RESEARCH-BASED PERSPECTIVE IN TEACHING ETHICS TO ENGINEERING STUDENTS

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Web pages:
http://gordana.se/ Personal
http://www.gordana.se/work/presentations.html

Chalmers University of Technology
https://www.chalmers.se/en/staff/Pages/gordana-dodig-crnkovic.aspx

Mälardalen University
http://www.es.mdh.se/staff/37-Gordana_Dodig_Crkovic

Beyond Compliance
Forum on Digital Ethics in Research
October 17/18, 2022
Institut Imagine, Paris and online
https://www.ercim.eu/beyond-compliance
Introduction

During more than twenty years, since 2001, I have been teaching students of Computer Science, Engineering, Interaction Design and occasionally Economics, in the following courses:

2001-2014 “Professional ethics” at Mälardalen University (Bachelor, MSc and PhD) and
2014-2017 “Research Ethics and Sustainable Development” at Chalmers University of Technology (PhD, Chalmers).

Even other courses that I have been teaching have important parts dedicated to ethics:
“Emerging trends and Critical Topics in Interaction Design” (Chalmers)
“Human-centered design” (BSc & MSc, Chalmers)
“Research Methods in Natural Sciences and Engineering” (PhD & MSc, MDH)
“Advanced Computational Thinking and Writing Research Toolbox” (2009-2012, MDH)
“Computational Thinking and Writing Research Toolbox” (20012-2013, MDH)

I have regular guest lectures in Professional Ethics, Ethics of Computing, Ethics of AI, Design Ethics, Ethics for Cognitive Scientists, Robotic Ethics and Ethics of Autonomous Cars for different classes of computer science and engineering students.
In this talk I present lessons learned, illustrated by concrete examples from my courses, sketching briefly future possibilities.

In developing my courses, I have similar approach to the one presented by Peter Bowden in the following:

“The course was based on the assumption that identifying the major ethical issues in the discipline, and subsequently presenting and analysing them in the classroom, would provide the future professional with knowledge of the ethical problems that they were likely to face on graduation. The student has then to be given the skills and knowledge to combat these concerns, should he/she wish to. These findings feed into several components of the course, such as the code of ethics, the role of a professional society or industry association and the role of ethical theory. The sources employed to identify the issues were surveys of the literature and case studies.”

Ethics publications in collaboration with my students

Ethics publications in collaboration with my students

- Dodig-Crnkovic G. and Çürüklü B. Robots - Ethical by Design, Ethics and Information Technology 2011, Volume 14, Number 1, pp. 61-71. http://www.springerlink.com/content/f432g33181787u63/fulltext.html
Ethics publications in collaboration with my students

Ethics publications in collaboration with my students


- Dodig-Crnkovic G., and Larsson, T. *Game Ethics - Homo Ludens as a Computer Game Designer and Consumer*. International Journal of Information Ethics, Special Issue on The Ethics of E-Games, Vol. 4 - December 2005


Doctoral symposium @IS4SI conference 2017

Papers written by my students based on their course essays


APA Computing and Philosophy journal

Papers written by my students based on their course essays

  APA Computing and Philosophy journal
Articles from the course Computing and Philosophy

Computing and Philosophy course started in 2004 as a Swedish National Course, developed as a result of collaboration in a research network PI (Torbjörn Lager, Joakim Nivre, Jan Odelstad, Björn Lisper, Peter Funk, Jan Gustafsson, Ulla Ahonen-Jonnarth, Gordana Dodig-Crnkovic). Participants from different universities (Blekinge, Dalarna, Mälardalen, Skövde, Uppsala) have taken part in the course. They have presented their research papers at the Mini-conference.

Several articles written for the course have been accepted for international conferences and published otherwise.

Afterward, for several years, the CAP course was held in collaboration with the University of Illinois Springfield (Peter Boltuc) with guest lecturers Luciano Floridi, Erik Sandewall, Lars-Göran Johansson, Vincent Müller, and others).

