International Recommendations for Handling Copyright Questions about Computer-Generated Works: What Are Our Concerns?†

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Received April 6, 1983

Throughout the world, authors and proprietors of copyrighted information are concerned with the electronic reuse of their material. We in the United States are still experiencing growing pains in coping with some of the provisions in the Copyright Act of 1976. Section 101 has been changed to include a definition of a computer program, and Section 117 has been amended to provide for limitations on exclusive rights for computer programs. Still, however, there are disagreements about copyright owners' rights, particularly in the field of data bases. With the ever-rapid advancement of computer technology and the increase of transborder data flow, we should keep abreast of international discussions and recommendations that may and can affect the U.S. Copyright Law and our rights as creaters, copyright owners, and/or users of protected materials.

We all know that information is valuable. It becomes more so when people want to use it and reuse it. Of course, there are certain limitations to use and reuse because of the exclusive rights that are afforded to copyright owners by law. On the other hand, statutory "fair use" permits certain uses that are considered not to infringe copyright. The factors that determine whether or not a use is permissible are so general that "fair use" is a much disputed section of the U.S. Copyright Law (Title 17, U.S. Code). To make matters more troublesome, laws enacted to protected proprietary rights cannot keep pace with the rapid advancement of technology. In 1980, the U.S. Copyright Act of 1976 was amended to include the definition of a computer program and to reword Section 117, regarding the limitations of exclusive rights for computer programs. But what about works that are generated by computers? Are these works proper subject matter for copyright? If so, who owns the copyright: the person who runs the computer program or the person who developed the software? These and other complex issues were discussed by an international committee of government experts on such matters. They wrote the document entitled "Recommendations for Settlement of Copyright Problems Arising from the Use of Computer Systems for Access to or the Creation of Works",[1] which I shall refer to as the recommendations document. The committee's meeting report, which accompanies the recommendations, will be referred to as the UNESCO/WIPO report.[2]

The recommendations document has already been disseminated throughout the world for countries to consider as national legislation. Of course, the proposed principles cannot serve as a complete model for any one country to endorse because the recommendations are compromises among existing natural laws and rules of the international copyright conventions. Nevertheless, we should be aware of this document and its recommendations, which might, some day, affect the U.S. Copyright Law and thus, inevitably, our rights as creators, copyright owners, and users of protected works.

The recommendations were first discussed in May 1979, when the Working Group on Copyright Problems Arising from the Use of Computers was convened by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Intellectual Property Organization (WIPO). These two groups are the specialized UN agencies that are responsible for administering the international copyright conventions.

There are two such conventions on copyright: the Berne Union, which is the oldest and which was formed in the 1890s by the western European powers, and the Universal Copyright Convention (UCC), which is administered by UNESCO. Nations that belong to the Berne Union do not have required copyright formalities and have the minimum standards of copyright protection. On the other hand, countries that belong to the UCC, including the United States, must abide by specified formalities, such as using a copyright notice, which consists of the word "Copyright" or the symbol ©, the name of the copyright owner, and the first year of publication. Because of the differences between the two copyright conventions, the UNESCO/WIPO recommendations were written as general principles.

UNESCO and WIPO have been and are working together to study computers and the use of computers with respect to copyrighted works. In December 1980, they convened the Committee of Government Experts on Copyright Problems Arising from the Use of Computers for Access to or the Creation of Works (hereafter referred to the Committe); this Committee was asked to study and act on the Working Group's report of June 1, 1979. The Committee's report of the 1980 meeting was distributed to various groups, including the American Chemical Society, for discussion and comment.[3]

In June 1982, the Second Committee of Government Experts met to discuss the draft recommendations and comments submitted by interested groups. This Committee adopted a final report which is dated August 13, 1982, and which was distributed to countries throughout the world. It includes participants' comments on the draft recommendations, international compromises, and points raised at the June 1982 meeting of government experts. The recommendations document is annexed to the UNESCO/WIPO report. Members of the Second Committee of Government Experts felt that the recommendations represented a "real and necessary step forward in the application of the international copyright conventions to the rapidly developing new technology and increasing transborder data flow".[2] They also felt that the document would prove to be a valuable guideline for national legislators.

The preamble to the adopted recommendations includes the following points: (a) high priority is being given to information policy on an international level; (b) due to the rapid development of information technology, users are able to have direct access to data bases through networks; (c) the practice of storing and retrieving copyrighted works in computer systems

† Presented before the Divisions of Chemical Information and Chemistry and the Law, and the Joint Board-Council Committee on Copyrights, Symposium on "Copyright and Ownership of Database Information", 185th National Meeting of the American Chemical Society, Seattle, Washington, March 22, 1983; American Chemistry Society: Washington, DC, 1983.

