

# Videogame Editions for Play and Study

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## **Abstract**

We discuss four types of access to videogames that are analogous to the use of different sorts of editions in literary scholarship: (1) the use of hardware to play games on platforms compatible with the original ones, (2) emulation as a means of playing games on contemporary computers, (3) ports, which translate games across platforms, and (4) documentation, which can describe some aspects of games when they cannot be accessed and can supplement play. These different editions provide different information and perspectives and can be used in teaching and research in several ways.

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As researchers look through archival materials, they usually seek those with the potential to yield important insights, novel knowledge and perspectives. Literary scholars seeking such knowledge also consult published editions, often accessing several different editions of a particular work to understand different aspects of it. Game scholars have the ability to access different “editions” of videogames, just as scholars of literature do. Games can be played on a hardware system of the sort for which the game was originally designed, played on an emulator, or played using a port of the game to a different platform. Finally, it is possible to view documentation of games. Here we will discuss some affordances of each means of access to videogames, each different sort of edition, focusing on the advantages for research and teaching purposes.

Our goal is to provide an alternative point of view on archiving and preserving digital media by sharing our experiences in a laboratory that provides access to different sorts of creative computing, including material videogame systems, home computers, and videogames on physical media. The Trope Tank is a small laboratory for teaching, research, and creative production at MIT. The resources in the lab include material computing systems and media to support the humanistic study of technology, with a focus on creative computing, including videogaming. By discussing how we use our resources, we hope to share with archivists, as well as other teachers and researchers, some ways in which these materials are already being productively used, and to outline some of the practical issues related to these materials that deserve attention.

This paper does not discuss the important, related issue of digital preservation and the practicality of maintaining access to games in different ways, systematically, over long periods of time. It is clearly a challenge to maintain older hardware in working condition, and we do not mean to suggest that over decades and centuries it will be easy, or even possible, to do so. Preserving emulated or migrated versions of games may be much more sensible over very long time scales. However, we have in fact maintained certain older, mass-market systems in usable condition up to now, and students and researchers have used these currently-available systems to better understand creative computing. We believe that those who have access to our lab or similar facilities should avail themselves of the opportunity to use older material computing systems, not as the exclusive way that games are played, but in addition to other means of access.

Although our focus here is on printed editions, it’s useful to shift our metaphorical ground for a moment. The problem of accessing original hardware can be compared to discussing a compelling staging of one of Shakespeare’s plays, one which is now being performed in one’s city and has had its run extended. We could bemoan that this particular staging of the play is impossible to preserve. But there are other options available now. We can go to see the play, and even take a class to see the play, which is still currently running. (We can also, of course, examine documentation of it later.) This analogy is not meant to map fine details of performance to computer games, but simply to show that in some cases there is still access to an experience which is difficult or impossible to preserve. By making vintage hardware available for use in a lab setting, and accessible to researchers and classes, we are taking people to see a play that is still running, providing an important experience that is still currently available.

Our focus here is not on original hardware exclusively, but on how the several different formats in which videogames and their platforms have been preserved, up to now, can serve different scholarly purposes. Videogames can be accessed in many ways, but we consider four main formats which we see as useful to compare to different types of literary editions:

**Hardware:** Can be considered the “original edition.” The game runs in the actual platform it was developed for, or some later platform that is hardware-compatible with the original one.

**Emulation:** A facsimile of sorts, which allows access to the software by running a virtual machine in a computer. The virtual machine emulates the platform for which the game was developed; where literary facsimiles are not similar is in how the emulator allows access to and modification of the game in ways different from the original. An emulator provides not just visual similarity but a comparable type of functioning or operation.

**Port:** Similar to a translation of a work, a port is a different work based on a game for a different platform. The code or the game concept has been translated to run in a different platform, sometimes one with very different capabilities.

**Documentation:** This does not just refer to just looking at game manuals, but to examining screenshots, recordings, reviews, and all sorts of materials that describe things about the game and play experience without providing that experience. The closest analogy would be to looking at references and discussion, but a volume of annotations is similar in some ways.

Each one of these videogame editions can aid research and teaching in a different way. How they are best consulted depends on the purposes of the researcher or teacher. Since the experience of a game may be possible using more than one of these options, we outline the major advantages and disadvantages of each method, considering the different purposes that a game scholar may have in mind and realizing that dedicated scholars and teachers considering particular games intensively will often wish to use several of these methods to access the same game.

### **Hardware: The Original Edition**

When a full hardware system, compatible with the game in question, is available, this system provides a context of input, storage media, and output. So far as these factors are concerned, it is possible to play the game in the way that was originally developed. In this case, the hardware can give us the opportunity to fully appreciate the material qualities of the game artifact, including the audiovisual quality and the responsiveness of the input.