Thomas Larsson: Ethics of the Hyperreal

Magnus Johansson: When Simulations Become Reality

Kim Anttila: Ethics in the Computer Profession

Mikael Sandberg: Gender Distribution Normalization in the Computer Game Development Arena

Omar Bagdadi: Is Big Brother a Human Necessity?

Virginia Horniak: Privacy of Computing – An Ethical Analysis
Articles from the course Computing and Philosophy


Two MSc students presenting at ECAP-2010 conference:


EXPERIENCES FROM MY TEACHING OF ETHICS
An Example of an introductory lecture for Ph.D.
students in software engineering with a focus on
automation - August 2018

IDEA League School
Engineering Complex Systems
with Big data and Information Technology
ECS-BIT’18, Gothenburg 2018 08 31

FORA Fog Computing for Robotics and Industrial
Automation Summer School Seminar on ETHICS,
Vienna 2018 06 08

Springer, Berlin, Heidelberg
Topics with ethical relevance that students identified in the questionnaire before the lecture – technology aspects

Data-related
- Data provenance (attribution, background)
- Data confidentiality
- Data privacy
- Public understanding of technology and protection of private data
- Data quality, property and equality
- Data-driven approaches
- Reproducibility of real time datasets
- Data is never “neutral”
- Data collection influences behavior
- Data-streching used in political purpose
- Security and reliability of the IoT devices
- “Surplus data” from screening of patients that can reveal much more
- Transparency vs. quality

Sustainability-related
- Fuel economy, lower emissions, reduced take-off and landing noise
- Environmental contributions of battery production, use and disposal
- Environmental impact of massive electronic production
- Increasing demand of rare elements
- Lack of life cycle assessment
- Rebound effect
- Digital sustainability?
Topics with ethical relevance identified - methodology aspects

- Values
- The method
- Epistemic problems related work - acknowledging its limitations
- Reducing reality into a model, with loss of depth and variety of perspectives?
- Marginalizing the designer in the design process?
- Level of transparency is acceptable for an automated tool?
- Should we rely on automated tools if we consider the intrinsic limits of the learning process?
- Data-driven development methodology
- genetic discrimination
- genetic modification/engineering
- Tradeoff between safety and innovation
- OPEN SCIENCE
- Simulation compared to real experiments
- Making connection between qualitative and quantitative information
- Application of the complex system in Landscape studies
- Reproducibility
- System's performance almost always evaluated in isolation [QUESTION OF INTERPRETATION OF RESEARCH RESULTS]
- Authors do not verify their results thoroughly enough, or they hide complications
- THE REVIEW PROCESS IS NOT DOUBLE-BLIND
- Presentation of results (overemphasizing of their importance)
- Value of an intervention compared to other applications
Topics with ethical relevance students identified - social aspects

- Cultural diversity
- Professional conduct
- Gender equality
- Quality of life
- Impact of technology on society at large
- Is the purpose of the analysis relevant enough to expose the users to privacy loss?
- Designing technology that could reduce the need for human employees?
- Entrusting the machine to define culturally relevant spaces for our cities?
- Legal issues related to copyright infringement
- Involving stakeholders/users
- Trust between stakeholders?
- Professional societies/organisations and Codes of Ethics
- Popular presentation of research and public opinion about research
- Informing the politics about possibilities and challenges of research
Topics that interest me: Ethics of AI

https://citp.princeton.edu/event/ai-and-ethics/
Topics that interest me:
Ethics in self-driving/autonomous cars

https://webcasts.weforum.org/widget/1/china2018?p=1&pi=1&th=1&id=a0W0X00000ClawBUAT&auto=1
Decisioon making by algorithms
Topics that interest me:
Gender issues in ICT

What Happened To Women In Computer Science?

% Of Women Majors, By Field

Source: National Science Foundation, American Bar Association, American Association of Medical Colleges
Credit: Quoctrung Bui/NPR
Ethical issues move technology forward. They are NOT slowing down the development of technology.

