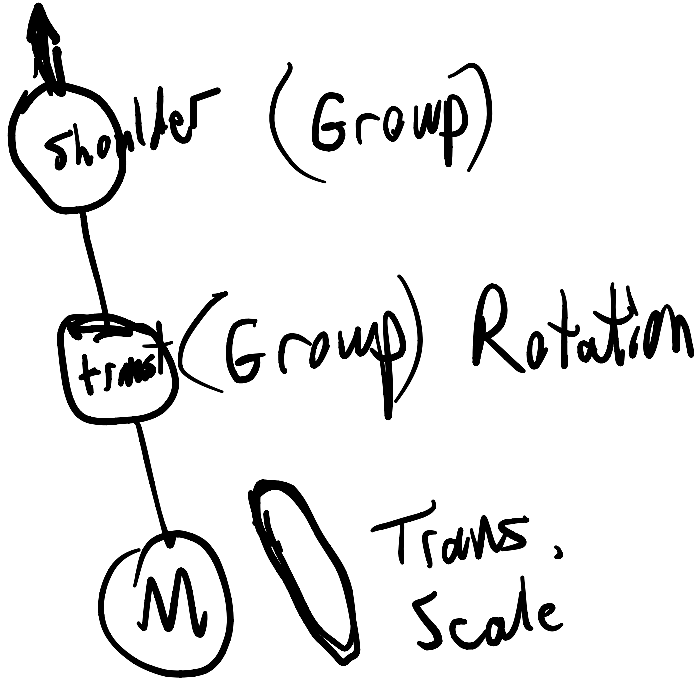
github ex2

11 – animation



Object3D

scale

quaternion

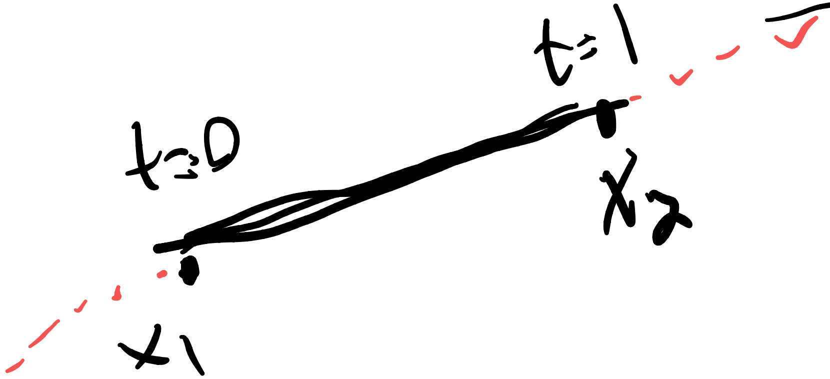
position

$T \cdot R \cdot S$

Keyframe Animation

Interpolating "values"

- Want to interpolate position, orientation, scale … also, color, etc
  - Anything that can be expressed parametrically



$$f(t) = x_2 t + (1-t)x_1$$

at time t_1 want an object to be at position x_1 & at time t_2 at position x_2

need $t = t_1$ want $p = 0$
$t = t_2$ want $p = 1$

use p as parameter for parametric form of line

t_1, x_1
to t_2, x_2

working through

$$\frac{x_2 - x_1}{t_2 - t_1} = \frac{6}{2} = 3$$

$t_1 = 2$
$t_2 = 4$

$x_{1x} = 4$
$x_{2x} = 10$

$p = 3(t - 2) + 4$ ← when t is between 2 & 4, p is $4 \to 10$

combining

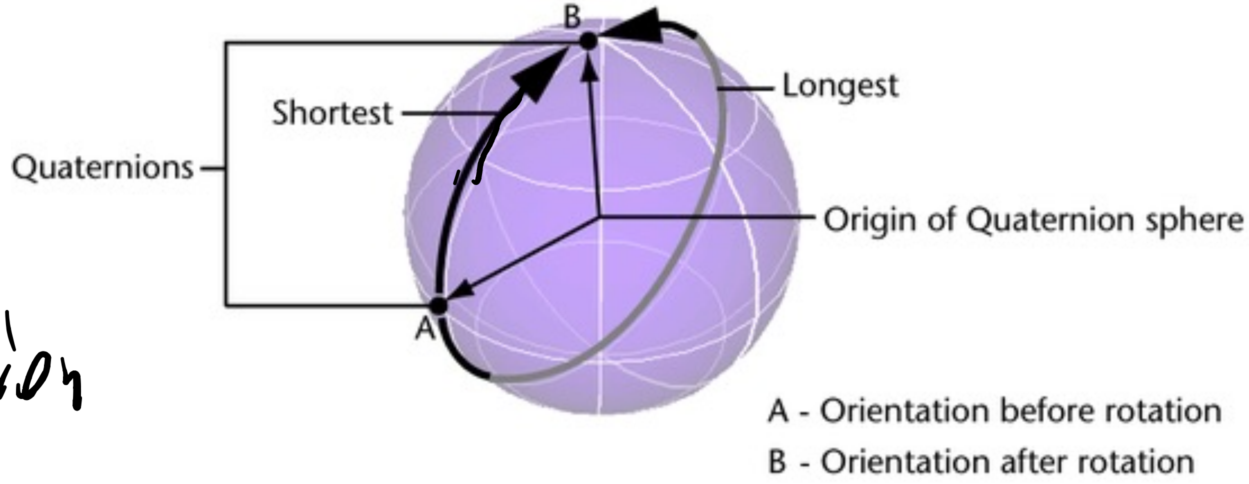
essentially: convert $(t_1, t_2) \Rightarrow [0, 1]$
convert with parametric line equation to x

