Animation Principles

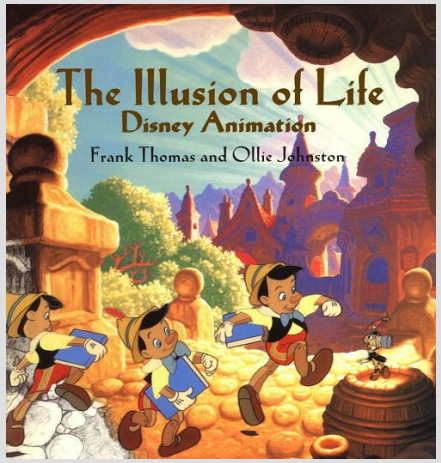
- From

  "Principles of Traditional Animation Applied to 3D Computer Animation"

  John Lasseter, ACM Computer Graphics, 21(4), 1987

- In turn from

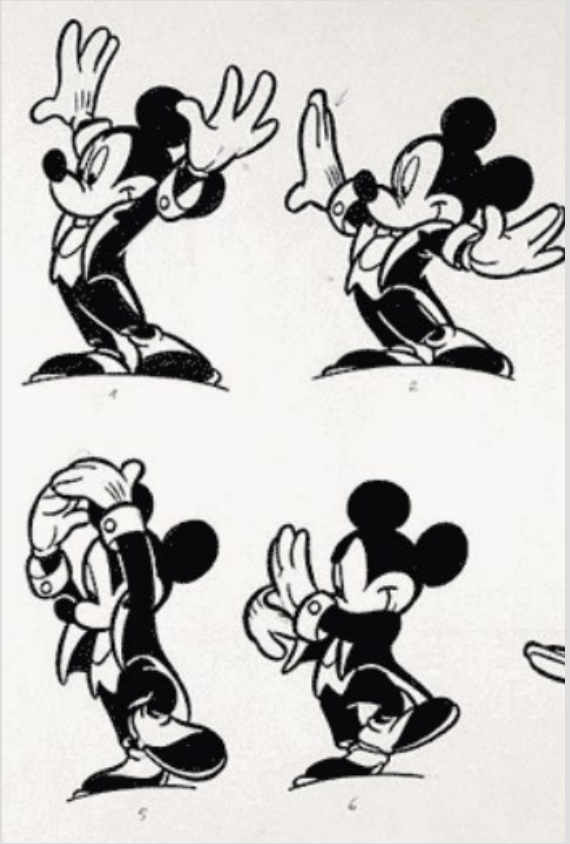
  "The Illusion of Life"



Principles of Animation

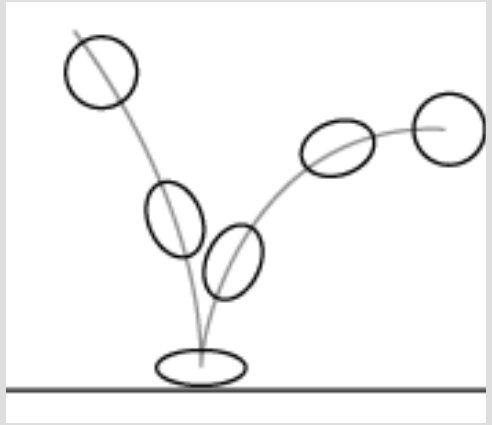
- Animators used old cartoon formula of standardized shapes, sizes, actions, gestures
  - little reference to nature

- Between 1920's – 1930's animation grew from a novelty to an art form at Walk Disney Studio
  - Actions became more convincing
  - Characters were emerging as true personalities
  - Classes in Disney on animation, which let to new set of animation rules: 12 principles of animation



Principles of Animation

- 12 Principles of Animation
  1. Squash and stretch
  2. Anticipation
  3. Staging
  4. Straight ahead action and pose to pose
  5. Follow through and overlapping Action
  6. Slow in and slow out
  7. Arcs
  8. Secondary action
  9. Timing
  10. Exaggeration
  11. Solid drawing
  12. Appeal



