

## Computer Animation

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CS395: Introduction to  
Computer Animation

## Animation

- Animate = “to give life to”
- Specify, directly or indirectly, how ‘thing’ moves in time and space
- Tools



## Two main categories

- Computer-assisted animation
  - 2D & 2 1/2 D
  - Inbetweening
  - Inking, virtual camera, managing data, etc
- Computer generated animation
  - Low level techniques
    - Precisely specifying motion
  - High level techniques
    - Describe general motion behavior



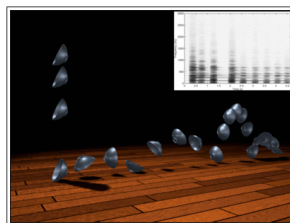
## Low level techniques

- Shape interpolation (in-betweening)
- Have to know what you want



## High level techniques

- Generate motion with set of rules or constraints
  - Physically based motion



<http://www.cs.berkeley.edu/~job/Projects/SoundGen/video.html>

## Abstraction

Animator colors each pixel

to

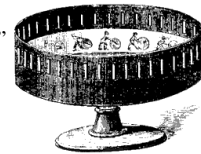
Tell computer to “make movie about a dog”

## Perception of Animations

- Playback rate
- Sampling or update rate
- TV: 30 images/second
- Sat Morning Cartoons:
  - 6 different images per second
  - Each image repeated five times

## Heritage of Animation

- Persistence of vision: discovered about 1800s
  - Zoetrope or “wheel of life”
  - Flip-book



## Heritage of Animation

- Camera to make lifeless things move
  - Meleis 1890 using simple tricks
  - Emil Cohl (1857-1938, French)



## Heritage of Animation

- J. Stuart Blackton (American)
  - Meet Thomas Edison in 1895
    - Combine drawing and file: “The Enchanted Drawing”
    - Six years later: “Humorous Phases of Funny Faces”
  - Animated smoke in 1900; First animated cartoon in 1906



### The Enchanted Drawing

©November 16, 1900  
Thomas A. Edison

### Humorous Phases of Funny Faces

©April 6, 1906  
The Vitagraph Co. of America

## Heritage of Animation

- First celebrated Animator
  - Winsor McCay (American)
    - Little nemo
    - Gertie the Dinosaur (1914)



### Gertie on Tour [Fragment]

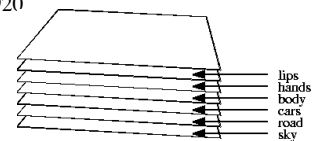
1921  
Rialto Productions

## Heritage of Animation

- First major technical development
  - John Bray /Earl Hurd (1910)
  - Translucent cels (short for celluloid) in compositing multiple layers
  - Use of grey scale (as opposed to B&W)
  - Color short in 1920



John Randolph Bray's Colonel Heeza Lair.



## Heritage of Animation

Out of Bray's studio

- Max Fleischer (Betty Boop,, Popeye)
  - Patented rotoscoping in 1915
  - Drawing images on cells by tracing over previously recorded live action
- Paul Terry (Terrytoons: Mighty Mouse)
- George Stallings(?)
- Walter Lantz (Woody Woodpecker)



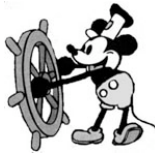
## Heritage of Animation

- Animation as an art form
  - First animated character with personality
    - Felix the cat by Otto Messmer (1920s)
- Force to reckon with
  - Sound and Walt Disney



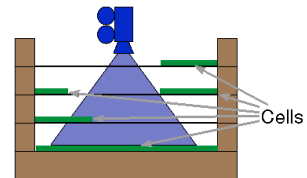
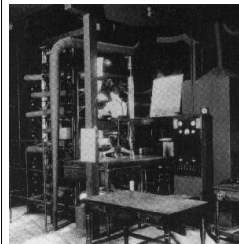
## Disney: Animation as an art form

- Innovations
  - Story board to review story
  - Pencil sketch to review motion
  - Multi-plane camera stand
  - Color (not first to use color)
  - Sound!
    - Steamboat Willie (1928)



## Multiplane Camera

- Move scene layers independently of camera



[http://www.geocities.com/SunsetStrip/Club/9199/Animation/Disney\\_Multiplane.html](http://www.geocities.com/SunsetStrip/Club/9199/Animation/Disney_Multiplane.html)

## MGM and Warner Brothers, etc.



## Other Media Animation

- Computer animation is often compared to stop motion animation
  - Puppet animation
    - Willis O'Brian (King Kong)
    - Ray Harryhausen (Might Joe Young, Jason and the Argonauts)

**The Dinosaur and the Missing Link,  
A Prehistoric Tragedy**  
©March 24, 1917  
Thomas A. Edison, Inc.  
Part 1 of 2



## Other Media Animation

- Claymation
- Pinhead animation
- Sand animation
- Physical object is manipulated, image captured, repeat



## Hierarchy of film/animation

Presentation



Act



Scene



Shot



Frame

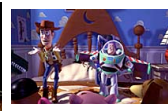
## Production of Animation

- Preliminary story
- Story board
- Detailed story
- Key Frames
- Test shot
- Pencil test
- Inbetweening
- Inking
- Coloring

Computer Animation  
basically follows this  
pipeline

## Computer Animation as Animation

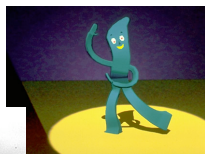
- Lasseter translated principles of animation as articulated by two of Nine Old Men of Disney to computer animation
  - Lasseter is conventionally trained animator
    - Worked at Disney before going to Pixar
    - Many celebrated animations
    - Knick-knack (oscar-winning)



## Short History of Computer Animation

In Research labs

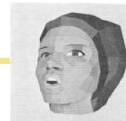
- NYIT



Still frame from Gumby animation by Hank Grebe and Dick Lundin, 1984.

