Computer Concepts 2018

Module 1
Digital Content

NEW PERSPECTIVES

PARSONS

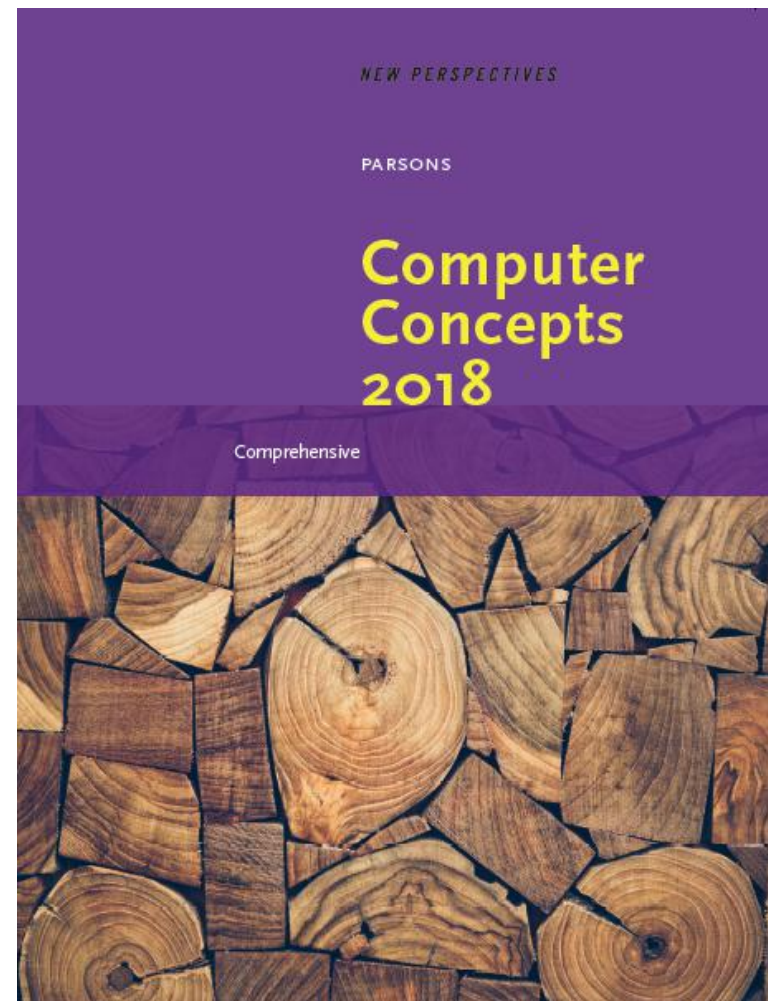**Computer Concepts 2018**

Comprehensive

Module Contents

- Section A: Digital Basics
- Section B: Digital Sound
- Section C: Bitmap Graphics
- Section D: Vector Graphics
- Section E: Digital Video

Section A: Digital Basics

- Data Representation Basics
- Representing Numbers
- Representing Text
- Bits and Bytes
- Compression

Section A: Objectives (1 of 2)

- List three technologies that digital devices use to physically store or transmit 1s and 0s

- Write the numbers 1 through 10 in binary

- Decipher ASCII text

- Demonstrate how to use the terms *bit*, *byte*, *megabyte*, *megabit*, and *gigabyte* in the context of data storage and digital devices

- Distinguish between data that would be represented by binary numbers and data that would be represented by ASCII or Unicode

- Explain how OCR relates to ASCII and Unicode

- Describe the difference between lossy and lossless compression

- Demonstrate how to compress a file

- **Data** refers to the symbols that represent people, events, things, and ideas. Data can be a name, a number, the colors in a photograph, or the notes in a musical composition

- **Data Representation** refers to the form in which data is stored, processed, and transmitted

- Devices such as smartphones, iPods, and computers store data in digital formats that can be handled by electronic circuitry

- **Digitization** is the process of converting information, such as text, numbers, photo, or music, into digital data that can be manipulated by electronic devices

- The digital revolution has evolved through four phases, beginning with big, expensive, standalone computers, and progressing to today's digital world in which small, inexpensive digital devices are everywhere

- The 0s and 1s used to represent digital data are referred to as binary digits — from this term we get the word *bit* that stands for *bi*nary digi*t*

- A bit is a 0 or 1 used in the digital representation of data

- A digital file, usually referred to simply as a file, is a named collection of data that exits on a storage medium, such as a hard disk, CD, DVD, or flash drive

Data Representation Basics (4 of 4)
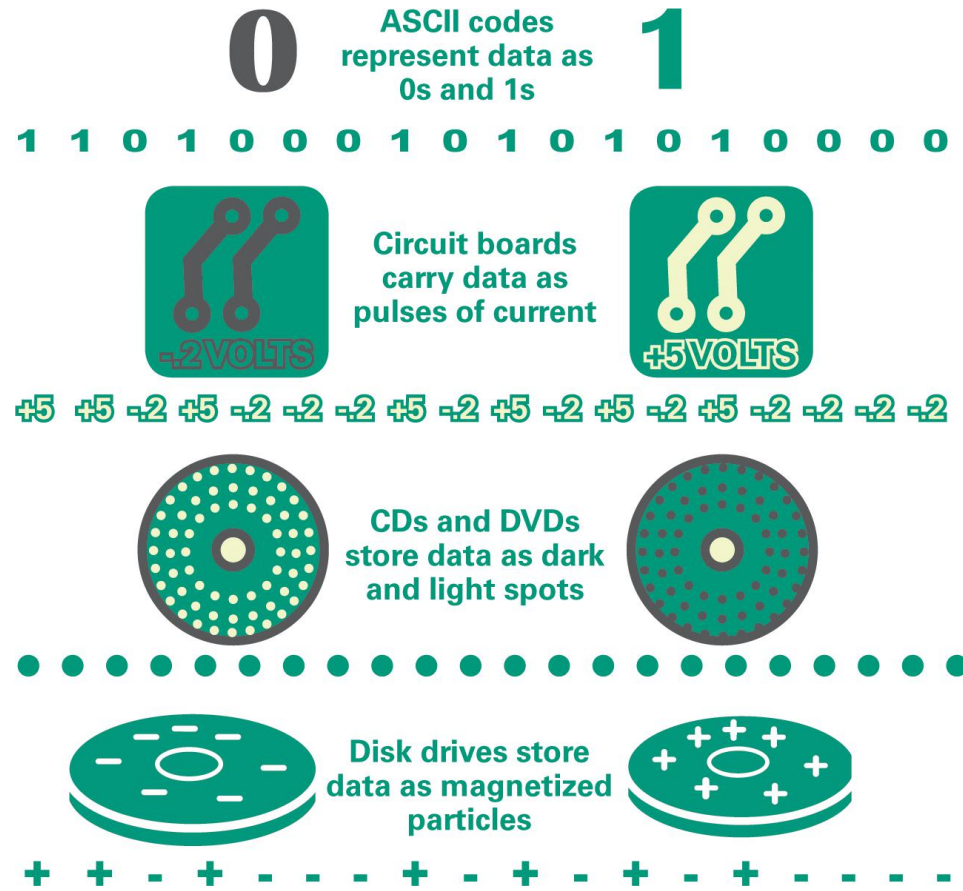
- **Numeric data** consists of numbers that can be used in arithmetic operations

- Digital devices represent numeric data using the binary number system, also called base 2

- The **binary number system** only has two digits: 0 and 1

- No numeral like 2 exists in the system, so the number "two" is represented in binary as 10 (pronounced "one zero")

Representing Numbers (2 of 2)

DECIMAL (BASE 10)	BINARY (BASE 2)
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
1000	1111101000

- **Character data** is composed of letters, symbols, and numerals that are not used in calculations
- Examples of character data include your name, address, and hair color
- Character data is commonly referred to as "text"

- Digital devices employ several types of codes to represent character data, including ASCII, Unicode, and their variants

- **ASCII** (American Standard Code for Information Interchange, pronounced "ASK ee") requires seven bits for each character

- The ASCII code for an uppercase *A* is 1000001

- **Extended ASCII** is a superset of ASCII that uses eight bits for each character

- For example, Extended ASCII represents the uppercase letter *A* as 01000001

- Using eight bits instead of seven bits allows Extended ASCII to provide codes for 256 characters

- **Unicode** (pronounced "YOU ni code") uses sixteen bits and provides codes or 65,000 characters
- This is a bonus for representing the alphabets of multiple languages
- **UTF-8** is a variable-length coding scheme that uses seven bits for common ASCII characters but uses sixteen-bit Unicode as necessary

Representing Text (5 of 9)

