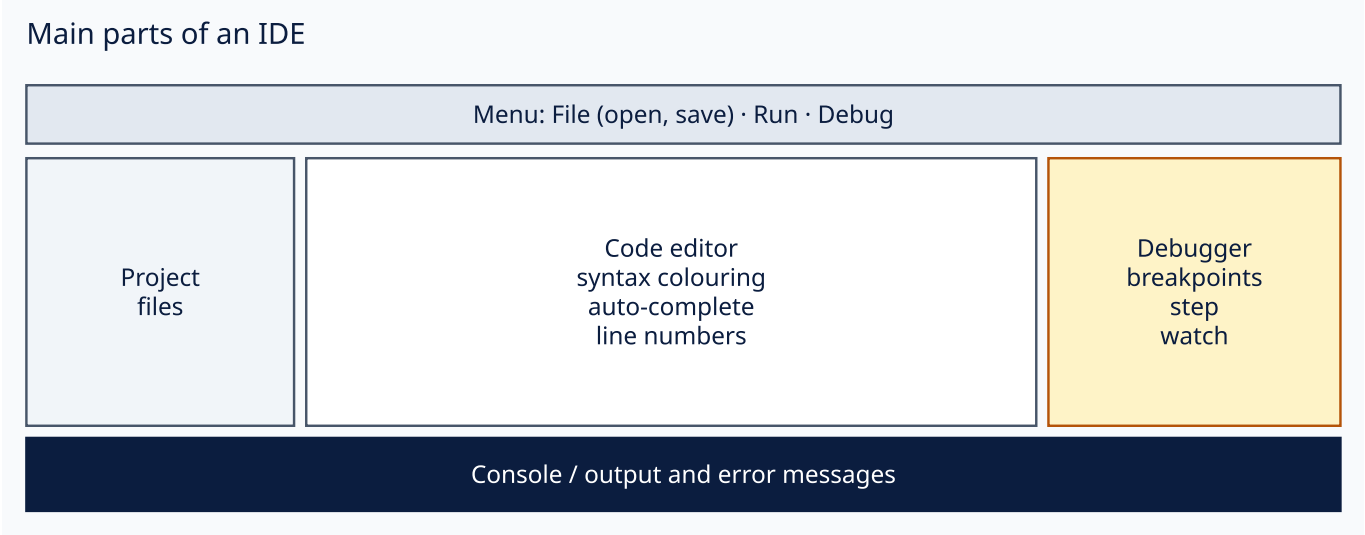
Grade 13 A/L ICT · Lesson 9

9.6 Integrated Development Environments and Debugging

Syllabus 9.6. An **IDE** brings together an editor, translator, runner and **debugger** in one program (for example IDLE, Thonny or VS Code). You learn to **open and save files**, **run** programs and use **debugging facilities** such as breakpoints, stepping and watching variables.

1. Basic features of an IDE



Parts of an IDE

- **Editor** with syntax colouring, auto-indent, auto-complete and line numbers.
- **File menu**: New, Open, Save, Save As (Python files end in .py).
- **Run**: translate and execute (F5 in IDLE); output and errors appear in the **console**.
- **Debugger**: breakpoints, step into/over, watch variables and the call stack.

2. Debugging an off-by-one error

🐍 Debugging an off-by-one error

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```
marks = [60, 70, 80]

def average_bug(m):
    total = 0
    for i in range(len(m) - 1):   # bug: skips the last item
        total += m[i]
    return total / len(m)

def average_fixed(m):
    total = 0
    for i in range(len(m)):
        total += m[i]
    return total / len(m)

print("Buggy:", average_bug(marks))
print("Fixed:", average_fixed(marks))
```

▶ Output

