

Exercise walk-through

7.1.1

Professional bodies, justifying a software licence, and the impact of AI

A-Level Computer Science

You must be able to

- show understanding of the need for and purpose of **ethics** as a computing professional, and
- show understanding of the need to act ethically, and the impact of acting ethically or
- show understanding of the need for **copyright** legislation
- show understanding of the different types of **software licencing**, and justify the use of a
- show understanding of **Artificial Intelligence** (AI), its applications, and its impact

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The method

Method — The professional bodies, and what joining one is actually for

A **computing professional** builds systems that other people have to trust and cannot inspect. Nobody outside the team can tell, by looking, whether a payroll system rounds fairly or whether a medical device logs its failures. **Ethics** 伦理 is what fills that gap where checking cannot.

The two bodies the syllabus names are the **BCS** (British Computer Society) and the **IEEE** (Institute of Electrical and Electronic Engineers). Learn **four reasons** for joining one:

- 1 You agree to a published **code of conduct**, so a client knows in advance what standard you hold yourself to.
- 2 You are **accountable** to the body: it can investigate a complaint and expel a member, which an employer alone cannot do.
- 3 **Continuing professional development** – the body sets and recognises training, so your competence keeps up with the technology.

Method — The professional bodies, and what joining one is actually for

4 **Membership is a recognised qualification**, which gives a client or employer evidence of competence without having to test it themselves.

△ In the exam, “act ethically” is never enough on its own. The marks are for the **consequence** in *that* situation – a specific person harmed, a specific trust lost, a specific cost paid.

Method — Copyright, and why a licence exists at all

- **Copyright** 版权 gives the author of a program the exclusive right to copy it, change it and pass it on. It exists automatically – no registration is needed – and it is what makes the effort of writing software worth paying for.
- A **licence** is the copyright holder writing down which of those rights you are being given. So **every** licence, including the free ones, rests on copyright. “Open source” does not mean “no copyright”; it means the copyright holder has chosen to grant more rights.

Method — Four licence families, and how to choose between them

- **Free Software Foundation** (e.g. the GPL) – free to run, read, modify and pass on, **but** anything you redistribute must carry the same licence. This is called **copyleft**: the freedom is made to travel with the code.
- **Open Source Initiative** (e.g. the MIT licence) – also free to run, read, modify and pass on, **without** the obligation to keep it open. A company may build a closed, paid product on top.
- **Shareware** – a full or partly-limited copy handed out free so you can **try** it. It is still closed and still copyrighted; after the trial you pay to keep using it.
- **Commercial** (proprietary) – you buy a licence to *use* a compiled copy. No source, no modification, and technical **support and updates** are part of what you are paying for.

How to justify one – answer in terms of the *situation*, in this order:

- 1 Does anyone need to **read or change the source**? If yes, only FSF or OSI will do.

Method — Four licence families, and how to choose between them

- 2 If changes will be redistributed, must they **stay open**? Yes → FSF; no → OSI.
- 3 Does the user need **guaranteed support, updates and someone to blame**? → commercial.
- 4 Is this a **trial before buying**? → shareware.

Method — Four licence families, and how to choose between them

How to justify one – answer in terms of the situation , in this order

	Free Software Foundation e.g. GPL	Open Source Initiative e.g. MIT	Shareware	Commercial proprietary
run the program	yes	yes	yes, for a trial period	yes
read the source code	yes	yes	no	no
modify it	yes	yes	no	no
pass it on to others	yes, <i>but</i> under this same licence	yes, and you may keep your changes closed	yes, unchanged, to let them trial it too	no
pay for it	no	no	to keep using it after the trial	yes, and support comes with it

