Interactive Computer Graphics Seminar

Computer Animation

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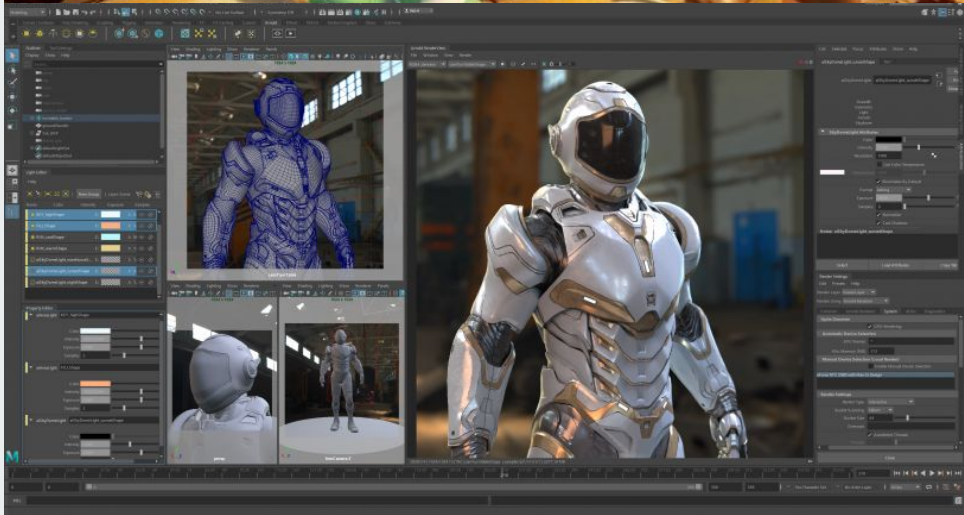
Introduction

What is Computer Animation?

Computer-based computation used in producing images intended to create the perception of motion.

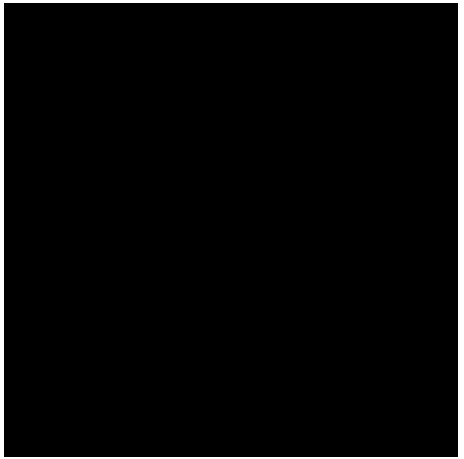


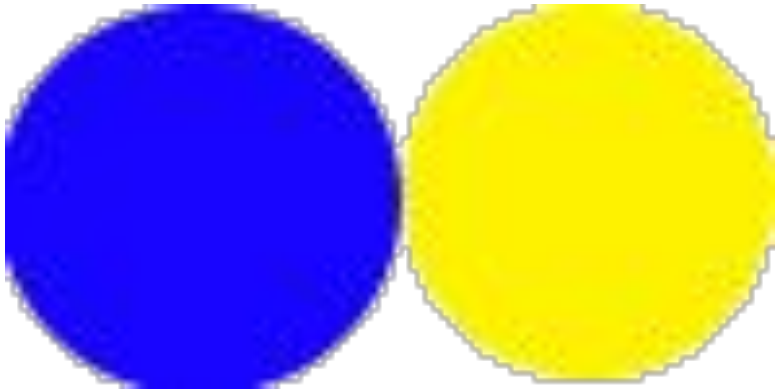
Motion Perception

A series of images, when displayed in rapid succession, are perceived by an observer as a single moving image.

Phenomenon known as beta movement

Due to **persistence of vision**





Persistence of vision

Persistence of vision: The eye retains a visual imprint of an image for a brief instant once the stimulus is removed. Imprints known as **positive afterimages** of the individual stills. These imprints fill in the gaps between the images to produce the perception of a continuously changing image.

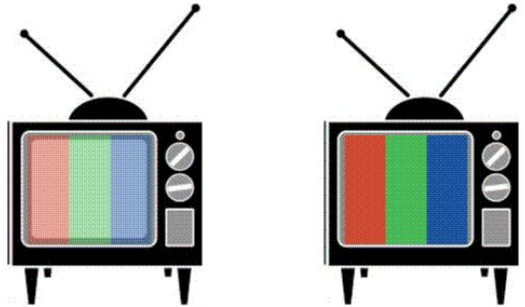
Concentrate in the 4 dots in the middle of the picture for about 30 secs. Then close your eyes and tilt you head back. You will see a circle of light, continue looking at the circle. What do you see? Amazing, right?

Related Terminology

- Flicker
- Critical Flicker Frequency
- Motion blur

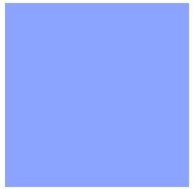
Related Terminology

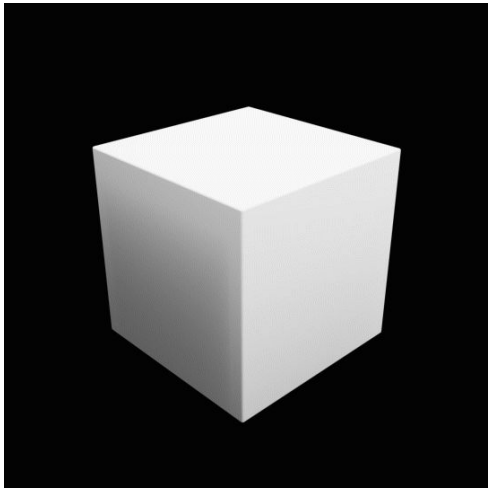
- Strobing
- Playback or refresh rate: The number of images per second displayed in the viewing process.
- Sampling or update rate: The number of different images that occur per second.

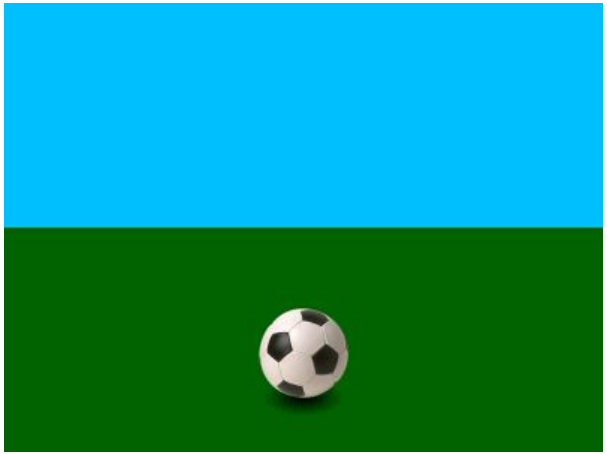


What all can be animated?

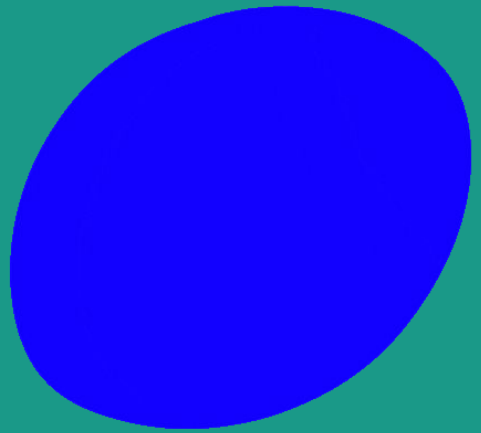
Any value that can be changed
Object’s position and orientation - obvious