Principles of Animation

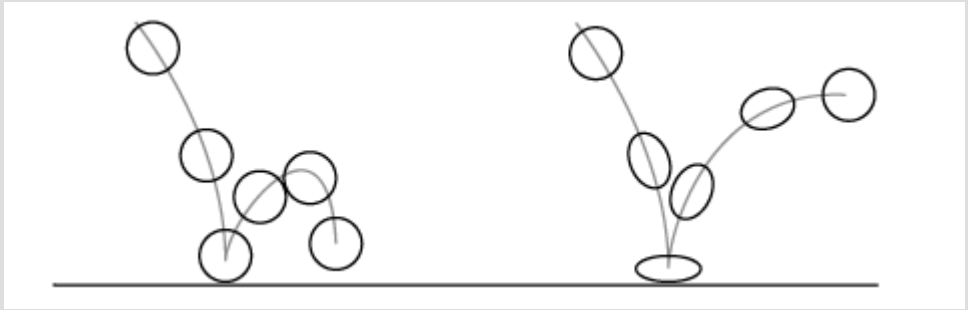
- Though originally intended to apply to traditional, hand-drawn animation, the principles still have great relevance for today's more prevalent computer animation.
  - Meaning stayed the same, but application changed due to difference in medium between 2D and 3D
- Character animation is about an artist bringing a character to life
- Use the principle of animations to create
  - Characters with personalities
  - Convincing actions and scenes
- These will increase user engagement with a game
  - But beware uncanny effects…

1. Squash and Stretch

- Living creatures always deform in shape in some manner
  - Bend your arm
- Defines the rigidity and mass of an object by distorting its shape during an action.
  - Determines feeling of weight, flexibility, response to pressure.
  - The volume of the object should remain constant at rest, squashed, or stretched
  - If rule is not obeyed, then the object appears to shrink when squashed and grow when stretched

Squash and Stretch

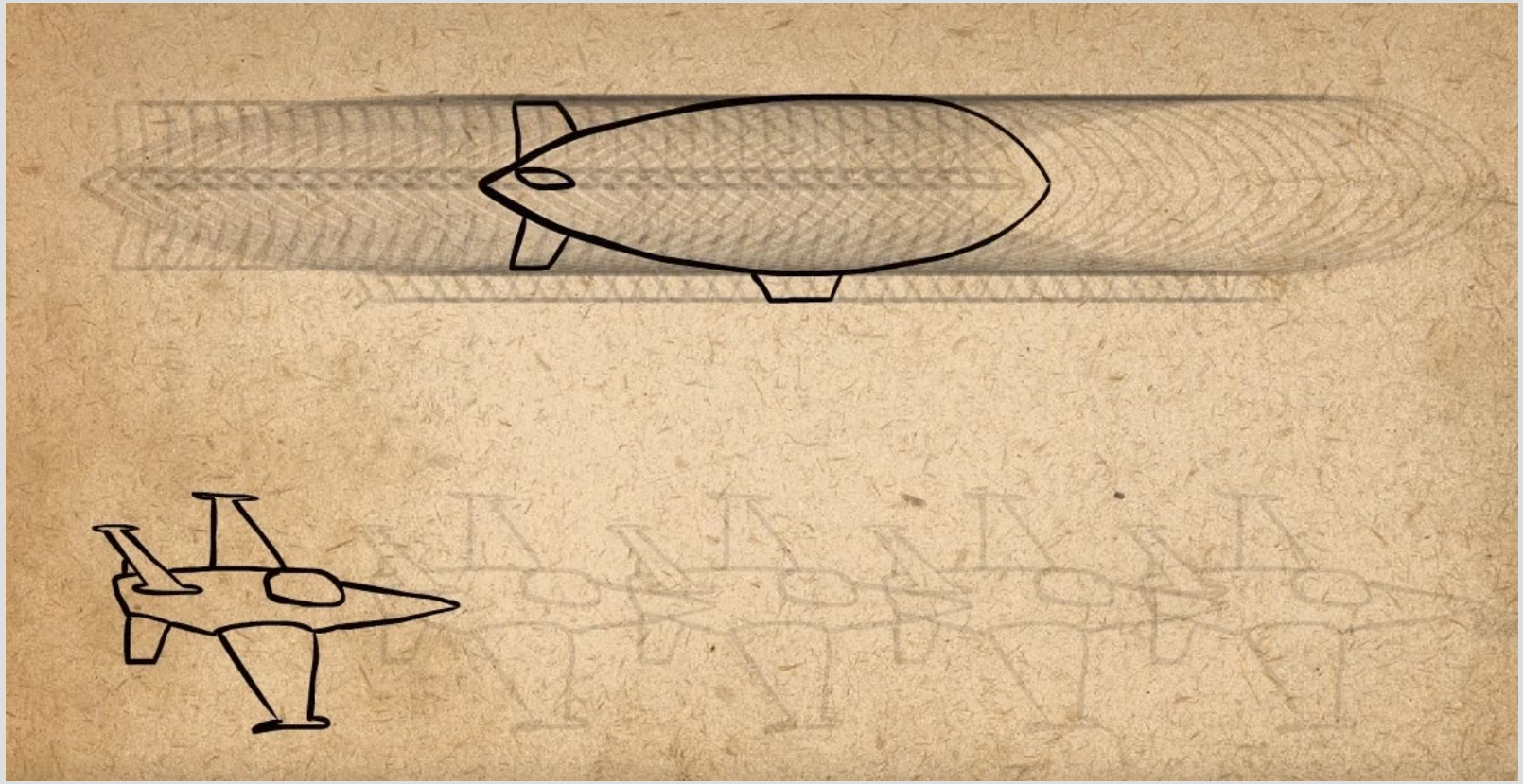
- Can be accomplished by scaling in 3D systems
  - Make sure to conserve volume
  - A squash in one direction must be accompanied by a stretch in the other directions
  - You do not need to deform all objects to show this principle
    - in the case of Luxo, Jr., you have a hinged object that is capable of folding in on itself (squash) and extending itself (stretch).



