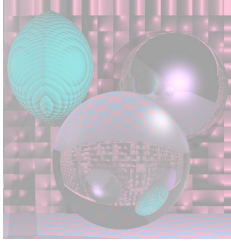


CS 4300

Computer Graphics

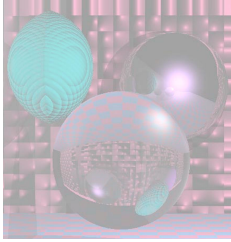
Prof. Harriet Fell
Fall 2012

Lecture 33 – November 26, 2012



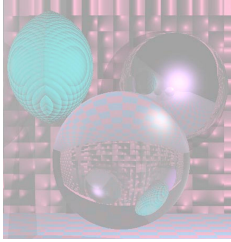
Today's Topics

- Animation



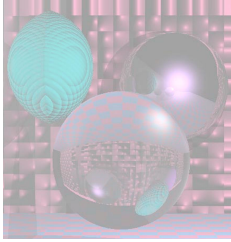
Static to Animated

- 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



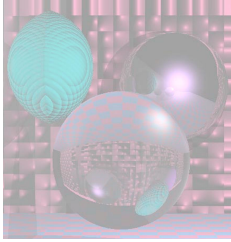
Moving Pictures

- 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



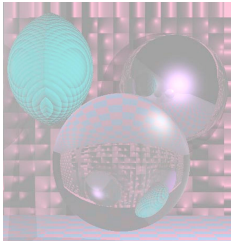
Aliasing

- 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



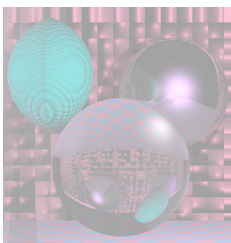
Live TV and Film vs. Animation

- 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



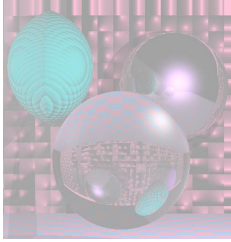
One of Stampfer's Stroboscopic Discs. c1830s





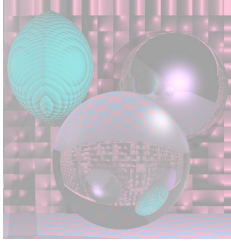
A scene from
"A trip to the moon" (1902) by Georges Méliès.





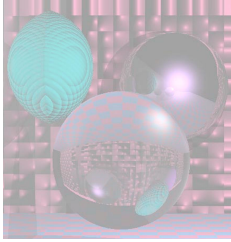
TV and Film

- 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*



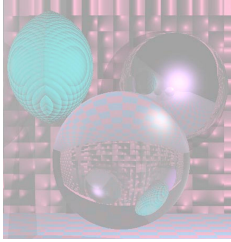
by Computer or by Hand

- 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:
 $(2H)(60m/H)(60s/m)(30f/s)=216000$ 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.

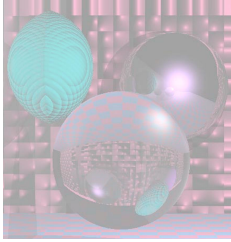


Key Principles of Animation

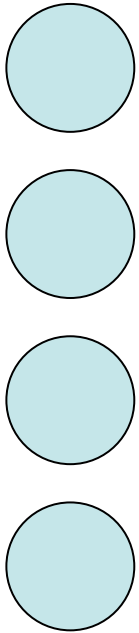
John Lasseter 1987

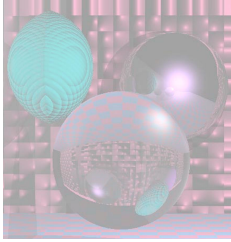
- Squash and stretch
- Timing
- Anticipation
- Follow through and overlapping action
- Slow-in and slow-out
- Staging
- Arcs
- Secondary action
- Straight ahead and pose-to-pose action
- Exaggeration
- Solid drawing skill
- Appeal

» [Siggraph web reference](#)



