

5.2.1 Partial compilation (Java) and the IDE

Name: _____ Class: _____ Date: _____

Total: 42 marks

KEY WORDS bytecode 字节码 • virtual machine 虚拟机

• integrated development environment 集成开发环境 • breakpoints 断点 • single stepping 单步执行

Objective

Learn to answer exam questions on a program that is **partially compiled and partially interpreted**, such as Java, and on the features of an **Integrated Development Environment** 集成开发环境 (IDE). Sheet 5.2 covered compilers and interpreters; this is the last sheet of topic 5.

You must be able to:

- explain how Java compiles to **bytecode** 字节码 that a **virtual machine** 虚拟机 runs, and why
- describe the IDE features the syllabus names, in its four groups: coding, initial error detection, presentation and debugging
- identify the group a feature belongs to, and describe how it helps the programmer
- describe how the debugging features are used to find an error

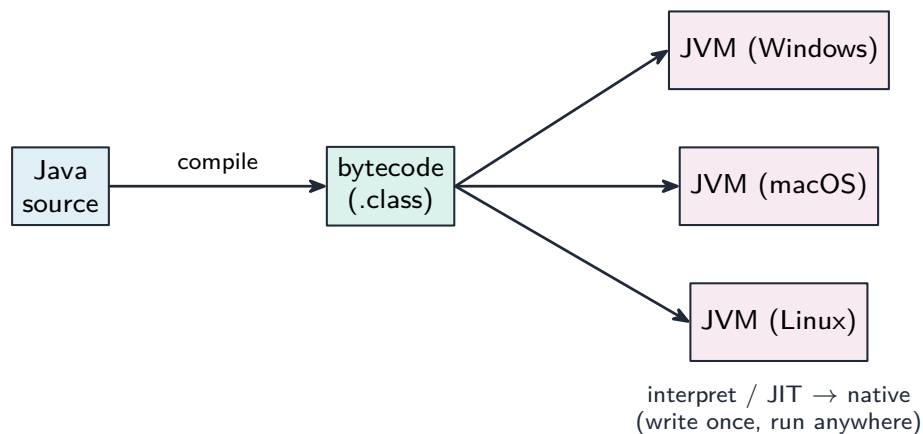
1 Worked examples

Study these first. Each one shows a **method** that a question later on this sheet needs.

■ Partially compiled, partially interpreted

Java is the syllabus's example. The program is translated in **two stages**:

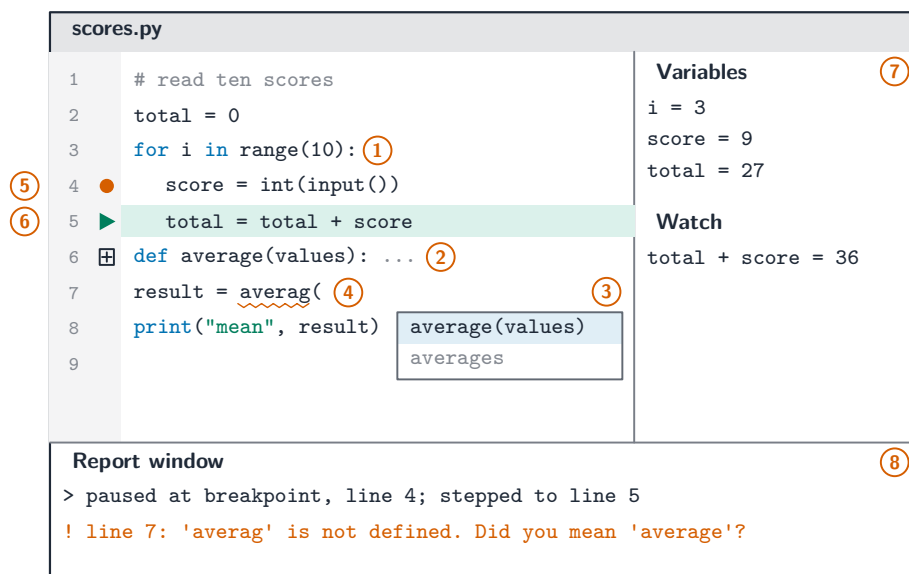
1. A **compiler** translates the source code once into **bytecode**, an intermediate form that is not the machine code of any real processor.
2. The bytecode is run by a **virtual machine** (the JVM), which **interprets** it into the machine code of the computer it is running on.



Why both? A compiler alone produces machine code for **one** processor and operating system; an interpreter alone is slow. Compiling to bytecode does the heavy translation once and reports the syntax errors early, and the **same** bytecode file then runs on any computer that has a JVM: “write once, run anywhere”. The price is speed, which a **just-in-time** 即时编译 compiler in the JVM recovers by compiling frequently run bytecode into native code while the program runs.

