The Constraints of Software: Borrowable Like Books?

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Abstract

Computer software media has long had intrinsic similarities to books...so why may one be borrowed in a library and not the other? The answer lies in the context and history of the creation of computer media. In this essay I explore the early history of software distribution, where many different proposals fought to succeed. I provide an overview of the software industry's early embrace of copy-protected floppy disks as a distribution medium, and how they harmed the notion of software as a borrowable medium. Lastly, I cover how CD-ROM materials were treated as books by publishers and libraries, yet these institutions failed to realize this premise with long-term success. I argue that a combination of industry actions and technological constraints over four decades caused computer software to fail at becoming a tangible medium that could be lent or borrowed in the same way as a book, causing detriment to patrons and libraries.

Keywords: software; intellectual property; libraries; licensing; media

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Introduction

Today, most people experience constant daily interactions with computers. Computer software allows a person to check e-mail, play a game, browse for information, and balance the chequebook with a few clicks of a mouse. Software is the series of binary instructions that provide a computer with knowledge and direction, which is similar to the way that printed words on a page enrich the mind of a human being. For distribution and consumption, software is compiled into discrete program packages much like literary passages are compiled into books. In the 1980s and 1990s, computer software titles were routinely sold by mail and alongside books in popular bookstore chains. Computer software was also distributed through many of the very same physical carriers used for recordings of music and spoken word such as cassette tapes and compact discs.

Despite the concept of lending books or audio recordings to friends or borrowing them at a public library being established beyond reproach, it is all too often an anomaly and a legal abhorrence for software to be treated the same way. This restriction is regrettable and unjustified because it limits the accessibility of software media for those unable to afford to purchase personal copies. Further, it prevents individuals from being introduced to creative and innovative software that they would not be exposed to otherwise through browsing and borrowing items.

Background: In the beginning . . .

In this section, I will trace the individual steps and stages of how software ceased to be borrowable. Forty or fifty years ago, many of the notions that presently define computers had yet to be established. The distribution of computer software was far different in this

era. Mainframe equipment vendors such as IBM routinely bundled software with hardware under a common price structure that treated the former as an overhead component necessary to enable the functionality of the latter (Cohan, 2009, para. 3).

The applicability of intellectual property law to software was also different in the 1970s. Future United States Supreme Court Justice Stephen Breyer (1970) stated that computer programs were “poles apart” from literary works (p. 370) and did not need copyright protection at all unless they began to be sold “off the shelf” at low prices to large numbers of widely dispersed buyers” (p. 347). His opinion was not unprecedented at the time. Software had an unclear or ambiguous legal status for the duration of the decade. It was not until the 1980s that developments such as the *Apple v. Franklin* court ruling in the United States and the Copyright (Computer Software) Amendment Act in the United Kingdom firmly and unambiguously asserted the laws for copyright of machine-readable code (*Apple Computer, Inc. v. Franklin Computer Corporation*, 1983).

With little incentive existing to do otherwise, vendors were at times unusually carefree about the information they divulged about their programs. Full source code was frequently distributed as a courtesy to technical-oriented users, and enterprises such as Harvard University required it (Williams, 2002, paras. 15-17). At the time, computers themselves were neither common nor generally accessible. The notion of software being sold as a product in itself, like a book, was a concept in its infancy and had the potential to develop in any direction.

Early home computing media: Multiple formats, multiple possibilities

With the advent of home computers such as the MITS Altair, Commodore PET, and Apple II in the second half of the decade came the need for a commercial software market as well as small physical carriers to convey this software and load it into the machines' memory. An example of one of these carriers is paper tape, which is the elongated incarnation of the paper punch cards used for decades in data entry. Being an inherently physical medium, paper tape could be carried about, lent, and borrowed like a book.