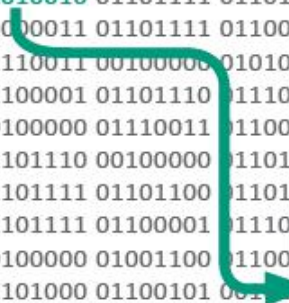|									
00100000	Space	00110011	3	01000110	F	01011001	Y	01101100	l
00100001	!	00110100	4	01000111	G	01011010	Z	01101101	m
00100010	"	00110101	5	01001000	H	01011011	[	01101110	n
00100011	#	00110110	6	01001001	I	01011100	\	01101111	o
00100100	$	00110111	7	01001010	J	01011101	]	01110000	p
00100101	%	00111000	8	01001011	K	01011110	^	01110001	q
00100110	&	00111001	9	01001100	L	01011111	_	01110010	r
00100111	'	00111010	:	01001101	M	01100000	`	01110011	s
00101000	(	00111011	;	01001110	N	01100001	a	01110100	t
00101001	)	00111100	<	01001111	O	01100010	b	01110101	u
00101010	*	00111101	=	01010000	P	01100011	c	01110110	v
00101011	+	00111110	>	01010001	Q	01100100	d	01110111	w
00101100	,	00111111	?	01010010	R	01100101	e	01111000	x
00101101	-	01000000	@	01010011	S	01100110	f	01111001	y
00101110	.	01000001	A	01010100	T	01100111	g	01111010	z
00101111	/	01000010	B	01010101	U	01101000	h	01111011	{
00110000	0	01000011	C	01010110	V	01101001	i	01111100	|
00110001	1	01000100	D	01010111	W	01101010	j	01111101	}
00110010	2	01000101	E	01011000	X	01101011	k	01111110	~

- ASCII codes are used for numerals, such as Social Security numbers and phone numbers
- Plain, unformatted text is sometimes called **ASCII text** and is stored in a so-called text file with a name ending in .txt
- On Apple devices these files are labeled "Plain Text." In Windows, these files are labeled "Text Document"

Representing Text (7 of 9)

- ASCII text files contain no formatting
- To create documents with styles and formats, formatting codes have to be embedded in the text

- Microsoft Word produces formatted text and creates documents in DOCX format

- Apple Pages produces documents in PAGES format

- Adobe Acrobat produces documents in PDF format

- HTML markup language used for Web pages produces documents in HTML format

Representing Text (9 of 9)

- All of the data stored and transmitted by digital devices is encoded as bits

- Terminology related to bits and bytes is extensively used to describe storage capacity and network access speed

- The word *bit*, an abbreviation for *binary digit*, can be further abbreviated as a lowercase *b*

- A group of eight bits is called a **byte** and is usually abbreviated as an uppercase *B*

- When reading about digital devices, you'll frequently encounter references such as 90 kilobits per second, 1.44 megabytes, 2.8 gigahertz, and 2 terabytes
- *Kilo, mega, giga, tera,* and similar terms are used to quantify digital data

Bits and Bytes (3 of 5)

Bit	One binary digit
Byte	8 bits
Kilobit	1,024 or 2^{10} bits
Kilobyte	1,024 or 2^{10} bytes
Megabit	1,048,576 or 2^{20} bits
Megabyte	1,048,576 or 2^{20} bytes
Gigabit	2^{30} bits
Gigabyte	2^{30} bytes
Terabyte	2^{40} bytes
Petabyte	2^{50} bytes
Exabyte	2^{60} bytes

- Use bits for data rates, such as Internet connection speeds, and movie download speeds
- Use bytes for file sizes and storage capacities
- **56 Kbps:** Kilobit (Kb or Kbit) can be used for slow data rates, such as a 56 Kbps (kilobits per second) dial-up connection.
- **104 KB:** Kilobyte (KB or Kbyte) is often used when referring to the size of small computer files.
- **50 Mbps:** Megabit (Mb or Mbit) is used for faster data rates, such as a 50 Mbps (megabits per second) Internet connection.

- **3.2 MB:** Megabyte (MB or MByte) is typically used when referring to the size of files containing photos and videos.
- **100 Gbit:** Gigabit (Gb or Gbit) is used for really fast network speeds.
- **16 GB:** Gigabyte (GB or GByte) is commonly used to refer to storage capacity.

- To reduce file size and transmission times, digital data can be compressed

- **Data compression** refers to any technique that recodes the data in a file so that it contains fewer bits

- Compression is commonly referred to as "zipping"

- Compression techniques divided into two categories: *lossless* and *lossy*

- **Lossless compression** provides a way to compress data and reconstitute it into its original state; uncompressed data stays exactly the same as the original data

- **Lossy compression** throws away some of the original data during the compression process; uncompressed data is *not* exactly the same as the original

Compression (3 of 4)

- Software for compressing data is sometimes referred to as a compression utility or a zip tool
- On laptops and desktop computers, the compression utility is accessed from the same screen used to manage files

FIGURE 1-8: COMPRESSING FILES
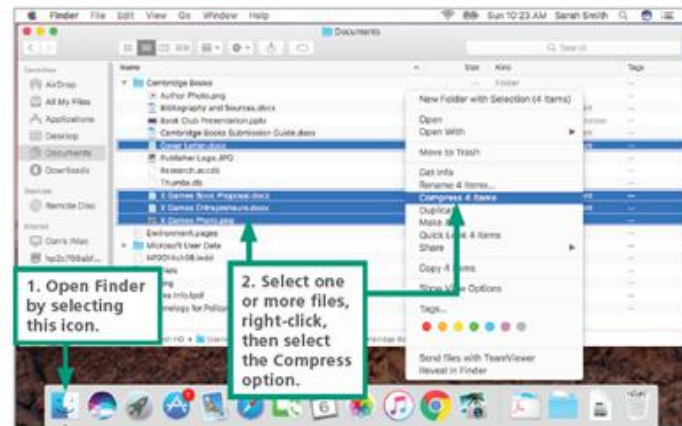
Compressing files using Finder on a Mac
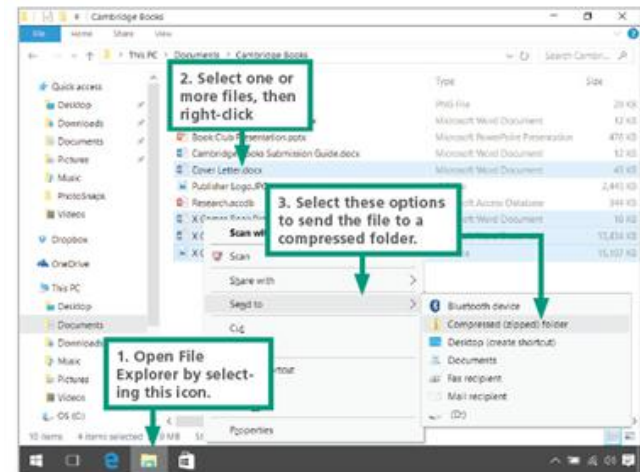
Compressing files using File Explorer on a PC

Compression (4 of 4)

- The process of reconstituting files is called extracting or unzipping
- Compressed files may end with a .zip, .gz, .pkg, or.tar.gz
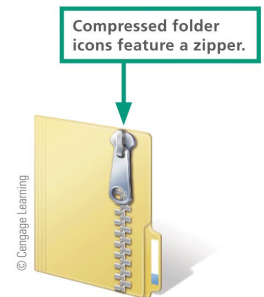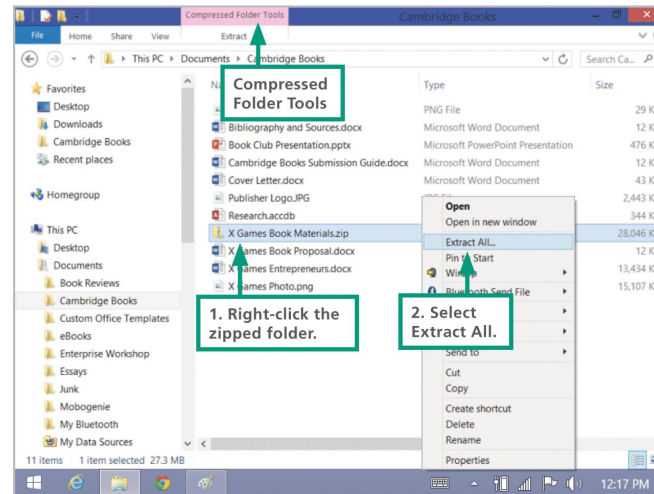
Section B: Digital Sound

- Digital Audio Basics

- Digital Audio File Formats

- MIDI

- Digitized Speech

Section B: Objectives

- Describe the process of digital sampling
- Select the appropriate sampling rate for a digital audio recording
- Identify digital audio files by their file name extensions
- Convert digital audio files from one format to another
- Understand why most audio files are compressed and how this affects sound quality
- Decide when to download, live stream, or stream music on demand
- Explain the difference between digital audio and MIDI
- Explain how Siri and similar services work

Digital Audio Basics (1 of 3)

- **Digital audio** is music, speech, and other sounds represented in binary format for use in digital devices

- Most digital devices have a built-in microphone and audio software, so recording external sounds is easy

- To digitally record sound, samples of a sound wave are collected at periodic intervals and stored as numeric data in an audio file

- Sound waves are sampled many times per second by an **analog-to-digital converter**

- A **digital-to-analog converter** transforms the digital bits into analog sound waves

Digital Audio Basics (2 of 3)

An analog sound wave is a smooth curve of continuous values.

