CHAPTER SIX 6

MULTIMEDIA & GRAPHICS
- New uses for computer graphics include: **Buttons | Charts | Diagrams | Animated images.**
- Challenges of computer images include:
    1. **Large file size**
    2. **Slow downloads and processing**
    3. **Possible inferior quality from original**
    4. **File format compatibility**
    5. **Images display differently on various monitors and printers.**

TRADITIONAL GRAPHICS:
- Contone image: **Composed of continuously varying shades of color.**
- Line art: **Combinations of lines to create images, Uses only two colors.**

BITMAPPED GRAPHICS
- **Bitmapped graphics ; Created as a pattern of discrete elements AND Each element is a pixel or "picture element."**
- **Pixels Small squares Assigned a binary code to define color. | More bits = more color possibilities**

BITMAPPED IMAGES
- Categories of bitmapped images are:
    1. **Line art | Produced using two colors usually black and white**
       Advantages Clear, crisp image. AND Small file size
       Uses include: Charts | Illustrations | Diagrams.
    2. **Grayscale | Produced using shades of gray, Generally 8-bit images of 256 shades of gray**
       Advantages
        1. **Excellent representation of black and white photos**
        2. **Smaller files size than full color**
        3. **Lower printing costs than color.**
    3. **Color | Produced with patterns of colored pixels.**
       - **Consists of a pattern of colored pixels**
       - **Bit depth: the number of bits used to encode each pixel determines the amount of color possibilities.**
       - **Photo-realistic color requires 24-bit color.**
- Two methods to create color on a computer:
    1. **Identify a table of possible colors for the computer (Color Lookup Table)**
    2. **Specify varying amounts of Red, Green, Blue.**

Image quality depends on:
    1. **Spatial resolution = density of pixels per inch.**
    2. **Color resolution = number of colors each pixel can**

SPATIAL RESOLUTION
- **Higher spatial resolution Captures more detail. Pixels are smaller and closely packed**
    - **Produces sharper, more accurate images.**
- **Lower spatial resolution Captures less detail. Pixels are larger AND Images appear fuzzy.**
- **High spatial resolutions yield large file sizes but better image quality.**

RESAMPLING BITMAPPED IMAGE
- **Process of increasing or decreasing the number of samples described in a file.**
- **Upsampling: adding samples to the file, used to enlarge the physical dimensions of an image on a given device.**
- **Downsampling: reducing the samples in the image.**
- **Downsampling: reducing the pixels in the file can produce smaller images that maintain good quality.**

COLOR RESOLUTION
- **Indexing**
    - **A specific palette of colors is identified to optimize the appearance of lower color resolution image.**
    - **Two methods to create the index of colors: Adaptive | Perceptual.**
- **Dithering**
    - **Combining pixels of different colors to produce another color not available in the indexed palette.**
    - **Improves image quality without increasing bit depth.**

BITMAPPED IMAGE SOURCES
- **Paint programs Specialized software for creating bitmapped images. { Photoshop, Paint. }**
- **Digital cameras Number of pixels sampled by the camera is the camera's spatial resolution.**
- **Scanner Capture existing or original art image | Capture 3-D objects.**
- **Clip art) Royality free | Licensed usage.**
- **Screen grab: Save image on monitor to a bitmapped file, Spatial resolution is generally low.**

VECTOR-DRAWN GRAPHICS
- **Vector: a line with length, curvature, and direction.**
- **Vector graphics: images created from mathematically defined shapes.**
- **Draw programs: software used to create vector graphics.**
- **Draw programs use tools that resemble those of a draftsman: Fixed shapes | Bezier curves | Pen.**
VECTOR-DRAWN Main advantages: **Images can be enlarged without distortion and Small file size.**

VECTOR to BITMAPPED & Back Again

- **Autotracing:** software analyzes a bitmapped image for shapes and converts the image to a vector graphic.
- **Rasterizing:** samples the vector image and saves it in bitmapped form.

VECTOR GRAPHIC FILE FORMATS

- **Files are saved** in native format or general purpose formats.
  - **Native format:** dependent on the application.
  - **General purpose:** can be used in many applications.
    - **Vector-only:** EPS—Encapsulated Postscript | PDF— Portable Document Format.
    - **Metafiles:** SVG—Scalable Vector Format.

	BITMAPPED (paint) IMAGES	VECTOR (Draw) IMAGES
ADVANTAGES	• Represent complex contones. • Full-featured photo editing. • Wide range of artistic effects. • Precise editing.	• Smooth scaling and reshaping. • Ease of editing objects in layers. • Low file size. • Device-independent.
DISADVANTAGES	• Large file sizes. • Loss of precise shapes when scaled or rotated. • Device-dependent.	• Inaccurate, incomplete representation of complex contone images. • No photo-editing capability. • Limited artistic control.

3-D GRAPHICS Four interconnected steps in creating 3-D images:

Modeling **|** Surface definition **|** Scene composition **|** Rendering.

STEP 1: MODELING: Process of specifying the shape of the 3-D object.