Similar to copying a novel with a photocopier, copying paper tape was a tedious exercise requiring patience and specialized equipment (Matley, 1967, p. 47). This concern, however, ameliorated the brunt of intellectual property concerns with paper tape. Since user duplication was so impractical, software authors could rest assured that they had a modicum of control over the number of copies of their work in circulation and could be compensated accordingly. When Bill Gates and Paul Allen wrote BASIC for the Altair in 1975, it was distributed on this medium (Freiberger & Swaine, 2000, p. 179). However, several qualities doomed the suitability of the format. For example, punched tape had very low data density, it required expensive equipment to read, and it could only be used once (Freiberger, 1982, p. 15). Home computers would require a different format to be chosen.

Computer users did not have to wait long for a potential solution to emerge. In 1975, Jerry Ogdin and Les Solomon published a proposal to use ordinary audio cassette tapes as a medium for data storage (Freiberger, 1982, p. 15). Cassettes had numerous advantages over paper tape for home computer use. First, cassettes were

durable, readily available, and inexpensive. They also offered high data capacities for their time: a 90-minute cassette encoded at 2000 bits per second could theoretically hold 1.3 megabytes, though shorter tapes were more common (Compact cassette for data, 2018, paras. 3-4). The medium achieved popularity quickly; Apple, Commodore, and Tandy all introduced models of computers in 1977 that were designed to use cassette tapes for storage (Computer History Museum, n.d.). IBM also touted cassettes when introducing its first PC to the market. As late as 1987 it was possible to purchase a new IBM Personal Computer with cassette storage and no disk drives (Great Hierophant, 2014, para. 1).

As with paper tape, cassette was an inherently borrowable format that required physical possession and manipulation to be read by a computer. Libraries were receptive to adding cassettes to their collections. The Oskaloosa Public Library in Iowa began acquiring spoken-word recordings on tape in 1982 and promptly discovered that they circulated heavily across users “of all ages and types” (Davis, 1984, p.165, paras. 5-6). Libraries devised methods to satisfactorily package and display music and spoken-word cassettes on shelves. It would have been trivial to add shelves for software on cassette packaged and displayed in an identical way...if the interest was there. Unfortunately, cassettes as a data medium were compromised by substantial setbacks – access was slow, reliability was variable, and saving data was a chore that required precise indexing to an unused portion of tape (Compact cassette for data, 2018, para. 5). A popular cross-platform data standard also failed to materialize, in spite of Ogdin’s and Solomon’s efforts to establish one (Freiberger, 1982, p. 15) By the mid-1980s cassettes for computers were completely defunct.

A third contender in software carriers was the ROM cartridge, which featured data stored in an integrated circuit mounted to a circuit board and surrounded by a plastic enclosure. These were the carriers of choice for the video game systems that achieved popularity in tandem with early home computers (Howe, n.d., para. 1). ROM cartridges were also used by certain computer systems like the TI-99/4 of 1979 (Stengel, 2016).

The advantages of ROM cartridges over other media formats still resonate today: they were extremely durable and were capable of being circulated in libraries and other institutional environments without risk of accidental damage. Further, this format did not degrade through routine use like other physical media, and it featured quick access times. Cartridges also had big-name backing; in 1983, IBM announced that ROM cartridges would be the prescribed software carrier for the PCjr, which was a lower-priced computer intended for the consumer market (IBM Corporation, 1983).

Unfortunately for libraries and software users, cartridges also failed to have a lasting impact. Their weaknesses as a computer software medium were low capacity and high price due to their complexity of construction. For example, the PCjr version of Lotus 1-2-3, the leading spreadsheet application of the 1980s, required a hefty two cartridges and a floppy disk to so much as run. Further, they retailed at the expensive sum of \$495 in the U.S. (Trivette, 1985, p. 63). The PCjr itself was discontinued soon afterward, and with it the notion of ROM cartridges as a practical carrier for computer software largely vanished.

