CS 6204 Character Animation

Course Introduction

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Introduction

Learning Goals:

- *Basic Concepts and Techniques (Lectures and Programming Assignments)*
- *State of Art Research (Paper Presentations)*
- *Novel Research Contributions (Project)*

Course Structure

- ***Lectures: First two weeks***
  - Animation Introduction, Research Overview, Skeleton Animation, Facial Animation
- ***Programming Assignments: Two***
  - Will be announced at Week 3 and Week 5. Each takes two weeks to finish.
- ***Paper Presentations:***
  - Each class session two papers, presented by one student. (Also lead discussion). Each student leads two class sessions.
- ***Project:***
  - Proposal due at Week 9 (8-pages), presentation.
  - Final Report due at the end of the semester (12-pages), presentation,

Grading Scheme

- ***Class participation: 5%***
- ***Programming assignment: 25%***
- ***Paper presentation: 20%***
- ***Project Proposal : 25%***
- ***Project presentation and final report: 25%***

Research Topics We Discuss

- ***Full Body Animation***
  - Data driven models: motion graph, statistical models, Physics based approaches, Skinning and deformation
- ***Facial Animation***
  - Lip syncing, Expressions, Physical models
- ***Crowd Simulation***
  - Agent based, crowd control, motion planning
- ***Hand Animation***
- ***Hair Animation***

Prerequisites

Intro to Graphics

- OpenGL
- User interface toolkits
- Standard rendering techniques

Mathematics (familiarity with…)

- Multivariate / Differential Calculus
- Probability / Statistics
- Linear Algebra

AI (familiarity with…)

Honor Code

Initial Assumption (assume this as default)

- All code is 100% you – no web, no other people

Relaxed Assumption

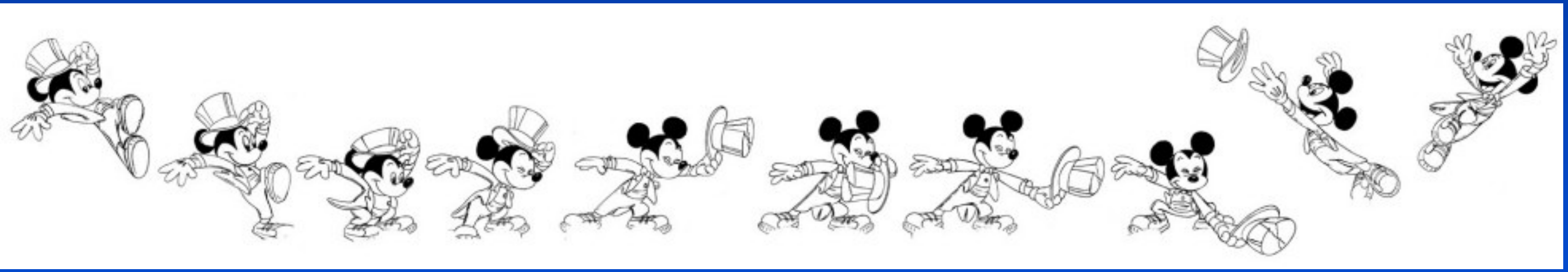
- You can use the web

Relaxed Assumption

- You can work with others

The operating assumption will be specified for each assignment

Principles of Animation

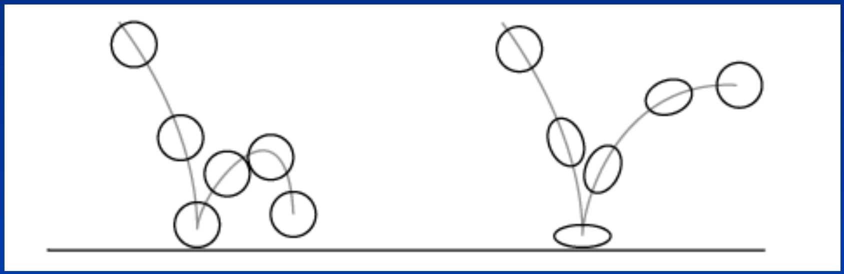


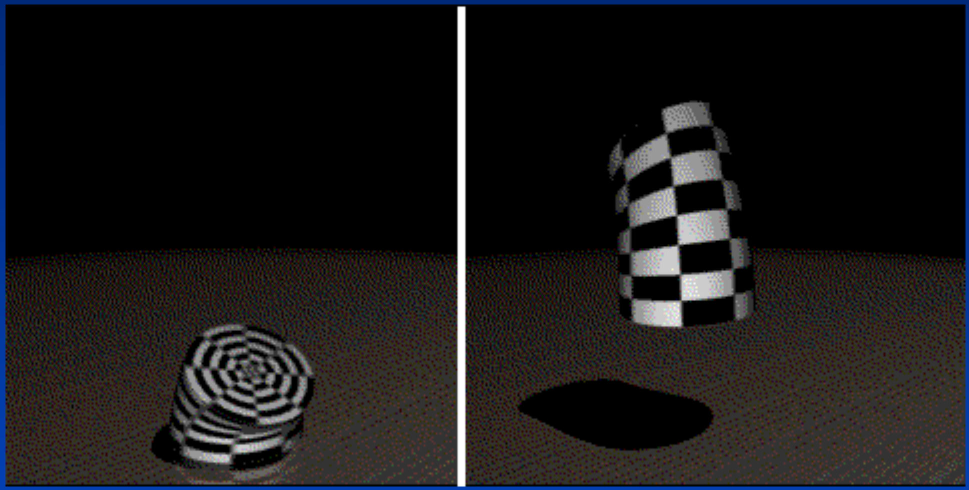
Principle of Traditional Animation – Disney

