Ethics 4 EU

#Ethics4EU

Existing Competencies in the Teaching of Ethics in Computer Science Faculties

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Executive Summary

Computer Ethics deals with the impact of digital Information and Communication Technologies (ICT) on our societies and the environment at large. It encompasses a range of issues and concerns from privacy and agency around personal information, digital literacy, big data including governance and accountability, the dominance of a small number of large network platforms, pervasive technology, the Internet of Things and surveillance applications, Artificial Intelligence (AI) and algorithmic decision making including the fairness, accountability, and transparency of those automated decisions, and automating human intelligence for robotics or autonomous vehicles. Importantly, it is not only about hardware and software, but it also concerns systems and how people and organizations and society and technology interact.

The Ethics4EU ("Ethics for you") project is targeted at third level educators, and specifically those that deliver Computer Science programmes and programmes from related disciplines. Ethics4EU will develop new curricula, learning resources and a virtual community of practice in Digital Ethics for Computer Science faculty. It follows a 'train the trainer' model for up-skilling Computer Science faculty in the delivery of Computer Ethics across Europe.

This report is one of the deliverables for the Ethics4EU project. It presents results obtained from a survey conducted in early 2020 that polled faculty from Computer Science and related disciplines on teaching practices in Computer Ethics in Computer Science across Europe. The survey was completed by respondents from 61 universities across 23 European countries. Participants were surveyed on whether or not Computer Ethics is taught to Computer Science students at each institution, the reasons why Computer Ethics is or is not taught, how Computer Ethics is taught (for example, as a standalone course or embedded within other courses), the background of staff who teach Computer Ethics and the scope of Computer Ethics curricula. Data was also gathered on teaching and learning methods used (theory, case studies, practical work) and how Computer Ethics is assessed. The results of the survey are a comprehensive insight into teaching practices for Computer Ethics in

Computer Science and related disciplines and will inform the development of new curricula and learning resources for Digital Computer Ethics as part of the Computer Ethics4EU project.

Some of the important findings that emerged from the survey include:

- Two thirds of the institutions surveyed teach Computer Ethics as part of Computer Science or related programmes, however one third do not.
- There is widespread agreement about the importance of teaching Computer Ethics to students enrolled on Computer Science or related programmes. This importance was noted whether or not an institute taught Computer Ethics as part of their Computer Science or related programmes.
- When Computer Ethics is not taught as part of Computer Science or related programmes the most common reasons given include a lack of staff availability and expertise.
- Most institutions devote a relatively small number of hours to teaching Computer Ethics in their Computer Science or related programmes, 67% of institutions surveyed teach 10 hours or less per semester.
- Computer Ethics is primarily taught in Computer Science or related courses that focus on the following topics - Artificial Intelligence, Computer Security and Human Computer Interaction.
- Computer Ethics is least commonly taught in Computer Science or related courses that focus on the following topics - Computer Architectures, Pervasive Computing, Scientific Computing and Simulation and Modelling.

Contents

A Brief Description of the Ethics4EU Project

The Ethics4EU project aims to support educators as it centers on bringing Computer Scientists and Ethics experts together to enhance the professional development of Computer Science lecturers, assisting them to develop high-quality and innovative curricula through collaboration with European colleagues in teaching and research roles in a multi-cultural context. As technology is rapidly evolving the ethical challenges that future Computer Science graduates will face will becomes more difficult to predict, but by educating them in the principles and philosophy of Computer Ethics, they will have the tools to deal with these challenges. As Skirpan *et al*. (2018)[1] comment "*embedding Ethics into the curriculum increase*[s] *the number of students who believe Ethics are important to their careers*". Integrating Computer Ethics into core teaching is a critical aspect of this project. This "*not only provides students valuable experience identifying, confronting, and working through ethical questions, but also communicates the need to identify, confront, and address ethical questions throughout their work in Computer Science. It provides them with ethical reasoning skills to take into their computing and information technology work after they graduate, equipping them to produce socially and ethically responsible computer technology, and knowledge of ways to argue with those with and for whom they work for their ethically-motivated design choices*[2]".

Therefore, assisting Computer Science lecturers in higher education (including Computer Ethics specialists) in upgrading their content to incorporate Computer Ethics as part of their teaching is both vital and necessary and they are the primary beneficiary target group of this project. As such the Ethics4EU project can be viewed as a 'Train the Trainers' project that addresses some of the core needs of this target group. Primarily, developing competence in embedding Computer Ethics across the curricula as too often Computer Ethics modules are taught as stand-alone modules and not linked to core curricula. Secondly, developing awareness of cultural contexts as Computer Ethics can mean different things in different countries and cultures. Thirdly, enhancing expertise within Computer Science faculties reducing their reliance on generic Computer Ethics expertise which is delivered without a technology background. Then making sure that lecturers stay up-to-date with trends in industry and also with the ethical implications of new technologies and finally, increasing awareness of case law as legislation is tested in practice.

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[1] Skirpan, M., Beard, N., Bhaduri, S., Fiesler, C., & Yeh, T. (2018, February). Computer Ethics education in context: A case study of novel Computer Ethics activities for the CS classroom. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education* (pp. 940-945).

[2] Grosz, B. J., Grant, D. G., Vredenburgh, K., Behrends, J., Hu, L., Simmons, A., & Waldo, J. (2019, August). Embedded Computer EthiCS: Integrating Computer Ethics Across CS Education. In *Communications of the ACM* (p.61).

The project has the following objectives:

- To identify gaps in Computer Science lecturers' knowledge of Computer Ethics
- To develop a common understanding of pan-European values in Computer Ethics in technology
- To develop a repository of open and accessible online curricula, teaching and assessment resources to support Computer Science Computer Ethics
- To produce practical guidelines and instructor guides for the teaching of Computer Science Computer Ethics
- To develop a sustainable European Community of Practice in Computer Science Computer Ethics
- To develop an online training program through the HubLinked Global Labs model for Computer Science lecturers in Computer Ethics.

The Ethics4EU project supports the development of open education and innovative practices in a digital era by developing curricula and learning resources underpinning a critical area of the EU Commission's Digital Agenda for 2020 and beyond. Employers will benefit from graduates with more relevant skills and better awareness and training in ethical issues. Policymakers need awareness of state of the art to mainstream initiatives, an awareness of ethical issues with technology and a supply of graduates in the workforce with these skills. This project is being carried out transnationally as the IT industry is inherently global and the internet ignores national boundaries. By pooling the resources of a European Community of Practice in this area, these issues can be addressed collectively to develop a shared understanding. High-quality teaching and assessment materials can be developed by a collective, enhancing understanding in European-wide context, building understanding between Computer Ethics specialists and technologists. European Computer Science lecturers will have access to a state-of-the-art staff training programme delivered online and transnationally to ensure their lecturers are at the forefront of these developments.