To digitize a wave, it is sliced into vertical segments, called samples. For purposes of illustration, this one-second sound wave was sliced into 30 samples.

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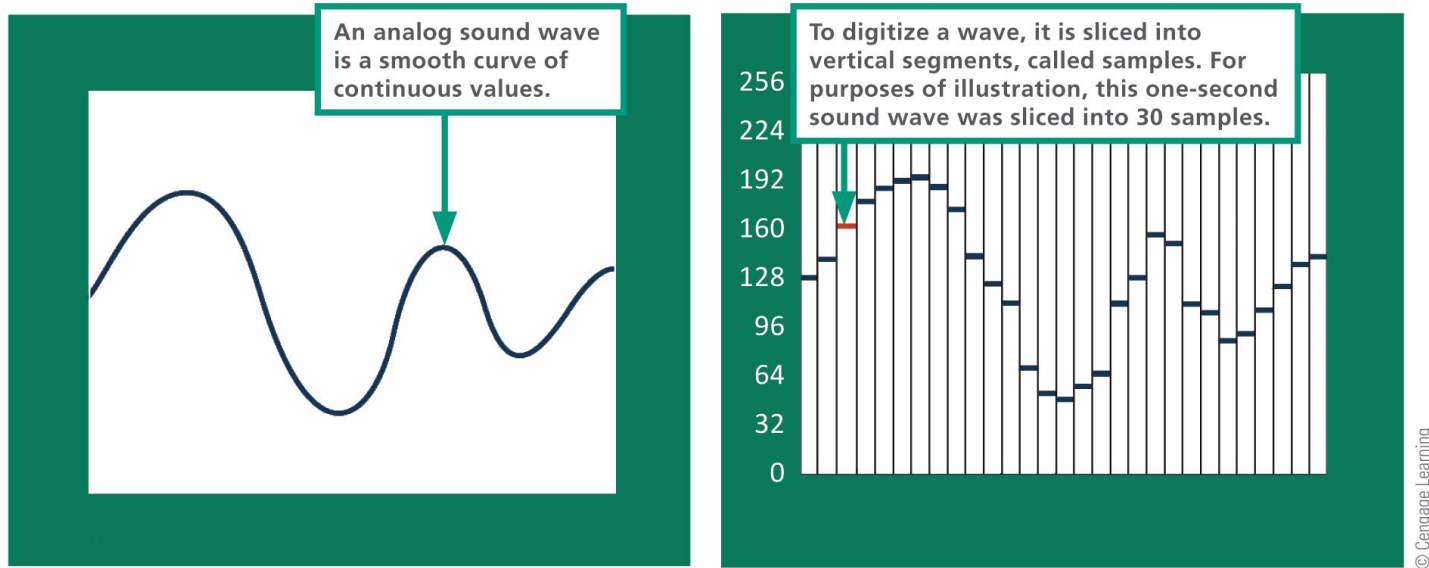
SAMPLE	SAMPLE HEIGHT (DECIMAL)	SAMPLE HEIGHT (BINARY)
1	130	10000010
2	140	1000110
3	160	10100000
4	175	10101111

The height of each sample is converted into a binary number and stored. The height of sample 3 is 160 (decimal), so it is stored as its binary equivalent—10100000.

Digital Audio Basics (3 of 3)

- **Sampling rate** refers to the number of times per second that a sound is measured during the recording process
- Higher sampling rates increase the quality of the recording but require more storage space
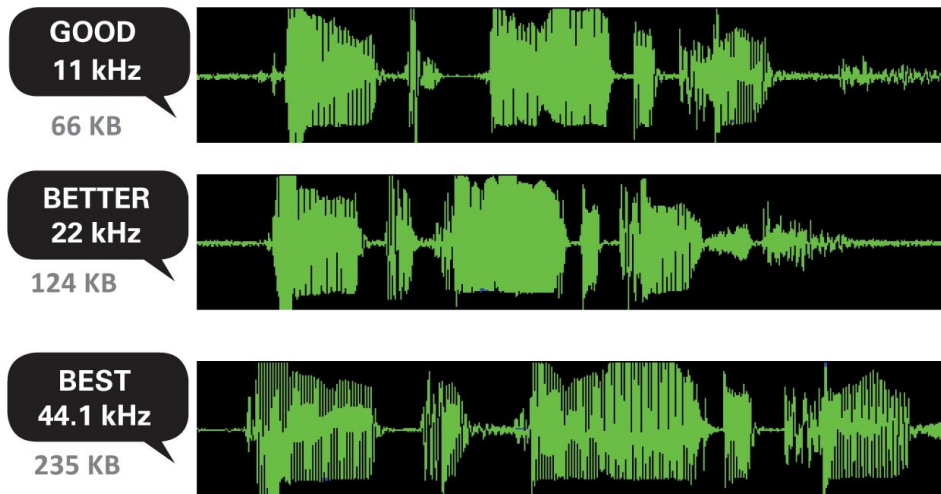
Digital Audio File Formats (1 of 6)

- A digital file can be identified by its type or its file extension, such as Thriller.mp3 (an audio file)
- The most popular digital audio formats are: **AAC, MP3, Ogg, Vorbis, WAV, FLAC,** and **WMA**

AUDIO FORMAT	EXTENSION	ADVANTAGES	DISADVANTAGES
AAC (Advanced Audio Coding)	.aac, .m4p, or .mp4	Very good sound quality based on MPEG-4; lossy compression; used for iTunes music	Files can be copy protected so that use is limited to approved devices
MP3 (also called MPEG-1 Layer 3)	.mp3	Good sound quality; lossy compres-sion; can be streamed over the Web	Might require a standalone player or browser plugin
Ogg Vorbis	.Ogg	Free, open standard; lossy compres-sion; supported by some browsers	Slow to catch on as a popular standard; part of Google's WebM format

Digital Audio File Formats (2 of 6)

AUDIO FORMAT	EXTENSION	ADVANTAGES	DISADVANTAGES
WAV	.Wav	Good sound quality; supported in browsers without a plugin	Audio data is stored in raw, noncompressed format, so files are very large
FLAC (Free Lossless Audio Compression)	.flac	Excellent sound quality; lossless compression	Open source format support ported by many devices
WMA (Windows Media Audio)	.wma	Lossy or lossless compression; very good sound quality; used on several music download sites	Files can be copy protected; requires an add-on player for some devices

- *Ripping* is a slang term that refers to the process of importing tracks from a CD or DVD to your computer's hard disk

- The technical term for ripping music tracks is **digital audio extraction**

- A **download** copies a file from a private network or Internet server to a local device

- Audio files can be acquired as a **live stream** or **on-demand stream** in addition to downloads

Digital Audio File Formats (4 of 6)
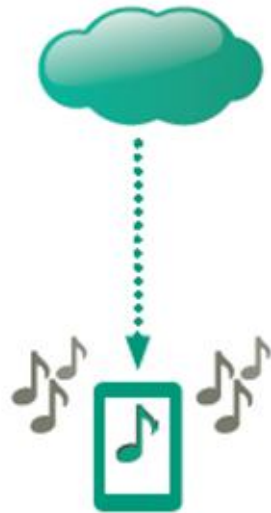
Download

A download transfers an audio file from a server to your local device.

You can play back the file even when your device is not online.

The file can be played with any compatible software or player.

Live stream

A live stream sends media from a server to your local device, where it is played, but not stored.

This method is also known as Webcasting.

You have to be online while listening.

The content stream cannot be paused, stored, or rewound.

On-demand stream

An on-demand stream sends the media to your local device, where it is stored temporarily, or "buffered," until there is enough data to begin playback.

You can fast-forward to any point in the stream without waiting for the entire file to download.