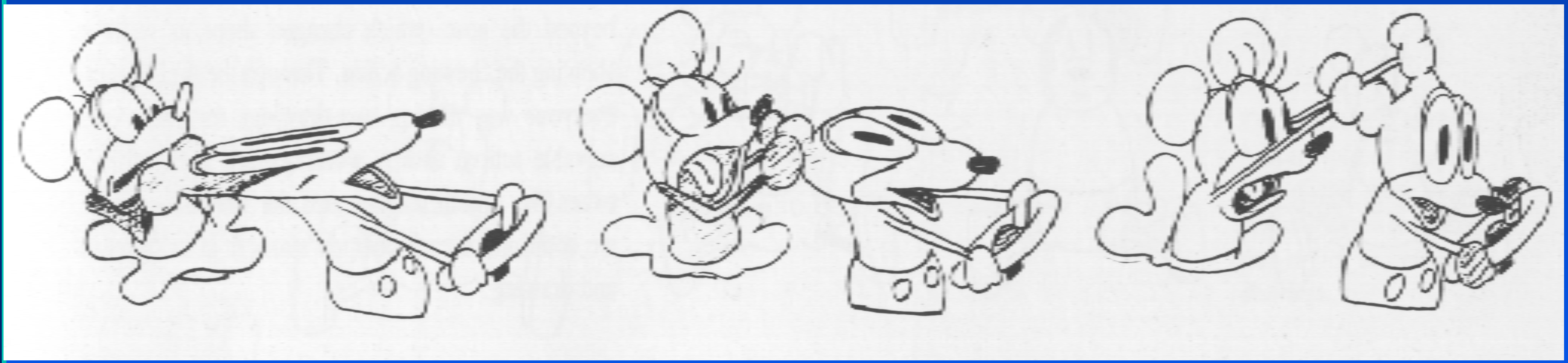
- *Squash and Stretch*
- *Slow In and Out*
- *Anticipation*
- *Exaggeration*
- *Follow Through and Overlapping Action*
- *Timing*
- *Staging*
- *Straight Ahead Action and Pose-to-Pose Action*
- *Arcs*
- *Secondary Action*
- *Appeal*

http://www.siggraph.org/education/materials/HyperGraph/animation/character_animation/principles/prin_trad_anim.htm