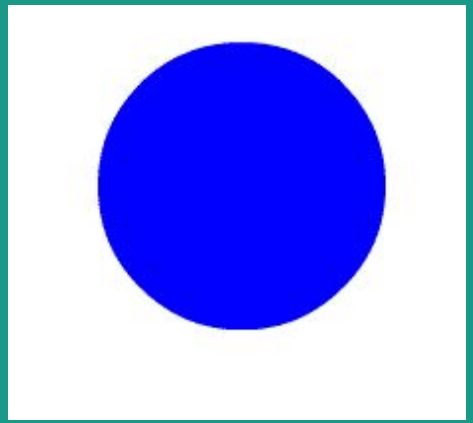


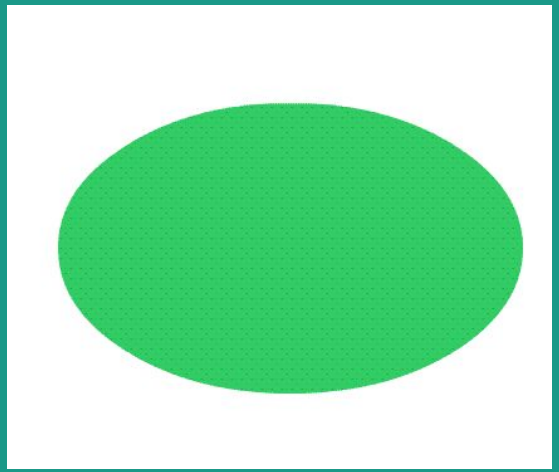




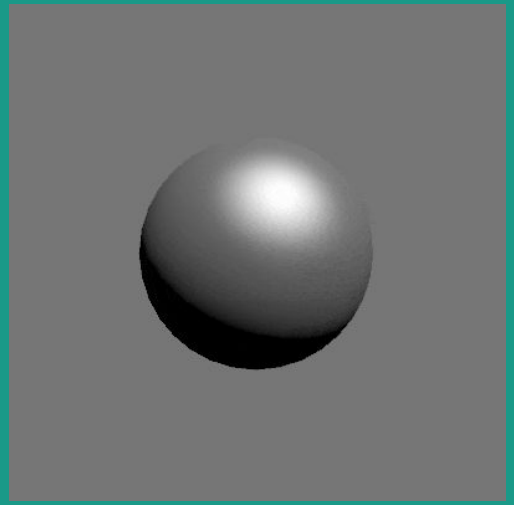
Object's shape



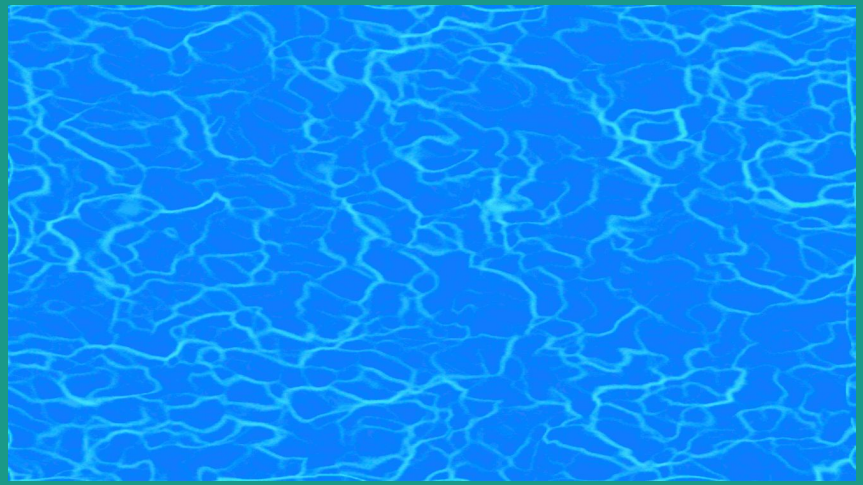


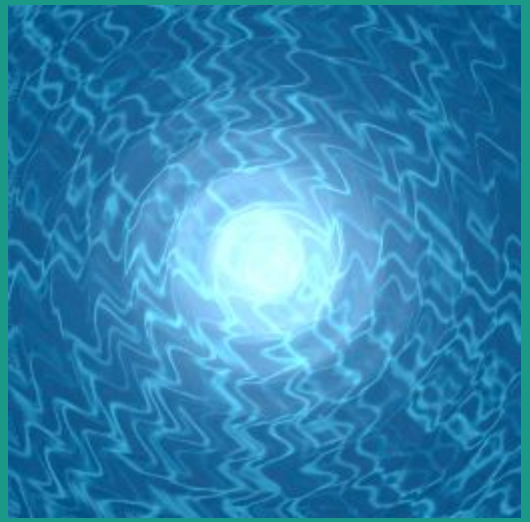


Shading Parameters

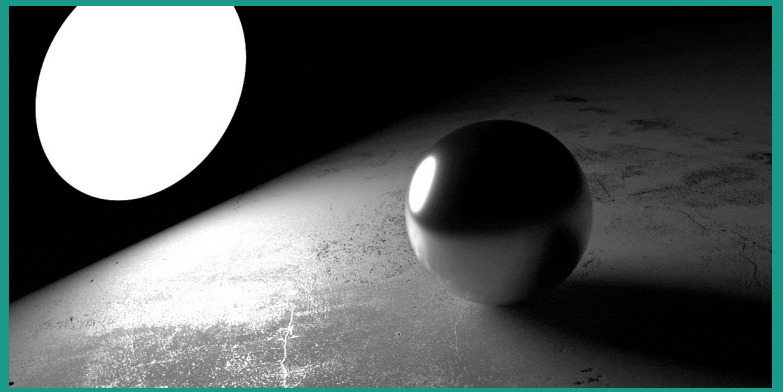


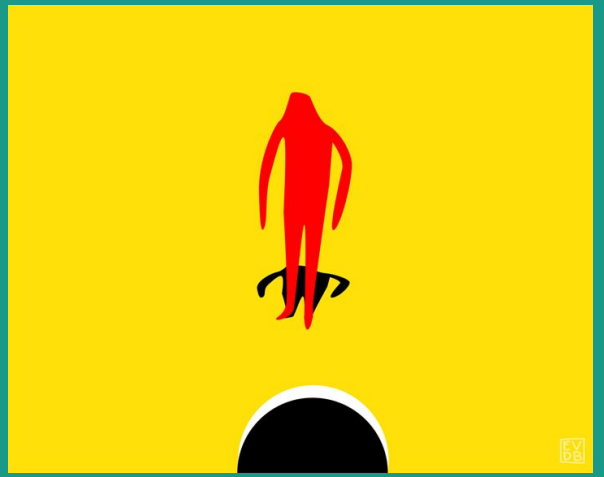
Texture



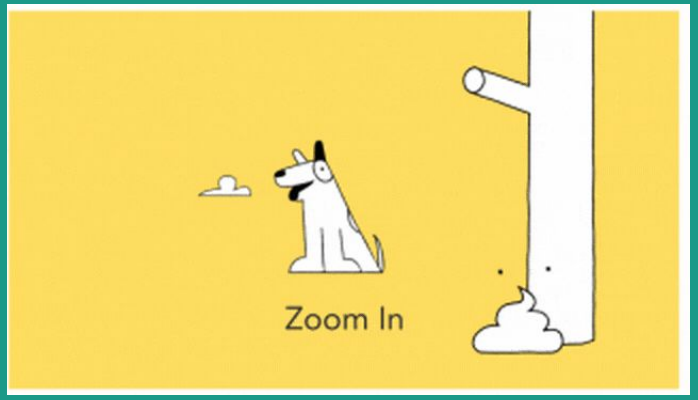


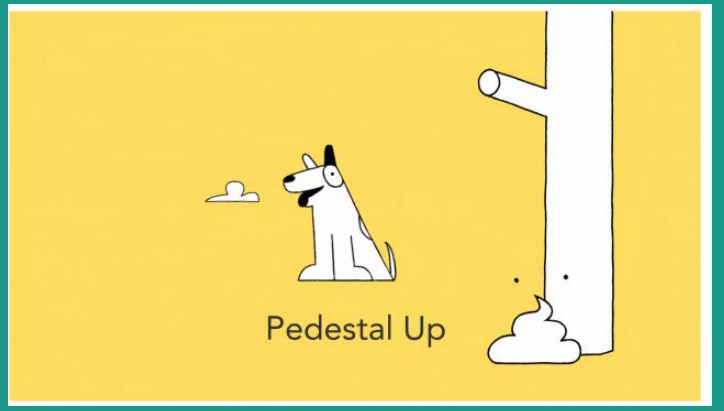
Light source parameters

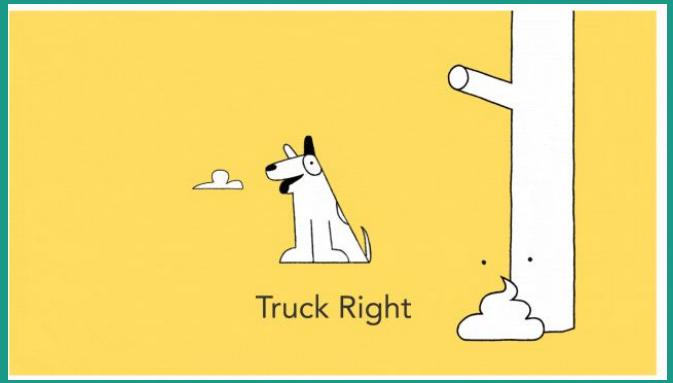




Camera Parameters







Early Devices

- Use of Persistence of vision as early as 1800s
- Thaumatrope
- Zoetrope
- Flipbook
- Praxinoscope

Thaumatrope

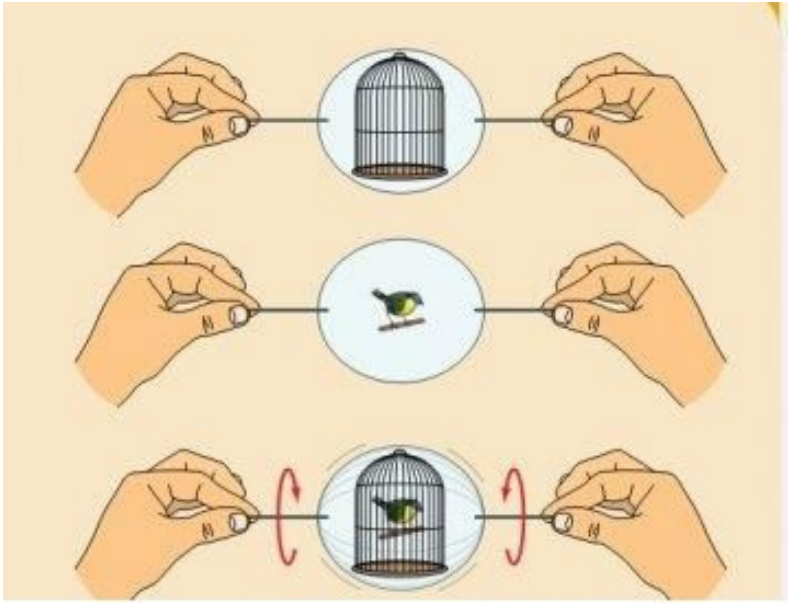
Invented in the 1820s

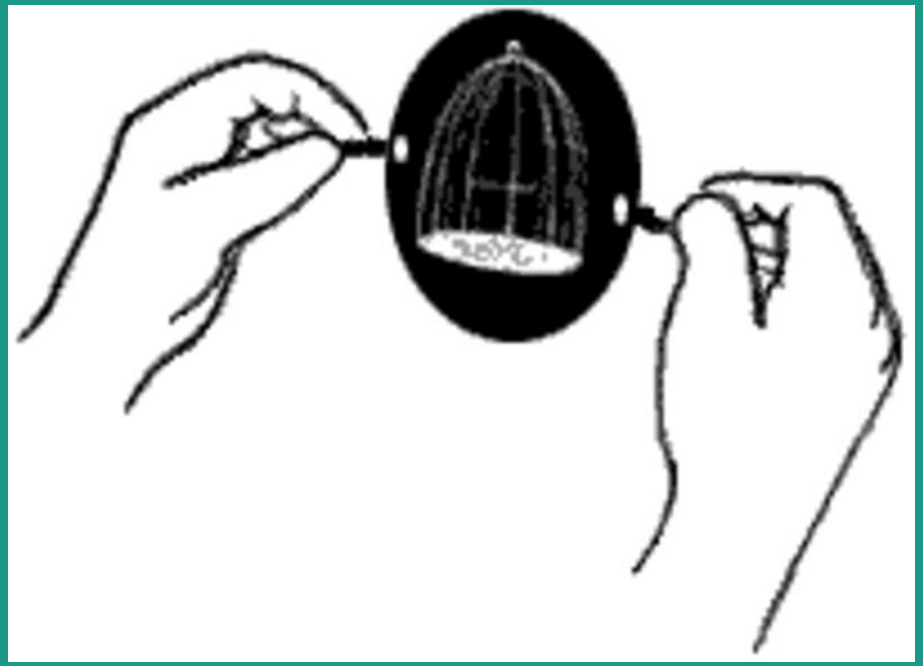
Name means “magic turn”

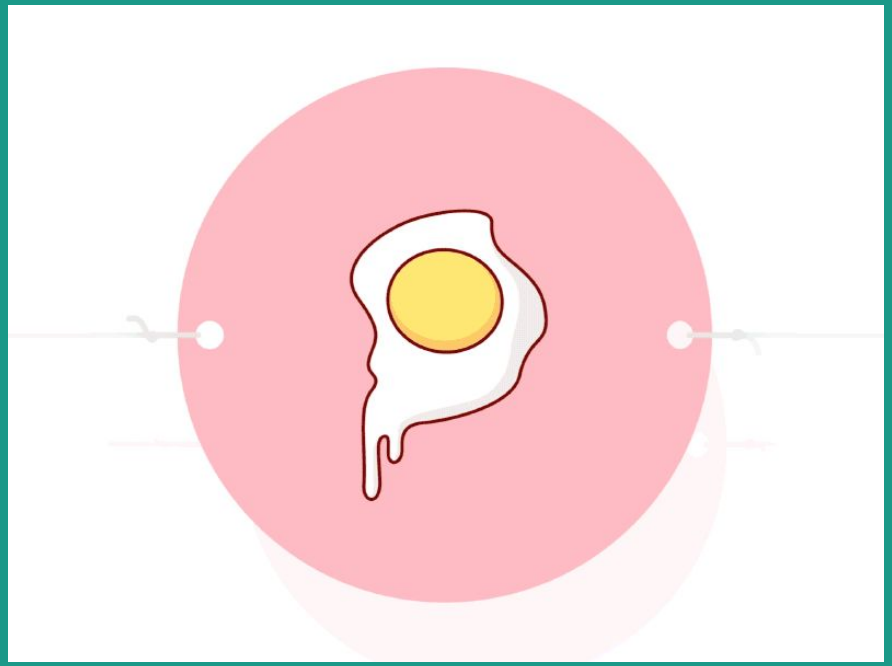
Designed to amuse children

Made of 2 pieces of paper and string

One image on the front, another on the back. As it spins it gives the illusion of combining the images.







Zoetrope

Invented in the 1860s

Also known as ‘Wheel of Life’

Designed to actually animate

Made of a cylinder with slits in it

Images were put on the inside of the cylinder

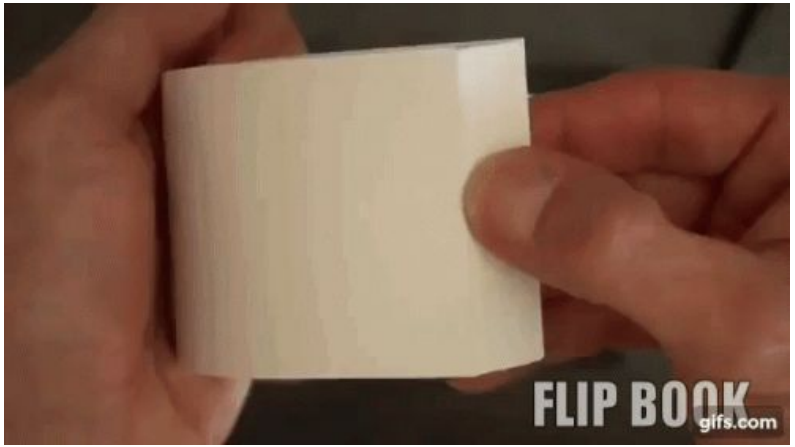
The viewer would spin the cylinder to see the images move


MakeAGIF.com

Flip Book

Made by layering sheets of paper with slightly altered images in a sequential order