The Trope Tank has several different older computer systems for running and displaying digital media, allowing us to compare the affordances of each type of software and system and see how different platforms perform alongside others. For instance, we have an Apple //c computer connected both to a green-on-black monochrome display and to a color composite monitor, both of which are from the time of the Apple II series. With this setup, it is possible to quickly see how the same

image was made to work on both displays, and to observe this in variety of games. This allows students to understand display differences they may not have been aware of; it also allows researchers to see in detail how different titles produced output. This output was more aesthetically pleasing across both displays in some cases and less pleasing in others, and these differences are worth consideration.

A clear example of how original hardware gives us insight into how a game was conceived is the famous early home console version of *Pac-Man* (Atari VCS, 1981). This port of the arcade classic is significantly degraded visually when played in emulation on the LED flat panels that are prevalent today. The game uses a flicker effect to produce the appearance of four “ghosts” – called “monsters” in the original arcade game. Due to the Atari VCS having only two sprites, and due to the requirement that the ghosts move independently rather than in a *Space-Invaders*-style lockstep, each ghost is drawn only once every four frames; programmer Tod Frye could not determine how to present them all simultaneously. What was a technical achievement for the time has rendered the game almost unplayable with the advent of new displays. Playing *Pac-Man* on a CRT display, however, allows one to see how the persistence of screen phosphors was used cleverly and to good effect.

Original hardware also allows us to explore the materiality of game controllers and how they work with particular games, seeing how the material properties of the system are essential to the experience of play. For instance, it is difficult to play some of the Atari VCS games, such as *Breakout* (Atari VCS, 1978) or *Kaboom* (Atari VCS, 1981), without the paddle controller for which they were developed. This controller came with the Atari VCS and implemented the familiar *Pong* controls (with the addition of a button per paddle), but it is an unusual controller today. As Atari VCS development continued over the years, developers came to favor the use of the more general and then-familiar joystick, and paddle-based games were made less and less often. Those seeking insight into this aspect of the history of the Atari VCS will do well to play some paddle games using the appropriate paddle controller.

At times the original hardware is not only a good way to appreciate the achievements (or failures) of a videogame. It may be absolutely necessary to run the game on its original platform, since some programs depend on hardware aspects that current software does not adequately reproduce or provide a substitute for. The game *Sherlock* (Commodore 64, 1984), for instance, was observed to crash on different emulators, due to issues with how the timer was emulated; the same program ran on a hardware Commodore 64 without problems. The games developed for the gun-like NES Zapper, such as *Duck Hunt* (NES, 1984) or *Gumshoe* (NES, 1986) are another case, since they are unplayable if the console is not connected to a CRT display. The Zapper is a light gun that used the display lag of CRT televisions to detect whether a target had been hit or not by displaying a back frame with the targets lit up in white. LCD televisions and flat panel displays do not produce this lag, making it impossible to play these games.

Hardware can also provide unintentional sorts of feedback, and this can become part of the experience of play. For instance, when playing text adventures that run on a floppy disk, a completely nonsensical input typically produces an immediate response, but typing a successful command that does something interesting can result in a pause of a

moment before the computer accesses and slowly reads from the disk, generating expectation about what the next thing will be. Such brief moments of drama have been removed with faster technologies, so that contemporary text adventures have had to create intentional devices to communicate similar feedback in turn, from more dramatic writing to the use of graphics and sound to make evident how the player is affecting the game. An example is seen in *Alabaster*, by Emily Short and others (Z-machine, 2009), which generates illustrations before displaying the next piece of text in key moments of the story.

Using the original hardware opens the way for discovery and insight of different types. Although it may seem that using the original hardware is the ideal format to access a game, it turns out that both emulators, ports, and documentation can also provide us with both technical and practical advantages for teaching and conducting research.

### **Emulation: Digital Facsimiles**

Emulators provide another way to see how games function. They are virtual machines, programs that implement earlier computers and can run software for them, emulating how a game or other program executes. Emulators are commonly identified as a software tool to implement the working of older or obsolete hardware using modern computers. It is also possible to emulate some more recent, and even current platforms, and this may be done to facilitate development or testing. To speak very generally, emulators of hardware before 2002 and emulators of portable gaming platforms often work relatively smoothly and at an acceptable speed. Attempts to emulate more recent gaming systems can get more complex, and they can run more slowly. In any case, game consoles from the last two generations are relatively easy to access. Although emulation can provide some advantages even in these cases, using software to implement recent hardware that is only marginally less powerful than our current systems, often requires such processing power that videogames cannot usefully run.

