

Ethics and ownership

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What you need to know

By the end of this topic you should be able to:

1. **Explain why computing professionals need ethics and what ethics is for**, and why it matters to join a professional ethical body such as the **BCS** (British Computer Society) or the **IEEE** (Institute of Electrical and Electronics Engineers).
2. **Explain why a professional must act ethically**, and describe what happens when someone acts ethically or unethically in a situation you are given.
3. **Explain why copyright laws are needed**.
4. **Describe the main types of software licence**: Free Software Foundation, Open Source Initiative, shareware and commercial. Choose the right one for a situation and justify the choice.
5. **Explain what Artificial Intelligence (AI) is used for**, and describe its social, economic and environmental impact.

Understand it

What ethics means for a computing professional

Ethics is a set of principles about what is right and wrong, used to decide how to behave. Laws say what you must not do; ethics goes further and asks what you **should** do, even where no law covers it.

Computing professionals need ethics because their work reaches huge numbers of people who can't check it themselves. A programmer can hide a bug, collect data users never agreed to share, or cut corners on testing, and nobody outside may notice until harm is done: a medical device gives a wrong dose, a bank leaks customers' details, a car's software fails. Ethics gives professionals a shared standard for these choices, so clients and the public can **trust** the people who build their software.

Professional ethical bodies and codes of conduct

A **professional ethical body** is an organisation that computing professionals join as members, like a doctors' or engineers' association. It is **not** your employer and not part of your company: you join it as an individual, and your membership stays with you when you change job. The syllabus names two:

- **BCS**, the Chartered Institute for IT (the British Computer Society);
- **IEEE**, the Institute of Electrical and Electronics Engineers, a worldwide body for engineers and computer scientists.

Each publishes a **code of conduct** (a code of ethics) that members promise to follow. A code of conduct is a written set of rules for how members, or an organisation's staff, should behave. Its purpose is to:

- make the **expected behaviour clear**, and the **consequences** of breaking the rules;
- set out **good practice**, so there are clear rules to follow in difficult situations;
- create a **safe, respectful and professional** working environment for everyone;
- **protect the reputation** of the profession or organisation and keep **public trust**.

The software engineering code of ethics written by the IEEE Computer Society and the ACM groups a professional's duties into eight areas. They are a useful checklist for any "is this ethical?" question:

Area	The professional should ...
Public	act in the public interest: health, safety, welfare, privacy
Client and employer	act in their best interest, as long as that fits the public interest
Product	make the product meet the highest standards they can: test it, report faults
Judgement	keep their judgement honest and independent
Management	managers should run teams and projects ethically
Profession	protect the good name of the profession
Colleagues	be fair to colleagues and support them
Self	keep learning, and only take on work they are competent to do

Benefits of joining a professional ethical body:

- **Ethical guidelines to follow.** The code is written down, so the professional doesn't have to decide alone what is ethical, and clients and colleagues know which standards are being applied.
- **Recognition and reputation.** Many bodies have an entry requirement or exam, so membership shows clients and employers that the person's skills and knowledge are recognised and that they are reputable.
- **Help and support**, such as **legal advice** if action is taken against them, and people to discuss an ethical problem with.
- **Training courses** and events that keep skills up to date.
- **Networking**: meeting other professionals, which can lead to contacts and jobs.

The **consequences of not joining** are the same list turned round: no clear guidelines or anyone to ask, so they might act unethically without realising, which could lead to legal action; no access to legal advice if that happens; no recognition of their skills; less training; fewer contacts and job opportunities.

Acting ethically, and what happens when you don't

Questions give a situation and ask why someone must act ethically, or why what they did was unethical. Work from **who is affected**.

Towards colleagues, a professional should:

- treat colleagues **fairly** and never discriminate;
- **give credit** for other people's work, so they feel valued and respected;
- **accept and offer constructive criticism**, so the technical work improves;
- **help and train** colleagues who need it.

The result is a team that feels valued, works well together and produces the best product for the client. A manager who acts unethically (favourites, taking credit, unfair criticism) gets the opposite: low morale, staff leaving and poorer work.