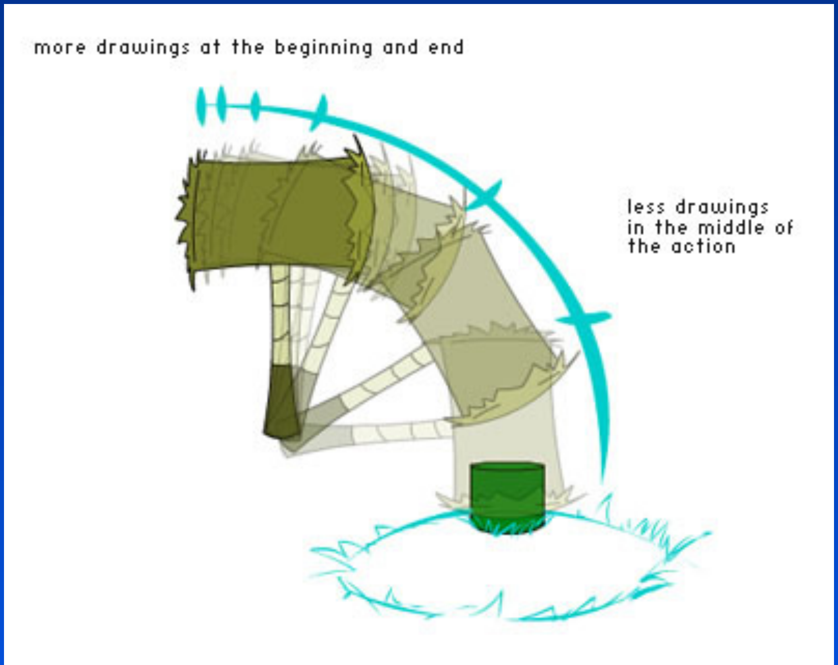
Squash and Stretch

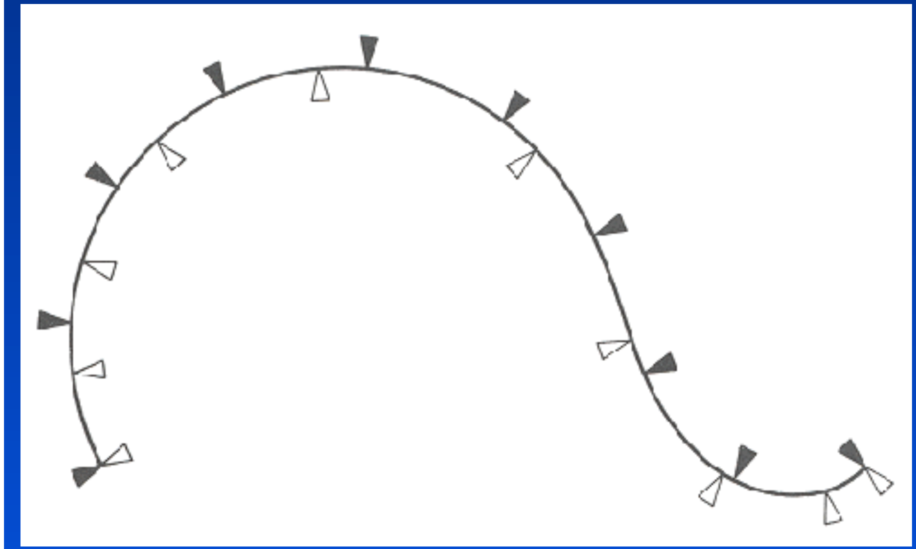




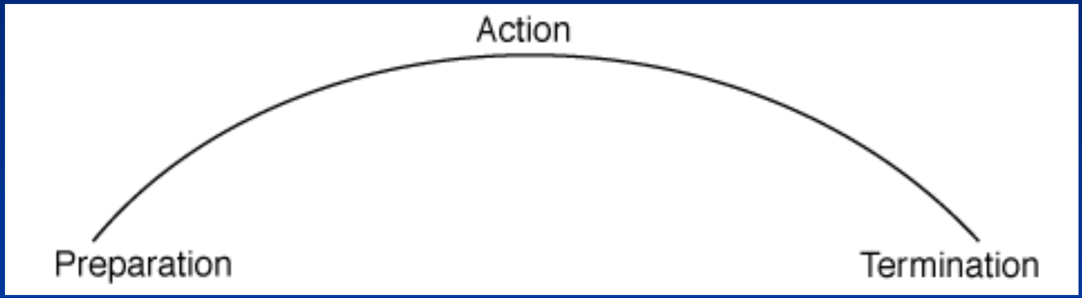


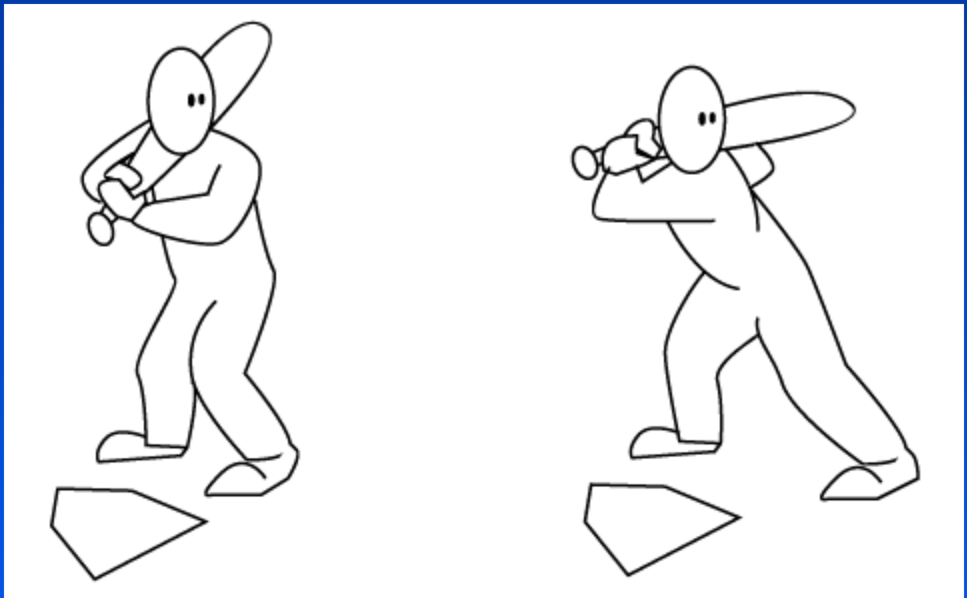
Slow In and Out



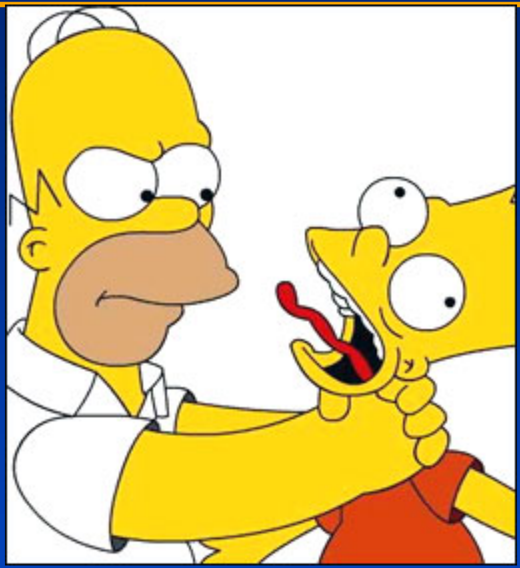


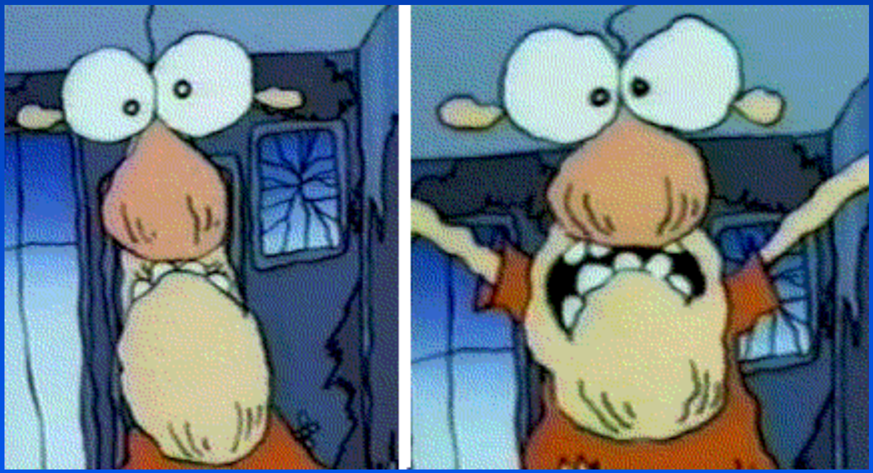
Anticipation



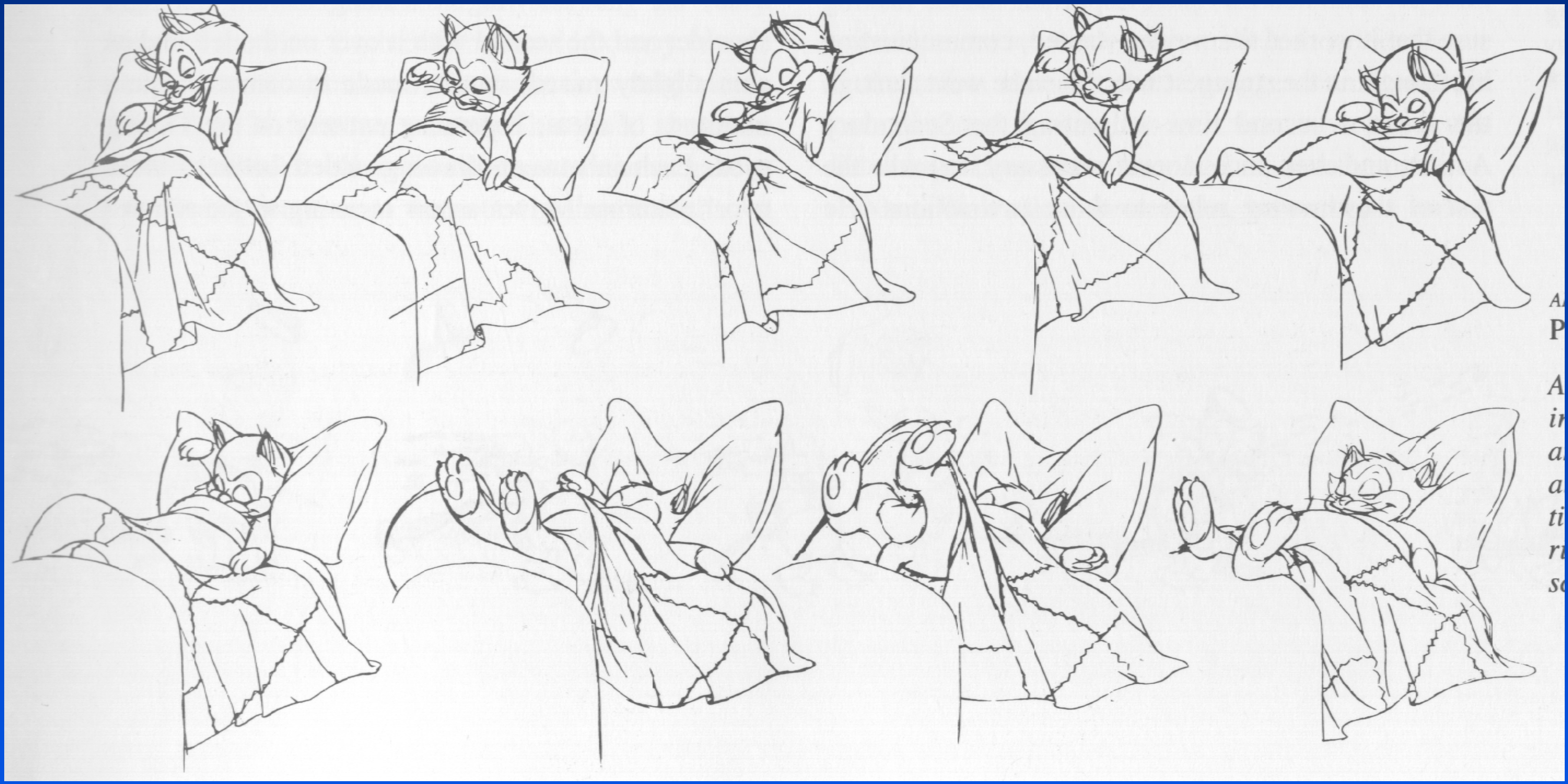


Exaggeration





Secondary actions



Animation – A broad Brush

Traditional Methods

- Cartoons, stop motion

Keyframing

- Digital inbetweens

Motion Capture

- What you record is what you get

Simulation

- Animate what you can model (with equations)

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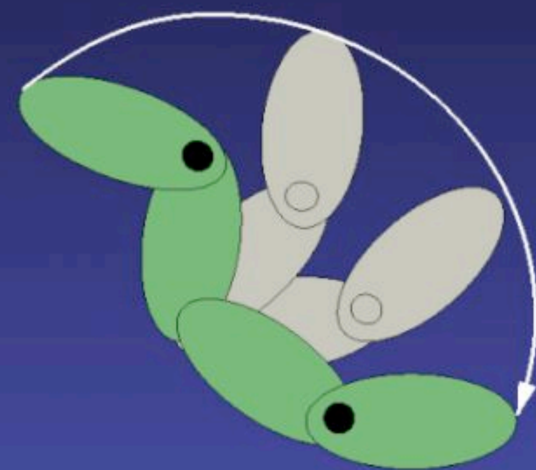
Animation Techniques

Keyframing



Keyframing

- *Traditional animation technique*
- *Dependent on artist to generate ‘key’ frames*
- *Additional, ‘inbetween’ frames are drawn automatically by computer*

Keyframing

How are we going to interpolate?

