

Digital Devices

As humans, we perceive the world in analog. Everything we see and hear is a continuous transmission of information to our senses. This continuous stream (of motion) is what defines analog data. Digital information, on the other hand, estimates analog data using only ones and zeros.

For example, a turntable (or record player) is an analog device, while a CD player is digital. This is because a turntable reads bumps and grooves from a record as a continuous signal, while a CD player only reads a series of ones and zeros. Likewise, a VCR is an analog device, while a DVD player is digital. A VCR reads audio and video from a tape as a continuous stream of information, while a DVD player just reads ones and zeros from a disc.

Since digital devices read only ones and zeros, they can only approximate an audio or video signal. This means **analog data is actually more accurate than digital data**. However, digital data can be manipulated easier and preserved better than analog data. More importantly, computers can only handle digital data, which is why most information today is stored digitally. But if you want to transfer video from old analog video tapes into your computer so you can edit them, you're not out of luck. You can use a digital to analog converter (DAC) to convert the analog information into a digital signal that can be recognized by your computer.

Digital media is a form of electronic media where data is stored in digital (as opposed to analog) form. It can refer to the technical aspect of storage and transmission (e.g. hard disk drives or computer networking) of information or to the "end product", such as digital video, augmented reality or digital art.



Flash



Floppy Disk



Zip Disk



CD + RW



CD + R



DVD + RW



DVD + R



Storage Tape



Smart Media



Removable
Hard - Drive



Micro Drive



Memory Stick



Smart Cards



Online Storage Site



PC Card

How to Back-Up Your Hard Drive

Decide on the proper backup media for your needs.



CD-R, DVD+-R, tape, hard drives (internal and external), online, and flash drives are all great choices, but the right tool for the job is always best. Do some research on the advantages of each, and choose the one which will best suit your needs

Choose a backup application.

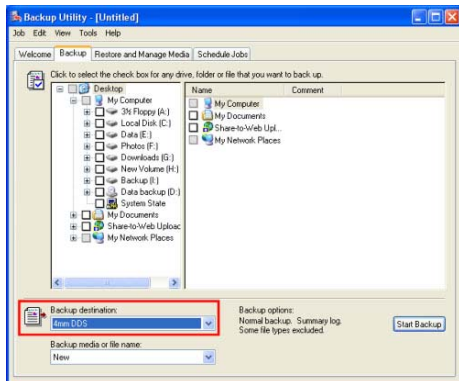
For personal computers, there are many options.

If you are using Microsoft Windows, there is a backup application built in (Start>Programs>Accessories>System Tools>Backup). You can also use third party back-up managers, ranging from small programs to full online backup services.

Prepare your backup device of choice.



If you are using a hard drive, it's best to use it just for backup purposes. Make sure whatever you are using is ready to accept the backup.



Open your choice of application, select the files you wish to keep, select the media where you will be saving the backup, and start it up.

- ✓ Keep your data in a safe place away from environmental hazards. Depending on how important it is, fire safes and safety deposit boxes are great places to keep backup media. If they are not very critical, filing cabinets or desks are fine places.
- ✓ Make sure your backup process completes successfully before using your computer again.
- ✓ Backing up your computer can take a long time, especially if you have quite a bit of data you would like to keep. Plan the backup for a time that your computer will be on (or you purposefully leave it on), but a time that you will not be using the files.
- ✓ Set a schedule to backup all of your important files. Depending on how often you use your computer and the files change, you can set it in most program to run however often you like. Just remember to have media ready and the computer on when it is time for backups.
- ✓ Do not use a computer while a backup is in progress. If you change a file during the process, you will not know which version was actually saved, or you could halt or corrupt the backup. It will also slow your computer down.
- ✓ Do not leave your backup media in an environment that has a tendency to get wet or is not climate controlled. Computer equipment is fairly sensitive, and there is a chance you will lose your backups.

Saving with Digital Storage Media

Original article by Jannette Hanna and Daniel Burge

Digital cameras make taking large numbers of photographs much easier than did the old film cameras. As a result, personal collections of digital images have become much larger. Printing digital images and saving image files correctly are important parts of preserving these digital memories. However, printing every image file from a personal collection would be overwhelming in both cost and time, so the long-term storage of many of these digital images in file form may be necessary. Selecting the right kind of digital storage media (hard drives, disks, and CDs, etc.) will be an important part of the digital preservation strategy.