Towards the public, a professional should:

- protect the public's **health, safety and welfare**, so nobody is put in danger by the software;
- be **honest and realistic** in claims about what the software can do, so public trust is kept;
- keep the public's **personal data secure** and private.

Towards the client, the employer and the product, a professional should work to the highest standard, **report faults** rather than hide them, be honest about progress and costs, and keep the client's information confidential.

Towards themselves, a professional should only take on work they are competent to do, and keep learning. So someone asked to use a tool they don't know should **tell their manager**, ask for **training** or a **mentor** to shadow, and **research** or **practise** with it, rather than pretend.

A worked situation. A tester finds a fault in code that has already been signed off and decides to say nothing, afraid of the blame. This is unethical because:

- it isn't in the interest of the **product**, which may fail because the fault was never fixed;
- it isn't in the interest of the **client**, who is let down by software that doesn't work;
- it isn't in the interest of the **employer**, because a fault left now costs more to fix later and harms its reputation;
- it lets down the **profession**, whose good name depends on honest reporting.

Notice each point says **why what they did** breaks a duty, not just what they should have done.

Impact of acting ethically: users are safe, clients and the public trust the software, the company's reputation grows, and the team works well. **Impact of acting unethically:** people can be harmed, data can be leaked, the company can be sued or fined, the person can lose their job or their membership of the professional body, and trust in the whole profession falls.

Students as computer users. The same thinking applies to a student joining their own laptop to a school network. Ethical considerations include: respect other people's **privacy**; don't use social networks inappropriately or **cyberbully**; don't **copy** other people's work and present it as your own; follow the school's **rules** for using the network and use it only for **legitimate** school purposes; don't try to **hack** other computers; and keep your laptop free of **malware** so you don't spread it.

Copyright

Copyright is the **legal right of ownership** of an original piece of work, its **intellectual property**: software, images, music, text, video. It gives the owner the right to decide who may copy, change, sell or distribute the work, and a **legal right of redress** (they can take legal action) if someone does so without permission.

Copyright does **not** physically stop anyone copying. It makes copying **illegal without the owner's permission**. And copyright is the owner's right, not the act of copying: "copyright means using something without permission" describes **breaking** copyright.

Why copyright laws are needed. Digital work can be copied perfectly, instantly and for free. Without laws, anyone could copy and sell a program that took a team years to write, and its creators would earn nothing, so there would be little reason to create new software, music or films. Copyright laws:

- **recognise the creator** as the owner or author of the work;
- **protect the creator's income**, because others can't legally copy or sell the work without paying;
- make it possible to take **legal action** against people who copy, steal or pirate it;
- encourage people and companies to **invest in creating** new work.

Why a programmer should copyright a program: to be formally recognised as its **owner or author**; so there are **legal consequences** if anyone copies or steals it; and to **restrict competition**, since nobody can legally sell a copy of it.

Software licences

A **software licence** is a **legal agreement** that sets out the **rights and terms of use** of a piece of software: whether users may install it, copy it, see and change its source code, and share it. The owner keeps the copyright and uses the licence to decide what others may do. There are four types to know.

Free software (Free Software Foundation). Here "free" means **free of restrictions** (freedom), **not** necessarily free of charge. The Free Software Foundation (FSF) says users must have four freedoms:

- to **run** the program for any purpose;
- to **study and change** it, so the **source code** comes with the program;
- to **share (redistribute)** copies with others;
- to **share changed versions** with others.

Free software can still be sold. Most FSF licences, such as the GNU General Public Licence (GPL), are **copyleft**: anyone who shares a changed version must share it under the same free licence, so the software and every version built from it stay free.

Open source software (Open Source Initiative). The source code is **available**, and the software can be **freely copied, distributed and adapted**. The Open Source Initiative (OSI) approves licences that meet its definition of open source. Its focus is practical: when many people can read and improve the code, bugs are found and fixed faster, features are added, and people collaborate. Open source is usually free of charge, but **not always**. OSI licences are more varied than FSF ones: some are copyleft, but many are not, and those let a company include open source code in its own closed product.

