

Professional Ethics in Computing and Intelligent Systems

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Abstract

Research and engineering have a decisive impact on the development of the society, providing not only the material artifacts, but also the ideas and other “tools of thought” used to conceptualize and relate to the world. Scientists and engineers are therefore required to take into consideration the welfare, safety and health of the public affected by their professional activities. Research and Engineering Ethics are highly relevant for the field of computing (with Intelligent Systems/AI as its sub-field). Computing Ethics has thus been developed as a particular branch of Applied Ethics. By professional organizations, ethical judgment is considered an essential component of professionalism. This paper will point out the significance of teaching ethics, especially for the future AI professionals. It argues that education in Ethics should be incorporated in computing curricula. Experience from the course “Professional Ethics in Science and Engineering” given at Mälardalen University in Sweden is presented as an illustration.

1 Introduction

Computers play an essential role in today’s industry, commerce, government, research, education, medicine, communication systems, entertainment, art and in many other fields. Professionals who contribute to the research, design, development, analysis, specification, certification, maintenance and evaluation of the many different applications of computer systems have a significant social impact.

Computing does not only produce artifacts, it also essentially changes our relation to world and to each other. To ensure that their efforts will be used for the general good, computing professionals must commit themselves to making computing a beneficial and respected profession, promoting an ethical approach to their professional practice.

Computing Curricula 2001, The Joint Task Force on Computing Curricula of IEEE Computer Society and Association for Computing Machinery (ACM), emphasizes strongly professional issues, as a *part of a core curriculum* for computing:

<http://www.computer.org/education/cc2001/index.htm>
Computing Curricula 2001.

The Engineering Criteria of the Accreditation Board for Engineering and Technology (ABET) (<http://www.ele.uri.edu/People/Faculty/daly/criteria.2000.html>) Accreditation Board for Engineering and Technology (ABET) Engineering Criteria 2000

Third Edition), affirm that “Engineering programs must demonstrate that their graduates have an understanding of professional and ethical responsibility.”

In spite of the above clear policy statements, professionalism and ethics are seldom present in undergraduate and graduate curricula in engineering and science. For example, in Sweden, only certain colleges and universities offer their students an opportunity to study professional ethics. Examples are The Royal Institute of Technology which gives courses in Engineering Ethics and Mälardalen University at which there is a course in Professional Ethics in Science and Engineering, presented for the first time in 2003. Beginning in September 2005, the Swedish Linköping University, the Norwegian University of Science and Technology NTNU, and Utrecht University jointly offer an Erasmus Mundus Master’s programme in Applied Ethics (MAE), the courses which it offers including Computing Ethics.

The aim of this paper is to show that ethics is required for the successful performance of a computing professional. There are many ethical concerns which are characteristic for computing and Intelligent Systems as its subfield. The following is the list of questions to be addressed (Barger, 2001):

- Social context of computing
- Methods and tools of ethical argument

- Professional and ethical responsibilities
- Risks and liabilities of safety-critical systems
- Intellectual property
- Privacy and civil liberties
- Social implications of the Internet
- Computer crime
- Philosophical foundations of ethics

Engineering and research decisions are based on both engineering and ethical principles. We argue that training and education in professionalism and ethics should be an obligatory part of a computing professional's curriculum. Following this assumption we have developed a course "Professional Ethics in Science and Engineering" now included in the Computer Science, Software Engineering and Interactive Computing Curriculum at Mälardalen University (MdH), (Dodig-Crnkovic 2005). We give a short overview of this course, our experience and that of our students, and we present some direct consequences in an industrial context evident through the work of our industrial PhD students.

The rest of the paper is organized as follows. Section 2 discusses engineering, its impact and possible (unwanted) consequences of engineering decisions. Section 3 gives an introduction to Professional and Computer Ethics, the basic principles of Ethics and the specifics of Computer Ethics. Section 4 argues why Ethics should be taught to students of computing. Section 5 presents the course developed at Mälardalen University with the experiences of both the teachers and students. Finally, Section 6 summarizes the conclusions.

2 Engineering as a Large Scale Social Experimentation

"All products of technology present some potential dangers, and thus engineering is an inherently risky activity. In order to underscore this fact and help in exploring its ethical implications, we suggest that engineering should be viewed as an experimental process. It is not, of course, an experiment conducted solely in a laboratory under controlled conditions. Rather, it is an experiment on a social scale involving human subjects."