The current debate in engineering

From the Swedish technical newspaper NyTeknik

Sustainability & Climate

Sustainable air transport

Sustainable concrete
CACM August 2018 – Ethics high on the agenda

- INFORMATICS EUROPE AND ACM EUROPE COUNCIL Regulating Automated Decision Making
- CERF'S UP Traceability - workshop on cybersecurity was how to preserve the freedom and openness of the Internet while protecting against the harmful behaviors
- LETTERS TO THE EDITOR Encourage ACM to Address U.S. Election Integrity
  - In the spirit of Moshe Y. Vardi’s call for ACM to "... be more active in addressing social responsibility issues raised by computing technology," we urge the ACM U.S. Public Policy Council to undertake a study of the technological …CACM Staff
- BLOG@CACM Assessing Responsibility for Program Output
  - We lack an easy way to indicate that algorithms do not make decisions and are not biased; programmers do, and are. Robin K. Hill
- Animals Teach Robots to Find Their Way
  - Navigation research demonstrates bio-machine symbiosis. Chris Edwards
- Electronics Are Leaving the Plane Stacking chips and connecting them vertically
- Broadening the Path for Women in STEM - Organizations work to address 'a notable absence of women in the field.' Esther Shein
- GLOBAL COMPUTING Designing Sustainable Rural Infrastructure Through the Lens of OpenCellular
- EDUCATION Providing Equitable Access to Computing Education
  - Seeking the best measures to reach advantaged and less-advantaged students equally. Mark Guzdial, Amy Bruckman
- COLUMN: KODE VICIOUS Every Silver Lining Has a Cloud

https://cacm.acm.org/magazines/2018/8
The topic is huge – Introduction to ethics

What this lecture can do is to open the window with a view

https://www.flickr.com/photos/mercolino/3424888900
Facing grand challenges

“The global community is facing Grand Challenges. The European Knowledge Society must tackle these through the best analysis, powerful actions and increased resources. Challenges must turn into sustainable solutions (...)

The Lund Declaration, 2009 [1]

Natural challenges: Global warming, Insufficient supplies of energy, water and food, Ageing societies, Public health, pandemics, Security, Environmental degradation

Unintended consequences of technology: AGI (artificial general intelligence), Nano-technology, Biotechnology/Bioinformatics, Autonomous machinery and control: Big data, Internet of things – internet of everything, Intelligent cities, Autonomous cars, Autonomous intelligent software as control physical systems, information systems etc.

... The Centre for the Study of Existential Risk (University of Cambridge; http://cserv.org

Education of new generations of engineers often focus on training abstract skills without careful consideration of the role of embeddedness of technology into context.
Global challenges and opportunities prompted Responsible Research and Innovation (RRI), defined as:

“a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).”

Von Schomberg

Education of future engineers should follow!
Facing grand challenges: The university of the future

The transformation of “ivory tower” context-independent to socially-aware paradigm in increasingly information-rich knowledge-based societies.

The triple helix model connects:
- ACADEMIC
- INDUSTRY/BUSINESS
- GOVERNMENT

Inspired by biology: THE TRIPLE HELIX
Gene, Organism, and Environment by Richard Lewontin

https://inquirumn.files.wordpress.com/2014/09/triple-helix.png
Science with and for society work program

Societal challenges for 2020 are formulated in the Science with and for Society work program, which meant to

“help build effective cooperation between science and society, to recruit new talent for science and to pair scientific excellence with social awareness and responsibility”

This new approach encourages all stakeholders (involved citizens, researchers, business, policymakers, etc.) to interact throughout the research and innovation process and to coordinate and align both the process and its outcomes with societal values and needs, in accordance with Responsible Research and Innovation (RRI).

Societal values and needs: sustainability, safety, privacy, equity, diversity, etc.

Organizational adaptation in the era of complexity and continuous change

A necessity of defining social/organizational responsibility in addition to customary personal responsibility [7].

We should take into account both intended and unintended consequences of research and technology in a preferably anticipatory and learning process that will in the first place prevent incidents and accidents and in the worst case mitigate their consequences, [8-13].

