



University
of Glasgow

Advanced Professional Software Engineering 2024-25

Lecture 4 – Responsible Software Engg'

S Waqar Nabi

(with thanks to Dr Peggy Gregory, SOC, University of Glasgow)

Mar 2025

**WORLD
CHANGING
GLASGOW**

**A WORLD
TOP 100
UNIVERSITY**

Page 1



Outline



Responsible computing – Doing the “right” thing



Ethical considerations



Professional considerations



Legal considerations

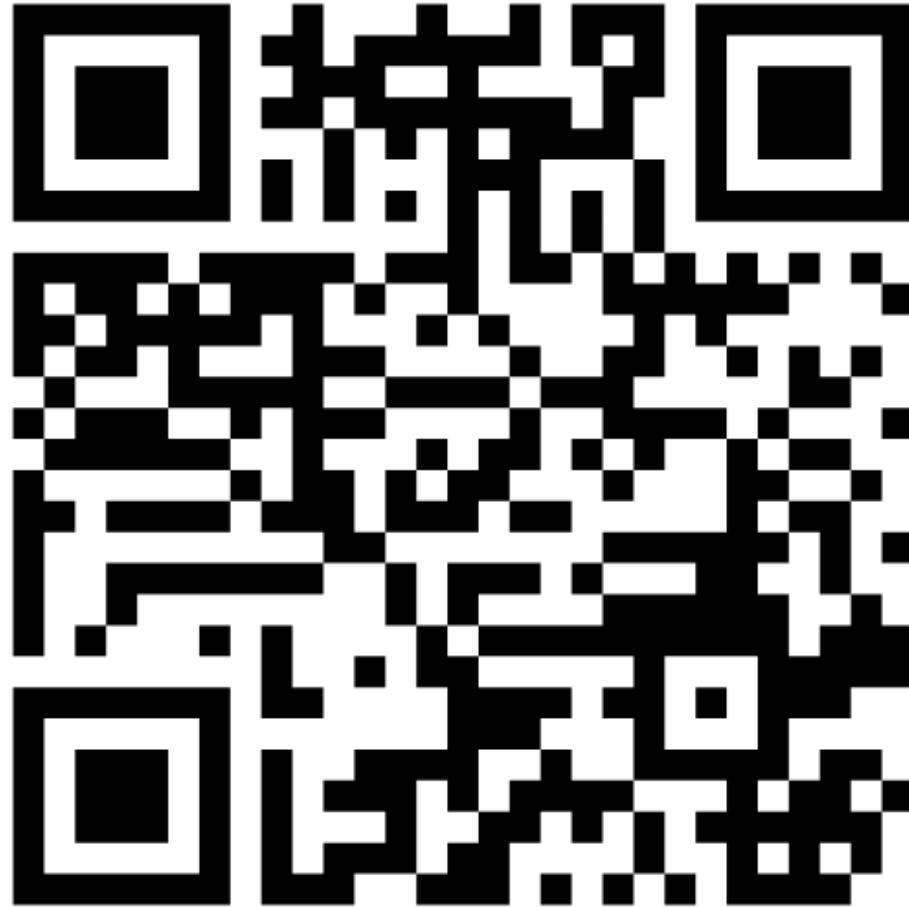


Sustainability considerations

Responsible Software Engineering – Doing the “right thing”

- Why do the “right thing” in the first place?
- What does it mean to be a responsible software engineer?
- Is there something about computing that calls for special consideration?

Join the Menti – Share your views



Join at menti.com | use code **1781 2597**

Why do we (or do we) need special considerations for
Computing / Software Engineering?

Special Properties of computing that may require special considerations

- **Logical malleability**
 - Computers can perform any activity that has inputs, outputs and connecting logical operations – infinite possibilities
- **Invisibility factor**
 - Most of the time and under most conditions computer operations are invisible (3 types: invisible abuse, invisible programming, invisible complex calculation)
- **Informationally enriching**
 - Computer technology is put to use in different fields of activity. Once in place it is used to modify activity and to enhance it with extra knowledge

Ethical Considerations



Thinking about ethics

- Ethics is concerned with what is good for individuals and society
 - *moral* decisions - what is good and bad?
 - our responsibilities and rights
 - how to live a good life
 - a branch of moral philosophy
- Ethical behaviour is not always:
 - What the law tells you to do
 - Decided by the majority
 - Determined by authority

Ethics and Morals are closely related concepts, influencing each other, and often used together in a context. They do have distinct meanings though:

- “**Ethics** – Rules of conduct in a particular culture or group recognised by an external source or social system.”
- “**Morals** – Principles or habits relating to right or wrong conduct, based on an individual’s own compass of right and wrong.”