- **Two major approaches to modeling:**
  - **Combine cubes, cones, cylinders and other 3-D shapes supplied with the graphics program - modeling with primitives.**
  - **Use a modeler to create shapes directly.**

3-D MODELING

- **Modeling with primitives uses basic shapes to create complex 3-D images.**
- **Parametric primitives**
  - **Objects that can be changed by specifying parameters such as radius.**
  - **Primitives can be scaled, rotated, moved, combined.**
  - **Constructive Solid Geometry (CSG)**
    - **Primitives are joined, subtracted from, or intersected with using Boolean operators.**
- **Four modeling techniques:**
  1. **Polygon modeling**
  2. **Spline modeling**
  3. **Metaball modeling**
  4. **Formula modeling.**
- **Modelers have ability to:**
  - **Extrude:** extend a 2-D shape through space to create a 3-D object.
  - **Lathe:** rotate a 2-D line on an axis.

POLYGON MODELING

- **Object is defined as pattern of straight-edged polygons.**
  - **Similar to bitmapped graphics in that the object is defined by fixed number of elements.**
    - **Fixed number of polygons for 3-D.**
    - **Fixed number of pixels for 2-D.**
- **Advantages:** High-quality, realistic surfaces,and precise editing control.
- **Disadvantages:** Large file sizes and scaling distortions.

SPLINE MODELING

- **Uses curves to create objects. Similar to 2-D vector graphics.**
- **NURB approach defines** an image using mathematical formulas that can be adjusted to vary size and shape.
- **Advantages:** Smaller file sizes, more flexible objects, NURBs are easily scaled.
- **Disadvantage:** Less editing control.

METABALL MODELING

- **Creates objects as combinations of elements called blobs.**
- **Blobs have various shapes and are either positive or negative.**
  - **Positive blobs add to the object.**
  - **Negative blobs subtract from the object.**
- **Metaball technique is good for objects with soft edges. The blobs are smoothed like lumps of clay.**

FORMULA MODELING

- **Creates objects by specifying mathematical formulas that are drawn by the computer.**
- **Requires knowledge of programming and advanced mathematics.**

STEP 2: SURFACE DEFINITION

- **Surface definition:** where textures are applied to the model's surface.
    – **Menu choices of surfaces include wood, glass, metal, skin.**
    – **Can vary the appearance of surfaces with color, opacity, reflectivity.**
- **Custom surfaces include:** Image maps | Bumb maps.

STEP 3: SCENE COMPOSITION

- **Objects are arranged, backgrounds introduced, environmental effects added, and lighting established.**
- **Lighting choices in a scene include:** Omni lights | Directional lights | Spot lights | Volumetric light.
- **Adjust lighting with brightness, color, and attenuation.**

STEP 4: RENDERING

- **Computer creates the scenes specified by the artist.**
- **Two main approaches:**
    – **Pre-rendering** Used primarily for still graphics, animation, and video with limited interactivity.
    – **Real-time rendering** Used for highly interactive 3-D applications such as video games.

GUIDELINES FOR USING GRAPHICS IN MULTIMEDIA

1. **Identify purpose of the graphic.**
2. **Choose best format for each image.**
3. **Match graphic design to purpose.**
4. **Locate graphics.**
5. **Preserve image quality.**
6. **Economize.**
7. **Organize and store graphics files for later use.**

CHAPTER SEVEN7

Sound is a form of mechanical energy transmitted as vibrations in a medium.

Sine wave captures three features of sound:

- **Amplitude** | Perceived as volume.
- **Frequency** | Perceived as pitch.
- **Duration** | Length of time sound lasts.

DIGITAL SOUND

- **Two major types of digital sound:**
    – **Sampled sound:** digital recording of previously existing analog sound wave.
        ▪ **File contains numeric values to describe the amplitude of the sound wave at a particular instant.**
        ▪ **Used to capture and edit naturally-occurring sounds.**
    – **Synthesized sound:** new sound generated by the computer.
        ▪ **File contains instructions the computer uses to reproduce the sound.**
        ▪ **Used to:**
            ❖ **Create original compositions**
            ❖ **Produce novel sound effects.**

Quality of the sampling depends on: Sample resolution | Sample rate.

SAMPLE RESOLUTION: Number of bits to encode amplitude.

SAMPLED SOUND DISTORTIONS

- **Quantization:** rounding a sample to the closest available value in the code being used.
    – **May produce background hissing or grainy sound, Caused by low sample resolution**
    – **Solution:** record at higher resolution Use 16-bit rather than 8-bit to increase the range of amplitudes.
- **Clipping:** wave amplitude exceeds available sample values.
    – **Causes:**
        ▪ **Recording equipment isn't designed for selected decibel range or**
        ▪ **Mixing tracks with amplitudes that exceed the available range.**
    – **Result is harsh, distorted sound.**
    – **Solutions:** Lower amplitude of source sound within the limits of the ADC circuitry, Adjust volume of mixed tracks or use higher sample resolution

SAMPLE RATE : Number of samples taken in a fixed interval of time.

- **Two measurements capture each cycle of the sound wave:**
    1. **High value or peak**
    2. **Low value or trough.**

SAMPLE RATE DISTORTION

- **Aliasing:** false representation of high frequencies as low frequencies.
    – **Occurs when source frequency is greater than one-half the sample rate being used.**
    – **Solutions:** Apply filters to source sound to eliminate frequencies above the sample rate.

SOUND COMPRESSION

- **Psychoacoustics:** eliminates frequencies indistinguishable to the human ear.
- **Variable bitrate encoding (VBR):** alters the number of bits to encode the sample depending on the complexity of the sound.