To achieve its goals the project proposes as outcomes a series of multipliers events and transnational meetings as well all seven intellectual outputs, including research reports, curricula guidelines, instructor guides and training, open access repositories and a pan-European community of practice. The study presented here is one of the two research reports proposed by the Ethics4EU Erasmus+project.

IO2: A Survey on Existing Competencies in the Teaching of Computer Ethics in Computer Science Faculties

The second intellectual output of the Ethics4EU project has been devised with the goal of better understanding the current landscape of Computer Ethics teaching in Computer Science higher education institutions across Europe. It is of central importance to the project to understand if and how Computer Ethics is currently taught in Computer Science programmes, the background of the teaching staff, the scope of the curricula, the teaching practices and learning methods, assessment and learning outcomes.

Our study builds on a previous investigation from one of the project partners (Informatics Europe) where a selected group of experts from European Universities contributed to a discussion addressing issues like the perceived importance, relevance and possible implementation of the teaching of ethical/social impact of Computer Science in university degree programmes in this discipline[3]. Here we extend and amplify that study, surveying more universities and adding more specific questions with the purpose of acquiring a broader understanding of the current practices for the teaching of Computer Ethics in Computer Science across Europe. Note that in this report, the term Computer Science is synonymous with the term Informatics, which was used in the Informatics Europe 2019 report. Computer Science and Informatics are used interchangeably across Europe and both refer to the same discipline. The former is mostly used in the UK and Ireland while the latter is the term used in mainland Europe.

Our study started in December 2019 when Technological University Dublin (TU Dublin)[4] together with Informatics Europe[5] and Mälardalen University[6], developed the first draft of an online questionnaire. The questionnaire was implemented using the Lime Survey software toolkit[7] and included over 20 questions. Before the survey was launched, it was pre-tested on a small sample of respondents from Ethics4EU partner institutions. Feedback on improving the questionnaire was incorporated, arriving to its final version, which is presented on Appendix 1.

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[3] Report of the Informatics Europe Working Group on Ethical/Social Impact of Informatics as a Study Subject in Informatics University Degree Programs. Informatics Europe, 2019, Paola Mello, Enrico Nardelli, with contribution from the Working Group Members.
[4] https://www.tudublin.ie/
[5] https://www.informatics-europe.org/
[6] https://www.mdh.se/en/malardalen-university/
[7] https://www.limesurvey.org/en/

In January 2020, the online questionnaire was sent to all members and networking partners of Informatics Europe and European Digital Learning Network (D-Learn)[8] reaching over 150 European Universities from more than 30 European countries. It was also publicly available from the Informatics Europe website. The data collection continued until the end of February. To get more survey responses, two weeks before the end of the fieldwork, reminders were sent to all previously contacted European Universities. In addition, the survey invitation was shared on a range of social media platforms, including: Twitter, Facebook and relevant LinkedIn groups that ultimately led to the planned number of participants - 61 universities from 23 European countries. Participants did not receive any incentives or remuneration to complete the survey.

The survey was structured in three parts. The first part consisted of demographic questions (Section A) answered by all 61 respondents. The rest of the questionnaire was split into two parts based on whether the respondent's institution teaches Computer Ethics as part of any Computer Science or related programmes. The second part (Section B) was addressed only to those that replied their institutions do not teach Computer Ethics as part of any Computer Science or related programmes, 22 out of 61 respondents. The third part (Section C) was completed by the 39 participants who responded their institutions teaches Computer Ethics as part of any Computer Science or related programmes. Below we present the results of the survey according to this structure, including all the detailed questions, statistics and qualitative answers.

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[8] http://dlearn.eu/

SECTION A

DEMOGRAPHICS

A1. What is your role within your institution?

In the survey we used the roles Lecturer and Professor to distinguish between early and later career faculty. Course leaders are faculty employed on a non-permanent basis. As can be seen in Table 1, the majority of the respondents have teaching roles, with the significant majority identifying as "Professor", and those in combination with the "Lecturer" category accounts for just over 77% of the responses (as these two terms are used interchangeably in different countries). Please note that in European counties, lecturers and professors are both full time academic staff who carry out teaching and research duties. Therefore 77% of respondents have direct teaching experience at University. It is also helpful that in this survey other respondents identify themselves as having academic management roles, given that they would be acutely aware of challenges associated to resource allocation, which has been identified as a key challenge in the teaching of Computer Ethics in Computer Science programmes. Please note that respondents could choose more than one role and as such the percentage sum is higher than 100%.

Table 1: Respondents role within the institution

	Count	Percentage
Lecturer	9	15%
Professor	38	62%
Course-Leader	8	13%
Head-of-Department	12	20%
Head-of-School	4	7%
Other	8	13%

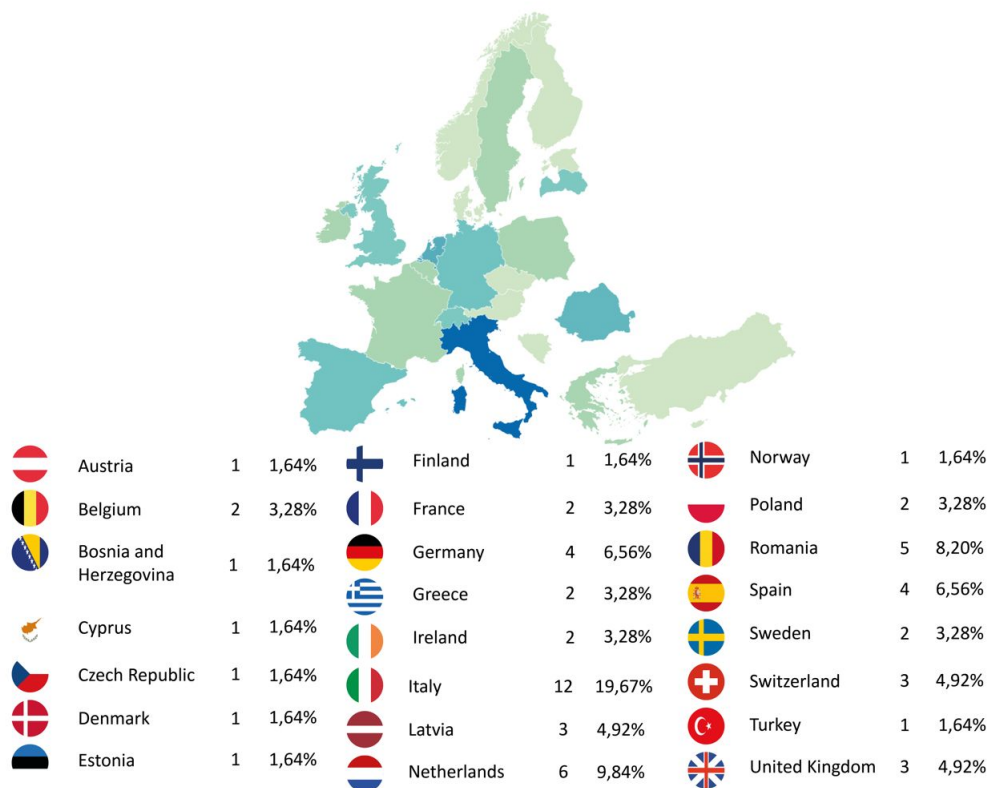Respondents could also provide other roles additionally to those shown in Table 1. The following roles were also provided:

