CS 4300
Computer Graphics

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Today’s Topics

• Animation
Static to Animated

- We have mostly created static scenes.
- Except when we applied affine transformations to set the pose (position and orientation) objects:
  - Defined in a local coordinate frame with respect to an enclosing global frame.
  - We change the transformation and re-draw the scene.
  - If the change between each redraw is small enough, the object appears to move continuously.
  - We make changes in response to mouse motion events, typically reported frequently enough that the relative motion from the last event is only a few pixels.
Moving Pictures

• in fact, this is how virtually all “moving pictures” work, whether they were recorded from live motion, generated by a computer, or drawn by hand: by quickly presenting a series of static images, each with an object in a slightly different pose, the human eye and brain “sees” an object which appears to actually be moving
Aliasing

• the faster an object is moving, the more change there will be in subsequent frames

• so for a fixed framerate, as an object moves faster, its motion will be represented with fewer samples, and this eventually starts to look bad

• this is yet another instance of taking discrete samples of a continuous physical process

• but faster framerates are harder to implement, because more data needs to be captured, transmitted, and redisplayed
Live TV and Film vs. Animation

• for normal “live action” TV and film, frames are recorded by a camera which takes a series of pictures of the real world at the same rate at which they will be played back

• typically, we reserve the word animation to refer to motion sequences that were not captured as images of the real world, but instead were either drawn by hand or by computer
One of Stampfer's Stroboscopic Discs. c1830s
A scene from "A trip to the moon" (1902) by Georges Méliès.
TV and Film

- both work this way
  - present a new image at a rate of about 30 times per second (30 frames per second or FPS)
  - each individual frame is a static image
  - \(~30\) FPS has been empirically found to be a good trade-off between visual quality and complexity of the system
  - actual systems use slightly different rates in practice for various implementation reasons
by Computer or by Hand

• in either case, it is possible for a human to specify each individual frame exactly
• but this is a lot of work!
• 2H feature film:
  \[(2H)(60m/H)(60s/m)(30f/s)=216000 \text{ frames}\]
• at roughly 1 to 10 man-hours to draw a frame
• about 2000 hours in a typical work year
• so from about 100 to 1000 man-years of work to draw all frames for a single feature length film!
Animation

• Keyframing
  ▪ Set data at key points and interpolate.

• Procedural
  ▪ Let mathematics make it happen.

• Physics-based
  ▪ Solve differential equations

• Motion Capture
  ▪ Turn real-world motion into animation.
Key Principles of Animation
John Lasseter 1987

• Squash and stretch
• Timing
• Anticipation
• Follow through and overlapping action
• Slow-in and slow-out
• Staging
• Arcs
• Secondary action
• Straight ahead and pose-to-pose action
• Exaggeration
• Solid drawing skill
• Appeal

» Siggraph web reference
PowerPoint Animation
Animated gif

Johan Ovlinger’s Trip to Earth and Back
Pyramid of 35 Spheres

Rendered by Blotwell using POV-Ray and converted with Adobe ImageReady.
Deformation
Blender
free software, under the terms of the
GNU General Public License
Character Animation
Physics-Based Animation

Flash Animation

POWER OF THE GEEK
Keyframing

- A **frame** is one of the many still images that make up a moving picture.
- A **key frame** is a frame that was drawn or otherwise constructed directly by the user.
- In hand-drawn animation, the senior artist would draw these frames; an apprentice would draw the "in between" frames.
- In computer animation, the animator creates only the first and last frames of a simple sequence; the computer fills in the gap.
- This is called *in-betweening* or *tweening*. 
Flash Basics

• **Media objects**
  - graphic, text, sound, video objects

• **The Timeline**
  - when specific media objects should appear on the Stage

• **ActionScript code**
  - programming code to make for user interactions and to finely control object behavior
Lord of the Rings
Inside Effects

- making of Gollum
- Helm's Deep
- http://www.lordoftherings.net/legend/video/
- http://www.youtube.com/watch?v=4ul3zwO8W50&noredirect=1