Computing ethics

- Computing is having a **global** impact
- Beyond the introduction stage, now at the **permeation** stage - computers have moved into every aspect of daily life
- How can ethics **guide** us with changes?

Approaching computer ethics

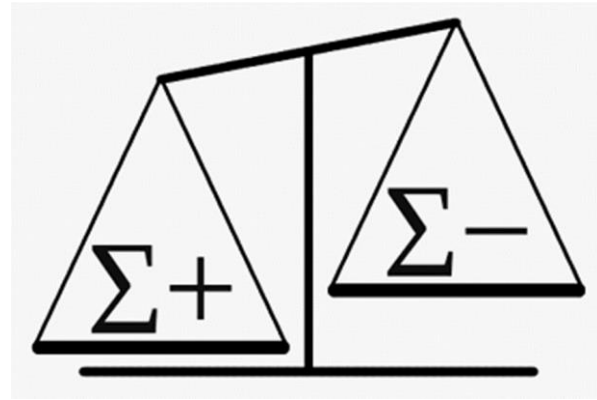
- Ethics is not just a decision about right and wrong, it is a process that can involve:
 - a) **Analysis** of the nature and social impact of computer technology
 - b) **Formulation and justification of policies** for the ethical use of technology
- Although we need a) before b), we often encounter problems before doing either
- Technology innovation moves quickly and is disseminated widely, often without an understanding of unintended consequences (often creating a **policy vacuum**)

Ethical Approaches

There are several *normative* ethical approaches; some important ones:

- **Consequentialism** – The right action is one with the best overall consequences
- **Deontology** (Duty-based ethics) – The right action is defined by certain rules, regardless of consequences
- **Virtue ethics** – A right act is the action a virtuous person would do in the same circumstances

Consequentialism



- Of all the things a person might do at any given moment the morally right action is the one with the best overall consequences
- Two principles:
 - Whether an act is right or wrong depends *only* on the results of that act
 - The more ‘good’ consequences an act produces, the better or more morally right that act
- **Utilitarianism** is its most common form:
 - people should maximise human welfare or well-being

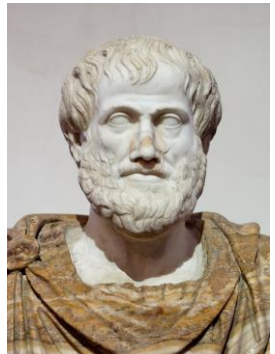
Duty-based ethics - Deontology

- Duty-based (deontological) ethics are concerned ***with what people do***, not with the consequences of their actions.
 - Do the right thing.
 - Do it because it's the right thing to do.
 - Don't do wrong things.
 - Avoid them because they are wrong.
- In this approach you don't justify an action by showing that it produces good consequences (non-consequentialist)
- 'Deontological' from Greek word *deon*, means 'duty'.
- Some kinds of action are wrong or right in themselves, regardless of the consequences.
- A popular form is: Kant's Categorical Imperative:
Always act in such a way that you would be willing for it to become a general law that everyone else should do the same in the same situation



Virtue ethics

- A right act is the action a virtuous person would do in the same circumstances
- Person-based rather than action-based, about moral character
- Virtue is an excellent character trait that is whole-heartedly understood by the person who possesses it
- We acquire virtue through practice and by honing virtuous habits people will make better choices when faced with ethical challenges
- Provides guidance about the characteristics of a good person
- Example virtues: Justive, Fidelity, Self-care, Prudence



Applied Ethics

- Different ethical perspectives have their own strengths and weaknesses
- Most people:
 - do not make conscious, deliberate decision to adopt one ethical framework or another, but nevertheless do have an implicit approach to ethics
 - are not strictly following just one ethical framework or another at all times
- Different ethical frameworks can give different answers to the same issue
→ **Ethical Dilemma**
- You can have Ethical Dilemma's even within the same ethical framework (e.g. within Deontology you can have different, conflicting rules)
- Do you think ethics-related conflicts in the workplace can arise due to people prescribing to different ethical frameworks, maybe implicitly?

