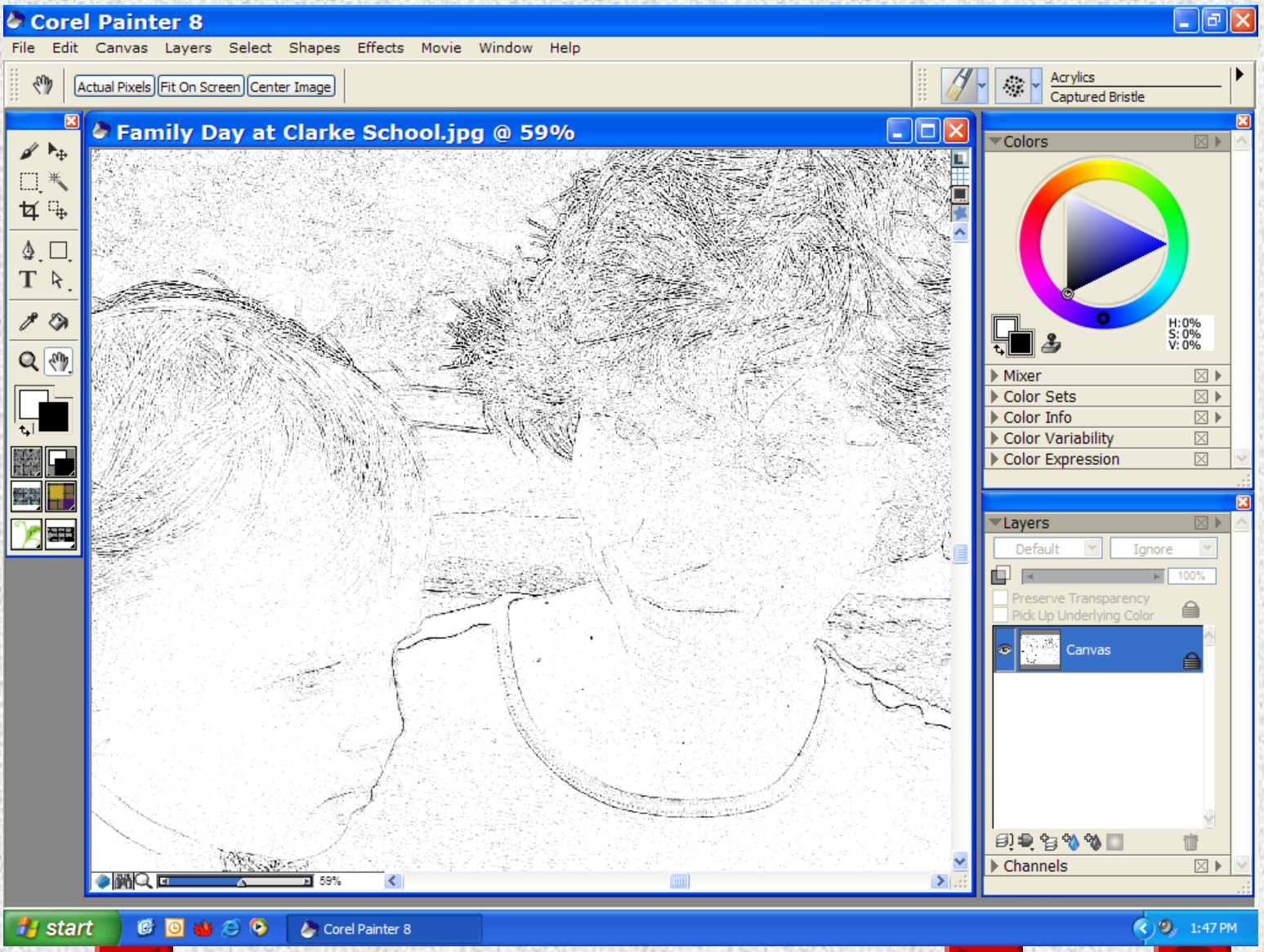
Chapter 6
Graphics, Digital Media, and Multimedia



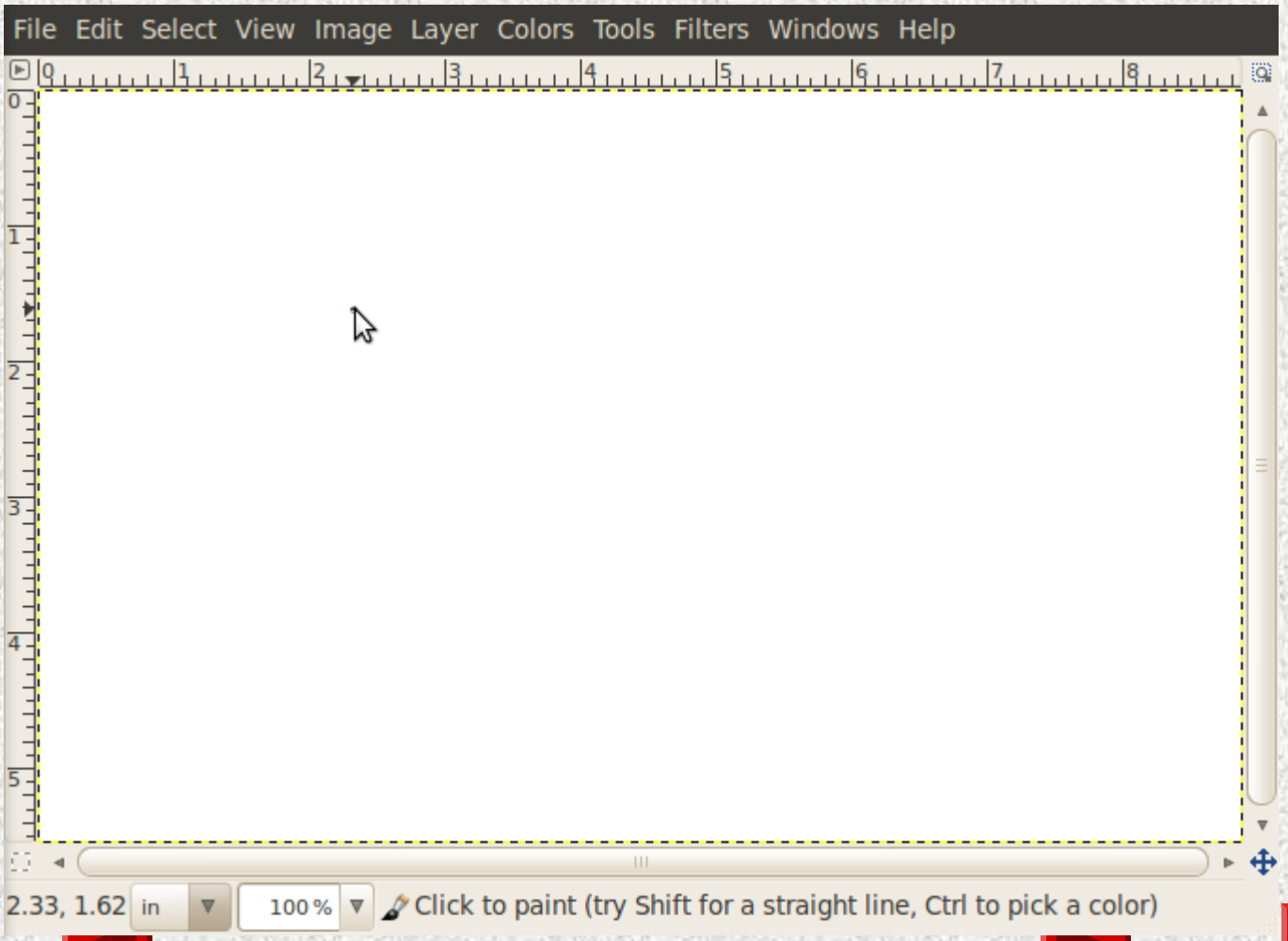
- **Pixels**: tiny dots of white, black, or color that make up images on the screen
- **Palette** of tools mimics real-world painting tools
  - Also contains other tools that are unique to computers
- **Bitmapped graphics** (or raster graphics): shows how the pixels are mapped on the screen
- **Color depth**: the number of bits devoted to each pixel (from 2 to 32)
- **Resolution:** the density (usu. per linear inch) of the pixels

Painting: Bitmapped Graphics

- Typical painting software:
  - Paints pixels on the screen using a pointing device (e.g., a tablet)
  - Pointer movements and clicks are translated onto lines and patterns on the screen
  - Stores an image at 300 dots per inch or higher




