Introducing Social and Ethical Concern in the Computer Science Curriculum: Why and How

John Krogstie   Guttorm Sindre

Norwegian Institute of Technology (NTH)
Faculty of Electrical Engineering and Computer Science
UNIT/NTH, IDT, N-7034 Trondheim, NORWAY
e-mail: johnkrog@idt.unit.no

Abstract

The current situation concerning ethics in the computer science curriculum at NTH is investigated, concluding that ethical concerns are given very little attention. In the following, it is argued that ethics *should* be an important component in the education of engineers and scientists, and that ethics is particularly important in a field like computing.

A rough outline of a course intended to introduce ethics in the computer science education at NTH is presented. The main purpose of this course is not to discuss ethics as such, but to introduce ethical concerns more specifically in a computing context.

1 The current status of ethics in computer science

Throughout history, there have been changing views on the extent to which scientific and technological endeavour should incorporate ethical concerns [24]. A dominant view in modern times, usually attributed to Max Weber, is that of *value freedom*, meaning that the scientist is supposed to be neutral

648

regarding moral, politics and religion when he acts as a scientist. This view can be exemplified by the following quotation taken from Lundberg [12]:

> *A chemist who invents a powerful explosive, should not concern himself if his product is used to blow up cathedrals, or to build tunnels.*

This view has been heavily criticized, and the general opinion has recently shifted towards a view that sees the value and need of ethical judgement being performed by scientists and engineers.

However, in computer science education, as well as in the practice of information systems engineering, value freedom still seems to be prevalent[10]. Most computer science students do not take any course in ethics, and for the few that do, this is more likely to be a general course in ethics than one which discusses particular ethical problems related to computerization.

The neglect for ethical concerns also shines through in several existing suggestions for computer science curricula:

Denning et al. [6], try to identify computing as a discipline, and come up with the following as the fundamental question underlying all of computing:

> *What can be (efficiently) automated?*

This might have been a proper way to look at it 20 years ago for a computer scientist. For an engineer, the question would rather be: "What is useful to automate", where we within useful also includes social, moral and economic factors. As it is now, the weight in their suggestion for a computer science curricula is on traditional, technical subjects, and ethical concerns are completely neglected. In being ACM's effort at curriculum standardization, the report has received much attention, and was for instance suggested as a starting point for the computing departments in Norwegian universities by an international evaluation committee hired by the national research council to evaluate research and teaching in Norway within the field of "informatikk" [14].

Parnas [17] emphasize the engineering tradition of computer science, building his suggestion for a curriculum on basic mathematics, basic science and engineering and various traditional computer science courses. Ethical and social concerns are not touched upon, at least not in his short article.

Dertouzos et al. [7] Has a somewhat broader focus, in that the report discusses the engineering education in general. It is added here since it has been influencing the general direction of the NTH curricula. It discusses what American engineering students should learn to regain their competitive edge, more or less neglecting social and environmental, and as such ethical issues [19].

The underlying philosophy of these suggestions for a curriculum seems to be that society is best served with people who are able to make systems that *work* — without concerning themselves with ethical and social questions related to these systems. In this respect, the attitudes underlying the mentioned suggestions have much in common with that of value freedom. One motivation for this view might be that engineers can be more effective at engineering if they can avoid ethical considerations.

The computer science curriculum at the NTH [23] has also previously suffered from a total neglect for professional ethics. However, the situation for ethics in NTH's education is improving. Recently, a course in ethics for technologists has been introduced (Technology, risks and values), based on a book by Andersen and Sørensen [3]. This is a course offered for all the students at the NTH and has no special material on ethical and social issues of computerization.

2 Why must ethics be taught?

We will in this section give a brief discussion for the need of including ethical and social concerns in the computer science curricula. The next section will discuss in more detail a proposal for including such concerns in the curriculum provided for computer scientists and engineers at NTH.

2.1 Ethics in general

Although there is a generally growing sympathy for introducing ethics in the curriculum at NTH, not everyone agrees to the need of this. There are several possible arguments against increasing the attention towards ethics in the curriculum. In the following we will review and discuss these arguments:

Argument 1: *People have ethical concerns anyway* and thus do not need a special course to deal with ethical issues in their job. This point was made by one of NTH's professors, whose impression was that the students at the school are interested in ethical dilemmas and environmental problems in the same way as everyone else. Giving them a mandatory course in ethics and environmental issues would be to disparage the students [19].