- To play a digital audio file, you must use some type of audio software, such as:

  - **Audio players**: small standalone software application or mobile app that offers tools for listening to digital audio and managing playlists, typically included with your computer's OS (operating system)

  - **Audio plugins**: software that works in conjunction with your computer's browser to manage and play audio from a Web page

  - **Audio software**: general-purpose software and apps used for recording, playing, and modifying audio files, such as iTunes, Windows Media Player, and Audacity

Digital Audio File Formats (6 of 6)
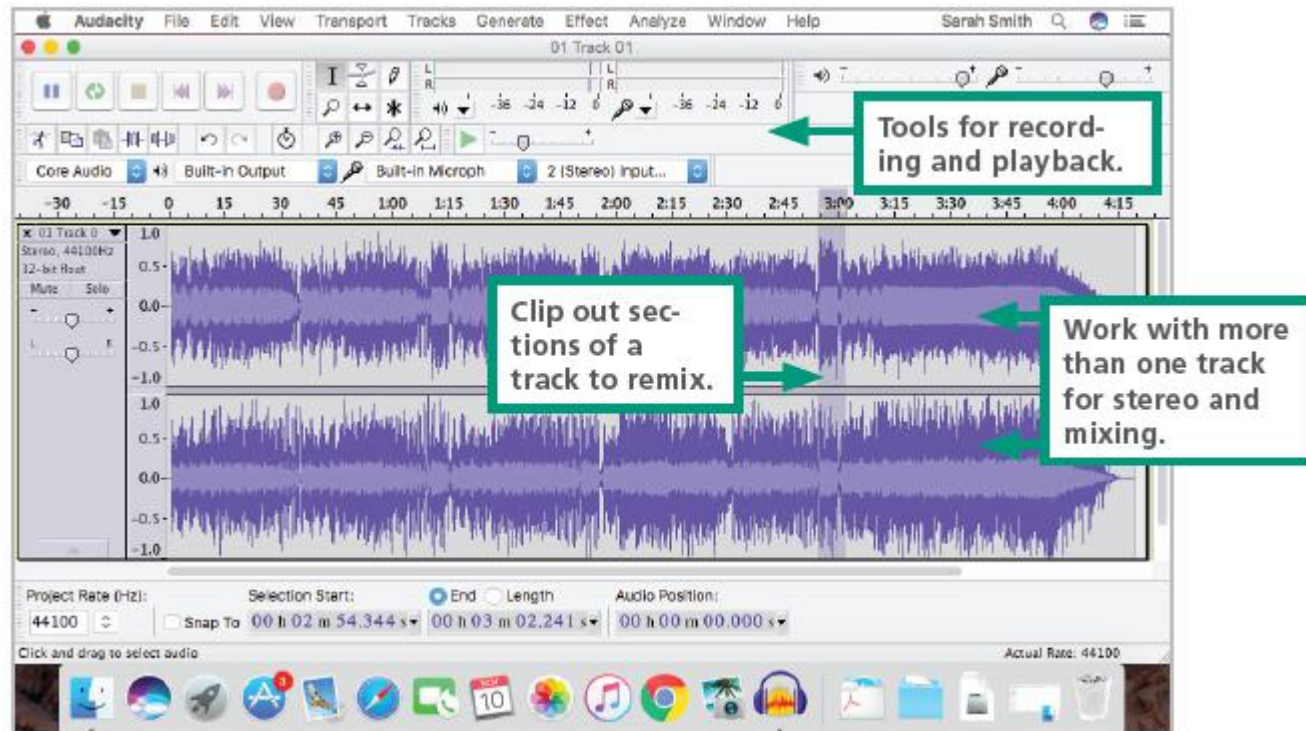
MIDI (1 of 2)

- MIDI (Musical Instrument Digital Interface) specifies a standard way to store music data for synthesizers, electronic MIDI instruments, and computers

- MIDI messages are instructions that specify the pitch of a note, the point at which the note begins, the volume of the note, etc.

- An MIDI message may look like this:

1001
Note on

0001
Channel 1 designates piano

01010100
Note number 84 designates high C

0111000
Velocity 122 designates loud volume

- Music composition software with MIDI support makes it easy to place notes on a screen-based music staff then play back the composition on a MIDI keyboard or through the speakers of a digital device
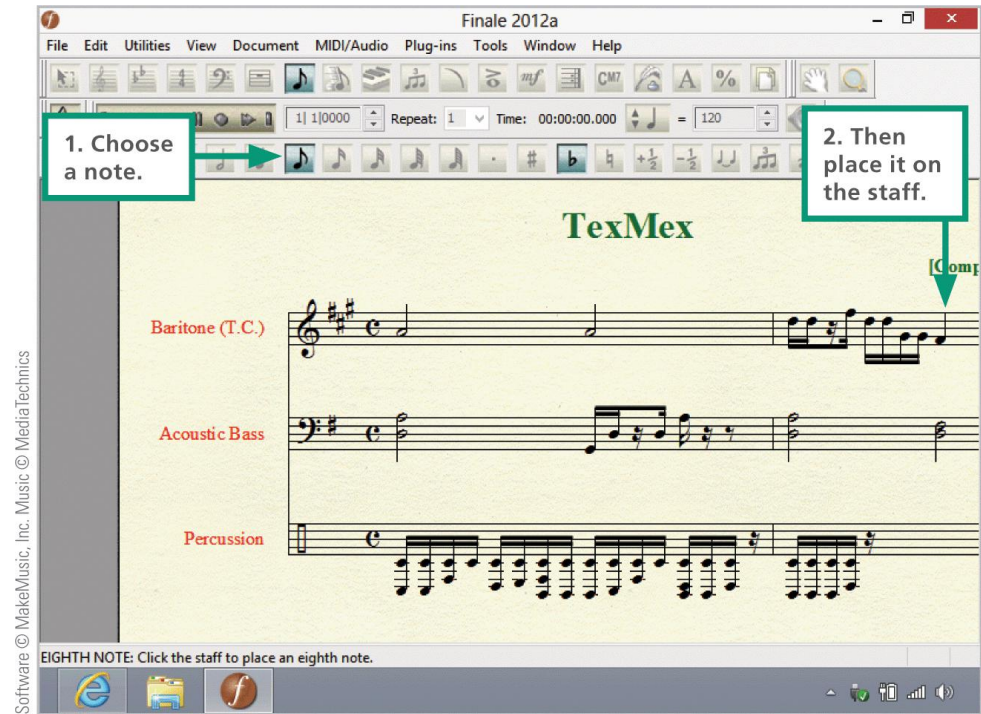
- **Speech synthesis** is the process by which machines produce sound that resembles spoken words
- **Speech recognition** (or voice recognition) refers to the ability of a machine to understand spoken words
- Speech recognition software analyzes the sounds of your voice and converts each word into groups of phonemes (basic sound units)
- The software then compares the groups to the words in a digital dictionary to find a match
- When a match is found, the software can display the word on the screen or use it to carry out a command

"It is located near a busy street"

"one two buckle my shoe"

"miles feet inches"
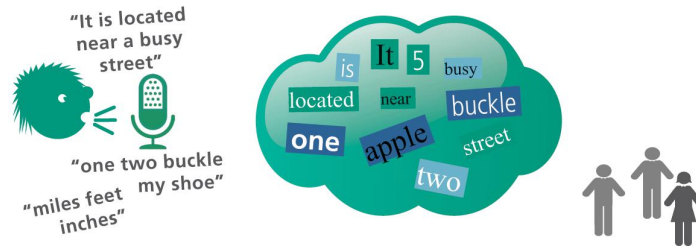
The voices of Siri were created by live actors, but they couldn't record every possible response to user queries.

Instead they record the words and sentences from a script. Although the script may appear nonsensical, the sentences are rich in phonemes.

When the recordings are complete, a team of linguists analyzes and tags various speech components and loads them into a database. The process is called concatenative speech synthesis.

Where is the nearest Starbucks?

It is located two miles east on Buckle Street.

1. Queries are encoded into digital audio, relayed to a nearby cell tower, and forwarded to an Apple server.

100 110 01 100 0110

00 101   001100

Apple, Inc.

3. Search algorithms look for an answer to the query, then access the speech database to assemble a response.

2. Apple's voice recognition system identifies words and looks for patterns similar to common queries.

Section C: Bitmap Graphics

- Bitmap Basics
- Bitmap Data Representation
- Image Compression
- Modifying Bitmap Images
- Panoramic and 360 Images
- Stereoscopy

- Describe the differences between bitmap and vector graphics file formats
- Explain how pixel color is represented in decimal, hexadecimal, and binary
- Calculate the size of a bitmap file given its resolution
- Decide which graphics format to use for school, work, or personal projects
- Describe how cameras and scanners produce digital images
- Explain how 3D images are created

- Describe the RGB and CMYK color models
- Explain what a color histogram represents and how to use one
- Provide examples of image stitching
- Describe two types of stereoscopic imaging

- As digital devices gained the ability to display images, two types of computer graphics evolved: bitmap and vector