Both FSF and OSI licences let other people **edit and redistribute** the program. A developer can still earn money from software released this way, for example by charging for **maintenance, support and security updates**.

Freeware is not free software. Freeware costs nothing, but the source code is not provided and users can't change it. Free software gives you the source code and the freedom to change it, whatever it costs.

Shareware. The user gets a **free trial**: either for a **limited time** (such as 30 days) or with **limited features**. To keep using it, or unlock every feature, they must **pay** or sign up. Shareware is copyrighted, and users don't get the source code or the right to change it.

Commercial software. The software is **sold for a fee** (a one-off price or a subscription). Users get **no access to the source code**, and **cannot legally change, copy or share** it. There are limits on use, for example how many computers it may be installed on. It protects the developer's **intellectual property**, and the developer usually provides **support and maintenance**: updates, bug fixes and help.

Licence	Cost	Source code	Change it?	Share it?
Free software (FSF)	may be free or paid	included	yes	yes, changed versions under the same licence
Open source (OSI)	usually free	available	yes	yes
Shareware	free trial, then pay	not given	no	trial copies only, if allowed
Commercial	paid before use	not given	no	no

Benefits of each licence to the developer:

- **Shareware**: more people try it because the trial is free; users who like it buy it, so the developer earns money; triallists give **feedback** and find **bugs** on many different computer set-ups; users tell others about it; the program stays copyrighted, so nobody can legally change it.
- **Commercial**: the developer **earns a fee** for every copy; the program is copyrighted, so illegal copies and changes can be stopped by law; the source code stays hidden, so competitors can't copy it; users trust it because it comes **well tested** with **support**.

- **Open source or free software:** users can **customise** the code to their needs, **report and fix errors** and **add features**, so the program improves through **collaboration**; the developer can still charge for support and maintenance.

Choosing a licence. Ask three questions about the situation:

1. **Does the developer want to earn money from each copy?** Yes: commercial (or shareware, if a trial will help sales).
2. **Should users be able to see, change and share the code?** Yes: open source or free software.
3. **Could a changed version cause harm?** If wrong output could hurt someone (a medical dose, an allergy warning, a safety system), a licence that lets anyone change and share the code is risky: someone could release a changed version that gives dangerous output. A commercial licence keeps control with the developer.

Artificial Intelligence

Artificial Intelligence (AI) is the ability of a computer system to do tasks that normally need human intelligence: recognising faces, objects, speech and writing, understanding language, making decisions and **learning** from experience. Most AI systems are **trained** on large amounts of example data (thousands of labelled photos, hours of recorded speech) so that they learn the patterns to look for.

Exam questions describe a system and ask **how AI is used** in it. Almost every answer follows the same chain:

1. **Capture** the input: a camera takes an image, a microphone records sound, sensors take readings.
2. **Analyse** it for **patterns or features**: the pixels of an image, or the shape of a sound wave.
3. **Compare** those patterns with patterns the AI has **learned** from its training data or has stored in a **database**.
4. **Choose the most probable match**: this face is customer 4127, these pixels are the letter "K", this sound is the word "pasta".

The AI rarely finds a perfect match; it gives each possible match a **probability**. A restaurant robot might score a spoken word as "pasta" with probability 0.86, "pastor" with 0.09 and "faster" with 0.05. The three add up to $0.86 + 0.09 + 0.05 = 1$, and it chooses "pasta", the highest.

5. **Act** on it: open a barrier, focus the camera, record, reply, translate.
6. **Learn**: store the result and any feedback, so future matches improve.