To this argument it might be said that, **yes**, to some extent ethics is something which people might "know" anyway. But is this a valid argument for not giving a course? First of all, there are many topics which people should know anyway, but where training still leaves a lot of room for improvement. One example of this could be oral presentation — although most students have been talking for more than 20 years, only few of them are able to make a really good oral presentation of a technical report. Second, the curriculum sends important signals to the students about what is considered important for them to know and what is not. If ethics is not included in the computer science curriculum, this *is* a signal that computer scientists and engineers do not have to think about ethics, at least not on the job. Finally, knowing that computer science departments attract some students which are occupied with computers and programming to the extent that they hardly participate in activities in the outside society, one might even question the claim that students are familiar with ethical and social issues from other sources.

Argument 2: *Technologists should deal with technology*, and leave ethical discussions guiding the development and use of technology to the politicians. Technologists could then restrict their duties in the ethical domain to

explaining the technology for politicians to assist their discussions.

From the perspective of work division, this is a tantalizing argument. However, there are several serious problems with such an arrangement. First, if the politicians themselves are unaware of the possibilities and threats of the technological evolution, they will not initiate the necessary discussions, i.e. the experts which could have helped them will not be summoned. Thus, the ethical debate around various technological issues tends to come first when serious problems have already occurred, alarming the politicians. Legislation guiding the development and use of technology generally comes several years too late. This means that to get the necessary debate in time, the initiate to start the debate must come from the technologists themselves, rather than from the politicians, and this requires ethically conscious technologists.

The low technological insight of politicians is an issue in its own right. Although the technological development is a major force in the shaping of our future society, politics on high levels (national and international) are dominated by people educated in disciplines such as law, economy, and administration. Is this because technological and political interest generally do not go together? Is it because political and social interest is not encouraged by technological education? Or is it because technological insight is not rewarded in political organizations? With the increasing importance of technology in our society, there should be more technologists in top politics, and more attention to ethical and social concerns in the curriculum could possibly help to inspire technologist to choose a political career.

Argument 3: *The curriculum is already so tight* that it is impossible to introduce something new without sacrificing something else which is also important. Thus, if students have to spend much time learning about ethics, they will have less time on technological subjects and possible graduate with an inferior technological platform, compared to students from schools which do not "waste" time on ethics.

At NTH, at least, this can hardly be an argument, since students have to learn many things which are rather peripheral to computer science (such as chemistry and mechanics). Few of the computer science graduates make use of this knowledge later. Besides, a course in professional ethics does not have to be big and time-consuming — the most important thing might be its signal effect: making the students aware of ethical problems and signalling that the school, and as such the society, finds it important that they think

about such issues.

Argument 4: *There is not a high demand* for ethical education in the job market for information system engineers. Employers of engineers usually want people who "fit in", e.g. who can easily learn a lot in a brief time and adapt to the way things are done in the company. People who worry a lot about ethical concerns may be harder to shape than those who do not.

It is probably true that many companies want people who are easy to shape. And at an engineering school like NTH, the school is rather occupied with providing industry with the kind of people they want. However, a university have duties beyond satisfying the short term wishes of industry — both when it comes to research and education. Rather than giving industry the people they want, a university should give industry the people that society needs. And society needs people who are able to combine technological skills with the understanding of ethical and social factors of their work.

2.2   Professional ethics in computer science

It could also be asked whether there is a need for a special ethics course for computer scientists — would it not suffice with a common course for all students, based on that everybody could relate the general ethical issues to his own discipline?

First of all it could be noticed that computerization is affecting a wide variety of human activities, its impact being much more radical than most other engineering activities. Based on this fact, Berztiss [5], quite contrary to Parnas [17], argues that education in computing should be more based on liberal arts than other engineering disciplines. Moreover, to some extent the ethical concerns with respect to computerization are different from the common ethical concerns in other disciplines. For instance, pollution and environmental issues are important in many other disciplines, but not so much for information systems engineering, where the product is logical rather than physical. On the other hand, privacy — which is a very important issue with respect to information systems — is hardly relevant in other engineering disciplines.

If ethics are only discussed in a generalized, abstract setting and not with specific reference to computerization, there is a danger that

- the students will not feel much of a coupling between their future work

roles and the ethics curriculum, and

- the ethical concerns might not go well together with the specific professional skills taught at the university.

