Grade 13 A/L ICT · Lesson 8

8.6 Transforming ER Diagrams to a Logical Schema

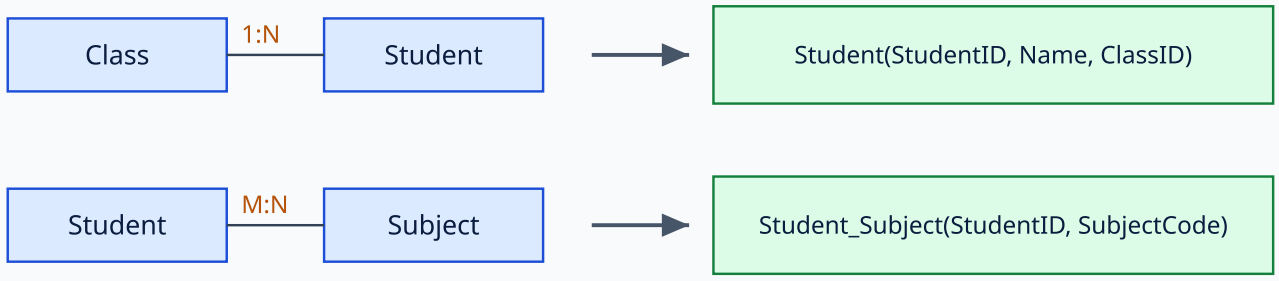
Syllabus 8.6. After drawing an ER diagram we **transform** it into tables. **Entities** become relations, **attributes** become columns, identifiers become **primary keys**, and **relationships** become **foreign keys** or new **linking tables** depending on cardinality.

1. Entity and attribute transformation

- Each strong **entity** → one table; the **identifier** → primary key.
- **Simple** attributes → columns; **composite** → one column per part (Street, City).
- **Multi-valued** → a new table with the owner key, e.g. StudentPhone(StudentID, Phone).
- **Derived** attributes are usually not stored (calculate Age when needed).

2. Relationship transformation

ER → tables: 1:N adds a foreign key, M:N adds a new table



Entity → table · attribute → column · identifier → primary key

1:N and M:N transformation

Cardinality	Rule	Example
1:1	Put the PK of one side as a FK (often UNIQUE) in the other	School(..., PrincipalID)
1:N	Put the PK of the “1” side as a FK in the “N” side	Student(..., ClassID)
M:N	Create a new table with both PKs as a composite PK	Student_Subject(StudentID, SubjectCode)

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🧮 **Worked example: Transform the school ER diagram (Class 1:N Student, Student M:N Subject).**
A program applied the rules: **4 tables** – Student(StudentID, Name, ClassID); Subject(SubjectCode, Title); Class(ClassID, ClassName); Student_Subject(StudentID, SubjectCode). Student gets the foreign key ClassID; the M:N becomes Student_Subject with a composite key.

Resulting logical schema

```
Student(StudentID, Name, ClassID)
Subject(SubjectCode, Title)
Class(ClassID, ClassName)
Student_Subject(StudentID, SubjectCode)
```

Attributes of an M:N relationship (e.g. DateBorrowed in the library) go into the linking table: Borrow(MemberNo, ISBN, DateBorrowed).

💡 Count tables: one per entity + one per M:N relationship + one per multi-valued attribute.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* ORM tools in 2026 (used with web frameworks) generate these tables automatically from class diagrams, using the same rules.

Key Words

Entity transformation – Turning each entity into a table.

Attribute transformation – Turning attributes into columns of a table.

Relationship transformation – Turning relationships into foreign keys or linking tables.

Linking table – Table created for an M:N relationship holding both keys.

One-to-many rule – The key of the one side goes into the many side.

Many-to-many rule – A new table with both primary keys is created.

One-to-one rule – The key of one side is placed as a unique foreign key in the other.

Composite primary key – Primary key made from two or more columns.

Strong entity – Entity with its own identifier.

Weak entity – Entity that depends on another for its identity.

Multi-valued table – Separate table that stores each value of a multi-valued attribute.

Mapping – The process of converting a conceptual model into a logical model.

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Sample Q&A

1. How is an entity transformed?

> **Answer:** Into a table; its identifier becomes the primary key.

2. How is a 1:N relationship transformed?

> **Answer:** The PK of the one side is added as FK to the many side.

3. How is an M:N relationship transformed?

> **Answer:** A linking table with both PKs as a composite key.

4. How many tables for the school ER?

> **Answer:** 4.

5. Where does DateBorrowed go?

> **Answer:** Into the linking table Borrow.

6. How is a multi-valued attribute stored?

> **Answer:** In a separate table with the owner key.

