**Topic Support Guide**

# Cambridge International AS & A Level Computer Science

# 9608

For examination from 2017

# Topic 1.7 Ethics and ownership

# Contents

# **Introduction**

## How to use this guide

The aim of this guide is to facilitate your teaching of Cambridge International AS and A Level Computer Science topic 1.7 Ethics and ownership. The guidance and activities in this resource are designed to help teachers devise programmes of study which provide teaching time devoted to theory work as well as activities that consolidate learning.

Section 1 lists some key terms used in this topic and their definitions. Section 2 introduces the theory and principles related to this topic. Section 3 lists some useful websites relevant to the topic for you or your learners to use. Section 4 provides a multiple-choice quiz and homework questions.

## Learning objectives

Using this document should help you guide learners in the following syllabus learning objectives:

1.7.1 Ethics and the computing professional

- show a basic understanding of ethics
- explain how ethics may impact on the job role of the computing professional
- show understanding of the eight principles listed in the ACM/IEEE Software Engineering Code of Ethics
- demonstrate the relevance of these principles to some typical software developer workplace scenarios
- show understanding of the need for a professional code of conduct for a computer system developer.


1.7.2 Ownership of software and data

- show understanding of the concept of ownership and copyright
- describe the need for legislation to protect ownership, usage and copyright
- discuss measures to restrict access to data made available through the internet and World Wide Web
- show understanding of the implications of different types of software licensing: Free Software Foundation, the Open Source Initiative, shareware and commercial software.

## Prior knowledge

**Before you begin teaching this topic you should:**

- understand the meaning of ethics and the need for codes of conduct for computing professionals
- be familiar with the eight principles of the ACM/IEEE Code of Ethics
- be familiar with some software workplace scenarios to which the Code of Ethics principles are relevant
- understand the concepts of ownership and copyright
- be familiar with ways of restricting access to data on the internet
- be familiar with the different types of software licensing and the implications of each.

# 1. Key terms

| Word/phrase | Meaning |
|---|---|
| **code of conduct** | a set of rules governing the behaviour of a group or organisation (e.g. computer professionals) |
| **computer ethics** | moral principles governing the design, building, implementation and use of computer systems |
| **copyright** | the legal right to intellectual property |
| **freeware** | copyrighted software that is available free of charge |
| **intellectual property** | something unique that has been physically created by someone (an idea that hasn't been implemented is not intellectual property) |
| **licence** | a permit to use/distribute/copy/adapt software |
| **open source software** | software that can be freely copied, distributed and adapted |
| **shareware** | copyrighted software that is available free of charge for a limited period, after which a licence must be obtained |

## 2. Theory

## 2.1 What are ethics?

Societies are a collection of individuals, each having their own ideas and beliefs about the type of behaviour that is acceptable, or not acceptable. These ideas and beliefs can vary widely, and what one person believes is good and right, another may see as bad and wrong. To make sure that societies function successfully, they develop principles that define what is morally good and right behaviour for individuals and the society itself. These principles are known as ethics.

Computer ethics are a set of principles that define what is morally good and right behaviour when using computers. These ethics cover:

- computers' contribution to the health, safety and welfare of the public
- privacy
- intellectual property rights (copyright)
- censorship.

Computers have an increasingly central role in society, industry, commerce, education, health and medicine, warfare and government. With so many people using, and being affected by computers, it is extremely important to have ethics that relate to the design, behaviour and use of computer systems.

## 2.2 Codes of conduct

A code of conduct is a set of rules or practices defining how a group or organisation should behave – organisations such as businesses, schools, and hospitals have codes of conduct. Many codes contain rules that seek to protect the organisation from the behaviour of individuals, as well as protecting the individuals within the organisation. For example, a school's code of conduct may include rules about behaviour, dress codes, bullying and respect for others and their property.

Codes of conduct are also applied to computers and their use. They seek to make sure that computers are used safely and lawfully, and to protect the interests of organisations and individuals.

Computer professionals in particular have a need to follow codes of conduct. The computer systems they design, build, implement and use may have a great impact on, for example, the success of an organisation, the protection and privacy of its employees, and the protection, privacy and safety of the public. When designing and building systems, software developers (engineers) have opportunities to cause harm to their clients and to the public, such as:

- failing to make sure their software is fit for purpose (for example, consider the implications of a safety system that has faulty software)
- including malicious software designed to spread malware
- including unauthorised and undeclared ways into the system (backdoor) so that they can later gain access without their client's knowledge.

