

Bibliometric Mapping of Computer and Information Ethics

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Abstract

This paper presents the first bibliometric mapping study of the literature on computer and information ethics (C&IE). It provides an all-in-one picture of the relations between 400 key terms in the field. This all-in-one picture is useful to get a quick overview of topics and concepts in the field, and to identify relations between on the one hand information and communication technology concepts (e.g., ambient intelligence, robotics) and on the other hand ethical concepts (e.g., privacy, autonomy, freedom). To create the term map, a data set of over thousand titles and abstracts of articles published in leading journals and conference proceedings in C&IE was constructed. With the help of a computer algorithm, key terms were identified in the data set and co-occurrence frequencies of these terms were calculated. Based on the co-occurrence frequencies, a term map was constructed. This was done using a computer program called VOSviewer. The term map gives a visual, all-in-one overview of the relations between key terms in the field of C&IE and provides a novel and original way of looking at the field.

Keywords Bibliometric mapping, Computer & Information Ethics, VOSviewer

1 Introduction

Computer and information ethics (hereafter C&IE) is a branch of applied ethics that emerged in the 1980s. It studies the social and ethical impact of information and communication technology (ICT) on individuals and society. The more specific term ‘computer ethics’, coined by Walter Maner in the 1970s, refers to the application of normative theories such as utilitarianism, Kantianism, or virtue ethics to particular ethical cases that involve computer systems or networks. Computer ethics is also used to refer to professional ethics for computer professionals such as ethical codes of conduct that can be used as guidelines for an ethical case. In 1985, Jim Moor (1985) and Deborah Johnson (1985) published seminal texts that helped define the field. From then on, the field was recognized as an established field in applied ethics with its own journals, conferences, research centers, and professional organizations. Particularly in the last decade, ICT received a significant amount of attention from ethicists as well as sociologists, anthropologists, and scholars in law, education, and communication studies. Recently, computer ethics broadened to ethics of information technology and information ethics, a more general field that includes computer ethics, media ethics, library ethics, and bioinformation ethics (Brey & Søraker, 2009). Overviews of the field can be found in handbooks (Floridi, 2010; Johnson,

2008; Tavani & Himma, 2008; Van den Hoven & Weckert, 2008), encyclopedia articles (Bynum, 2008; Brey & Søraker, 2009) and papers (Buchanan, 1999). These documents give overviews of C&IE by providing a history of the field and by discussing and analyzing the most important topics.

The main aim of this paper is to provide an all-in-one overview of the field of C&IE. Given the size and complexity of the field, it is helpful to have a comprehensive all-in-one overview of the most important topics and concepts and their relations. In this paper, we take a bibliometric mapping approach to obtain such an overview. Our approach yields a map of the relations between key terms in the field of and information ethics. A data set was constructed of over thousand titles and abstracts of articles published in journals and conference proceedings on C&IE in the period 2003–2009. Key terms in the data set were identified with the help of a computer algorithm, and for each pair of terms the number of times the terms occur together in the same article was counted. The number of co-occurrences of two terms was used as a measure of the relatedness of the terms. A computer program called VOSviewer (Van Eck & Waltman, 2010; freely available at www.vosviewer.com) was used to construct a map of the key terms based on their co-occurrence frequencies. In general, the larger the co-occurrence frequency of two terms, the closer the terms are located to each other in the map. The resulting term map gives a visual, all-in-one overview of the relations between key terms in the field of C&IE and provides a novel and original way of looking at the field.

Our analysis may also serve as a starting point for a dynamic analysis of the field of C&IE. Other bibliometric mapping studies of the field may be done in the future and could then be compared to the present study. In this way, one can examine the development of the field. By comparing different bibliometric mapping studies, one could for example analyze which new concepts are introduced over time, which concepts gain or lose attention over time, and which concepts gain or lose importance in relation to other concepts.¹

The remaining sections of this paper are organized as follows. We discuss our methodology in Section 2. We first describe how we constructed our data set, and we then explain how we performed our analysis. We present our results in Section 3. Finally, in section 4, we summarize our most important findings and we draw some general conclusions.