Squash and Stretch

2. Timing

- The personality and nature of an animation is greatly affected by the number of frames inserted between each main action



Timing

- Rate of acceleration conveys weight
  - Hit heavy ball vs. light ball
- Speed and acceleration of character's movements convey emotion
  - examples with same keyframes, different times:

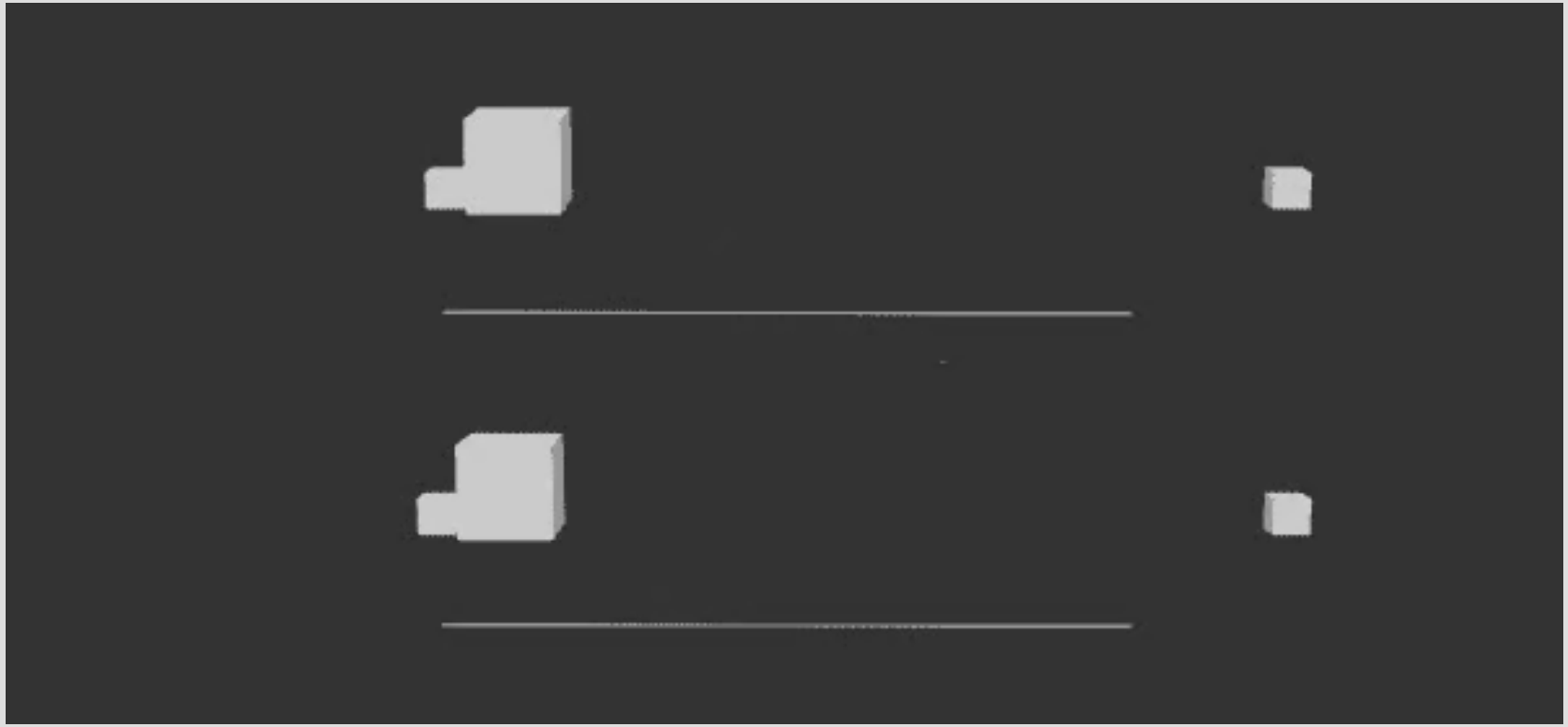
60fr: looking around

30fr: "no"