- Vice Dean of Faculty
- Associate Professor
- Vice Rector and Former Head of School
- Head of Ethics Committee; Research Integrity Officer
- Teaching and Research Assistant
- Teaching Fellow
- Vice Dean
- Assistant Professor

A2. What country is your institution primarily based in?

Twenty-three countries were represented among the 61 respondents that took part in this survey. It is worth noting that the majority of the EU member countries are represented, as well as several other European countries. The majority (near 20%) of the respondents are from institutions in Italy, which most probably resulted from strongly connected Italian networks both in Informatics Europe and D-Learn. To assure that the Italian answers did not bias the results all subsequent questions were carefully analysed. As responses were grouped by whether an institution teaches ethics or not, the responses from Italian universities were balanced with the rest of the countries for Section C (institutions that do teach ethics). On the other hand, in section B (institutions that do not teach ethics), Italian institutions accounted for almost one third of the responses (7 out of 22). Steps were taken to balance the data using Jackknife resampling[9] whereby each response is systematically left out of the overall sample to ensure that no single response has a significant impact on the overall outcome. Additionally, pairs and trios of the responses from the Italian institutions were left out to explore whether or not those responses had a significant impact on the overall trends, and it was found that they did not.

Figure 1: Country in which the institution is primarily based

Country	Count	%	Country	Count	%	Country	Count	%
Austria	1	1,64%	Finland	1	1,64%	Norway	1	1,64%
Belgium	2	3,28%	France	2	3,28%	Poland	2	3,28%
Bosnia and Herzegovina	1	1,64%	Germany	4	6,56%	Romania	5	8,20%
			Greece	2	3,28%	Spain	4	6,56%
Cyprus	1	1,64%	Ireland	2	3,28%	Sweden	2	3,28%
Czech Republic	1	1,64%	Italy	12	19,67%	Switzerland	3	4,92%
Denmark	1	1,64%	Latvia	3	4,92%	Turkey	1	1,64%
Estonia	1	1,64%	Netherlands	6	9,84%	United Kingdom	3	4,92%

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[9] Tukey, J. W. (1977). *Exploratory data analysis* (Vol. 2). Reading, MA.

A3. Does your institution teach all subjects or focus on technical ones?

This question highlights that around one-third of the respondents are from institutions (where institution is a whole institution such as a University or a Technical University) that focus exclusively on technical subjects (e.g. technical universities), whereas around two-thirds are from institutions that provide a broader range of content (e.g. traditional universities).

Table 2: Type of institution

	Count	Percentage
Teach all subjects	42	69%
Focus on technical ones	19	31%

A4. Approximately how many students in total attend your institution?

As can be seen below, a wide range of institutions sizes are represented in this survey, with the number of students ranging from 1-1000 to 50000+. It is important to notice that most of the institutions represented in our survey are big universities, 79% of them having more than 10000 students.

Table 3: Number of students who attend the institution

	Count	Percentage
1-1000	4	6%
1001-5000	6	10%
5001-10000	3	5%
10001-25000	22	36%
25001-50000	23	38%
50000+	3	5%

A5. Approximately how many students are studying on Computer Science or related programmes?

The majority of institutions surveyed report having between 100 and 2500 students enrolled in Computer Science and related programmes.

Table 4: Number of Computer Science or related subjects students

	Count	Percentage
1-100	1	1%
101-500	12	20%
501-1001	14	23%
1001-2500	18	30%
2501-5000	10	16%
5000+	6	10%

A6. At which level of education does your institution offer Computer Science or related programmes?

NOTE: In this case a "programme" refers to a complete collection of subjects a student has to study before achieving a qualification, e.g. a BSc in Computer Science.

Of the 61 institutions surveyed, only 3 exclusively teach postgraduate programmes, and 1 exclusively teaches undergraduate, whereas the overwhelming majority teaches a combination of both.

Table 5: Programmes where Computer Science or related subjects are taught

	Count	Percentage
Bachelor + Master + PhD	55	90%
Bachelor only	1	2%
Bachelor and Master only	2	3%
Master and PhD only	1	2%
PhD only	2	3%

A7. Does your institution teach Ethics as part of any Computer Science or related programmes?

This is one of the most important findings of the survey, 36% of the respondents report that their institutions are not teaching Computer Ethics in their Computer Science (and related) programmes. This is a concerning statistic, given the complex ethical digital challenges that Computer Science graduates are now facing in workplaces upon graduation.

Table 6: Does your institution teach Ethics as part of any Computer Science or related programmes?

	Count	Percentage
Yes	39	64%
No	22	36%

S ECTION B

I NSTITUTIONS THAT DO NOT TEACH C OMPUTER E THICS

(22 out of 61 total responses, or 36%)

B1. How important is it that Ethics is taught in Computer Science or related programmes?

In institutions that do not teach Computer Ethics, almost two-thirds (63%) of the respondents' consider the teaching of Ethics as either being "Important" or "Very Important" for Computer Science (and related) programmes.

Table 7: How important is it that Ethics is taught in Computer Science or related programmes?

	Count	Percentage
1 = Not at all important	0	0%
2	3	14%
3	5	23%
4	8	36%
5 = Very important	6	27%

B2. Please explain in a sentence or two why you answered the previous question the way you did.

The respondents gave a range of reasons as to why the teaching of Computer Ethics is important. The most common was the ever-growing impact that computers have on society which was mentioned in one way or another by almost 50% of the respondents. Some of the respondents highlighted specific areas within Computer Science where Computer Ethics is important - Data Science, Artificial Intelligence, Computer Security and Ubiquitous Computing were mentioned multiple times.