As the viewer quickly “flips” through the book, they see a quick animation



Other devices

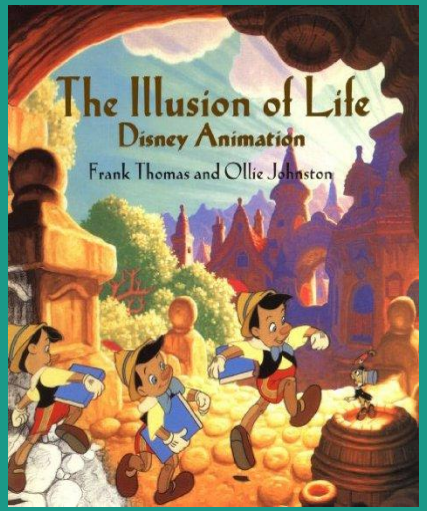
Praxinoscope

Phenakistoscope

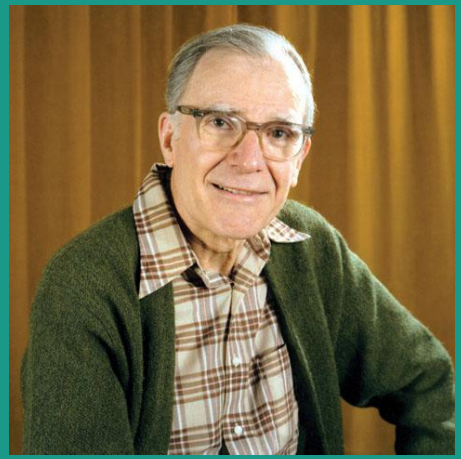
12 Principles of Animation

Introduction

Ollie Johnston



The illusion of life : Disney Animation

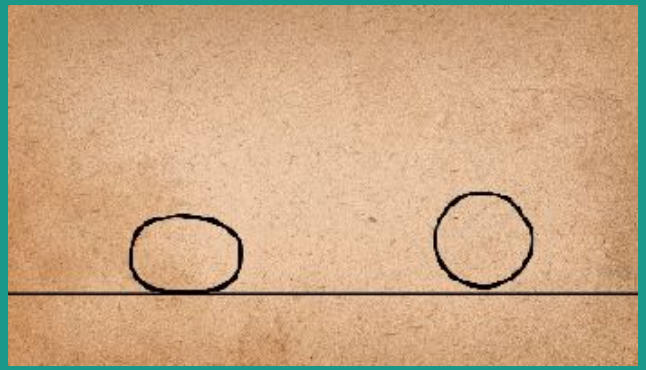


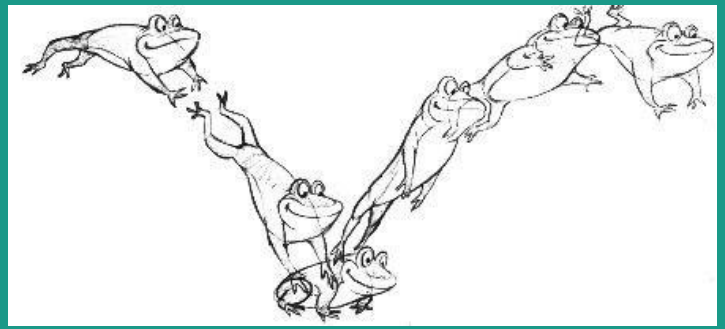
Frank Thomas

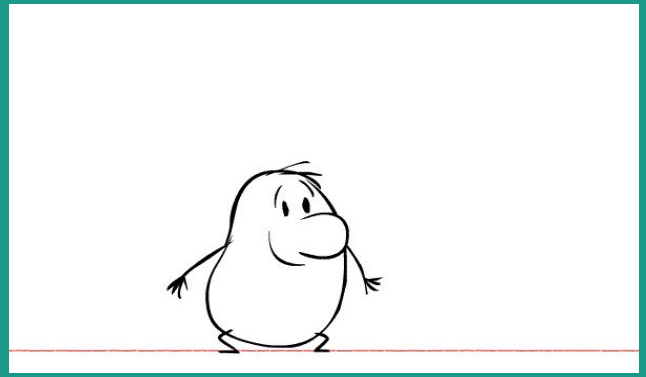
Simulating Physics

- Squash and Stretch
- Timing
- Secondary Action
- Slow in and Slow out
- Arcs

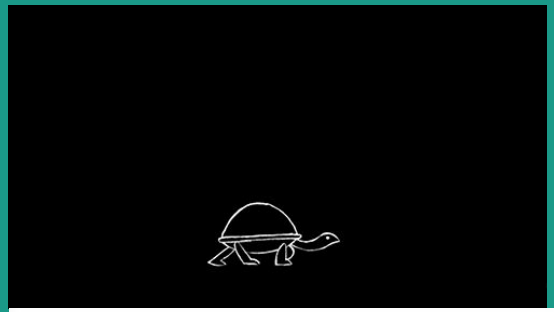
Squash and Stretch

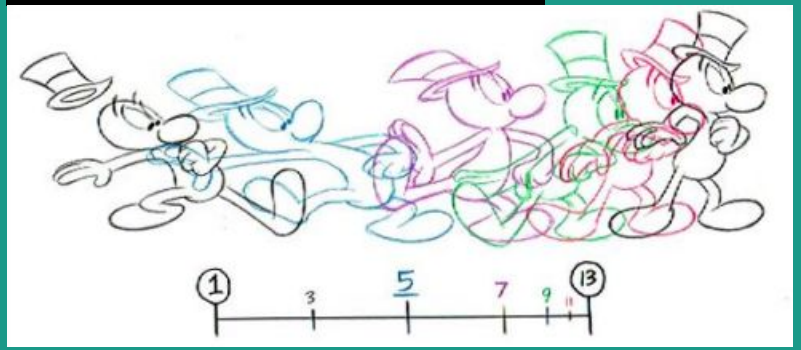


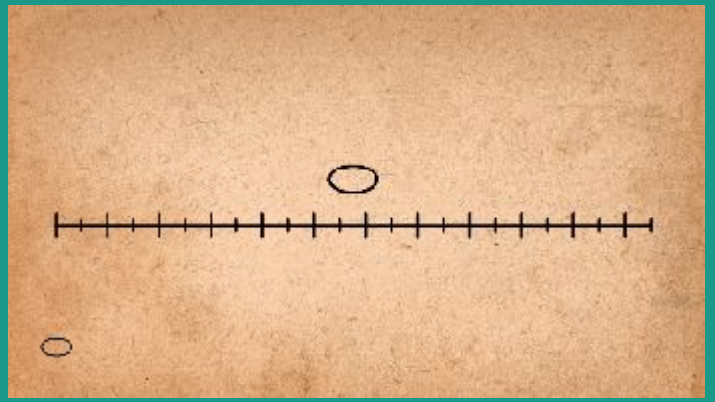


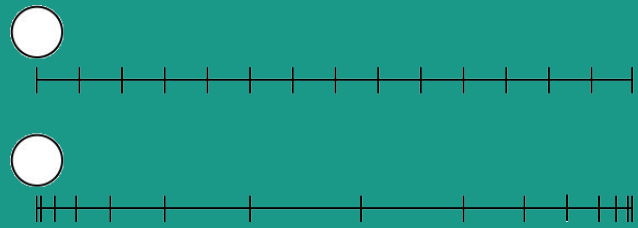


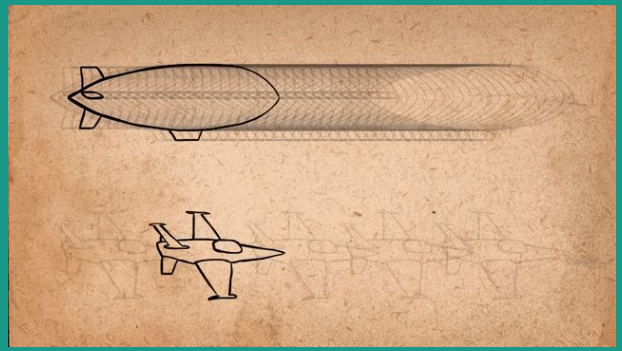
Timing



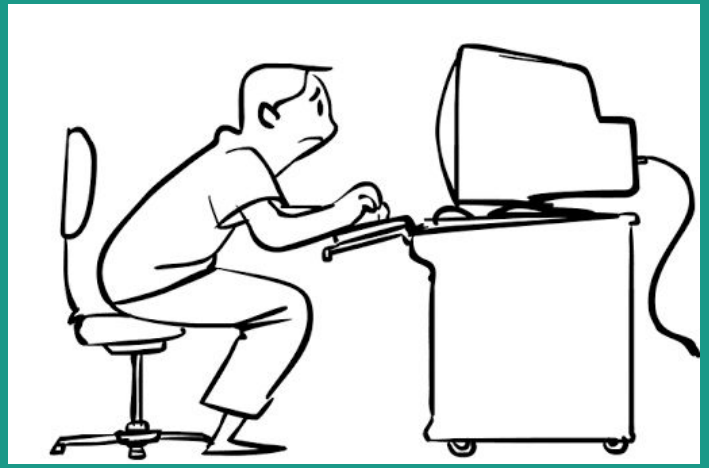


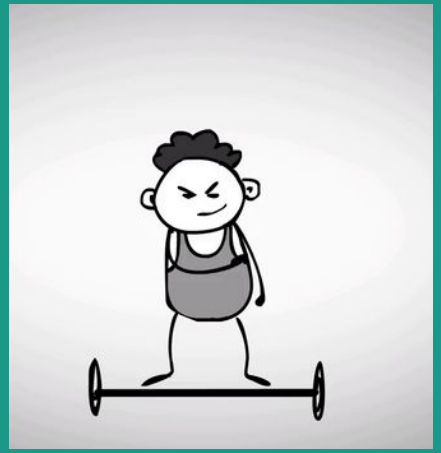


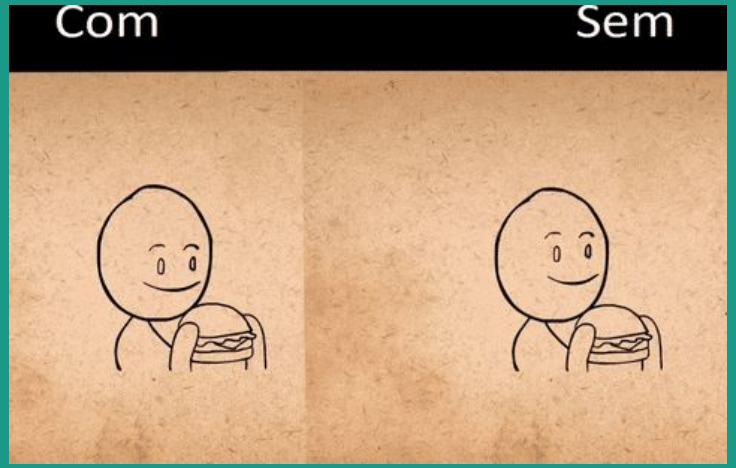




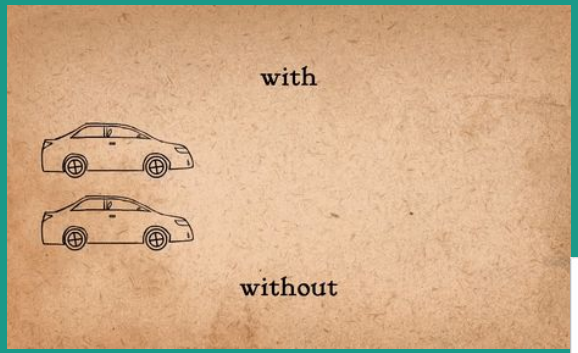
Secondary Action

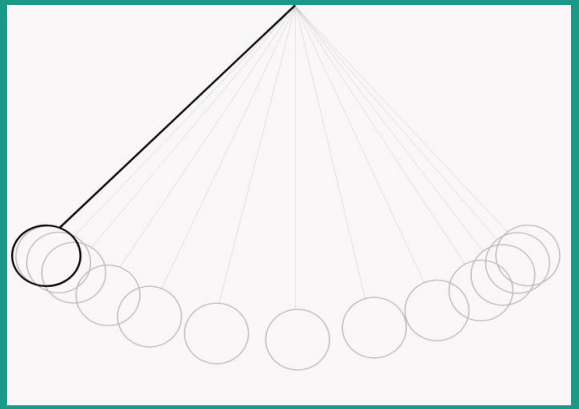