The first storage medium that image files are “written to” is the **flash memory card** inside the digital camera. Flash cards come in different shapes: compact flash cards, memory sticks, SD cards, and are produced by various manufacturers. Most of these cards are relatively robust when dropped or handled roughly, so they are generally hard to damage except in extreme circumstances. Flash media cards are also very compact and easy to carry. On the other hand, they are expensive per megabyte of storage capacity. The cost of a 700-

megabyte CD is about a hundredth of the cost of 700 megabytes in flash memory. The cards are also difficult to label and organize in storage because of their small size and shape. For these reasons, flash memory is generally not recommended for long-term file storage. Camera files should be downloaded to a computer hard drive for editing and storage. These files may eventually be copied to CDs, DVDs, USB drives, or online storage sites to free up space on the hard drive.



Hard drives are in all personal computers. They are simply sets of spinning metal discs that are written to magnetically to store both files and software programs. They range in capacity but are much less costly per megabyte of data than flash memory cards. Some personal computers may have multiple hard drives, and others may have individual hard drives separated into

“partitions” to keep data sets apart. If there are multiple hard drives in your computer system, you may wish to store your image collection on the drive that does not contain the operating system (e.g., Microsoft Windows or Linux), as the drive with the operating system will receive the greatest use and be more likely to fail. If a separate drive is not available, then creating a partition on the drive to separate the digital photo collection from the program files can make managing the collection more efficient and safe. In addition, access to the partitioned area can be restricted to prevent computer viruses from damaging the images. Computer hard drives will always be vulnerable to viruses and file corruption, so anti-virus and firewall software should always be updated. Using the hard drive as the sole digital image storage site is not recommended, however. If the hard drive fails, it will be almost impossible to retrieve the image collection. It is better to copy and save files to inexpensive, portable, and easily organized storage media.



Writable and rewritable CDs and DVDs are some of the most common storage media used to keep files that have been copied from the hard drive. They are very similar in chemical composition, but CDs will hold 700 to 800 megabytes of data while DVDs can hold up to 4.7 gigabytes (more than six times that of a CD). Both CDs and DVDs are made up of a series of layered materials including rigid

plastic, a sensitive dye layer, a thin, reflective metal layer, and a protective topcoat. These layers are held together with adhesives, but dramatic changes in temperature and humidity can cause stress on the layers and may result in their delamination. Even slight damage to the layers can render the disc unreadable in the future. Therefore, CDs and DVDs should be stored in cool, dry environments in which temperature and humidity do not fluctuate much.

Blu-ray Disc is an optical disc storage medium designed to supersede the DVD format. The plastic disc is the same size as DVDs and CDs. Blu-ray Discs contain 25 GB per layer, with dual layer discs (50 GB) being the norm for feature-length video discs. Triple layer discs (100 GB) and quadruple layers (128 GB) are available for *BD-XL* re-writer drives.



The dye layer and the thin metal layer are both sensitive to the environment, and different types of metal are used in different discs. The reflective metal layer in most CDs is made of aluminum, which can corrode on the surface if exposed to air through delamination or scratches. Some CDs and DVDs are now made with a layer of gold, which is more stable. Gold discs cost more than aluminum ones, but they

may be worth the cost if their intended use is to store files for many years. Rewritable CD-RWs and DVD-RWs are not recommended for the long-term storage of files. They are useful for transporting files, but they can be accidentally erased, and neither is as stable as a CD-R or DVD-R.

They should be held only on the inside clear plastic ring or by the very outside edge. When holding discs by the edges it is important to avoid flexing the disc, as this can stress or delaminate the layers and speed up decay. The flat surface of the disc on either the top or the bottom should never be touched. If fingerprints, dirt, or other substances get onto the surface of the disc, they could impair the ability of the laser to read data. In this case, the disc should be cleaned. First try blowing off dust with canned air or removing by gentle brushing. If that is not successful, use a soft cotton or chamois cloth to wipe the disc, always wiping from the center of the disc straight out to the edge, like the spokes of a bicycle wheel. Never rub a disc in a circular motion. If the dry cloth is still not sufficient, use a cloth dampened with a gentle cleaning solution of mild soap and water.

All discs should be labeled for identification and organization purposes. Adhesive labels put onto the surface of the disc are not recommended. If you want to label your discs with a marker, use a marker made especially for discs. Never use a writing instrument with a hard point, like a ballpoint pen or a pencil. Any scratches or indentations on the disc can render it unreadable. The best location on a disc to write is the clear plastic area at the center. Some disc readers can be damaged by the additional thickness of a label so be sure to check the owner's manual for recommendations or warnings. Some discs are designed to be printed on with compatible printers. They have an ink receiver layer built right onto the surface. Again, they should always be used as recommended by the manufacturer. Any additional information you may want to include should be placed with the disc inside its jewel case.