The techniques to name:

Technique	What it does
Image recognition	analyses the pixels of an image to find patterns that match known objects
Facial recognition	finds a face in an image, measures the distances between facial features (eyes, nose, mouth), and compares these with the measurements stored for known people

Technique	What it does
Optical character recognition (OCR)	finds the area of an image that holds writing, then compares the pattern of pixels of each character with the shapes of known letters and digits, turning the image into text
Speech (voice) recognition	records sound and compares it with a database of known sounds and words, choosing the word with the highest probability
Natural language processing (NLP)	combines words into sentences and works out their meaning, matching them to known phrases or commands; it can also translate between languages and predict missing words
Text-to-speech	turns text into sound: it generates the sound wave for each word
Game playing	stores the rules and results of past games, looks ahead at possible moves, picks the move most likely to win , and learns from wins and losses

Applications of AI include: police cameras spotting wanted people; face ID to unlock phones, pay or pass a barrier; number-plate recognition in car parks and on roads; cameras that focus automatically on faces; CCTV that detects a person and follows them; voice assistants and chatbots; translation apps; self-driving cars (staying in lane, avoiding collisions, parking); medical diagnosis from scans; fault diagnosis in machines; recommendation systems in online shops; fraud detection in banks; computer game characters that react to the player.

Impacts of AI. Always give the impact **and its consequence**.

Social impacts (on people and society):

- **Accessibility:** people with visual impairments can have signs and labels read aloud; people can understand a language they don't speak; people with reading difficulties get support.
- **Safety and crime:** cameras can find criminals and people feel safer, but **misidentification** can deny innocent people access or wrongly accuse them.
- **Privacy:** constant monitoring makes people uncomfortable, and their images or data may be stored or passed to third parties without consent.
- **Bias:** an AI trained on unbalanced data can treat some groups unfairly.
- **Jobs:** some jobs disappear or change (checkout staff, drivers, call centres), while new ones appear.
- **Learning and skills:** students who let AI do their homework may not develop their own reasoning and problem-solving, may get wrong answers (misinformation), and may work together less; used well, AI gives extra support at the student's own pace. Students without the technology fall behind (the **digital divide**).
- **Wellbeing:** more screen time and less face-to-face contact can add to isolation, stress and anxiety.

Economic impacts (on money, businesses and jobs):

- **Lower costs and higher productivity:** tasks such as diagnosing a fault are done faster, so fewer staff hours are needed and more work is completed.
- **More profit, or lower prices** that win more customers.

- **Cost of the system:** buying, maintaining and updating AI software and hardware is expensive, which can cut profit margins.
- **Job losses** in some roles, and new jobs and industries in others (building, training and maintaining AI).

Environmental impacts:

- Training and running large AI systems uses a lot of **electricity** in data centres, which adds to **carbon emissions**, and data centres use large amounts of **water** for cooling.
- Making the specialised hardware uses raw materials, and old hardware becomes **electronic waste**.
- On the positive side, AI can **reduce** harm to the environment: planning shorter routes cuts fuel use, controlling heating and power grids saves energy, precision farming uses less water and fewer chemicals, and AI helps model the climate and monitor wildlife.

Ethical impacts combine these: privacy and consent, fairness (bias), and who is responsible when an AI makes a wrong decision.

Key facts and formulas

This topic has no formulas, and the exam gives no formula list for it, so every fact below is **Learn it**.

Fact	Status
Professional ethical bodies: BCS and IEEE; you join as an individual, not as an employee	Learn it
Benefits of joining: written guidelines, recognition and reputation, legal advice and support, training, networking	Learn it
Code of conduct: clear expectations and consequences, good practice, professional workplace, reputation and public trust	Learn it
Ethical duties: public, client and employer, product, judgement, management, profession, colleagues, self	Learn it
Copyright: legal right of ownership of intellectual property; makes copying illegal without permission; right of legal redress	Learn it
Software licence: legal agreement setting out the rights and terms of use	Learn it
Free software (FSF): free of restrictions, not necessarily free of charge; source code included; may run, change and share	Learn it
Open source (OSI): source available; may be freely copied, distributed and adapted	Learn it
Shareware: free trial (limited time or features), then pay	Learn it

Fact	Status
Commercial: paid, no source code, can't legally change or share, install limits, support and updates	Learn it
AI chain: capture → analyse patterns → compare with learned or stored patterns → most probable match → act → learn	Learn it
AI impacts: social, economic, environmental (and ethical)	Learn it

How to do it

In the Paper 1 questions we have tagged for this topic (28 questions, 2021–2025), the types came up this often. 10 of the 28 questions mix more than one type, so the counts add up to more than 28.

