CS 174C Week 1

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Animation Basics

- Vision
  - Foveal vs. Peripheral vision
- Persistence of Vision
  - We see a bright flash for a while after it's gone
  - A sequence of images shown fast enough is hard to distinguish from continuous motion
    - What is fast enough?
    - However fast the eye is able to see with fine acuity
- Frame rate (fps = frames per second)
  - Legacy Film: 24
    - Often shown at 48, each frame twice, to reduce flicker
    - Sometimes animated "on twos" = 12fps, "on threes" = 8fps, or even slower
  - Legacy TV: 30 for NTSC, 25, for PAL (European, Asian)
    - Interlaced - double the speed to reduce flicker
  - Computers: 60Hz or more, gamers prefer 60fps, 120fps, ...

Motion Blur

Since light persists in our vision for a while, fast moving objects leave a blurred streak. Similarly, film/video cameras leave "shutter" open for a while.

- Moving objects blurred from position a start of shutter time to position at end.

Without motion blur (or tricks to simulate it) we get strobing effect

- Temporal aliasing, akin to "jaggies"
- Spinning wheels rotate backwards
- Movie Camera vs Stop-Motion

  - At the start, stop-motion was used for all movies since it was the best you could do. (Ex. King Kong)

Motion blur is required for "realism". We use motion blur to "fool" the eye, to make the image as real as possible.

Animation Principles

Squash and Stretch

Rigid objects look robotic, so let them deform to make the motion more natural and fluid.
Accounts for the physics of deformation

- Think of a tennis ball...
- Communicates to viewer what the object is made of, how heavy it is, etc.
- Usually large deformations conserve volume: if you squash in one dimension, stretch in another to keep volume constant

Also accounts for the persistence of vision

- Fast moving objects leave an elongated streak on our retinas

Timing

- Pay careful attention to how long an action takes - how many frames
- How something moves defines its weight and mood to the audience.
- Also think dramatically: give the audience time to understand one event before going to the next, but don't bore them

Anticipation

The preparation before a motion.

- E.g., crouching before jumping, pitcher winding up to throw a ball

Often physically necessary, and indicates how much effort a character is making.

Also essential for controlling the audience's attention, to make sure they don't miss the action.

- Signals something is about to happen, and where it is going to happen

Staging

- Make the action clear
- Avoid confusing the audience by having two or more things happen at the same time

- Select a camera viewpoint, and pose the characters, so that visually you can't mistake what is going on
  - Clear enough so you can tell what's happening just from the silhouettes (highest contrast)

Follow-through and Secondary Motion

Again, physics demands follow-through - the inertia that is carried over after an action

- E.g., knees bending after a jump
- Also helps define weight, rigidity, etc.

Secondary motion is movement that's not part of the main action, but is physically necessary to support it.

- E.g., arms swinging in a jump

Just about everything should always be in motion.

- Animator has to give the audience an impression of reality, or things look stilted and rigid.

Overlapping Actions and Asymmetry

Overlapping action: start the next action before the current one finishes

- Otherwise looks scripted and robotic instead of natural and fluid

Asymmetry: natural motion is rarely exactly the same on both sides of the body, or for 2 or more characters

- People very good at spotting "twins", synchronization, etc.
- Break up symmetries to avoid scripted or robotic feel

Slow In and Out

Also called "Easing in" and "Easing out"

- More physics: objects generally smoothly accelerate and decelerate, depending on mass and forces

Arcs

Natural motions tend not to be in straight lines, instead should be curved arcs

- Just doing straight-line interpolation gives weird, robotic movement

Also part of physics

- gravity causes parabolic trajectories

Exaggeration

Obvious in the old Loony Tunes cartoons - "cartoon physics"

- Not so obvious, but necessary ingredient in photo-realistic special effects
- If you're too subtle, even if that is accurate, the audience will miss it: confusing and boring
- Think of stage make-up, movie lighting, and other "photo surrealistic" techniques

Don't worry about being physically accurate: convey the correct psychological impression as effectively as possible.

Appeal

- Make animations that people enjoy watching
- Appealing characters aren't necessarily attractive, just well designed and rendered
  - All the principles of art still apply to each still frame
  - E.g., controlling symmetry - avoid "twins", avoid needless complexity
- Present scenes that are clear and communicate the story effectively.

Straight-Ahead vs. Pose-to-Pose

- "Straight Ahead" means making one frame after the other
  - Especially suited for rapid, unpredictable motion
- "Pose-to-Pose" means planning it out, making "key frames" of the most important poses, then interpolating in between the key frames later
  - The typical approach for most scenes

Extremes

Keyframes are also called "Extremes", since they usually define the extremes positions of a character.

- The frames in between (or "inbetweens") introduce relatively little new - watching the keyframes should reveal the action
- May add additional keyframes to add some interest and/or better control the interpolated motion
- E.g., for a sit-to-stand animation:
  - Sitting
  - Pushing off
  - Straighten up

Layering

- Work out the big picture first
  - e.g., where the characters need to be and when
- Then layer by layer add more details
  - Which way the characters face
  - Move their limbs and heads
  - Move their fingers and faces
  - Add small details like wrinkles in clothing, hair, etc.

Computer Animation

- The task boils down to setting various animation parameters in each frame
- Can mix the straight-ahead and pose-to-pose methods
  - Keyframe some variables, do others straight-ahead.