Contemporary global society is organized in networks of networks of interacting agents. Each individual belongs to a variety of networks, which define their different roles as stakeholders in various aspects of research and technology. In this context complexity and trans-disciplinarity /inter-disciplinarity comes as important aspect of research and development.

Values, priorities, and actions are negotiated by stakeholders, globally.
Educating engineers for the future

We are educating engineers that will solve future problems.

Future is already at our doors: it comes in form of digitalization that is going to radically change our technology and society.

**Choices** are made all the time in design and engineering and sensitivity to the consequences of choices is needed – involves moral judgment.
The terms ethics and morality are often used interchangeably - indeed, they usually can mean the same thing, and in everyday conversation, there isn't a problem with switching between one and the other.

However, there is a distinction between them in philosophy!
Morality and ethics have the same roots, *mores* which means manner and customs in Latin, and *etos* which means custom and habits in Greek. (Robert Louden, Morality and Moral Theory)

Strictly speaking, morality is used to refer to what we would call *moral conduct* while ethics is used to refer to the *formal study of moral conduct*.

Ethics is also often called *moral philosophy*. 
Ethics and morality, in short

- **MORALITY** - PRACTICE: the first-order set of beliefs and practices about how to live a good life.

- **ETHICS** - THEORY: a second-order, conscious reflection on the adequacy of our moral beliefs.

In a presentation at Chalmers in October 2015, ethicist Prof. Ibo van de Poel from TU Delft in the Netherlands suggested that the students need to develop the following “moral competencies”:

- Moral sensibility
- Moral analysis skills
- Moral creativity
- Moral judgment skills
- Moral decision-making skills
- Moral argumentation skills
Societal normative systems
Ethics as continuum
- An ongoing conversation

- World changes constantly, and we have to interpret/construe it over and over again.

- We come back to ideas again and again, finding new meaning in them.

- Professional discussions of ethical issues in journals.

See http://www.utm.edu/research/iep/e/ethics.htm Ethics
What to expect from ethics

Functions of theory:
- Describe (What?)
- Explain (Why?)
- Prescribe (How?)
- Support (Yes, we can!)
  - Open new possibilities and insights
  - Wonder – move on exploring ethical aspects
On what ethical basis do people typically make moral decisions?

- **Divine Command Theories**
- **Utilitarianism (Consequentialism)**
  The action is best, which procures the greatest happiness for the greatest number...
- **Virtue Ethics**
  Maximize virtue, minimize vices
On what ethical basis do people make moral decisions?

- **The Ethics of Duty** (Deontological Ethics)
  - Immanuel Kant’s Moral Theory. The categorical imperative: “Act so that the maxim [determining motive of the will] may be capable of becoming a universal law for all rational beings.”

- **Ethical Egoism**
  - “Ayn Rand, The Ethics of Selfishness
    Well known for her novels, especially, Atlas Shrugged

- “Machiavellism” – "The end justifies the means"
  - Nicolo Macchiavelli (The Prince) - rationalization of war

* ‘deon’ = duty
On what ethical basis do people make moral decisions?

- **The Ethics of Natural and Human Rights** – all people are created ...with certain basic rights

- **Social Contract Ethics** (We agree to be civil to one another under threat of punishment from a government established for this purpose. [Plato, Republic. Thomas Hobbes])

- **Evolutionary Ethics** – Being social increases our chances to survive
POLICY VACUUMS
Ethics of present-day technology and developing society – example of computer ethics

“A typical problem in computer ethics arises because there is a policy vacuum about how computer technology should be used. Computers provide us with new capabilities and these in turn give us new choices for action. Often, either no policies for conduct in these situations exist or existing policies seem inadequate. A central task of computer ethics is to determine what we should do in such cases, i.e., to formulate policies to guide our actions. Of course, some ethical situations confront us as individuals and some as a society. Computer ethics includes consideration of both personal and social policies for the ethical use of computer technology.”