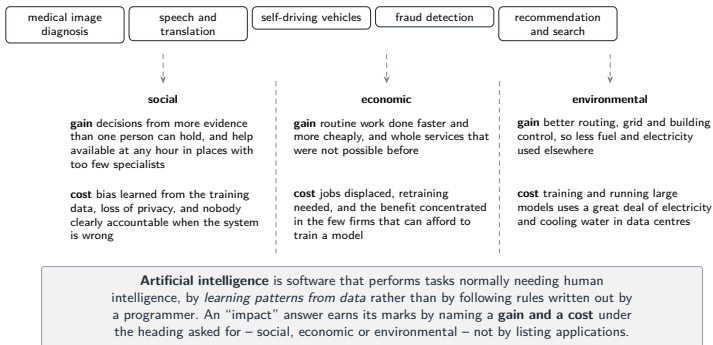
All four are **copyright** works – the licence is the copyright holder saying what you may do. So the exam question is never “which licence is best” but “which fits *this* situation”: ask who needs the **source**, who needs **support**, and who is **paying**.

Method — Artificial intelligence, and what an “impact” answer must contain

- **Artificial intelligence** 人工智能 is software that performs tasks normally requiring human intelligence, by **learning patterns from data** rather than by following rules a programmer wrote out in advance. That second half is the definition mark most answers miss.
- **Applications:** medical image diagnosis, speech recognition and translation, self-driving vehicles, fraud detection, recommendation and search.
- An impact question names a **heading** – social, economic or environmental – and wants a **gain and a cost** under *that* heading. Listing more applications earns nothing.

Method — Artificial intelligence, and what an “impact” answer must contain

AI is already used for



Applications of AI feeding three impact headings, each with a gain and a cost

2

Practice

Practice 2.1 ■ 2 marks

State **two** reasons why a computing professional should join a professional ethical body such as the BCS or the IEEE.

Solution 2.1

Method: The professional bodies, and what joining one is actually for — p.4

Worked steps

any **two** of:

- you agree to a published **code of conduct**, so clients know the standard you work to **B1**
- the body can investigate complaints and expel members, so you are **accountable** to someone outside your employer **B1**
- it sets and recognises **continuing professional development**, keeping your competence current
- membership is a **recognised qualification**, which is evidence of competence to a client or employer

Practice 2.2 ■ 3 marks

A charity wants to use and modify an existing program, and is happy for its improvements to be available to everyone else too. Name the licence family it should choose and justify your answer.

Solution 2.2

Method: Four licence families, and how to choose between them — p.7

Worked steps

- a **Free Software Foundation** licence, such as the **GPL** **B1**
- it may run, read and modify the source code freely, which is what “use and modify” needs **B1**
- the GPL’s **copyleft** condition requires anything redistributed to carry the same licence, so the charity’s improvements stay available to everyone – which is exactly what it wants **B1**
- (an OSI licence would also allow the modification, but would let someone close the improvements again, so it does not meet the second requirement)

Practice 2.3 ■ 3 marks

Describe what is meant by **shareware**, and state **one** way in which it differs from open-source software.

Solution 2.3

Method: Four licence families, and how to choose between them — p.7

Worked steps

- shareware is a **closed-source, copyrighted** program given out free of charge so that a user can **try** it before buying **B1**
- the trial is limited – by time, or by features disabled, or by a watermark or reminder screen – and payment is needed to keep using it **B1**
- unlike open-source software, the **source code is not supplied** and the user may not modify it **B1**

Practice 2.4 ■ 2 marks

State **two** applications of artificial intelligence.

Solution 2.4

Method: Artificial intelligence, and what an “impact” answer must contain — p.10

Worked steps

any **two** of: **B1** *each*

- medical image diagnosis; speech recognition and translation; self-driving vehicles; fraud detection; recommendation or search systems; game playing; handwriting recognition

Practice 2.5 ■ 2 marks

Explain **one** environmental impact of the growth of artificial intelligence.

Solution 2.5

Method: Artificial intelligence, and what an “impact” answer must contain — p.10

Worked steps

- training and running large AI models consumes a **great deal of electricity** in data centres **B1**
- much of which is still generated by burning fossil fuels, so carbon emissions rise – and the cooling of those data centres also consumes water **B1**
- (a gain is also creditable: better routing, grid and building control can cut fuel use elsewhere)

3

Exam-style

Exam-style 3.1 ■ 1 mark

A licence allows a user to run a program, read and modify its source code, and pass on a modified version – but requires that any version passed on carries this same licence. Which term best describes this licence?