■ The IDE

An IDE is **one application** that brings together the tools for writing, translating, running and debugging a program, so the programmer never leaves it. The syllabus sorts its features into **four groups**.

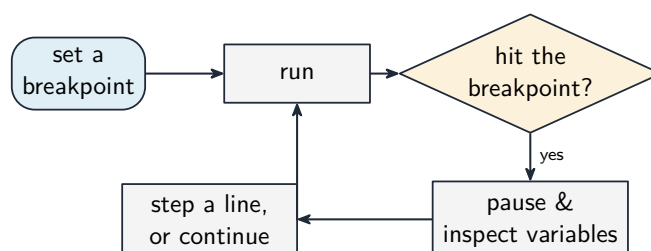


- | | |
|---|---|
| ① prettyprint: coloured keywords/strings/comments | ⑤ breakpoint: the program pauses here |
| ② expand / collapse a code block | ⑥ single stepping: run one line at a time |
| ③ context-sensitive prompt | ⑦ variables and expressions, watched while paused |
| ④ dynamic syntax check, flagged as you type | ⑧ report window: errors, warnings and output |

group	feature	what it does for the programmer
coding	context-sensitive prompts 上下文相关提示	pops up the identifiers, keywords or parameters that fit at this point; auto-complete finishes the name
initial error detection	dynamic syntax checks 动态语法检查	checks the syntax as you type and underlines a mistake before the program is translated
presentation	prettyprint 代码美化	keywords, identifiers and comments in different colours or fonts, with consistent indentation
presentation	expand and collapse code blocks	hides the body of a loop, an IF or a subroutine, so the outline is visible
debugging	breakpoints 断点	the running program pauses when it reaches a marked line
debugging	single stepping 单步执行	from the pause, runs one statement at a time
debugging	a window for variables and expressions	shows the current value of each variable, and of any expression you ask for, while paused
debugging	the report window 报告窗口	lists errors, warnings and output

A question that gives one feature and asks for “one other” from the same group wants a feature from the **same row group**: prettyprint pairs with expand and collapse; single stepping pairs with breakpoints, the variables window or the report window.

■ Finding an error with the debugger, for four marks



A function returns an unexpected value. Describe how the debugging features of an IDE help find the cause.

1. Set a **breakpoint** on the first line of the function, so the program pauses there instead of running through.
2. **Single-step** through the function one statement at a time.
3. After each step, read the values in the **variables and expressions** window and compare them with the values you expected.
4. The first statement after which a value is wrong is where the error is; the **report window** shows any run-time error message and the output so far.

2 Practice

Now use the methods above. The first questions need one idea each.

2.1 Complete the sentences by writing the missing words. [3]

A Java program is first compiled into This is then run by a , which it one instruction at a time on the computer it runs on.

2.2 Write the letter of the group that each IDE feature belongs to. [4]

letter	group
A	coding
B	initial error detection
C	presentation
D	debugging

feature	letter
breakpoint	_____
context-sensitive prompt	_____
dynamic syntax check	_____
expand and collapse code blocks	_____
prettyprint	_____
report window	_____
single stepping	_____
variables and expressions window	_____

2.3 Name the IDE feature described in each sentence. [3]

- (a) As the programmer types **Total.**, a list of the things that can follow appears.
- (b) A wavy red line appears under a line with a missing bracket before the program is run.
- (c) The programmer clicks a small arrow and the 30 lines of a subroutine are hidden, leaving only its header.

2.4 State what happens when a running program reaches a **breakpoint**. [1]

2.5 Describe **prettyprint**. [2]

2.6 State **two** benefits of compiling a program to bytecode rather than to machine code. [2]

3 Exam-style questions

3.1 A company writes an app in Java. The app must run on phones, laptops and smart TVs, which use different processors and operating systems.

(a) **Describe** how the app is translated and run on each device. [3]

(b) **Explain one** benefit and **one** drawback of this approach compared with compiling the app directly to machine code. [4]

3.2 For each IDE feature, **state** the group the syllabus places it in and **describe** how it helps the programmer. [8]

(a) context-sensitive prompts

(b) expand and collapse code blocks

(c) report window

(d) dynamic syntax checks

3.3 A function `Average()` should return the mean of a list of marks but returns a value that is too large.

Describe how the programmer uses the debugging features of an IDE to find the line that contains the error. [4]

3.4 A programmer has to read a program of 2000 lines written by somebody else.

Identify two presentation features of an IDE and **describe** how each one helps the programmer read the program. [4]

3.5 A student says: “An IDE is just a text editor with a compile button.”

Explain two ways in which an IDE does more than this. [4]