Interpolate Angles using Quaternions

"pose" is a 3D orientation

THREE.Quaterion()

Spherical Linear Rotation (SLERP)



Quaternion rotation interpolation

Animate time from 0..1 and interpolate value

init

$t_1 = 2$
$t_2 = 5$

Code (t = current time) ← assume between t_1 & t_2

ts = $(t - t_1)/(t_2 - t_1)$

⋮

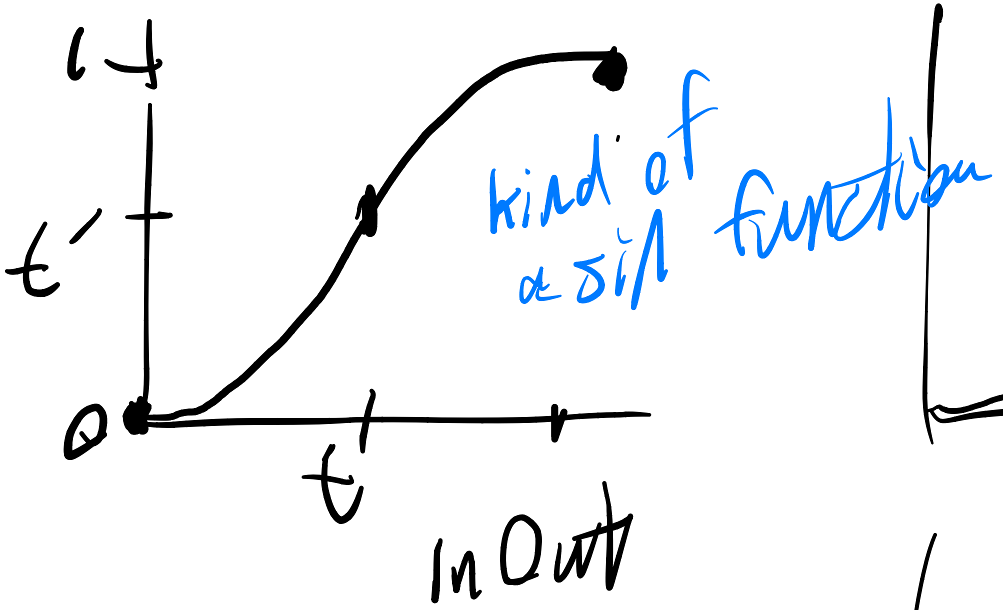
Specifying time: absolute or speed

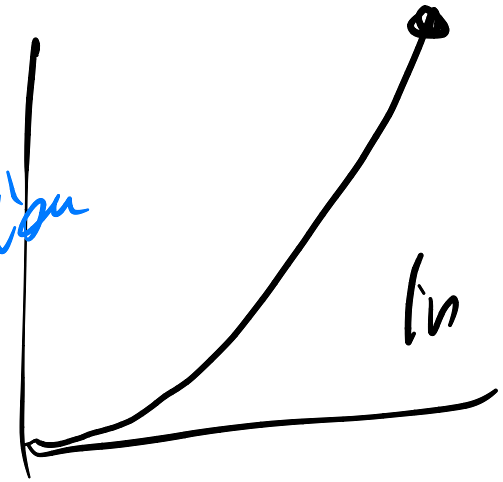
- start & end values for pos, rot, –
  start time
  velocity (pos)
  angular velocity.