Question type	Questions
Explain how AI works in a given application	10
Describe or identify software licence types	7
Choose and justify a licence, or give a licence's benefits to the developer	6
Explain the benefits of a professional ethical body (or code of conduct)	6
Explain acting ethically or unethically in a given situation	5
Describe social, economic or ethical impacts of AI	5
Explain copyright and why to copyright a program	4

This topic is marked **one mark per valid point**, and the best answers are **point + "... so" expansion** pairs, tied to the scenario.

1. Explain how AI works in a given application (10 questions)

- Name the technique** for this input: image, facial or number-plate recognition and OCR for a camera; speech recognition and natural language processing for a microphone; text-to-speech for spoken output.
- Follow the chain** from "Understand it", one mark per step: capture → analyse the pixels or sound wave for patterns → compare with a database or trained patterns → most probable match → act.
- Use the scenario's own words** at every step: "the AI compares the characters with the expected shapes of letters and numbers on a registration plate", not "the AI learns".

For example, a car park camera reading number plates: it uses **image recognition** to find the area of the image that matches the **expected shape, size and colour** of a registration plate; then **OCR** analyses the **pixels** within that area and **compares** each pattern with the expected **characters**, letters and numbers, giving the registration number as text.

Variations you will meet:

- **Face ID** (a shop, a bank app, a phone): capture an image, find the face, **measure the distances between facial features**, compare with the values stored in the database for each customer, and accept the most probable match.
- **Camera autofocus on faces**: scan each frame in real time, analyse the pixels for the pattern of a face, then focus on the area that matches.
- **CCTV tracking a person**: image recognition spots a shape matching a person and **starts recording**; the system works out the **direction of movement** to move the camera or switch on the next camera.
- **Speech to commands or orders** (a restaurant robot, a voice-controlled program): speech recognition identifies each word from the sound, comparing it with a database of sounds and choosing the most probable word; natural language processing combines the words and matches the sentence to a known command, which is then carried out.
- **Read, translate and speak** (a label-reading app): OCR converts the pixels into characters; NLP combines characters into words and matches them in the original language, then finds the matching words in the chosen language (predicting any missing words); text-to-speech generates the audio.
- **Board-game opponent**: rules and past games stored; looks ahead at possible moves; picks the move most likely to succeed; learns by storing whether each choice won or lost and changing future choices.
- **"Describe one application of AI"**: name **one** application (not a list) for 1 mark, then two points on how AI works in it.

2. Describe or identify software licence types (7 questions)

1. Learn the key words for each licence from the table in "Understand it".
2. **Describe**: give two facts for each, such as cost and source code, or what the user may do.
3. **Identify from a description**: pick out the clues: "fee, no source, no trial" → commercial; "try before buying, not all features" → shareware; "source code can be changed" → open source or free software.

Variations you will meet:

- **Describe "software licence" itself**: a legal agreement that sets out the rights and terms of use of the software.
- **"Two licences that allow others to edit and redistribute"**: Open Source Initiative and Free Software Foundation. Not freeware.
- **Free software**: say it is free of **restrictions**, **not necessarily free of charge**; the source code comes with it; users can change it and share it.
- **Tick grids**: a statement can match more than one licence ("the user can edit the source code" fits both FSF and OSI), so tick every column that fits.

3. Choose and justify a licence, or give a licence's benefits to the developer (6 questions)

1. **Name one licence** that suits the situation, using the three questions in "Understand it". The name earns at most 1 mark.

2. **Justify it with points from the scenario:** who pays, who needs the source code, what the developer gains.
3. For "benefits of distributing under ...", give the developer's benefits from the list in "Understand it", each with a short reason.