The question of values

Too often, new technology develops with little attention to its impact upon human values.
VALUES AND ETHICS IN KNOWLEDGE PRODUCTION

Nancy Tuana (2015)
Coupled Ethical-Epistemic Analysis in Teaching Ethics. Critical reflection on value choices.
CACM VOL. 500 NO. 12. Pages 27-29

ETHICAL-EPISTEMIC* ANALYSIS

How values and priorities affect knowledge production

“Computer experts aren’t just building and manipulating hardware, software, and code, they are building systems that help to achieve important social functions, systems that constitute social arrangements, relationships, institutions. computer experts can facilitate and constrain behavior, and materialize social values.”

Deborah Johnson

Values serve as a guide to action and knowledge.

Epistemology-the branch of philosophy concerned with the nature and scope of knowledge.
Values in knowledge production

Values → Science → Data → Information → Knowledge → Values
VALUES

Values serve as a guide to action and knowledge. They are relevant to all aspects of scientific and engineering practice, including discovery, analysis, and application.

Cognitive scientists have found values to be integral parts of STEM (Science, Technology, Engineering, and Mathematics) research.
TYPES OF VALUES

Various types of values can be involved in decision making and reasoning:

- ethical values (the good of society, equity, sustainability)
- *aesthetic* values (simplicity, elegance, complexity), or
- *epistemic* values (predictive power, reliability, coherence, scope).
- *economic* values, etc.
Code of conduct for research integrity basic principles - values

**Reliability** in ensuring the quality of research is reflected in the design, the methodology, the analysis, and the use of resources.

**Honesty** in developing, undertaking, reviewing, reporting, and communicating research in a transparent, fair, full, and unbiased way.

**Respect** for colleagues, research participants, society, ecosystems, cultural heritage and the environment.

**Accountability** for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts.

The European Science Foundations Code of Conduct for Research Integrity

Values related to risks

- Reliability
- Safety
- Security
- Privacy
- Human well-being

VALUES IN RESEARCH
– THE CHOICES WE MAKE

● The selection of research topics. What is a good basis for
(We get involved with existing research. Or we get funding for a specific
research. Or we choose freely. Why is this research worth our time and effort?)

● Choice of approach, methodology, tools. What are the values
of a model, hypothesis, or theoretical explanation in providing
convincing explanation?

● Judgment of the support for a research result. What values of
evidence constitute robust evidence?

● How are ethical aspects of research taken care of?
REQUIREMENT FOR TRANSPARENCY OF VALUES

Transparency of values is essential for trustworthiness and credibility of research. It is central to transdisciplinary research such as e.g., the National Science Foundation’s Sustainability Research Network on Sustainable Climate Risk Management (SCRiM, http://scrimhub.org).

Coupled ethical-epistemic analysis helps to identify new and refined research topics, and inform modeling for multi-objective, robust decision making.
Ethical IT innovation: a value-based system design approach

Sarah Spiekermann:

IEEE P7000
The first global standard process for addressing ethical concerns in system design

What if we could see in any wavelength of the electromagnetic spectrum, from gamma-rays to radio waves? How would the world appear to us?
STAKEHOLDERS IN AN ACADEMIC RESEARCH PROJECT

- International Academic research community
- Professional Organizations Societies
- Research Communities
- Nature
- Family, Relatives, Friends (Private Sphere)
- Academia
- PhD Student
- PhD Advisors
- Research group
- Financing bodies
- Society at Large
STAKEHOLDERS IN AN INDUSTRIAL RESEARCH PROJECT

- Nature
  - Family, Relatives, Friends (Private Sphere)
  - Engineering firm
  - Manager
  - Engineer
  - Colleagues

- Industry (Other firms)
- Profession (Societies)
- Clients
- Consumers
- Society at Large

- Other firms
- Societies
HUMAN COGNITIVE BIASES

The Top 12 Most Useful & Universal Mental Models

Copyright Michael Simmons. Medium.com/@michaelsimmons
The informational model of moral action - Floridi

1. (Set of) 1./2. Objects (Agent - Patient)
2. Message
3. Information process
4. Shell (Subjective Info-frame encapsulation)
5. Factual information
6. Envelope (Moral Situation)
7. Infosphere

A activates information process affects P

The action activates the process which affects the event P.
The informational model of moral action - Floridi
Moral action = information process

https://doi.org/10.1007/s11229-007-9163-z


data structures constituting the nature of the entity in question (state of the object, its unique identity, and attributes)
Ethical sensitivity

Why must scientists become more ethically sensitive than they used to be? John Ziman 1998

“Academic science” vs. “Industrial science”
Academic science basically individualistic, following Merton norms (1942) Science as free “speech community.”