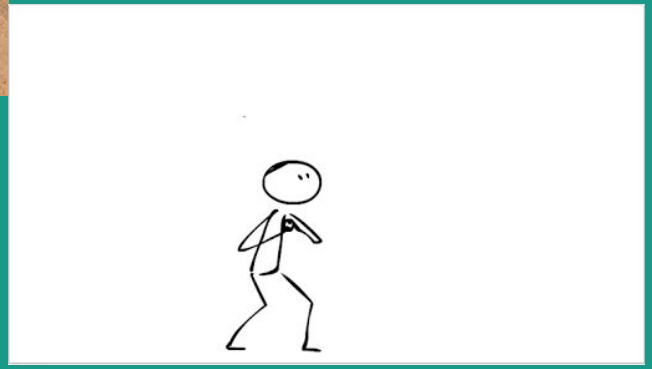


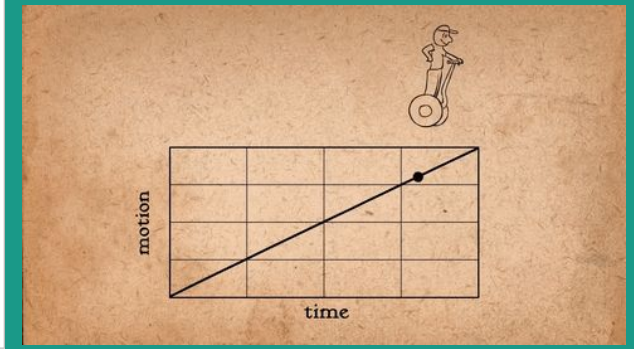


Slow in and Slow out

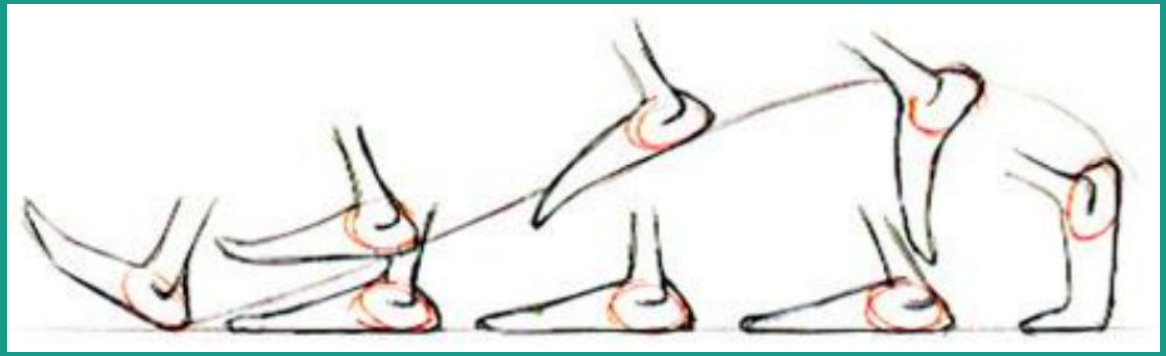


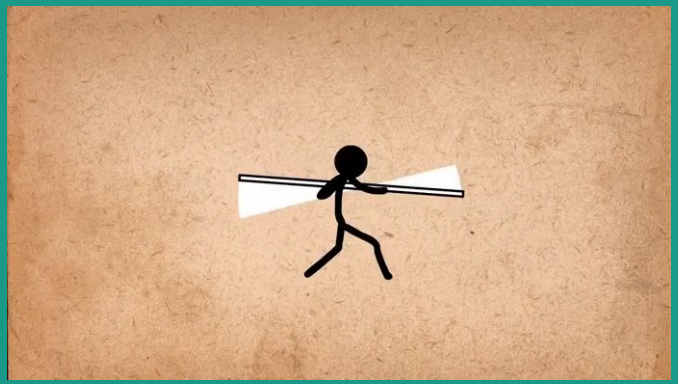






Arcs

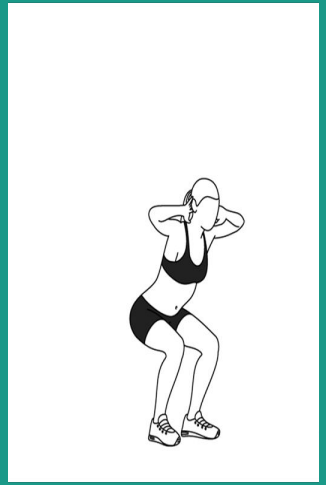


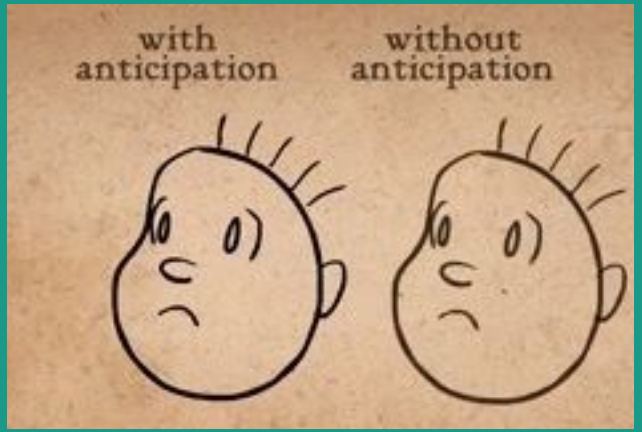


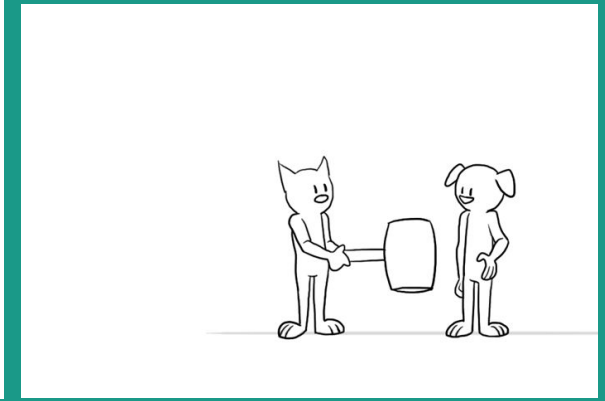
Effectively presenting action

- **Anticipation**
- **Staging**
- **Exaggeration**

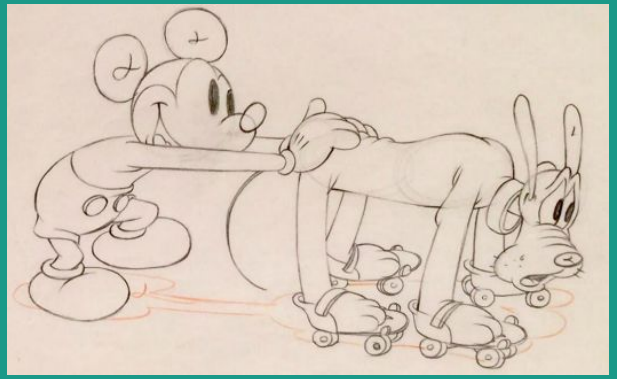
Anticipation



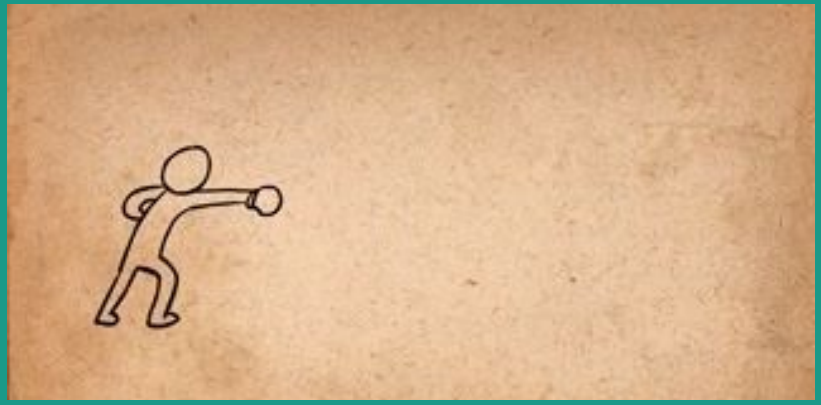


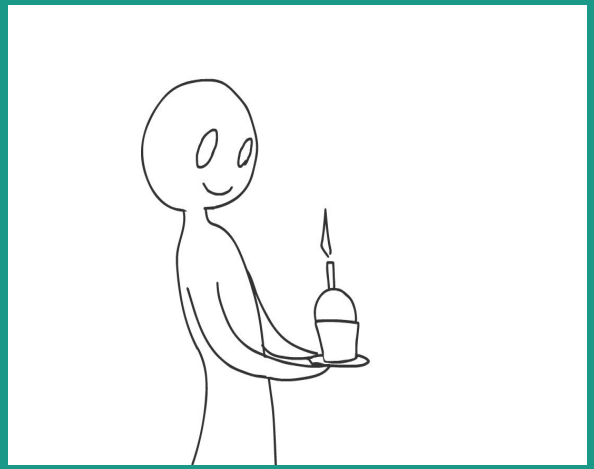


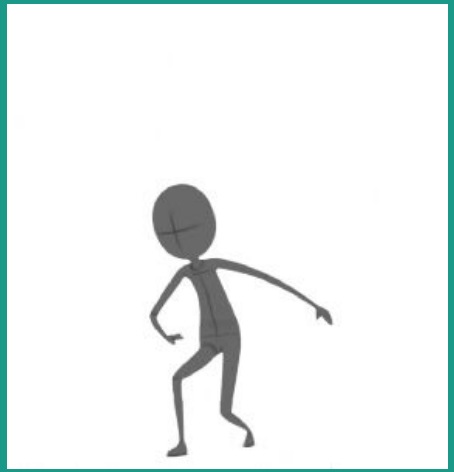
Staging



Exaggeration



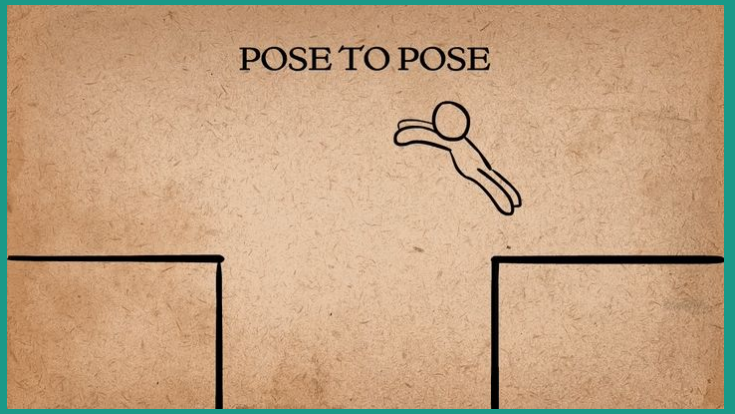


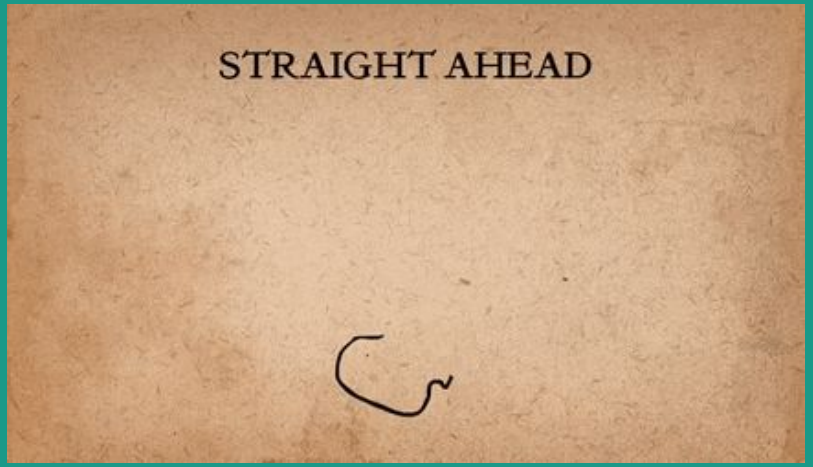


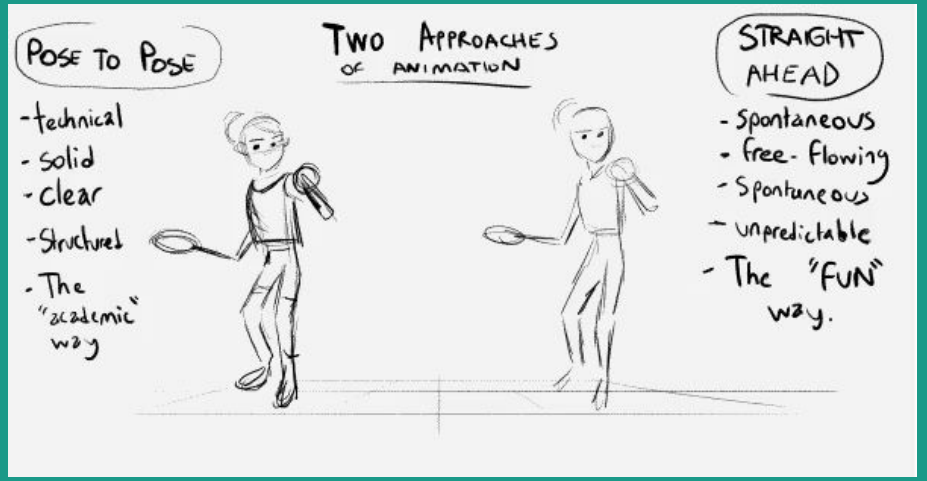
Production Technique

- **Straight ahead action and pose to pose**

Straight ahead action and pose to pose



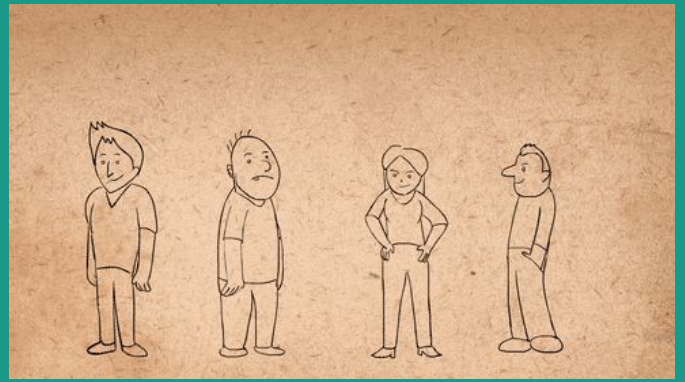




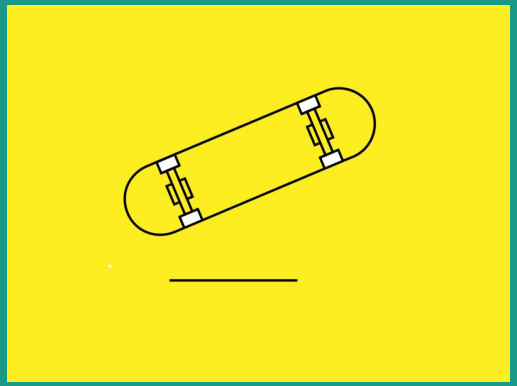
Designing aesthetically pleasing actions

