G.C.E. O/L Grade 11 ICT · Lesson 1

1.11 Programming Languages, Translators and Debugging

Syllabus 10.11. A computer only understands **0s and 1s**. People prefer words like print and if. In this part we see the different **kinds of programming languages**, how a **translator** (interpreter or compiler) changes our code into machine code, and how to **test and debug** a program.

1. Low-level and high-level languages

Type	What it looks like	Notes
Machine language	10110000 01100001	Only 0s and 1s. The CPU runs it directly. Very hard for people.
Assembly language	MOV AL, 61h	Short words (mnemonics). Needs an **assembler**. Depends on the CPU.
High-level language	print("Hello")	English-like, easy to learn, runs on many computers. Needs a compiler or interpreter. E.g. Python, Pascal, Java, C.

Machine and assembly languages are called **low-level** languages because they are close to the hardware.

2. Kinds of high-level languages

Procedural
Tell the computer **how** to do it, step by step. E.g. Pascal, C.

Declarative
Tell the computer **what** you want; it finds how. E.g. SQL, Prolog.

Structured
Built only from sequence, selection, iteration and sub-programs (no messy jumps). E.g. Pascal.

Object-oriented
Built from **objects** that hold data and actions together (e.g. a Student object). E.g. Java, C++, Python.

3. Programming and scripting languages

Scripting languages are usually interpreted and used to control other software or add actions to web pages – e.g. **JavaScript** (web pages), **PHP** (web servers), Python scripts. **Programming languages** such as C or Pascal are usually compiled into stand-alone programs.

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> NEW 2026 2026 – **Python** is now one of the most popular programming languages in the world. It is used for AI, data science, websites and school teaching, because its code is short and easy to read.

4. Translators: compiler and interpreter

	Compiler	Interpreter
How it translates	the whole program at once	one line at a time, then runs it
Output	an executable file (e.g. .exe)	no separate file
Errors	listed after compiling the whole program	stops at the first line with an error
Speed when running	faster	slower
Example	Free Pascal (FPC), C	Python

The code we write is the **source code**. The translated result is **machine code** (object code). An **assembler** translates assembly language.

5. Program errors

Error	Meaning	Example
Syntax error	Breaking the grammar rules of the language. The translator finds it.	prnt("Hi") / missing ;
Runtime error	The program stops while running.	dividing by zero
Logic error	The program runs but gives a **wrong answer**.	total / 2 instead of total / 3

6. Testing and debugging

Testing means running the program with chosen data and checking the output against the expected answer. **Debugging** means finding and fixing the errors (bugs). The program below should find the average of three marks, but it has a **logic error**.

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Logic error: dividing by the wrong number

Pascal

```
program AverageBug;
var
  m1, m2, m3, total: integer;
  avg: real;
begin
  write('Enter mark 1: ');
  readln(m1);
  write('Enter mark 2: ');
  readln(m2);
  write('Enter mark 3: ');
  readln(m3);
  total := m1 + m2 + m3;
  avg := total / 2;            { BUG: should be / 3 }
  writeln('Average = ', avg:0:2);
end.
```

Python

```
m1 = int(input("Enter mark 1: "))
m2 = int(input("Enter mark 2: "))
m3 = int(input("Enter mark 3: "))
total = m1 + m2 + m3
avg = total / 2               # BUG: should be / 3
print(f"Average = {avg:.2f}")
```

Sample run

```
Enter mark 1: 75
Enter mark 2: 68
Enter mark 3: 72
Average = 107.50
```

💡 Expected average of 75, 68 and 72 = 215 ÷ 3 = 71.67, but the program shows 107.50. Fix: divide by 3. Test with **normal** data (60), **boundary** data (0, 100, 35) and **invalid** data (−5, 150).

Ways to debug: read the error message, use a **trace table** (dry run), print variable values, and use the debugger in an IDE to run **step by step**.

7. IDEs and tools in 2026

An **IDE** (Integrated Development Environment) gives an editor, translator and debugger in one program.

- **IDLE** – comes free with Python; simple for beginners.
- **Thonny** – a beginner Python IDE that shows variables step by step.
- **VS Code** – a popular free editor for Python, Pascal and many languages.
- **Free Pascal / Lazarus** – for Pascal; **online compilers** run code in a web browser.
- **Scratch** – block coding: drag blocks instead of typing; a fun first step before Python.

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NEW 2026 2026 – **AI assistants** (such as chatbots inside VS Code) can explain errors and suggest code. Use them **responsibly**: try the problem yourself first, understand every line before using it, test the code, never submit AI work as your own in exams or assignments, and do not paste personal data into them.

Key Words

Machine language – Instructions in 0s and 1s that the CPU runs directly.

Assembly language – A low-level language using short mnemonics like MOV.

High-level language – An English-like language such as Python or Pascal.

Compiler – Translates the whole program at once into machine code.

Interpreter – Translates and runs one line at a time.

Assembler – Translates assembly language into machine code.

Source code – The program as written by the programmer.

Syntax error – A mistake in the grammar rules of the language.

Logic error – The program runs but gives a wrong result.

Runtime error – An error that stops the program while running.

Debugging – Finding and correcting errors in a program.

IDE – A program with an editor, translator and debugger together.

Sample Q&A

1. Why do high-level programs need a translator?

> **Answer:** The CPU understands only machine code (0s and 1s).