Join the Menti – Share your views



Join at menti.com | use code **1781 2597**

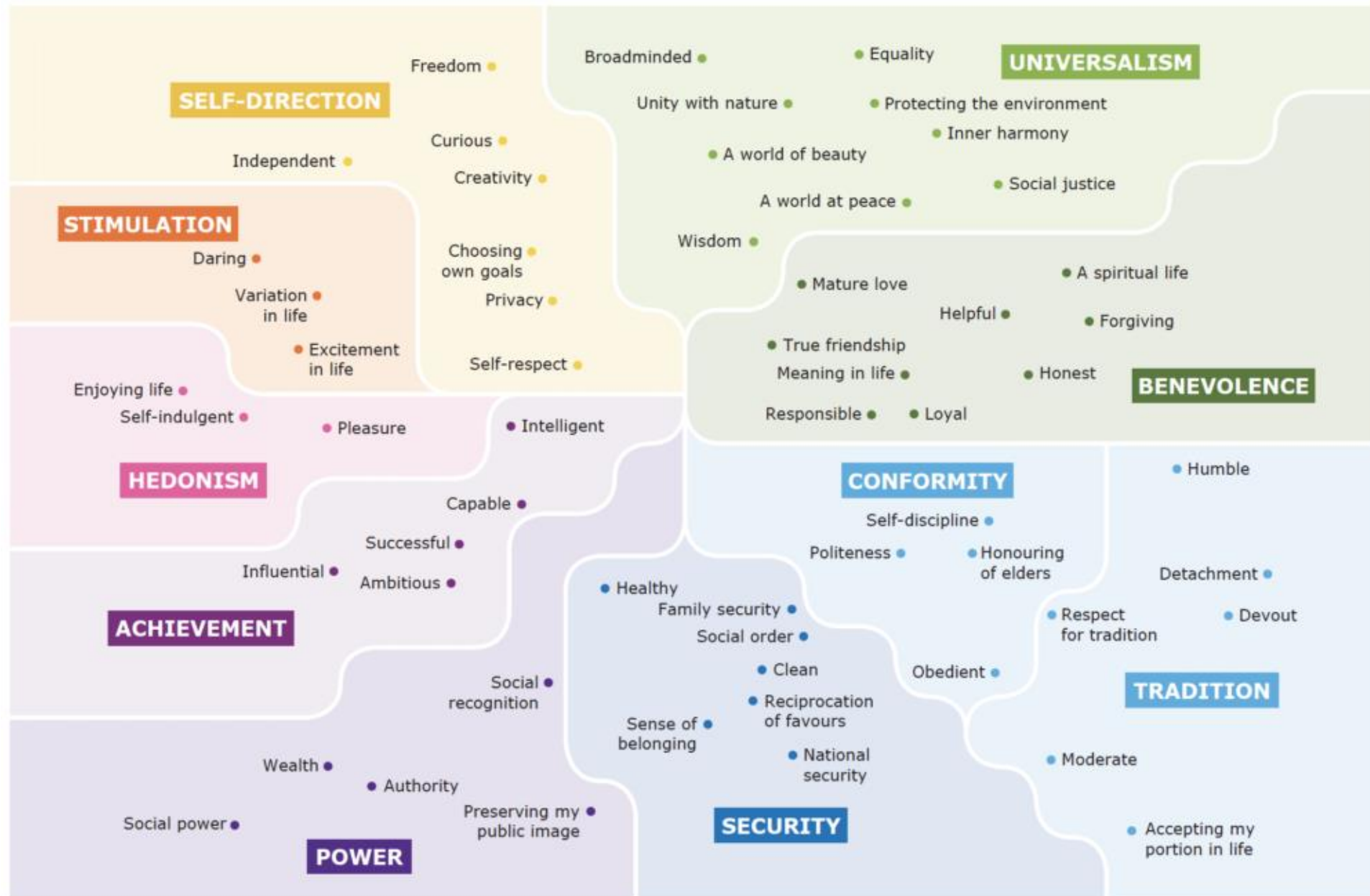
Values

- **Values** reflect beliefs, personal and/or shared, about what individuals consider important, desirable, and meaningful in life. Values serve as motivators that influence attitudes, behaviours, and choices.
 - *Shared values* are considered important in a *collective*
- **Ethics** looks at moral principles and guidelines that help people think about what is right and wrong. Ethics seeks to answer questions about how individuals '**should**' act, make decisions, and interact with other.