Painting: Bitmapped Graphics



Painting: Bitmapped Graphics

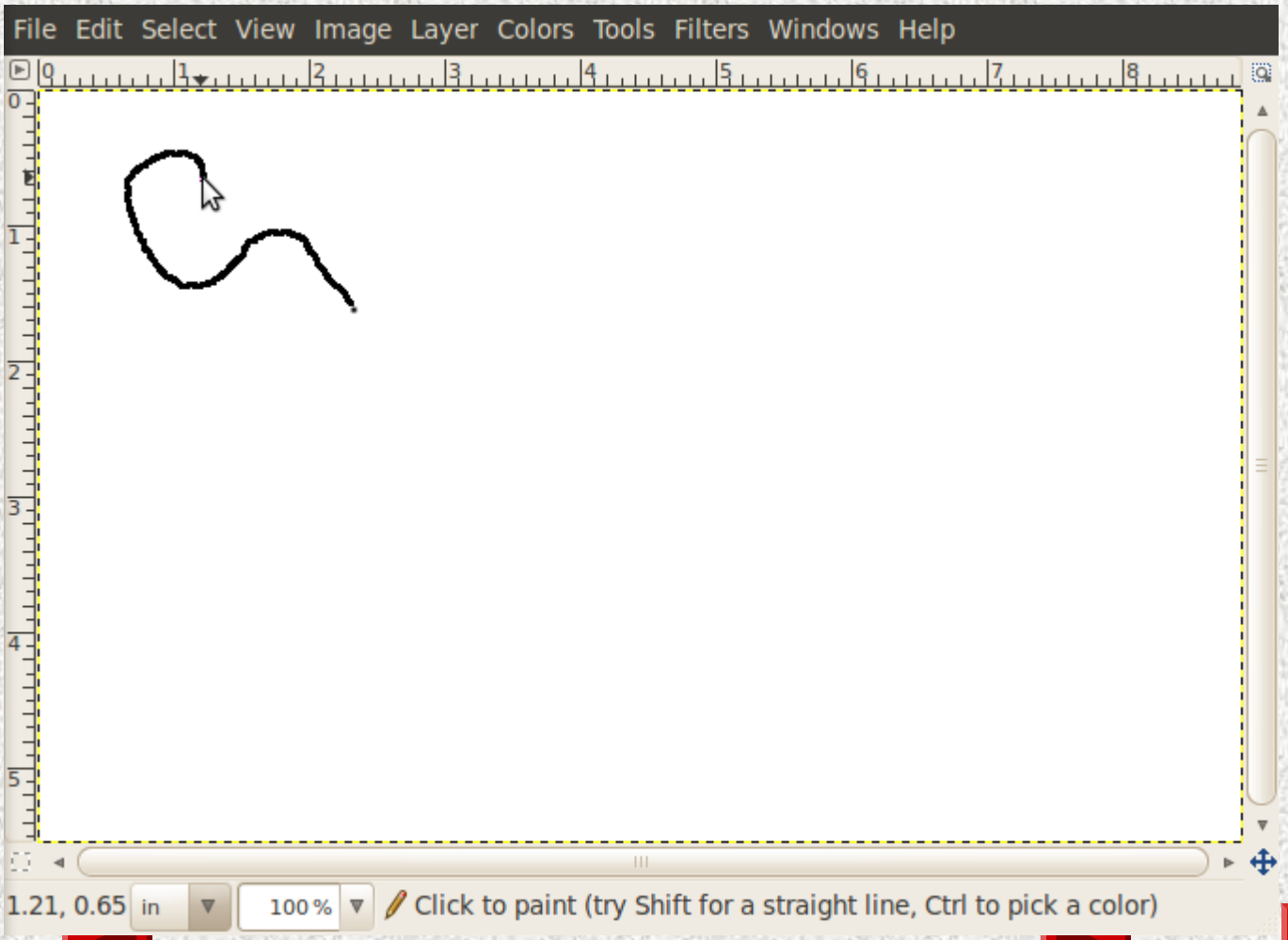


Image Processing: Photographic Editing by Computer

- ✓ Allows the user to manipulate photographs and other high-resolution images with tools such as Adobe Photoshop
- ✓ Far more powerful than traditional photo-retouching techniques
  - ➢ Can distort and combine photos as demonstrated in the tabloids
  - ➢ Can create fabricated images that show no evidence of tampering




✓Digital ***photo management software*** programs such as Apple iPhoto and Microsoft PictureIt! simplify and automate common tasks associated with capturing, organizing, editing, and sharing digital images.

Take an image

Combine it with other objects

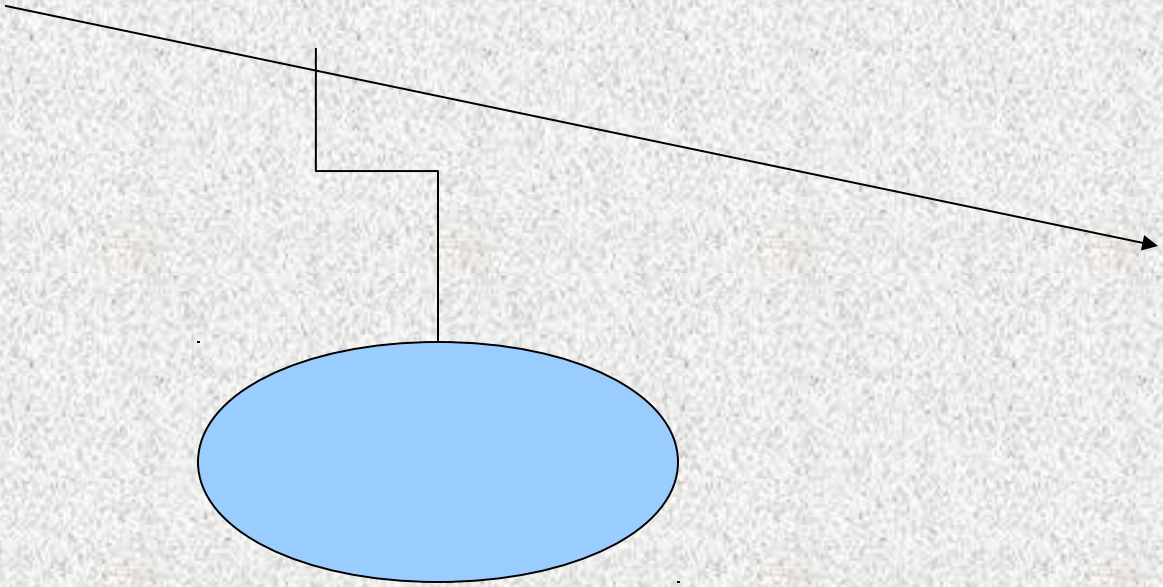
Make a statement

Drawing: Object-Oriented Graphics

- ✓ Drawing software stores a picture as a collection of lines and shapes (called **vector graphics**), or
- ✓ with image described indirectly by an object endowed with a self-rendering method which assigns colors to the image pixels (called **object-oriented graphics**).




Drawing: Object-Oriented Graphics



Drawing: Object-Oriented Graphics

- ✓Memory demands on storage are not as high as for bit-mapped images.
- ✓Many drawing tools–line, shape, and text tools–are similar to painting tools in bitmapped programs.




- **PostScript:** a standard **page-description language** for describing text fonts, illustrations, and other elements of the printed page
  - Used by professional drawing programs such as Adobe Illustrator and Macromedia FreeHand
  - Built into many laser printers and other high-end output devices so those devices can understand and follow PostScript instructions
  - PostScript-based drawing software constructs a PostScript program as the user draws