In order to prevent these types of behaviour and their consequences, computer codes of conduct are becoming increasingly important.

## 2.3 The ACM/IEEE Software Engineering Code of Ethics

Organisations exist that aim to provide standards for professionals. Two organisations that represent computing professionals are the Association for Computing Machinery (ACM), and the Institute of Electrical and Electronics Engineers (IEEE) Computer Society. Between them, these organisations developed the ACM/IEEE Software Engineering Code of Ethics. These ethics aim to provide rules, standards and protection for software developers and their clients.

The Code of Ethics has eight principles:

1.     PUBLIC – Software engineers shall act consistently with the public interest.

2.     CLIENT AND EMPLOYER – Software engineers shall act in a manner that is in the best interests of their client and employer, consistent with the public interest.

3.     PRODUCT – Software engineers shall ensure that their products and related modifications meet the highest professional standards possible.

4.     JUDGEMENT – Software engineers shall maintain integrity and independence in their professional judgement.

5.     MANAGEMENT – Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance.

6.     PROFESSION – Software engineers shall advance the integrity and reputation of the profession consistent with the public interest.

7.     COLLEAGUES – Software engineers shall be fair to and supportive of their colleagues.

8.     SELF – Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession.

Source: http://www.acm.org/about/se-code

Collectively, these principles seek to ask software engineers to: behave ethically and to use ethical judgement in their work, as opposed to blindly following rules or client instructions; to consider who is affected by the decisions they make; and to put the welfare and safety of the public above everything else.

## 2.4 Applying the ACM/IEEE Code of Ethics principles

### 2.4.1 The Google self-driving Car

The 'Google car' is a concept for a self-driving car that autonomously takes the passenger where they wish to go. When designing, building and testing the software for the car, Google's software developers had one principle placed above all others: the safety of the passenger and the public. In doing so, Google's developers had to consider ethical questions about safety and breaking the law.

Consider this situation: a passenger in a Google car may fall ill and need urgent hospital attention. The Google car is programmed to stay within speed limits, even if the road is clear. However, keeping to the speed limit may mean that the passenger does not receive medical treatment in time. Google's developers have to consider the ethical considerations of both the passenger and the public at large. In this situation, speeding may endanger the public, but driving legally might endanger the passenger. What should the car do?

### 2.4.2 The smartwatch

The introduction of smartwatches has raised privacy concerns that developers have had to address. Many smartwatches have health-monitoring facilities such as detection of heart rate and the amount of exercise the user has undertaken. The data from this monitoring is often sent over the internet to third-party applications, to help users monitor their fitness. Developers have an ethical duty to make sure that this data remains private: developers of the watch need to make sure that the data is transmitted securely, and developers of the third-party applications have to make sure that the data remains private.

### 2.4.3 Borland Interbase

Developers at Borland included a backdoor in their Interbase database product to make sure that a client could never be accidentally locked out of their database. This backdoor could be accessed over the internet. When knowledge of this backdoor became public, Borland were faced with the possibility that any client's database could be accessed by an unauthorised user. From an ethical point of view, Borland originally included the backdoor with the aim of protecting their clients' data. After the backdoor was exposed, Borland acted ethically and closed the backdoor through issuing a software patch.

### 2.4.4 Network monitoring

In the workplace, computer users might find themselves placed in a situation with conflicting ethics. For example, the management of a company might suspect that an employee is wasting work time accessing social networking sites on the company's computers. This highlights the importance of having a computer code of conduct in place. If the code of conduct forbids access to social networking sites via the company's computers, then the management have an ethical right to check that the code is being upheld. Without a code, checking on the employee could be considered an invasion of privacy. However, even with a code of conduct, to behave ethically the company could only check on those employees for whom they have evidence of unethical behaviour, as employees' privacy must still be considered.

## 2.5 Ownership

When we create something unique, we have ownership of it. The thing that has been created (which in computing, could be software or hardware, but not simply an idea) is known as intellectual property. Copyright laws exist to protect our intellectual property. Copyright gives an individual (or an organisation) the sole and exclusive right to copy intellectual property, sell it, develop it or license it to others. Copyright makes it illegal for anyone else to duplicate, replicate, sell or license to others our intellectual property.

Many countries have copyright laws. For example, in the United Kingdom the Copyright, Designs and Patents Act (1998) protects intellectual property, and the United States of America has the Copyright Act of 1976.