- A **bitmap graphic** is composed of a grid of tiny rectangular cells

- Each cell is a picture element, commonly called a **pixel**

- Each pixel is assigned a color, which is stored as a binary number

Bitmap Basics (2 of 6)
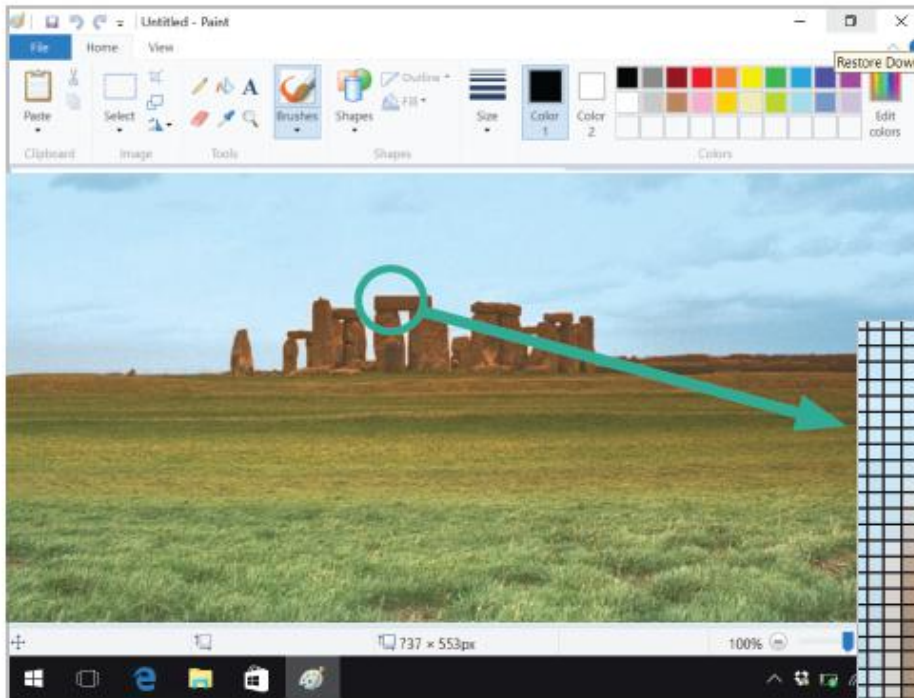
One gray pixel
stored as
100101101001011010010110

CENGAGE
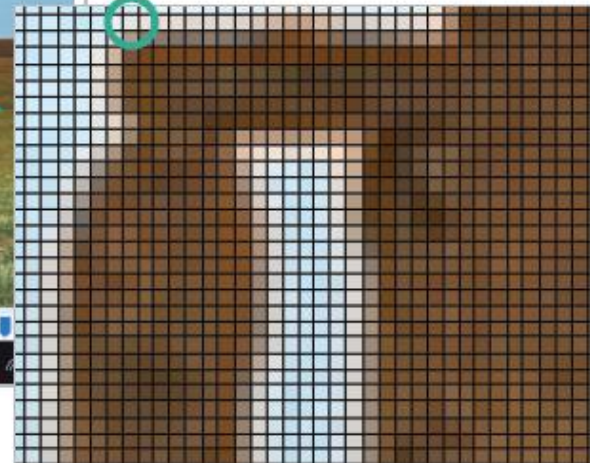
- You can create a bitmap graphic from scratch using the tools provided by graphics software — specifically a category of graphics software referred to as paint software

- Examples of paint software are Adobe Photoshop, Apple Photos, and Microsoft Paint

- You can use a **scanner** to convert a printed image into a bitmap graphic

- A scanner divides an image into a fine grid of cells and assigns a digital value for the color of each cell

- As a scan progresses, the values are transferred to a digital device and stored as a bitmap graphics file

- To scan an image, turn on the scanner and start your scanner software. Place the image face down on the scanner glass, then use the scanner software to initiate the scan. The scanned image is saved in memory and can then be saved on your computer's hard disk or in another storage location.

- In a digital camera, the lens focuses light from the image onto a small image sensor called a **CCD** (charge-coupled device)

- A CCD contains a grid of tiny light-sensitive diodes called **photosites**

- Photosites correspond to pixels; the more pixels used to capture an image, the higher its resolution

- Cameras, scanners, and graphics software offer a choice of bitmap formats, such as BMP, RAW, TIFF, JPEG, GIF, and PNG

Bitmap Data Representation (1 of 3)

- Color and resolution are key elements in bitmap data representation

- Today's color display devices represent color using the **RGB color model**

- Look at the center where the circles intersect to see the color that is generated. Color numbers are shown in decimal, hexadecimal, and binary.

White

Red	Green	Blue
255	255	255

#FFFFFF

11111111 11111111 11111111

Violet

Red	Green	Blue
238	130	238

#EE82EE

11101110 10000010 11101110
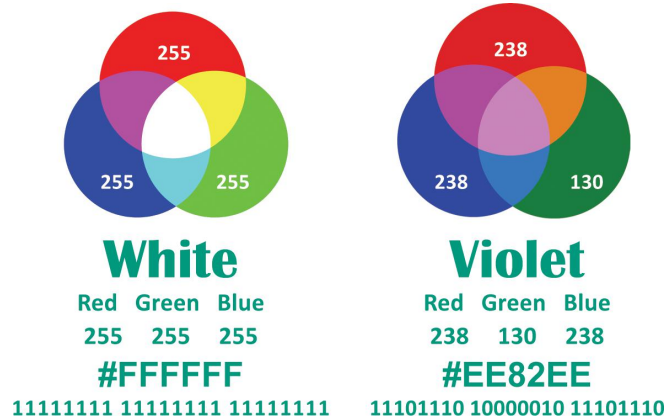
- Color values can be specified in decimal (base 10), hexadecimal (base 16), or binary (base 2)
- With 8 bits used to represent each color value, one pixel requires 24 bits
- The number of colors available in a graphic is referred to as **color depth**
- The dimensions of the grid that forms a bitmap graphic are referred to as **image resolution**
- High-resolution graphics contain more data than low-resolution graphics; more data makes it possible to display and print high-quality images that are sharper and clearer

Bitmap Data Representation (3 of 3)

- Graphics software, such as Adobe Photoshop, can help you gauge how large an image can be printed before the quality begins to deteriorate

Check these specifications to determine maximum print size.

Image Size

Pixel Dimensions: 14.4M

Width: 1936 pixels
Height: 2592 pixels

Document Size:

Width: 12.907 inches
Height: 17.28 inches
Resolution: 150 pixels/inch

☑ Scale Styles
☑ Constrain Proportions
☐ Resample Image:

Bicubic (best for smo...)

OK
Cancel
Auto...

Resampling an image requires pixel interpolation and may decrease the image quality. To maintain quality, do not resample.
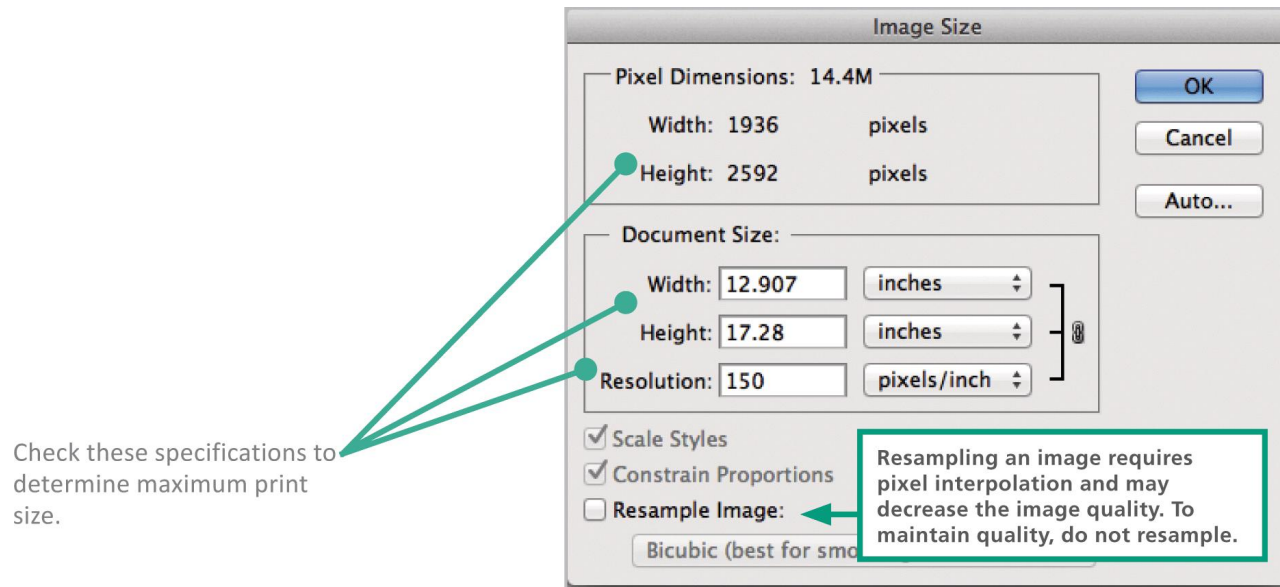
- **Image compression** refers to any technique that recodes the data in an image file so that it contains fewer bits