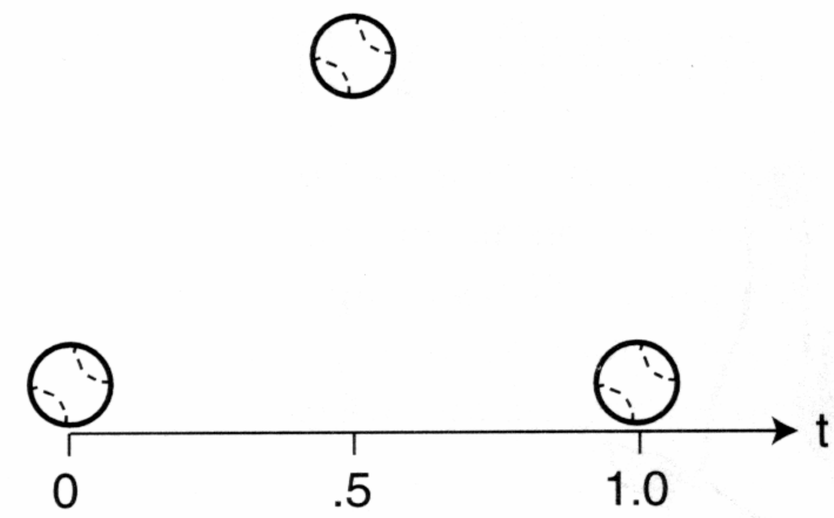
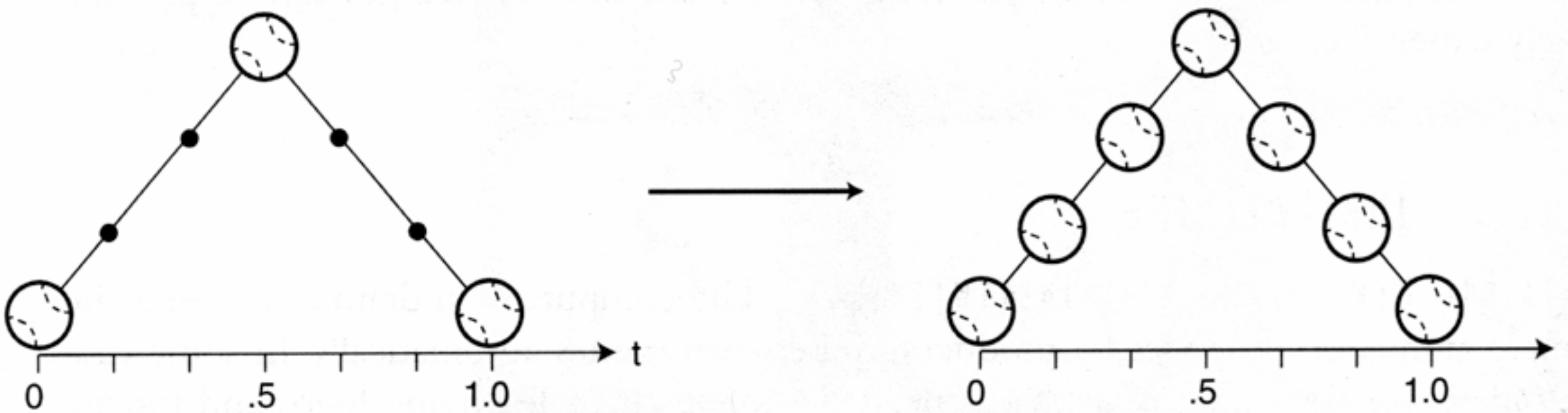


Figure 10.4 Three keyframes. Three key-frames representing a ball on the ground, at its highest point, and back on the ground.

From "The computer in the visual arts", Spalter, 1999

Linear Interpolation

Figure 10.5 **Inbetweening with linear interpolation.** Linear interpolation creates inbetween frames at equal intervals along straight lines. The ball moves at a constant speed. Ticks indicate the locations of inbetween frames at regular time intervals (determined by the number of frames per second chosen by the user).