PowerPoint Animation

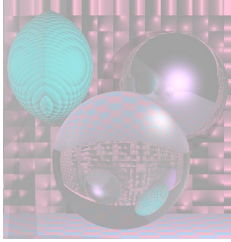




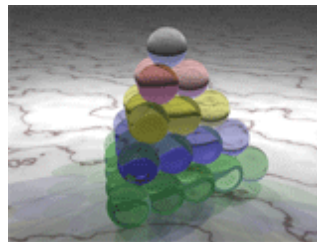
Animated gif



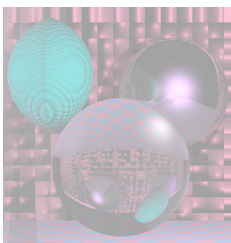
Johan Ovlinger's Trip to Earth and Back



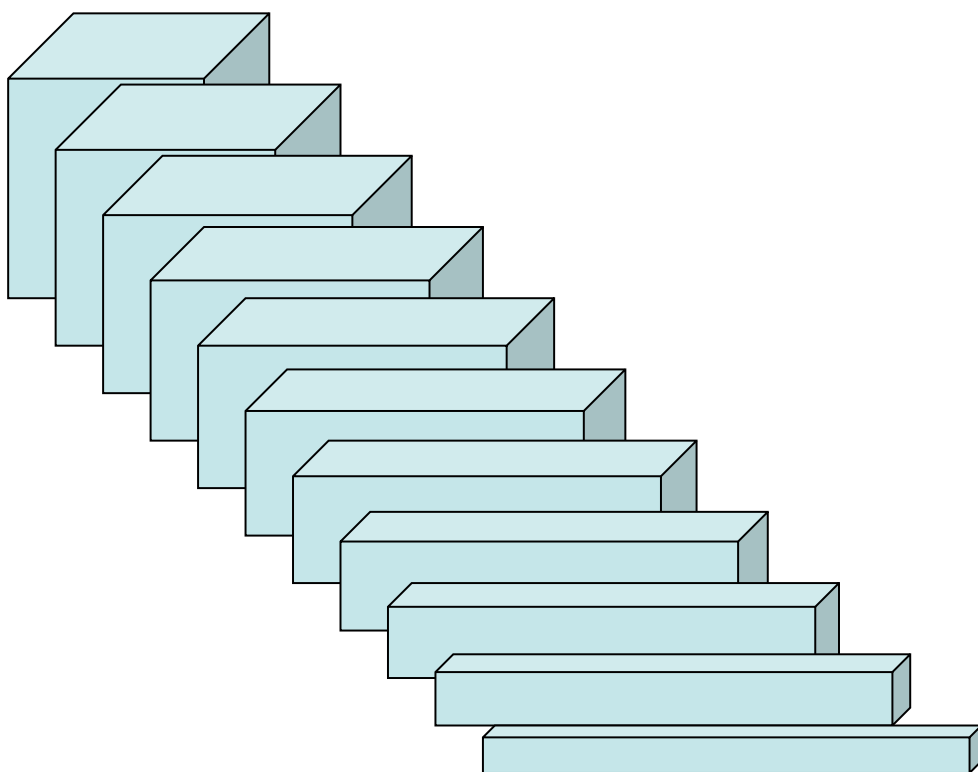
Pyramid of 35 Spheres

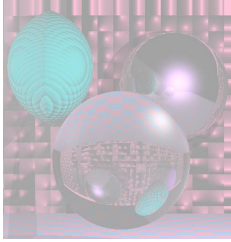


Rendered by [Blotwell](#) using POV-Ray and converted with Adobe ImageReady.



