Computer Animation Algorithms and Techniques

Introduction

Computer

Using a computer

Animation

Moving things that can't move themselves

Techniques

"artistic" animation - key frames & interpolation
data-driven animation - mocap
procedural animation - physics, behavioral

Perception

persistence of vision - positive afterimage

perception of motion - beta motion

flicker, critical flicker frequency

motion blur

update rate v. display rate

NTSC - 39.95 fps, interlaced, 640x480

The Heritage of Animation

Early devices

Conventional animation

Disney

Stop Motion Animation

Early Devices

Flipbook
Thaumatrop
Zoetrope
Lumiere brothers
Edison

Conventional Animation

Winsor McCay

Stuart Blackman

Disney

Camera stand

Rotoscoping

Art form

Stop Motion Animation

Willis O'Brien

Ray Harrihausen

Nick Park

Tim Burton

Computer Animation

Principles of Animation

9 old men of Disney
Illusions of Life
Art form

Squash and stretch
Arcs
Secondary action
Slow in & slow out
Anticipation
Exaggeration
Solid drawing
Appeal
In-between v. straight ahead
Follow-through
Staging

Principles of Animation

Squash and stretch
Arcs
Secondary action
Slow in & slow out

Simulating physics
Make it appealing
Effective presentation
Production alternatives

Anticipation
Exaggeration
Solid drawing
Appeal
In-between v. straight ahead
Follow-through
Staging

Principles of Filmmaking

they have rules and guidelines!

180 degree rule
rule of thirds
types of shots
3-point lighting
tilt
framing
focus the viewer's attention

Production->sequence->shot->frame

Storyboard: the proposal

Model sheet: consistency

Animatic: storyboard with timing
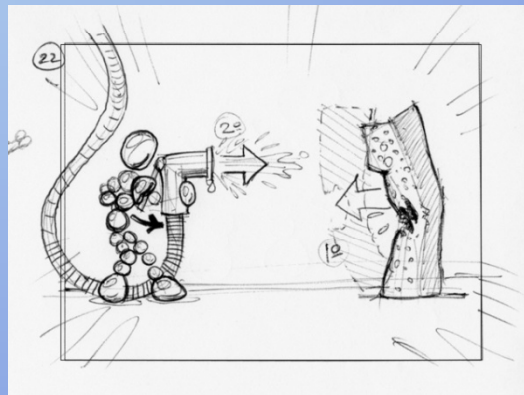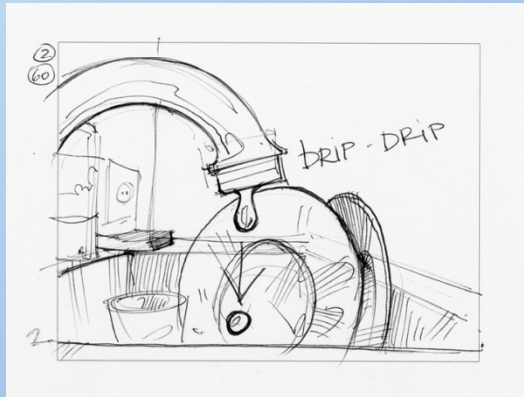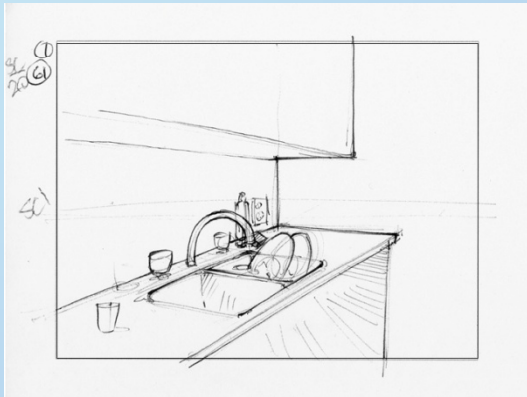
Key frames & in-betweens

Test shot

Pencil tests

Inking: drawings onto cells

Painting: coloring in

Sound: voice, body, special effects, background

Animation Production

Storyboard

Computer Animation Production

Pencil tests - rendering controls
      shadows
      physics
      articulation
      textures
      facial animation