(Martin and Schinzinger, 1996)

There are uncertainties in every design process which are the result of our limited (finite) resources. Thus pharmaceuticals are tested in a limited (but of course representative) context. Construction materials are tested under certain conditions. Computer programs are tested for a large but finite number of cases. Intelligent systems behavior is likewise un-

derstood within some given limits. This implies that an engineered product may, sooner or later in its application, be used under conditions for which it has never been tested. New uncontrolled, unpredicted circumstances can appear. We expect the product to function properly, or at least safely, even in such circumstances. It is an engineer's responsibility to foresee and prevent as far as possible any severe consequences of product/system malfunction.

Modern history provides a wealth of examples of engineering failures with severe consequences. The intense media coverage of disasters such as the explosion of the Ariane V rocket in 1996, because of the incorrect reuse of some of the software developed for the Ariane IV and the radiation overdoses in the Therac-25 computerized linear accelerator for cancer treatment has increased the interest in engineering ethics. Major technical disasters are extremely costly but fortunately happen rarely. The judgment made by an engineer about what "rest (unknown, unaddressed) risk" in a safety analysis is acceptable, is to a high degree, an *ethical* one.

3 Computing Ethics

Computing Ethics might be defined as the analysis of the nature and social impact of computing technology and the corresponding formulation and justification of policies for the ethical use of such technology, (Moor, 1985).

Ethical problems arise most often when there are differences of judgment or expectations about what constitutes the true state of affairs or a proper course of action. An individual makes ethical decisions, in his/her capacity as a member of different groups. In order to make ethical decisions, an engineer or researcher interacts in many directions and within variety of contexts, each of which can show the actual situation in a different light. For example, solving the problem of the relation individual – colleagues – management could lead to certain choices, which e.g. do not necessarily coincide with the views of his or her own family or friends.

When faced with a moral/ethical dilemma, a professional must be able to make rational and well-motivated decisions. Courses in Ethics can help professionals by offering tools and methods useful in such situations.

3.1 Problems of Intelligent Systems Ethics as a Part of Computing Ethics

The basic principles of ethics are constant, no matter in which area they might be applied. The principles of Medical Ethics, Legal Ethics, and Computing Ethics are basically the same. However, only the first two of these are generally acknowledged as

branches of Applied Ethics. In much the same way as for other Applied Ethics fields, new circumstances related to the computer do raise new questions about how general principles are to be applied, which results in policy vacuums designated thus by (Moor 1985) and further discussed in (Barger 2001; Tavani 2002 and Johnson 2003).

We argue that the social importance of the computer as a revolutionary machine together with its specific features give rise to new ethical problems and demands the introduction of the field of Computer Ethics. Some of the characteristic ethical problems of computing technology and in particular Intelligent Systems are listed in the following.

Logical malleability. Computers are malleable in a logical sense in that the results they produce can be shaped and molded to simulate any activity that can be characterized in terms of inputs, outputs, and associated logical operations (Moor, 1985). This is especially true of the AI field. Computers are used as tools for representation, modeling and simulation and they thereby have become a materialization of our conceptual knowledge of the world. For our epoch, they are The Revolutionary Machine in the same sense as the steam engine was for the industrial era. The ethical consequences of the fact that the computer is an artifact defining our contemporary culture are many. To this class of ethical issues belongs *Roboethics*¹, good examples are Stanford and Genova groups <http://roboethics.stanford.edu/> and <http://www.scuoladirobotica.it/roboethics/>.

Speed. Speed and the simplicity of handling large amounts of data are connected with risks for unintentional transfer of incorrect data, as well as other ethical problems such as privacy and security intrusion because of unintended or uncontrolled movement of data.

Storage of huge amounts of data. When recorded and shared with other computers, information about people can be used to invade personal privacy and integrity in a way never before possible in history. The ease with which data saved in a computer can be manipulated, “as if they are greased” (Moor 2004) makes the use of surveillance, monitoring and spyware methods a simple technical operation. (Dodig-Crnkovic and Horniak 2006)

Identity vagueness. It is possible with a computer to steal another person’s identity, forge a message, or send a message anonymously. There is an on-

going ethical debate about the pros and contras of anonymity, and under which condition anonymity can be acceptable in communication. An interesting related topic is AI-aided misrepresentation of oneself. (Dodig-Crnkovic and Horniak 2005)

Copying. Images, text and sound can be copied with a computer by means of a few clicks and the copy easily used out of context or without attribution to the author. This has resulted in the ongoing discussion about intellectual property.