In terms of the delivery of content, some respondents felt that Computer Ethics should be taught by incorporating it into existing modules, whereas others felt it should be delivered as an optional module. Specific content that respondents suggested includes teaching about Codes of Ethics, IP rights, and privacy, as well as the broad area of the design and development of software, and where Computer Ethics fits into that process.

Those who felt that there was not a need for teaching Computer Ethics suggested that employers do not ask for it, and although it is important, it's not the most important thing,

and it's not cost effective (in terms of the time that would have to be invested into it versus the results). Others claimed that a Computer Ethics course would not help the students become more ethical, or that they should already know about Computer Ethics before they come into tertiary-level education (from secondary-level education and their family). One respondent claimed that Computer Ethics is not taught in programmes for the other sciences, so wondered why Computer Science should be different; and another suggested it is only relevant in Computer Science research.

B3. Rate each of the following as possible reasons why Ethics is not taught.

Respondents were asked to select from a number of possible options and responses to this question reaffirms the notion that the majority of respondents in this part of the survey acknowledge the importance of teaching Computer Ethics (72%), and feel that Computer Ethics is sufficiently related to Computer Science (and related) programmes. The majority proposes that the reasons their institution does not teach it is a lack of time and a lack of staff availability. Half of the respondents suggests a lack of staff expertise in this topic.

Table 8: Rate each of the following as possible reasons why Ethics is not taught at the institution

	Count			Percentage		
	Somewhat disagree up to fully disagree	Neither agree nor disagree	Fully agree up to somewhat agree	Somewhat disagree up to fully disagree	Neither agree nor disagree	Fully agree up to somewhat agree
Ethics isn't that important	15	3	3	72%	14%	14%
Lack of staff expertise	4	7	11	18%	32%	50%
Lack of staff availability	3	3	16	14%	14%	72%
Lack of time	2	4	16	9%	18%	73%
The content too far away from Ethics	9	10	2	43%	48%	9%

Figure 2: Rate each of the following as possible reasons why Ethics is not taught at the institution
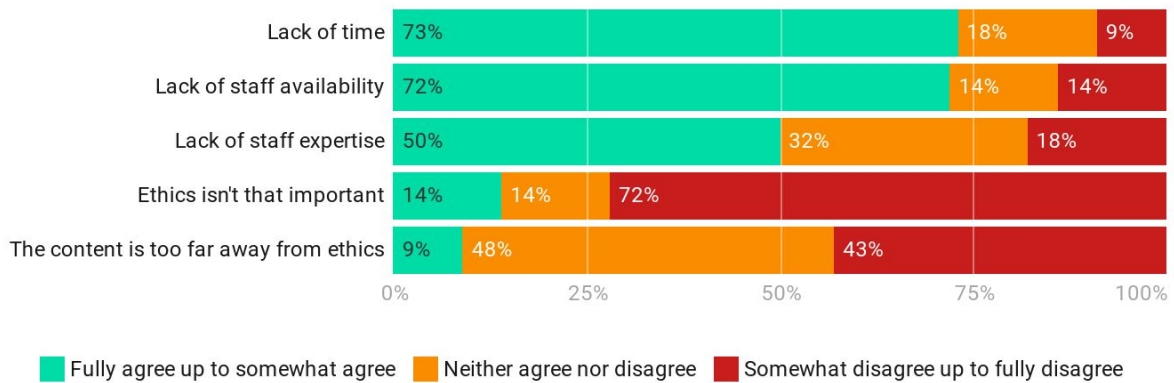
B4. Are there plans to teach Ethics in Computer Science or related programmes?

The answer to this question is noteworthy as it indicates that at least 40% of the respondents' institutions are planning to begin teaching Ethics in their Computer Science (and related) programmes, thus underscoring the timeliness and vital importance of developing Computer Ethics content and a Community of Practice in the area.

Table 9: Are there plans to teach Ethics in Computer Science or related programmes?

	Count	Percentage
Yes	9	41%
No	9	41%
Do not know	4	18%

For those respondents whose institutions are planning to teach Computer Ethics (at both BSc and MSc level), the main areas explicitly mentioned were Data Science, Artificial Intelligence, Computer Security, Health Informatics & Bioinformatics, Requirements Engineering, and CSCW (Computer-Supported Cooperative Work). One respondent mentioned that his institution is launching an Ethical-legal stream on their Data Science MSc programme.

For those who said their institutions have no plans to teach Computer Ethics in Computer Science (and related) programmes, it was stated as reasons either a lack of interest in the topic or a lack of expertise. One respondent did mention that the students have the option of doing a Computer Ethics module in another facility as part of their programmes.

Guidelines from Section B

Based on the responses from Section B of the survey we have developed the following guidelines that will direct the development of digital Computer Ethics curricula in the Ethics4EU project.

Guideline 1

Develop off-the-shelf teaching and assessment content and a Community of Practice that makes it easy for any Computer Science lecturer to deliver lessons on the topic of Computer Ethics.

Guideline 2

Develop content that discusses the general impact that computers are having on society, and specifically the ethical dimension of that impact.

Guideline 3

Develop content that addresses ethical issues for Computer Science areas explicitly mentioned by respondents, and that are regularly featured in the news media, for example, Data Science, Ubiquitous Computing, Artificial Intelligence and Computer Security. NOTE: There are other areas in Computer Science that were overlooked by respondents, like Computer Graphics and Computer Networks.

Guideline 4

Develop content that explores the broad area of the design and development of software, and where Computer Ethics fits into that process.

Guideline 5

Develop content that teaches specific topics such as Codes of Ethics, IP Rights, and Privacy.

Guideline 6

Develop content that can be delivered either as a stand-alone module or incorporated into other modules.

Guideline 7

Develop content that highlights the importance of teaching Computer Ethics and its impact on students.

Guideline 8

Develop content that highlights the range of different disciplines that teach Computer Ethics.

Guideline 9

Develop content that will aid lecturers who wish to incorporate Computer Ethics content into their programmes by creating a collection of materials, including news items and arguments that highlight vital importance of equipping graduates with their own ethical framework.

Guideline 10

Develop Quality Assurance documentation, such as Module Descriptor documents, to male the incorporation of Computer Ethics into existing programmes as easy as possible.

SECTION C

INSTITUTIONS THAT DO TEACH COMPUTER ETHICS

(39 out of 61 total respondents, or 64%)

C1. How important is it that Ethics is taught in Computer Science or related programmes?

In institutions that are already teaching Computer Ethics in Computer Science or related programmes, no one surveyed regarded the teaching of Computer Ethics as unimportant, while 95% of the respondents rate the teaching of Computer Ethics as either being "Important" or "Very Important".

