

Sustainability, Computing and Ethics

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Introduction

- AI offers new opportunities and challenges for Computer Science, and graduates need an ethical framework as they develop and apply this to problems
- Sustainable Development offers a context to aid in motivating and engaging students with suitable real-world applications of computer science, and especially AI
- In this talk, we will consider how global challenges can provide a framework for developing and contextualising ethical dilemmas and choices, especially with applications of AI

Sustainable Development

- SD has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

<https://www.un.org/sustainabledevelopment/development-agenda/>

- Education for Sustainable Development:
“empowers people to change the way they think and work towards a sustainable future”

<https://en.unesco.org/themes/education-sustainable-development>

The United Nations Sustainable Development Goals: a setting for Professional and Research skills

1. End poverty;
2. End hunger;
3. Ensure health & well-being;
4. Ensure access to education;
5. Achieve gender equality;
6. Ensure clean water and sanitation;
7. Achieve access to sustainable energy;
8. Promote sustainable economies and decent work for all;
9. Build industry, and infrastructure and foster innovation;



The United Nations Sustainable Development Goals: a setting for Professional and Research skills

10. Reduce inequality;
11. Ensure sustainable cities and communities;
12. Ensure supportable production and consumption;
13. Take climate action;
14. Conserve and clean oceans;
15. Protect and restore ecosystems (land);
16. Promote peace & justice;
17. Strengthen SD through partnerships to develop the goals.



The dark side of computing and AI

- Energy use/ pollution
- Waste
- Health
- Video game addiction
- Privacy



- Intrusion of rights through big data and AI
 - E.g. Cambridge Analytica
 - The singularity – Hawkins
 - Amazon – sexist AI shortlisting

Estimates of the % of carbon footprint attributable to computing vary: typically 5% to 12% (the latter equivalent to aviation)

UK Government plans to achieve the UN SD Goals

- Goal 4: Promote digital skills and inclusion by continuing to tackle the root causes of digital exclusion and increasing digital capability
- Goal 9: Harness digital technologies to drive inclusive economic growth and alleviate poverty, including through a technology accelerator programme to bring UK and African entrepreneurs together to learn from each other
- Goal 9: Support growth and security through international partnerships in digital, tech, cultural and creative industries
- Goal 14: Champion reform of the WTO to enable it to tackle 21st century trade issues, by advocating new rules for digital trade, liberalisation of trade in services, advancing ongoing negotiations on fisheries subsidies, and addressing level playing field issues such as industrial subsidies

<https://www.gov.uk/government/publications/implementing-the-sustainable-development-goals/implementing-the-sustainable-development-goals--2>

The cost of AI and Machine Learning

- IT/computing is a significant consumer of resources: both raw materials, and the energy to function
- Transmitting, storing and processing large volumes of data all have associated costs
- The consequences of some of the wider use – with impacts on employment, society and human welfare – all raise questions about the ethical use of these

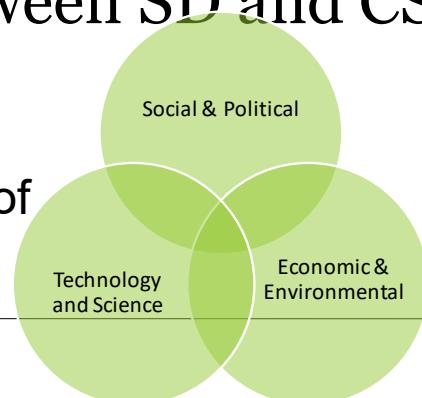
The benefit of AI and ML

- The challenge for computing as a discipline, and for our students as they embark on their professional lives – is how to ensure the benefits of AI and ML are realised and outweigh the concerns
- Ensuring students can respond to the ethical challenges is part of that preparation
- Use of these technologies to reduce the 90% of carbon and energy use not attributed directly to computing

Sustainable Computing: Global Challenges

- Sustainable Development is concerned with utilisation of resources in a sustainable way, and the appropriate use of science (i.e. technology) to inform such use
- Computer Science offers the potential to develop systems which reduce resource demand (e.g. optimising transport; intelligent cities and homes; developing “smart” energy systems)
- As both a solution and a contributor to the problem makes it important to understand the connection between SD and CS hardware and software methods.