The best way to store discs is in plastic jewel cases. The jewel cases hold discs so that nothing contacts the surface. The cases should be stored vertically like albums; the discs are more likely to warp if stored horizontally. Never use plastic PVC sleeves as they may eventually deposit oil onto the disc surfaces. PVC may also pull off or dissolve any labeling or writing on the disc. Any paper material that you include with a disc should be of good quality, acid-free, and lignin-free.

Jewel cases should be stored on end, like books, to prevent disc distortion

Most files are currently stored on media CDs, DVDs, and hard drives, but USB drives are becoming more commonly used for collecting and transferring data. The cost for these USB drives per megabyte of storage space is higher than that of storage discs and hard drives but much less than flash memory. The storage capacity of these drives can be as large as several gigabytes. These drives are very small and usually used for transporting or storing files temporarily. They are hard to label, and easy to lose (which is why many come on lanyards or key chains now). For now, USB drives are not recommended for long-term file storage.



Another option is an external hard drive. These act like an internal hard drive but only need to be connected when specific files are needed. These devices can hold huge amounts of data and can be effective ways to save not only your image files but to back up your entire computer. Like internal hard drives, they are still mechanical devices and subject to failure, so care must be taken to maintain them. Some of these drives are solid-state. They have no moving parts, so they will be much safer than current drives. Staying aware of technology advances will help you incorporate new and safer media on which to store your images and will help you avoid data loss due to media, hardware, and software obsolescence.



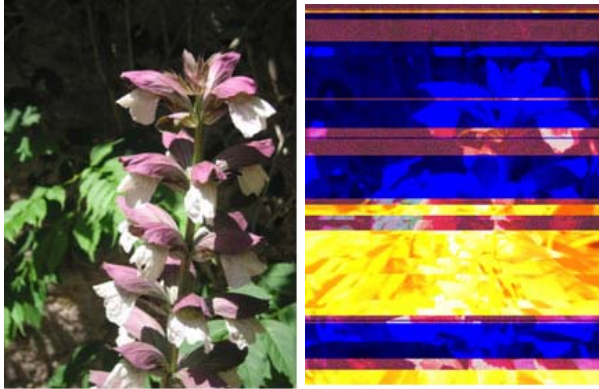
The final option for file storage is online at photo sharing, printing, and storage websites. The storage capacity of these sites is variable, but most are greater than most consumers will actually ever need. The files are (generally) backed up on additional systems by the company, so total collection loss is unlikely. Access to these sites requires a high-speed internet connection, so computers should always have virus and firewall protection. Most of these websites require that

prints or other products be purchased periodically to keep the account active. The website terms usually state that the websites can delete your photographs or terminate your account if not enough prints are ordered per month or year. Also, there is always the danger that the company may go out of business or dramatically change its policies, resulting in no access or reduced access to your images. Some sites may charge additional fees to download files back to your computer, even though they have been storing the files for free. It is prudent to always keep additional copies in your control.

Most importantly, image files should not be copied to media and left for years unattended or unchecked, because of the potential for data corruption or media obsolescence. As computer and digital photography technologies change, the older storage media types and file formats may fall out of common usage. The files will then be difficult or impossible to retrieve. Avoiding obsolescence may require moving files from one type of storage medium to another, and possibly even resaving files using new file types and file type extensions (e.g. *.jpg or *.tif). Files stored on digital media should also be checked occasionally to verify that the storage medium itself has remained stable and the files can still be opened.



Image files that have been corrupted by a virus or as a result of disc damage may open but will not look the same as an uncorrupted original file. Keeping files stored in multiple locations is an important safety net, should something like this happen.



Uncorrupted file ***Corrupted file (simulated)***

As any collection of unprinted digital images grows, it will become imperative to store files somewhere other than the computer's hard drive. Storage media will change over time as technology advances. As this article is a guide only for the media that are currently available, recommendations will undoubtedly change over time as well. Files and storage media should be properly named and labeled so that you can quickly find what you're looking for. Saving multiple copies of images is always recommended, and, if possible, send copies of the most precious images to family or friends that live elsewhere. This way, in the event of a disaster, copies of your favorite images will survive.