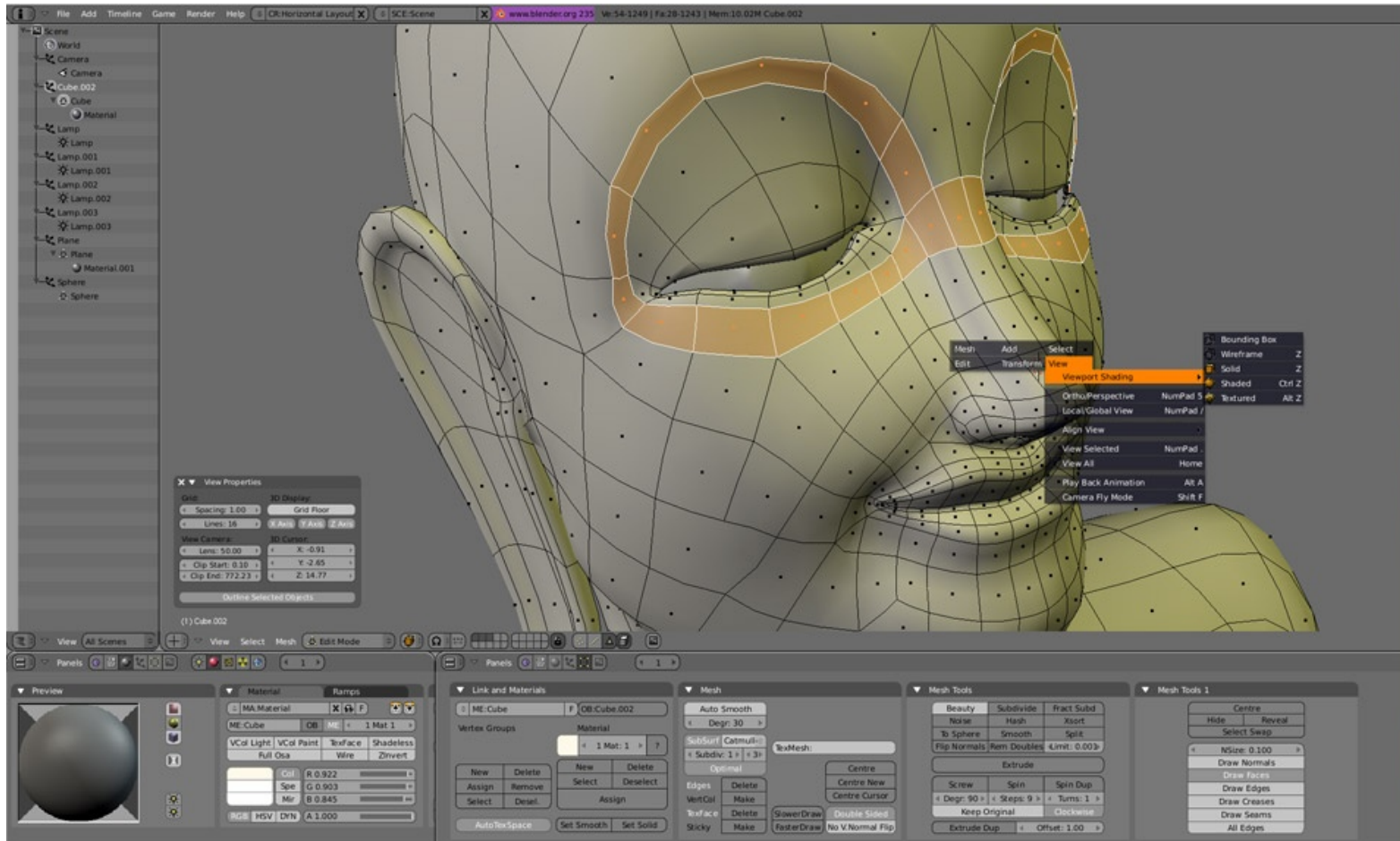
Deformation

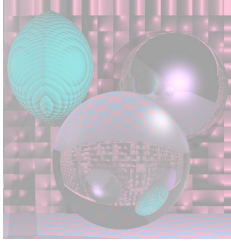




Blender

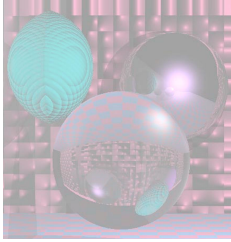
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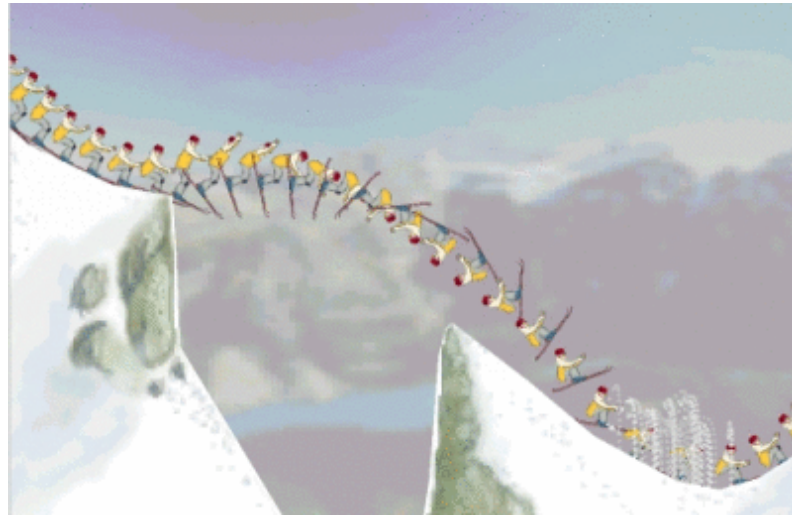


Character Animation

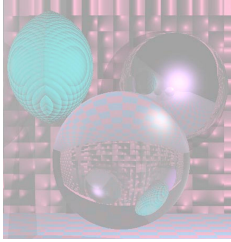




Physics-Based Animation

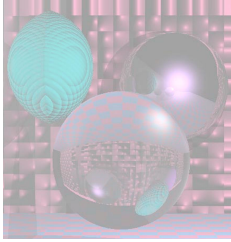


<http://www.cs.ubc.ca/labs/imager/imager-web/Research/images/michiel.gif>



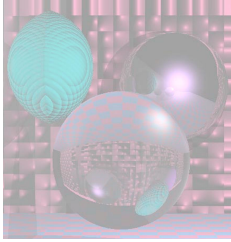
Flash Animation

POWER OF THE GEEK



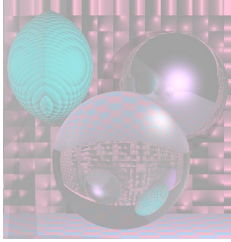
Keyframing

- 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>