Floppy disks: A decidedly imperfect solution

Throughout the 1970s and early 1980s, formats of software carriers were thrust into prominence with great promises, experienced short bursts of success, and ultimately failed. Although the long-standing victor, the floppy disk had a trajectory that was completely different. Floppy disks were first marketed in 1971 and by the time affordable implementations of the technology began to emerge on home computers nearly a decade later, they had the virtue of already being a tested and proven technology (IBM Corporation, n.d.). The floppy disk had physical dimensions of either 5¼ or 3½ inches (square) and capacities ranging from 80 kilobytes to two megabytes or more. Further, floppy disks were on par with cassettes for capacity, but were faster than cassettes in retrieval speed. They were suitable for random access, unlike tape, and less expensive than ROM cartridges (Halfhill, 1983, p. 54; Disc Interchange Service Company, 2010, 5.25" Floppy Disks and 3.5" Floppy Disks sections). The appeal of the format was obvious.

However, unlike cassettes and ROM cartridges, floppy disks were fragile and difficult to file. 5¼-inch disks were wafer-thin, magnetically sensitive, prone to bending or melting (which ruined the media), and contained an exposed window that had to be kept free of dust and fingerprints for reliable operation (Indiana University, 2018, paras. 2-10). For libraries, this alone provided a significant disincentive for lending and borrowing. Floppy disks could not be treated carelessly or with ease; they had to be safeguarded from mistreatment and stored in covered containers.

The impact of disk copy protection on borrowing

Since floppy disks were an intrinsically fragile medium, it was worthwhile for users to create backup copies of purchased software titles. The impact of this fragility would have been magnified for libraries dealing with mishandling by patrons. Data stored on floppy disks was inherently easy to copy; on computers equipped with two floppy drives and running MS-DOS, the single command “diskcopy” was all that was necessary to create a perfect clone of one disk on to another (Murdock, 1998). Far from the tedious routines required for backups in the paper-tape era, this was the computer-data equivalent of placing a novel on the glass of a photocopier, pressing a button, and receiving a complete bound and paginated copy of the book come from the slot.

If it was simple to make legally-legitimate copies of a software title purchased and owned by the consumer, it was also equally simple to make legally-illegitimate copies of a title *not* purchased or owned by the consumer. This realization concerned software vendors even before disk storage became common. As early as 1976, Microsoft founders Bill Gates and Paul Allen were lambasting the lack of rigorous intellectual property policies in the software sphere. They referred to software copiers as “thieves” and demanded compensation for every manifestation made of their work (Freiberger & Swaine, 2000, p. 195).

As the industry waited for software intellectual property law to slowly manifest itself in legislatures and courts, vendors took matters of enforcement into their own hands by implementing copy-protection schemes on disk media. These schemes most often exploited idiosyncrasies in track and sector structures to produce disks that could be read by hardware but could not be copied without producing errors (Great

Hierophant, 2011, section 3). Some schemes contained a counter, granting the purchaser of the software the ability to make a limited number of copies before being revoked of the privilege (Fawcette, 1985, p. 5). A few proposals even involved the use of hardware locks, such as physical keys attached to a computer's serial port to permit software to run (Fawcette, 1985, p. 5). Regardless of their exact nature, all of these schemes added inconveniences for users and made it impractical and difficult for copies to be lent or borrowed in legally-legitimate circumstances.

Copy-protected disks abounded for business and productivity software in the first half of the 1980s, and persisted on educational software through the end of the decade (Hertzberg, 1989, p. 8), but gradually lost favour. In 1985, Sierra On-Line and two other members of the Software Publishing Association trade group announced that they would stop using copy-protection due to concerns about user inconvenience and the inability to run software from hard drives (Mace, 1985, p. 16). Several large vendors followed suit in the following year, including Ashton-Tate, makers of the dBase database program (Ashton ends copy protection on software, 1986, para. 1). Executive hypocrisy, however, also impacted the picture. WordPerfect founder Alan Ashton planned to ship a copy-protected version of his company's word processor, yet used a non-protected copy himself (Peterson, 1998, p. 41). After fifteen minutes of being forced to use the copy-protected version, Ashton relented and ordered copy-protection to be removed.