Variations you will meet:

- **A game or app to sell to the public:** commercial, because users pay so the programmer earns an income, and copyright means users can't legally edit, copy or resell it, so the programmer keeps control and can take legal action. Shareware also fits: players try it free and more of them go on to buy.
- **A business that must change the source code and pays for maintenance:** open source (OSI) or free software (FSF), because the business can examine the source code and adapt it to its needs, while the programmer still earns money from maintenance and security updates.
- **Why open source is wrong** for a program whose wrong output could harm someone: the source code would be accessible, so anyone could change it; a changed version could give an incorrect output; a user acting on it could be harmed (for example buying food they are allergic to).
- **Why some programs are open source:** so users can customise the code, report and fix errors, and add features, and so people can collaborate.

4. Explain the benefits of a professional ethical body (or code of conduct) (6 questions)

1. **Make each point a benefit to the person:** guidelines, recognition, support and legal advice, training, networking.
2. **Expand each one with "... so":** "It has a written code of ethics **so** he doesn't have to decide alone what is ethical, and clients know the standards he works to."
3. Remember the body is **not his employer**; don't write about the company's rules.

Variations you will meet:

- **Consequences of not joining:** turn the benefits round (no legal advice if action is taken against them; fewer contacts, so missed jobs; no clear guidelines, so they may act unethically, which could lead to legal action).
- **Purpose of a code of conduct** (2 marks): clear expectations and consequences; good-practice rules for difficult situations; a safe, professional workplace; protecting the organisation's reputation and public trust.

5. Explain acting ethically or unethically in a given situation (5 questions)

1. **Find who is affected:** colleagues, the public, the client, the employer, the product, the profession.
2. **Give distinct points for each group** asked about, each with a reason: "treat colleagues fairly and give credit for their work, **so** they feel valued and the team works well".
3. **For an unethical act**, say why what they did breaks each duty: "he did not act in the best interest of the client, **because** the software they receive may fail".

Variations you will meet:

- **Colleagues and the public in one question:** keep two separate lists; a point about the team doesn't score in the public part.
- **Unfamiliar with a tool or task:** tell the manager, ask for training or a mentor, research and practise it.
- **Ethical considerations for a student using the school network:** privacy, no cyberbullying, no copying others' work, follow the rules, legitimate use only, no hacking, no spreading malware.

6. Describe social, economic or ethical impacts of AI (5 questions)

1. **Check which kind** of impact is asked for. An economic answer is about money, costs, profits or jobs; a social one is about people's lives; an ethical one is about right and wrong (privacy, fairness, consent).
2. **State the impact, then its consequence in the scenario:** "diagnosis is faster, **so** the garage's technicians complete more repairs each day and its profit rises".
3. **Give exactly the number asked for.** If the question asks for one impact, only the first one you write is marked.

Variations you will meet:

- **Facial recognition in public places:** faster boarding and catching criminals, feeling safer; but misidentification denying access, and privacy worries.
- **AI in education:** students may miss out on developing skills, rely on answers that are wrong, and work together less; some benefit from extra support at their own pace; schools may need to change how they set and assess work.
- **AI monitoring people** (a classroom camera): personalised learning and early help for struggling students, against privacy, discomfort at being watched, data passed to third parties and stress.
- **Benefits of a named system** (a reading aid): who it helps and how.
- **Environmental:** energy and water use of data centres, electronic waste; or savings such as efficient routes and energy use.

7. Explain copyright and why to copyright a program (4 questions)

1. **Define copyright:** the formal legal right of ownership of intellectual property; it protects against unauthorised copying and gives the owner a legal right of redress.
2. **Talk about the work in the question:** if it's an image, write about the image, not software.
3. For **"why copyright the program"**: recognised as the owner or author; legal consequences if anyone copies or steals it; restricts competition.

Worked examples

The bold codes show where marks are earned, as in Cambridge mark schemes. The number is how many marks.

- **B1** mark for a correct result on its own, with no method needed.
-

Example 1

Mateo writes a program that helps musicians tune their instruments. He shares it online.