3

SAMPLED SOUND FILE FORMATS

- **AIFF:** Apple Computer | Uncompressed, high quality sound.
- **WAV:** Microsoft and IBM standard | Uncompressed, high quality sound.
- **AU:** Sun Microsystems | Internet transmission of lower quality sound files.
- **RealAudio:** Real Media | Streaming audio at low bandwidths.
- **MP3:** (MPEG-1, audio layer 3) | Significant compression of high quality sound.
- **WMA**: Windows Media Audio | Delivers lossy compression comparable to MP3 at lower bitrates.
  - **AAC:** Advanced Audio Coding | Successor to MP3 specified in the MPEG-4 standard, Produces better quality sound than MP3 standard at comparable bitrates.

SYNTHESIZED SOUND: Computer sends commands to specialized electronic device called a synthesizer.
MIDI (Musical Instrument Digital Interface). Most common standard to code commands for **synthesizers.**
Sequencer; Device to control the flow or sequencing of the MIDI data to a multitimbral synthesizer.

SAMPLED vs. SYNTHESIZED

- **Sampled Advantages:** 1. High quality. 2. Ease of creation. 3. Ease of editing. 4. Consistent playback quality.
- **Sampled Challenges: 1.** Large file sizes.   2. Editing limitations.
- **Synthesized Advantages: 1.** Exceptional editing control.   2. Small file size.
- **Synthesized Challenges: 1.** Musical expertise required.   2. Playback quality is not consistent.
  3. Not effective for natural sounds and human voice

ADVANTAGES OF DIGITAL SOUND

1. **Noise reduction**
2. **Recording accuracy**
3. **No generation decay**
4. **Durability**
5. **Random access**
6. **Editing is easier and less expensive**
7. **Easily distributed by:** CDs - Networks.

Strategies for DELIVERING DIGITAL SOUNDS

- **Downloaded audio:** transfers the complete audio file from the server to the client.
- **Streaming audio:** real-time sound that is played as it is being delivered. Not saved on client computer.

Progressive downloads: file is saved to client computer, but begins to play from RAM as it is downloading.

GUIDELINES FOR USE OF SOUND

1. **Identify the purpose of the sound and use it for good reasons.**
2. **Use high-quality sound.**
3. **Conserve file space.**
4. **Consider playback environment.**
5. **Avoid excessive use of sound.**
6. **Organize sound files and preserve original sources.**

CHAPTER EIGHT8

DIGITAL VIDEO CHALLENGES

- **Large file sizes |** Every second of uncompressed digital video requires 30MB of storage.
- **Hardware performance |** Computer processors, memory and bus size must deliver digital video to the screen at full motion frame rates.
- **Distribution methods** DVD players | High speed network bandwidth.

DIGITAL VIDEO QUALITY Factors:

- **Screen resolution|** Number of horizontal and vertical pixels used to present the video image.
- **Frame rate |** Number of individual video frames displayed per second.
- **Compression method |** Algorithm used to compress and decompress the video.

Three strategies for compressing video:

1. **Intra-frame:** re-encodes within the frame.
2. **Inter-frame:** eliminates intervening frames saving only changes between the frames.
3. **Variable bit rate (VBR)**
   - **CBR** (constant bit rate) assigns same number of bits per second to all parts of the video.
   - **VBR** assigns more bits to complex scenes and fewer bits to simpler scenes.

- **Choosing compression depends on:**
  - **Output destination** DVD | Internet | Mobile device
  - **Editing capability** Detailed editing tasks | Limited editing tasks
  - **Type of images in video** Complex scenes | Similar scenes

MPEG compression identifies:

- **I-frames:** "intra-frame" or complete compressed frames
- **P-frames:** predictive frames record more significant changes.
- **B-frames:** bidirectional frames record smaller changes between the I and P frame.

COMMON VIDEO CODECS
- **MPEG**
  - **MPEG-1**(short videos on Video CD—optical disc format).
  - **MPEG-4 (video over the web).**
- **M-JPEG (less-compressed higher quality files without inter-frame loss)**
- **Real Video (proprietary codec for streaming video on web)**
- **Flash Video (popular Internet video standard)**
- **QuickTime (cross-platform format supporting variety of codecs and screen resolutions)**
- **Windows Media Video (highly compressed streaming video format from Microsoft)**
- **SDTV (digital format that uses roughly same resolution as analog TV)**
- **HDTV (uses 16:9 aspect ration and progressing scanning)**
- **AVCHD (a variant of MPEG-4 compression recording at 1080i, 1080p, or 720p)**
- **Motion JPEG 2000 (produces smaller files at higher quality, uses intra-frame compression, visually lossless, lossy or mathematically lossless compression.**

Three main steps in creating original digital video: **Shooting | Editing | Rendering.**

SHOOTING Requires planning for:
  - **Intended uses of video**
  - **List of shots required**
  - **Weather and lighting conditions**
  - **Availability of personnel**
  - **How the video will be integrated in the project.**

DIGITAL VIDEO CAMERA CONSIDERATIONS
- **CCD (Charge-Coupled Device).**
- **Lenses**
- **Microphones**
- **Light Sensitivity**
- **Storage Media**
- **File Format**

Number of CCDs
  - **One CCD:** Light is filtered and level of each filtered color is recorded.
  - **Three CCDs:** Light is split into three channels and each CCD records separate levels of RGB.