The Impact of
Computing



Ethics and Computing

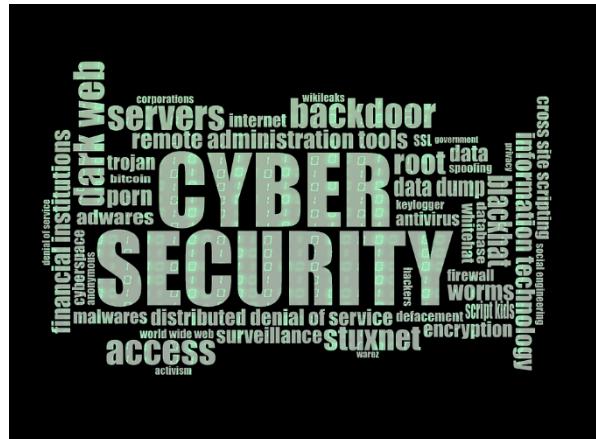
- Privacy and data-veillance
- Hacking and Cybersecurity
- Cyber bullying and Cyber-stalking
- Blogs, Post-Truth and social media
- Cloud and data protection
- Computer Games and Society
- Computers and Health
- Computing and the environment
- Intellectual Property Rights (IPR): ownership and recognition
- Safety Critical software
- Safety critical applications
- Globalisation
- Digital divide
- Changes to work
- VR and sense of self
- Internet of Things and pervasive (invasive) computing
- Rights of people and rights of machines



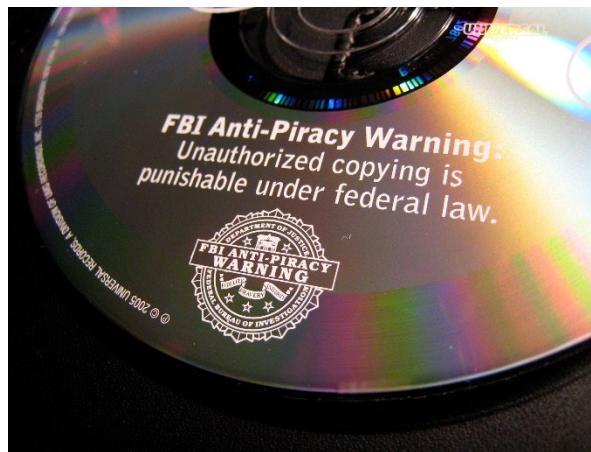
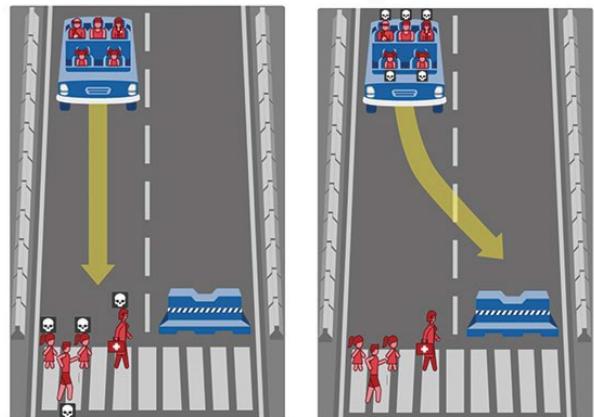
Example topics used in the module: students were free to identify their own

There are similar ethical, moral & social questions in all academic areas.

AI and Sustainable Computing



What should the self-driving car do?