- (a) Describe what is meant by a shareware licence. **[2]**
- (b) Mateo wants other programmers to be able to improve his program and share their improved versions, and he wants every improved version to stay open for anyone to change. Identify the most suitable type of licence and justify your choice. **[3]**
- (c) Explain why Mateo should copyright his program. **[2]**
- (a)** The user can download and use the software free for a trial period, or with limited features **B1**. After the trial they must pay to keep using it or to unlock the full version **B1**.
- (b)** Free Software Foundation licence **B1**. The source code comes with the program, so other programmers can study it and change it to improve it **B1**. It is copyleft, so anyone who shares an improved version must share it under the same free licence, keeping every version open to change **B1**.
- (c)** It formally recognises Mateo as the owner and author of the program **B1**, and gives him legal action if anyone copies it, steals it or sells it without his permission **B1**.

Example 2

Keira starts her first job as a programmer for a company that writes software for hospitals.

- (a) Her manager suggests that she joins a professional ethical body. Explain the benefits to Keira of joining. **[4]**
- (b) Keira's team is under pressure to meet a deadline. Her manager asks her to release an update to a hospital's medicine-ordering system without finishing the tests. Explain why releasing the untested update would be unethical. **[3]**
- (c) The company has a code of conduct for its staff. Describe the purpose of a code of conduct. **[2]**
- (a)** Any four of:
- She has a written code of ethics to follow **B1** ...
 - ... so she doesn't have to decide alone what is ethical, and clients know the standards she works to **B1**.
 - Membership recognises her skills and knowledge, so clients and employers know she is reputable **B1**.

- The body gives help and support, such as legal advice if action is taken against her **B1**.
- It runs training courses, so she can keep her skills up to date **B1**.

(b) Any three of:

- It doesn't act in the interest of the **public**: an error in the update could order the wrong medicine and harm patients **B1**.
- It doesn't act in the interest of the **client**: the hospital is let down by software that may not work **B1**.
- It doesn't meet the duty to the **product**: releasing without testing means the product is not of the highest standard she can make it **B1**.
- It doesn't act in the interest of the **employer** or the **profession**: a fault found later costs more to fix and damages their reputation **B1**.

(c) It makes clear how staff are expected to behave, and the consequences of breaking the rules **B1**. It protects the company's reputation and keeps the trust of clients and the public **B1**.

Example 3

A farm uses drones with digital cameras to fly over its fields. Artificial Intelligence (AI) analyses the images to find plants with disease.

(a) Explain how AI is used to identify diseased plants. **[4]**

(b) Describe **one** economic impact of this system on the farm. **[2]**

(c) Describe **one** environmental impact of the use of AI in this system. **[2]**

(a) Any four of:

- The drone's camera captures images of the crops **B1**.
- The AI uses image recognition to analyse the pixels of each image **B1** ...
- ... looking for patterns such as the colour and shape of the leaves **B1**.
- It compares these patterns with those it learned from a large number of images of healthy and diseased plants **B1** ...
- ... and labels the plant as diseased when that is the most probable match, recording its location **B1**.

(b) Costs fall **B1** because fewer workers are needed to walk the fields checking every plant, and disease is caught early, so less of the crop is lost and more can be sold **B1**. (Alternatively: the drones and AI software are expensive to buy and maintain **B1**, which reduces the farm's profit margin **B1**.)

(c) The farm can spray only the diseased plants instead of the whole field **B1**, so fewer chemicals get into the soil and rivers **B1**. (Alternatively: processing the images uses a lot of electricity in data centres **B1**, which adds to carbon emissions **B1**.)