5fr: just been hit

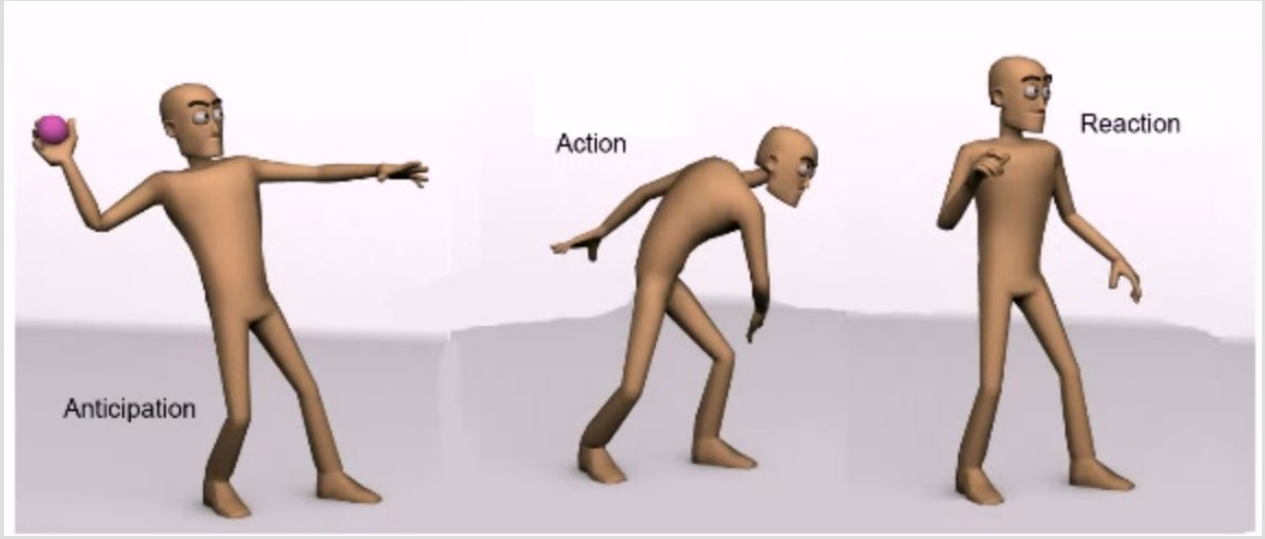
Michael B. Comet - Character Animation: Principles and Practice
http://schools.sd68.bc.ca/well/onlineCourses/DMD11/cometcartoonhelp/index.html

Timing



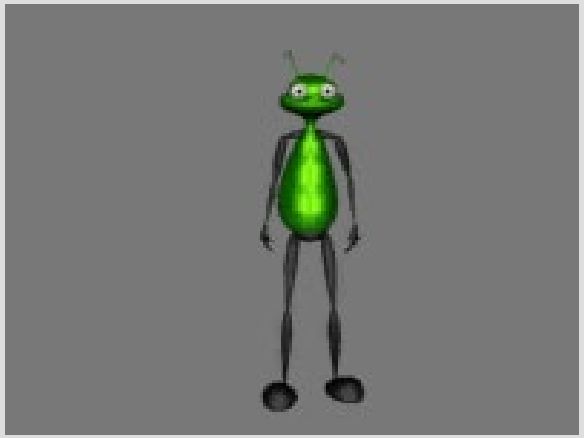
3. Anticipation

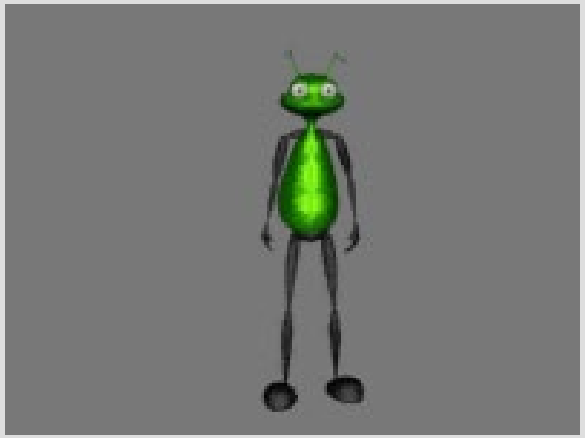
- An "anatomical provision" for an action
  - There are 3 parts to an action
    - Anticipation, Action, Reaction
  - Avoids abrupt, stiff, unnatural actions
  - Foot has to be pulled back before it can kick a ball