For instance, students learn that a major goal in information systems engineering is to represent the client's requirements correctly, and then to build a system which satisfies these requirements. There are seldom concerns that some of the client's requirements might be unethical, and thus, the students receive no guidance on what they should do if this happens — or even how they should, at all, decide that requirements are unethical. If ethical education only provided some vague general discussion, it is unlikely that the student who has not heard anything about ethical concerns in connection with the much more concrete process of requirements engineering, will suddenly spend time on ethical concerns at requirements engineering when he gets out in industry, with tight schedules and budgets and a client which might be lost if he is not satisfied. To stand any chance when things get down to business, ethical concerns must be closely connected with the very development processes that the engineers are taught to follow. This makes it necessary with a computer specific ethics course in addition to the general one.

It should also be noted that professional ethics in computer science have received increasing attention lately, and several professional computer science communities such as ACM [1], IFIP [18], IEEE , BCS (British Computer Society), DPMA (Data Processing Management Association) and ICCP (Institute for Certification of Computer Professionals) have developed proposals for ethical codes for its members.

3   Course Outline

We are presently in the process of building up a course in ethics for computer science students. Having a separate course is certainly not the only way to introduce social and ethical concern in the curriculum, others have proposed instead to make ethics an integral part of several of the traditional courses. This is not a bad idea , but we feel that it is easier to present a coherent picture of the problem area through a separate course. It is also our experience that having one lecture in a technically dominated course in computer science about social and ethical problem in the area often have little impact,

and is often neglected by the students. On a more pragmatic note, we find it easier to come up with a suggestion for a new course, since we then not have to try to influence all the professors and other teachers of the institute to make changes to their courses. This is not to say that we are against including ethical concerns in other courses where they have a natural place. This points to the importance of making such a course that we are suggesting fit in with the rest of the curriculum. We feel that it is beyond the scope of this article to discuss a complete computer science curricula, but has taken this into account in the suggestion for a course outlined below.

Finally, we are aware that several courses of this kind already exist, among those one given at the Department of Informatics at the University of Trondheim. This course, built around a book made especially for the course in 1986 [20], is supposed to go through an extensive revision in the near future, and it feels natural to coordinate our work with this effort, especially taking into account that none of the authors have a thorough ethical education. The main motivation for having a separate book, and not have the syllabus being built up from several separate articles is partly because very little material exist that discusses Norwegian matters and partly to be able to create a more coherent course.

In the following we will first discuss the contents of the course, and then briefly outline how it should be taught. A detailed syllabus is not presented, since we expect to coordinate the effort as described above, resulting in a new version of the book used on the course at the University of Trondheim which can also be used as a cornerstone of the course given at NTH.

3.1   Topical content

There are many topics which could be included in a discussion of the social and ethical issues of computerization. If a course should try to cover every relevant topic, it would have to spend little time on each topic, and easily become superficial. One of the most important purposes of a course in ethics might be to provoke and inspire people to think for themselves. Then, a somewhat deeper treatment of fewer issues could be preferable. The selection of topics have been performed taking into account that most of our graduates ends up in engineering positions in private companies or consultancies, having direct or indirect influence on the development of new information systems. In this view, we regard the following issues as particularly important:

- System development: History and future
  One of the main motivation for learning the history of ones own discipline is to avoid making the same mistakes over and over again, as well as understanding why mistakes cannot altogether be avoided. For the development of this part, contact with technology historians at the University of Trondheim is being taken. We note that several existing overviews of this area already exist (see for instance [2] or [21] which has a special section on the history of computer science). Apart from pure technological history, it is also interesting to discuss various philosophical schools in systems development (see for instance [10]), and the philosophical ideas that has guided (or misguided) the development within computer science through time (see for instance [9]).

  It is also interesting to look into the future of computerization — scientists and engineers should be trained to have an imaginative foresight concerning the problems related to technological progress, rather than just understanding problems which have already been experienced. As cases for the discussions of the future, one could use ideas put forward in science fiction literature in addition to more traditional works where future development is predicted. Although this may seem far-fetched to some, it must be remembered that literature has previously exhibited an impressive ability to foresee the technological development, e.g. the novels of Jules Verne.