Openness and availability. Computer networks make it easy for the user to acquire a virtually unlimited amount of information. Propaganda or other sorts of disinformation and misinformation might be difficult to handle by some users. Cyberstalking is an example mentioned in Tavani (2002). Even spam and other unwanted messaging is a consequence of the openness of the system and the availability of data such as e-mail addresses. Of ethical interest is also spreading of the use of AI in excessively violent computer games and simulations. (Dodig-Crnkovic and Larsson 2005)

Globalization. Computer communication does not stop at national boundaries. What is considered legal in one country might not be allowed in some other country.

Safety. Interesting ethical problem is responsibility for errors in expert systems, safety critical systems (such as intelligent transportation systems, intelligent medical equipment, and automated computerized security equipment). Ethical aspects of self-modifying systems deserve special attention.

Power mediation. Computing is still a predominantly well-educated-younger-male-dominated field. The computer is increasingly becoming such a basic tool that it is a problem for certain social groups to be denied equal access to it, especially in the e-government era. The related ethical questions include the political power, equity, fairness and justice.

Privacy. Computers are powerful tools for collecting data about people in order to determine their habits and patterns of behavior and they may be used for both legal and illegal surveillance. This can be used to enhance public security and safety, but also to invade the privacy and personal integrity of the citizen. Related field within Intelligent Systems is automated monitoring of conversations (phone, email, and web). This may be solved by technical and ethics research into the development of protocols and policies that effectively balance privacy rights with Internet security. Intelligent systems are often related to this sort of ethical concerns.

New ethical challenges within Roboethics include the use of robots, ubiquitous sensing systems, direct neural interfaces and invasive nano devices that actualize ethical issues of self, control, privacy and access.

¹ Stanford group definition: Roboethics builds upon bioethics and the more specific topic of neuroethics, the engineering disciplines of robotics, nanotechnology and user interface design, and the bioengineering domain of direct brain interfaces, also called, depending on the specific project focus, neural prostheses, neural implants, brain-computer interfaces, or brain computer communication interfaces.

Ethical consequences of the increased use of robotics that will cause extensive social and economic changes, must be given due attention in the ethical theory and debate. For example, the relationship between humankind and robots, and other artificial autonomous agents should be discussed.

If the prediction of Veruggio (CNR-Robotlab, Italy) comes true, "... the net will be not only a network of computers, but of robots, and it will have eyes, ears and hands, it will be itself a robot." this envisaged robot-net will possess ethical challenges never seen before.

3.2 Codes of Ethics

How can we work to ensure that computing technology including Intelligent systems not only respects but also advances human values? It is necessary to integrate computing technology and human values in such a way that the technology protects and advances rather than harms human values. Much of the ground work in doing this is performed with the help of codes of ethics.

Professional societies in science and engineering publish their ethical codes or guidelines. (See the List of Codes of Ethics), which presents a sampling of ethical codes from societies of professional engineers and scientists. Some differ widely in their content, because of their origins and their specific purposes, but the main topics and the general ethical standards they articulate are similar.

Professional codes of ethics should be understood as conventions between professionals (Luegenbiehl 1983; Martin and Schinzinger 1995). Having a code of ethics allows an engineer to object to pressure to produce substandard work not merely as an ordinary citizen but as a professional engineer (or doctor, or scientist, etc.) who can say "As a professional, I cannot ethically put business concerns ahead of professional ethics." (Davis, 1991)

Harris and Pritchard (1995) summarize Unger's analysis of the possible functions of a code of ethics: "First, it can serve as a collective recognition by members of a profession of its responsibilities. Second, it can help create an environment in which ethical behavior is the norm. Third, it can serve as a guide or reminder in specific situations. Fourth, the process of developing and modifying a code of ethics can be valuable for a profession. Fifth, a code can serve as an educational tool, providing a focal point for discussion in classes and professional meetings. Finally, a code can indicate to others that the profession is seriously concerned with responsible, professional conduct."

Codes of ethics and case studies are always closely related. Without guiding principles, case studies are difficult to evaluate and analyze; without context, codes of ethics are incomprehensible. The

best way to use these codes is to apply them in a variety of situations and study the results. It is from the back and forth evaluation of the codes and relevant cases that well-reasoned moral judgments can be arrived at.

4 Why Study Professional Ethics?

"Would you tell me, please, which way I ought to go from here?"