Even when libraries and individuals were not affected by copy-protection schemes, restrictive licences dictated the limits of what they could legally do in fanatic detail. MicroPro, the developer of WordStar, forbid purchasers of its products from using them on more than one computer or transferring the licence to another individual (Chin,

1984, p. 34). Other vendors obligated users to notify the company and ask for consent from the original purchaser when reselling or transferring software, under the implication that their behaviour would constitute piracy if they failed to do so (Morgan, 1994, p. 46). Some vendors were more permissive; Borland and Claris allowed individuals owning desktop and laptop computers to use a single copy of software on both devices. Borland specifically described its licence as a “no nonsense” agreement where “a piece of software should be treated just like a book” (Gillin, 1992, p. 52; Kahn, 1992, p. 28). Zegarelli (1988) concurred, and expressed a desire for software to take after books in distribution as well as licence policy: “If I can borrow a painting, a record, a movie, or a book at my public library, then I should be able to borrow a computer program” (p. 52). Unfortunately, these moments were exceptions to the rule.

If floppy disks had been a more durable format or other software carrier formats such as cassette tapes and ROM cartridges had achieved lasting penetration instead, it is likely that there would have been less incentive for illicit copying and, in turn, less incentive for the industry to adopt copy protection. The incentive for copy protection could have also been reduced if more libraries had built collections of computer software for circulation earlier, enabling patrons to make free and temporal use of a community copy. However, these theoretical outcomes are far from what emerged.

Partially due to copy protection and restrictive licence policies, years of inherently fragile media and presumptions of dishonesty among users had done substantial damage to the notion of software as a borrowable, book-like product. Instead of lending, copying was now the expected means of sharing a material between individuals. To

reconsider this perception, a new type of software and a new type of software carrier would be required.

CD-ROM: Borrowing's rebirth and redeath

The compact digital disc was devised as a sound carrier much like the cassette, and was launched in Japan in November 1982 (Philips N.V., n.d., para. 1). Compact discs encoded recordings as a stream of digital bits in the same manner as computer data. The technology had versatile applications that went beyond music alone. Efforts to apply the compact disc to computers as a storage medium began almost immediately, and were prototyped as early as 1983 (Edwards, 2012, Life as CD-ROM section).

As a software carrier, compact discs had distinct advantages over other popular formats. Although the 74-minute audio capacity of CDs was slightly less than that of long-length cassettes, CDs were far denser for data storage applications. A CD-ROM could store up to 650 megabytes of data, which was almost an academic limit by the standards of the 1980s. This was when 360-kilobyte floppy disks were common and a top-of-line IBM PC AT cost more than \$5,000 shipped with a 30-megabyte hard drive (IBM Corporation, 1986, Description section). No part of the disc media aside from the central hub touched the player when being used. Therefore, CD-ROMs did not wear out through routine use.

In addition to cavernous capacities and durability, the CD-ROM format also had several distinct characteristics that made it more similar to books than prior computer data formats. The format was exceedingly difficult to copy, making widespread user piracy moot. Recordable CDs were rare and uncommon until the late 1990s (Edwards,

2012, Life as CD-ROM section), while hard drives were dwarfed by the capacities of CD-ROMs until the same late era. CD-ROM maintained the integrity of a physical medium; the disc had to be physically present in order to be used, and data was accessed directly from the disc. Due to the initial scarcity of CD-ROM media, it was also permitted and even expected for users to move the carrier from one computer to another. Libraries and universities also had the option of sharing CD-ROM content with multiple users over a local area network (Dryden, 1990, pp. S10-S11).