0095-2338/83/1623-0168$01.50/0

is likely to grow; (d) copyright plays an important role as a stimulus for creativity and the development of society.[1]

This is a good place to stop to review the basics of copyright, because point d is a principle of copyright which was based on the U.S. Constitution. Article I, Section 8, grants Congress the power "to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries". So, "the primary purpose of copyright legislation is to foster the creation and dissemination of intellectual works for the public welfare; an important secondary purpose is to give creators the reward due them for their contribution to society".[4]

In order to better understand the complex issues presented in the recommendations document, it is helpful to know certain definitions given in the U.S. Copyright Law, which was enacted October 19, 1976, and which became effective January 1, 1978. Copyright protection, as described in Section 102, extends to "original works of authorship fixed in any tangible medium of expression, now known or later developed, for which they can be preceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device.... In no case does copyright protection ...extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery...".[5] Other laws, such as patent laws, protect ideas, procedures, etc., independent of their forms of expression.

The important word to note in the definition of works protected by copyright is "fixed". Section 101 of the U.S. Copyright Law describes a work as being "fixed" in a "tangible medium of expression when its embodiment in a copy or phonorecord...is sufficiently permanent or stable to permit it to be preceived, reproduced, or otherwise communicated for a period of more than transitory duration...".[5] In other words, if a work is created on a word processor so that it is projected briefly on a screen or captured only momentarily in the memory of a computer, that work is not fixed and cannot be protected by copyright. On the other hand, computer data bases, which are electronic files of information "formed by the collection, assembly, and arrangement of preexisting materials or data, are clearly [protected], provided the resulting work as a whole consistutes original authorship".[6] Also, data bases are subject to copyright because a data base permits works to be "preceived, reproduced or otherwise communicated for a period more than transitory duration".[5]

This brings us back to some of the other points noted in the preamble of the UNESCO/WIPO recommendations document: (a) the use of new technologies should be more user friendly and provide for the appropriate protection of works; (b) because of the development toward international computerized information systems and the increase of transborder data flow, it is highly desirable to have international cooperation in reaching common and practical solutions for settling copyright problems; (c) in order to stimulate the creativity of authors but not hamper the dissemination of works in computer systems, legislation must take into account the legitimate interests of both copyright owners and users of protected works; (d) countries should be guided by the recommendations presented in the UNESCO/WIPO document when considering or enacting legal solutions and provisions governing problems which arise from the use of computers for accessing or creating works.[1]

The first major section of the final UNESCO/WIPO document is entitled "Subject Matter to Which the Recommendations Apply". The document regards such subject matter to be that which is considered to enjoy copyright protection because it constitutes intellectual creation or material which otherwise enjoys protection under copyright legislation. Bibliographic data per se, including the name of the author, title of the work, publisher, year of publication, and so forth, are not considered to be protected works. Subject to the given provisions of acceptable subject matter, protected works are listed as (a) full texts, or substantial parts thereof, and other complete representations of protected works, (b) abbreviated representations of works in the form of adaptations, derivative works, or independent works, (c) collections and compilations of information, including bibliographic data of several works, and (d) thesauri and similar works intended for the exploitation of computerized data bases.[1]

The Committee originally addressed the question of whether and what kinds of abstracts should be given copyright protection, but this topic proved highly controversial, and all mention of abstracts was subsequently eliminated in both the Committee's report and recommendations document.

The next section of the UNESCO/WIPO document is entitled "Rights Concerned". In the opening sentence, storage in and retrieval from computer systems are clearly noted as being acts of input and output. According to the recommendations, these acts involve at *least* the following rights of authors; (a) the right to make or authorize the making of translations, adaptations, or other derivative works; (b) the right to reproduce any work involved; (c) the right to make the work available to the public by direct communication; (d) the moral rights.[1] I will address moral rights later.

In the next section "Acts Concened" input of a copyrighted work into a computer system is defined as including reproduction of a work in machine-readable form and fixation of a work in the memory of a computer system. Any acts of input, such as reproduction, are subject to the author's exclusive rights and therefore require the copyright owner's permission. For the purpose of this section of the recommendations, a work is considered "reproduced" when it is "fixed in a form sufficiently stable to permit its communication to an individual".[1] The medium on which subject matter is fixed for storage purposes is not expressely mentioned in the recommendations document because the Committee felt that there was the possibility of new media being invented in the future. They agreed that more general and not limiting terminology be used in the final document.[1]

Output is also addressed under "Acts Concerned". Countries are requested to consider copyright protection for output of works from computer systems, whether such output is found to be a reproduction or a corresponding act (such as the production of a hard-copy printout, the fixation of texts, drawings, machine-readable forms, sounds, or audio–visual works in physical form, or the transmission of the contents of a data base into the memory of another computer system) or an act whereby a work is made available to the public (examples include visual images or other perceivable forms of a presentation of a work). The recommendations further state that countries should consider including in their national laws express recognition of the exclusive right of the author to make his work available to the public by means of computer systems. The author or copyright owner should have the sole right to control the destination of his work. Of course, this exclusive right may apply to the acts of input or output or of input only, which is the starting point of control.[1]