Simple, but discontinuous velocity

Nonlinear Interpolation

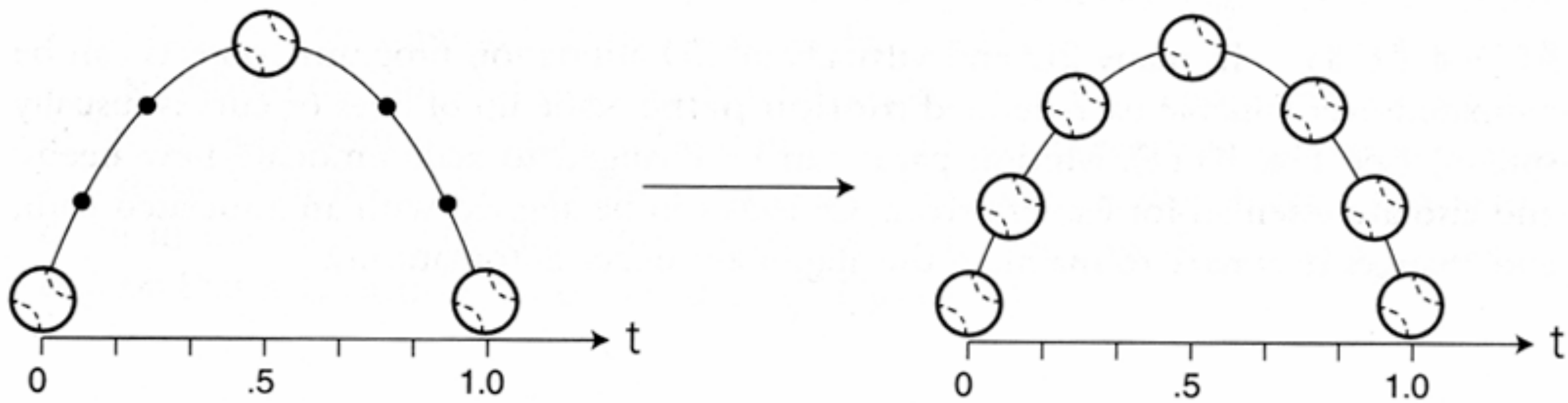


Figure 10.9 **Inbetweening with nonlinear interpolation.** Nonlinear interpolation can create equally spaced inbetween frames along curved paths. The ball still moves at a constant speed. (Note that the three keyframes used here and in Fig. 10.10 are the same as in Fig. 10.4.)

Smooth ball trajectory and continuous velocity, but loss of timing

Easing

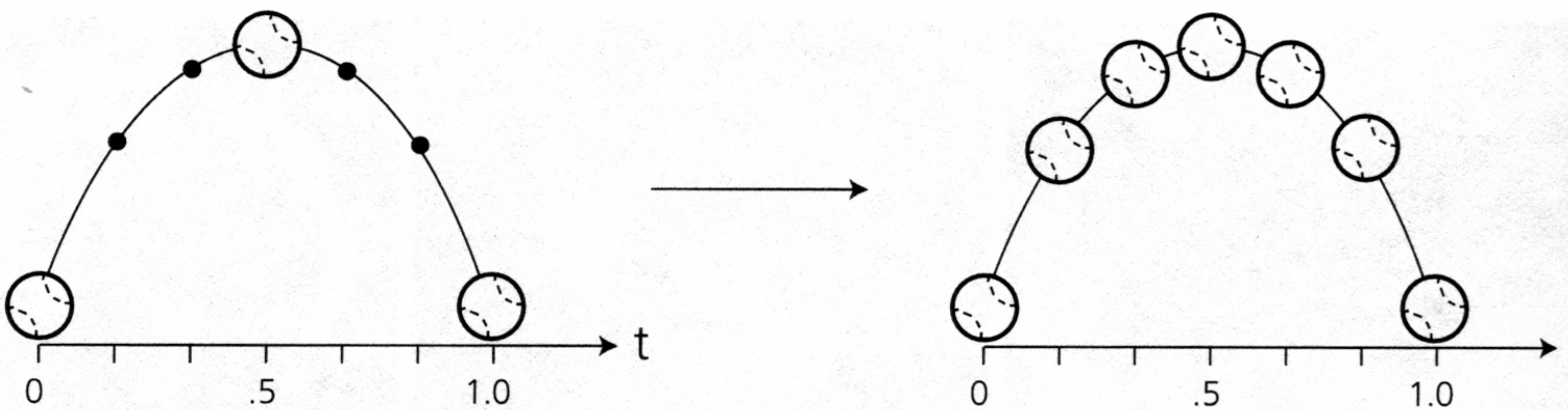


Figure 10.10 Inbetweening with nonlinear interpolation and easing. The ball changes speed as it approaches and leaves keyframes, so the dots indicating calculations made at equal time intervals are no longer equidistant along the path.

Adjust the timing of the inbetween frames. Can be automated by adjusting the stepsize of parameter, t.

Interpolation

Many parameters can be interpolated to generate animation

Simple interpolation techniques can only generate simple inbetweens

More complicated inbetweening will require a more complicated model of animated object and simulation

Interpolation

Strengths

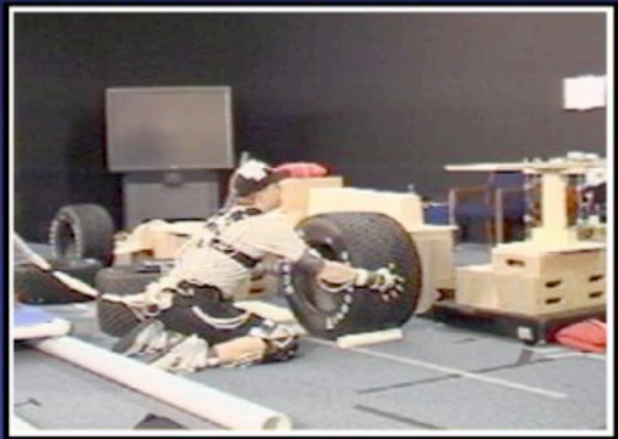
- Animator has exacting control (Woody’s face)

Weaknesses

- Interpolation hooks must be simple and direct
  - *Remember the problems with Euler angle interp?*
- Time consuming and skill intensive
- Difficult to reuse and adjust

Animation Techniques

Motion Capture



Microsoft Motion Capture Group

Motion Analysis

Examples

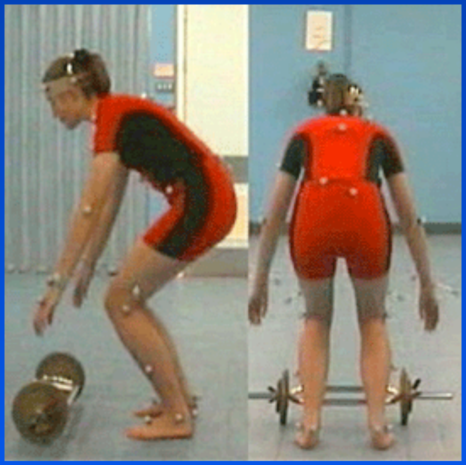
Sports video games

- Madden Football

Many movie characters

- Phantom Menace

Cartoons



Bobby Leach Image Courtesy of Film East.