Table 10: How important is it that Ethics is taught in Computer Science or related programmes?

	Count	Percentage
1 = Not at all important	0	0%
2	1	2%
3	1	3%
4	8	21%
5 = Very important	28	74%

C2. Do you think your institution/department is teaching enough Ethics in Computer Science or related programmes?

Over one-third (36%) of the participants responded they felt that there is not enough Computer Ethics being taught in their institutions. Almost half felt enough Computer Ethics is being taught "to a certain extent". 15% percent of those surveyed do believe that their intuitions are teaching enough Computer Ethics in their Computer Science or related programmes.

Table 11: Do you think your institution/department is teaching enough Ethics in Computer Science or related programmes?

	Count	Percentage
Yes	6	15%
To a certain extent	19	49%
No	14	36%

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C3. At which level of education is Ethics taught as part of your Computer Science or related programmes?

Computer Ethics is taught in 26% of the surveyed institutions at BSc level only. In 23% of the surveyed institutions it is taught at both BSc and MSc level. In 28% of institutions it is taught at BSc, MSc, and PhD level. The final 23% represents other combinations, such as "BSc and PhD level" or "MSc level only".

Table 12: At which level of education is Ethics taught as part of your Computer Science or related programmes?

	Count	Percentage
BSc only	10	26%
BSc & MSc	9	23%
BSc & MSc & PhD	11	28%
Other combinations	9	23%

C4. How is Ethics taught in your Computer Science or related programmes?

NOTE: in this case, a "module" refers to a single topic that a student studies over one or two semesters, e.g. Databases, Computer Networks, etc.

This question explores if Ethics is being taught as a stand-alone module, or distributed throughout several modules, or a combination of both.

Table 13: How is Ethics taught in your Computer Science or related programmes?

	Count	Percentage
Threaded throughout several modules	11	28%
As a stand-alone module	15	39%
A combination of both above approaches	13	33%

C5. What background does the person or people who teach Ethics in your Computer Science or related programmes have?

The results presented here show that the people teaching Computer Ethics come from a wide variety of backgrounds, with many coming from multiple disciplines. The most represented discipline is Computer Science at 72%. However, a large number of those teaching Computer Ethics have backgrounds in Ethics, Philosophy and Law. Please note that

respondents could choose more than one background and as such the percentage sum is higher than 100%.

Table 14: Background of the people who teaching Ethics in Computer Science or related programmes

|	Count	Percentage
Computer Science	28	72%
Ethics	17	44%
Philosophy	12	31%
Sociology	6	15%
Law	9	23%
Other	4	10%

Other backgrounds were provided by respondents in free text answers and included: *"Economics"; "Linguistics, Cognitive Science"*.

C6. Which of the following teaching methods are used to teach Ethics in your Computer Science or related programmes?

It is clear that the traditional approaches to teaching, such as "Lecturing" and "Case Studies" are in the dominant forms of teaching Computer Ethics, with "Debates" and "Problem Based Learning" the next most popular pair of approaches. These four techniques are certainly appropriate approaches for teaching Computer Ethics, but since the topic is so diverse and wide-spanning, there may be some benefit in exploring how other disciplines present Computer Ethics content. Guest Lectures from Academia and Industry are the next two most common categories, followed by three more experimental approaches to teaching: "Role Playing", "Blended Learning", and "Work-Based Learning". The lowest two techniques are Guest Lectures, from Government Bodies and Professional Bodies. Other Methods listed includes:

- Groupwork, Peer Instruction (using PeerWise), Student Discussions
- Seminars and Guest lecturers from the Arts
- Interviews with Researchers
- Student Presentations
- Embedded Videos.

Figure 3: Methods used to teach Ethics in Computer Science or related programmes
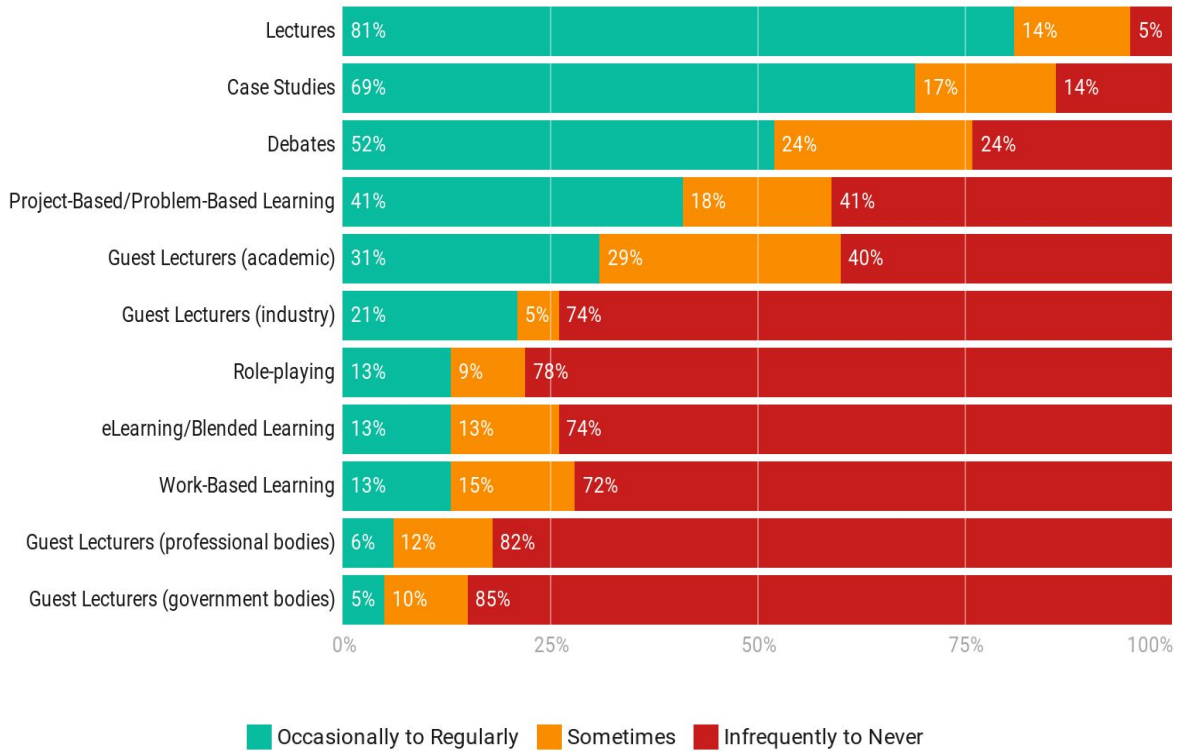
C7. How many teaching hours per semester is devoted to Ethics topics in your Computer Science or related programmes?