Resolution of CCD: Higher resolution delivers more accurate images.

- **Microphones: placement, type, and quality.**
  - **Omni-directional:** optimized for broad range of background sound.
  - **Unidirectional:** record from narrowly defined location.
- **Storage Media**
  - **Tape**
    - ❖ **Advantages:**
      1. **Inexpensive archive format**
      2. **DV and HDV formats are well-established.**
    - ❖ **Disadvantages:**
      1. **Sequential access is demanding on tape**
      2. **Transfer of video to another device is time consuming.**
  - **Optical media & Solid state media**
    - **Random access to video**
    - **Rapid transfer from camera**
    - **Light weight, low power consumption, ease of exchange and transport.**
    - **Declining costs and increased capacities**
  - **File Format:** Source video footage should be captured at highest resolution possible and not be highly compressed.
  - **DV format:**
    - **Limits compression to 5:1**
    - **Has relatively high resolution**
    - **Uses M-JPEG compression.**
  - **HD & 3D format:**
    - **New formats are emerging.**
    - **HD formats can increase processor demand during editing if using inter-frame compression.**

SHOOTING BASICS
- **Framing a Shot**
  - **Rule of thirds—widely embraced guideline for framing a video shot.**
    - **Preserves its interest.**
    - **Meaningfully relates it to action taking place.**
    - **Helps ensure adequate side and headroom.**
- **Minimize camera motion.**
  - **Use tripod or steady surface to support camera.**
  - **Keep the camera still at all times.**

- **Camera controls for generating motion:**
  - **Pan—moving side to side.**
  - **Zoom—enlarge camera lens.**
- **Take care of time code.**
  - **Format of hours, minutes, seconds, frames.**
  - **Time code becomes the frame address.**

Type of Shots:

- **Close up shot (CU)**
- **Medium shot (MS)**
- **Wide shot (WS)**
- **Establishing shot**
- **Cutaway**
- **Point of view shot**
- **Reverse angle shot**
- **Over-the-shoulder shot**

STEP TWO: EDITING
- **Editing software options:**
  - **Consumer packages.**
  - **Prosumer applications.**
  - **Specialized video and film production.**
- **Digital Video Major Task (Features):**
  - **Capture video from external source.**
  - **Arrange separate video clips.**
  - **Split and trim clips.**
  - **Add transitions and special effects.**

CAPTURE/IMPORTING VIDEO
- **Transfer video from camera to computer through USB, FireWire, or Thunderbolt connection.**
- **Transfer includes:**
  - **Video images & audio**
  - **Time Code**
  - **Date Stamp**
  - **Scene Detection**
  - **Geotagging**
- **Editing software can use changes in data to identify different recording sessions.**

Master video: is a series of instructions and pointers for performing operations on the original source footage.

EDITING SOFTWARE
- **Preview window | Shows source video.**
- **Library window | Lists clips transferred to the computer.**
- **Construction window | Presents assembled clips.**
- **Timeline | Shows duration of video's multiple tracks.**

EDITING OPERATIONS
- **Splitting: dividing clip into multiple parts.**
- **Trimming: removing unwanted frames from clips.**
- **Transitions: effects to move into or out of a clip. These include:**
  1. Cut   2. Fades   3. Dissolve   4. Wipe.

STEP THREE: RENDERING
- **Process of applying the editing operations specified by the master video to produce a new, independent video file.**
  - **Can be processor intensive and time consuming process.**
  - **Output options are based on video's intended use. These include:**
    1. **Video compression method**
    2. **Resolution or screen size**
    3. **Frame rate and video data rate**
    4. **Audio data rate and audio format.**

RENDERING DECISIONS
- **Choice of a codec.**
  - **All video must be compressed.**
  - **Choice will determine quality of resulting video.**
    - **Variable bit rate encoding better than constant bit rate.**
- **Choice of frame rate.**
  - **Impacts size of video file.**
  - **Web video must be significantly reduced for a wide viewing audience.**
- **Choice of audio compression and data rate.**
  - **If file size is not critical, use PCM format.**
  - **Also widely used are MP3 and Dolby Digital AC-3 formats.**
- **Choice of computer hardware.**
  - **Video complexity could make render time over 1 hour per minute of video.**
  - **CPU speed, amount of RAM, size of hard drive can save you time.**
    - **Multi-core processors and distributed processing can also reduce the time for rendering.**

GUIDELINES FOR VIDEO Shooting:

- Choose camera carefully.
- Steady the camera.
- White balance prior to shooting.
- Avoid shooting into light and backlit scenes.
- Limit pans and zooms.
- Frame the subject.
- Make inventory of required shots.
- Use highest resolution available.
- Add external microphones.
- Use headphones to monitor sound quality.
- Record background sound for use in editing.
- don't break the time code.

GUIDELINES FOR VIDEO Editing:
- Protect source video.
- Save a copy of the master video prior to rendering.

GUIDELINES FOR VIDEO Rendering
- Match codec, resolution, frame rate, and data rate to intended use and delivery medium.
- Use variable bit rate encoding when available.

CHAPTER NINE9

Animation: rapidly displayed sequence of individual, still images.

Early animating devices: Thaumatrope | Zoetrope.

