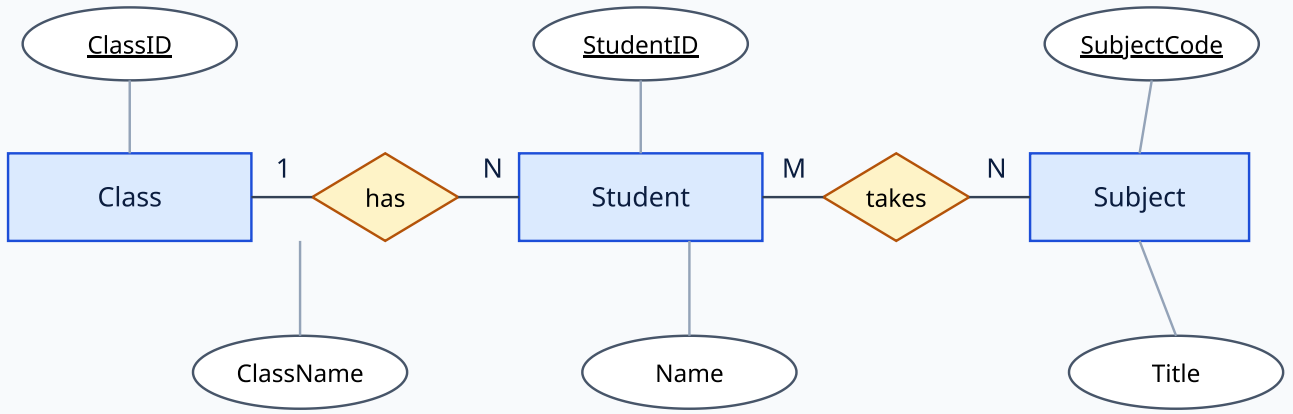
Grade 13 A/L ICT · Lesson 8

8.4 ER Diagrams: Conceptual Database Design

Syllabus 8.4. The **conceptual schema** shows what data an organisation needs, without tables or code. We draw it as an **Entity Relationship (ER) diagram** with **entities**, **attributes**, **entity identifiers**, **relationships** and **cardinality**, and meet **Extended ER (EER)** ideas such as subtypes.

1. Building blocks

ER diagram (Chen notation)



Rectangle = entity · ellipse = attribute (underlined = identifier) · diamond = relationship

ER diagram for a school

Entity (rectangle)
A thing we store data about: Student, Class, Subject.

Attribute (ellipse)
A property of an entity: Name, Title.

Identifier (underlined)
Attribute that is unique for each entity: StudentID.

Relationship (diamond)
An association between entities: has, takes.

2. Attribute types

- **Simple** (Age) vs **composite** (Address = Street + City).
- **Single-valued** vs **multi-valued** (Phone numbers) – double ellipse.
- **Derived** (Age from DateOfBirth) – dashed ellipse.

3. Cardinality

Type	Meaning	School example
1:1	one to one	Principal manages School

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1:N	one to many	Class has Students
M:N	many to many	Students take Subjects

🧱 **Worked example: Library scenario: "A member can borrow many books; a book can be borrowed by many members over time. Each book has one publisher." Find the entities and cardinalities.**
Entities: **Member, Book, Publisher**. Member–Book is **M:N** (borrows, with attribute DateBorrowed). Publisher–Book is **1:N** (publishes). Identifiers: MemberNo, ISBN, PublisherID.

4. Extended ER (EER)

EER adds **specialisation/generalisation**: a supertype Person can have subtypes Student and Teacher that inherit its attributes. Subtypes can be **disjoint** (only one) or **overlapping** (both).

💡 Read a relationship both ways: one Class has many Students; one Student is in one Class → 1:N.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Design tools in 2026 can sketch an ER diagram from a written scenario, but you must still check cardinality and identifiers yourself.

Key Words

Conceptual schema – High-level description of data needs without implementation detail.

ER diagram – Diagram of entities, attributes and relationships.

Entity – A real-world thing about which data is stored.

Attribute – A property that describes an entity.

Entity identifier – Attribute whose value is unique for each entity.

Relationship – An association between two or more entities.

Cardinality – How many instances of one entity relate to another.

Composite attribute – Attribute made of smaller parts such as an address.

Multi-valued attribute – Attribute that can hold several values such as phone numbers.

Derived attribute – Attribute calculated from others such as age.

EER diagram – ER diagram extended with supertypes and subtypes.

Specialisation – Dividing a supertype into more specific subtypes.

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Sample Q&A

1. What does a diamond show in an ER diagram?

> **Answer:** A relationship.

2. How is an identifier shown?

> **Answer:** Underlined attribute name.

3. Cardinality of Students and Subjects?

> **Answer:** M:N – a student takes many subjects and a subject has many students.

4. Give a derived attribute.

> **Answer:** Age, calculated from DateOfBirth.

5. What is a multi-valued attribute?

> **Answer:** An attribute with several values for one entity, e.g. phone numbers (double ellipse).

6. What does EER add?

> **Answer:** Supertypes/subtypes with inheritance (specialisation and generalisation).

