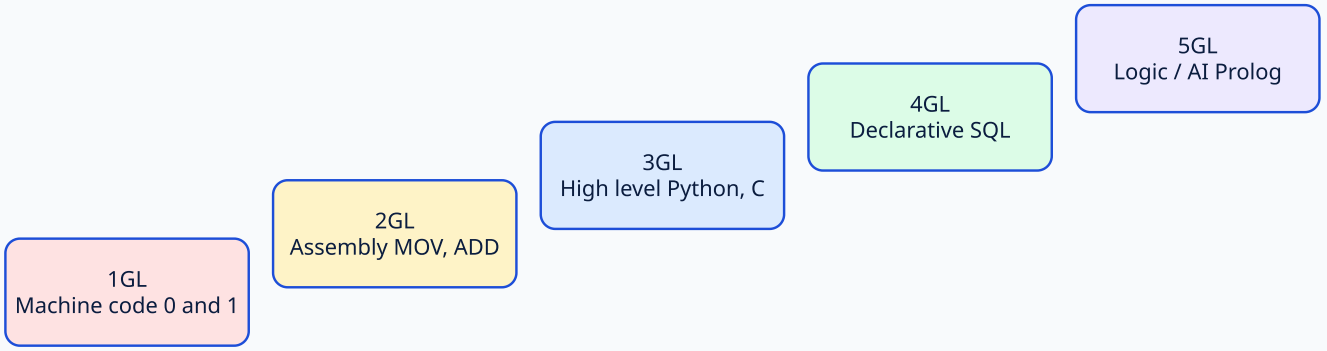
Grade 13 A/L ICT · Lesson 9

9.4 Programming Languages and Paradigms

Syllabus 9.4. Programming languages have evolved through **generations**, from machine code to languages close to human thinking. A **paradigm** is a style of programming: **imperative** (how, step by step), **declarative** (what result is wanted) and **object oriented** (objects that combine data and methods).

1. Generations

Generations of programming languages



Higher generations are closer to human language and further from the hardware.

Language generations 1GL–5GL

Generation	Example	Feature
1GL machine	10110000 01100001	Binary; runs directly; hard to write
2GL assembly	MOV AL, 61h	Mnemonics; needs an assembler
3GL high level	Python, C, Java	English-like; portable; compiled or interpreted
4GL	SQL	Say what you want; fewer lines
5GL	Prolog	Rules and logic for AI

2. Paradigms

Imperative
Commands change the program state step by step (C, Pascal, Python loops).

Declarative
Describe the result; the system decides how (SQL, Prolog, HTML).

Object oriented
Classes and objects with encapsulation, inheritance and polymorphism (Java, Python, C++).

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🐍 One task in three styles

```
prices = [120, 80, 200]

# imperative: say HOW, step by step
total = 0
for p in prices:
    total = total + p
print("Imperative:", total)

# declarative style: say WHAT you want
print("Declarative:", sum(prices))

# object oriented: data + methods in a class
class Cart:
    def __init__(self, items):
        self.items = items
    def total(self):
        return sum(self.items)

print("OOP:", Cart(prices).total())
```

▶ Output

```
Imperative: 400
Declarative: 400
OOP: 400
```

🧱 **Worked example: The cart prices are 120, 80 and 200. Do the three styles agree?**
Hand total = 120 + 80 + 200 = **400**. The imperative loop, the declarative sum() and the Cart object all printed **400**.

💡 Python is multi-paradigm: it supports imperative, object oriented and some declarative styles.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* In 2026 many developers describe what they want in plain language to an AI – an even more declarative style – but they still read and test the code.

Key Words

Machine language – First generation binary code run directly by the CPU.

Assembly language – Second generation language using mnemonics.

High-level language – Third generation English-like portable language.

Fourth generation language – Language where you state the result, such as SQL.

Fifth generation language – Logic and rule based language for AI such as Prolog.

Programming paradigm – A style or approach to writing programs.

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Imperative paradigm – Style where statements change state step by step.	**Declarative paradigm** – Style that states what result is needed, not how.
Object oriented paradigm – Style built on objects combining data and methods.	**Class** – Template that defines attributes and methods of objects.
Object – Instance of a class holding its own data.	**Encapsulation** – Keeping data and methods together and hiding details.

Sample Q&A

1. List the five generations.

> **Answer:** Machine, assembly, high level, 4GL, 5GL.

2. Give a 4GL example.

> **Answer:** SQL.

3. Imperative vs declarative?

> **Answer:** Imperative says how; declarative says what.

4. Three OOP features?

> **Answer:** Encapsulation, inheritance, polymorphism.

5. What do all three styles print for the cart?

> **Answer:** 400.

6. Why is Python multi-paradigm?

> **Answer:** It supports imperative, OOP and declarative features.