Anticipation

- Prepare the audience for an action
- Make the action appear more realistic
- To direct audience's attention
  - Can be used to mislead: prepare audience for one thing and jump to a surprise outcome

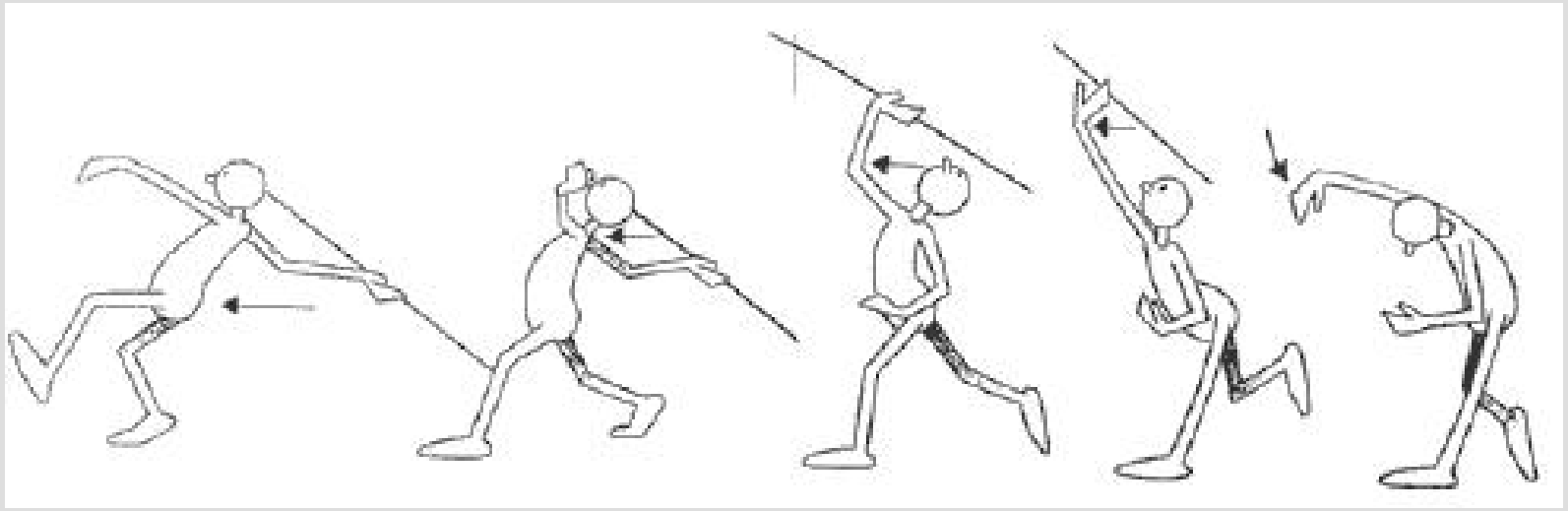




Anticipation

4. Follow Through

- Overlapping motion
- Motion doesn't stop suddenly
- Pieces continue at different rates
- One motion starts while previous is finishing, keeps animation smooth