This confluence of circumstances was a boon for libraries, and enabled CD-ROM to become established as a legitimately borrowable, book-like medium in the late 1980s and 1990s. It also did not hurt that the first applications of CD-ROM as a software carrier were for digitizations of physical books. The United States Department of Commerce published agricultural census data on CD-ROM as early as 1985, three years before the Yellow Book standard for the format was even finalized (U.S. Department of Commerce, 1992, 121; Rouse, n.d., para. 1). In 1985, the publishing firm Grolier announced that it would release its KnowledgeDisc encyclopedia on CD-ROM for \$199 in the United States (Takiff, 1985, p. 1). Microsoft released the first version of Bookshelf, a collection of ten digitized reference books two years later (Waurzyniak, 1987, p. 5).

Libraries were ecstatic about the possibilities suggested by CD-ROM as a software carrier. Writing for *American Libraries*, Kuhlman and Lee (1986) noted that “for approximately \$7,000 in hardware and a few hundred dollars in software, any library will soon be able to possess and access data sets now available only at the largest research institutions” (p. 760). CD-ROM was a space-saver and a convenience because

a single disc could hold more content than a shelf of books. This made publications such as the digital version of the United States County and City Data Book practical due to the fact that they that had previously required 33 floppy disks (Kuhlman & Lee, 1986, p. 758). Apple released the first Macintosh computer with a built-in CD-ROM drive in October 1992 (LEM Staff, 2016, Details section). By 1994 CD-ROM drives were virtually standard on consumer-level computers, and manufacturers such as Compaq were even equipping them on servers as well (Corcoran, 1994, p. 6). The release of Myst in late 1993 expanded the scope of CD-ROM into the world of immersive games (Kohler, 2008). Microsoft's Encarta expanded the reach of CD-ROM encyclopedias by combining volumes of text with multimedia content, and was frequently bundled with new computers (Smith, 2017, section 2). By the latter half of the 1990s CD-ROM titles were even being retailed by Columbia House. This company was a mail-order merchant that now promoted "hit programs" with the intensity once reserved for "eight CDs for a penny" promotions (Columbia House, 1997, p. 15).

Herther (1995) notes that the penetration of the technology increased as its price dropped, and that by 1995 a complete computer system cost half the price that a CD-ROM drive alone once did (Surveying the Landscape section). Libraries viewed CD-ROM titles as "integral parts" of their collections, circulating them like books, and anticipating new titles published in more and more categories (Herther, 1995, Dealing with Complex Issues section). Librarians were also conditioning themselves to the possibility of CD-ROMs replacing books outright. Quoting Jerry McFaul, Herther (1995) noted that "this will eventually happen as the 'access' technology becomes as convenient and easy to use as the book itself" (p. 117). CD-ROM indeed made an

incredible amount of headway in the 1990s, inside and outside of libraries and nearly fulfilled the promise of software as a book-like medium.

Slowly and unfortunately, however, this format began to unravel. A CD-ROM may have had superficial similarities to an audio CD, but it could not be “played,” it needed to be “installed,” and it required loading a stub header on each computer (Crawford, 2001, pp. 67-68). Each CD-ROM publisher had different installation procedures, and due to the variety in computer hardware, there was no certainty that any given CD-ROM title would work or be fully functional on any given computer. Overtaxed librarians could easily have found themselves fielding technical-support questions they were ill-prepared to answer, and they could not guarantee playback or operation. In 1991, Microsoft and a number of associated companies attempted to remedy these issues by unveiling the Multimedia PC standard, which was a set of minimum hardware and software specifications devised to impose a modicum of compatibility between computers and CD-ROM titles (Cole, 1995, para. 3). Adherence to the standard was never consistent or universal, and it was ultimately doomed by changes in technology. The Multimedia PC standard was ramped up and revised twice in reaction (Cole, 1995, paras. 1-4), but then it faded away due to its promise of uniformity being unmet. The advent of 32-bit Windows versions and PowerPC-based Macs further fragmented the CD-ROM market by configuration. Mail-order vendors had to spell out system requirements for each title that they carried (Columbia House, 1997, p. 15).