MCQ

1. In an ER diagram an entity is drawn as a

A. cylinder
B. arrow
C. rectangle
D. ellipse
E. diamond

2. A relationship is drawn as a

A. diamond
B. double line only
C. ellipse
D. circle with number
E. rectangle

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3. An underlined attribute is the

A. derived attribute
B. relationship name
C. foreign key only
D. multi-valued attribute
E. entity identifier

4. One class has many students is

A. 1:1
B. 1:N
C. N:1:M
D. 0:0
E. M:N

5. Students and subjects have cardinality

A. none
B. 1:N
C. M:N
D. N:1
E. 1:1

6. Age calculated from date of birth is a

A. multi-valued attribute
B. entity
C. composite attribute
D. derived attribute
E. identifier

7. Address made of Street and City is a

A. subtype
B. relationship
C. derived attribute
D. composite attribute
E. identifier

8. Person with subtypes Student and Teacher is shown in an

A. DFD level 1
B. EER diagram
C. context diagram
D. flat file
E. Gantt chart

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9. Which term means: “High-level description of data needs without implementation detail”?

A. Composite attribute
B. EER diagram
C. Entity
D. Relationship
E. Conceptual schema

10. Which term means: “Diagram of entities, attributes and relationships”?

A. ER diagram
B. Cardinality
C. Attribute
D. Specialisation
E. Multi-valued attribute

11. Which term means: “A real-world thing about which data is stored”?

A. Conceptual schema
B. Entity
C. Composite attribute
D. Entity identifier
E. Derived attribute

12. Which term means: “A property that describes an entity”?

A. Relationship
B. Multi-valued attribute
C. Attribute
D. EER diagram
E. ER diagram

13. Which term means: “Attribute whose value is unique for each entity”?

A. Cardinality
B. Specialisation
C. Entity
D. Derived attribute
E. Entity identifier

14. Which term means: “An association between two or more entities”?

A. Relationship
B. Composite attribute
C. EER diagram
D. Conceptual schema
E. Attribute

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15. Which term means: “How many instances of one entity relate to another”?

A. ER diagram
B. Entity identifier
C. Specialisation
D. Cardinality
E. Multi-valued attribute

16. Which term means: “Attribute made of smaller parts such as an address”?

A. Conceptual schema
B. Relationship
C. Derived attribute
D. Composite attribute
E. Entity

17. Which term means: “Attribute that can hold several values such as phone numbers”?

A. ER diagram
B. Attribute
C. Cardinality
D. EER diagram
E. Multi-valued attribute

18. Which term means: “Attribute calculated from others such as age”?

A. Entity
B. Derived attribute
C. Specialisation
D. Entity identifier
E. Composite attribute

19. Which term means: “ER diagram extended with supertypes and subtypes”?

A. Conceptual schema
B. Attribute
C. EER diagram
D. Multi-valued attribute
E. Relationship

20. Which term means: “Dividing a supertype into more specific subtypes”?

A. Specialisation
B. Cardinality
C. Derived attribute
D. ER diagram
E. Entity identifier

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Structured Questions

1. Name and draw the symbols of an ER diagram. *(4 marks)*

> Rectangle entity; ellipse attribute; underline identifier; diamond relationship.

2. Explain 1:1, 1:N and M:N with school examples. *(3 marks)*

> 1:1 principal–school; 1:N class–students; M:N students–subjects.

3. Draw an ER diagram for the library scenario. *(4 marks)*

> Member, Book, Publisher; borrows M:N with DateBorrowed; publishes 1:N; identifiers.

4. Describe composite, multi-valued and derived attributes. *(3 marks)*

> Composite parts; multi-valued many values; derived calculated.

5. Explain specialisation in an EER diagram. *(4 marks)*

> Supertype Person; subtypes Student/Teacher; inherit attributes; disjoint or overlapping.

Summary

- ER diagrams model the conceptual schema.
- Rectangle = entity, ellipse = attribute, diamond = relationship.
- Identifiers are underlined.
- Cardinality is 1:1, 1:N or M:N.
- EER adds supertypes and subtypes.

MCQ answer key – 8.4

1. **C** – Rectangle.
2. **A** – Diamond.
3. **E** – Identifier.
4. **B** – One to many.
5. **C** – Many to many.
6. **D** – Derived.
7. **D** – Composite.
8. **B** – EER.
9. **E** – Conceptual schema – High-level description of data needs without implementation detail.
10. **A** – ER diagram – Diagram of entities, attributes and relationships.
11. **B** – Entity – A real-world thing about which data is stored.
12. **C** – Attribute – A property that describes an entity.
13. **E** – Entity identifier – Attribute whose value is unique for each entity.
14. **A** – Relationship – An association between two or more entities.
15. **D** – Cardinality – How many instances of one entity relate to another.

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16. **D** – Composite attribute – Attribute made of smaller parts such as an address.
17. **E** – Multi-valued attribute – Attribute that can hold several values such as phone numbers.
18. **B** – Derived attribute – Attribute calculated from others such as age.
19. **C** – EER diagram – ER diagram extended with supertypes and subtypes.
20. **A** – Specialisation – Dividing a supertype into more specific subtypes.

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