Schwartz's ten basic values

- Suggests that there is a set of human values that is *Universal*, even if relative importance given to different values changes across individuals and groups.
- Some values conflict with one another (e.g., benevolence and power), whereas others are compatible (e.g., conformity and security)

Value	Defining goal
<i>Self-Direction</i>	independent thought and action, expressed in choosing, creating and exploring
<i>Stimulation</i>	excitement, novelty, and challenge in life
<i>Hedonism</i>	pleasure or sensuous gratification for oneself
<i>Achievement</i>	personal success through demonstrating competence according to social standards
<i>Power</i>	control or dominance over people and resources
<i>Security</i>	safety, harmony, and stability of society, of relationships, and of self
<i>Conformity</i>	restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms
<i>Tradition</i>	respect, commitment, and acceptance of the customs and ideas that one's culture or religion provides
<i>Benevolence</i>	preserving and enhancing the welfare of those with whom one is in frequent personal contact (the 'in-group')
<i>Universalism</i>	understanding, appreciation, tolerance, and protection for the welfare of <i>all</i> people and for nature



Values vs Ethics?

- Codified ethics can often conflict with personal values, leading to dilemmas
 - E.g., perhaps in a certain situation the ethical thing to do would be to report an an incident, whereas the value of *loyalty* might point the other way.



Legal Considerations

Relevant Legislations

- There are many legislations that would apply to the practice of Computing and Software Engineering professionals, some more direct, some less so.
- For example
 - Computer Misuse Act 1990 (UK)
 - Online Safety Act 2023 (UK)
 - Data Protection Act (UK) / GDPR (EU)
 - Universal Declaration of Human Rights / Human Rights Act
 - Copyright, Designs and Patents Act 1988 / The Copyright (Computer Programs) Regulations 1992

Computer Misuse Act 1990

“An Act to make provision for securing computer material against unauthorised access or modification; and for connected purposes”

- **Section 1: unauthorised access** to computer material
 - Must be knowledge that unauthorised & there must be intention to access
- **Section 2: unauthorised access with intent to commit further offences**
 - As above with intent to commit a serious ‘further’ offence i.e. blackmail
- **Section 3: unauthorised acts with intent to impair, or recklessness as to impairing, the operation of computer**
 - Impair operation of any computer, prevent or hinder access to program or data (i.e. DoS attack), impair operation of program or reliability of data. Extra sections added 3A (hacking tools), 3ZA (damage to human welfare)
 - Penalties – fine or up to 2 (s1), 5 (s2&s3A) or 10 yrs (s3) or life (s3ZA) in prison

UK data protection laws

- **Data protection (DP)** legislations set out rules for the handling ('processing') of information ('personal data') about living identifiable individuals ('data subjects') by organisations ('data controllers')
- Applies to organisations in public and private sectors. It applies to electronic and most paper records. It doesn't apply to anonymous information or to information about the deceased
- Since 1 January 2021, the principal legislations have been:
 - The UK General Data Protection Regulation (the UK GDPR)
 - The Data Protection Act 2018 (DPA 2018) which supplements the UK GDPR

History of data protection law

- **Data Protection Act (DPA)** first passed in 1984 to protect **personal data (PD)** in paper-based filing systems and on computers
- In May 2018 EU enacted **General Data Protection Regulation (GDPR)** some sections open to interpretation. Updated DPA 2018 so it is UK supplement to GDPR
- In 2020 UK left EU & kept GDPR with small changes enacted as **UK GDPR**.
- Organisations must comply with **UK GDPR and DPA** if working in **UK**, if they process data of EU residents they must comply with **EU GDPR**.