- Computerization and the Transformation of Work.
  Dunlop and Kling[8] states that it is particularly important to pay attention to how computerization is transforming work, since work is an important part of many people's lives, and since they are (at least so far) more visibly touched by computerization at work than in their spare time. Since most of our graduates will enter jobs that will change and influence the working conditions of other people, we feel that knowledge about the problems and possibilities that this gives should be obtained. To help us with the development of this part, we have contacted people of the Faculty of Economics and Industrial Management at NTH, where work on a Ph.D. level is presently being undertaken within this area.

  However, one of the most boosting areas for computing at the moment is in the home — both for amusement as such (e.g. games) and to

support various hobby activities. Thus, one should not totally neglect the possible effects of computerized spare time activities either even if few of our graduates currently end up developing this kind of systems.

- System Dependability and the Limits of Technology.
  From an ethical point of view, it is not so interesting to teach techniques for making reliable or secure systems. A more interesting angle is discussing the limits of rationality as such; the fact that systems can never be completely dependable, and thus the dangers of putting too much thrust in the technology. Whereas a good introduction to dependability as such is given by Laprie [11] the problem area of philosophical as well as practical limits to computer technology is treated by researcher such as Weizenbaum [25], Smith [22], and Parnas [16].

  Parallel to our work, there is plans for developing a separate course within systems dependability, focusing on the technical side of this problem, and we feel it would be natural to transfer this part of the course to this other course, when and if it will be implemented. As long as it is lacking though, we feel that the more fundamental problems of systems dependability should be raised in the curriculum.

- Privacy.
  Privacy is not exclusively related to computerization, but is a complicated cultural issue [13]. However, computerization has increased massively the speed and capacity of information processing, and at the same time reduced its cost. Thus, surveillance has become technologically and economically feasible in a much larger scale than what would otherwise have been the case. It can also be questioned whether computing is merely a passive, enabling factor when it comes to increasing surveillance, or if it also contributes to changing the opinion. We have made preliminary contact with the Norwegian watch-dog institution within this area, "Datatilsynet", which are positive to contribute with guest lectures within this area.

- Ethical Perspectives and Professional Responsibilities.
  As already mentioned, organizations such as ACM and IFIP have proposed ethical codes for professional conduct [1, 18]. An additional issue which has been hotly debated recently is whether software engineers should need some kind of certification. So far, the discussion about

certification has largely focused on purely technical skills. However, if certification is adopted, it might be an idea to introduce some aspects of professional ethics in the certification process. We are not proposing to adopt existing rule-sets blindly though. Rules for professional ethics is found in most engineering disciplines, but many of these have been critizised for a paternalistic attitude, and a focus on relationships between colleagues more than regard for the society and environment, which usually is only mentioned in general terms [3]. ACM states that their rules addresses this critique [4], but we should generally be aware of this problem if we want to have similar rules for computer scientists and engineers, and reevaluate the rules periodically. Another reason for not adopting existing rule-sets, is that they are made to function within a different social context than the one found in Norway. As already mentioned, the lack of material directed towards the special problem areas that we face in Norway is a major problem when trying to construct a course of this kind.

All in all, it should be emphasized that a course in ethics should not focus too much on hard facts and thumb rules. For some social issues of computerization — where there has been substantial research, for instance the influence on computerization on working conditions — the presented material should be empirically based and of top international journal quality. However, because of the ethical angle, it cannot be avoided that the course must have some speculative components, too. It should be appearant from the presentation which parts that are speculative and which are not. The main motivation should not be to teach the students long lists of ethical and social issues to memorize, but rather to create ethical awareness and provoke people to think for themselves. Most often ethical decisions are performed holding different arguments and values up against each other, and training in this kind of decision-process is as such vital.

3.2   Teaching methods

According to the goal to provoke and create awareness, the traditional lecture format might not be suitable for the course, at least not for more than smaller parts of it, introducing the different problem areas. The teachers should emphasize discussions and group-work.

To support the course, mandatory group work treating case-studies involving ethical conflicts within the different areas should be performed. This can be based upon existing material (e.g. [4, 15]). The group-work should take place to enable deeper understanding among the students of the problem area. Moreover, lectures given could have a provocative profile, introducing guest lecturers with particular interest (and controversial views?) on various topics.

Even if the main syllabus is thought to go into the new version of the book "Revolusjonen som forsvant", a large cursory syllabus should also be provided, pointing the students to further sources of information which might prove useful during their professional career.