- **Run-length encoding** (RLE) is a type of lossless compression that replaces a series of similarly colored pixels with a binary code that indicates the number of pixels and their colors

Image Compression (2 of 2)

- Lossy compression techniques discard some data from an image to shrink its file size

- For many images, lossy compression results in only a minor reduction in the sharpness of the images

Noncompressed JPEG image

JPEG image with 35% compression

Modifying Bitmap Images (1 of 2)

- Photoshop software and a host of local and online apps make it easy to modify digital images

- Photoediting software includes sophisticated tools based on graphics algorithms that produce amazing transformations of digital images

- Characteristics of bitmap that can be modified:
  - **Noise reduction** – "noise" refers to spots, dust, and scratches left on old photos after they are scanned
  - **Image enhancement** – improves brightness, color saturation, and focus
  - **Selective color change** – algorithms are used to colorize black and white photos
  - **Correcting image distortion** – reconstructing perspective with photoediting
  - **Cloning** – employs algorithms pulling pixels from one area and moving them to another
  - **Inpainting** – reconstructing lost or unwanted areas in a photo
  - **Digital compositing** – assembling more than one image into one by using clipping paths and alpha bending

Panoramic and 360 Images (1 of 3)

- Photos are no longer limited to flat rectangles; gone beyond the box to become panoramic views, 360-degree images, and immersive photo spheres

- These image formats are made possible by a technology called image stitching

- **Image stitching** (or photo stitching) creates a panoramic image by combining two or more separate photographs that have overlapping edges

- The photos are captured from a fixed location

- Stitching uses photos in standard bitmap formats, such as JPEG and PNG
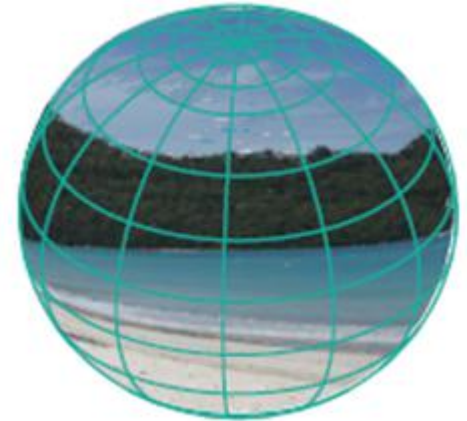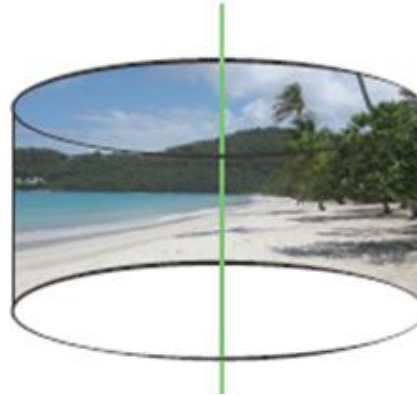
1. **Rectilinear projections** are viewed in a two-dimensional plane, typically as a long horizontal photo. These images can be produced using the panoramic feature of a digital camera.

2. **Cylindrical projections** produce a 360-degree image similar to the view from a merry-go-round. Images are captured from the front, back, and sides, and then stitched together.

3. **Spherical projections** include images from the 360-degree vertical view as well as the 360-degree horizontal panorama.

- A series of photos can be manually stitched together using software, such as Autopano and AutoStitch, but many digital cameras take care of stitching automatically

- Apps, such as Google Street View and Photo Sphere, guide photographers through the rotational process to capture a 360-degree view, which is then stitched together into a continuous image.

- Special cameras are also available for capturing and stitching photos for cylindrical and spherical projections

- **Stereoscopic imaging** (or stereoscopy) is a graphical technique used to produce an illusion of spatial depth from flat, two-dimensional images
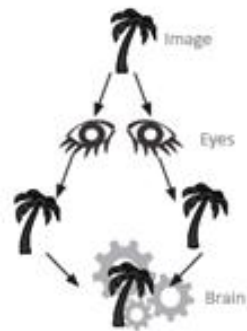
Because human eyes are spaced apart, they project two slightly different images onto the retinas. Those images are processed by the brain, which constructs an image of the world that corresponds to a three-dimensional environment with spatial depth.

Most cameras capture a photo using only one lens, so the image does not convey spatial depth. Two cameras, or a camera with two front-facing lenses, can produce two photos called a **stereo pair** that mimic the dual images captured by human eyes. Two images from a stereo pair displayed side by side are called a **stereogram**.

Simply looking at two similar photographs does not produce a 3D experience. Each image must be viewed with only one eye. A stereoscopic viewer, or stereoscope, provides this differentiation using lenses. Old-fashioned stereoscopic viewers placed images 5–11" away from the eyes and required a partition between the lenses to separate overlapping views.

Stereoscopy (2 of 3)

- Modern stereoscopic imaging uses digital images and viewers
- A stereoscopic viewer, such as Google Cardboard, displays images generated by mobile devices

Google Cardboard stereoscope

Digital stereogram

Stereoscopy (3 of 3)

- An **anaglyph** is a graphic composed of two images, one that is tinted red and the other that is tinted blue

- Viewing anaglyph images requires red-green or red-blue glasses

- Usually, the red lens on the left filters out blue and green, while the blue- or green-colored lens on the right filters out red

Section D: Vector Graphics

- Vector Graphics Basics
- Vector Tools
- 3D Graphics
- Vectors and Virtual Reality

- Identify vector graphics used on Web sites and social media

- Based on the characteristics of vector graphics, determine when they are more suitable for a project than bitmaps

- Draw simple vector shapes and outlines using drawing software

- Convert a vector drawing into a bitmap

- Explain the process of rendering a 3D wireframe into an image

- Identify the key difference between rendering 3D graphics for computer games and creating special effects for movies

- Explain how vector graphics relate to augmented reality

- Describe the type of graphics commonly used for virtual reality

Vector Graphics Basics (1 of 3)

- The first graphics that appeared on computer screens were not photos, but simple shapes consisting of lines and curves, each referred to as a **vector**
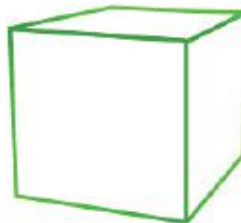

Lines

Shape

Filled shape

Gradient-filled 2D shape

3D shape

Gradient-filled 3D shape

- A **vector graphic** consists of a set of instructions for creating a picture
- Vector graphics include standard shapes such as circles and rectangles
- Vector Graphics vs. Bitmap Images
  – Resize better than bitmaps
  – Require less storage space
  – Not as realistic as bitmap images
  – Editing an object is easier than in bitmap

Vector Graphics Basics (3 of 3)

- Vector graphics are used for floor plans, engineering diagrams, and spreadsheet charts

Vector images created by combining shapes can look primitive.

Combining circles and other simple shapes with outlined shapes produces clip art images.

More sophisticated vector images are created by outlining paths drawn from one point to another.

Charts combine simple shapes and text.

Fonts are also created using outlines and curves.

Gradients can be added to vector objects to create the illusion of three dimensions.

Floor plans merge shapes and text.

Vector Tools

- Vector graphics are created from scratch using drawing software such as:
    - Adobe Illustrator
    - LibreOffice Draw
    - Open source Inkscape
    - Various vector drawing apps

- 3D graphics are based on vectors stored as a set of instructions describing the coordinates for lines and shapes in a three-dimensional space

- Vectors form a wireframe that works like the framework for a tent

- The process of covering the wireframe surface with color and texture is called **rendering**