Online Safety Act 2023

- Aims to **protect children and adults online**
- Creates a **set of duties for social media companies and search services**, making them more responsible for their users' safety on their platforms
- Gives providers duties to implement systems and processes to **reduce risks** their services are used for illegal activity, and to take down illegal content
- **The strongest protections are designed for children.** Platforms will be required to prevent children from accessing harmful and age-inappropriate content and provide parents and children with clear and accessible ways to report problems online when they do arise.
- **Also protects adult users**, requiring major platforms to be transparent about which kinds of potentially harmful content they allow, and give people control over the types of content they want to see.

Universal Declaration of human rights

- United Nations – created in 1945 by representatives of 50 countries – a response to the end of WW2
- The Commission on Human Rights set up by the UN to draft the UDHR. It was made up of 18 members from various political, cultural and religious backgrounds. Eleanor Roosevelt, widow of American President Franklin D. Roosevelt, chaired the committee
- A roadmap to guarantee the rights of every individual everywhere
- UDHR adopted by UN General Assembly, consisting of over 50 member states, on 10 December 1948, with 8 nations abstaining but none dissenting.
- It marked a historical turning point, as a text promoting peace and diplomacy

30 basic human rights

1. Have and respect human rights
2. Life
3. Freedom from torture
4. Freedom from slavery
5. Liberty and security
6. Seen as a person before law
7. Equality in law
8. Remedy through law
9. Freedom from arbitrary arrest
10. Fair trial
11. Innocent until proved guilty
12. Privacy & family life
13. Freedom of movement
14. Freedom from persecution
15. A nationality
16. To marry and have a family
17. Own property
18. Freedom of thought, conscience, religion
19. Freedom of opinion & expression
20. Freedom of association
21. Take part in govt and vote in elections
22. To have basic needs met – social security
23. To work & receive fair pay
24. To rest & leisure
25. Adequate standard of living
26. Education
27. Participate in cultural activities
28. To have rights realised internationally
29. Duty to community
30. Not to have any rights removed

European Convention on Human Right: ECHR

- Protects the human rights of people in countries that belong to the Council of Europe, including the UK
- The Convention was based on the Universal Declaration of Human Rights. It was signed in Rome in 1950 and came into force in 1953.
- Judgments finding violations are binding on the States concerned and they are obliged to carry them out
- UK's Human Rights Act (1998) aim to "give further effect" in UK law to the rights contained in the European Convention on Human Rights

IPR: Intellectual Property Rights

- Intellectual Property Rights
 - Rights – legally protected ability to control ownership
- Protection for intangible, but valuable things
 - Writings, Inventions, Music, Drawings, Software
 - Things that can be duplicated easily
- Protected by
 - Copyright Law
 - Patent Law
- Allow creators to benefit from their ideas but avoid monopoly

What works does Copyright protect?

- Original works (i.e. created by author)
 - Literary, dramatic, music & artistic works.
 - Sound recordings, films, broadcasts
 - Typographical arrangements of published editions
 - Layouts, fonts
 - **Software, software design materials & databases**
- It is *not* meant to protect ideas themselves
 - But includes detailed plot of story as well as words
- It's EASY to get COPYRIGHT, HARD to get a PATENT

Idea v Expression

- Copyright doesn't protect ideas, procedures, methods of operation or mathematical concepts
- Copyright protects the *expression* of an idea
 - Something has to be formulated and written down – or recorded
- Judges have spent long hours deciding whether or not something is an idea, or an expression.
 - Idea – An platform where people can chat
 - Expression – mIRC, Yahoo messenger, Skype, Teams, Discord, etc.

Extracting Ideas and Principles

- It is NOT an infringement of copyright for a lawful user of a copy of a computer program to observe, study or test the functioning of the program
- To determine the ideas and principles which underlie any element of the program

What is a Patent?

- A monopoly right to stop others making, using or selling an invention
 - *Even if they think of it for themselves*
- Lasts for up to 20 years
 - After this it passes into the public domain
- The right can be sold or licensed to others
 - It can have a value
- The invention must be disclosed

Copyright and Patent Laws

- **UK Statutes**

- Patents Act 2004
 - Patents Act 1977
- Copyright, Designs and Patents Act 1988
 - Copyright Act 1956

- **Regulations / Statutory Instruments**

- Patents Rules (various years)
- Significant case law interpreting laws

Professional Considerations



Professionalism

- Computing is not a 'profession' in the same way as medicine, law, engineering
- However – there are professional societies (BCS, ACM, IEEE) that try to encourage professionalism in practise
- Technology is a powerful tool and needs to be developed with care

Defining professionalism

- Professionals require mastery of a body of knowledge – usually through higher education
- Professionals often have a good deal of autonomy in their work
- Professions usually have a professional organisation – often acknowledged by government that controls admission and sets guidelines for practice
- Professionals fulfil an important social function – i.e. doctors, lawyers

Are computer professionals professional?