Virtual machines in general are a boon to the study of games, since a virtual machine released for new platform may be able to run a large variety of software. Adventure games in the 80s and throughout the 90s, in the form of text adventures and graphical adventures, took advantage of the power of the virtual machine early on to help their development and distribution. A videogame genre that was principally developed for home computers, the sheer variety of computer models made it unpractical to develop different versions for every single one of them. The solution was creating a virtual machine that would run the same version of the game software across different home computers; thus developers only had to develop a virtual machine and then the specially formatted game would almost automatically run in all of them. The prevalence of virtual machines in adventure games in particular has made it relatively easy to make them run in current platforms. Infocom was one major game-maker that used a virtual machine, the Z-Machine. Later, LucasArts created the SCUMM platform for their games. Programs such as Frotz or SCUMMV now allow playing a large variety of text and graphical adventures respectively in a variety of current hardware, from practically every computer operating system to smartphones, greatly facilitating the access to these games.

Emulators provide easily downloadable implementations of systems that may be hard to locate in their hardware forms, or difficult to set up and use even if one does have access to the hardware. Emulators are more or less essential for demonstrating, here in the U.S., games for home computers that were not released in this country, such as the different models of the Spectrum Sinclair, the Amstrad or the MSX home computers, to name but a few. Even when a researcher in the U.S. has a computer of this sort, a power converter is needed along with some way to display a PAL TV signal. If a flat-panel display is used rather than a PAL CRT, one of the major reasons for going to the trouble of using the original hardware is obviated. A foreign hardware setup, while it can be made to work with great effort, can become so cumbersome that the option of emulation can be particularly appealing and effective.

Apart from ease of access, many of the advantages of emulation have to do with teaching and with student access to games. To begin with, virtual machines make games portable: we can run them on a current computer and project them on a screen to show them to a class. Emulation also makes it easy to take screenshots for articles and books and to produce videos as a pedagogical resource. There is specialized software to capture video and images from any computer application, whereas taking photos or video from a console again may require additional cables and hardware as well as some technical expertise. Another technical advantage is the possibility to save the state of a game at a specific point, which we cannot always do with original hardware. Thus we can prepare a saved game, allowing a class to access a specific point without having to play all the way there. This is even possible at points in the game where the original hardware did not have a save point. We can also distribute these save points to students, so that they play the specific section of the game themselves. In practical terms, emulators often save teachers and researchers load time – loading a program from a cassette deck or a Commodore 1541 disk drive can take ten minutes or more. Since a program may not load correctly, as tapes and disks degrade over time, this long span of time is particularly problematic in a class presentation situation.

In more technical terms, emulators allow significant access to and understanding of how games and other software make use of the hardware. An emulator, such as Stella for the Atari VCS, allows users to trace execution, inspect registers, and learn in detail about the machine state. It functions as a tool for reverse-engineering and for learning about the software and the platform it runs on. Even if there are some differences between some aspects of the functionality of the emulator and the hardware, an emulator, which represents the system well in many other ways, provides a powerful learning tool, offering insight into its workings that the original hardware does not provide.

### **Ports: Translating across Platforms**

Ports are versions or interpretations of a game for different platforms. They offer the opportunity for a comparative analysis of what is usually thought of as the same game across different platforms, an analysis which can offer insights into both the game and the platforms. Modifications, expansions, and omissions in ports can help us understand the affordances of different platforms, the defining features of a particular game, and what “fidelity” might mean in digital translations.

In a port, the original program is translated so it can run in other hardware. At times, the translation may involve translating code to another programming language; at other times, the programming language used may be the same, but the hardware in which it is implemented may be quite different, so that the original program may need to be adapted. It is standard practice in some cases to port games by adapting their code, while in other cases, even though the original code may be available, the person doing the port may never even look at the original code.

One case in which the adaptation of code was typical was with BASIC games. Many home computers in the 1980s used different versions of Microsoft BASIC, as was the case with the Commodore 64, computers in the Apple II series, and computers implemented in the MSX standard. BASIC facilitated the translation of programs between them, but each program had to be adapted to each system and the particular way that BASIC was implemented. Sometimes this would be done by the user, who typed in a program and would have to figure out how to modify it to make it work with his or her system.

Ports, like translations, are certainly worthy of study as new works in and of themselves, but they can also be seen as editions of the game on which they are based. In the same way that a translation involves interpreting the original text and deciding what is essential to it to carry it over to the target language, ports involve making decisions about how to transfer the original program, from the user interface to the gameplay to the algorithms that determine the behavior of the game objects. (This is discussed in the book *10 PRINT CHR(\$205.5)+RND(1) : GOTO 10* by Nick Montfort et al., for instance on p. 52, and in the discussion of VCS ports of arcade games in *Racing the Beam* by Nick Montfort and Ian Bogost.) When the target platform is overall more limited, with fewer affordances than the original platform, a port may put the technology of the target platform to the test. That was the case of the Atari VCS *Pac-Man* mentioned above, which challenged the graphical capabilities of the platform by featuring five independently moving sprites on screen.