Flipbook technique: Still images showing a different stage of motion are created on each page, Pages are "flipped" in rapid succession to view the motion.

Animation basics used in flipbook:
- **Quality** of motion is based on rate of display.
- **Speed** is based on differences between images.
- **Onionskinning:** a technique used to draw new image based on the previous image.
- **Registration:** physically aligns images with one another.

TRADITIONAL ANIMATION
- **Film based process**
- Images are photographed and recorded as separate frames on long strip of transparent film.
- Film passed in front of light source and animation appeared on a screen.
- **Film enhanced possibilities of animation.**
- Multiple reels allowed longer animations.
- Projectors displayed images at reliable frame rates.
- Animators could add sound to the motion.

CHALLENGES OF TRADITIONAL ANIMATION
- Number of images to create.
- 24 frames per second requires 1,440 individual still images for each minute of animation.
- **Methods to generate images include:**
  - **Shooting on twos** cuts number of images in half.
  - **Cycle** of images can be reused to extend repetitive motion.
  - **Holds** produce sequence of identical drawings to extend a particular state or action.
- **Artistic strategies to create realistic world require:**
- Awareness of how things move in the world.
  - Ease-in and ease-out address the physics of motion.
  - Overshooting a resting point addresses kinetic energy of motion.
  - Different components of objects move independently of one another (overlapping motion).
- Exaggerate motion for dramatic effect using:
  - Variations in speed
  - Stretch and squash.

Traditional Techniques
- **Strategies for achieving motion have been applied to:**
- Paper cut-outs | Clay figurines | Puppets | Natural objects photographed, reposed and re-photographed.

CEL ANIMATION
- **Perfected and made popular by Disney studios.**
- Cel: drawings of individual frames made on sheets of celluloid.
- Drawings were then photographed to produce the animated film.
- Technique that directly influenced development of digital animation.

CEL ANIMATION Advantages:
- **Artists saved drawing time.**
  - Fixed components of a scene were drawn once and layered on the bottom of a stack of celluloid sheets.
  - Moving components were drawn separately and placed on top of the fixed scene components.
- **Gave precise control over elements.**
  - Individual cel layers could reproduce interdependent, complex motions.
- **Encouraged division of labor and promoted high artistic standards.**
  - Master artists drew key frames or extremes.

- • **Additional specialists included:**
  - ▪ **Producers | Directors | Script writers | Audio specialists | Camera operators | Checkers.**

PRODUCING CEL ANIMATION
- • **Cost and complexity of creating animation required a carefully defined process.**
  - – **Storyboard:** sequence of drawings that sketch out content of major scenes in the production.
  - – **Pencil test:** series of simple sketches that are photographed and projected to test the design of the animated sequences.
  - – **Scratch track:** draft of animation's audio track.
  - – **Leica reel:** working draft of the complete animation.
- • **Uses specialized equipment in production process.**
  - – **Specialized paints to convey proper hue.**
  - – **Specialized camera and lighting to capture cels.**
  - – **Devices to:**
    - ▪ **Track changes in paths of animated characters.**
    - ▪ **Align and hold the cels for camera shots.**
    - ▪ **Synchronize and edit the final film.**
- • **Cel animation is complex, demanding, and expensive animation.**
  - – **Computers dramatically improved the process.**

DIGITAL ANIMATION
TWO DIFFERENT FORMS:
  - – **2-D** evolved from traditional animation techniques.
  - – **3-D** exploited capabilities unique to the computer.

2-D ANIMATION
- • **Produced by mimicking basic traditional techniques such as:**
  - ▪ **Flipbook technique**
  - ▪ **Cutout animation technique**
  - ▪ **Rotoscoping**
  - ▪ **Cel animation.**
- • **Paint/draw programs are used to create the components.**
- • **Animation software can sequence, set timing, transitions, and produce the final animation.**

Elements of Flash organization.
  - – **Timeline:** horizontal row of frames.
  - – **Frames:** have multiple layers in columns.
  - – **Keyframes:** define major changes in a frame.
  - – **Tweens:** frames created automatically by software.
  - – **Onionskinning:** assists in drawing changes from one frame to the next.
- • **Frame-by-frame animation:** each frame is manually drawn to reflect motion sequence.
- • **Tween animation:** computer generates in-between frames based on two designated key frames.
- • **Provide tools to support animation process.**
  - – **Image-editing tools**
  - – **Alignment tools and grids to control placement**
  - – **Text tools**
  - – **Basic sound control**
  - – **Strategies to support interactivity.**

PROGRAMMED ANIMATION
- • **Animators write commands and the computer generates the animation.**
  - – **Requires knowledge of programming and mathematical techniques to specify motion.**
- • **Advantages:**
  - – **File sizes are smaller.**
  - – **Animations load and play faster.**
  - – **Reduces bandwidth and processor demands.**
  - – **Efficient creation of different versions of animated sequence.**

Scripting languages frequently used to generate programmed animations: Lingo | ActionScript | JavaScript.

Elements of 3-D animation set in motion include: Objects | Sounds | Cameras | Lights.

Techniques of 3-D animation: Key frame | Tween motion.

MOTION CAPTURE: Also called performance animation. Technique of recording motion of actual objects and mapping these motions to a computer-generated animated character AND Used to capture complex natural motions that are difficult to create.