- Possess some of the characteristics:
 - Mastered a body of knowledge
 - Usually gone through higher education
 - Many have a degree of autonomy, but this varies
 - i.e. If run own business or are involved in making decisions may have a lot of autonomy. However, some software developers simply implement the designs of others
 - There are professional computing bodies such as the BCS, ACM, IEEE – but there is no ‘legal body in charge of admissions or standards in the field of computing’
 - Computing is crucial to society, but it is not a ‘good’ in itself as are health and justice (or is it?). It supports activities in society, but they are varied.

What's the purpose of a code?

- A Professional Code of Ethics serves several functions:
 - Symbolises the professionalism of the group
 - Defines and promotes a standard for external relations with clients and employers
 - Protects the group's interests
 - Codifies members' rights
 - Expresses ideals to aspire to
 - Offers guidelines in “grey areas”

Examples of Codes of Ethics

- British Computer Society Code of Ethics & Conduct
 - <https://www.bcs.org/membership-and-registrations/become-a-member/bcs-code-of-conduct/>
 - 4 sections
- ACM Code of Ethics and Professional Conduct.
 - <https://www.acm.org/code-of-ethics>
 - 4 sections: ethics, professionalism, leadership, compliance
- IEEE Ethics and Member Conduct
 - <http://www.ieee.org/about/ethics/index.html>
 - Separate code of ethics (3 sections) & code of conduct (5 sections)

Characteristics of codes

- They are not simple ethical algorithms that generate ethical decisions.
- Sometimes elements of the code may be in tension with each other or other sources.
 - Requires the IT professional to use ethical judgement to act in the spirit of the code of ethics.
- A good code of ethics/conduct will set out fundamental principles that require thought rather than blind allegiance.

How do you apply codes?

- Consider the ethical dilemma you are facing
- Decide which principles and rules are at stake
- Decide if there are any conflicts between principles in this case
- Make a decision based on prioritisation of principles