2 Methodology

Data Set

The first step in this study is the construction of a representative data set of C&IE literature. To construct such a data set, we needed to select the sources in which the best and most comprehensive studies on ethical issues related to ICT can be found. Scholars in C&IE publish and interact in a limited number of journals and conferences. We selected these journals and conferences based on our experience and expertise in the field and also based on information provided by journals and conferences on their websites. After selecting the relevant journals and conferences, we constructed an extensive data set. This data set contains titles and abstracts of

¹ A somewhat similar study was done by Waaijer, Van Bochove & Van Eck (2010). They used VOSviewer to compare the topics discussed in editorials in *Nature* and *Science*.

articles published in twelve journals and three conference proceedings. The articles were published in the period 2003–2009. This period is representative for the recent development of the field of C&IE.

The following journals are the only journals that explicitly deal with ethical issues of information and information and communication technology.

- *Ethics and Information Technology* (Published by Springer). Abstracts indexed from volume 5, issue 1 (published in 2003) till volume 11, issue 4 (published in 2009).
- *Information, Communication and Society* (Published by Taylor and Francis). Abstracts indexed from volume 6, issue 1 (published in 2003) till volume 12, issue 7 (published in 2009).
- *International Review of Information Ethics* (Published by the International Center for Information Ethics). Abstracts indexed from volume 1 (published in 2004) till volume 11 (published in 2009), which is everything published in this journal.
- *Journal of Information, Communication & Ethics in Society* (Published by Emerald). Abstracts indexed from volume 1, issue 1 (published in 2003) till volume 7, issue 4 (published in 2009), which is everything published in this journal.
- *Journal of Information Ethics* (Published by Springer). Abstracts indexed from volume 15, issue 1 (published in 2006) till volume 18, issue 1 (published in 2009). No abstracts available after 2006.
- *The Ethicomp Journal* (Published by the Center for Computing and Social Responsibility). Abstracts indexed from volume 1, issue 1 (published in 2004) till volume 3, issue 2 (published in 2008), which is everything published in this journal.

Because of the convergence of ICT with other technologies such as biotechnology, nanotechnology, and cognitive science, we also took into account articles from journals that cover the phenomenon of converging technologies. Furthermore, articles on C&IE are published not only in the above-mentioned journals but also in other journals. We selected six journals that are relevant and leading in adjacent fields. From these journals we included the titles and abstracts of articles related to ICT.

- *AI & Society* (Published by Springer). Abstracts indexed from volume 17, issue 1 (published in 2003) till volume 24, issue 4 (published in 2009).
- *Behavior and Information Technology* (Published by Taylor and Francis). Abstracts indexed from volume 22, issue 1 (published in 2003) till volume 28, issue 6 (published in 2009).
- *Nanoethics* (Published by Springer). Abstracts indexed from volume 1, issue 1 (published in 2007) till volume 3, issue 2 (published in 2009), which is everything published in this journal.
- *Neuroethics* (Published by Springer). Abstracts indexed from volume 1, issue 1 (published in 2008) till volume 2, issue 3 (published in 2009), which is everything published in this journal.
- *New Media & Society* (Published by SAGE). Abstracts indexed from volume 5, issue 1 (published in 2003) till volume 11, issue 6 (published in 2009).

- *Science and Engineering Ethics* (Published by Springer). Abstracts indexed from volume 9, issue 1 (published in 2003) till volume 15, issue 3 (published in 2009).

There are several conferences that are partially or completely devoted to C&IE. These conferences have proceedings in which conference articles are published. Titles and abstracts of articles published in the proceedings of the conferences listed below were included in the data set. In case of the SPT 2009 conference, only articles from the 'Philosophy and Ethics of Information Technology' track were taken into account.