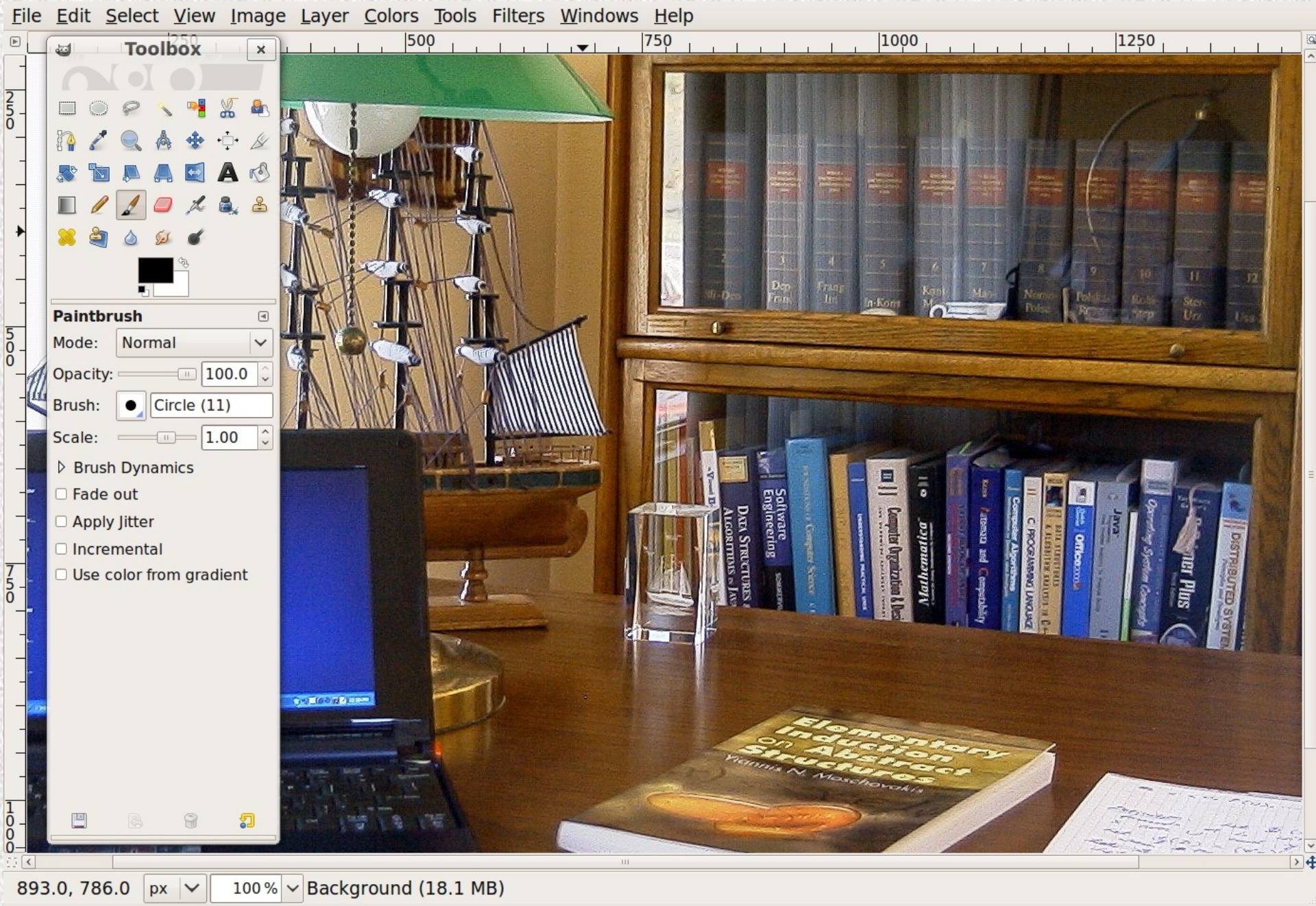


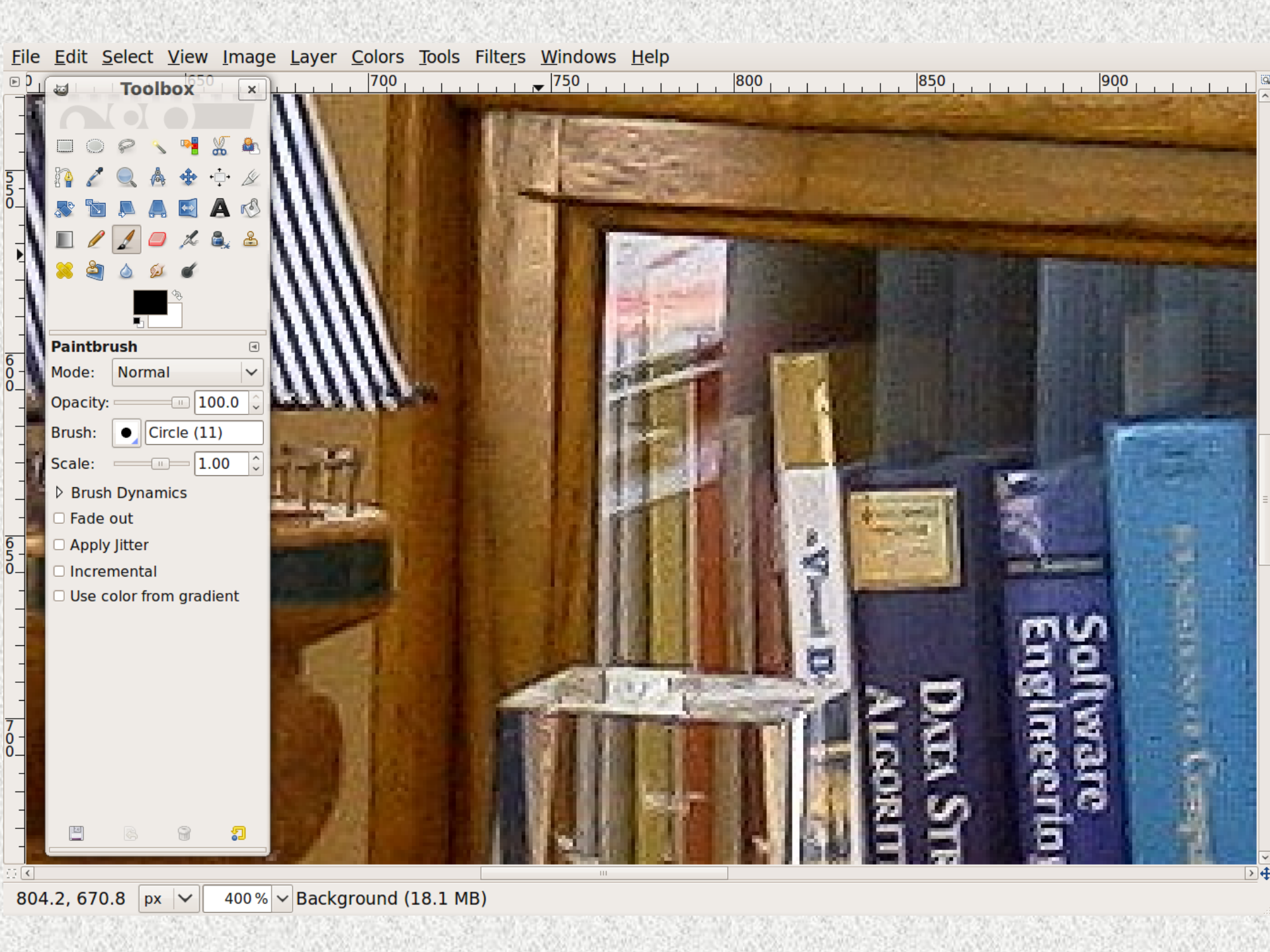

- **PostScript cont'd:** a standard **page-description language** for describing text fonts, illustrations, and other elements of the printed page
  - Since 1991, gradually replaced with a simpler format PDF (Portable Document Format)
  - Unlike PostScript, PDF is known to carry viruses that activate themselves under Adobe Acrobat
  - Adobe Reader is distributed free of charge