Since the intrinsic inconsistency and incompatibility of computer hardware was a major hurdle for CD-ROM penetration, potential solutions existed that eliminated computers altogether. These promises also failed to deliver. Philips’ CD-i was a defined

standard for multimedia content read by a standalone player similar to a video game console and displayed on a TV set (Christopher-Mason, n.d., para. 1). The low resolution of the CRT TVs of the era meant that CD-i was poor for text reproduction, which was the focus of many CD-ROM titles. CD-i was further hampered by high prices and a lack of quality titles, and the format was discontinued in 1996 as a commercial failure (Grundhauser, 2016, para. 13).

Walt Crawford (2001) described the technical failings of the CD-ROM format in succinct detail:

When Dorling Kindersley publishes one of its magnificent illustrated books, it can predict that fully sighted readers will be able to see all the pictures. When DK Multimedia translates that book to CD-ROM, it cannot predict universal operation (p. 67).

He opined that in addition to technical reasons, the format also failed because publishers flooded the market with titles and expected sales far in excess of what their price points and distribution allowed.

The effects of this failure were not subtle, and the quantity of titles Crawford (2001) reviewed in his capacity as a contributor to library-related publications had dwindled from 45 per year in 1995 to zero in 2000 (p. 68). By 2009, even long-established stalwart CD-ROM software titles such as Microsoft's Encarta had been discontinued (Fried, 2009). Speaking prophetically, Terry Chadwick of InfoQuest opined in 1995 that "once everyone is wired with ISDN-like capabilities, online may be the future" (Herther, 1995, p. 117). The long-term decline of the "title" CD-ROM format that

technical problems had sparked was accelerated by the Internet. Wikipedia had become widespread by 2009 and so had high-speed Internet access, making the advantages of the physical CD-ROM carrier appear moot. The 650-megabyte capacity of CD-ROM that had seemed insurmountably huge in the 1980s also became a constraint. Later releases of Microsoft Encarta shipped on multiple CD-ROMs or required a player capable of reading the DVD-ROM format, which was higher in density but less widespread (Microsoft Corporation, 1997).

Conclusion

When computer software first emerged as a consumer product four decades ago, it had the potential to develop in a direction that would have benefited both libraries and the communities they serve. Because of software's inherent similarity to books and audio recordings, it could have emerged as a tangible physical medium included in library collections to be lent to patrons. This availability of the medium could potentially increase the exposure of creative and innovative works under legal circumstances.

A combination of technological constraints and conscious industry actions caused computer software to repeatedly fail at this mandate. This confluence of circumstances manifested itself in the failure of paper tapes, cassettes, and ROM cartridges to achieve lasting popularity as software carriers due to low densities, low speeds, and high prices. This manifested itself in the ulterior impact of floppy disks on libraries and computer users, where the fragility and ease of copying the medium led to detrimental copy-protection schemes and licences restricting user behaviour. Lastly, it manifested itself in CD-ROM, which nearly realized the ideal, yet declined precipitously

from initial levels of popularity due to compatibility issues, capacity limitation, and redundancy.

The past four decades of software carrier history are a cautionary tale that continue to inform the present-day reality in which libraries find themselves. Physical carriers for software have largely disappeared, which leaves no tangible medium to lend, borrow, or serve as a functional unit of collections development. Much of the interaction with computers that was formerly accomplished with software purchased and possessed by the user is now accomplished through the Internet. This current day reality is still governed by severe restrictions on ownership, extended use, transferability, and is mediated through servers on “the cloud” that can revoke access at any time. Books and software still have a certain degree of intrinsic similarities to each other and both continue to be fodder for knowledge and direction, but it is unlikely at the present time that software will re-emerge as a book-like, borrowable medium. Libraries and library patrons are both poorer for this as a consequence.

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