- *Computer Ethics: Philosophical Enquiry (CEPE), 2005 and 2007*
- *Society for Philosophy and Technology (SPT), 2009*

In total, titles and abstracts of 1038 articles published in the above-mentioned journals and conference proceedings were included in our data set. A number of limitations of the data set should be mentioned. First, the data set is based on English language articles only. It may well be that articles on C&IE are published in other languages as well. Second, ethical issues related to ICT are also discussed in non-academic sources such as blogs, newspapers, websites, newsletters, and so on. Third, academic sources such as (edited) books and (online) encyclopedias also discuss issues related to C&IE. And fourth, in our selection of journals, we may have missed some journals in which ethical issues related to ICT are discussed. Our data set is based on articles only from the above-mentioned journals and conference proceedings, not from books, encyclopedias, websites, newspapers, and so on. Thus, we acknowledge that our data set provides only a partial view on C&IE. However, it is fair to say that the data set largely covers what was written on C&IE in journals and conference proceedings in the period 2003–2009.

Bibliometric Mapping

We analyzed our data set using a bibliometric mapping approach. Bibliometrics is a scientific field that is concerned with the quantitative study of books, articles, and other types of written communication. Within the field of bibliometrics, a significant amount of attention is paid to bibliometric mapping. Bibliometric mapping aims to produce visual representations of the relations between certain units of interest. The units of interest can be for example documents, authors, or keywords, and the relations between the units can be based on for example citations, co-citations, co-authorship, or co-occurrences of keywords. In our analysis, we focus on relations between key terms in C&IE based on co-occurrences in titles and abstracts of articles. We will now discuss our bibliometric mapping approach in more detail.

Using a computer algorithm, we identified noun phrases in the titles and abstracts of the 1038 articles in our data set. For our purpose, a noun phrase is defined as a sequence of words such that the last word in the sequence is a noun and each other word is either a noun or an adjective. Only noun phrases occurring at least six times in the titles and abstracts were taken into consideration. This resulted in a set of 1368 noun phrases. Some noun phrases, such as Author, Abstract, or Preparation, are not particularly informative about C&IE. We manually removed such irrelevant noun phrases. More specifically, we grouped the identified noun phrases into the following five categories:

- *Ethical noun phrases* such as Privacy, Confidentiality, Responsibility, Reliability, and Plagiarism (304 noun phrases).
- *ICT noun phrases* such as Data, Ambient Intelligence, Virtuality, Robots, and Internet (180 noun phrases).
- *Hybrids of ethical and ICT noun phrases* such as Informational Privacy, Information Society, Software Piracy, Online Trust, and E-Democracy (31 noun phrases).²
- *Institutional/governmental/social noun phrases* such as Friendship, Australia, Policy, and Public Sector (192 noun phrases).
- *Irrelevant noun phrases* such as Author, Abstract, and Preparation (661 noun phrases).

The 661 noun phrases categorized as irrelevant were excluded from further analysis. Out of the remaining 707 noun phrases, the 400 noun phrases that seemed most relevant and most interesting were selected. The selection of the noun phrases was done using an automatic term identification technique (Van Eck, Waltman, Noyons, & Buter, 2010). This technique aims to distinguish general noun phrases with a broad meaning (e.g., Need, State, and Quality) from more specific noun phrases (e.g., Informational Privacy, Teaching Ethics, and Computer Professional) The latter noun phrases tend to be the more interesting ones and were therefore selected by the algorithm. The selected noun phrases can be regarded as important terms in C&IE. The rest of our analysis is based on the selected set of 400 terms.

For each pair of terms, we counted the number of times the terms occur together in the same article (or more precisely, in the title or abstract of the same article). Co-occurrence frequencies of terms are a commonly used measure of the relatedness of terms. We used the co-occurrence frequencies of our terms as input for a computer program called VOSviewer (Van Eck & Waltman, 2010; freely available at www.vosviewer.com). Based on the co-occurrence frequencies, the VOSviewer software constructed a term map. This is a two-dimensional map in which the 400 terms are located in such a way that the distance between any two terms reflects the relatedness of the terms as closely as possible. In general, the stronger the relation between two terms, the smaller the distance between the terms in the map. Each term in the term map also has a color. Colors are used to indicate the grouping or clustering of the terms. Terms with the same color belong to the same cluster and tend to be more closely related than terms with different colors. The clustering of the terms was produced using a recently developed clustering technique (Waltman, Van Eck, & Noyons, 2010). The clustering consists of three clusters. We also tried out larger numbers of clusters, but a term map with three clusters seemed to yield the most satisfactory interpretation.