Examples

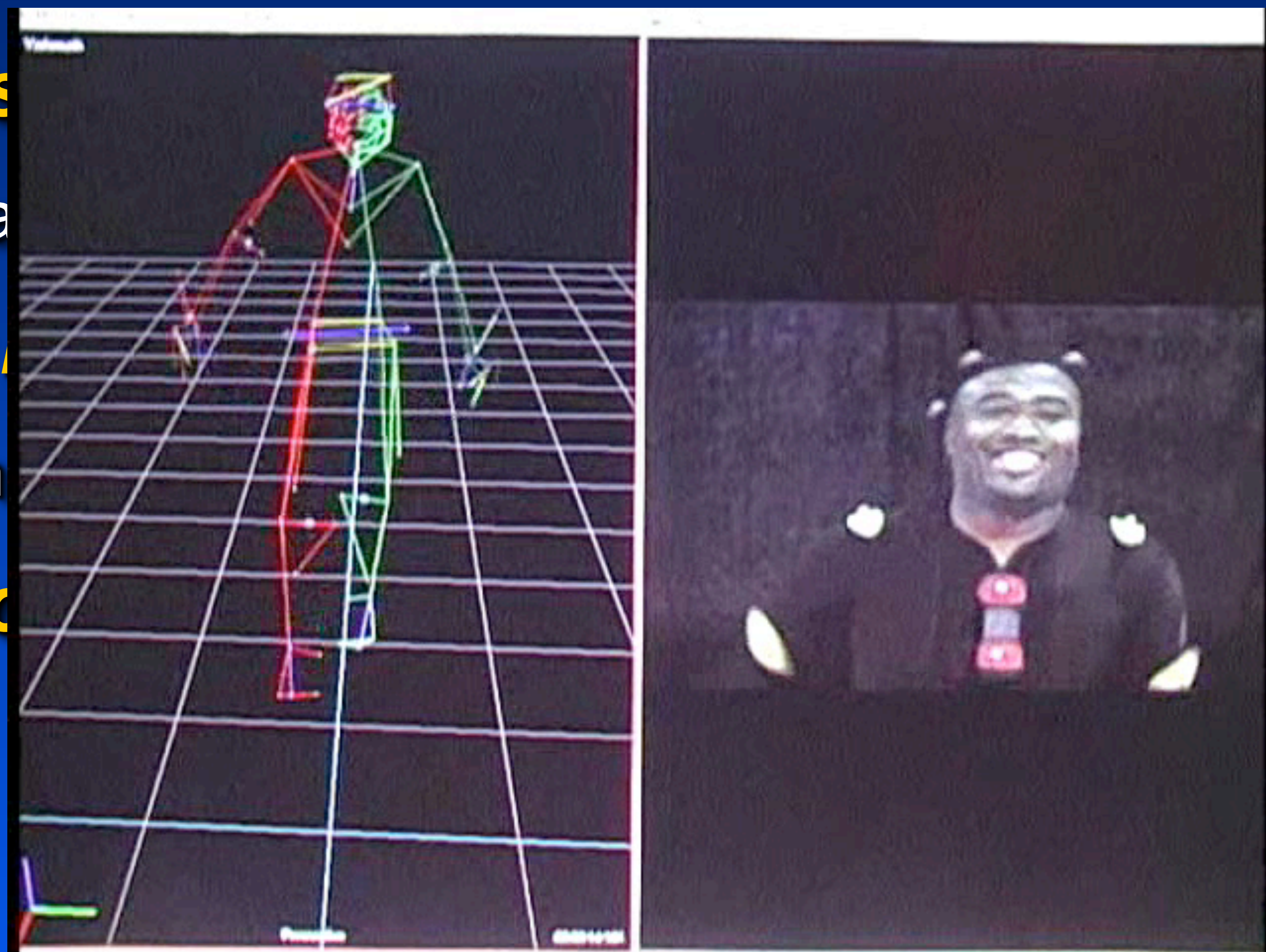
Sports

- Ma

Many

- Ph

Carto



Examples

Sport [redacted]

- Ma [redacted]

Many [redacted]

- Ph [redacted]

Carto [redacted]

Motion Capture Strengths

Exactly captures the motions of the actor

- Michael Jordan's video game character will capture his style

Easy to capture data

Motion Capture Weaknesses

Noise, noise, noise!

Magnetic system inteference

Visual system occlusions

Mechanical system mass

Tethered (wireless is available now)

Motion Capture Weaknesses

Aligning motion data with CG character

- Limb lengths
- Idealized perfect joints
- Foot sliding

Reusing motion data

- Difficult to scale in size (must also scale in time)
- Changing one part of motion