FORWARD KINEMATICS
- • **Kinematics is study of motion of bodies or systems of bodies.**
  - – **The motion of one part generates related motion in others.**
- • **Animator must adjust all motion in all related parts of the body.**
  - – **Simple to implement.**
  - – **Models easily defined.**
  - – **Computer processing is minimal.**
  - – **Quality of motion depends on animator's skill.**
  - – **Animation is time consuming process.**

INVERSE KINEMATICS
- **Motion of one body part produces related motions in other body parts.**
  - **Simplifies animator's work and ensures consistent, realistic motion.**
- **Software embodies the knowledge of anatomical motion.**
  - **Requires innovative programming.**
  - **Demands more processing power than forward kinematics.**
- **Significantly reduces work of animator.**

COMPLETING THE ANIMATION
- **Rendering creates the final animation frames by applying:**
  - **The modeling**
  - **Surface definition**
  - **Scene composition as specified by animator.**

RENDERING OPTIONS
- **Pre-render: Requires enormous processing resources and time for animated movies.**
- **Render in real time: Computer produces animation immediately, Used in video games and highly interactive 3-D animations.**

ANIMATION TIPS & GUIDELINES
- **Prepare for a learning curve: Animation programs are more difficult to master.**
- **Design for delivery: Minimize file size if delivery is for Web.**
- **Consider clip animation to reduce costs.**
- **Consult the tradition in developing motion.**
  - **Cycles, holds, shooting on twos, tweening, stretch and squash, ease in & ease out, overshoot & overlap motion are traditional techniques.**

CHAPTER TEN 10

METHODS TO INTEGRATE MEDIA
- **Programming**
  1. **Languages specify how the media is presented and user interactions carried out.**
  2. **Requires command of the language.**
  3. **Is time consuming.**
- **Authoring**
  - **Applications specially designed to integrate and present media elements.**
  - **Developers can concentrate on design, interactivity, and functionality of the project.**

AUTHORING APPLICATIONS
- **Software designed for creation of multimedia projects.**
- **Applications are used to:**
  Assemble media elements | Synchronize content | Design user interface | Provide user interactivity.

AUTHORING METAPHORS
- **Authoring applications are grouped around three metaphors: Card | Icon | Timeline.**
- **Metaphors help orient developer to how the software organizes the media, sequences events, and presents final project.**

CARD METAPHOR
- **Media is organized in sequential order on a stack of cards or slides.**
  - **Appropriate for static media that is normally experienced in sequence.**
- **Cards have two layers:**
  - **Background layer contains shared elements. Foreground layer contains content specific to that card or slide.**
- **Benefits of card layers.**
  1. **Background content is created once which saves development time.**
  2. **Common background layer provides consistent design.**
  3. **File sizes are minimized by sharing background elements.**

ICON METAPHOR
- **Icons define media and forms of interactivity.**
- **Icons are placed on a flowline to create the application structure.**
- **Flowline is a graphical representation of the relationships between components of the application.**

TIMELINE METAPHOR
- **Organizes media and interactivity as sequence of frames.**
  - **Each frame can have multiple layers.**
  - **Layers define the stacking order of the content to be displayed.**

APPLICATION DESIGN
- **Authoring software supports the design process.**
- **Storyboard is a series of screen sketches to guide development process.**

CREATE AND EDIT CONTENT
- **All authoring applications include some tools for creating and editing media content. For example:**
  - **Text adjustments to font size and color.**
  - **Paint tools to add shapes and edit image features.**
  - **Sound adjustment on volume, duration.**
  - **Animation changes to speed and direction.**

ESTABLISHING NAVIGATION
- Authoring software can establish the order of the content on playback.
- Basic navigation structures include: Linear or sequential | Hierarchical | Networked | Conditional.

PROGRAMMING
- Provides more flexibility and control.
  - For projects with extensive interactivity, custom features.
- Two programming methods.
  - Script: series of commands specifying properties or behavior of an element in the project.
    - Commands are *interpreted* as the project is executed.
  - Icon: dialog boxes allow the developer to specify parameters for icon's use.
- Does not require programming knowledge but does limit commands to icon parameter
- *Debugger tools* can identify errors in program code.

PROJECT DELIVERY: Projects are published so they play outside the authoring environment.
- Two approaches to publishing.
  - Remote delivery ; Store the application and data on a server for access through a network, most often the WWW.
  - Local installation ; Application is installed and maintained on user's device.
- Remote delivery through a network connection.
  - Advantages:
    1. Content revisions are managed by server database.
    2. Wide market access
    3. Developer can track users and determine patterns of usage.
  - Limitations:
    1. Bandwidth restrictions may apply depending on user's location or network service.
    2. Browser applications are not uniformly compatible with all devices or applications.
- Local installation on user device.
  - Advantages:
    1. Project does not require constant connection to a network.
    2. Developer can incorporate larger data files within the application.
  - Disadvantages:
    1. Platform dependency.
    2. Version control and critical updates are user dependent.
    3. Inability to track demographics and patterns of use.

Local Delivery approaches:
  - Project requires a separate player program to present the multimedia content, Flash, and MediaPlayer programs.
  - Project embeds the player in the multimedia project, Larger files, but project is a stand-alone application.