Just under half of all respondents (49%) indicated that they teach between up to 5 hours per semester, in contrast to 18% of respondents who indicated that they teach Computer Ethics for 20+ hours per semester. There is clearly a wide variance to the amount of time institutions devote to the teaching of Computer Ethics in Computer Science (and related) programmes.

**Table 15: Teaching hours per semester devoted to Ethics in Computer Science or related programmes**

	Count	Percentage
0-1 hours	6	16%
2-5 hours	13	33%
6-10 hours	7	18%
11-20 hours	4	10%
20+ hours	7	18%
Do not know	2	5%

C8. Which Ethics topics are taught in your Computer Science or related programmes?

The most common type of ethical content (76%) delivered relates to Ethical Issues. Just over half of the participants (51%) teach the Code of Ethics of a professional body, and exactly half (50%) teach Ethical Theory; both of which could be viewed as relatively static, and agreed, content. Other topics mentioned included:

● Responsibility
● Legal Issues
● Ethics Washing
● Epistemic Issues
● EU Ethics.

Figure 4: Ethics topics taught in Computer Science or related programmes
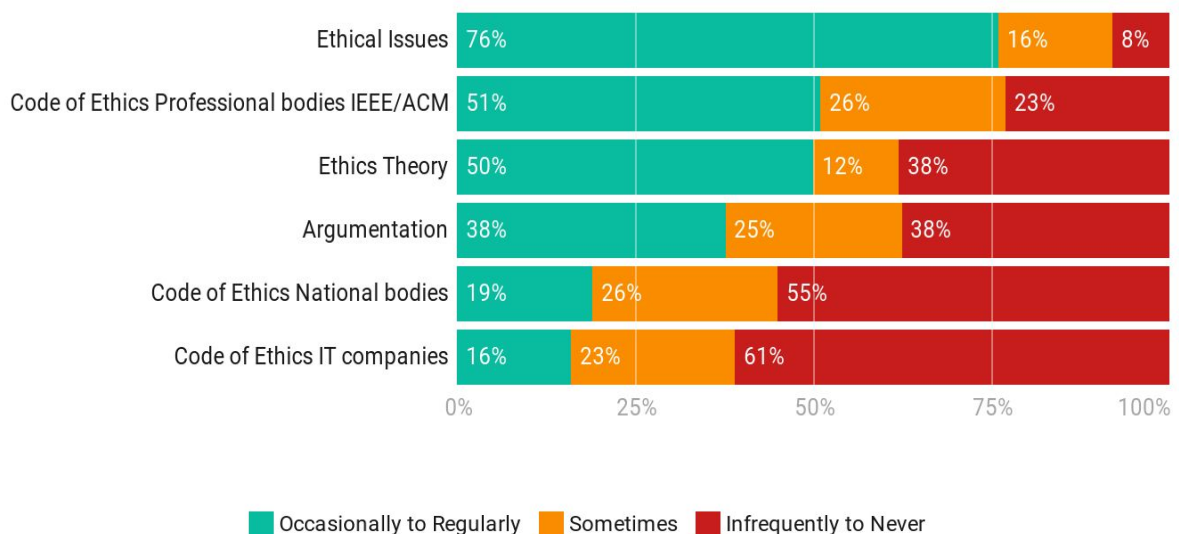
C9. How is Ethics assessed in your programmes?

The top three methods of assessing the students' understanding of Computer Ethics topics are Exams, Essays, and Presentations; three very standard approaches to assessing any Computer Science content. With much lower representation we find Quizzes, Portfolios, and Rubrics; which are slightly more dynamic, and less typical for Computer Science assessment. Some other mentioned approaches included more student-centred methods such as Debates, Peer Instruction with PeerWise, and Discussion; and more dynamic and real-world approaches such as Risk Analysis, Real Use Cases, and Videos. Please note that respondents could choose more than one method of assessment and as such the percentage sum is higher than 100%.

Table 16: Assessment of Ethics in Computer Science or related programmes

|	Count	Percentage
Exams	27	68%
Essays	25	64%
Quizzes	11	28%
Rubrics	3	8%
Presentations	21	54%
Portfolios	4	10%

C10. Does your institution teach Ethics as part of any of the Computer Science areas outlined below?

The survey used the European Research Council's Peer Evaluation (PE) panel classifications of Computer Science (PE6) areas to comment on their applicability to Computer Ethics. The categories are as follows:

- **PE6_1**: Computer architecture, pervasive computing, ubiquitous computing
- **PE6_2**: Computer systems, parallel/distributed systems, sensor networks, embedded systems, cyber-physical systems
- **PE6_3**: Software engineering, operating systems, computer languages
- **PE6_4**: Theoretical computer science, formal methods, and quantum computing
- **PE6_5**: Cryptology, security, privacy, quantum crypto
- **PE6_6**: Algorithms, distributed, parallel and network algorithms, algorithmic game theory
- **PE6_7**: Artificial intelligence, intelligent systems, multi agent systems
- **PE6_8**: Computer graphics, computer vision, multi-media, computer games
- **PE6_9**: Human computer interaction and interface, visualization and natural language processing
- **PE6_10**: Web and information systems, database systems, information retrieval and digital libraries, data fusion
- **PE6_11**: Machine learning, statistical data processing and applications using signal processing (e.g. speech, image, video)
- **PE6_12**: Scientific computing, simulation and modelling tools
- **PE6_13**: Bioinformatics, biocomputing, and DNA and molecular computation.

The survey asked respondents to rank the "Teaching Ethics as part of these areas in your institution" with reference to each of the 13 categories. The results are presented below.