Equality, Diversity & Inclusion

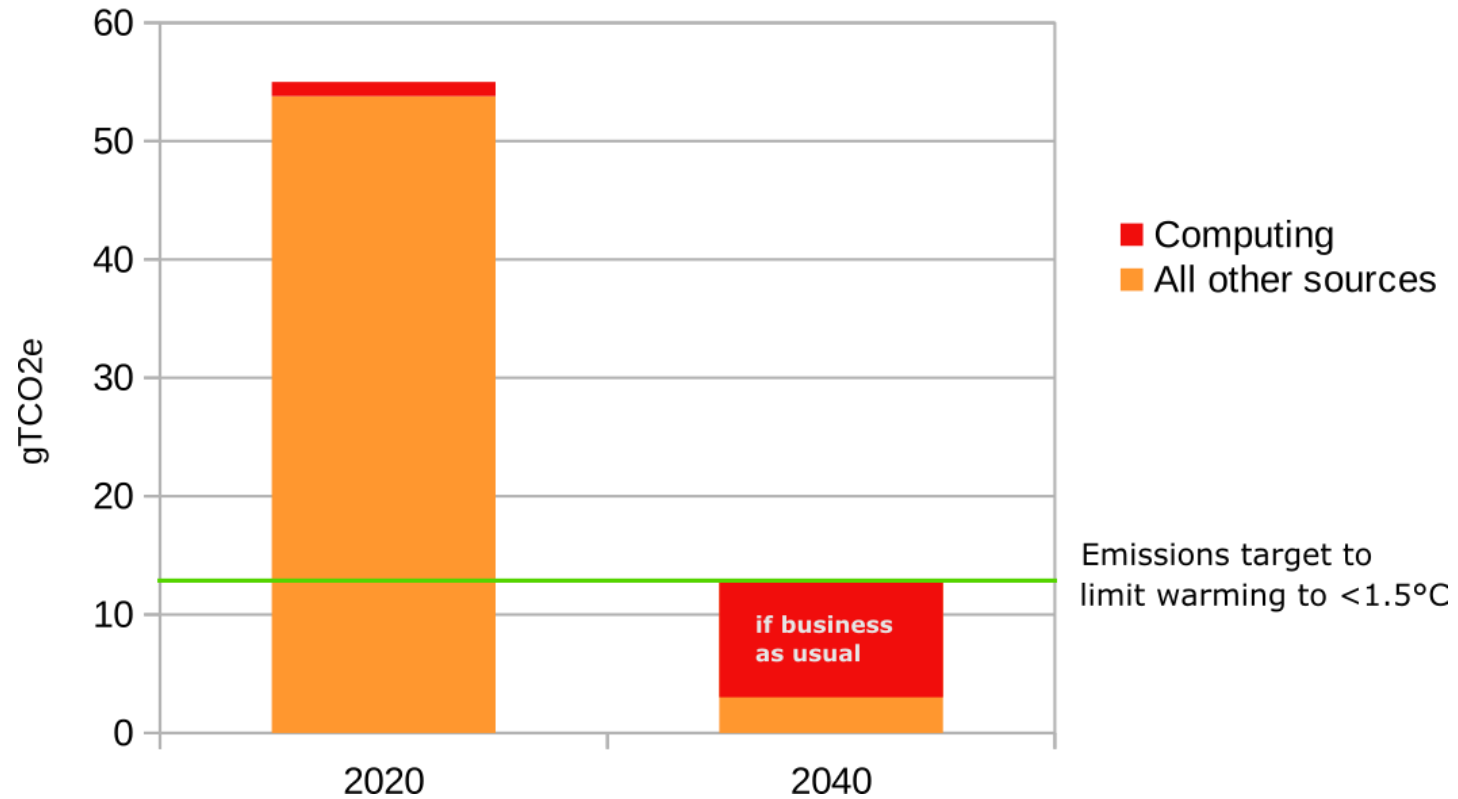
- Related to professionalism – and relevant for the IT workplace AND IT systems that we develop as software engineers
- Compelling reasons for considering this in SE development
 - Legal issues ... i.e. not to discriminate ... Equality Act 2010
 - Professional issues ... it's mentioned in the codes of conduct
 - Ethical issues ... fairness and justice
 - Social issues ... ensuring that IT systems represent and can be useful to the whole of society
- Equality Act 2010 - 9 protected characteristics – Age, Disability, Gender reassignment, Marriage or civil partnership, Pregnancy and maternity, Race, Religion or belief, Sex, Sexual orientation

Sustainable and Low- Carbon Computing



The Problem

Contribution of emissions from production and operation of computing resources to total emissions



The Problem

- The current emissions from computing are about 2% of the world total but are projected to rise steeply over the next two decades.
- By 2040 emissions from computing alone will be more than half the emissions level acceptable to keep global warming below 1.5°C.
- The emissions from production of computing devices far exceed the emissions from operating them, so even if devices are more energy efficient, producing more of them will make the emissions problem worse.
- Software Engineering can play a huge role in enabling this: smarter tools, cleaner and more efficient code, better compilers, better software compatibility with hardware to help extend its life, etc.
 - It is not just a hardware issue.

Enter: Generative AI

- Generative AI, both its training and use (inference), is extremely resource intensive.
- E.g.: A GenAI query can consume in the order of $\sim 70\times$ more energy than an equivalent query to a search engine
- Impact already visible (e.g. bringing coal-powered plants back online)

UN Sustainable Development Goals:

One framework to rule them all?



SUSTAINABLE DEVELOPMENT GOALS



Responsible Software Engineering

- Crucial aspect of being a professional in any domain
- Has many dimensions, we looked at three important ones:
 - Ethical: *Doing the “right” thing*
 - Legal: *Abiding by the relevant legislations*
 - Professional: *Following professional best practices and codes of conduct*
 - Other aspects too: Societal Considerations, Competence, Accountability, Sustainability, etc
- Sustainable and Low Carbon Computing will become increasingly important