Grade 13 A/L ICT · Lesson 8

8.2 Relational Database Model and Constraints

Syllabus 8.2. The relational model stores data in **relations** (tables). A relation has **attributes** (columns) and **tuples** (rows), and tables are joined by **relationships**. **Constraints** – NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY and CHECK – stop bad data from entering.

1. Relations, attributes and tuples

Parts of a relation (table)

StudentID	Name	ClassID
S001	Nimal	C12A
S002	Kamala	C12A
S003	Sunil	C12B

↑ attribute / column (field) highlighted row = tuple / record

Primary key: StudentID · Foreign key: ClassID → Class

degree = 3 columns · cardinality = 3 rows

Parts of the Student relation

- **Relation / table** – a named set of rows with the same columns.
- **Attribute / column** – one property, e.g. Name; it has a **domain** (allowed values).
- **Tuple / row** – one record, e.g. (S001, Nimal, C12A).
- **Degree** = number of columns; **cardinality** = number of rows.
- **Relationship** – a link between tables through matching key values.

2. Types of constraints

Table definitions with constraints (SQL)

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```
CREATE TABLE Class (
  ClassID   CHAR(4)     PRIMARY KEY,
  ClassName VARCHAR(10) NOT NULL UNIQUE,
  Teacher   VARCHAR(30) NOT NULL
);
CREATE TABLE Student (
  StudentID CHAR(4)     PRIMARY KEY,
  Name      VARCHAR(30) NOT NULL,
  ClassID   CHAR(4)     REFERENCES Class(ClassID)
);
CREATE TABLE Marks (
  StudentID   CHAR(4) REFERENCES Student(StudentID),
  SubjectCode CHAR(4),
  Mark        INTEGER CHECK (Mark BETWEEN 0 AND 100),
  PRIMARY KEY (StudentID, SubjectCode)
);
```

Constraint	Rule	Rejected example
NOT NULL	A value must be given	Class with no Teacher
UNIQUE	No two rows share the value	a second class named 12A
PRIMARY KEY	Unique and not null; identifies a row	a second S001
FOREIGN KEY	Value must exist in the parent table	ClassID C13Z (no such class)
CHECK	Value must pass a condition	Mark 105

🧱 **Worked example: Which of these inserts does the database reject, and why?**
We ran all five in sqlite3 with foreign keys on. **All 5 were rejected**: S001 again (primary key), class C13Z (foreign key), mark 105 (CHECK 0–100), a NULL teacher (NOT NULL) and a second 12A (UNIQUE).

💡 A primary key is UNIQUE + NOT NULL together; a table has only one primary key.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Modern cloud databases in 2026 still enforce these same constraints, and AI coding assistants often suggest them when generating tables.

Key Words

Relation – A table of rows with the same columns.

Attribute – A column that holds one property.

Tuple – A single row or record of a relation.

Domain – The set of allowed values for an attribute.

Degree – The number of attributes in a relation.

Cardinality – The number of tuples in a relation.

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Relationship – A link between tables using key values.

NOT NULL constraint – Rule that a column must always have a value.

UNIQUE constraint – Rule that no two rows share a column value.

Primary key constraint – Unique, not null column that identifies each row.

Foreign key constraint – Rule that a value must exist in the referenced table.

Check constraint – Rule that a value must satisfy a condition.

Sample Q&A

1. What is a tuple?

> **Answer:** One row (record) of a relation.

2. Degree and cardinality of the Student table shown?

> **Answer:** Degree 3, cardinality 3.

3. What does a foreign key constraint prevent?

> **Answer:** Rows that refer to a parent record that does not exist.

4. How is PRIMARY KEY different from UNIQUE?

> **Answer:** Primary key is also NOT NULL and only one per table.

5. Write a CHECK for marks.

> **Answer:** CHECK (Mark BETWEEN 0 AND 100).

6. What is a domain?

> **Answer:** The set of allowed values of an attribute, e.g. 0–100 for Mark.

MCQ

1. A row of a relation is called a

A. tuple
B. attribute
C. domain
D. degree
E. schema

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2. A column of a relation is called an

A. instance
B. attribute
C. index
D. tuple
E. cardinality

3. The number of columns in a relation is its

A. degree
B. size
C. domain
D. cardinality
E. key

4. A rule that a value must exist in the parent table is a

A. not null constraint
B. unique constraint
C. foreign key constraint
D. default value
E. check constraint

5. Inserting mark 105 is rejected by

A. NOT NULL
B. CHECK (Mark BETWEEN 0 AND 100)