- The technique for adding light and shadows to a 3D image is called **ray tracing**
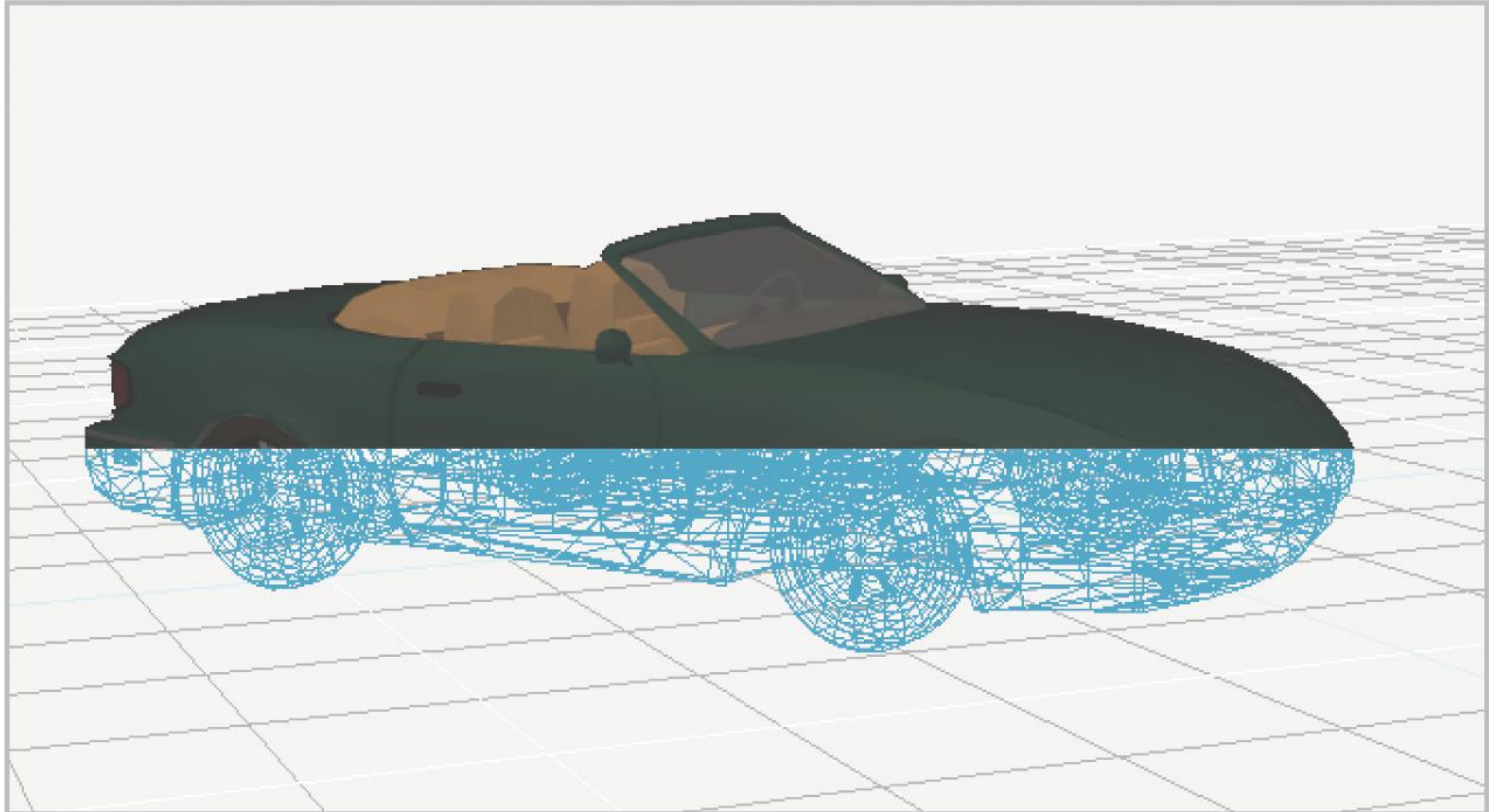
3D Graphics (2 of 4)

- A 3D vector image may have a three-dimensional appearance, but as a single image, it cannot convey visual depth

- A 3D-rendered image can be modified to create a second rendering slightly offset from the original

- A smartphone camera captures an image of the real world, and then a game character is rendered onto that image

- The composite image is output to the smartphone screen

3D Graphics (4 of 4)

Vectors and Virtual Reality (1 of 3)

- A **vector animation** is a type of motion graphic in which a series of vector images is displayed sequentially to convey the illusion of movement
- Each image is called a **frame**

- The process of rendering vector-based frames and packaging them into a digital movie file is called **pre-rendering**

- Pre-rendering is used to create special effect sequences for films, as well as full-length animated movies; these pre-rendered clips are referred to as **CGI** (computer-generated imagery)

- **Real-time rendering** fills in wireframe objects and generates a bitmap image as the action unfolds

Vectors and Virtual Reality (3 of 3)

- Most interactive virtual reality visuals are generated from 3D vector graphics and displayed on VR headsets, such as Google Cardboard and Oculus Rift

- A **game engine** is graphics software that allows developers to create interactive videogames and educational modules

Section E: Digital Video

- Digital Video Basics
- Video Compression
- Video File Formats
- Digital Video Variations

- Recognize digital video files by their file name extensions

- List the video formats that are commonly used on the following: YouTube, iPhone, Android phone, television, Web browsers

- List devices and other sources that are commonly used to capture video footage

- List factors that affect the size and quality of digital videos

- Explain the contents of a video container
- Differentiate between interlaced and progressive scan
- State the most commonly used aspect ratios on the following: iPhone screen, iPad screen, YouTube, Windows laptop computer screen
- Explain the purpose of a codec
- List the variety of videos that originate as bitmap graphics

- Digital video uses bits to store color and brightness data for each video frame, a process similar to storing the data for a series of bitmap images in which the color of each pixel is represented by a binary number

- Footage from Super 8 home movies, VHS tapes, and other older sources can be digitized using video capture equipment

- You can shoot footage for digital video with:
  - A consumer-quality camcorder
  - A webcam
  - A smartphone camera

- Digital cinematography is used in the motion picture industry; it captures moving images as bits, rather than on film

- Digital video is a core technology for digital television, videoconferencing systems, and video messaging

Digital Video Basics (3 of 10)

- Digital video displays bitmap images in rapid succession

- Each bitmap image is referred to as a frame

- The number of frames that are displayed per second is the **frame rate** (fps)

6 — Frame rate for the first 3D videogame

24 — Standard frame rate for motion pictures

24 — Standard frame rate for YouTube videos

48 — Frame rate for *The Hobbit: An Unexpected Journey*

60 — Frame rate for broadcast television

30–60 — Acceptable frame rates for modern videogames

60 — Maximum frame rate for YouTube videos
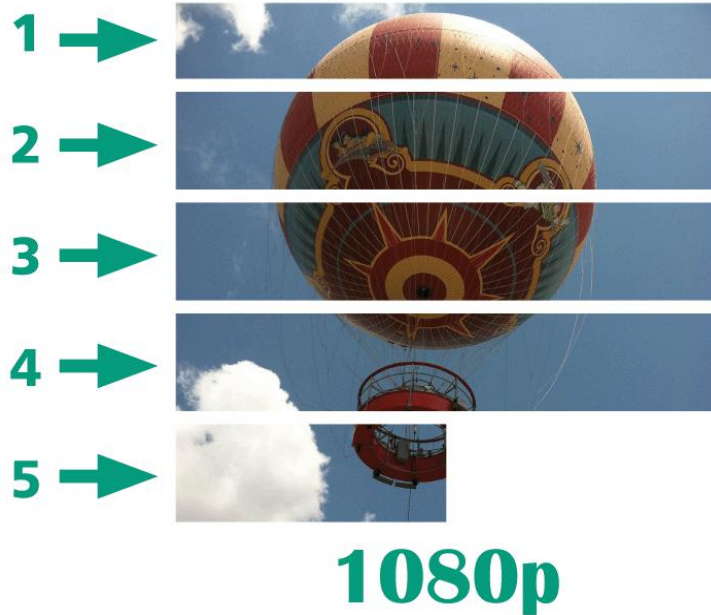
- Video resolutions can be expressed as width x height, as the horizontal resolution, or as the vertical resolution

- Cameras used for digital cinematography capture video with a resolution of 2048 x 1536

- This resolution is referred to as 2K because the horizontal resolution is about 2,000 pixels

- Vertical resolutions are expressed with a "p" for **progressive scan**, in which the frame is drawn line by line in sequence from top to bottom

- An **interlaced scan** is a contrasting scanning technique that produces an image by drawing every other line, then going back and filling in the in-between lines

- Digital video for computers typically uses progressive scanning; digital television uses interlaced scanning
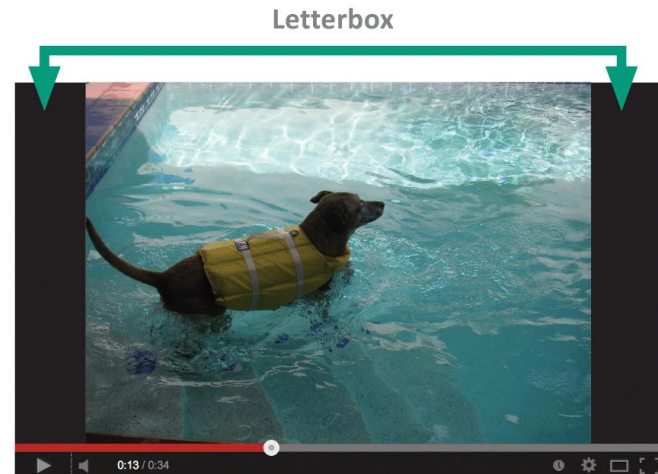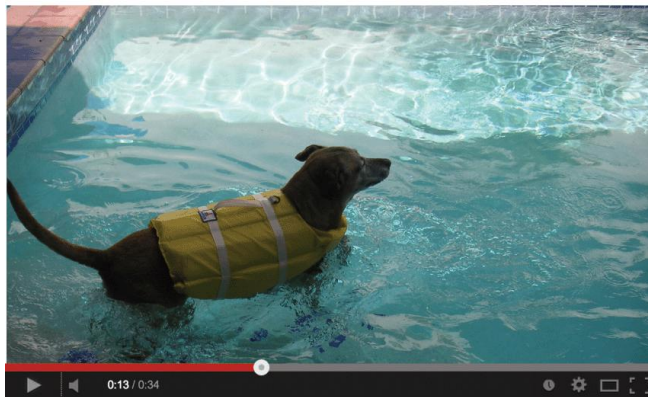
Digital Video Basics (6 of 10)

- **Aspect ratio** is the proportional relation between the width and height of an image or video frame
  - iPads use a 4:3 aspect ratio
  - Widescreen devices, such as laptops and smartphones, use a 16:9 aspect ratio

Digital Video Basics (8 of 10)

- When 4:3 videos are displayed on a widescreen player, they are bordered by the black bars of a letterbox

The video on the left has a 16:9 aspect ratio that fits into the YouTube player window. The video on the right has a 4:3 aspect ratio. A letterbox creates black bars to fill the playback window.