Digital Media

cheap digital storage -high resolution

no degradation

digital recording process, digital display process

digital special effects

Pencil tests & Motion studies

Place holder objects
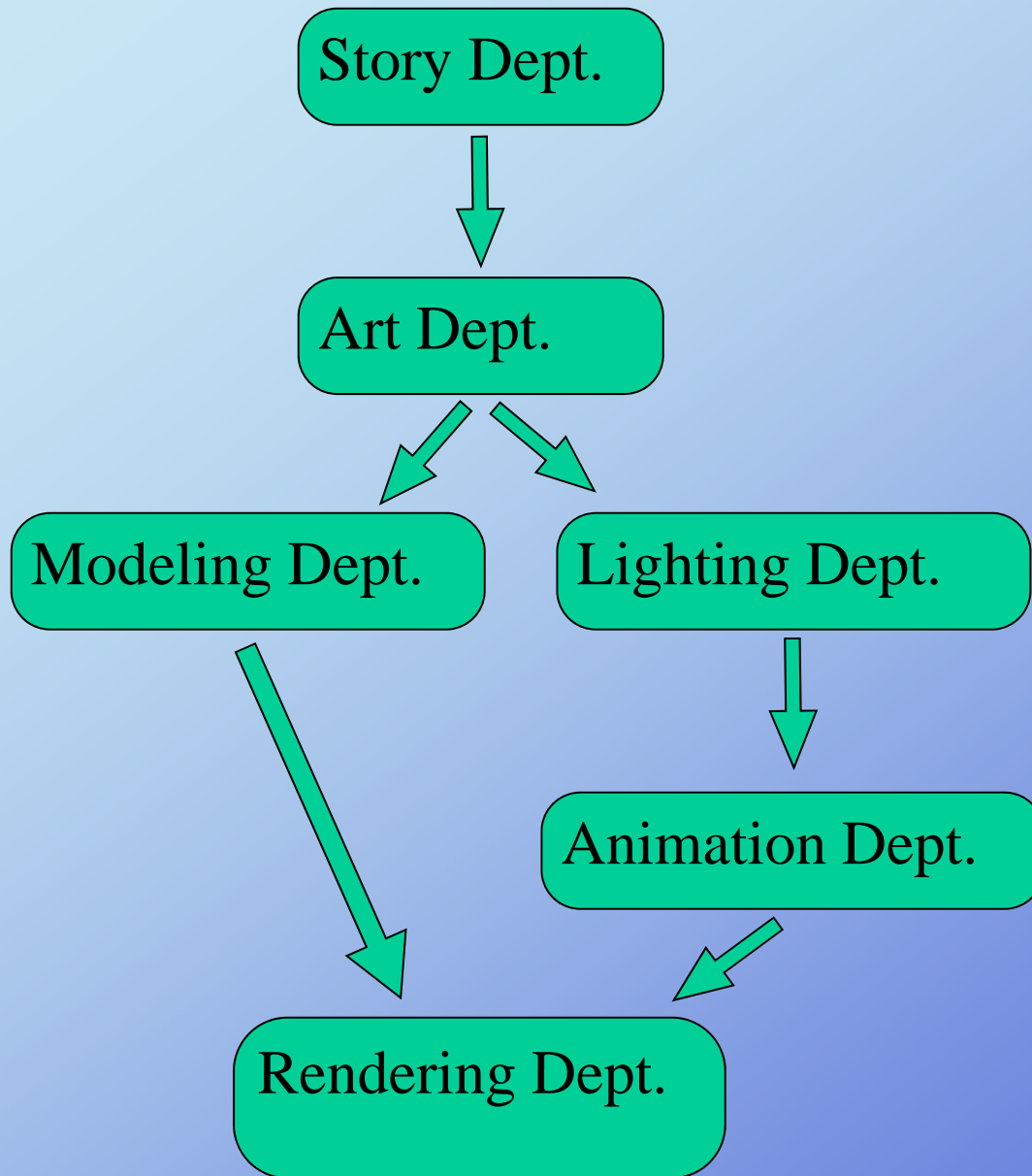>   Levels of Detail
>   solids of revolution

Partial renderings
>   shadows
>   texture
>   reflections

Interpolated movement

CA
Production
Tasks

Story Dept. → Art Dept. → Modeling Dept. / Lighting Dept. → Animation Dept. → Rendering Dept.

Digital Media

Digital editing

Digital video

Digital audio

History of Computer Animation

Early activity

The middle years

Animation comes of age

Early Activity

Utah - first in graphics: DoD

       Evans & Sutherland, Frank Crow, Ed Catmull, Jim Blinn

CMU - Don Greenberg, Architecture

       Michael Cohen, Andrew Witkin, Barr, Jessica Hodgins

Ohio State - Artistic animation, Chuck Csuri

       zGrass, Dave Zeltzer, Doug Roble

U. Penn - Norm Badler - human figure animation

N.C. State - John Staudhammer,

       Early hardware raster displays

N.Y.U. - Utah graduates: Ed Catmull, Alvy Ray Smith

Montreal - Daniel Thalmann & Nadia Megnenat-Thalmann

The Middle Years: the 80's

Pixar - six shorts; first to win Academy Award

The Works - NYU

Young Sherlock Holmes - first CG character

Tron - first extensive use of CG

The Last Starfighter - first synthetic space ship

Future World - first use of CG

Looker - first CG character

The Abyss - first CG blobby particle system effect

CA comes of age! : the 90's breakthrough films

Terminator 2 - extensive use of CG effects

Jurrasic Park - first integrated CG figures

Batman Returns - first use of CG stunt double

Jumanji - first use of real CG figures

Titanic - extensive use of CG human figures

Star Wars - first major CG character

Final Fantasy - most realistic use of CG human figures

CA comes of age!

Use of CG in traditional animation

Beauty and the Beast - CG environment (ballroom)

Tarzan - hand-drawn figures in CG environment (trees)

Prince of Egypt - CG figures in hand-drawn environment

Lion King - flocking control of wildebeast stampede

CA comes of age!

Use of CG astraditional animation

Toy Story

Shrek

ANTZ

Cars

Etc.

CA comes of age!
Other notable films

Saving Private Ryan - extensive use of CG sets & doubles

LotR - extensive use of CG effects, characters

Spiderman, Batman, ….