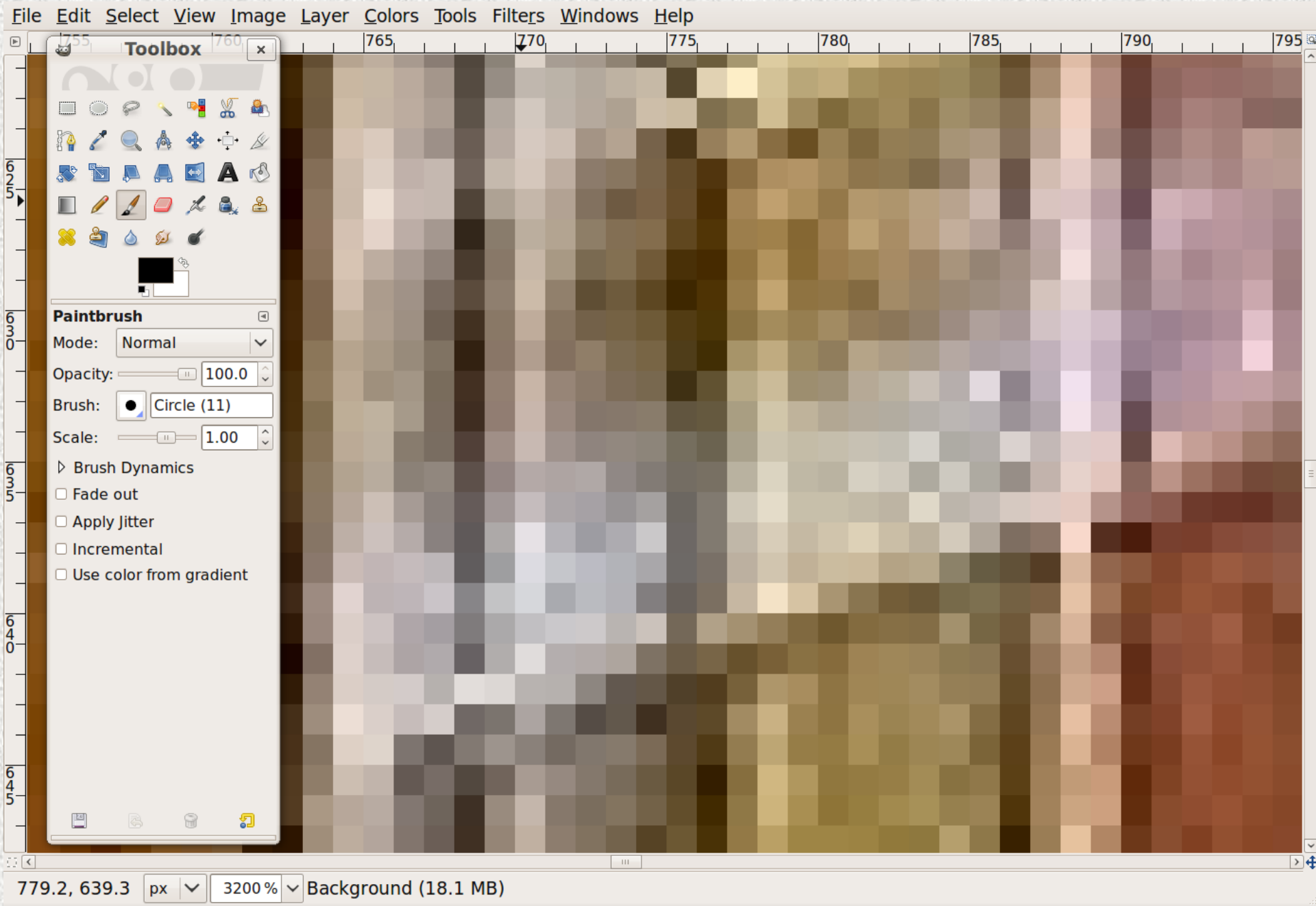


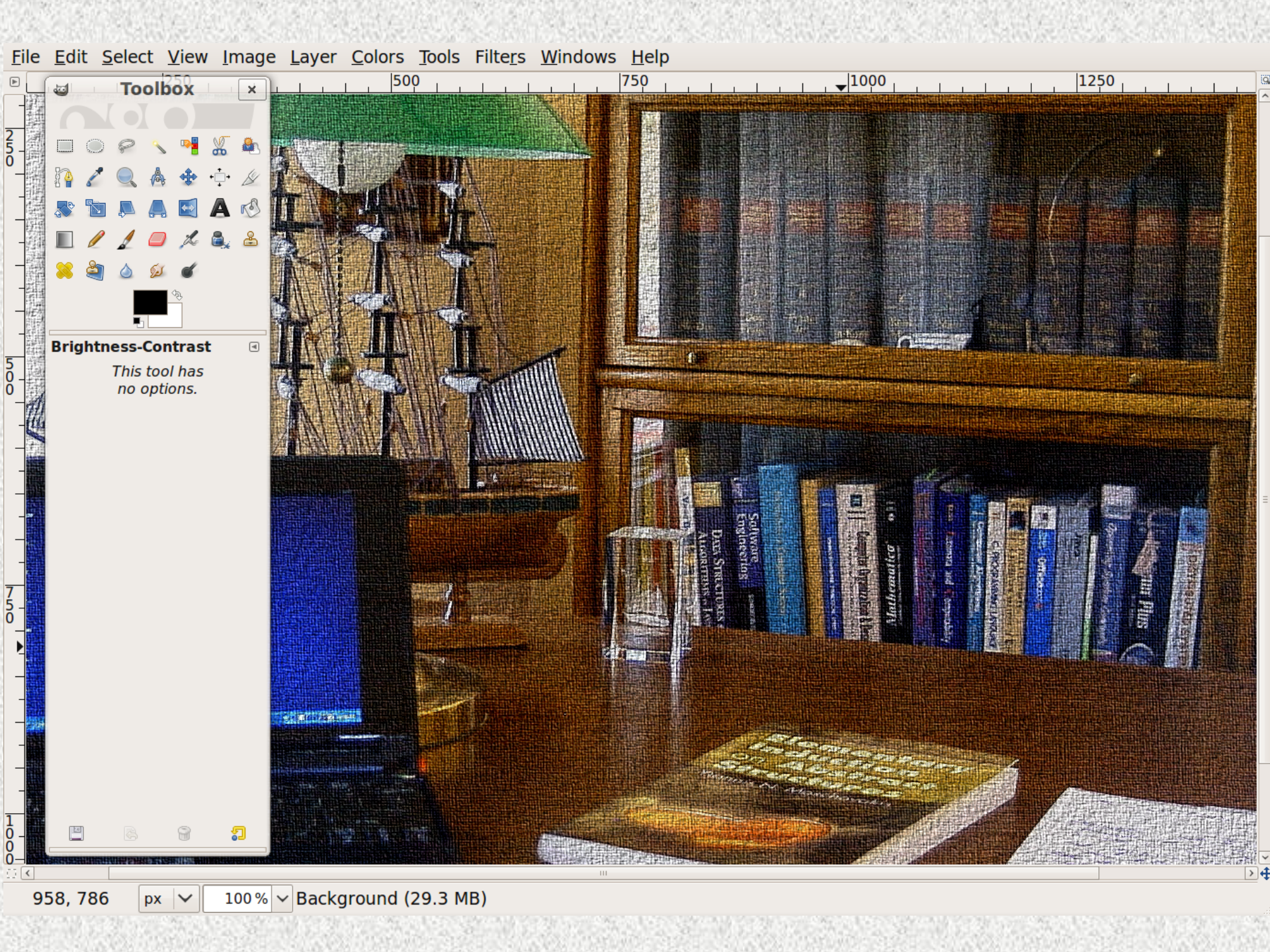

- **Bit-mapped painting** (pixels) gives the user these advantages:
  - More control over textures, shading, and fine detail
  - Appropriate for screen displays, simulating natural paint media, and embellishing photographs

