Topic 13:

Animation

Animation Timeline

1908: Emile Cohl (1857-1938) France, makes his first film, FANTASMAGORIE, arguably the first animated film.

1911: Winsor McCay (1867-1934) makes his first film, LITTLE NEMO. McCay, already famous for comic strips, used the film in his vaudeville act. His advice on animation:

Any idiot that wants to make a couple of thousand drawings for a hundred feet of film is welcome to join the club.

1928: Walter Disney (1901-1966) working at the Kansas City Slide Company creates Mickey Mouse.

1974: First Computer animated film "Faim" from NFB nominated for an Oscar.

Animation Principles

Squash & Stretch
Timing
Ease-In & Ease-Out
Arcs
Anticipation
Follow-through & Secondary Motion
Overlapping Action & Asymmetry
Exaggeration
Staging
Appeal
Straight-Ahead vs. Pose-to-Pose

Squash and Stretch

Rigid objects look robotic: deformations make motion natural

Accounts for physics of deformation

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

Also accounts for persistence of vision

- Fast moving objects leave an elongated streak on our retinas

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.

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What can be animated?

Lights
Camera
Jointed figures
Deformable objects
Clothing
Skin/muscles
Wind/water/fire/smoke
Hair
…any variable, Given the right time scale, almost anything…

Elements of CG (animation)

How does one make digital models move?

Keyframing

Physical simulation

Motion capture

Behavior rules

Keyframes

Keyframes, also called extremes, define important poses of a character:

Jump example:
- the start
- the lowest crouch
- the lift-off
- the highest part
- the touch-down
- the lowest follow-through

- Frames in between ("inbetweens") introduce nothing new to the motion.
- May add additional keyframes to add some interest, better control the interpolated motion.

Keyframe Animation

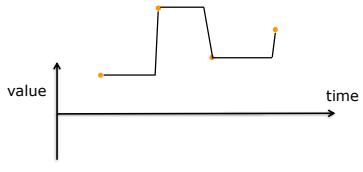
The task boils down to setting animated variables (e.g. positions, angles, sizes, …) at each frame.

Straight-ahead: set variables in frame 0, then frame 1, frame 2, … forward in time.

Pose-to-pose: set the variables at keyframes, let the computer smoothly interpolate values for frames in between.

Keyframe: Interpolation

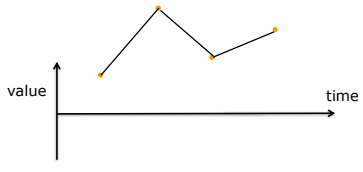
How do we interpolate between two values?



Hold

Keyframe: Interpolation

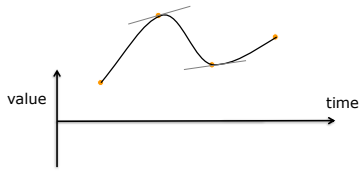
How do we interpolate between two values?



Linear

Keyframe: Interpolation

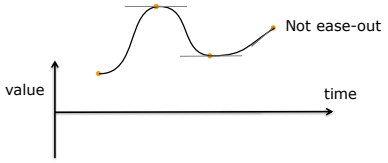
How do we interpolate between two values?



Spline

Keyframe: Interpolation

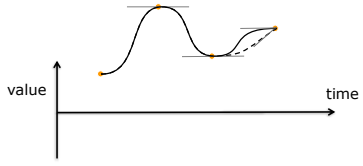
How do we interpolate between two values?



Ease-in Ease-out

Keyframe: Interpolation

How do we interpolate between two values?



Ease-in Ease-out

Physical Simulation (moovl)

Particles

Position x
Velocity $v = dx/dt$
Acceleration $a = dv/dt = d^2x/dt^2$

Forces

Gravity f=mg
Spring-damper f=-kx-cv

...

Simulation: x,v,a used to compute forces yeilding total force F.
F=ma used to update a, a used to update v, to update x...