In the area of "Moral Rights", the general provisions in national and international law should apply. The United States does not have a section on "moral rights" in the U.S. Copyright Law. The closest provision that we have to ethical considerations is fair use, which is broadly described in Section 107 of the U.S. Copyright Act. The factors to be considered in determining whether use of a work is "fair use" include (1) the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes, (2) the nature of the work, (3) the amount and

substantiality of the portion used in relation to the work as a whole, and (4) the effect of the use upon the potential market for or value of the copyrighted work.[5]

"Limitations on Copyright" is the next section in the UNESCO/WIPO recommendations document. Countries are urged to give special consideration to the limitations permitted by the international conventions and provided for in national laws concerning the use of the copyrighted works in computerized systems. National laws may include, as exceptions to the exclusive rights, certain uses of protected works in computer systems, but such uses must be within the limits established by the international convention to which the country belongs.

It should be noted that Section 117 of the U.S. Copyright Law was amended to provide for limitations on exclusive rights concerning computer programs. The owner of a physical copy of a computer program may make or authorize the making of another copy or adaptation of that program provided that such action is necessary to use the program *or* that the copy made is for archival purposes only and that all such copies are destroyed when the owner of the computer program no longer has the right to possess it.

The next section of the UNESCO/WIPO document is "Administration and Exercise of Rights and Legislative Measures". The recommendations advise use of contractual agreements or other negotiated licenses to control input and output of copyrighted works. Moral rights are expressed again in this section of the document, which begins with the premise that "both authors and society at large are mutually interested in rapid and easy dissemination of works...". Countries are asked to consider taking measures to facilitate effective systems for both exercising and administering rights to works used in computer systems and to assess the practical possibilities of exercising moral rights.[1]

When freely negotiated licenses are not feasible, mandatory licenses may be introduced, provided they are in keeping with the provisions of the international copyright conventions. Although material in computer systems can be transmitted across international borders, the effect of a nonvoluntary license would only apply in the country in which the license had been prescribed. This conforms to the Berne Convention.

The last section of the UNESCO/WIPO report is titled "Use of Computer Systems for Creation of Protected Works". Computer software, which may enjoy protection under other national laws (e.g., patent, copyright, unfair competition, or trade secrets), is not included or dealt with in the recommendations document because some delegates felt that this subject was out of the Committee's realm. However, they also felt that computer software "could be discussed to a certain extent when considering creation of works with the use of computer systems". They understood that it would be difficult to "make a clear and complete distinction between a computer as a mere tool for the creation of works and the program used for that tool".[2] Because of this complex issue, the Committe decided to address the topic of computer software at another time; however, some delegates noted in the report that they were in favor of copyright protection for computer software.

The United States affords copyright protection to computer software. A computer program, as defined by the 1980 amendment to Section 101 of the U.S. Copyright Law, is "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result".

Paragraph 14 of the UNESCO/WIPO recommendations document states the following: "Where computer systems are used for the creation of works, [countries] should basically consider them as a technical means used in the process of creation for achieving the results desired by human beings."[1] The Committee agreed that the recommendations on this subject should be flexible and that countries should consider the general principles given when applying them to concrete situations or practical problems.

One of the first drafts of the recommendations contained three paragraphs dealing with ownership of copyright in computer-generated works. Although these paragraphs were deleted in the final recommendations, they were included in the Committee's final report as possible applications of the general statements presented in the recommendations document:

(a) "If the program is capable of producing one work only, then the author who has given instructions or the composer and the programmer who not only provides technical assistance in utilization of the computer but whose contribution is a creative one should be considered the author or co-authors of the resulting work, as the case may be."

(b) "If the program is capable of producing different results and the author has himself made a choice among these results, he should be regarded as the author of the resulting work; if he has asked a programmer or another person to choose the elements for the composition of the final version, then this programmer or another person and the author himself should be normally regarded as co-authors to the extent that they make a creative contribution."

(c) "If the program is capable of producing different results but the final choice is made by a third party, the mere choice by itself should not be regarded as creative contribution."[2]

The following general principles, to which the Committee referred to in its report, appeared in paragraphs 15 and 16 of the final recommendations document:

15. "In order to be eligible for copyright protection, the work produced with the help of computer systems must satisfy the general requirements for such protection established by the international conventions and national law on copyright."

16. "In the case of works produced with the use of computer systems, the copyright owner in such works can basically only be the person or persons who produced the creative element without which the resulting work would not be entitled to copyright protection. Consequently, the programmer (the person who created the programs) could be recognized as co-author only if he or she contributed the work by such a creative effort."