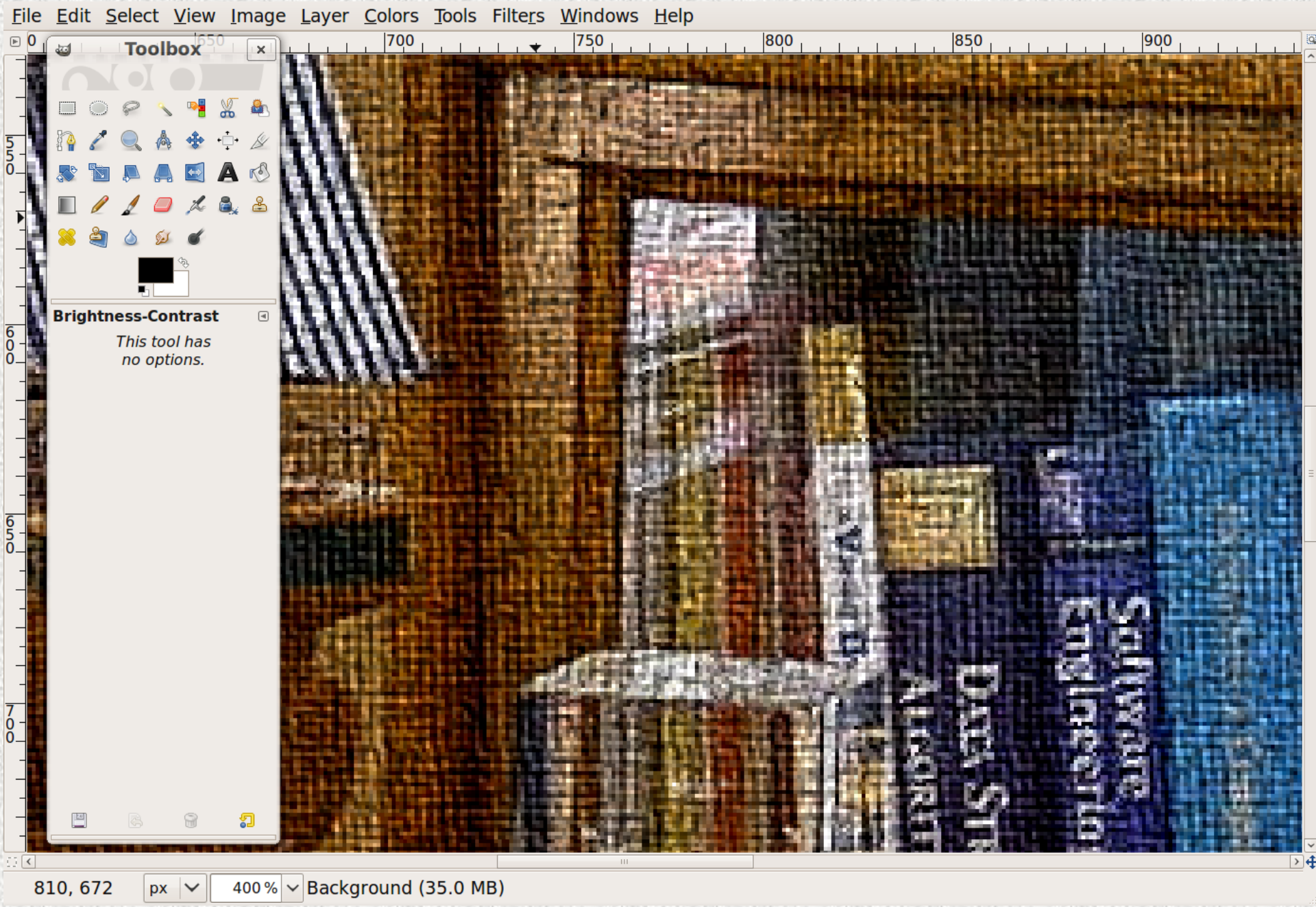


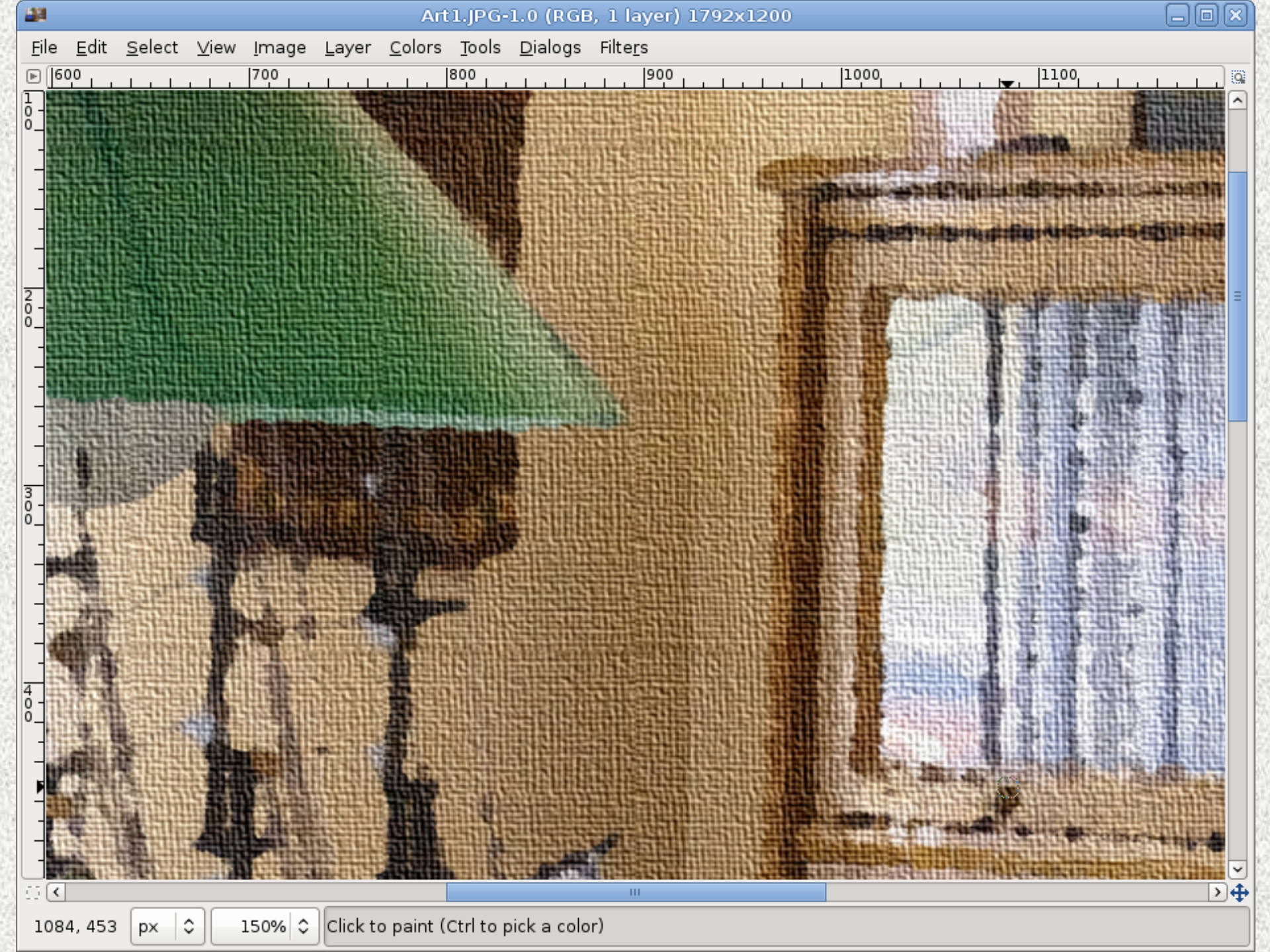


File Edit Select View Image Layer Colors Tools Filters Windows Help
Toolbox
Paintbrush
Mode: Normal
Opacity: 100.0
Brush: Circle (11)
Scale: 1.00
Brush Dynamics
Fade out
Apply Jitter
Incremental
Use color from gradient
Elementary Induction on Abstract Structures
893.0, 786.0 px 100 % Background (18.1 MB)

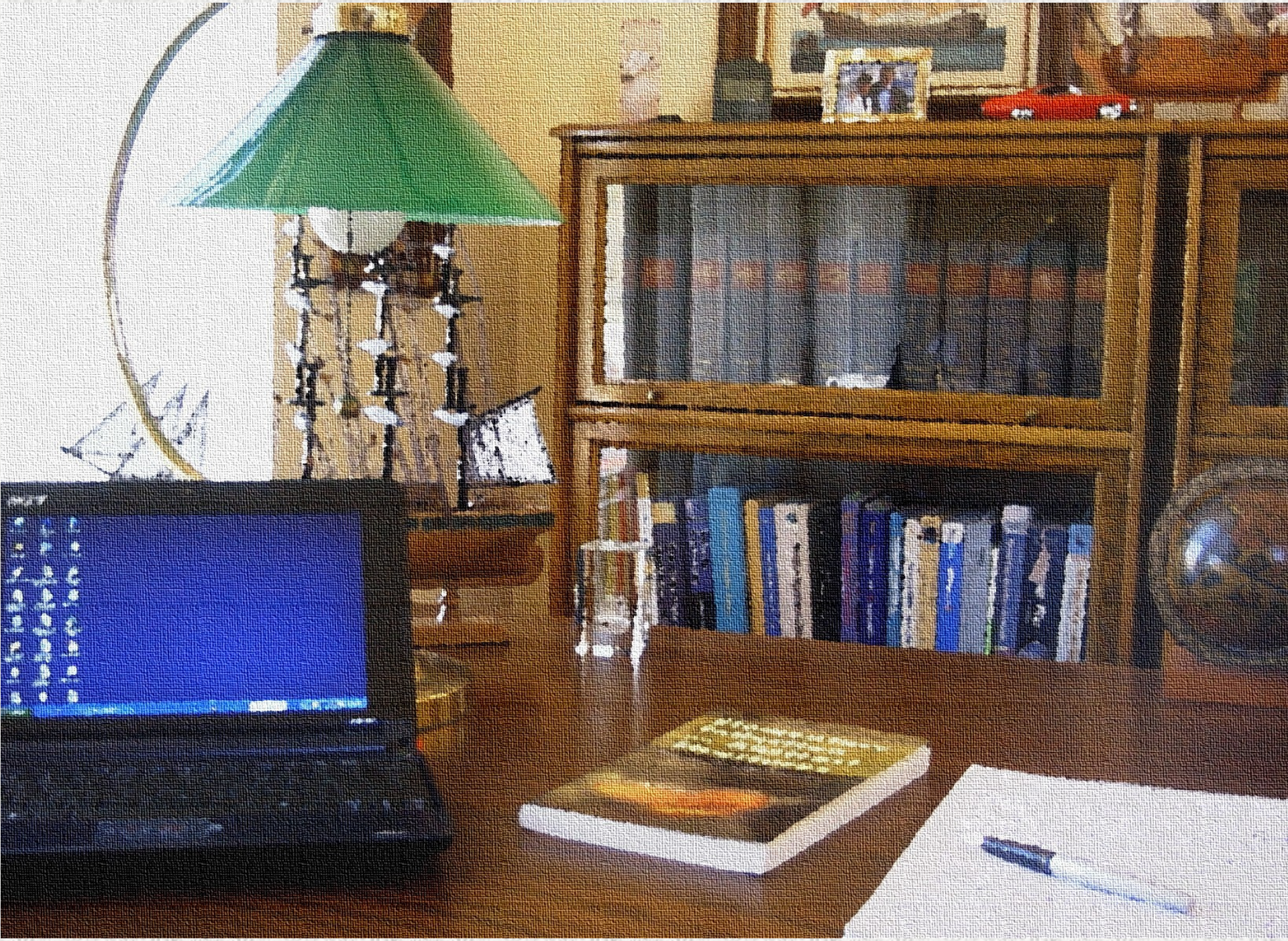

File Edit Select View Image Layer Colors Tools Filters Windows Help
Toolbox
Paintbrush
Mode: Normal
Opacity: 100.0
Brush: Circle (11)
Scale: 1.00
Brush Dynamics
Fade out
Apply Jitter
Incremental
Use color from gradient
Software Engineering
804.2, 670.8 px 400 % Background (18.1 MB)