```
Buggy: 43.333333333333336
Fixed: 70.0
```

🧱 **Worked example: The buggy average of 60, 70, 80 is wrong. How does a debugger find the cause?**
Set a breakpoint inside the loop and watch i and total. i takes only 0 and 1, so total reaches 130 and 130 ÷ 3 = **43.33**. The range should be range(len(m)); then total = 210 and the average is **70.0**.

Error type	Found by	Example
Syntax	Translator, before running	missing colon after if
Runtime	Program crash while running	division by zero
Logic	Wrong output; use the debugger	range(len(m) - 1)

💡 Logic errors give no error message – only testing with expected results reveals them.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* In 2026 IDEs include AI assistants that explain errors and suggest fixes; always test the suggestion before accepting it.

Key Words

IDE – Software combining editor, translator, runner and debugger.

Code editor – Part of an IDE where source code is typed.

Syntax highlighting – Colouring keywords and strings to aid reading.

Auto-complete – Suggesting names while typing.

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Console – Window showing program output and errors.

Debugger – Tool for running a program step by step to find errors.

Breakpoint – Marked line where execution pauses.

Step into – Run the next line, entering any function called.

Watch – Showing the current value of chosen variables.

Logic error – Mistake that gives wrong results without crashing.

Off-by-one error – Loop that runs one time too many or too few.

Call stack – List of functions currently being executed.

Sample Q&A

1. Name four IDE features.

> **Answer:** Editor, file open/save, run, debugger.

2. What is a breakpoint?

> **Answer:** A line where execution pauses so you can inspect variables.

3. Buggy and fixed averages?

> **Answer:** 43.33 and 70.0.

4. What caused the bug?

> **Answer:** range(len(m) - 1) skipped the last item.

5. Which errors give no message?

> **Answer:** Logic errors.

6. How do you save a Python file?

> **Answer:** File → Save / Save As with a .py name.

MCQ

1. The IDE part that pauses at a marked line is a

A. linker
B. breakpoint
C. console
D. comment
E. compiler

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2. Showing a variable value during debugging is

A. compile all
B. comment out
C. save as
D. link
E. watch

3. The buggy program prints average

A. 80.00
B. 60.00
C. 70.00
D. 43.33
E. 65.00

4. The fixed program prints average

A. 65.0
B. 210.0
C. 70.0
D. 80.0
E. 43.3

5. range(len(m) - 1) instead of range(len(m)) is an

A. off-by-one logic error
B. linker error
C. syntax error
D. runtime crash
E. hardware error

6. Output and error messages appear in the

A. structure chart
B. breakpoint
C. console
D. file menu
E. linker

7. A missing colon after if is found

A. before the program runs (syntax error)
B. only after output
C. by the printer
D. by the linker
E. never

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8. Python source files are saved with the extension

A. .exe
B. .docx
C. .obj
D. .txt only
E. .py

9. Which term means: “Software combining editor, translator, runner and debugger”?

A. Off-by-one error
B. Step into
C. Debugger
D. IDE
E. Syntax highlighting

10. Which term means: “Part of an IDE where source code is typed”?

A. Auto-complete
B. Breakpoint
C. Watch
D. Call stack
E. Code editor

11. Which term means: “Colouring keywords and strings to aid reading”?

A. Step into
B. Syntax highlighting
C. IDE
D. Logic error
E. Console

12. Which term means: “Suggesting names while typing”?

A. Auto-complete
B. Debugger
C. Code editor
D. Watch
E. Off-by-one error

13. Which term means: “Window showing program output and errors”?

A. Logic error
B. Console
C. Syntax highlighting
D. Breakpoint
E. Call stack

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14. Which term means: “Tool for running a program step by step to find errors”?

A. IDE
B. Off-by-one error
C. Debugger
D. Auto-complete
E. Step into

15. Which term means: “Marked line where execution pauses”?

A. Call stack
B. Console
C. Watch
D. Breakpoint
E. Code editor

16. Which term means: “Run the next line, entering any function called”?

A. Step into
B. Debugger
C. Syntax highlighting
D. IDE
E. Logic error

17. Which term means: “Showing the current value of chosen variables”?

A. Off-by-one error
B. Auto-complete
C. Watch
D. Code editor
E. Breakpoint

18. Which term means: “Mistake that gives wrong results without crashing”?

A. Step into
B. Logic error
C. Call stack
D. Syntax highlighting
E. Console

19. Which term means: “Loop that runs one time too many or too few”?

A. Debugger
B. Auto-complete
C. Watch
D. Off-by-one error
E. IDE

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20. Which term means: “List of functions currently being executed”?

A. Console
B. Logic error
C. Code editor
D. Breakpoint
E. Call stack

Structured Questions

1. Describe four basic features of an IDE. *(4 marks)*

> Editor; file management; run/console; debugger.

2. List the steps to open, edit, save and run a Python file in an IDE. *(5 marks)*

> File Open; edit; File Save as .py; Run (F5); read console.

3. Explain breakpoint, step and watch. *(3 marks)*

> Pause at line; run one line; show variable values.

4. Find and fix the bug in average_bug(). *(3 marks)*

> range(len(m) - 1) skips last; use range(len(m)); 70.0.

5. Distinguish syntax, runtime and logic errors. *(3 marks)*

> Syntax grammar; runtime crash; logic wrong output.

Summary

- An IDE combines editor, runner and debugger.
- Save Python files as .py.
- Breakpoints pause execution.
- Step and watch reveal logic errors.
- Logic errors need testing to be found.

MCQ answer key – 9.6

1. **B** – Breakpoint.
2. **E** – Watch.
3. **D** – 130 ÷ 3.
4. **C** – 210 ÷ 3.
5. **A** – Logic.
6. **C** – Console.
7. **A** – Syntax.

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8. **E** – .py.
9. **D** – IDE – Software combining editor, translator, runner and debugger.
10. **E** – Code editor – Part of an IDE where source code is typed.
11. **B** – Syntax highlighting – Colouring keywords and strings to aid reading.
12. **A** – Auto-complete – Suggesting names while typing.
13. **B** – Console – Window showing program output and errors.
14. **C** – Debugger – Tool for running a program step by step to find errors.
15. **D** – Breakpoint – Marked line where execution pauses.
16. **A** – Step into – Run the next line, entering any function called.
17. **C** – Watch – Showing the current value of chosen variables.
18. **B** – Logic error – Mistake that gives wrong results without crashing.
19. **D** – Off-by-one error – Loop that runs one time too many or too few.
20. **E** – Call stack – List of functions currently being executed.

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