CHOOSING AN AUTHORING APPLICATION
- No single authoring tool is suitable for all projects. To select the right application:
  - Consider the subject (static or dynamic media).
  - Consider the media (source file formats compatible).
  - Consider delivery (where used, means of distribution).
  - Consider maintenance (expertise needed to revise content, frequent update cycles).

CHAPTER ELEVEN 11

Multimedia development requires:
- Team members provide specialized knowledge of media creation.
- Plan defines the set of tasks and procedures needed for successful project development.

DEVELOPMENT TEAM
- Team of experts is important for project.
- Development is both:
  - Interactive—team members share expertise and ideas during the development cycle.
  - Iterative—revisions result from development feedback.

TEAM MEMBERS
- Project manager: Responsible for delivering the product with promised features, on time, and on budget.
- Project designer: Responsible for overall structure of content, the look, feel, and functionality of user interface.
- Content expert: Has detailed understanding of the topic.
- Writers: Create original text for the project, Provide written requirements of the project such as documentation, contracts, help screens, Technical writing skills are useful.

MEDIA SPECIALISTS: Responsible for preparation of individual elements in a multimedia application.
  - Graphics specialist Artists skilled in design principles and most current digital technology.
  - Sound specialist: Trained in traditional sound production and has a working knowledge of a sound studio.
  - Animation artist: Understands the principles of composition and color and can produce drawings, Understands the elements of motion and can envision action sequences.
  - Video specialist Videographers who have knowledge of film techniques, writing, sound, and digital video production and editing.
  - Programmer: Responsible for computer code that unites the media elements and provides the product's functionality.
  - Acquisitions Specialist: Knowledgeable about sources for copyright-protected content and process of securing permissions, Establishes agreements to protect the creative work of the project developers.

DEVELOPMENT PLAN Addresses three essential tasks: Definition | Design | Production.
STAGE 1: DEFINITION
- **Identify project goal or purpose. :** **What should the application accomplish?**
- **Identify the audience. :** **Who are the intended users?**
- **Identify role of multimedia in this project.**
    - **Advantages of multimedia to accomplish goal.**
    - **Media elements it requires.**
    - **Forms of interactivity to provide.**
    - **Delivery method and cost estimate.**

KEY DOCUMENTS IN STAGE 1
- **Preliminary Proposal** Short description of the proposed application.
    - **Includes** project goal, audience, outcomes, description of media, types and uses of interactivity, preliminary cost estimate.
    - **Often includes a flowchart. :** A simple box diagram with brief descriptions of product contents.
- **Storyboard**
    - **Series of sketches of major screens.**
    - **Rough drawings of media elements such as photos, animations, or videos are sketched in.**
    - **Navigational aides are identified.**
    - **Used to:**
        1. **Communicate with the client during the definition stage**
        2. **Communicate project goals and requirements to the development team.**
- **Functional specification**
    - **Detailed description of the elements and performance of multimedia project.**
    - **Basis of a detailed business contract.**
        - **Developer and client understanding of what has been promised and the procedures to follow if changes are made in specifications.**

STAGE 2: DESIGN
- **Purpose is to create an incomplete working model of the project—prototype.**
- **Media Creation**
    - **Required media identified in a content inventory list.**
    - **Media preproduction, production, postproduction are carried out.**

Goal of interface design is to engage the user.
- **Features of user interface**
    - **Intuitive:** Immediately understood by the user, Common strategy is to use a metaphor.
    - **Consistent:** Common backgrounds and consistent location of user controls.
    - **Predictable and reliable:** Similar actions should produce similar results, Identical actions produce identical results.

PROTOTYPE: An incomplete working model of the final product.
Functions of prototype:
1. **Refine the definition of the product**
2. **Test proposed features**
3. **Guide further work of team members.**

prototype Used to test the product itself.
1. **Test proposals.**
2. **Test assumptions of definition and design stage.**
3. **Test product to see if it performs as anticipated.**
4. **Test navigation of product.**
5. **Obtain internal and external product review.**

STAGE 3: PRODUCTION: Remaining elements of product are created and integrated into the application.
1. Includes quality assurance testing with bug reports and corrective measures.
    - **Alpha version:** includes most media elements but also many "bugs."
    - **Beta version:** includes all media but still has a few bugs.
    - **Gold master:** complete, bug-file application.
2. **Completion of release notes, manuals, and packaging.**
3. **Project materials are systematically archived.**

CHAPTER TWELVE 12

Code of ethics is a statement of obligations and standards that define a practitioner's professional responsibilities.

GENERAL PRINCIPLES ACM/IEEE CODE OF ETHICS

- The **"Public" Principle:** "Software engineers shall act consistently with the public interest."
- The **"Client and Employer" Principle:** "Software engineers shall act in a manner that is in the best interests of their client and employer, consistent with the public interest."
- The **"Product" Principle:** "Software engineers shall ensure that their products and related modifications meet the highest professional standards possible."
- The **"Judgment" Principle:** "Software engineers shall maintain integrity and independence in their professional judgment."
- The **"Management" Principle:** "Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance."
- The **"Profession" Principle:** "Software engineers shall advance the integrity and reputation of the profession consistent with the public interest."
- The **"Colleagues" Principle:** "Software engineers shall be fair to and supportive of their colleagues."
- The **"Self" Principle:** "Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession."

THE COPYRIGHT TRADITION RIGHTS | REMEDIES | EXCEPTIONS

DEVELOPERS AND COPYRIGHT.