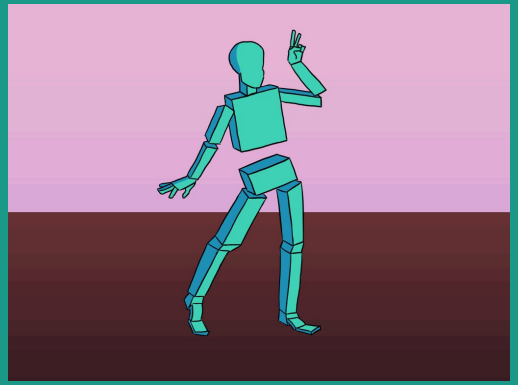
- Appeal
- Solid drawing and solid posing
- Follow through and overlapping action

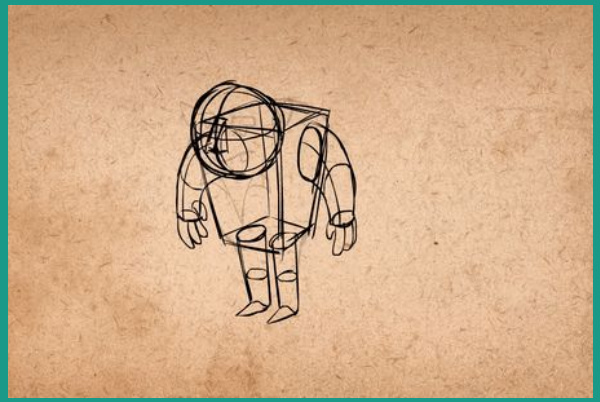
Appeal



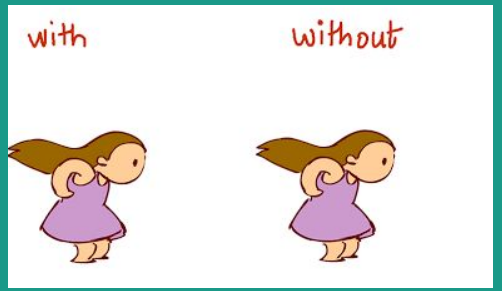
Solid Drawing and Solid Posing





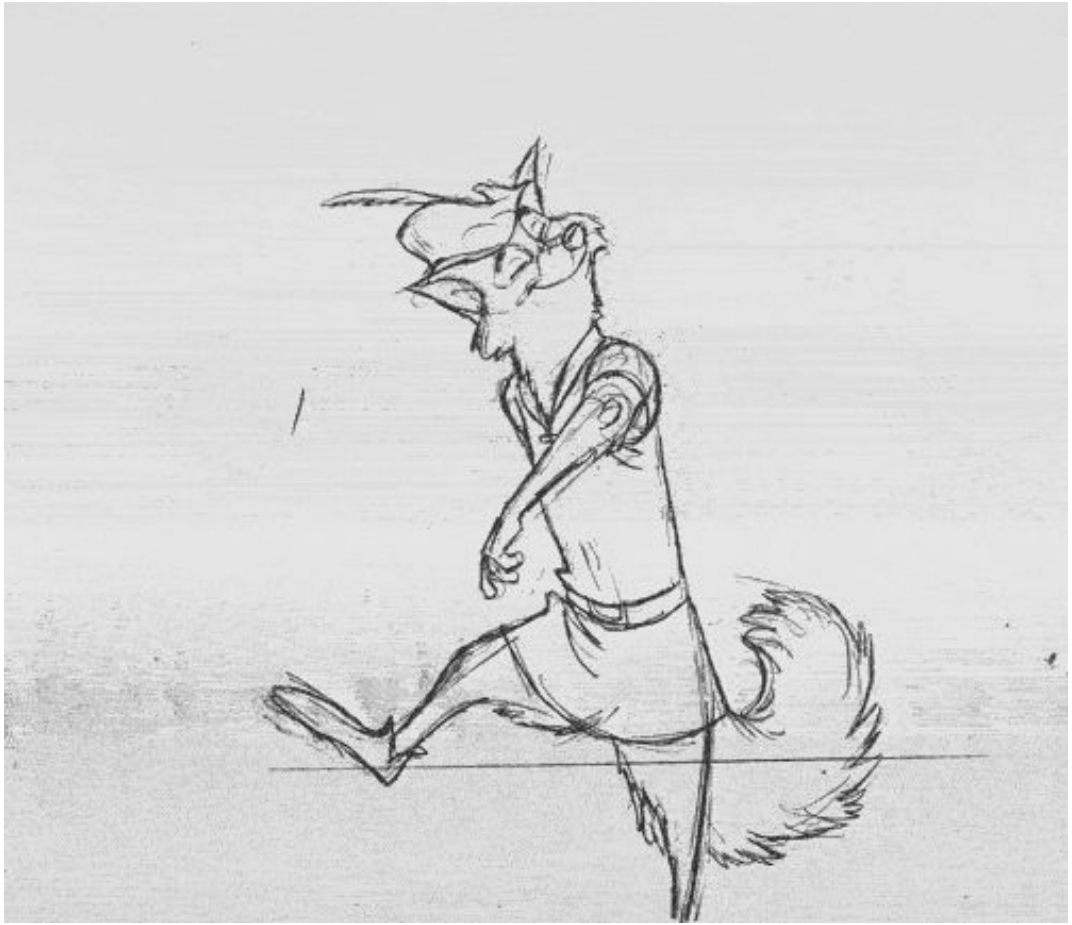


Follow Through and Overlapping Action

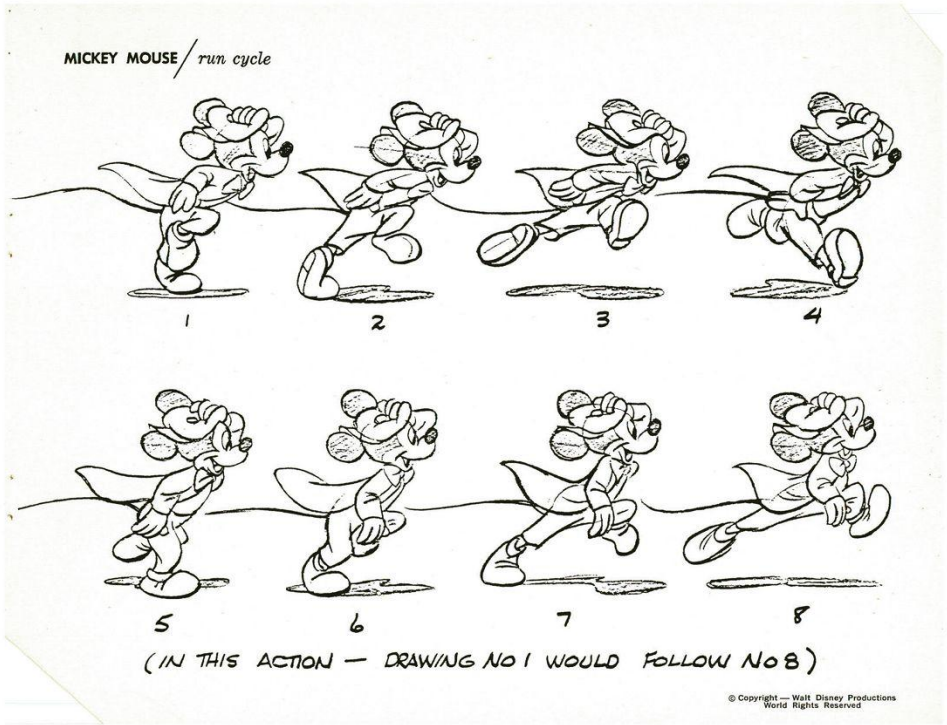


Types of Animation

- **Traditional Animation -**



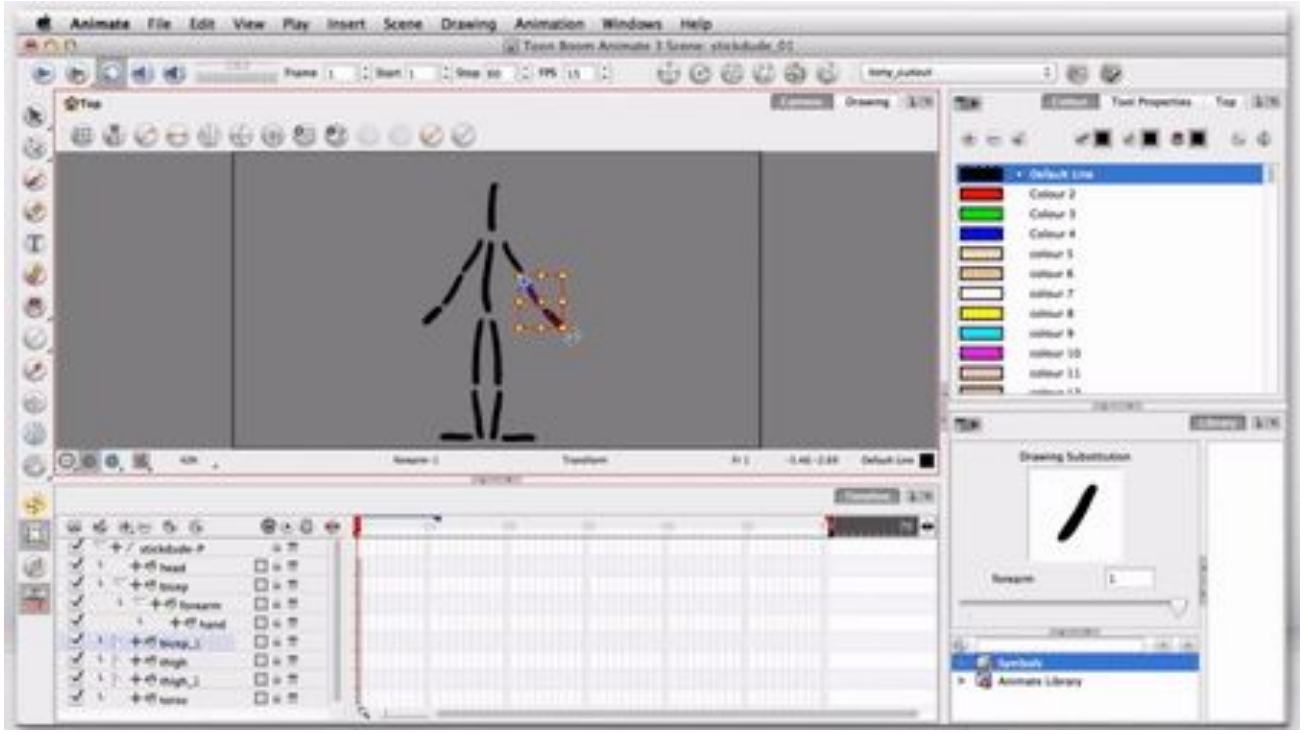
- Traditional animation (or classical animation, cel animation, hand-drawn animation, 2D animation or just 2D) is an animation technique in which each frame is drawn by hand.
- The technique was the dominant form of animation in cinema until the advent of computer animation.



Animator draws every frame to create a animation sequence

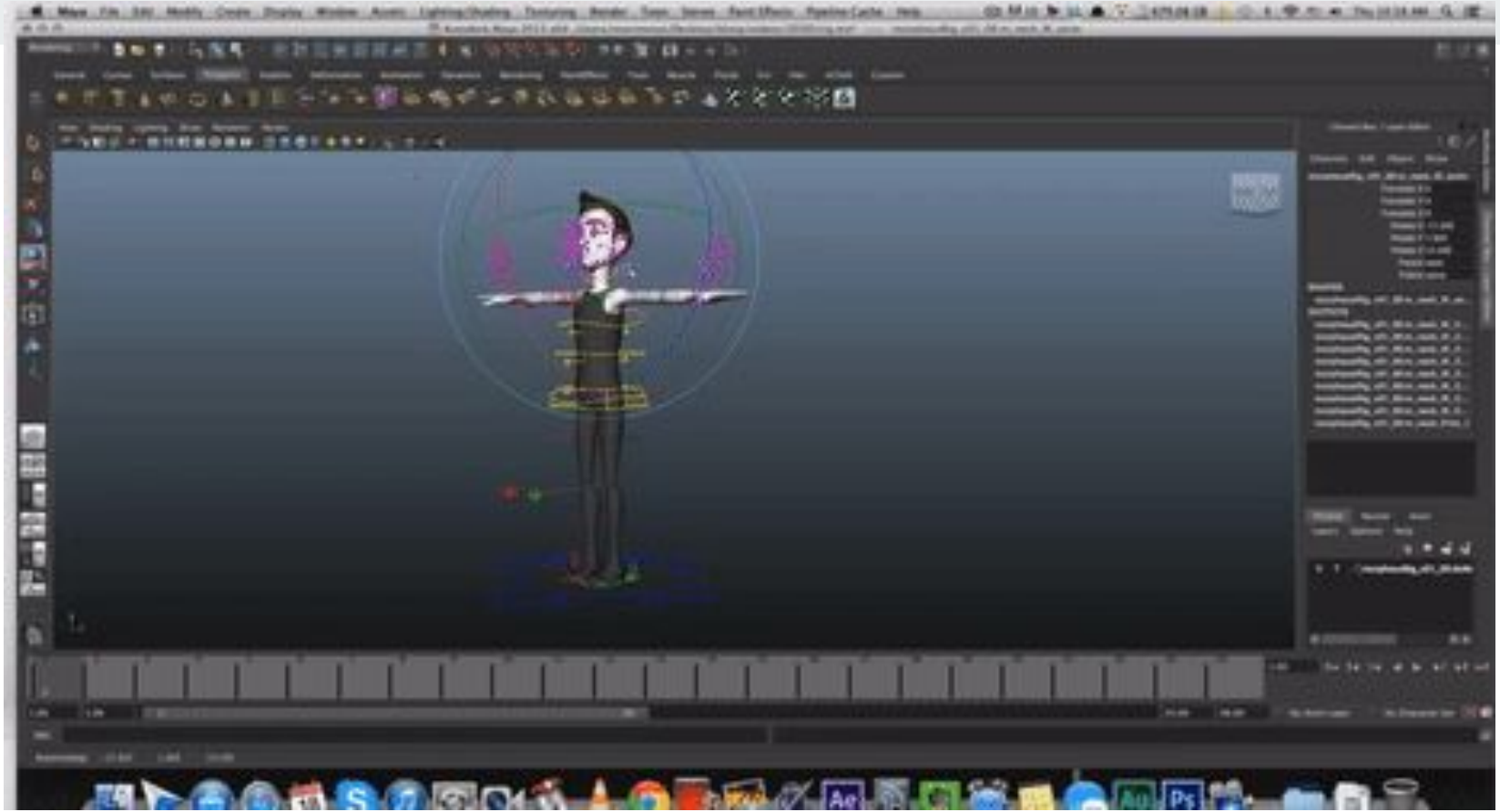
- **2D Animation -**

2D animation is the art of creating movement in a two-dimensional space. This includes characters, creatures, FX and backgrounds.