“The only constraint—an immensely powerful one in practice—was that the results of their research would be closely scrutinized by other members of one of the innumerable specialized research communities that partition the scientific world.” [PEER REVIEW]
“Mode 1” and “Mode 2” research

Mode 1, classical academic
Mode 2, collaboration with industry and society, usually undertaken as a succession of projects, each justified in advance to a funding body whose members are usually not scientists.

Important feature of “mode-2” science is that it is largely the work of teams of scientists, often networked over several different institutions.

Where, then, do the ethical responsibilities lie?

OPEN QUESTION: HOW DO WE INVOLVE ALL IMPORTANT STAKEHOLDERS AND HOW TO NEGOTIATE COMMON SOLUTIONS? (THINKING IN TERMS OF COMPLEX SOCIO-TECHNOLOGICAL NETWORKS)
ETHICS IN RESEARCH

The state of the art in today’s research and society
Domains of research ethics

You will recognize this **domain-based** view in the analysis of many different types of problems – organization of society, sustainability of cities, ecology, economics, ethical aspects etc.

Source: American Psychological Association website
Complexity aspects relating Micro – Meso – Exo – Macro levels of analysis – example of city

A holarchy, in the terminology of Arthur Koestler, is a connection between holons, where a holon is both a part and a whole. The term was coined in Koestler's 1967 book The Ghost in the Machine.

http://www.newsociety.com/Books/I/Integral-City
EXAMPLE OF DOCUMENTS ADDRESSING ETHICAL CONSIDERATIONS

Future Intelligent Autonomous Systems

The IEEE Global Initiative for Ethical Considerations in Artificial Intelligence and Autonomous Systems

http://standards.ieee.org/develop/indconn/ec/autonomous_systems.html

Prioritizing human well being in the age of artificial intelligence: https://youtu.be/z5yZU8tp9W8 (5:56)
EXAMPLE OF DOCUMENTS ADDRESSING ETHICAL CONSIDERATIONS

The European Science Foundations Code of Conduct for Research Integrity
PROFESSIONAL ETHICS COURSE
AT MÅLARDALEN UNIVERSITY
SWEDEN
LECTURES

Professional Ethics in Science and Engineering, CD5590

Teacher and examiner: Gordana Dodig-Crnkovic, gordana.dodig-crnkovic@mdh.se

Time & Place: Monday & Thursday, 13:15 - 15:00, Classroom V220 (V222 on 11-27 and 12-05)

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RESEARCH ETHICS & SUSTAINABLE DEVELOPMENT

CHALMERS UNIVERSITY OF TECHNOLOGY
SWEDEN
Research Ethics & Sustainable Development
3.0 ECTS

GFOK025

Day 1 Part 1 – Course Introduction
Gordana Dodig-Crnkovic
The aims of this course are to:

1) understand the nature and range of ethical issues in research and sustainable development;

2) understand what is meant by sustainable development and potential implications for research, in particular in the own research project;

3) familiarize with a framework for decision making when faced with ethical issues and

4) appreciate the complex relation between science and society.
A successful completion of this course will be judged on the following:

1. Attendance and preparation for the in-class discussions.
2. Writing an essay describing ethical and sustainability aspects of the PhD research project (or equivalent) of the participant. It is based on the interviews with at least two stakeholders.
3. Participation in a peer review seminar in which you give feedback on other graduate students essays and receive feedback on your own essay.
5. A Mini-conference with “lightning talk” presentations of individual essays, common group conclusions and the subsequent class discussion.
Course Overview

Day 1
Problems & Principles
Course intro & Ethics (Gordana)
Sustainable Development (Magdalena)

Day 2
Science and Society
Research Policy (Sven)
Publishing Ethics & Societal Aspects of Technology (Guest lectures)

Assignment and readings
Assignment and readings
Course Overview

Day 3

Peer Review Meeting for SD-RE Essays
(Class in Review Groups)

Essay SD-RE

Day 4

Group Meetings
(Class, preparation for Mini-conf.)