File Edit Select View Image Layer Colors Tools Filters Windows Help
Toolbox
Paintbrush
Mode: Normal
Opacity: 100.0
Brush: Circle (11)
Scale: 1.00
Brush Dynamics
Fade out
Apply Jitter
Incremental
Use color from gradient
755 760 765 770 775 780 785 790 795
625 630 635 640 645
779.2, 639.3 px 3200 % Background (18.1 MB)


File Edit Select View Image Layer Colors Tools Filters Windows Help
Toolbox
Brightness-Contrast
This tool has no options.
958, 786
px
100 %
Background (29.3 MB)


File Edit Select View Image Layer Colors Tools Filters Windows Help
Toolbox
Brightness-Contrast
This tool has
no options.
810, 672
px
400 %
Background (35.0 MB)


Art1.JPG-1.0 (RGB, 1 layer) 1792x1200
File Edit Select View Image Layer Colors Tools Dialogs Filters
600 700 800 900 1000 1100
100 200 300 400
1084, 453 px 150% Click to paint (Ctrl to pick a color)



- Object-oriented and vector drawing gives the user these advantages:
  - Better for creating printed graphs, charts, and other regular or analytically describable shapes
  - Lines are cleaner and shapes are smoother
  - Image can be enlarged without resolution loss




Compression

JPEG (abbr: JPG) file represents a digital image using a fraction of the computer storage that might be expected. It is the most common image format and uses lossy compression.

JPEG is an acronym for “Joint Photographic Experts Group”.

Image Compression: Seeing What's Not There

http://www.ams.org/samplings/feature-column/fcarc-image-compression

Compression

GIF is a bit-map digital image format that uses lossless data compression with 8 bits/pixel coding.

GIF is an acronym for “Graphics Interchange Format” that was introduced by CompuServe in 1987.

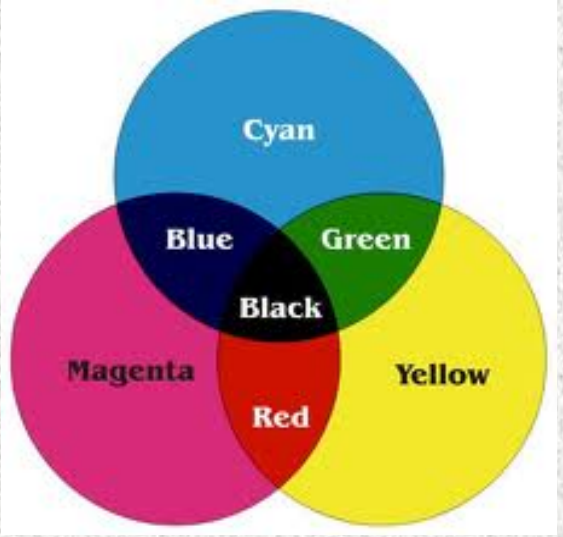
Compression

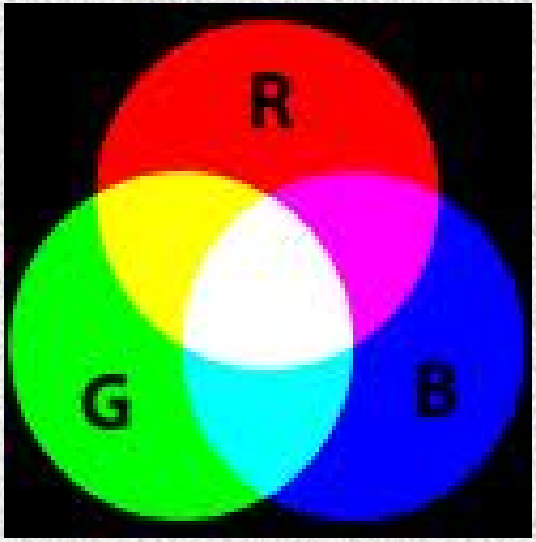
TIFF (Tagged Image File Format) format is a flexible container format for digital images that normally saves 8 bits or 16 bits per color (RGB, additive) for 24-bit and 48-bit totals.

TIFF can contain images with lossy (e.g., JPEG) and lossless (e.g., PackBits) compression, and 32-bit or 64-bit CMYK (subtractive) or 24-bit or 48-bit RGB (additive) uncompressed images.

Flash back

CMYK vs RGB





Compression

PNG (Portable Network Graphics) container / file format was created as the free, open-source successor of the GIF. The PNG file format supports uncompressed 24-bit truecolor (16 million colors) while the GIF supports only 8-bit color (256 colors).

PNG is best suited for lossless formats.

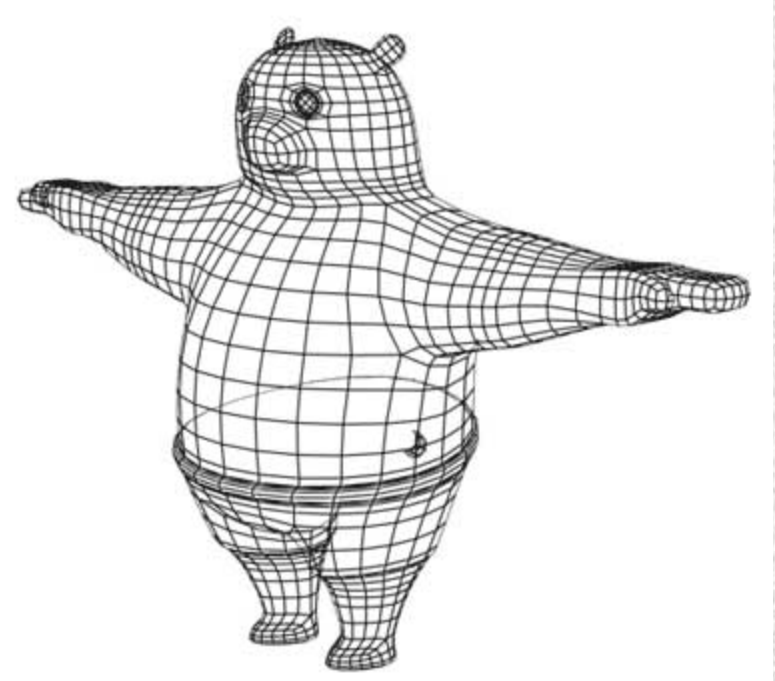
PNG file may contain lossy format files, like JPG, that are best for web distribution of photographic images, because JPG files are usually smaller than uncompressed files.

Compression

BMP file format (Windows bitmap) handles graphics files within the Microsoft Windows OS. Typically, BMP files are uncompressed, hence they are large; the advantage is their simplicity and wide acceptance in Windows programs.

3-D Modeling Software

- ✓Used to create three-dimensional objects with tools similar to those in drawing software
- ✓A wire frame model is a visual presentation of a three dimensional or physical object used in 3D computer graphics.