Although some ports of arcade games to the Atari VCS are regarded as poor games (partly because current players experience them through emulation), these ports often pushed the technology of the VCS, as they did with other platforms. Even the 1978 game *Space Invaders*, which hardly seems like a technological wonder today, was a challenge for the Atari VCS, for which a version was released in 1980. That console had native support for only two sprites. *Space Invaders*, the arcade game, features an array of attackers. Fortunately, a trick on the Atari VCS allows for sprites to be duplicated down the screen, in vertical bands. This was discovered very early on and used in the launch title *Air-Sea Battle*. When Richard Maurer was given the assignment of programming *Space Invaders*, he needed to use this task and also replicate a sprite horizontally. He found that the same trick could be used within a scan line to duplicate a sprite to the right as well as down, as long as all the sprites were moving in lockstep. Meeting the challenge of *Space Invaders* meant developing a new technique which would be employed again in later Atari VCS games.

Porting an older game to a current platform is usually regarded as an improvement, because the new version may allow for additional features and perhaps an audiovisual

upgrade. *Super Mario DS*, the Nintendo DS port of *Super Mario 64* (1996; 2004), for example, improves the graphics of the original game and uses 3D models featuring more polygons and higher resolution textures. This version also includes mini-games and additional rooms that were not available in the original game, effectively adding new goals and gameplay. The controls of the game were also optimized to use the touchscreen of the Nintendo DS as an analog joystick, whose sensibility was noticeably different from the N64's controller. On the other hand, such upgrades are not as prominent in the enhanced version of the Dreamcast/PS2 game *Rez*, called *Rez HD* and available for the Xbox 360 (2001; 2008). This game includes new visual options and features not present in the original game, but, perhaps thanks to the care taken by the original game developer, Tetsuya Mizuguchi, it supports a gaming experience quite similar to the original.

Ports can be quite complex and unusual, deviating from the original game in ways that are less predictable and systematic than with emulated games. However, the differences between a port and the original can also be very interesting. They can reveal, at the very least, what one dedicated designer/programmer who spent extensive time and effort ended up valuing about a particular game – what that person imagined to be the most important aspects of the game and what that person thought was expendable.

### **Documentation: Annotations and Descriptions**

Although the code to the very early videogame *Spacewar* and re-implementations of that game exist, some games are lost and will never be directly made available in functioning editions. If we know anything about such games, however, it is because some form of documentation exists and can be consulted.

Perhaps a reasonable analogy in the history of print is a book that contains the notes to a primary source without including the text of that primary work, such as *Ulysses Annotated* by Don Gifford. If the text of *Ulysses* were lost and all scholars had to consult was *Ulysses Annotated*, they certainly would not have access to the original book, but they would be in a much better situation, and have a much more detailed idea of what that book was like, than without those notes.

Whether or not the game itself is somehow accessible, the original packaging of the game, with box, manual, and other materials, provides an important material way to help researchers understand videogames, especially for games before the generalized use of CD-ROM drives in 1991. Boxes and manuals were often used to flesh out the narrative framing of the game, for which there was usually limited or no storage in older games. We know that the name of the protagonist of the Atari VCS Activision game *Pitfall!* is named “Pitfall Harry” because of the manual. More importantly, the original package included materials that were part of the copy protection system of the game – the materiality of the game was an aspect that was commercially valued. The Infocom text adventures of the 1980s have become famous for including “feelies,” a set of memorabilia and documents that provided information needed in the game, such as clues and codes. Without these materials, players may be able to start playing but then get stuck, since they were missing key knowledge to advance in the game.

When lined up against different videogame editions, documentation may seem like a



poor substitute for the original. But it can offer some insights that the original does not. Contemporary reviews of games express how they were received and understood in their early context. Video records of early play give a perspective on how players of the time encountered the game which isn't present in the working game itself, as we play it today. Ideally, documentation will be included in critical editions of games along with emulated and ported versions of those games. It should certainly be consulted by serious scholars, whether or not working editions of a game are available.

## **Conclusion**

We have provided an overview of the different “editions” in which videogames can be accessed, with specific examples of how these have been used in our everyday research, scholarship, and teaching practice. Our purpose has been to understand the different types of access to videogames and their relationship to printed editions.

What we provide is not a list of best practices or a simple set of instructions for all videogame researchers to follow, but rather a description of some of the major aspects of each type of access, in an attempt to describe the range of options for play and study that are available.

As researchers and teachers, we often try to let our materials speak to us, see what we can learn from them. The differentiation between game editions and the ways in which we use them in practice should help us get beyond the idea that certain editions are inherently better and are the appropriate ones to use in every circumstance. This allows us to understand the virtues and limitations of hardware, emulation, and ports as ways of accessing games, and what documentation offers, to see when each type of access, or when more than one type of access, is appropriate. Considering these types of access should also enlighten us on how and why to preserve games and certain materials related to them.