At the suggestion of one delegate to the Committee, the final document covers works created by the use of computer systems in connection with commissioned works. The paragraph dealing with this subject mentions that the "matter of attribution of copyright ownership should be left to national legislation".[2]

What do these comments and recommendations mean to us? There is a possibility that they will be considered when our own copyright law is amended or completely revised, such as we experienced effective January 1, 1978. Our copyright law has already been amended to provide for the definition and limitations on exclusive rights concerning computer programs. It might not be too long until our law might include sections dealing with data bases, electronic publishing, downloading, or limitations on exclusive rights for the flow of transborder data. Who knows what inventions are around the corner that will affect us in our daily lives? The use of small computers for personal tasks, as well as for business purposes, is increasing. People are realizing more and more that information is valuable and will be readily available only for a fee.

What are some of our other concerns? Those that have already been voiced include the following.

(1) Is downloading permissible? Downloading is the electronic transfer of information from one data base to another, including that from an on-line data base service through one's own local microcomputer. At the Online '82 Conference &

Exposition, Carlos Cuadra, President of Cuadra Associates, Inc., said that "many publishers have come to accept the idea that there are legitimate reasons for the temporary retention of data obtained from an online search, and they have given [such] permission.... More and more users want to retain records permanently, to make them part of their own local electronic library." He urged publishers "to give immediate attention to...user needs and to develope pricing policies...that serve those needs, while protecting their own rights in the data".[7] Although I am not in a position to give any legal advice, I suggest you look at the contract you have with the copyright owner or data base producer. If you do not already have a contract and you are reusing information gleaned from an on-line system, perhaps you should request a copy. I suggest you ensure that what you want to do with data base information is permissible and spelled out in your agreement. Also, do not hesitate to seek legal advice. These steps might save you a lot of headaches (and possible lawsuits) in the long run. Keep in mind that the copyright owner has the exclusive right to determine the conditions under which data is made available to others.

(2) What happens to information after users receive it? This is an old and a present concern that we cannot really do anything about, except perhaps through negotiated contracts, licenses, and agreements. I still believe that most people are honest and would be willing to abide by the copyright law and by reasonable terms set by publishers.

(3) Does copyright infringement of works in a computer system occur at the point of input or output? The Subcommittee on Databases of the National Commission on New Technological Uses of Copyrighted Works, better known as CONTU, came to the same conclusion as the UNESCO/WIPO group: the act of storing a computerized data base in the memory of a computer is the exclusive right of the copyright owner.[8]

(4) Does "fair use" apply to computer-generated works? CONTU determined that fair use of machine-readable data bases follows "the same guidelines as are applicable to print materials. This means that the user could retrieve and use information derived from the data base, such as a citation or in fact, just as he would with any other copyrighted work. He may not, however, use a substantial portion of the data base without violating the owner's copyright."[8]

I am sure there are countless other concerns and questions that one may have with the copyrightability of computer-generated works or works accessed from computerized systems. It is well-known that users want and need information that is timely and cost effective. It is almost certain that "downloading will soon become a way of life",[9] and we will have to pay for the right to use and reuse that valuable resource known as information.

Until our copyright law and other laws catch up, or at least come close, to the rapidly advancing and ever-changing technology, I urge you to use good judgement concerning the use and reuse of copyrighted material. I leave you with a word of advice, which I have adapted from the late Joseph McDonald: Take not from others to the extent that you would be resentful if they took that from you.

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Unique Numbering and Cataloguing of Molecular Structures[1]

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Received February 28, 1983

A simple procedure is offered for creating a unique canonical numbering of a molecular skeleton, or general graph, based on the maximization of the linear binary number corresponding to its adjacency matrix. This numbering allows ready comparison of two molecules for identity, i.e., of two graphs for isomorphism, and a catalog of these identity numbers may be assembled in numerical order for quick searching. The method also identifies equivalence classes for automorphism and is error free and rapid both by hand and computer. Comparisons with other such systems are made to show its superiority in computer speed and work space.

For our program in synthesis design[1] we required a catalog of available starting material molecules arranged for rapid search and comparison with the starting material molecules generated by the program. We required a notation system for the computer which possessed the following features: (1) unique canonical numbering of the atoms; (2) separation of the skeleton of the molecule from its functionality; (3) rapid comparison of two molecules for identity; (4) rapid search of the catalog; (5) minimal storage requirements for each molecule in the catalog. The skeleton of the molecule is simply a graph of points (atoms) and lines (bonds) and may be represented most easily in the computer by its adjacency matrix, an $n \times n$ matrix of the n skeletal atoms in which the elements are simply 1 or 0, indicating atoms bonded or nonbonded,

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