Digital Video Basics (9 of 10)

16:9
- 3840 x 2160 (2160P)
- 2560 x 1440 (1440P)
- 1920 x 1080 (1080P)
- 1280 x 720 (720P)
- 854 x 480 (480P)
- 640 x 360 (360P)

4:3
- 1600 x 1200
- 1024 x 768
- 800 x 600
- 640 x 480
- 320 x 240

Smartphones, laptops, and tablets

Legacy computers, iPads

HDTVs and desktops
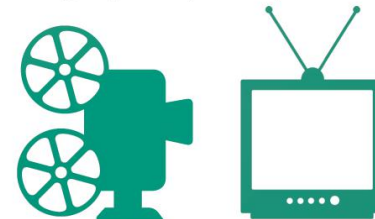
Film projectors, analog televisions

- 1,194,393,600 bits are needed for one second of digital video

- A feature-length video requires an astounding 8,599,633,920,000 bits! More than one trillion bytes!

- A bit rate is the number of bits that are processed during a specific unit of time, usually during one second

- Bit rate can be expressed as bits per second (b/sec or bps) and kilobits per second (Kbit/s or Kbps)

Video Compression (1 of 3)

- Choosing a lower resolution when saving a video reduces the bit rate

REDUCE RESOLUTION

Lower resolutions produce smaller file sizes and bit rates.

SPECIFY DESTINATION

Choosing a video service produces files sized appropriately for use.

SELECT FILE SIZE

Smaller file sizes are achieved through compression that may reduce video quality.

CHOOSE BIT RATE

Compression can produce videos with lower bit rates that stream quickly, but quality might degrade.

- Compression removes some of the data (bits) through the following techniques:

- Compressor/decompressor software

  - **Image compression** – frames of a video are compressed using lossy and lossless compression

  - **Interframe compression** – stores only the pixels that change color from one frame to the next

- A **codec** (compressor/decompressor) is the software that compresses a video stream when a video is stored and decompresses the file when the video is played

- Each codec uses a unique algorithm to shrink the size of a video file, so they are not interchangeable
- Popular codecs include: MPEG, VP8, DivX, H.264, Theora, and Windows Media Video

- Video files are stored in **container formats** that hold the compressed video stream and an audio stream
- **AVI**, **MOV**, **MPEG**, **WebM**, **ASF**, **VOB**, and **Ogg Theora** are popular video container formats

Video File Formats (2 of 4)

FORMAT	EXTENSION	PLATFORM	DESCRIPTION AND USE
MPEG (Moving Picture Experts Group)	.mpg, .mp4, .mpeg	PC, Mac, UNIX, Linux	Versions include MPEG-1, MPEG-2, and MPEG-4; used for downloaded and streaming Web video
WebM	.webm	PC, Mac, UNIX, Linux	Royalty-free, high-quality open format for use with HTML5
AVI (Audio Video Interleave)	.avi	PC	A format sometimes used for storing digital clips from video cameras; used for legacy video on the PC platform
MOV (QuickTime Movie)	.mov	PC, Mac, UNIX, Linux	A legacy format for downloaded and Streaming Web videos
ASF (Advanced Systems Format)	.asf, .wmv	PC	Container format for Microsoft's Windows Media Video (WMV); supports downloads and streaming
VOB (Video Object)	.vob	Standalone DVD player, PC, Mac, Linux	Industry-standard format for standalone DVD players
Ogg Theora	.ogg	PC, Mac	A non-proprietary container (Ogg) and video codec (Theora)

- Digital videos can be converted from one format to another through a process called transcoding

- Basic video editing tools are used to arrange video clips, add a soundtrack, insert captions, select special effects such as fades between clips, and choose output format

Video File Formats (4 of 4)
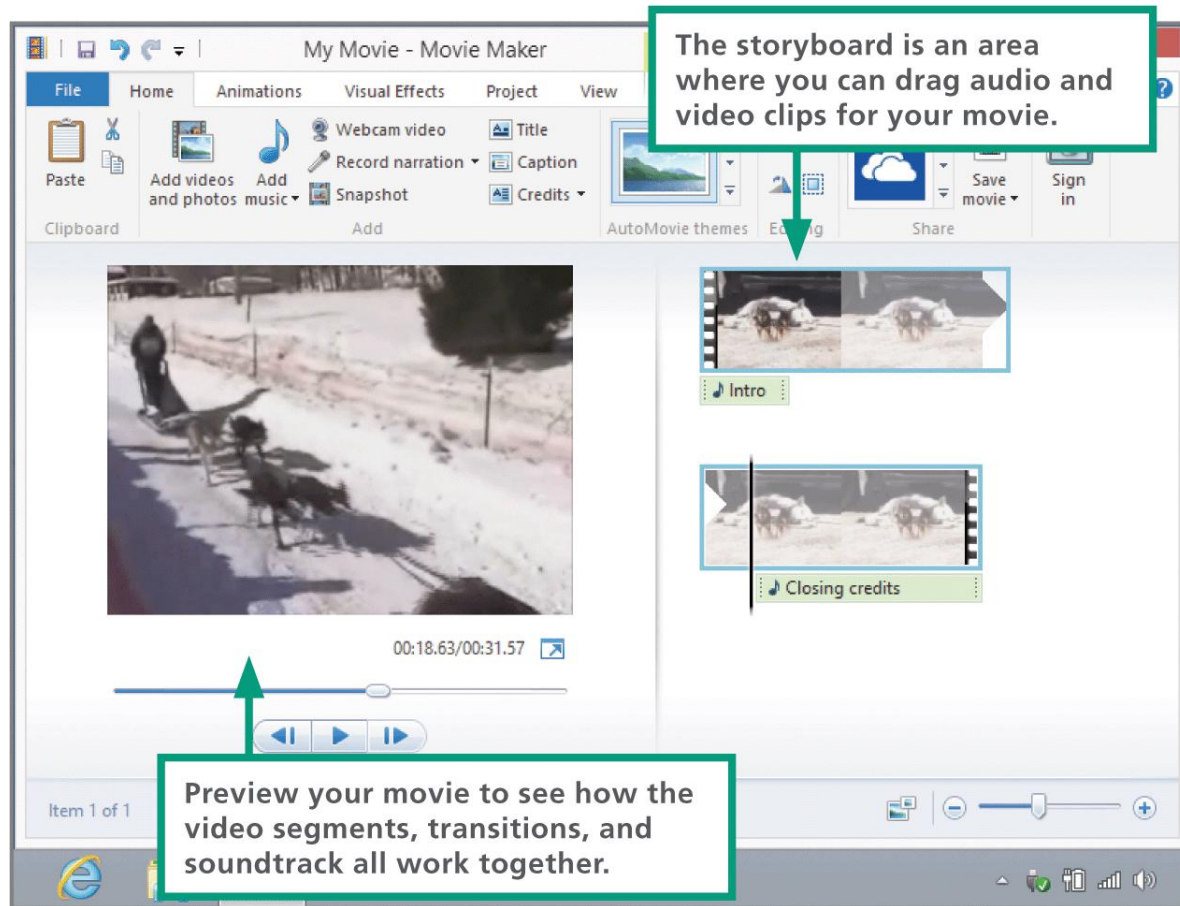
Digital Video Variations (1 of 2)

- Movies are simply multiframe bitmaps that build on techniques used to create basic bitmap still images

- A photographer uses multiple video cameras to simultaneously film footage from all angles

- A 360-degree video is a motion graphic that depicts continuous events happening within a 360-degree radius or sphere of a single pivot point

Digital Video Variations (2 of 2)

- Movies that appear to have visual depth are commonly called "3D," but technically, they are stereoscopic

- When movies are constructed with anaglyphs, each frame contains a blue and red stereo pair. Viewers wear glasses with red and blue lenses to experience the effect of visual depth