MCQ

1. Binary code run directly by the CPU is

A. SQL
B. Prolog
C. machine language
D. assembly language
E. Python

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2. A language using mnemonics such as MOV is

A. assembly language
B. Prolog
C. SQL
D. machine language
E. HTML

3. SQL belongs to the

A. fifth generation
B. first generation
C. second generation
D. third generation
E. fourth generation

4. Prolog is mainly

A. a 3GL
B. a logic / 5GL language
C. assembly
D. a markup language
E. machine code

5. Stating WHAT result is wanted rather than HOW is

A. assembly
B. machine level
C. declarative
D. imperative
E. procedural

6. A template that defines objects is a

A. compiler
B. loop
C. constant
D. class
E. tuple

7. In the paradigms program every style prints

A. 480
B. 120
C. 200
D. 400
E. 380

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8. Hiding data inside an object with its methods is

A. normalisation
B. encapsulation
C. compilation
D. iteration
E. recursion

9. Which term means: “First generation binary code run directly by the CPU”?

A. High-level language
B. Declarative paradigm
C. Object
D. Programming paradigm
E. Machine language

10. Which term means: “Second generation language using mnemonics”?

A. Assembly language
B. Imperative paradigm
C. Encapsulation
D. Object oriented paradigm
E. Fourth generation language

11. Which term means: “Third generation English-like portable language”?

A. Declarative paradigm
B. High-level language
C. Fifth generation language
D. Machine language
E. Class

12. Which term means: “Language where you state the result, such as SQL”?

A. Object oriented paradigm
B. Assembly language
C. Fourth generation language
D. Object
E. Programming paradigm

13. Which term means: “Logic and rule based language for AI such as Prolog”?

A. Class
B. Imperative paradigm
C. Encapsulation
D. High-level language
E. Fifth generation language

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14. Which term means: “A style or approach to writing programs”?

A. Programming paradigm
B. Machine language
C. Object
D. Fourth generation language
E. Declarative paradigm

15. Which term means: “Style where statements change state step by step”?

A. Assembly language
B. Encapsulation
C. Fifth generation language
D. Imperative paradigm
E. Object oriented paradigm

16. Which term means: “Style that states what result is needed, not how”?

A. Programming paradigm
B. High-level language
C. Machine language
D. Declarative paradigm
E. Class

17. Which term means: “Style built on objects combining data and methods”?

A. Fourth generation language
B. Object
C. Imperative paradigm
D. Assembly language
E. Object oriented paradigm

18. Which term means: “Template that defines attributes and methods of objects”?

A. High-level language
B. Class
C. Fifth generation language
D. Encapsulation
E. Declarative paradigm

19. Which term means: “Instance of a class holding its own data”?

A. Programming paradigm
B. Fourth generation language
C. Object
D. Object oriented paradigm
E. Machine language

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20. Which term means: “Keeping data and methods together and hiding details”?

A. Encapsulation
B. Assembly language
C. Class
D. Fifth generation language
E. Imperative paradigm

Structured Questions

1. Describe the five generations of programming languages. *(5 marks)*

> 1GL binary; 2GL assembly; 3GL high level; 4GL SQL; 5GL logic AI.

2. Compare imperative and declarative paradigms with examples. *(2 marks)*

> Imperative how, C/Python loop; declarative what, SQL/Prolog.

3. Explain class, object and encapsulation. *(3 marks)*

> Class template; object instance; encapsulation data + methods together.

4. Give two advantages of high-level languages over assembly. *(2 marks)*

> Easier to read/write; portable across machines.

5. Write Python to total a list in imperative and declarative style. *(2 marks)*

> for loop adding to total; sum(prices).

Summary

- Languages evolved from 1GL to 5GL.
- Higher generations are closer to people.
- Imperative says how.
- Declarative says what.
- OOP uses classes and objects.

MCQ answer key – 9.4

1. **C** – 1GL.
2. **A** – 2GL.
3. **E** – 4GL.
4. **B** – 5GL.
5. **C** – Declarative.
6. **D** – Class.
7. **D** – 120 + 80 + 200.

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8. **B** – Encapsulation.
9. **E** – Machine language – First generation binary code run directly by the CPU.
10. **A** – Assembly language – Second generation language using mnemonics.
11. **B** – High-level language – Third generation English-like portable language.
12. **C** – Fourth generation language – Language where you state the result, such as SQL.
13. **E** – Fifth generation language – Logic and rule based language for AI such as Prolog.
14. **A** – Programming paradigm – A style or approach to writing programs.
15. **D** – Imperative paradigm – Style where statements change state step by step.
16. **D** – Declarative paradigm – Style that states what result is needed, not how.
17. **E** – Object oriented paradigm – Style built on objects combining data and methods.
18. **B** – Class – Template that defines attributes and methods of objects.
19. **C** – Object – Instance of a class holding its own data.
20. **A** – Encapsulation – Keeping data and methods together and hiding details.

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