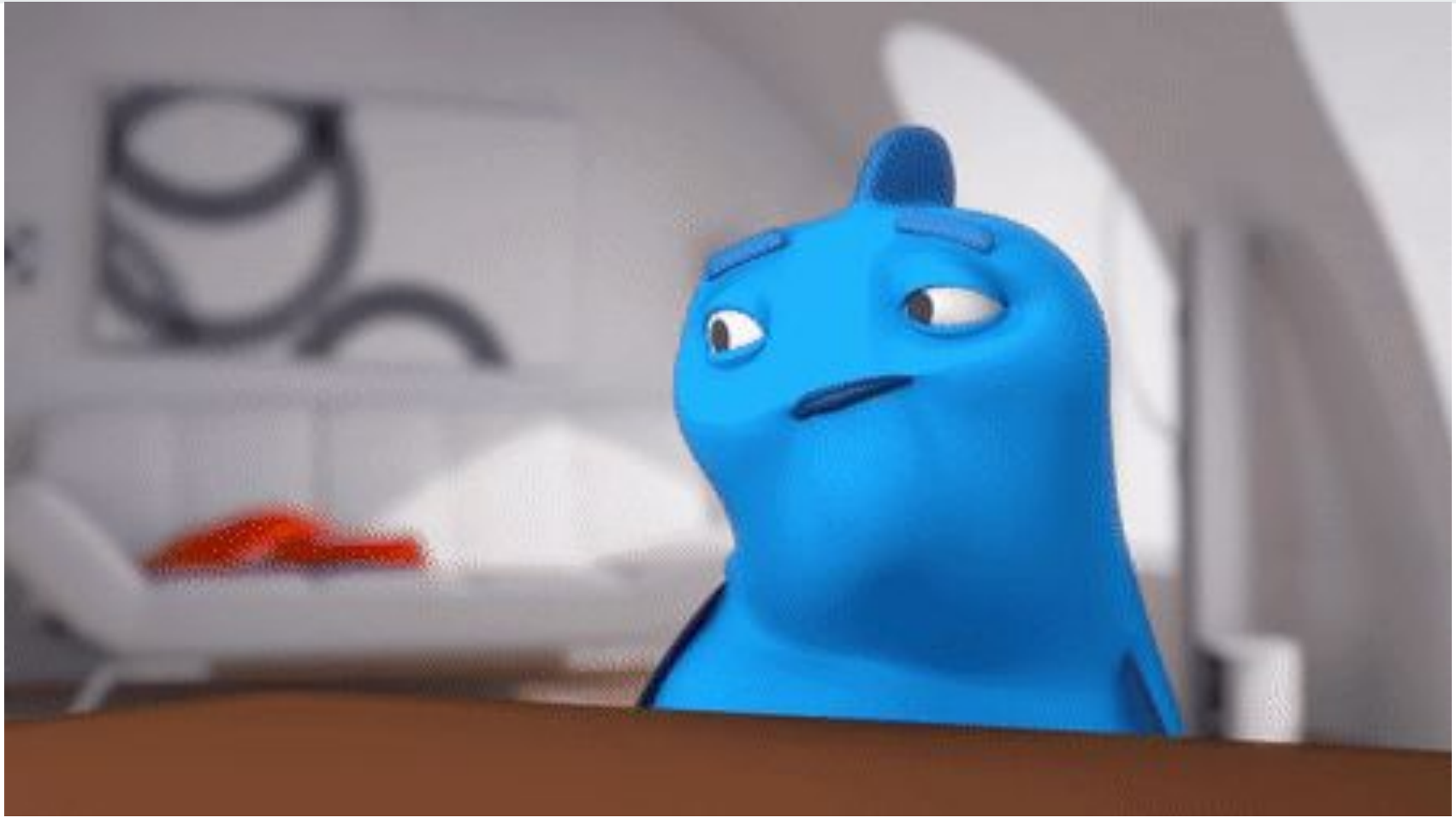


Using **Flash**, we can create rigs in the characters instead drawing the character over and over again

- 3D Animation -



Animating using Maya Software



- Motion Graphics -

Motion graphics are pieces of animation or digital footage which create the illusion of **motion** or rotation, and are usually combined with audio for use in multimedia projects.

- Stop Motion -


Howcast.com

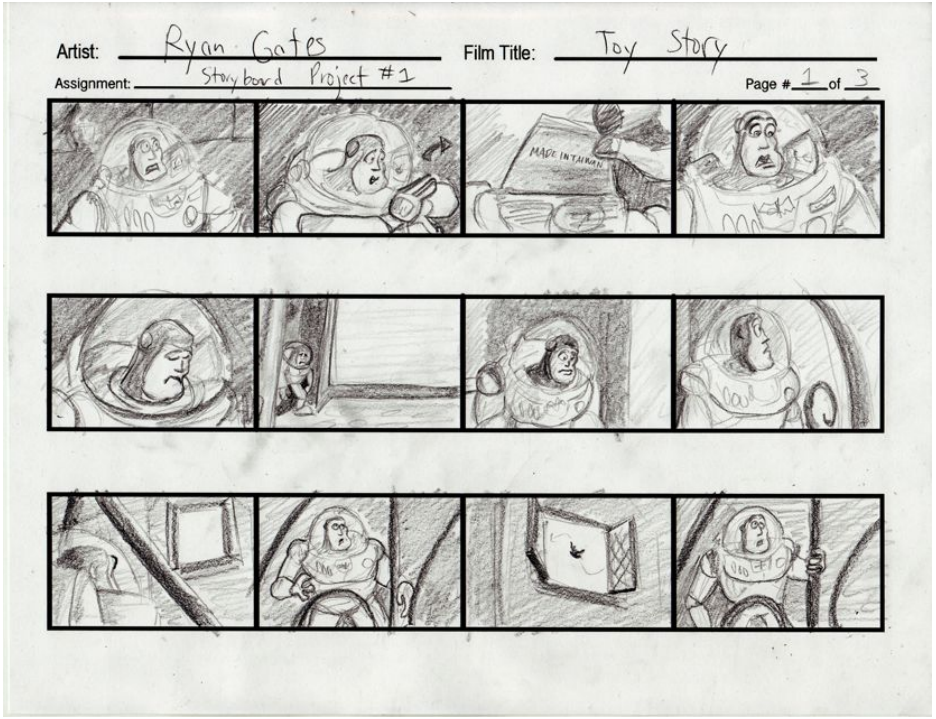
Computer Animation Production

Pixar's Toy Story

Story Department

This department translates the verbal into the visual form.

The screenplay enters, Storyboard is developed and story reels leaves.



Art Department

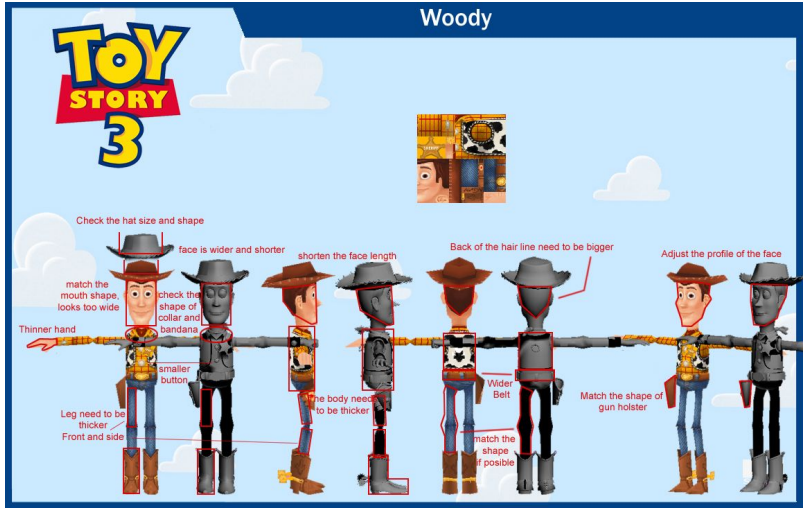
It creates the designs and color studies for the film, including detailed model descriptions and lighting scenarios.

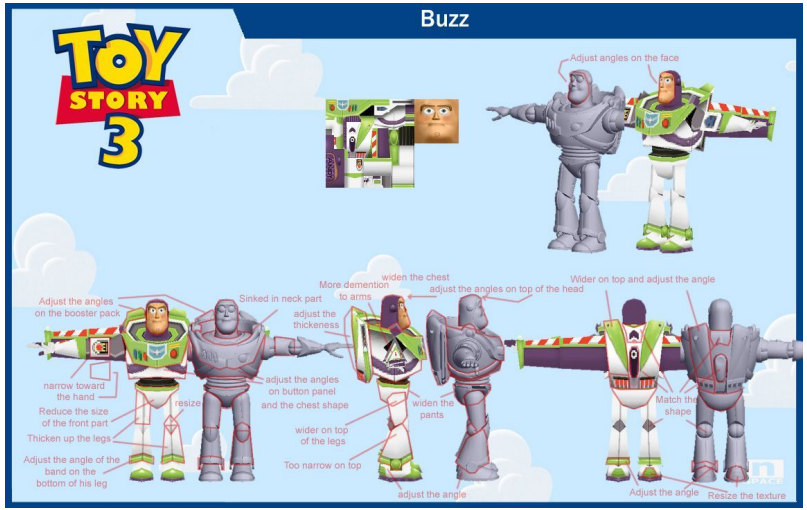
The Art Department develops a consistent look to be used in the imagery.

Modelling Department

It creates the characters and the world in which they live.

Often, figures with jointed appendages, or other models with characteristic motion, are created as parameterized models.





Shading Department

Shading must translate the attributes of the object that relate to its visual appearance into texture maps, displacement shaders, and lighting models.

Layout Department

Layout is responsible for taking the film from two dimensions to three dimensions.

Animation Department

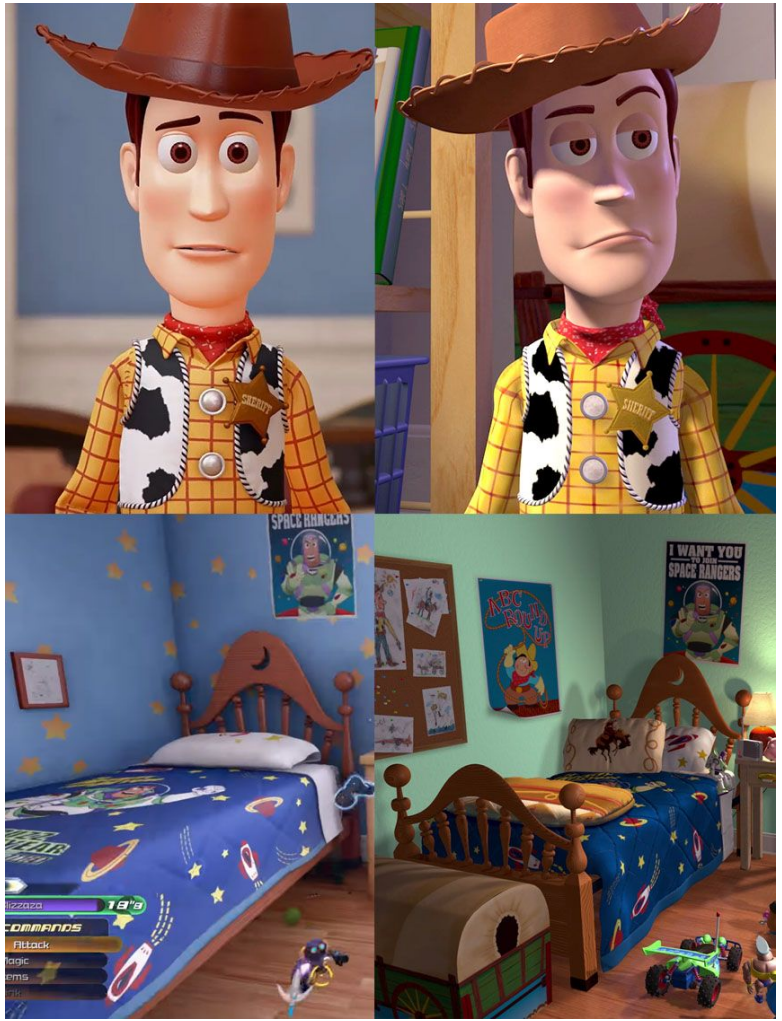
Department responsible for bringing life into the characters!

