An Hours Worth of Computer Animation

What is Animation?

To bring to life

Broadly: make moving images of (normally) non-moving objects

Computer Animation

making moving images with a computer

You drag something around?
A window opens and closes?
The paper clip?

Ideas from animation help - everywhere
⇓
Art of Communication
Film-making

Where is animation?

- desktop
- web pages
- video / film
- science
- special effects

What is special about animation

- lots of images
- consider how things move
- modeling for control (so you can make them move)
- rendering for coherence

There's a lot to this!
(a rich and evolving art form)
(loads of technical challenge)

Can we really do it justice in an hour?
NO
If you're really interested, take next semester's class

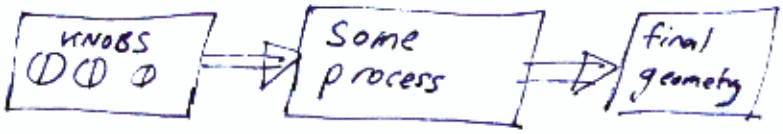
What will I talk about –
use animation to emphasize concepts from class (RANDOM ASSORTMENT)

⇒ Talk about hierarchical modeling ⇒ control for animation
Talk about compression ⇒ reminder of imaging issues
Talk about physics ⇒ reminder of sampling issues
⇒ Talk about skinning as a way to think about geometry and transformations

Say you want to animate a "human" like character

You have a model → a mesh
lots of triangles
too many points to control

Need a simplified set of controls



What are good knobs for a human figure?
What is a good simplification?

Rigid pieces
Connected by rotational joints

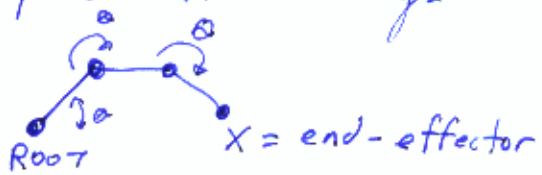
ARTICULATED FIGURE
HIERARCHICAL MODEL
1 - position (root) ← can be any point
many - joint angles pick for convenience

Root as center?
Root as foot?

Why hierarchical?
fixed limb lengths
fixed connection

FORWARD KINEMATICS

given params (root, joint angles)
compute where things are



INVERSE KINEMATICS

given end effector (and/or other info)
compute parameters

harder problem –
solve non-linear equations

Why hard?
non-linear
coupled
possibly no solutions
usually many solutions
└ must select among

Which to pick?
any (just get something)
easiest to find
closest to original (or something)
"best" (most natural,..)..)

How to solve IK problems?

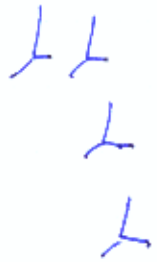
- non-linear equation solving ↺ handle multiple goals
- non-linear optimization ↺ handle objectives
- analytic / geometric solution
  - 2 limbs easy -
    - distance
    - shoulder set up.
    - elbow angle
  - multi-segment hack
    - bad way to choose which solution
- iterative hack
  - game developer meme

So once you have the character posed
(generating poses is the hard part)

how to draw?

What we have:

set of co-ordinate systems



+ some geometry we want to move along with these coordinate systems

Method 1

- independent rigid pieces

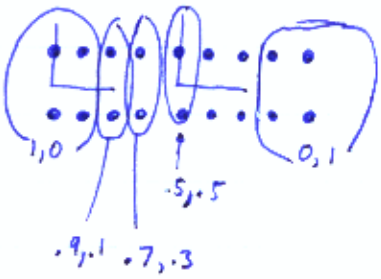
Method 2

single skin, each point in 1 coord sys
some triangles span boundaries

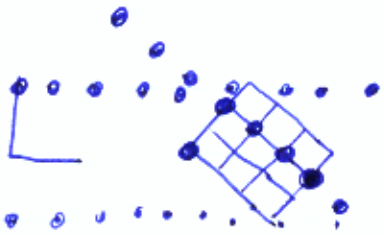
Method 3

each point in multiple co-ord systems
blend co-ord systems (compute point in each)

linear blend method



each coordinate system has a weight



each point is in 2 C-systems
blend the amount in each

get smooth transitions

What's wrong with this?

pinching & twisting
little control
have to come up with weights

Why do people like this so much?

fast
easy
clever weights get interesting effects