- A** commercial
- B** copyleft, as used by the Free Software Foundation
- C** shareware
- D** a permissive open-source licence

Solution 3.1

Method: Four licence families, and how to choose between them — p.7

- A commercial
- B copyleft, as used by the Free Software Foundation 
- C shareware
- D a permissive open-source licence

Worked steps

B

- the right to read, modify and pass on identifies it as a free/open licence, which rules out **A** and **C**
B1
- the requirement that the same licence travels with any redistributed version is **copyleft**, which a permissive licence such as MIT (**D**) does not impose

Exam-style 3.2 ■ 7 marks

A school is choosing software for its computer room.

Exam-style 3.2 (a) ■ 3 marks

The school needs an office suite with guaranteed technical support and regular security updates, and it has a budget for this. State the most suitable licence type and justify your answer.

Solution 3.2 (a)

Method: Four licence families, and how to choose between them — p.7

Worked steps

- **commercial** (proprietary) software **B1**
- nobody at the school needs to read or change the source code, so the freedoms of an open licence buy it nothing **B1**
- the fee pays for **guaranteed technical support and regular updates**, which the school has said it needs and which no one is obliged to provide for a free licence **B1**

Exam-style 3.2 (b) ■ 2 marks

A teacher wants to try a video-editing package for two weeks before the department decides whether to buy it. State the most suitable licence type, and state **one** limitation the teacher should expect during the trial.

Solution 3.2 (b)

Worked steps

- **shareware** **B1**
- one limitation: the trial expires after a set period / some features are disabled / exported video carries a watermark / a reminder screen appears **B1**

Exam-style 3.2 (c) ■ 2 marks

The computing department wants a programming environment that students can install at home at no cost, and that the technician can change to remove features the class should not use. State the most suitable licence type and justify your answer.

Solution 3.2 (c)

Worked steps

- **open source**, under either an OSI or an FSF licence **B1**
- it can be copied and installed at home at no cost, and the **source code is available**, so the technician may modify it to remove the unwanted features **B1**

Exam-style 3.3 ■ 10 marks

A hospital introduces an AI system that reads patients' scans and flags the ones that probably show a tumour, for a radiologist to check.

Exam-style 3.3 (a) ■ 2 marks

State what is meant by **artificial intelligence**.

Solution 3.3 (a)

Method: Artificial intelligence, and what an “impact” answer must contain — p.10

Worked steps

- software that performs tasks that would normally require human intelligence
B1
- by **learning patterns from data** (here, from many previous scans) rather than by following rules written out by a programmer B1

Exam-style 3.3 (b) ■ 4 marks

Describe **one** social benefit and **one** social risk of using this system.

Solution 3.3 (b)

Worked steps

- **benefit:** the system can compare each scan against far more previous cases than one radiologist could hold in mind (B1)
- so tumours are more likely to be caught early, and patients in hospitals with too few specialists can still be screened quickly (B1)
- **risk:** the model learns from its training data, so if that data under-represents some group of patients the system will be less accurate for them (B1)
- and if a radiologist comes to rely on the flags, a missed tumour may go unchallenged – with no clear answer to who is **accountable**, the hospital, the radiologist or the supplier (B1)

Exam-style 3.3 (c) ■ 2 marks

Describe **one** economic impact of introducing this system.

Solution 3.3 (c)

Worked steps

- radiologists' time is used only on the scans that need judgement, so the hospital screens more patients for the same staffing cost **B1**
- against which the hospital must pay for the system, its licensing and its maintenance, and fewer junior posts may be needed – so jobs are displaced even where the total cost falls **B1**
- (either direction earns the marks, provided the point is genuinely **economic**)

Exam-style 3.3 (d) ■ 2 marks

The AI model was trained in a large data centre. State and explain **one** environmental impact of that training.

Solution 3.3 (d)

Worked steps

- training a large model runs many processors continuously for a long time, consuming a very large amount of **electricity** **B1**
- which produces carbon emissions wherever that electricity is generated from fossil fuels, and the data centre additionally consumes water for cooling **B1**