It is important to emphasize that our methodology is completely based on co-occurrences of terms. No knowledge of the meaning of terms is used in our methodology. A consequence of this is that our methodology is unable to recognize synonyms and homonyms. Hence, terms that have the same meaning like e.g., Virtual Reality, Virtual Space, Virtual World, and Virtuality, will not be recognized as synonyms and will therefore be treated separately from each other in the analysis. Also, when a term has multiple meanings such as e.g., Right (being correct, going to the right, or have the right to do x) - will not be recognized as a homonym and its interpretation in the analysis may therefore be ambiguous. These limitations of our methodology, which are

² These hybrid terms are characteristic for the field of C&IE.

	All terms	Term frequency	ICT terms	Term frequency	Ethical terms	Term frequency
1	Internet	228	Internet	175	Ethics	228
2	Ethics	175	Computing	131	Privacy	42
3	Privacy	131	Game	72	Right	41
4	Student	79	Machine	63	Responsibility	40
5	Government	74	Cyberspace	48	Surveillance	39
6	Right	72	Infrastructure	37	Security	38
7	Responsibility	63	Robot	31	Protection	35
8	Human	49	Internet use	30	Threat	34
9	Surveillance	48	Site	30	Philosophy	30
10	University	47	Information system	30	Morality	27
11	Market	42	Engineering	28	Intellectual property	25
12	Computing	42	Computer science	24	Family	25
13	Security	42	Social network	21	Teaching	23
14	Game	41	Offline	21	Expression	22
15	Protection	40	Database	21	Legislation	22
16	Machine	40	Email	21	Transparency	22
17	Cyberspace	39	Device	20	Philosopher	21
18	Information ethic	39	Information age	19	Ethical problem	19
19	Professional	38	Music	19	Moral agent	19
20	Computer ethic	37	Computer technology	17	Profession	17
21	Code	35	Robotic	17	Ethical implication	17
22	Infrastructure	34	Website	17	Ethical aspect	17
23	Robot	34	Interface	16	Learning	15
24	Organization	33	Telephone	15	Disclosure	15
25	Internet use	32	Artificial intelligence	15	Activist	14
26	Threat	31	Ubiquitous computing	15	Personal privacy	13
27	Philosophy	30	Software development	14	Ethical theory	12
28	Site	30	Connectivity	14	Privacy concern	12
29	Morality	30	Computer game	13	Sharing	12
30	Health	28	Virtual community	13	Inclusion	12

Table 1: Table with the 30 most occurring terms, ICT terms, and ethical terms.

Figure 1 shows that each of the three clusters has a more or less central term around which the other terms are positioned. These three central terms are Privacy, Internet, and Ethics³. They are also represented as the largest terms. The size of each term corresponds to its term frequency; the larger a term the more frequent it occurs in the data set. Thus, Privacy, Internet, and Ethics are the most prominent and most often discussed topics of the last decade in the C&IE literature. (In table 1 one can see the term frequency of the 30 most used terms as well as the 30 most occurring ICT terms and 30 most occurring ethical terms.)

The fact that Ethics is one of the most occurring terms in the field should not come as a surprise and needs no further explanation. The prominence of Privacy problems may be explained by the fact that they are the epitome of ethical concerns regarding ICT. Privacy problems easily resonate with personal experiences, are close to home, and easily give rise to academic and public debate. Issues regarding Informed Consent, Security, Safety, Liberty, Freedom of Speech, and many more, are often discussed in relation to privacy in the literature. Furthermore, the fact

³ In the map, you see the word Ethic instead of Ethics. This is because our algorithms reduce words to their stem.

that the Internet is the most prominent manifestation of ICT in the C&IE literature should not come as a surprise either. In the last decade, the Internet has had a profound influence on the life of human beings in all segments of society all around the world. This influence has been widely examined and discussed in the C&IE literature. The three clusters will now be analysed and discussed by identifying patterns, categories of subtopics and their interrelations.