## In Research Labs

- University of Utah
  - Films on walking and talking figure
  - Animated hand and animated face (1972)
- University of Pennsylvania
  - Human figure animation (Norm Badler)
- Cornell University
  - architectural walk-throughs (Don Greenberg)



## History of Computer Animation

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- 1974: Hunger by Rene Jodoin and Peter Földes
  - 2.5D system, object interpolation



## Current activity Centers

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- University of Toronto's Computer Science Department
- Simon-Fraser University's Graphics and Multimedia Research Lab
- Georgia Tech's Graphics Visualization and Usability Center
- Brown Computer Graphics Group
- Ohio State University's ACCAD
- Ohio State University's Department of Computer and Information Science
- George Washington University Graphics Group
- UC San Diego's Department of Computer Science and Engineering
- University of North Carolina's Computer Science Department
- MIT's Media Lab
- MIT's Laboratory for Computer Science
- University of Wisconsin at Madison

## History of Film & Video

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- Companies
  - Mathematical Applications Group, Inc. (MAGI)
  - Information International Inc. (III, or Triple-I)
  - Digital Production
  - Digital Effects
  - Image West
  - Robert Abel and Associates
  - Cranston-Csuri.

## Current Companies

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- Pixar
- Industrial Light and Magic (ILM)
- Pacific Data Images (PDI)
- Disney
- Xaos
- Rhythm & Hues
- Digital Domain
- Lamb & Company
- Metrolight Studios
- Boss Film Studios
- deGraf/Wahrman
- R/Greenberg Associates
- Blue Sky Productions
- Sony Pictures
- Cinesite
- Imageworks
- Apple....

## Animations that paved the way

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- Pixar
- Luxo Jr. (1986)
    - first computer animation to be nominated for an Academy Award
  - Red's Dream (1987)
  - Tin Toy (1988)
    - first computer animation to win an Academy Award
  - Knick Knack (1989)

## Early CG in film

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- Future World (1976)
- Star Wars (1977)
  - Lawnmower man (1992, Xaos, Angel Studios)
    - Hollywood's view of VR
- Tron (1982, MAGI)
  - Supposed to look like a computer
- The Last Starfighter (1984)
  - Use CG in place of models
- Willow (1988, ILM)
  - Morphing video
  - First digital blue screen matte extraction
- Howard the Duck (1986, ILM)
  - First wire removal
- The Abyss (1989, ILM)

## More early CG in film

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- Jurassic Park (1993, ILM)
  - Forest Gump (1994, Digital Domain)
    - Insert CG ping pong ball
  - Babe (1995, Rhythm & Hues)
    - Move mouths of animals & fill in background
- Toy Story (1995, Pixar & Disney)
  - First full length fully CG 3D animation

## Early CG on TV

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- Reboot (1995, Limelight Ltd. BLT Productions)
  - Similar intention of “inside computer”
  - First fully 3D Sat. morning cartoon
- Babylon 5 (1995)
  - Routinely used CG models as regular features
- Simpsons (1995 PDI)



## Resources

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- Milestones of the animation industry in the 20th Century
  - <http://www.awn.com/mag/issue4.10/4.10pages/cohenmilestones.php3>
- <http://www.fact-index.com/a/an/animation.html#History%20of%20Animation>
- Brief History of NYIT Computer Graphics Lab <http://www-2.cs.cmu.edu/~ph/nyit/masson/nyit.html>

## Resources (con't.)

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- Timeline from Brown Animation class
  - <http://www.cs.brown.edu/courses/cs229/animTimeline.html>
- In-betweening
  - <http://alpha.luc.ac.be/~lucp1112/research/CA2001/results.html>

## Credits/Resources

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- Rick Parent
  - <http://www.cis.ohio-state.edu/~parent/book/Intr.html>
  - <http://www.cis.ohio-state.edu/~parent/book/outline.html>
- America's Story
  - [http://www.americanlibrary.gov/cgi-bin/page.cgi/sh/animation/blacktn\\_2](http://www.americanlibrary.gov/cgi-bin/page.cgi/sh/animation/blacktn_2)

## Character Animation

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- Control motion of articulated limbs
- Skeletal-muscle-skin models
- Facial animation
- Representation and Animation of surface detail
  - Hair
  - Clothes

## Utah CG History

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- <http://silicon-valley.siggraph.org/text/MeetingNotes/Utah.html>