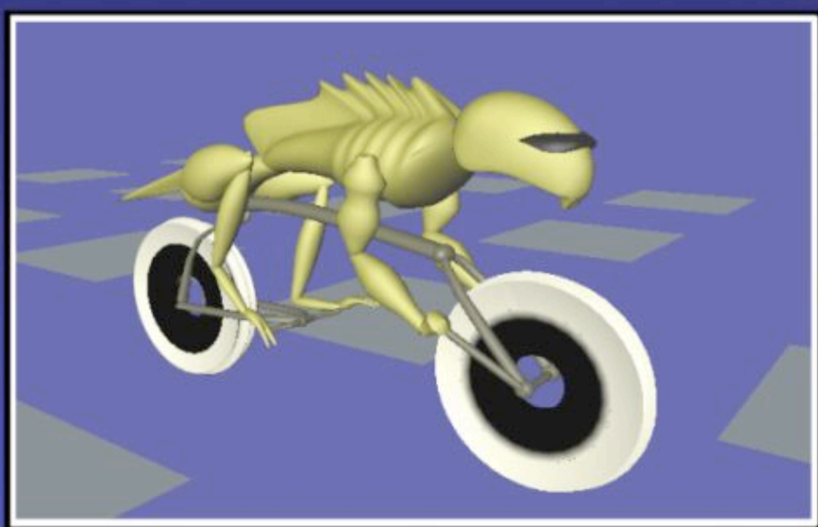
Motion Capture Weaknesses

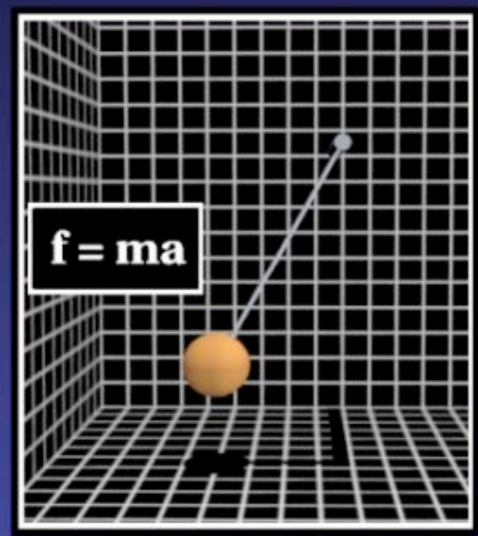
Blending segments

- Motion clips are short (due to range and tethers)
- Dynamic motion generation requires blending at run time
- Difficult to manage smooth transition

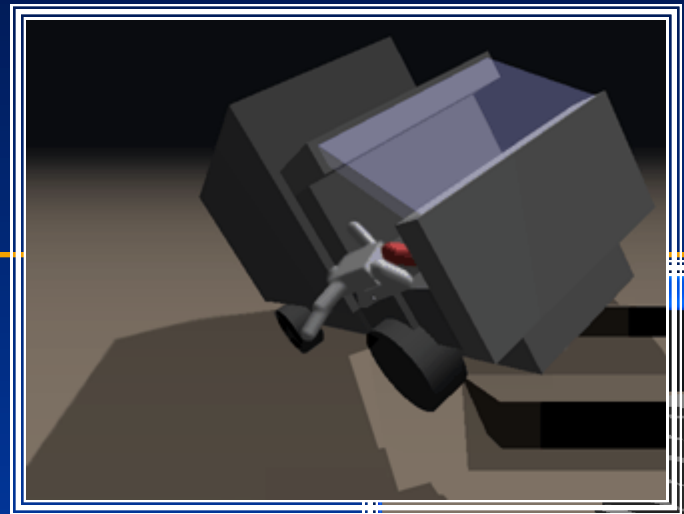
Animation Techniques

Procedural Techniques

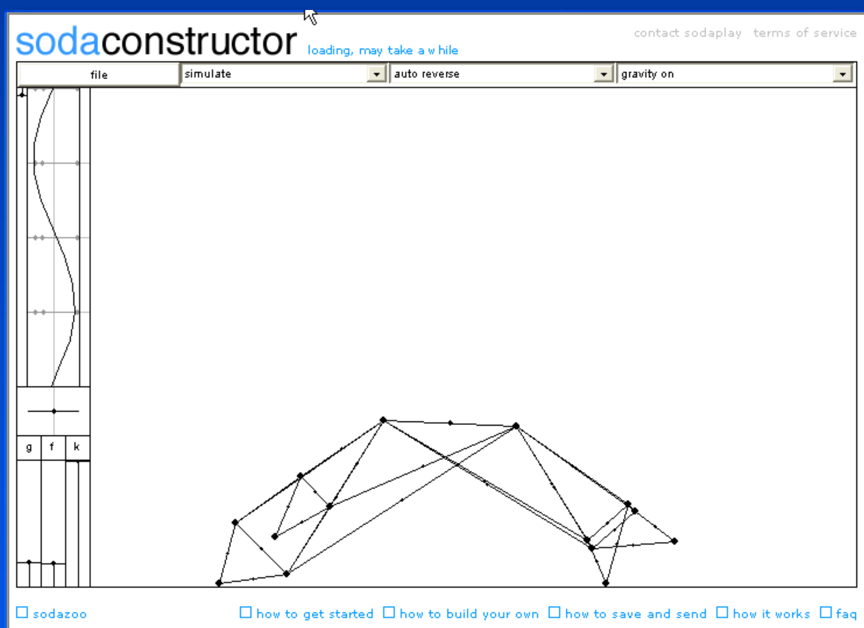




Procedural



http://jet.ro/dismount



www.sodaplay.com

Examples

Inanimate video game objects

- GT Racer cars

Special effects

- Explosions, water, secondary motion

Procedural Animation

- ***Very general term for a technique that puts more complex algorithms behind the scenes***
- ***Technique attempts to consolidate artistic efforts in algorithms and heuristics***
- ***Allows for optimization and physical simulation***

Procedural Animation Strengths

- *Animation can be generated 'on the fly'*
- *Dynamic response to user*
- *Write-once, use-often*
- *Algorithms provide accuracy and exhaustive search that animators cannot*

Procedural Animation Weaknesses

We're not great at boiling human skill down to algorithms

- How do we move when juggling?

Difficult to generate

Expensive to compute

Difficult to force system to generate a particular solution

- Bicycles will fall down