Common mistakes

- **Thinking a professional ethical body is the employer.** Examiners saw many answers assuming the developer would work for the body, or that it was part of his company. It is an independent organisation that you join as a member.
- **Writing what someone should have done instead of why their act was unethical.** "He should act in the best interest of the company" does not answer "why did he act unethically". Write "he did not act in the best interest of the company, because the company's customers will be let down by software he knew was faulty".
- **Writing the same point twice in different words.** Two marks need two distinct points, for example "treat them fairly" and "give credit for their work", not "be nice" and "be kind".
- **Confusing freeware with free software.** Freeware only costs nothing; free software means freedom to see, change and share the source code, and can be sold.
- **Saying open source is always free of charge.** It usually is, but not always.
- **Saying copyright stops copying.** It doesn't; it makes copying **illegal** without the owner's permission. And "copyright means using something without permission" describes breaking copyright, not copyright.
- **Writing about software when the question is about something else.** If the copyrighted work is an image, write about the image.
- **Generic AI answers.** "The AI uses machine learning to learn" scores nothing. Name the technique and describe the steps for **this** system. For a CCTV question, describing a motion sensor without the AI's role also scores nothing.
- **Giving several impacts when one is asked for.** Only the first is marked. And an economic impact must be about money or jobs, not convenience.
- **Listing applications of AI** when asked to describe **one**.

How to get the marks

- **Identify, state, give:** a name or a short fact is enough. **Describe:** say what it is or does, in two or more linked points. **Explain:** give reasons, the "why" or "how".
- **Point, then expansion.** Mark schemes pair points: "has ethical guidelines" **then** "... so clients know the standards being applied". Write the "... so" part every time.
- **Apply to the scenario.** Use the question's people, product and data. For AI, name the camera, the plate, the face, the spoken order.
- **Name the licence precisely:** "Open Source Initiative", "Free Software Foundation", "shareware", "commercial". Don't write "free licence" or "freeware".
- **A licence choice earns little on its own:** the marks are for the justification.
- **Count the points:** a 3-mark question needs three distinct points; a 4-mark "explain how AI is used" needs four steps.
- **Stick to the number asked for** when it says "one" or "two".
- **Keep sections separate.** In "colleagues" and "the public" parts, each point only counts in its own part.

Quick check

1. Name the type of software licence each statement describes.
 - (i) The program can be used free for 14 days; after that it stops working until a licence key is bought.
 - (ii) The program is paid for, only runs on one computer per licence, and comes with technical support.
 - (iii) Users receive the source code and may change it and share changed versions, but every shared version must keep the same licence.
2. State the difference between freeware and free software.
3. A developer notices that an app his company has launched collects users' locations without telling them. Give **two** reasons why it would be unethical for him to say nothing.
4. A bank replaces its telephone helpline with an AI chatbot. Describe **one** social impact and **one** economic impact.
5. A student says: "Copyright means other people can't copy my photograph." Explain what is wrong with this statement.

Answers

1. (i) Shareware (a time-limited trial). (ii) Commercial. (iii) Free software (Free Software Foundation), because shared versions must keep the same licence (copyleft).
2. Freeware is free of charge, but the source code isn't provided and users can't change or share changed versions. Free software comes with its source code and the freedom to run, change and share it, but it is not necessarily free of charge.
3. Any two of: it isn't in the public interest, because users' privacy is broken without their consent; it isn't in the client's or employer's interest, because the company could be fined or sued and lose users' trust when it's found out; it lets down the profession, whose good name depends on honesty about personal data.
4. Social: customers can get help at any time of day without waiting, but people who find technology difficult, such as some elderly customers, may struggle to get the help they need. Economic: the bank's costs fall because fewer helpline staff are needed, but some helpline workers lose their jobs.
5. Copyright doesn't physically stop anyone copying the photograph. It gives the owner the legal right of ownership, so copying it without permission is illegal and the owner can take legal action.

Past questions to try

- **9618/12/M/J/21 Q2**: acting ethically as a team manager, how a computer uses AI to play a board game, and matching statements to licence types.
- **9618/13/O/N/21 Q4**: parts (a) to (c): the benefits of joining a professional ethical body, acting ethically with an unfamiliar IDE, and why hiding a known error is unethical (parts (b)(ii) and (d) are on IDEs and translators).
- **9618/13/O/N/22 Q8**: why programs are open source, the benefits of a commercial licence, and one economic impact of AI in a garage.
- **9618/11/M/J/23 Q4**: part (c) only: how AI detects and tracks a person on CCTV (the other parts are on memory, storage and IP addresses).