4 Conclusion

As of now, the course is still in the planning state. The political will to offer such a course at the institute is present, making us confident that we will be able to offer an adequate course which will fit in neatly with the existing and future curriculum. By involving external forces which have more knowledge in the areas of ethics and organizational science, we hope to be able to give a course of high quality, even if we will have to somewhat sacrifice the depth of the treatment if we are to cover all the fields outlined above.

References

[1] ACM Code of Professional Conduct and Procedures for the Enforcement of the ACM Code of Professional Conduct. ACM, 1991.

[2] H. W. Andersen. Et kort riss av informasjonsteknologiens utvikling (In Norwegian). In P. M. Schiefloe and K. H. Sørrensen, editors, *Revolusjonen som forsvant*, pages 49–94. Universitetsforlaget, 1986.

[3] H. W. Andersen and K. H. Sørrensen. *Frankensteins Dilemma (In Norwegian)*. Gyldendal, 1992.

[4] R. E. Anderson, D. G. Johnson, D. Gotterbarn, and J. Perrolle. Using the new ACM code of ethics in decission making. *Communications of the ACM*, 36(2):98–107, February 1993.

[5] A. T. Berztiss. Engineering principles and software engineering. In *Proceedings of the 6th International Conference on Software Engineering Education*, pages 437–51, San Diego, USA, October 5–7 1992. Springer Verlag.

[6] P. J. Denning, D. E. Comer, D. Gries, M. C. Mulder, A. Tucker, A. J. Turner, and P. R. Young. Computing as a discipline. *Communications of the ACM*, 32(1):pages 9–23, January 1989.

[7] M. L. Dertouzos et al. Made in America - regaining the productive edge. Technical report, MIT, 1989.

[8] C. Dunlop and R. Kling. Computerization and the transformation of work. In C. Dunlop and R. Kling, editors, *Computerization and Controversy : Value Conflicts and Social Choices*, pages 182–199. Academic Press, 1991.

[9] R. A. Hirschheim. Information systems epistemology: An historical perspective. In E. Mumford, R. A. Hirschheim, G. Fitzgerald, and A. T. Wood-Harper, editors, *Research Methods in Information Systems*, pages 13–36. North-Holland, 1985.

[10] R. A. Hirschheim and H. K. Klein. Four paradigms of information systems development. *Communications of the ACM*, 32(10):pages 1199–1216, October 1989.

[11] J. C. Laprie. *Dependability: Basic Concepts and Terminology*. Springer Verlag, 1992.

[12] G. A. Lundberg. *Trends in American Sociology*. Harper, 1929.

[13] R. Lunheim and G. Sindre. Privacy and computing: A cultural perspective. In *IFIP WG 9.6 working conference on Security and Control of IT in Society*, M/S Ilich, August 12–17 1993. Elsevier, Amsterdam.

[14] E. J. Neuhold et al. Informatikk: Research and teaching in Norway. A critical evaluation. Technical report, NAVF, The Council for Natural Science Research, 1992.

[15] D. B. Parker, S. Swope, and B. N. Baker. *Ethical Conflicts in Information and Computer Science, Technology , and Business*. QED Information Sciences, 1990.

[16] D. L. Parnas. Software aspects of strategic defense systems. *American Scientist*, 73(5):pages 432–440, 1986.

[17] D. L. Parnas. Education for computing professionals. *IEEE Computer*, 23(1):pages 17–22, 1990.

[18] H. Sackman. A prototype IFIP code of ethics based on participative international consensus. In *Computerization and Controversy : Value Conflicts and Social Choices*, pages 698–703. Academic Press, 1991.

[19] P. Sandberg. NTH-utbildningen för framtiden (in Swedish). *Dragen*, 5(2):pages 121–125, 1992.

[20] P. M. Schiefloe and K. H. Sørrensen, editors. *Revolusjonen som forsvant (In Norwegian)*. Universitetsforlaget, 1986.

[21] R. Shinghal. *Formal Concepts in Artificial Intelligence*. Chapman & Hall, 1992.

[22] B. C. Smith. Limits of correctness in computers. Technical Report CSLI-85-35, Center for the study of Language and Information, Standford University, 1985.

[23] NTH Studieadministrasjonen. *Studieplan 1992–93*. NTH Trykk, 1992.

[24] K. E. Tranøy. *Vitenskapen - samfunnsmakt og livsform (In Norwegian)*. Universitetsforlaget, 1986.

[25] J. Weizenbaum. *Computer Power and Human Reason*. Freeman, San Francisco, USA, 1976.