Preparation for the Mini-conference
Day 5

Course Overview

Mini-conference
(Class, Gordana)
1 2 3 4 5 6 7 8

“Lightning talk” individual presentations; group conclusions followed by the class discussion
EXAMINATION FORMS IN MY ETHICS COURSES

- INDIVIDUAL CLASS-NOTES – What did I find interesting in this lecture – students’ own reflections

- IN-CLASS PRESENTATION OF A CHOSEN TOPIC – Students choose a topic from their research. For undergrads, topics that interest them.

- RESEARCH PAPER, WITH THE AIM TO PRESENT AT A CONFERENCE OR PUBLISH IN A JOURNAL

- PRESENTATION ON THE MINI-CONFERENCE (IN CLASS)
At the beginning (2000), it was not easy to develop a course on ethics for students of computing and engineering. There was “no place” for yet another course in the curriculum. There was no feeling of urgency, which gradually formed with the recent huge advances of AI.

The hope is the introduction of ethics education to change the situation and encourage and support colleagues researchers, young and established, by exchange of experiences and resources.

In the future, given the impressive development of intelligent, nano-, bio-, neuro-, medical-, and other emerging technologies that can radically change our personal lives and the whole civilization, in which computing professionals are heavily involved, it is of central importance that professionals contribute to our common knowledge about possible features, promises, and challenges of emerging technologies.
What I find important is

- Relevance of ethics topics for students’ own context
- Applicability and generalizability of approaches from what is learned
- Humble teaching attitude – no preaching and no besserwisser (know-all) style
- Using authority/power with utmost care
- Ethics is not about being perfect but being as good as reasonably possible, given human cognitive constraints
- Introducing students to the world of research and real-world problems
- Cultivating analytic-synthetic thinking, and logical reasoning/argument
- Respect for different positions/traditions/cultures, stakeholders
- Arguing for the necessity of understanding the subject matter (technology) in order to make informed judgments
- Interdisciplinarity/Transdisciplinarity center-stage
- Keeping in mind – we are educating for the FUTURE – identifying seeds of future developments and addressing their promises and challenges
- Educating T-SHAPED ENGINEERS – deep in technology, broad in humanities (Barry Bohm)
SOME CONCLUSIONS

- Bringing in guest lecturers with relevant experiences
team-work, networking
- Sharing experiences in peer-review meetings & group work

Course Teaching Team

Experiences from the course “Research Ethics and Sustainable Development” at Chalmers

Gordana Dodig-Crnkovic, course responsible
Magdalena Svanström
Sven Andersson
Guest lectures: Erik Bohlin, Claes Strannegård

Previous editions course responsible:
Elisabeth Saalman
Tom Adawi
P.S.

The idealized picture of the roles of the teacher and students in a research-based ethics course can be compared to the work of a renaissance art studio. It is definitely beyond compliance (the action of complying with a wish or command.)

Young Leonardo da Vinci was taken by his father to Florence to begin his apprenticeship in the studio of Andrea Verrocchio. It was the most important workshop in the city and many of the young apprentices working there, such as Botticelli and Perugino, would later become famous. Around the time Leonardo arrived, Verrocchio was busy making the gilt bronze ball for the Cathedral dome. It was in this workshop that Leonardo received the training that best suited his spirit of enthusiastic experimenter. Verrocchio coordinated the many activities of his workshop. Ever since the thirteenth century, it was usual for the master to allow his best pupils to complete works that had been thought of and sketched out by him.

REFERENCES

References in full text can be found on my web page:
http://gordana.se/