The Privacy Cluster

Let's begin with the privacy (green) cluster. After careful analysis, four subtopics can be distinguished in this cluster. The first, although strictly speaking not a subtopic, contains terms that can roughly be seen as synonyms of Privacy such as Privacy Concern, Information Privacy, Personal Privacy, and Online Privacy. The second contains ethical terms that are directly relevant for the academic debate on Privacy in relation to ICT like, for instance, Informed Consent, Consent, Security, Safety, Infringement, Personal Information, Free Speech, and Liberty. The third contains terms that may somehow cause Privacy issues such as Ubiquitous Computing, Surveillance, Information Flow, Corporation, Information System, Camera, Data Collection, Radio Frequency Identification, Airport, Terrorism, and Workplace. And the fourth contains terms associated with legal and governmental issues like Intellectual Property, Intellectual Property Right, Government, E-Government, Welfare State, Privacy Policy, Privacy Right, Civil Liberty, Property Right, Legislation, Rights, Privacy Protection, and Legal Protection.

Two things are remarkable here. First, privacy issues that are discussed under the heading of Data Protection and Personal Data are separated from discussions about Privacy. This represents a USA-EU opposition of terminologies and conceptual frameworks, where Privacy is the dominant term in the USA and Data Protection is the preferred vocabulary to discuss ethical issues concerning Personal Information and Data Flows in the EU. The bibliometric analysis, as we would expect according to this opposition of terminologies, puts Personal Information in the green (Privacy) cluster and not in the red (Ethics) cluster where Personal Data and Data Protection are in. A second noteworthy feature of the map as depicted in the density view (see Figure 2) is the way the term Government naturally connects the most prominent themes of Internet and Privacy. This accommodates the fact of a much discussed and widespread fear of a ubiquitous prying E-Government. It also accounts for the fact that there is an extensive literature in public administration on ethical issues in E-Government, which has started quite early in the history of ICT. Furthermore, Government is cast in two roles in the literature which explains its prominence here. First as a threat to privacy and second as the party that needs to solve privacy problems by means of regulation.

The four subtopics in this cluster (i.e. Privacy and its synonyms, ethical terms that are directly relevant for the academic debate on Privacy, terms that may somehow cause Privacy issues, and terms associated with legal and governmental issues) are closely related and nicely capture the debate on Privacy in relation to ICT. Roughly, these four subtopics can be explained as follows. Governmental institutions can both cause privacy issues by prying on citizens as well as solve privacy issues caused by Surveillance, Terrorism, Corporations and ICTs by means of legal and policy regulations. And finally, figure 2 shows that discussion on Ubiquitous Computing is a relatively isolated and coherent sub-cluster within the Privacy cluster.

The Ethics Cluster

Four subtopics can be identified in the Ethics (red) cluster. First, topics that can roughly be seen as synonyms, or branches, of Ethics like, e.g., Morality, Moral Reasoning, Disclosive Ethics, Moral Action, Virtue Ethics, Good Life, Duty, Moral Status, Moral Responsibility, Ethical Theory, Information Ethics, Computer Ethics, Professional Ethics, and Ethical Decision. Second, topics related to educational issues such as Teaching, Classroom, Student, Learning, Faculty, High Education, Instructor, Educator, Academic, and Teaching Ethics. Third, topics associated with ICT as a profession and academic discipline like Professional, Professionalism, Information Professional, Computer Professional, Software Engineering, Computer Science, and Information Science. And fourth, the Ethics cluster contains examples of ICTs such as Robot, Robotic, Robotics, Artificial Intelligence, Database, Cyborg, Engineering, Infosphere, and Software Agent.