- **Reasons multimedia developers need to understand the copyright laws.**
    - They must guard against intentional or unintentional violation of the rights of others.
    - Developers must protect their own work.
    - Developers must frame agreements with the client to specify copyright ownership.

COPYRIGHT PROTECTION

- **Copyright is** a form of legal protection given to creators of "original works of authorship. AND THE Purpose of copyright protection is **cultural advancement**.

Copyright differs from patent protection.
   a. Copyright applies to original or creative *expression*.
   b. Patent protects original *inventions*.

Owner of a copyright has five major rights:
   1. To reproduce the copyrighted work.
   2. To produce derivative works.
   3. To distribute copies to the public.
   4. To perform the work publicly.
   5. To display the work publicly.

- **Protection is granted for set period of time.**
    - Works created after 1978 extend to life of creator + 70 yrs.
    - Corporate rights extend 95 yrs. from date of publication or 120 years from creation, whichever comes first.
    - **Copyright registration is required if:**
    - Lawsuits are being filed for infringement.
    - Statutory damages and attorneys' fees are involved.
    - **COPYRIGHT REGISTRATION**
    - **Registration:** Provides evidence of copyright claim, Establishes basis for legal enforcement.
    - **Infringement can lead to:**
    - Injunctions to prohibit further production and distribution.
    - Compensation for monetary damages.
    - Statutory damages and criminal sanctions.

COPYRIGHT EXCEPTIONS
- **Public Domain**
    - Works for which copyright has expired.
    - Works where it was never applied such as: Government documents, Works not in fixed form.
- **Fair Use** A doctrine intended to advance important social goals.
    - Free and open press
    - Education
    - Research and scholarship.

FAIR USE CRITERIA
   1. Purpose and character of the use.
   2. Nature of the copyrighted work.
   3. Amount and significance of the portion used.
   4. Effect of the use on the value of the work.

Fair use is likely to be found for uses that:
   1. Are non-profit.
   2. Are factual rather than creative.
   3. Use small amounts of the work.
   4. Have little or no effect on the value or potential market of the work.

COPYRIGHT AND DIGITAL MEDIA

- **Copyright law was developed in age of analog media,** Media was more difficult to copy and distribute in analog form.
- **Digital versions of media pose <u>challenges</u> to traditional protections.**
  - **Easy to copy in full fidelity.**
  - **Editing tools easily generate derivative works that are difficult to detect.**
  - **Public display rights are threatened by Web technologies.**
- **Responses to preserving copyright and digital media:**
  - **Strengthen and improve enforcement of existing legal protections.**
  - **Develop new strategies within the digital media itself to protect content.**

Digital Rights Management: The application of digital technologies to the management of intellectual property (IP).

DIGITAL RIGHTS MANAGEMENT

- **Applied to many forms of intellectual property (IP) including:**
  - **Patents**
  - **Corporate reports and communications**
  - **Creative works traditionally covered by copyright (analog "legacy media")**
  - **Original digital media.**
- **Contract law also protects creative works.**
  - **Owners of creative works can sell a license to use the product.**
  - **End User License Agreements (EULAs) are popular for software programs and in use with digital books or "ebooks."**

USES OF DRM

- **DRM has often focused on rights of content owners.**
- **Commonly used to control copying and accessing digital content.**
  - **Adobe "eBooks"**
  - **Content Scrambling System (CSS)**
  - **Audio CDs (Sony BMG)**
  - **Music sold on the Web.**
- **Digital Millennium Copyright Act (DMCA) reinforced DRM copy/access protections.**

DIGITAL MILLENNIUM COPYRIGHT ACT

- **DMCA contains provisions that directly affect the work of digital media professionals.**
- **The DMCA has generated controversy:**
  1. **Potential abuse of copyright claims**
  2. **Limitations on fair use**
  3. **Discouragement of research**
  4. **Stifling of creative expression.**

Two Generations of DRM

- **First Generation: a "prevent and protect" strategy intended to limit access to, and use of, digital media.**
- **Second Generation: a "respect and promote" strategy to facilitate legal distribution and use of digital media.**

Elements of Second Generation DRM

1. **Rights description, validation, and record keeping**
2. **Media access**
3. **Trading**
4. **Implementing/monitoring rights usage**
5. **Tracking.**

DRM and Digital Watermarks

- **Digital watermarks - alterations to a media file that encode information about the file. For instance:**
  1. **Copyright ownership**
  2. **Identity of creator**
  3. **Identity of purchasers of copyright.**
- **Used to enforce copyright but also may support broader goals of "Second Generation" DRM.**

Benefits of Second Generation DRM

1. **New compensation models for creators of media (Magnatune)**
2. **New methods of distribution (Weed)**
3. **Less expensive, more efficient access to copyright permissions**
4. **More flexible permission and licensing options.**

Promoting Second Generation DRM

- **Creative Commons:**

Goals:
  1. **Share knowledge and creativity with the world**
  2. **Encourage creation of a common digital culture where creative works are readily available for use by others.**
- **Open Source Initiative: A standards body to promote development, distribution, and maintenance of open source software.**
- **Open Source Initiative key features:**
  1. **Free redistribution of software.**
  2. **Access to the source code for modification.**
  3. **Ability to create derivative works ,i.e. develop other software based on the original source code.**