Figure 5: Ethics teaching as part of PE6 areas
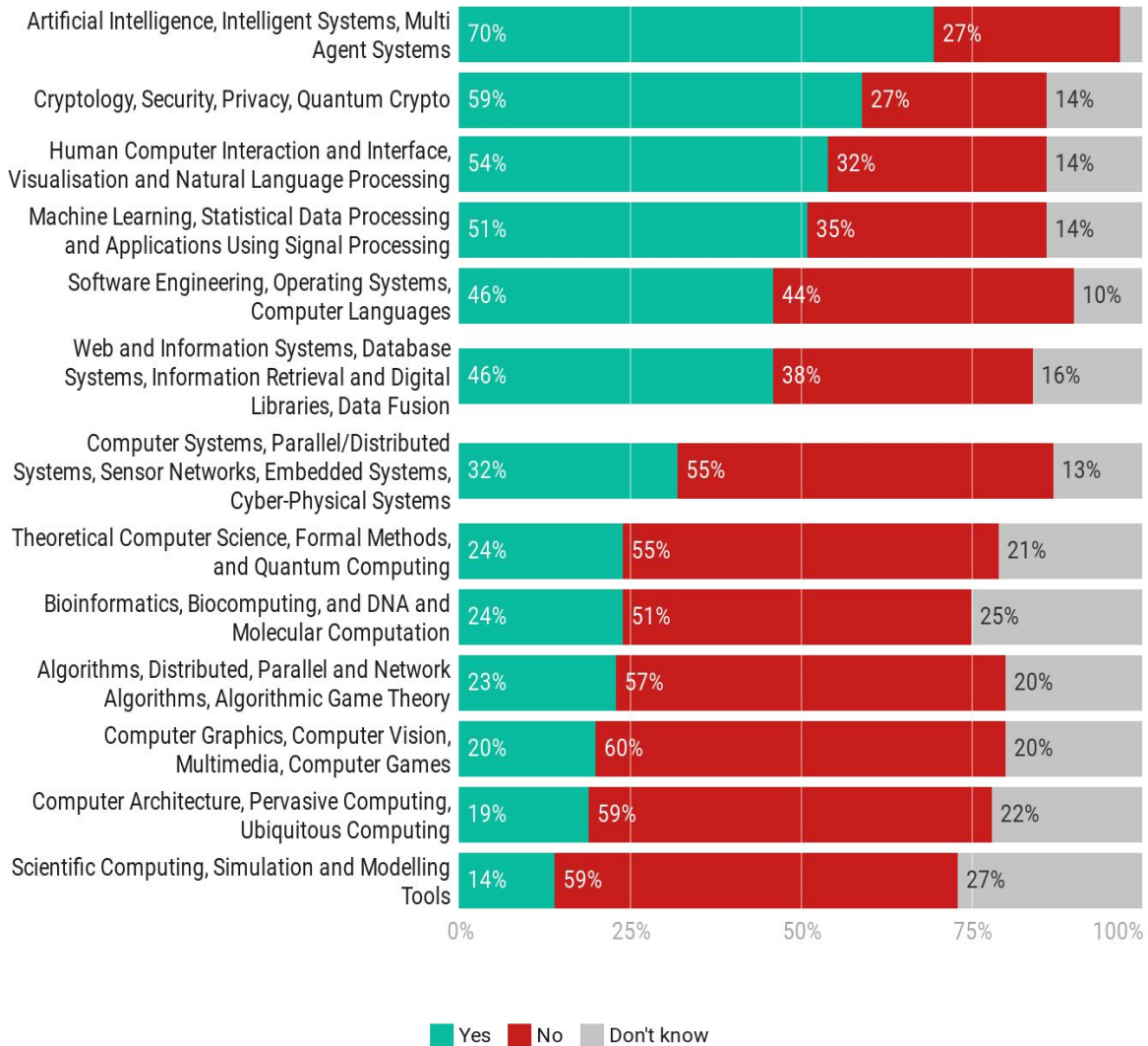
As seen in Figure 11, the leading PE6 areas where Ethics is taught are:

1. PE6_7: Artificial Intelligence, Intelligent Systems, Multi Agent Systems
2. PE6_5: Cryptology, Security, Privacy, Quantum Crypto
3. PE6_9: Human Computer Interaction and Interface, Visualization and Natural Language Processing
4. PE6_11: Machine Learning, Statistical Data Processing and Applications using Signal Processing (e.g. Speech, Image, Video)
5. PE6_3: Software Engineering, Operating Systems, Computer Languages
6. PE6_10: Web and Information Systems, Database Systems, Information Retrieval and Digital Libraries, Data Fusion.

The PE6 areas where least Ethics is taught are:

1. PE6_8: Computer graphics, computer vision, multi-media, computer games
2. PE6_1: Computer architecture, pervasive computing, ubiquitous computing
3. PE6_12: Scientific Computing, Simulation and Modelling Tools.

Guidelines from Section C

Based on the responses from Section C of the survey we have developed the following guidelines that will direct the development of teaching curricula in the Ethics4EU project.

Guideline 11

Develop content that explores approaches to teaching and assessing Computer Ethics, both from within the Computer Science discipline, and from other disciplines.

Guideline 12

Develop content that teaches students about ethical issues in all thirteen areas of the European Research Council's Peer Evaluation (PE) panel classifications of Computer Science.

APPENDIX 1

THE FULL QUESTIONNAIRE FOR THE 2020 ETHICS4EU SURVEY

SURVEY ON EXISTING PRACTICES IN THE TEACHING OF ETHICS IN COMPUTER SCIENCE PROGRAMMES

Dear colleagues,

We cordially invite you to participate in our survey examining existing practices in the **teaching of Ethics in Computer Science programmes.**

This survey is run within a new project " Ethics4EU",
led by TU Dublin School of Computer Science in partnership with Informatics Europe, Mälardalen University, Télécom SudParis and the European Digital E-learning Network. The goal of the whole project is to develop new curricula, best practices and learning resources for Computer Ethics for Computer Science students. And to do so, we firstly need to understand how Computer Ethics is actually taught in accredited Computer Science and Computer Science related programmes across Europe, what are the learning outcomes of Computer Ethics modules, the teaching and learning methods used, what is the background of staff who teach Computer Ethics and how Computer Ethics is assessed for Computer Science students.

Your answers to these questions will help us to prepare a report in which we summarize the existing practices and outline possible approaches for developing a future curriculum of Computer Ethics in Computer Science programmes. The report will be publicly available and shared with all survey participants.

We would be grateful if you could fill in this questionnaire on behalf of your institution by February 29. It will take only 15-20 minutes of your time. Thank you for your contribution!

Best regards, Ethics4EU team.