The observation that topics associated with educational issues are presented in the cluster about Ethics seems consistent with our expectations. There have been substantial discussions about the best approaches to ethics teaching and the use of normative ethical theory which are most suited to computers scientists, ICT professionals and computer science students. Some scholars have advocated a virtue ethics approach, character building, development of personal resources in dealing with ethical dilemmas, and methods for exposing students to rich case materials. Others have worked with codes of ethics, checklists and software to support ethical analysis. And yet others preferred to extend the lessons learned from other areas of applied ethics to the ICT field.

Furthermore, the third and fourth subtopics (i.e. terms associated with ICT as a profession and academic discipline, and examples of ICTs) are closely related and overlap. ICT professionals and computer scientists design and produce the ICTs that cause ethical issues. This observation is consistent with the literature on C&IE, since the relation between designers of ICT, the ICTs themselves, and the ethical issues they cause is a widely debated topic in the C&IE literature. And finally, figure 2 shows that discussions on Virtual Reality, Moral Agent/Moral Agency/Artificial Agents, and Personal Data/Data Protection can be seen to form relatively isolated and coherent sub-clusters within the Ethics cluster.

The Internet Cluster

The Internet (blue) cluster accommodates much of the issues that have become associated with Internet use in the last decade in the academic as well as public debate on the Internet. Two categories of subtopics can be distinguished. First, terms that are somehow instantiations of the Internet like, for example, Site, Blogs, Website, Social Networking Site, Virtual world, Virtuality, Online Game, Cyberspace, Avatar, Online Community, Interface, Electronic Medium, Internet Information, Portal, and Online Environment. And second, terms that are associated with social issues in relation to the Internet such as Health, Inclusion, Social Ty, Political Participation, Parent, Intimacy, Race, Social Interaction, Gender Equality, Social Capital, Social Network, Friend, Protest, Democratic Potential, Individualism, Human Relationship, and Public Access.

The fact that these two categories (i.e. instantiations of the Internet, and social issues in relation to the Internet) are put in the same cluster seems logical, since the first exerts an influence over the second, which is at the heart of the C&IE literature. And finally, figure 2 shows that discussion on Childs is a relatively isolated and coherent sub-cluster within the Internet cluster.

Some Limitations

Finally, we would like to point out some limitations of our term map. Sometimes terms are located close to each other in the map even though the way in which they are related to each other is not immediately apparent. For example, the terms Internet, Hope, and Adult are located close to each other in the map, while the relation among these terms is not directly clear to us. To properly interpret the map, it is important to realize that terms are sometimes located close to each other even though they do not or almost not co-occur with each other in articles. Terms may for instance be located close to each other because they are indirectly related through co-occurrences with other terms. As an example, it could be that terms such as Hope and Adult do not co-occur with each other but that they both co-occur frequently with the term Internet. This then establishes an indirect relation between Hope and Adult and may cause the terms to be located close to each other in the map.

In addition to the possibility of indirect relations, terms may also be located close to each other as a consequence of the limited dimensionality of the term map. The map has just two dimensions. From a technical point of view, we could easily have constructed a map with more than two dimensions, but such a map would have been much more difficult to interpret. Given the availability of just two dimensions, terms sometimes need to be located relatively close to each other in the map without being strongly related to each other.

Furthermore, special care should be taken with terms that occur in only a small number of articles. For such terms, only a very limited amount of data is available, and their location in the term map may therefore not be very accurate. An example could be the term Child Pornography, which occurs in only four articles. This term is located relatively far away from the terms Child and Internet, with which one would expect a strong relation. The somewhat unexpected location of Child Pornography could be due to the limited amount of data available for this term.

Finally, if terms are distant from each other in the term map, it does not necessarily mean that they are completely unrelated. It could be that the terms do co-occur with each other in articles and, hence, do have a relation with each other. However, compared with other relations that the terms have, their relation with each other may be relatively weak. As an example, consider the names Floridi and Sanders. In the map, these names are located close to terms such as Moral Agent, Intentionality, Moral Agency, and Artificial Agent. Floridi and Sanders indeed publish on those topics, but based on the map we should not conclude that they do not publish on other topics as well. The map merely indicates that compared with other topics the topic of moral agents receives a lot of attention in the work of Floridi and Sanders.