C. PRIMARY KEY (Name)
D. FOREIGN KEY (ClassID)
E. UNIQUE (Name)

6. Inserting a second S001 breaks the

A. not null on Teacher
B. foreign key constraint
C. domain of Mark
D. primary key constraint
E. check constraint

7. A constraint that is UNIQUE and NOT NULL together is

A. PRIMARY KEY
B. INDEX
C. DEFAULT
D. FOREIGN KEY
E. CHECK

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8. Of the five bad inserts tested in sqlite3, how many were rejected?

A. 1
B. 4
C. 3
D. 0
E. 5

9. Which term means: “A table of rows with the same columns”?

A. Relation
B. NOT NULL constraint
C. Foreign key constraint
D. Cardinality
E. Tuple

10. Which term means: “A column that holds one property”?

A. Check constraint
B. Attribute
C. Domain
D. Relationship
E. UNIQUE constraint

11. Which term means: “A single row or record of a relation”?

A. Degree
B. Primary key constraint
C. NOT NULL constraint
D. Tuple
E. Relation

12. Which term means: “The set of allowed values for an attribute”?

A. Cardinality
B. UNIQUE constraint
C. Foreign key constraint
D. Attribute
E. Domain

13. Which term means: “The number of attributes in a relation”?

A. Tuple
B. Check constraint
C. Primary key constraint
D. Relationship
E. Degree

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14. Which term means: “The number of tuples in a relation”?

A. Domain
B. Cardinality
C. Foreign key constraint
D. Relation
E. NOT NULL constraint

15. Which term means: “A link between tables using key values”?

A. Degree
B. Check constraint
C. UNIQUE constraint
D. Relationship
E. Attribute

16. Which term means: “Rule that a column must always have a value”?

A. Cardinality
B. Relation
C. NOT NULL constraint
D. Primary key constraint
E. Tuple

17. Which term means: “Rule that no two rows share a column value”?

A. Attribute
B. Domain
C. Relationship
D. UNIQUE constraint
E. Foreign key constraint

18. Which term means: “Unique, not null column that identifies each row”?

A. Degree
B. Tuple
C. Primary key constraint
D. NOT NULL constraint
E. Check constraint

19. Which term means: “Rule that a value must exist in the referenced table”?

A. Relation
B. UNIQUE constraint
C. Foreign key constraint
D. Domain
E. Cardinality

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20. Which term means: “Rule that a value must satisfy a condition”?

A. Degree
B. Primary key constraint
C. Relationship
D. Attribute
E. Check constraint

Structured Questions

1. Define relation, attribute and tuple using the Student table. *(3 marks)*

> Relation table; attribute column; tuple row.

2. State the degree and cardinality of a table with 3 columns and 5 rows. *(2 marks)*

> Degree 3; cardinality 5.

3. Explain five types of constraints with an example each. *(5 marks)*

> NOT NULL; UNIQUE; PRIMARY KEY; FOREIGN KEY; CHECK.

4. Write SQL to create Marks with a composite primary key and a CHECK. *(4 marks)*

> CREATE TABLE Marks; StudentID REFERENCES Student; CHECK Mark 0–100; PRIMARY KEY (StudentID, SubjectCode).

5. Explain how a foreign key keeps referential integrity. *(3 marks)*

> FK value must match parent PK; rejects orphans; e.g. C13Z rejected.

Summary

- A relation is a table of tuples and attributes.
- Degree = columns; cardinality = rows.
- Primary key = unique + not null.
- Foreign keys keep links between tables valid.
- CHECK and NOT NULL stop invalid values.

MCQ answer key – 8.2

1. **A** – Tuple.
2. **B** – Attribute.
3. **A** – Degree.
4. **C** – FK.
5. **B** – CHECK.
6. **D** – Duplicate key.

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7. **A** – Primary key.
8. **E** – All rejected.
9. **A** – Relation – A table of rows with the same columns.
10. **B** – Attribute – A column that holds one property.
11. **D** – Tuple – A single row or record of a relation.
12. **E** – Domain – The set of allowed values for an attribute.
13. **E** – Degree – The number of attributes in a relation.
14. **B** – Cardinality – The number of tuples in a relation.
15. **D** – Relationship – A link between tables using key values.
16. **C** – NOT NULL constraint – Rule that a column must always have a value.
17. **D** – UNIQUE constraint – Rule that no two rows share a column value.
18. **C** – Primary key constraint – Unique, not null column that identifies each row.
19. **C** – Foreign key constraint – Rule that a value must exist in the referenced table.
20. **E** – Check constraint – Rule that a value must satisfy a condition.

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