2. Give one difference between a compiler and an interpreter.

> **Answer:** A compiler translates the whole program at once; an interpreter translates one line at a time.

3. Procedural vs declarative?

> **Answer:** Procedural says how (steps); declarative says what is wanted.

4. What kind of error is total / 2 instead of total / 3?

> **Answer:** A logic error.

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5. Name two IDEs for Python.

> **Answer:** IDLE and Thonny (or VS Code).

6. Give one rule for using AI assistants responsibly.

> **Answer:** Understand and test the code; do not submit it as your own work.

MCQ

1. The language the CPU runs directly is…

A. Python
B. SQL
C. machine language
D. Pascal

2. MOV AL, 61h is written in…

A. assembly language
B. SQL
C. Python
D. HTML

3. Assembly language is translated by an…

A. editor
B. interpreter only
C. assembler
D. browser

4. Which is a high-level language?

A. Python
B. machine code
C. binary
D. assembly

5. A compiler translates…

A. only data
B. the whole program at once
C. one line at a time
D. only comments

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6. Python is usually run by an…

A. interpreter
B. scanner
C. printer
D. assembler

7. SQL, which says what data is wanted, is…

A. machine code
B. declarative
C. assembly
D. procedural

8. A language built around objects that hold data and actions is…

A. machine
B. object-oriented
C. assembly
D. declarative

9. JavaScript, used to add actions to web pages, is a…

A. assembler
B. machine language
C. data type
D. scripting language

10. Writing prnt("Hi") in Python causes a…

A. hardware error
B. syntax error
C. logic error
D. no error

11. A program that runs but gives a wrong answer has a…

A. virus
B. syntax error
C. compiler
D. logic error

12. Dividing by zero while running causes a…

A. runtime error
B. syntax error
C. comment
D. logic error only

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13. Marks 75, 68, 72 with total / 2 give Average = ...

A. 71.67
B. 72.50
C. 107.50
D. 215.00

14. Finding and fixing errors in a program is...

A. declaring
B. compiling
C. nesting
D. debugging

15. A responsible way to use an AI coding assistant is to...

A. submit its answers as your own work
B. paste your passwords into it
C. understand and test its code before using it
D. never test the code

Structured Questions

1. (i) Name two low-level languages. (1 mark)
(ii) Give two advantages of high-level languages. (2 marks) *(3 marks)*

> (i) Machine language, assembly language. (ii) English-like / easy to learn; runs on different computers; fewer errors (any two).

2. Compare a compiler and an interpreter under three headings. (3 marks) *(3 marks)*

> Translation: whole program vs line by line; output: executable file vs none; errors: listed together vs stops at the first; speed: faster vs slower (any three).

3. State the difference between (a) procedural and declarative languages (b) structured and object-oriented programming. (4 marks) *(4 marks)*

> (a) Procedural gives step-by-step how (Pascal); declarative states what is wanted (SQL) (2). (b) Structured uses sequence, selection, iteration and sub-programs; OOP builds programs from objects holding data and actions (2).

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4. A program to find the average of three marks displays 107.50 for 75, 68, 72.
(i) What type of error is this? (1 mark)
(ii) What is the correct answer and how do you fix it? (2 marks)
(iii) Give two other types of error with an example. (2 marks) *(5 marks)*

(i) Logic error. (ii) 71.67; divide the total by 3. (iii) Syntax error – prnt("Hi"); runtime error – dividing by zero.

Logic error: dividing by the wrong number

Pascal

```
program AverageBug;
var
  m1, m2, m3, total: integer;
  avg: real;
begin
  write('Enter mark 1: ');
  readln(m1);
  write('Enter mark 2: ');
  readln(m2);
  write('Enter mark 3: ');
  readln(m3);
  total := m1 + m2 + m3;
  avg := total / 2;            { BUG: should be / 3 }
  writeln('Average = ', avg:0:2);
end.
```

Python

```
m1 = int(input("Enter mark 1: "))
m2 = int(input("Enter mark 2: "))
m3 = int(input("Enter mark 3: "))
total = m1 + m2 + m3
avg = total / 2               # BUG: should be / 3
print(f"Average = {avg:.2f}")
```

Sample run

```
Enter mark 1: 75
Enter mark 2: 68
Enter mark 3: 72
Average = 107.50
```

5. What is an IDE? Name two IDEs used for Python and state two rules for using AI assistants responsibly. (4 marks) *(4 marks)*

Editor, translator and debugger in one program (1); IDLE, Thonny or VS Code (1); try yourself first / understand and test the code / do not submit as your own / no personal data (2).

Summary

- Low-level: machine (0/1) and assembly.

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- High-level: English-like – Python, Pascal.
- Procedural = how; declarative = what.
- Structured vs object-oriented.
- Compiler: whole program; interpreter: line by line.
- Errors: syntax, runtime, logic.
- Test with normal, boundary, invalid data.
- IDEs: IDLE, Thonny, VS Code; use AI responsibly.

MCQ answer key – 1.11

1. **C** – 0s and 1s.
2. **A** – Mnemonics.
3. **C** – Assembler.
4. **A** – English-like.
5. **B** – Compiler.
6. **A** – Interpreter.
7. **B** – What, not how.
8. **B** – OOP.
9. **D** – Scripting.
10. **B** – Misspelt word.
11. **D** – Logic.
12. **A** – Runtime.
13. **C** – 215 ÷ 2.
14. **D** – Debugging.
15. **C** – Responsible use.

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