4 Conclusion

In this paper we have presented and discussed a bibliometric analysis of titles and abstracts from academic articles in the field of C&IE. A representative data set of over thousand titles and abstracts of articles published in leading journals and conference proceedings in C&IE was constructed and subsequently analyzed with a computer program called VOSviewer. The bibliometric map contains three clusters (i.e. Privacy, Ethics, and Internet) that have been separately analyzed. It is fair to say that privacy issues related to the Internet are the most prominent topics in the C&IE literature of the last decade. Other important topics in C&IE are: privacy in relation to governmental and legal institutions; educational issues in ethics teaching;

the relation between designers of ICT, the ICTs themselves, and the ethical issues they cause; and social issues in relation to the Internet.

The framing of privacy issues in terms of personal data and data protection are remarkably distant from privacy and in a way insulated. Other insularities can be seen in debates initiated by Floridi and Sanders on moral agency of autonomous agents, and debates on ubiquitous computing. The insular clustering seems to indicate a separate but prominent debate in C&IE. Discussions about identity in relation to ICT and on-line environments seem to be less prominent in the period studied and may possibly constitute a recent conceptual and terminological turn in debates about Privacy and Data Protection, which could be shown by follow-up research. Then, by performing a comparative study, we may also be able to discover the new upcoming trends in the field.

Of all the ethical terms in the data set, Privacy has received the most attention, which is followed by Right, Responsibility, Surveillance, Security, Protection, Threat, Philosophy, Morality, and Intellectual Property. And of all the ICTs in the data set, the Internet has received the most attention, which is followed by Computing, Game, Machine, Cyberspace, Robot, Internet Use, Site, Information System, and Engineering.

Finally, there is much more to say about the relations and patterns in the term map. We have restricted ourselves to discussing the three clusters by identifying general patterns, categories of subtopics and their interrelations. However, we invite anyone who is interested in the field of C&IE to examine the term map in more detail and to interpret the map from his/her own perspective. The map is accessible at www.vosviewer.com/maps/computer_ethics/, where it can be explored using the freely available VOSviewer software.

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References

- Brey, P., & Søraker, J.H. (2009). Philosophy of computing and information technology. In Meijers, A. (Ed.), *Philosophy of technology and engineering sciences* (pp. 1341–1408). Elsevier.
- Buchanan, E.A. (1999). An overview of information ethics issues in a world-wide context. *Ethics and Information Technology*, (1)3, 193–201.
- Bynum, T. (2008). C&IE. In *Stanford Encyclopedia of Philosophy*. Retrieved February 25, 2010, from <http://plato.stanford.edu/entries/ethics-computer/>
- Floridi, L. (Ed.). (2009). *The Cambridge handbook of information and computer ethics*. Cambridge University Press.
- Johnson, D. (1985). *Computer ethics*. 1st Edition. Prentice Hall.
- Johnson, D. (2008). *Computer ethics*. 3rd Edition. Prentice Hall.

- Moor, J.H. (1985). What is Computer Ethics? *Metaphilosophy* 16, 266-275.
- Tavani, H., & Himma, K. (Eds.). (2008). *The handbook of information and computer ethics*. Wiley.
- Van den Hoven, J., & Weckert, J. (Eds.). (2008). *Information technology and moral philosophy*. Cambridge University Press.
- Van Eck, N.J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538.
- Van Eck, N.J., Waltman, L., Noyons, E.C.M., & Buter, R.K. (2010). Automatic term identification for bibliometric mapping. *Scientometrics*, 82(3), 581–596.
- Waaijer, C.J.F., Van Bochove, C.A., & Van Eck, N.J. (2010). Journal Editorials give indication of driving science issues. *Nature*, 463(7278), 157.
- Waltman, L., Van Eck, N.J., & Noyons, E.C.M. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of Informetrics*, 4(4), 629–635.