ABOUT YOUR INSTITUTION

In this survey

- *INSTITUTION refers to a University, University College, Technical University, Institute of Technology, Polytechnic University and other types of higher education institutions;*
- *PROGRAMME refers to a complete collection of subjects a student had to study before achieving a qualification, e.g. a BSc in Computer Science;*

- *MODULE refers to a single topic that a student studies over one or two semesters, e.g. Databases, Computer Networks, etc.*

1. **What is your role within your institution? (choose all that apply)**

- Lecturer
- Professor
- Course Leader
- Head of Department
- Head of School
- Other, please specify:

2. **What country is your institution primarily based in? (choose only one answer)**

- Albania
- Andorra
- Armenia
- Austria
- Azerbaijan
- Belarus
- Belgium
- Bosnia and Herzegovina
- Bulgaria
- Croatia
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Georgia
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Italy
- Kazakhstan
- Kosovo
- Latvia
- Liechtenstein
- Lithuania
- Luxembourg
- Malta
- Moldova
- Monaco
- Montenegro
- Netherlands
- North Macedonia
- Norway
- Poland
- Portugal
- Romania
- Russia
- San Marino
- Serbia
- Slovakia
- Slovenia
- Spain
- Sweden
- Switzerland
- Turkey
- Ukraine
- United Kingdom

3. **Does your institution teach all subjects or focus on technical ones? (choose only one answer)**

- Teach all subjects
- Focus on technical ones

4. **Approximately how many students in total attend your institution? (choose only one answer)**

- 1-1000
- 1001-5000
- 5001-10000
- 10001-25000
- 25001-50000
- 50000+

5. **Approximately how many students are studying on Computer Science or Computer Science related courses (e.g. Informatics, Information Systems, Analytics, Computing for Business, Computer Engineering, etc.)? (choose only one answer)**

- 1-100
- 101-500
- 501-1001
- 1001-2500
- 2501-5000
- 5000+

6. **At which level of education does your institution teach Computer Science or related programmes? (choose all that apply)**

- Bachelor
- Master
- PhD

7. **Does your institution teach Ethics as part of any Computer Science or related programmes? (choose only one answer)**

- Yes -> *Go to Section: Your institution is currently Teaching Ethics as part of Computer Science programmes*
- No -> *Go to Section: Your institution is not currently Teaching Ethics as part of Computer Science programmes*

  PROGRAMME refers to a complete collection of subjects a student had to study before achieving a qualification, e.g. a BSc in Computer Science.

YOUR INSTITUTION IS NOT CURRENTLY TEACHING ETHICS AS PART OF COMPUTER SCIENCE PROGRAMMES

Only answer this section if your answer was 'NO' at question '7. Does your institution teach Ethics as part of any Computer Science or related programmes?'

1. **How important do you think it is that Ethics is taught in Computer Science or related programmes? (1=not at all important, 5=very important)**

- 1
- 2
- 3
- 4
- 5

   PROGRAMME refers to a complete collection of subjects a student had to study before achieving a qualification, e.g. a BSc in Computer Science.

2. **Please explain in a sentence or two why you answered the previous question the way you did.**

3. **Rate which of the following as reasons why Ethics isn't taught.**

	1 (disagree)	2	3	4	5 (agree)
Ethics isn't that important					
We have a lack of staff expertise					
We have a lack of staff availability					
We have a lack of time (there's too many other things to teach)					
The content we teach is too far away from Ethics					

   If none of the reasons above fits, specify your reason why Ethics isn't taught in Computer Science or related programmes in your institution.

4. **Are there plans to teach Ethics in Computer Science or related programmes?**

- Yes   Please comment:
- No
- Don't know

YOUR INSTITUTION IS CURRENTLY TEACHING ETHICS AS PART OF COMPUTER SCIENCE PROGRAMMES

Only answer this section if your answer was 'YES' at question '7. Does your institution teach Ethics as part of any Computer Science or related programmes?'

1. **How important do you think it is that Ethics is taught Computer Science or related programmes? (1=not at all important, 5=very important)**

- 1
- 2
- 3
- 4
- 5

   PROGRAMME refers to a complete collection of subjects a student had to study before achieving a qualification, e.g. a BSc in Computer Science.

2. **Do you think your institution/department is teaching enough Ethics Computer Science or related programmes? (choose only one answer)**

- Yes
- To a certain extent
- No

3. **At which level of education is Ethics taught as part of Computer Science or related programmes? (choose all that apply)**

- Bachelor
- Master
- PhD

4. **How is Ethics taught? (choose only one answer)**

- As a stand-alone module
- Threaded throughout several modules
- A combination of both above approaches

 MODULE refers to a single topic that a student studies over one or two semesters, e.g. Databases, Computer Networks, etc.

5. **Which background has the person or people who teach Ethics in your Computer Science or related programmes? (choose all that apply)**

- Computer Science
- Ethics
- Philosophy
- Sociology
- Legal studies
- Other, please specify:

6. **Which of the following teaching methods are used to teach Ethics in your Computer Science or related programmes?**

	1 (never)	2	3	4	5 (regularly)
Lectures					
Case Studies					
Debates					
Role-playing					
eLearning or Blended Learning					
Project-Based or Problem-Based Learning					
Work-Based Learning					
Guest Lecturers (academic)					
Guest Lecturers (industry)					
Guest Lecturers (government bodies)					
Guest Lecturers (professional bodies)					
Others, please specify:					

7. **How many teaching hours per semester is devoted to Ethics topics in your Computer Science or related programmes? (choose only one answer)**

- 0-1 hours
- 2-5 hours
- 6-10 hours
- 11-20 hours
- 20+ hours
- Don't know

8. Which of the following topics are taught in your Computer Science or related programmes?

	1 (never)	2	3	4	5 (regularly)
Ethics Theory					
Ethical Issues					
Argumentation					
Code of Ethics (Professional bodies), e.g. IEEE, ACM					
Code of Ethics (National bodies)					
Code of Ethics (IT companies)					
Others, please specify:					

9. How is Ethics assessed in these programmes? (choose all that apply)

- Exams
- Essays
- Quizzes
- Rubrics
- Presentations
- Portfolios
- Other, please specify:

10. Does your institution teach Ethics as part of any of the Computing topics outlined below?

	Yes	No	Don't know
Computer Architecture, Pervasive Computing, Ubiquitous Computing			
Computer Systems, Parallel/Distributed Systems, Sensor Networks, Embedded Systems, Cyber-Physical Systems			
Software Engineering, Operating Systems, Computer Languages			
Theoretical Computer Science, Formal Methods, and Quantum Computing			
Cryptology, Security, Privacy, Quantum Crypto			
Algorithms, Distributed, Parallel and Network Algorithms, Algorithmic Game Theory			
Artificial Intelligence, Intelligent Systems, Multi Agent Systems			
Computer Graphics, Computer Vision, Multimedia, Computer Games			
Human Computer Interaction and Interface, Visualisation and Natural Language Processing			
Web and Information Systems, Database Systems, Information Retrieval and Digital Libraries, Data Fusion			

Machine Learning, Statistical Data Processing and Applications Using Signal Processing			
Scientific Computing, Simulation and Modelling Tools			
Bioinformatics, Biocomputing, and DNA and Molecular Computation			

FINISHING OFF

1. **Your Institution name**

2. **Your name / email address (optional)**

3. **Any further comments regarding Ethics in Computer Science or Computer Science related programmes**