A lot of intellectual property exists in digital format. Computers make the copying and distribution of digital property very easy, meaning that unauthorised copies can also be easily made and distributed. Money made from these illegal copies is essentially theft. Copyright acts make it illegal to copy and distribute intellectual property without the permission of the copyright owner, whether via a computer or otherwise.

Many websites offer free downloads of copyrighted music, books, films, television programs, images and software. This distribution is illegal unless:

- the website holds the copyright of whatever is being distributed
- the website has the copyright owner's permission
- no copyright exists.

Websites that have copyright permission are given a licence. The licence grants permission for the copying and distribution of copyrighted material.

## 2.6 Software licensing

Several types of licence can apply to software:

- Commercial – copyrighted software that must be paid for. The copying, distribution and selling of such software is restricted to those individuals or organisations that hold a licence to that software.
- Freeware – software that is copyrighted but made available free of charge. Keeping hold of the copyright allows the author to retain control and ownership of the software in case they wish to charge for it or develop it in the future. The licence does not allow the software to be modified.
- Shareware – copyrighted software that is initially given away on a free basis. The software usually remains free to use for a limited period of time, after which a licence must be obtained. Software is often made available as shareware to allow users to try it out and to encourage its distribution. Shareware licences do not allow software to be modified.
- Open source software – software that allows anyone to copy, distribute, amend or develop for their own purposes. Open source software is often developed collaboratively by anyone who has an interest.

Several bodies exist that promote open source software and freeware:

- The Free Software Foundation (FSF) promotes and encourages the right to freely copy, distribute and modify software. FSF aims to allow users to collaboratively develop software that is free for anyone to use and adapt. Such software holds the GNU Public Licence that states that no-one can copyright the software. The FSF also developed GNU, a collection of free software that users can employ to build an operating system similar to Unix.
- The Open Source Initiative promotes open source software. It encourages open source software to meet certain licence requirements, such as:
  - free redistribution
  - the original source code must be supplied alongside any developed work
  - the original licence must apply to any derived work
  - the software must be available for anyone to use – no-one must be barred from using it.

A user should always be careful to note the licence that software holds. Failure to so do may lead to illegal activity and prosecution.

## 3. Online resources

The following are useful resources for understanding ethics and ownership.

The content of websites is dynamic and constantly changing. Schools are strongly advised to check each site for content and accessibility prior to using it with learners. Cambridge International Examinations is not responsible for the accuracy or content of information contained in these sites. The inclusion of a link to an external website should not be understood to be an endorsement of that website or the site's owners (or their products/services).

## 3.1 Websites

Covers codes of conduct and ethics, linked to the OCR AS/A Level syllabus:

www.teach-ict.com/as_a2_ict_new/ocr/A2_G063/336_implications_ict/ethics/home_ethics.html

Slides 34–42 expand on the eight principles of the ACM/IEEE Code of Ethics:

www.slideshare.net/lemiorhan/professional-code-of-ethics-in-software-engineering

Lecture notes from the University of Toronto that include example scenarios of ethical dilemmas:

www.cs.toronto.edu/~sme/CSC340F/slides/tutorial-ethics.pdf

Explanation of the different types of software licence (requires an account for full access):

http://study.com/academy/lesson/software-licensing-proprietary-and-free-and-open-source-licenses.html

The website of the Open Source Initiative:

https://opensource.org/

The GNU website, includes information about free software:

https://www.gnu.org/

# 4. Class and homework activities

## 4.1 Quiz

1. Computer ethics are:

   a. a set of moral principles that govern the design, building, implementation and use of computers*

   b. a set of legal rules defining how a computer must be used

   c. laws defining ownership of intellectual property


2. A code of conduct for computers is:

   a. a law restricting the circumstances in which a computer may be used

   b. a set of rules defining what can and cannot be done with computers*

   c. a set of rules defining how software may be distributed


3. The ACM/IEEE Software Engineering Code of Ethics aims to:

   a. provide professional standards for software developers*

   b. Encourage the free use of software

   c. Restrict the use of shareware


4. Copyright aims to:

   a. encourage the distribution of commercial software

   b. encourage the distribution of open source software

   c. protect intellectual property*


5. Shareware entitles a user to:

   a. use source software for free

   b. freely modify the software

   c. use software for free for a limited period*

## 4.2 Homework questions

1.  Discuss the possible implications for a business that does not have a computer code of conduct in place

2.  Describe the difference between open source software and freeware

3.  Explain how a company might benefit from providing its software under a shareware licence

4.  Discuss the ethical implications of including a backdoor in commercial software

5.  How may it be legal for a website to offer free software?