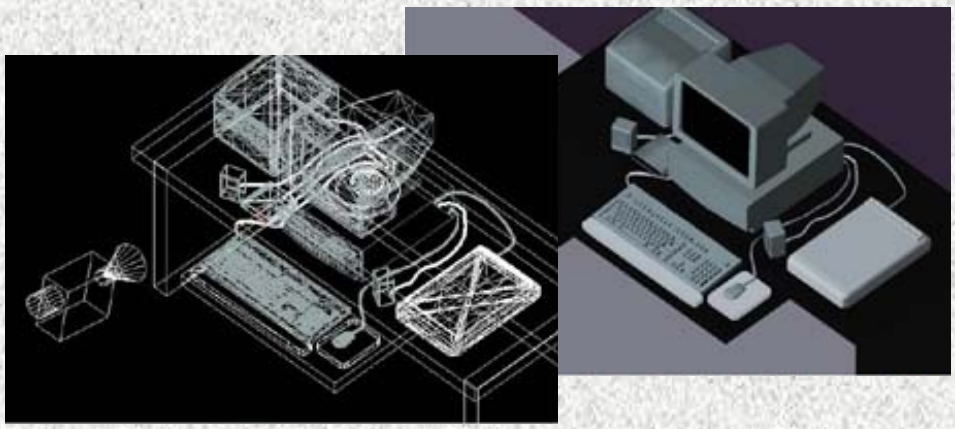


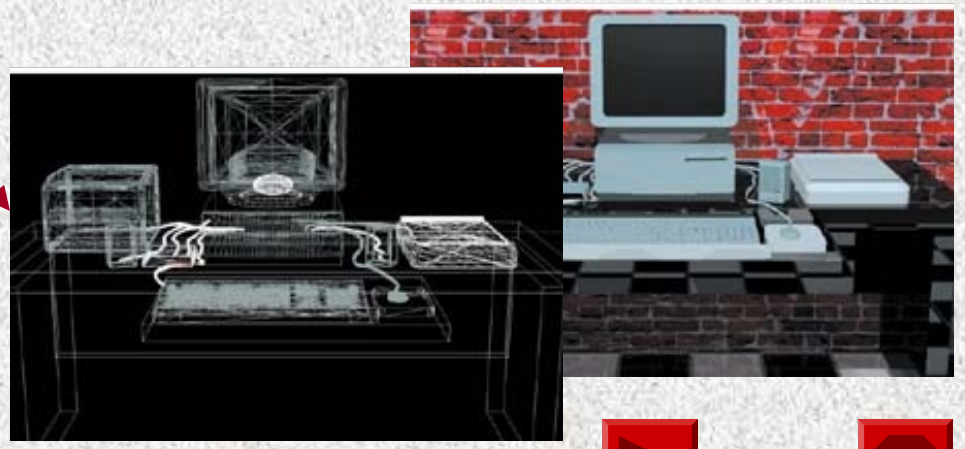
3-D Modeling Software

- ✓Goal for some applications: to create an animated presentation on a computer screen or videotape
- ✓Flexible: can create a 3-D model, rotate it, view it from different angles
- ✓Can “walk-through” a 3-D environment that exists only in the computer’s memory




Images in wireframe view; those on the right are fully rendered to add surface textures

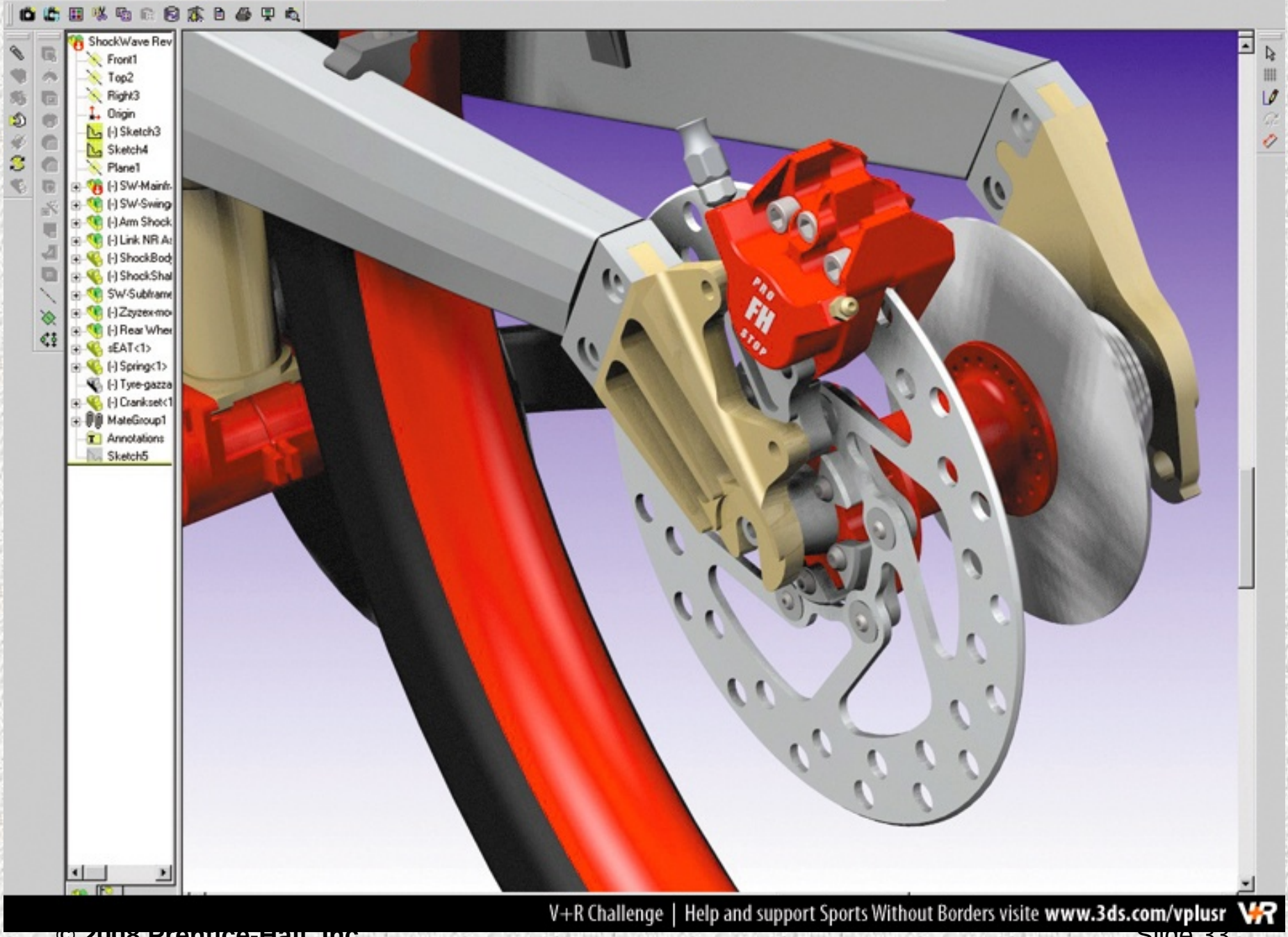




CAD/CAM: Turning Pictures into Products

- **Computer Aided Design *(*CAD) software:**
  - Allows engineers, designers, and architects to create designs on screen for products ranging from computer chips to public buildings
  - Can test product prototypes
  - Cheaper, faster, and more accurate than traditional design-by-hand techniques

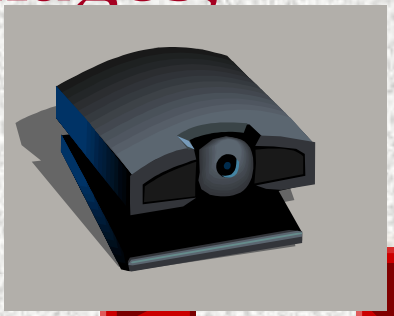


- **Computer-Aided Manufacturing** *(CAM)* is the process by which data related to the product design are fed into a program that controls the manufacturing of parts.
- **Computer-Integrated Manufacturing** *(CIM)* refers to the combination of CAD/CAM and is a major step toward a fully automated factory.

Presentation Graphics: Bringing Lectures to Life

- ✓ Automates the creation of visual aids for lectures, training sessions, sales demonstrations, and other presentations
- ✓ Creates slide shows directly on computer monitors or LCD projectors, including still images, animation, and video clips.



- Modern media contains dynamic information, which is information that changes over time or in response to user input.
  - Animation
  - Desktop Video
  - Audio
  - Hypertext and hypermedia

*"**We're on the threshold** of a moment in cinematic history that is unparalleled. **Anything** you can **imagine** can be done. If you can **draw it,** if you can **describe it**, we can **do it**. It's just a matter of cost."*
—James Cameron, filmmaker



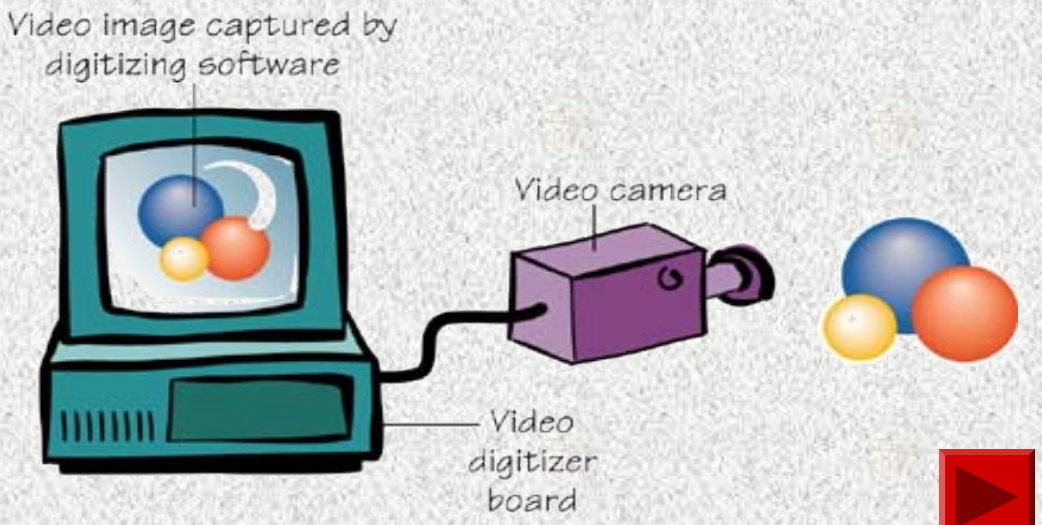

Animation: Graphics in Time

- Each frame of computer-based animation is a computer-drawn picture; the computer displays these frames in rapid succession.
- **Tweening:** Instead of drawing each frame by hand, the animator can create key frames and objects and use software to help fill in the gaps.