Non-linear motion: easing functions

0 < t < 1

convert





var t = ...

t = somefn(t

Applying Traditional Animation to 3D

- Based on paper (read if you are interested)
  - John Lasseter, “Principles of traditional animation applied to 3D computer animation”, Proceedings of SIGGRAPH ‘87, pp. 35 - 44
- Additional papers, applying it to 2D Uis (if you are interested)
  - Bay-Wei Chang, David Ungar, “Animation: From Cartoons to the User Interface”, Proceedings of UIST’ 93, pp.45-55.
  - Scott E. Hudson, John T. Stasko, “Animation Support in a User Interface Toolkit: Flexible, Robust and Reusable Abstractions”, Proceedings of UIST ‘93, pp.57-67.

Why Animation?

- Gives a feeling of reality and liveness
  - "animation" = "bring to life"
  - make inanimate object animate
- Provides visual continuity (and other effects) enhancing perception
  - particularly perception of change
    - hard to follow things that just flash into & out of existence
    - real world doesn't act this way

Why Animation?

- Can also be used to direct attention
    - movement draws attention
    - strong evolutionary reasons
        - Therein lies a danger
        - Overuse tends to demand too much attention
            - e.g., the dreaded paper clip!
- Used sparingly and intelligently, animation can enhance interfaces

Three principles from traditional animation

(Not mutually exclusive)

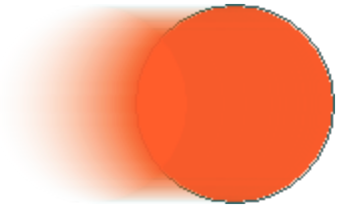
1. Solidity
    - Want objects to appear solid and have mass
2. Exaggeration
    - Exaggerate certain physical actions to enhance perception
3. Reinforcement
    - Effects used to drive home feeling of reality

Solidity in Practice

- No teleportation
  - Objects must come from somewhere
    - Not just “pop into existence”
  - Nothing in the real world does this (things with mass can’t do this)

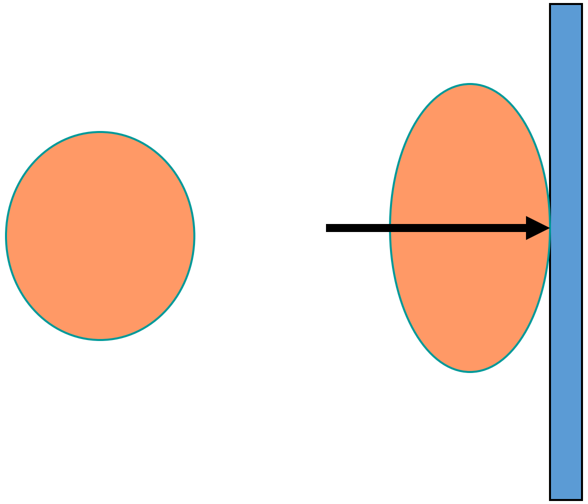
Solidity in Practice

- Motion blur
  - If objects move more than their own length (some say 1/2 length) in one frame, motion blur should be used
  - Matches real world perception
  - Makes movement look smoother
  - Doesn’t need to be realistic



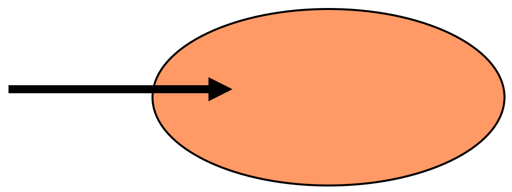
Solidity in Practice

- Squash and stretch
  - Cartoon objects typically designed to look “squishy”
  - When they stop, hit something, land, etc., they tend to squash
    - Compress in direction of travel



Solidity in Practice

- Squash and stretch
  - Also stretch when they accelerate
    - Opposite direction
  - Basically an approximation of inertia + conservation of volume (area)



- Comment
  - Although S&S makes things look “squishy” they contribute to solidity because they show mass
    - This tends to be exaggerated