Lighting Department

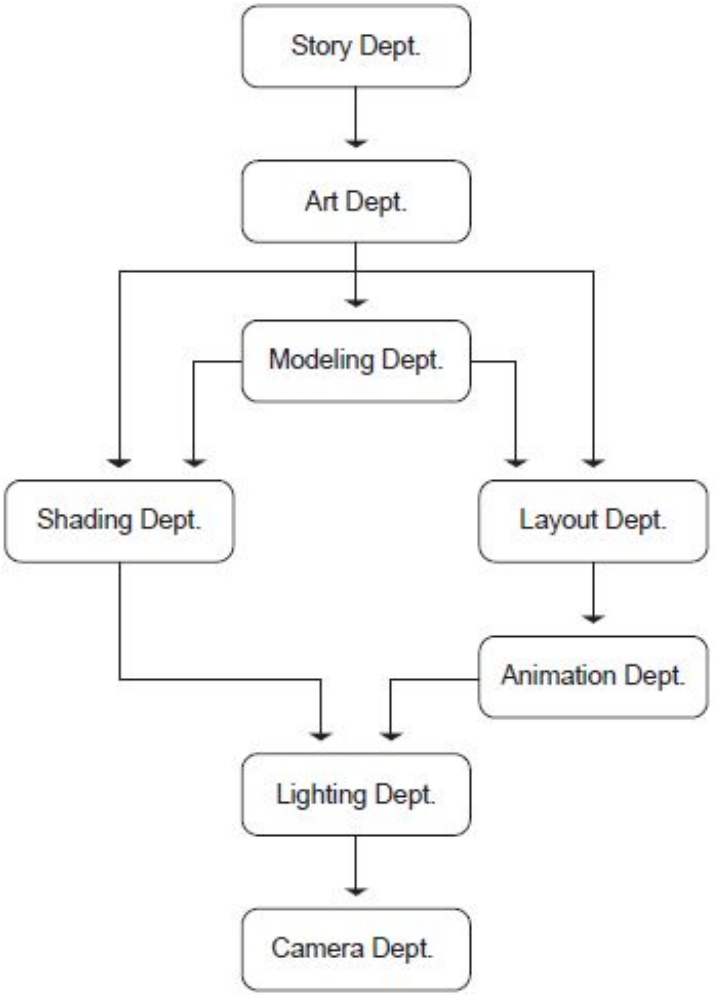
Key lights are set to establish the basic lighting environment. Subtler lighting particular to an individual shot refines this in order to establish the correct mood and bring focus to the action

Camera Department

Department is responsible for actually rendering the frames.



Computer Animation Production Pipeline



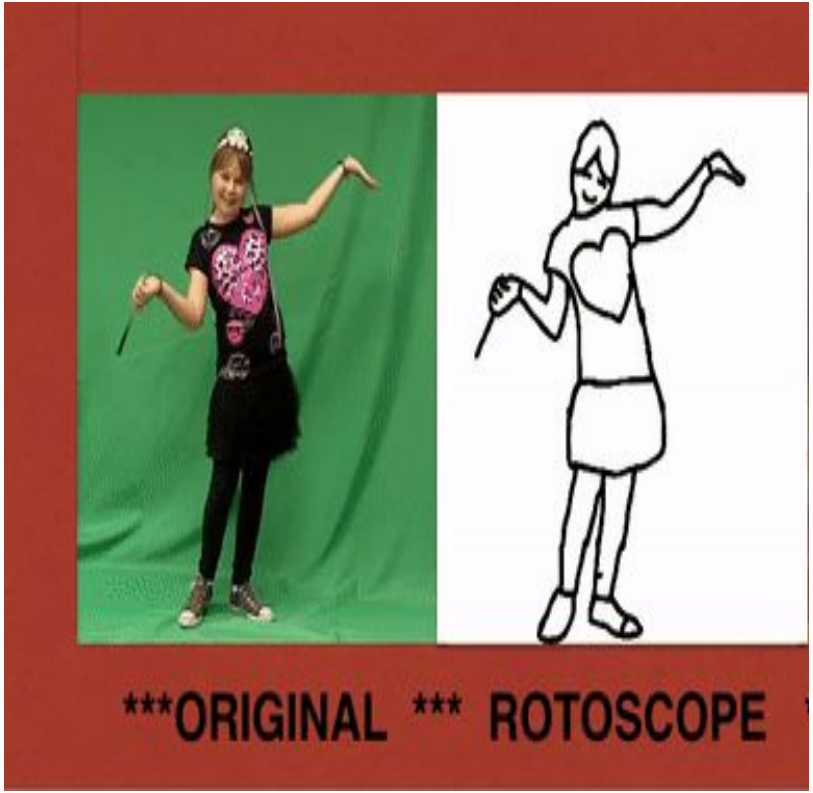
Motion Capture

What is Motion Capture?

- Recording object movement through specialized cameras and mapping them onto a character model.

History

- Motion Capture in animated movies was first created using the extension of “Rotoscoping Technique”.
- Invented by Max Fleischer in 1915



How Rotoscoping works?

- Capture video
- Tracing
- Post processing

Today , software has made rotoscoping easier

Disadvantage

- Insanely time consuming

Advantage

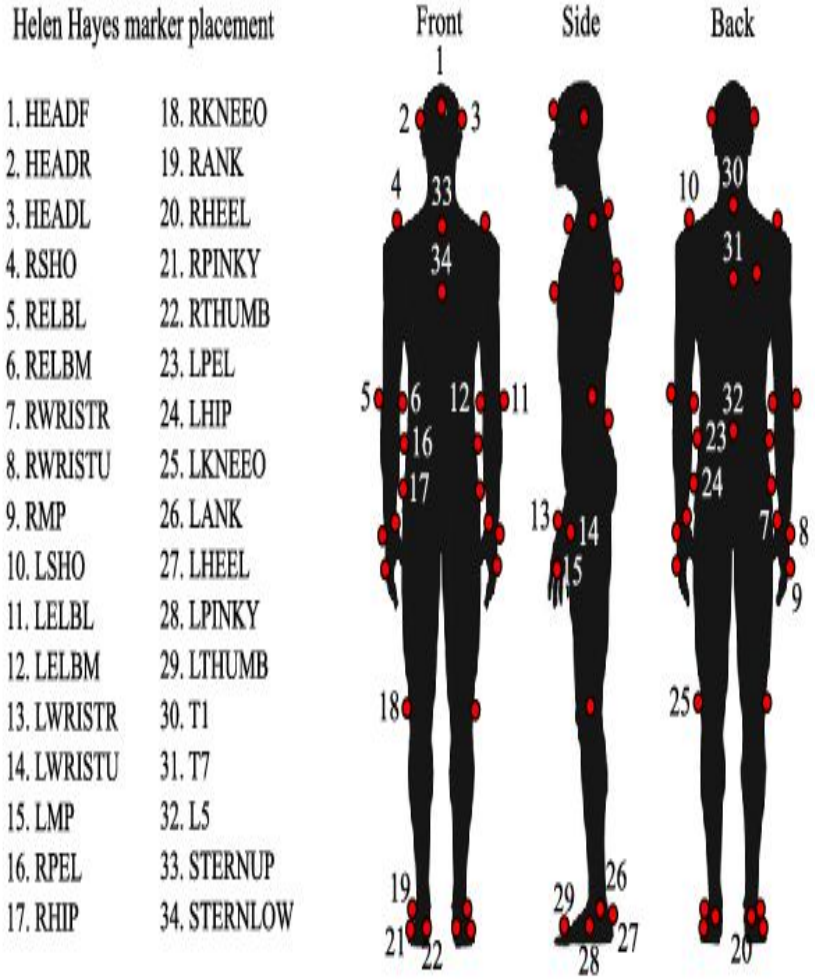
- Animating complex movements

Motion Capture Technique

Optical Motion Capture

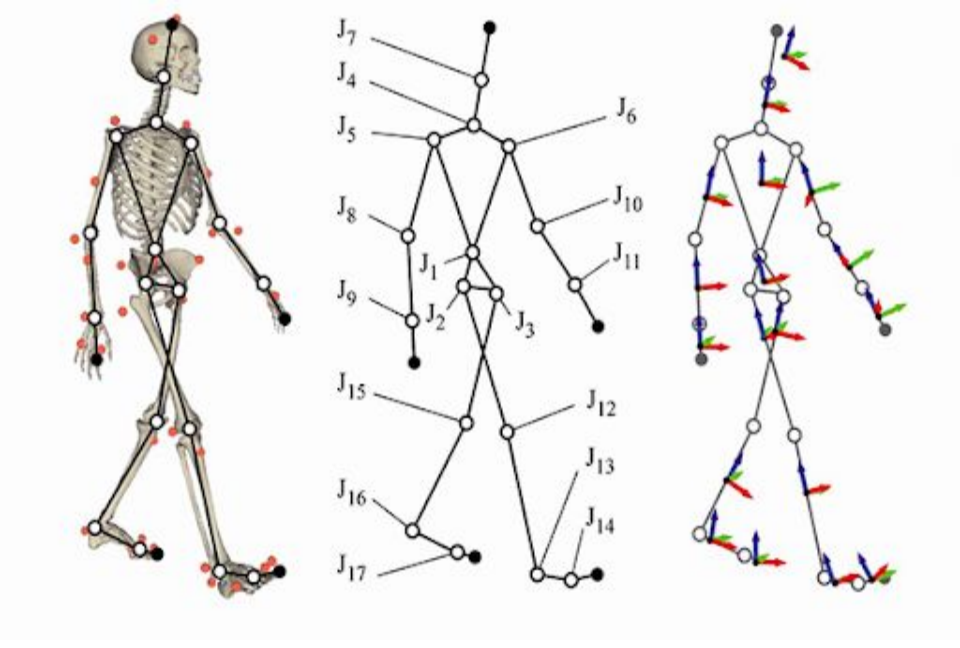
- The capture is based on optical shooting several synchronized cameras
- 2 to 32 cameras controlled by computer