MCQ

1. Each entity in an ER diagram becomes a

A. column
B. table
C. index
D. view
E. foreign key only

2. An entity identifier becomes the

A. foreign key
B. check rule
C. domain
D. index only
E. primary key

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3. For Class 1:N Student, the foreign key goes in

A. neither table
B. both tables
C. Class
D. Student
E. a new table

4. An M:N relationship becomes

A. one extra column
B. nothing
C. a new linking table
D. a derived attribute
E. a CHECK rule

5. The school ER (3 entities, one 1:N, one M:N) gives

A. 4 tables
B. 3 tables
C. 6 tables
D. 2 tables
E. 5 tables

6. The key of Student_Subject is

A. StudentID only
B. SubjectCode only
C. (StudentID, SubjectCode)
D. ClassID
E. Title

7. A multi-valued attribute such as Phone becomes

A. a separate table
B. a diamond
C. a derived column
D. a primary key
E. a CHECK

8. A composite attribute Address becomes

A. a new entity always
B. one diamond
C. a foreign key
D. a linking table
E. separate columns for each part

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9. Which term means: “Turning each entity into a table”?

A. Many-to-many rule
B. Composite primary key
C. Relationship transformation
D. Entity transformation
E. Multi-valued table

10. Which term means: “Turning attributes into columns of a table”?

A. Linking table
B. Mapping
C. One-to-one rule
D. Strong entity
E. Attribute transformation

11. Which term means: “Turning relationships into foreign keys or linking tables”?

A. Weak entity
B. Relationship transformation
C. One-to-many rule
D. Composite primary key
E. Entity transformation

12. Which term means: “Table created for an M:N relationship holding both keys”?

A. Linking table
B. Attribute transformation
C. Many-to-many rule
D. Strong entity
E. Multi-valued table

13. Which term means: “The key of the one side goes into the many side”?

A. Mapping
B. One-to-many rule
C. Weak entity
D. Relationship transformation
E. One-to-one rule

14. Which term means: “A new table with both primary keys is created”?

A. Multi-valued table
B. Entity transformation
C. Many-to-many rule
D. Composite primary key
E. Linking table

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15. Which term means: “The key of one side is placed as a unique foreign key in the other”?

A. Strong entity
B. One-to-many rule
C. Mapping
D. One-to-one rule
E. Attribute transformation

16. Which term means: “Primary key made from two or more columns”?

A. Composite primary key
B. Relationship transformation
C. Weak entity
D. Entity transformation
E. Many-to-many rule

17. Which term means: “Entity with its own identifier”?

A. Attribute transformation
B. Multi-valued table
C. Strong entity
D. One-to-one rule
E. Linking table

18. Which term means: “Entity that depends on another for its identity”?

A. Mapping
B. Weak entity
C. One-to-many rule
D. Relationship transformation
E. Composite primary key

19. Which term means: “Separate table that stores each value of a multi-valued attribute”?

A. Strong entity
B. Many-to-many rule
C. Entity transformation
D. Multi-valued table
E. Linking table

20. Which term means: “The process of converting a conceptual model into a logical model”?

A. One-to-many rule
B. Weak entity
C. One-to-one rule
D. Attribute transformation
E. Mapping

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Structured Questions

1. State the rules to transform entities and attributes. *(5 marks)*

> Entity table; identifier PK; simple column; composite parts; multi-valued table.

2. Explain the transformation of 1:1, 1:N and M:N relationships. *(3 marks)*

> 1:1 unique FK; 1:N FK in many side; M:N linking table.

3. Transform the school ER diagram into a logical schema. *(4 marks)*

> Class; Student with ClassID FK; Subject; Student_Subject composite key.

4. Transform the library ER (Member M:N Book, Publisher 1:N Book). *(4 marks)*

> Member; Publisher; Book with PublisherID FK; Borrow(MemberNo, ISBN, DateBorrowed).

5. Why is a derived attribute normally not stored? *(3 marks)*

> Can be calculated; avoids redundancy; avoids out-of-date values.

Summary

- Entity → table; identifier → primary key.
- Attribute → column; composite → parts.
- 1:N → foreign key in the many side.
- M:N → linking table with a composite key.
- Multi-valued → separate table.

MCQ answer key – 8.6

1. **B** – Table.
2. **E** – PK.
3. **D** – Many side.
4. **C** – Linking table.
5. **A** – 3 + 1.
6. **C** – Composite.
7. **A** – Separate table.
8. **E** – Parts.
9. **D** – Entity transformation – Turning each entity into a table.
10. **E** – Attribute transformation – Turning attributes into columns of a table.
11. **B** – Relationship transformation – Turning relationships into foreign keys or linking tables.
12. **A** – Linking table – Table created for an M:N relationship holding both keys.
13. **B** – One-to-many rule – The key of the one side goes into the many side.
14. **C** – Many-to-many rule – A new table with both primary keys is created.
15. **D** – One-to-one rule – The key of one side is placed as a unique foreign key in the other.

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16. **A** – Composite primary key – Primary key made from two or more columns.
17. **C** – Strong entity – Entity with its own identifier.
18. **B** – Weak entity – Entity that depends on another for its identity.
19. **D** – Multi-valued table – Separate table that stores each value of a multi-valued attribute.
20. **E** – Mapping – The process of converting a conceptual model into a logical model.

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