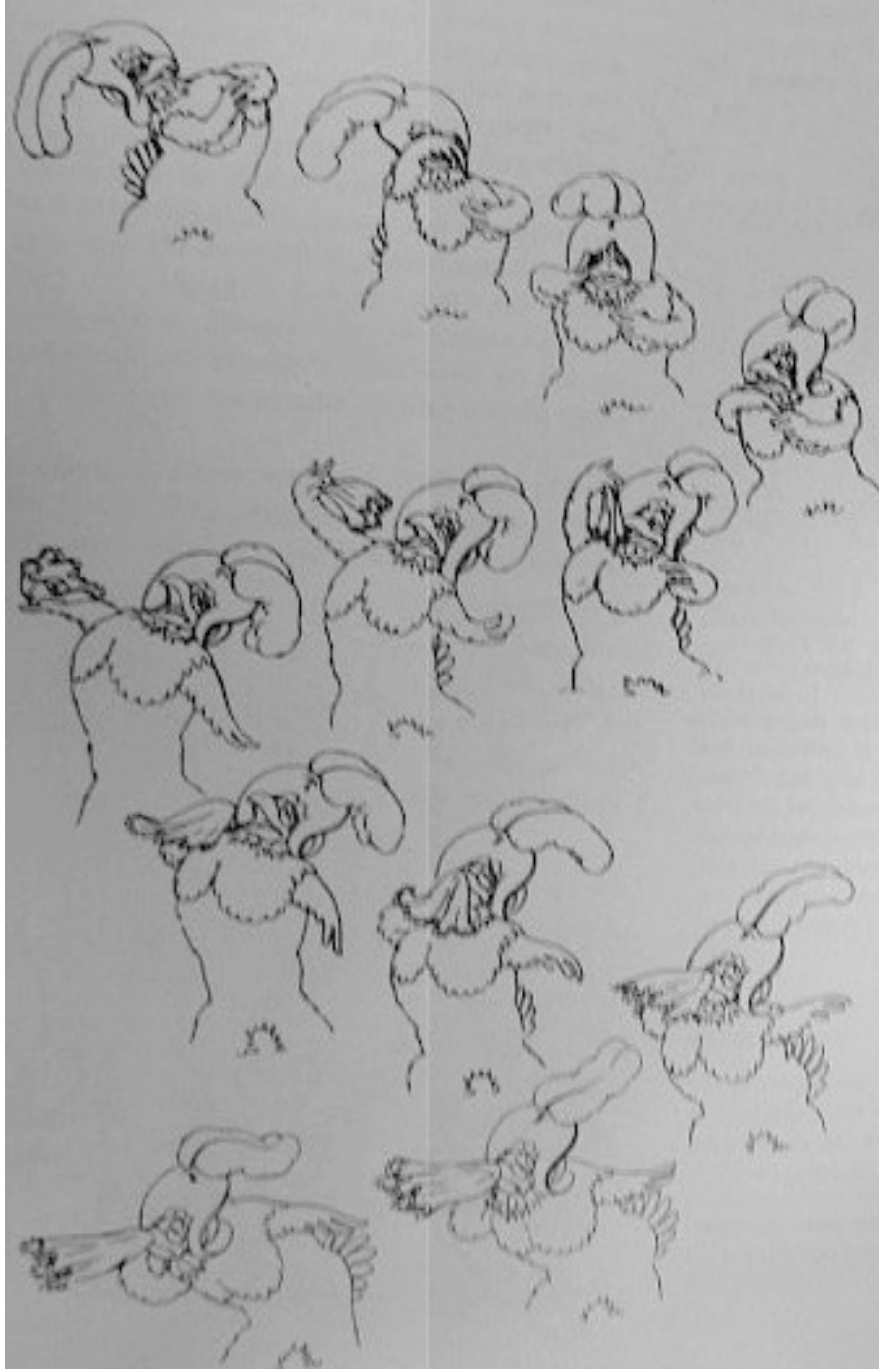
Solidity in Practice

- Follow through (& secondary action)
  - Objects don’t just stop, they continue parts of the motion
    - e.g., clothes keep moving, body parts keep moving
  - Reinforces that object has mass via inertia
  - (also tends to be exaggerated)

Solidity: Example

- S&S of various parts
- Follow Through
  - Notice feather lags behind character

- From: Thomas & Johnston "The Illusion of Life: Disney Animation", Hyperion, 1981



Exaggeration in Practice

- Cartoon animation tends to do this in a number of ways
  - paradoxically increases realism (liveness) by being less literal
- What is really going on is tweaking the perceptual system at just the right points

Exaggeration in Practice

- Anticipation
  - Small counter movement just prior to the main movement
  - This sets our attention on the object where the action is (or will be)
- Squash & stretch
- Follow through

Reinforcement in Practice

- Slow-in / Slow-out
  - Movement between two points starts slow, is fast in the middle, and ends slow
  - Two effects here
    - Objects with mass must accelerate
    - Interesting parts typically at ends of motion

Reinforcement in Practice

- Movement in arcs
  - Objects move in gently curving paths, not straight lines
  - Movements by "*real*" animate objects are in arcs (due to mechanics of joints)
  - Most movements in gravity also in arcs

Recap: Animation Principles in Practice

- Appearance of mass
  - Solidity & conservation of volume
  - Several ways to show inertia
- Tweak perception
  - Direct attention to things that count
  - Time on conceptually important parts
- Caricature of reality

Revisit easing functions