Labeled Marker Placement



Skeleton Graph

- Skeleton maintained as graph

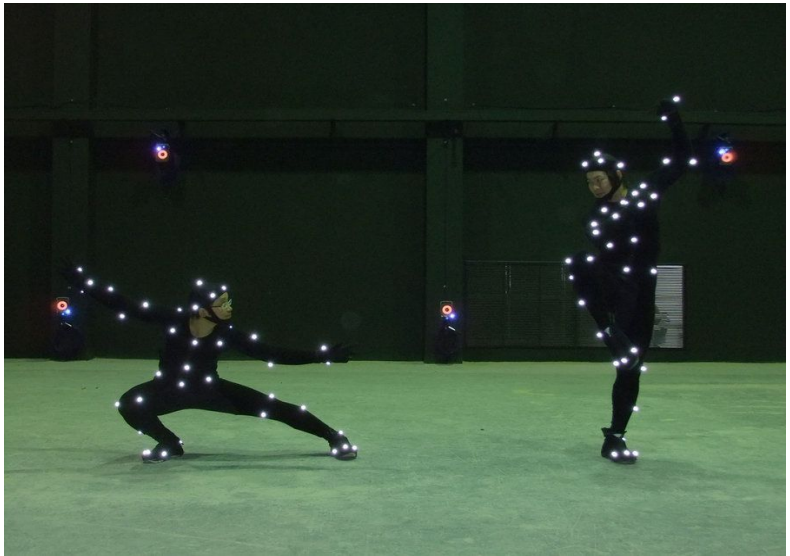


Detecting and Locating Markers

- Requires basic image processing technique

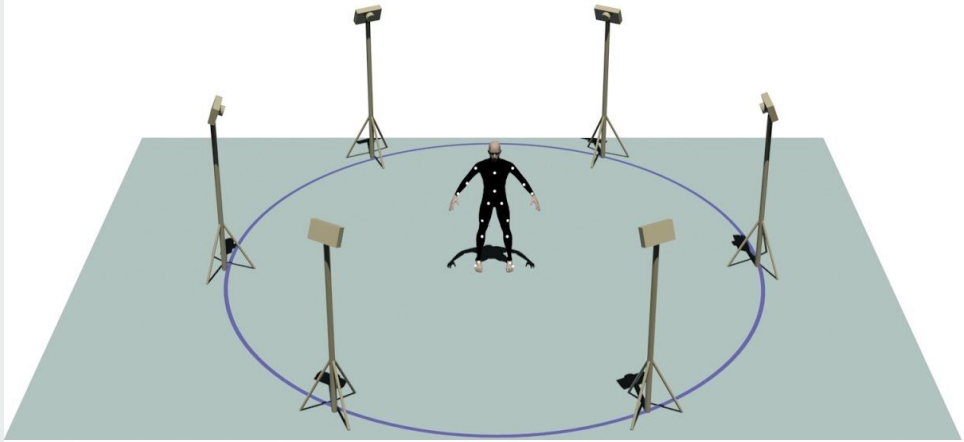
Operating principle is similar to radar

Infrared Camera

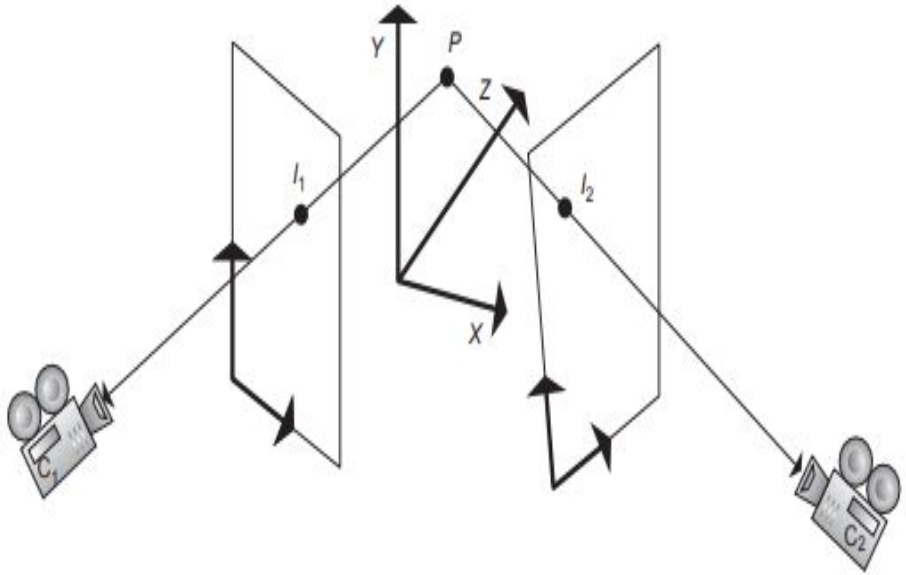


How to construct 3D image ?

- We only have multiple camera views that too in 2D



Triangulation



3D coordinates of the point P can be recovered by calculating the intersection of the two vectors (i1-C1) and (i2-C2)

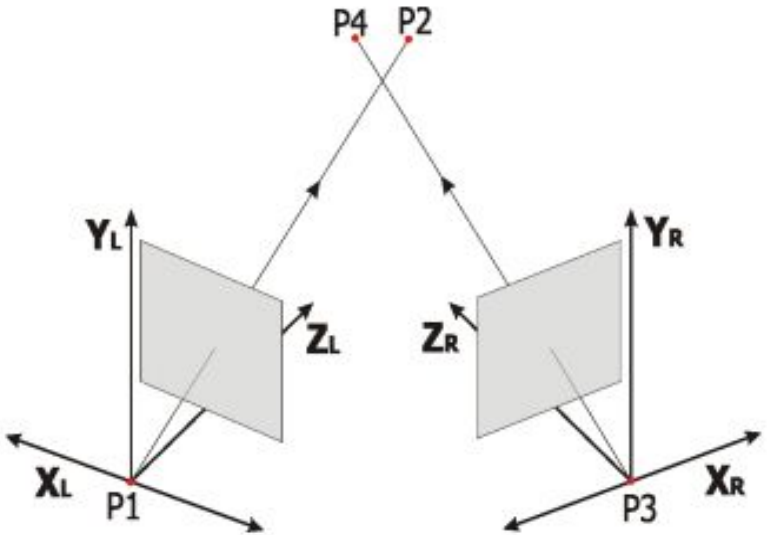
$$C_1 + k_1(I_1 - C_1) = P$$

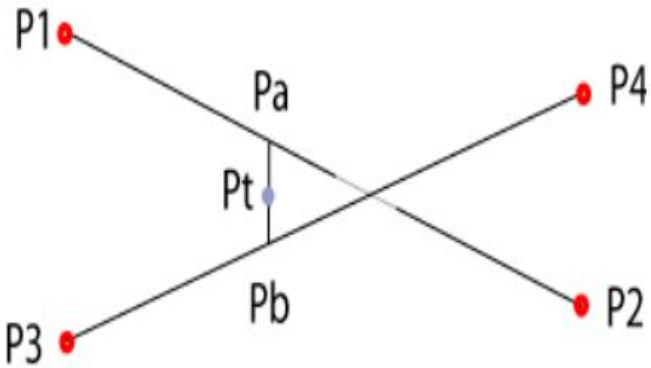
$$C_2 + k_2(I_2 - C_2) = P$$

$$C_1 + k_1(I_1 - C_1) = C_2 + k_2(I_2 - C_2)$$

Noise tends to complicate the ideal world!

- Slight disturbance in camera position





Find minimum chord ?

Continued....

$$P_a = P_1 + \mu_a(P_2 - P_1)$$

$$P_b = P_3 + \mu_b(P_4 - P_3)$$

$$(P_a - P_b).(P_2 - P_1) = 0$$

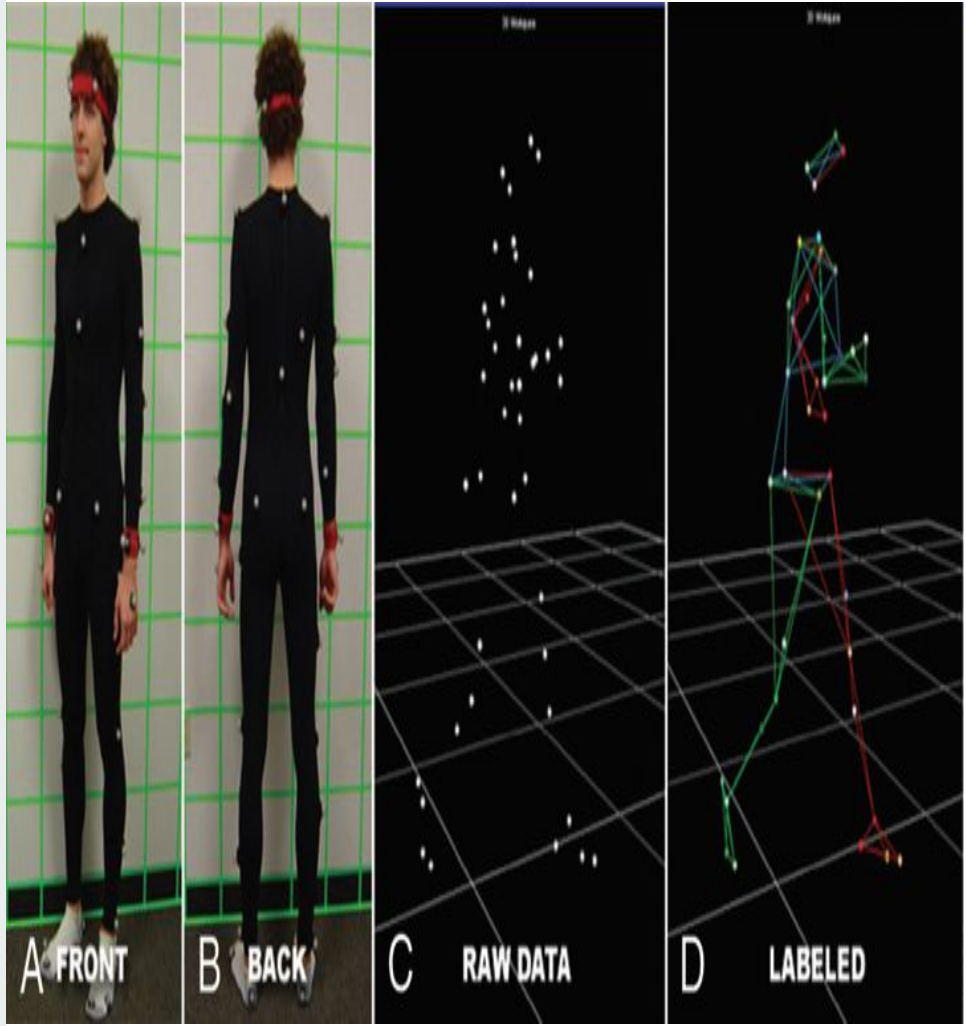
$$(P_a - P_b).(P_4 - P_3) = 0$$

$$(P_1 - P_3 + \mu_a(P_2 - P_1) - \mu_b(P_4 - P_3)).(P_2 - P_1) = 0$$

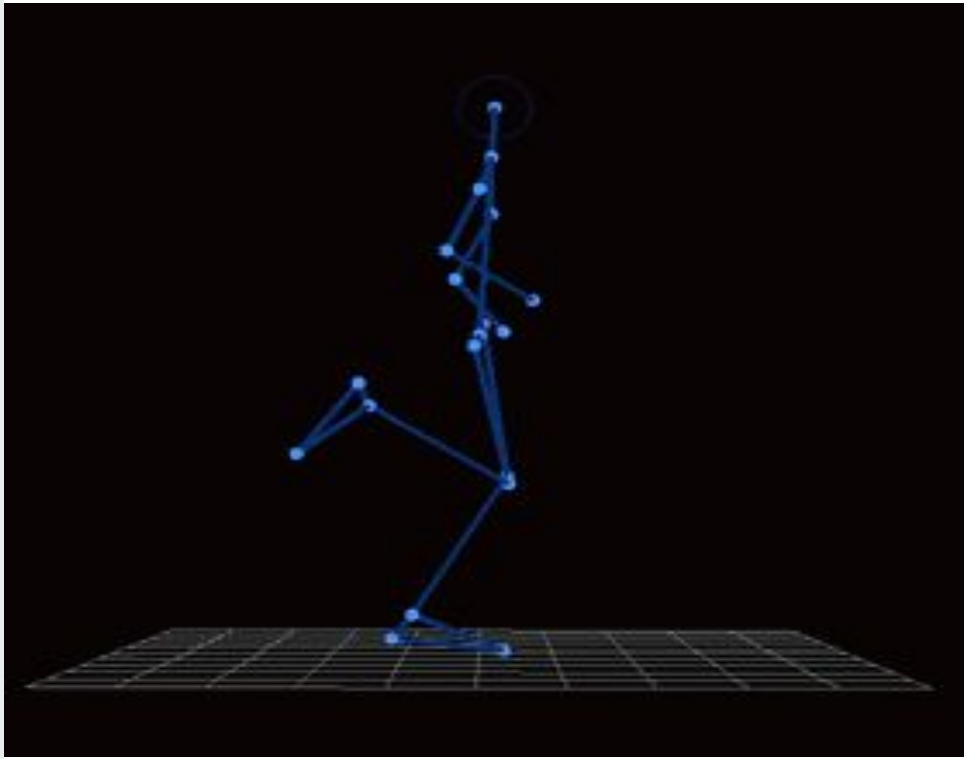
$$(P_1 - P_3 + \mu_a(P_2 - P_1) - \mu_b(P_4 - P_3)).(P_4 - P_3) = 0$$

$$P_t = \frac{(P_a + P_b)}{2}$$

Workflow



Skeleton



Next ?

- Data given to animator
- Manipulation of digital skeleton
- Helps character creation

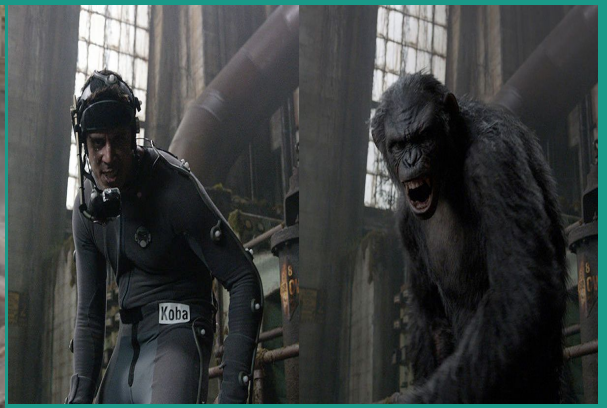
Applications

Entertainment : Live Action Films

Avatar

Avenger

Dawn of the Planet of Apes



Video Games

Science & Engineering