"That's depends a good deal on where you want to get to."...

L Carroll, Alice in Wonderland, Chapter VI, 1865

What is the point in studying ethics of computing? What can be gained from taking an Ethics course?

A Professional Ethics course is aimed to increase the ability of concerned engineers, researchers and citizens, to first recognize and then responsibly confront moral issues raised by technological activity. The goal is to cultivate moral autonomy, i.e. the skill and habit of to think rationally about ethical issues in the professional activity, and to increase the ability to think critically about moral matters. For the role of Computer Ethics in the Computer Science Curriculum, see Bynum (2004), and Moor (1985).

We are studying Ethics in order to:

- deal with the true nature of computing as a service to other human beings (Gotterbarn, 1991).
- convey a sense of professional responsibility not covered in other courses
- sensitize students to Computer Ethics issues
- provide tools and methods for analyzing cases
- provide practice in applying the tools and methods to actual or realistic cases
- develop in the student good judgment and helpful intuitions - ethical autonomy.

These important topics are not addressed outside the computing curricula education.

5 Professional Ethics Course at MdH Sweden

Following the lines of reasoning presented in this article, we have developed a course in Professional Ethics at Mälardalen University, intended in the first place for Computer Science and Engineering students. The emphasis is on cultivating sensibility to ethical problems, the development of moral autonomy, ethical pluralism and critical thinking.

The course gives an insight into the ethical problems important for professionals in Engineering and Science. It forms a framework in which professional and ethical issues can be analyzed, and builds up an awareness of various views of ethical issues and the ethical responsibilities of professionals.

The course is delivered as a combination of lectures, guest lectures, classroom training (discussions), and training in writing essays. For Professional Ethics in Science and Engineering Course, see: <http://www.idt.mdh.se/kurser/cd5590/>

Our experiences of the course up to now (2003-2006) have been very positive. Students have participated actively in discussions, case studies and research on chosen topics. Even predominantly technically-minded students were able to assimilate and use philosophical concepts. The examination forms for the course were the writing of a research paper on an ethical topic of interest and an oral presentation of a chosen topic (such as safety and security, intellectual property, environmental ethics, privacy and personal integrity etc.) followed by an in-class discussion led by the students responsible for the actual presentation. Course evaluation results show that students experienced the course as very useful and relevant to their future professional activities.

Moreover, two industrial PhD students have included specific chapters on ethical aspects of their work in their PhD respective Licentiate Theses as a consequence of taking part in the Ethics course (Larsson M. 2004 and Larsson S. 2005). They have investigated ethical consequences of software testing practices, and the software development teams effectiveness related to different ethical attitudes. Three other students have published articles on their field of interest in international journals and at CEPE and E-CAP conferences.

6 Conclusions

The growing importance of computers in the society makes the study of Computing Ethics essential when it comes to issues such as safety, security, privacy, environmental impact and quality related to the research, design and development of computational systems. Of all fields within computing, Intelligent Systems have most interesting and diverse ethical aspects. It is therefore of special significance for the field to develop the ethical attitude. Good examples are Stanford and Genova Roboethics groups: (<http://roboethics.stanford.edu/> <http://www.scuoladirobotica.it/roboethics/>).

Ethics courses in science and engineering are aimed to increase the ability of future professionals to recognize and solve ethical problems, to accept

different ethical perspectives and to adopt ethical pluralism. They develop the skill and habit of thinking rationally about ethical issues and in that way prepare students for the challenges of their profession. Experiences from the Professional Ethics in Science and Engineering Course at MdH are encouraging.

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<http://www.asce.org/inside/codeofethics.cfm>
- Software Engineering Code Of Ethics And Professional Practice
<http://www.computer.org/tab/seprof/code.htm>
- Ethics in Computing "site map"
http://legacy.eos.ncsu.edu/eos/info/computer_ethics/
- Codes of Ethics Online
<http://www.iit.edu/departments/csep/PublicWWW/codes/>

Codes of Ethics Links

- IEEE Code of Ethics
www.ieee.org/about/whatis/code.html
- ACM Code of Ethics and Professional Conduct
<http://www.acm.org/constitution/code.html>
- Responsible Conduct In Research
<http://www.nap.edu/readingroom/books/obas>
- Codes of Ethics for Engineering
<http://www.iit.edu/departments/csep/PublicWWW/codes/engineer.html>
- Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering, A Volume