Desktop Video: Computers, Film, and TV

- Analog and Digital Video
  - A video digitizer can convert analog video signals from a television broadcast or videotape into digital data.



- Many video digitizers can import signals from televisions, videotapes, video cameras, and other sources.
  - Signals are displayed on the computer's screen in ***real time***—at the same time they're created or imported.
- ***Digital video cameras*** capture footage in digital form.
- Digital video can be copied, edited, stored, and played back without any loss of quality.




Video Production Goes Digital

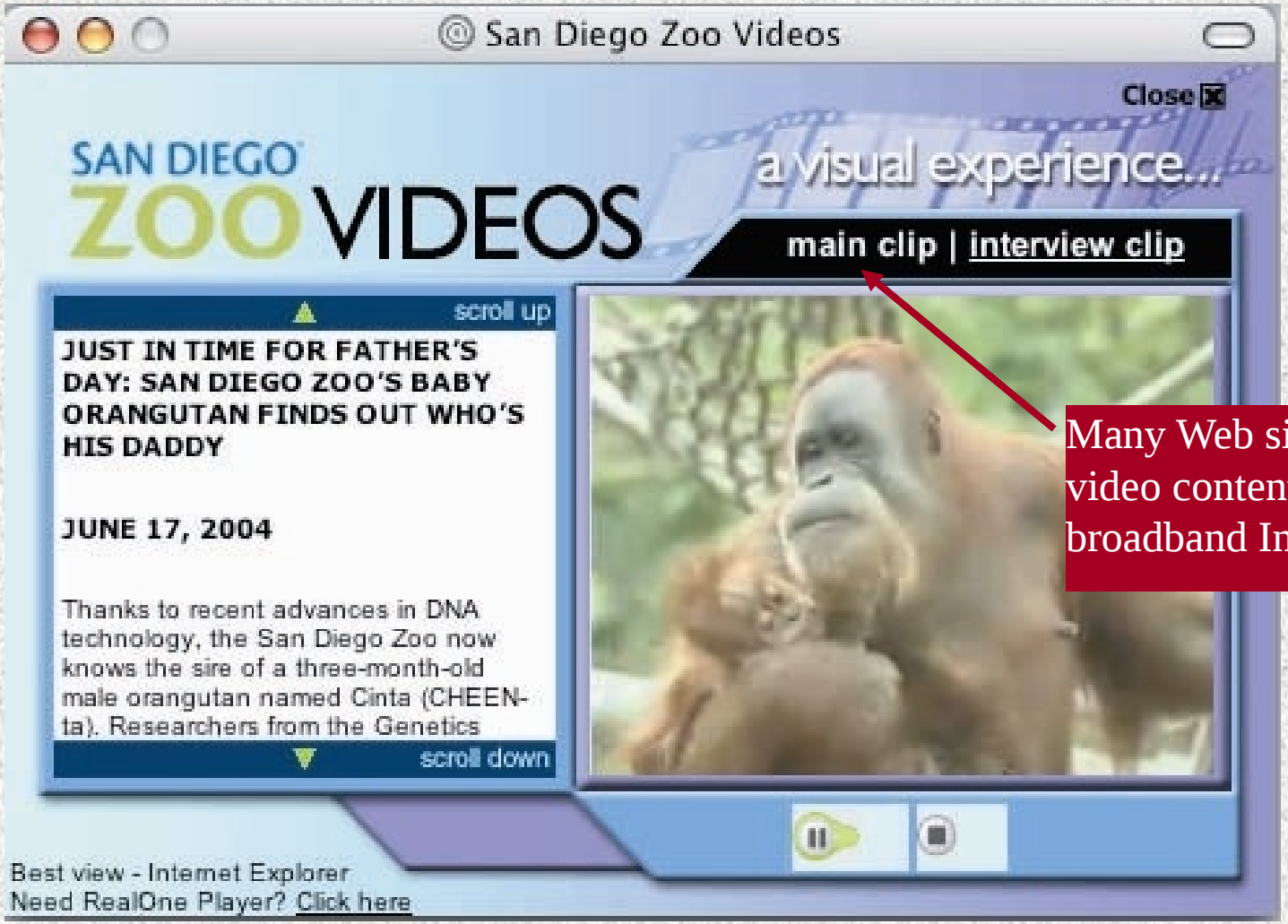
- ✓Today most video editing is done using **nonlinear editing** that offers the flexibility of film editing, with random access and easy project organization.
- ✓**Video editing software**, such as Adobe Premiere, makes it easy to eliminate extraneous footage, combine clips from multiple takes, splice together scenes, create specific effects and perform a variety of other activities.




Video Production Goes Digital

- **Morphs** are video clips in which one image metamorphoses into another.
- **Data compression** software and hardware are used to squeeze data out of movies so that they can be stored in smaller spaces.



Many Web sites deliver streaming video content to viewers with fast broadband Internet connections.

The Synthetic Musician: Computers and Audio

- **Audio digitizer** – captures sound and stores it as a data file
- **Synthesizer** – an electronic instrument that synthesizes sounds using methods borrowed from calculus
- **MIDI** (Musical Instrument Digital Interface) – standard interface that allows electronic instruments and computers to communicate with each other




WAV (Waveform Audio File), AIFF (Audio Interchange File Format)

Standard formats for uncompressed audio for Windows and the Mac OS, respectively. Both formats are supported on Windows, Mac OS, and Linux. Both create large files. Both are lossless (because they are uncompressed) – a CD track encoded with WAV or AIFF sounds identical to the original.

MP3 (Moving Picture Experts Group)

A popular lossy compression format for transmitting audio on the Internet.

A CD track converted to MP3 format can be 1/10 the size of the original – or smaller – but still sound very similar.

WMA (Windows Media Audio)

An alternative to MP3 developed by Microsoft for Windows. WMA lossy compression can result in smaller files of higher fidelity. WMA files may be protected by DRM (Digital Rights Management).

AAC (Advanced Audio Coding)

Apple's alternative to MP3 and WMA is used primarily by iTunes and iTunes Music Store. AAC lossy compression is sonically superior to MP3 compression. AAC files may be protected by DRM.

OGG

Similar to WMA and AAC in sound quality and lossy compression, OGG Vorbis is open source and freely available – not controlled by any company.

Hypertext and Hypermedia

- ✓Ted Nelson coined both terms in 1965

Hypertext and Hypermedia

- **Hypertext** refers to information linked in non-sequential ways via hyperlinks.
- **Hypermedia** combines text, numbers, graphics, animation, sound effects, music, and other media in hyperlinked documents.
  - Useful for on-line help files
  - Lets the user jump between documents all over the Internet

http://www.livinginternet.com/w/wi_nelson.htm




Interactive Multimedia: What Is It?

- ✓ A combination of text, graphics, animation, video, music, voice, and sound effects that allows the user to take an active part in the experience
- ✓ Typical requirements: high-quality color monitors, fast (multiple) processors, large memory, (CD-ROM drives,) speakers, and graphics, video, and sound cards




Interactive Multimedia: What Is It?

- ✓ Popular interface:
- ✓ HDMI : High-Definition Multimedia Interface




Inventing the Future: Shared Virtual Spaces

- **Virtual reality** combines virtual worlds with networking.
  - It places multiple participants in a virtual space.
  - People see representations of each other, sometimes called **avatars.**

- **Tele-immersion:**
  - Uses multiple cameras and high-speed networks to create a videoconferencing environment in which multiple remote users can interact with each other and with computer-generated objects
  - Combines the display and interaction techniques of virtual reality with new vision technologies that allow participants to move around in shared virtual spaces, all the while maintaining their unique points of view
- **Augmented reality (AR):**
  - The use of computer displays that add virtual information to a person's sensory perceptions




Tomorrow's Technology and You 8/e
Chapter 6
Lesson Summary

- ✓ Computer graphics today encompass more than quantitative charts and graphs generated by spreadsheets.
- ✓ Computers today aren't limited to working with static images; they're widely used to create and edit documents in media that change over time or in response to user interaction.
- ✓ The interactive nature of the personal computer makes it possible to create nonlinear documents that enable users to take individual paths through information.




Tomorrow's Technology and You 8/e
Chapter 6
Lesson Summary (continued)

- ✓ Today we can create or explore hypermedia documents—interactive documents that mix text, graphics, sounds, and moving images with onscreen navigation buttons—on disk and on the World Wide Web.
- ✓ Multimedia computer systems make a new kind of software possible—software that uses text, graphics, animation, video, music, voice, and sound effects to communicate.
- ✓ Regardless of the hardware, interactive multimedia software enables the user to control the presentation rather than just watch or listen passively.