

[2]

Exercises 2.1-2.3

2.1 Which design helps avoid duplicated customer-address updates? Choose one answer.

- **A** Separate customers and orders linked by keys
- **B** Repeat the address in every order without a rule
- **C** Use names as guaranteed unique identifiers

[1]

2.1 A A join combines rows according to a specified condition. The result count depends on relationship cardinality and filters. A foreign key constraint enforces a relationship rule; it does not automatically encrypt personal data.

2.2 Three customers have 1, 3 and 2 orders. How many rows does the customer-order inner join return? Show the relation, substitution and units.

[2]

2.2 Inner join has one row per matching order: $1+3+2=6$ rows.

2.3 Decide whether this claim is true and justify: A foreign key automatically encrypts every row.

[2]

2.3 False. A primary key need not be a person name. A join is not a simple concatenation of tables. Use parameterized queries for untrusted input rather than building SQL from raw strings.

Exercises 2.4·3.1

2.4 Attribute set uniquely identifying a table row: write the technical term. [1]

3.1 Customers A,B,C have 2,0,1 orders. Compare customer-order inner and left-join row counts. Why can counting joined rows miscount customers? [4]

Exercises 2.4-3.1

2.4 Attribute set uniquely identifying a table row: write the technical term. [1]

2.4 primary key. primary key means Attribute set uniquely identifying a table row.

3.1 Customers A,B,C have 2,0,1 orders. Compare customer-order inner and left-join row counts. Why can counting joined rows miscount customers? [4]

3.1 Inner join:3 rows; left join:4 including a null match for B. COUNT(*) counts rows; COUNT(order__id) excludes null; DISTINCT customer__id counts represented customers. State keys and join conditions.