AI for Good – How Artificial Intelligence can Help Sustainable Development

- AI use case of satellite data is [Global Fishing Watch](#) to protect global fisheries
- [Stanford University](#) project to use high resolution images of rural areas in Africa in order to identify infrastructure and characteristic features and predict needs
- monitor and optimize their distribution grids in real time
- Digital ethics needed to ensure suitable use
- <https://medium.com/@C8215/ai-for-good-how-artificial-intelligence-can-help-sustainable-development-58b47d1c289a>

Education (Goal 4)

- AI and education
- Intelligent and adaptive learning systems that
- Ensuring fair and equitable access



How AI-based Tutors can Engage Students In Learning



CBSE To School Grade 8, 9 Students On AI Basics With Intel Tie-Up

Gender equality

- Improving access to education and work
- Avoiding bias, not learning it
- E.g. Amazon shortlisting



A GP App Endorsed By
The NHS Has Been
Criticised For Gender
Bias

Health

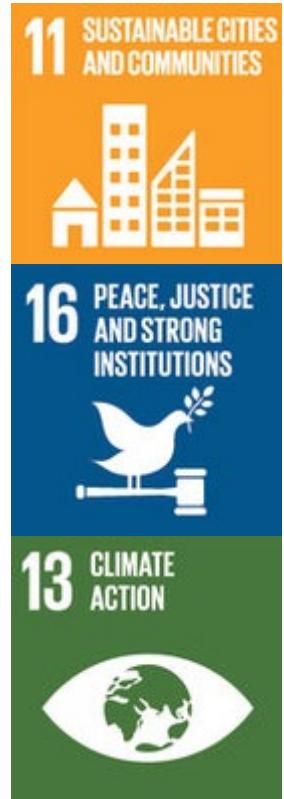
- Improved health processes
- Improved health education
- Ensuring fair access
- Filtering for reliable information



Virtus Health taps into artificial intelligence to improve IVF success rates

Sustainable Cities

- Smart cities that create sustainable communities
- Tools to aid in running and maintaining communities
- Intelligent cities – reducing pollution, managing needs
- Optimised transport



Hull to become UK's first
'programmable Smart City'



Hull City Council to use
smart city operating system



Hull City Council rolls out a
Smart City OS to deliver
better public services

Work, robots and AI

- Need to engage with wider policy and decision making
- Efficiency is relative: what do the displaced do? Is it energy efficient overall? Share the work and the benefits?



Intelligent approaches to manufacturing and logistics

- AI applications for farming (on land and sea)
- For logistics and manufacturing
- Intelligent energy systems and distribution



SD as a A Framework for Legal, Social, Ethical and Professional issues⁶

- Professional attributes can be mapped onto many aspects of SD
- Expectations of social, economic and environment reflect many professional topics



⁶ Adapted from Gordon, N (2014), Sustainable Development as a framework for ethics and skills in Higher Education Computing courses, in Integrative Approaches to Sustainable Development at University Level: making the links, Ed. Leal, W. Springer. Pp345-357

Sample Course topics

1. Introduction to Sustainable Development
2. Ethics, Professionalism and Codes of Conduct
3. Professional Practice, Society and Sustainability
4. Research Methods
5. Data Analysis
6. Data and Cybersecurity
7. Cyber security and Team Working
8. Green Computing
9. Sustainable Computing, related topics and coursework
10. Encryption
11. Digital Identities
12. Module conclusions

In practice

- These topics offer a range of ways to engage students
- Focusing on societal positive impact can provide more motivation for different student categories
- Given 80%+ male cohorts, of majority 18-21 year olds, experience indices a majority of students seem to have naïve or laisse faire attitudes to responsibility itself, and ethical quandaries

Conclusions

- Computer Science should have a key role in supporting Sustainable Development
- AI and ML technologies in particular can be applied to a range of SD problems (goals)
- This application of CS technologies can offer a counter balance to some of the more negative perceptions of these technologies
- The examples from Sustainable Computing offer an effective framework to discuss ethical and professional issues for students