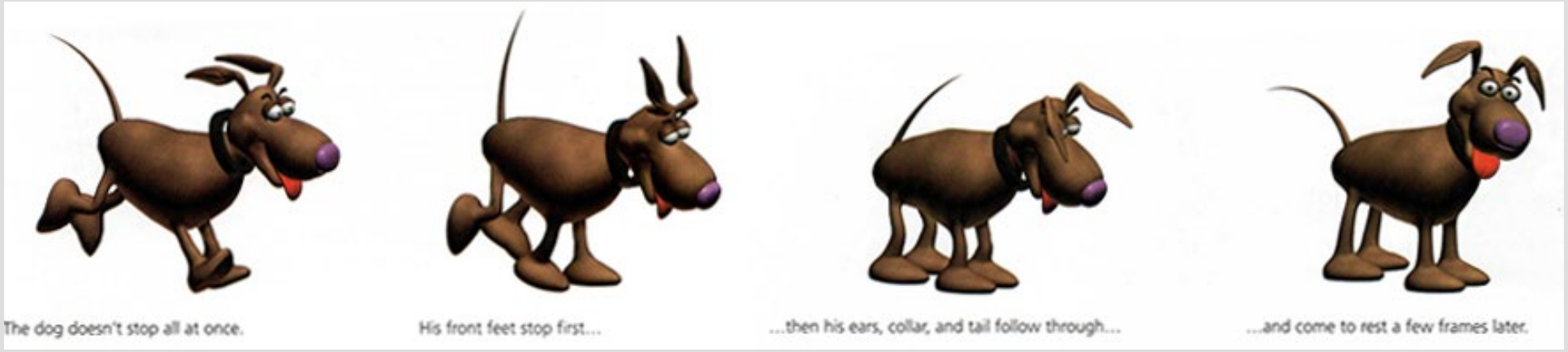


Follow Through

- The dog does not stop all at once
  - His front feet stop first…

    …the his ears, collar, and tail follow through…

    …and come to rest a few frames later



Follow Through

- Walt Disney Quote:

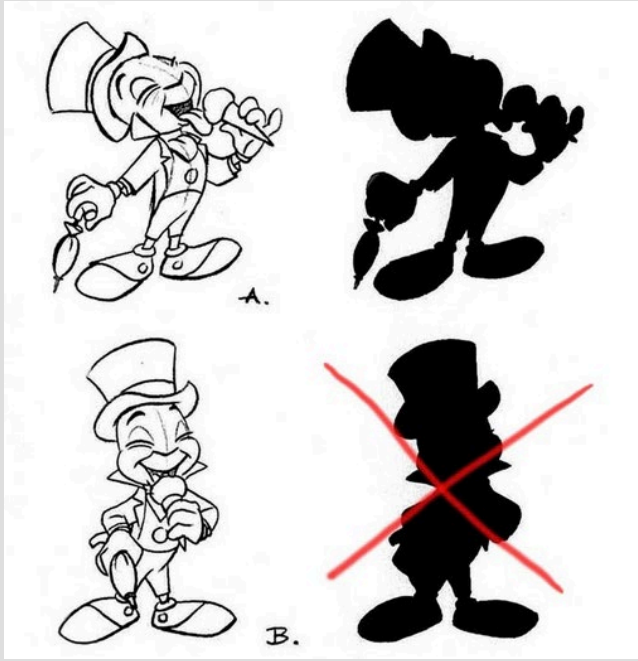
  *"It is not necessary for an animator to **take** a character to one point, complete that action completely, and then turn to the following action as if he had never given it a thought until after completing the first action.*

- *When a character knows what he is **going to do** he doesn't have to stop before each individual action and **think to do it**. He has it **planned** in advance in his mind"*

Follow Through

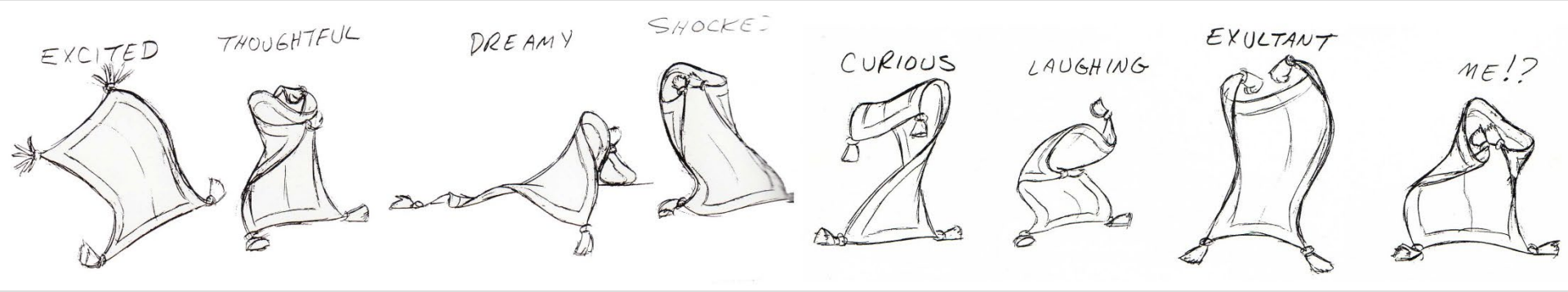
5. Staging

- Presentation of an idea so that it is completely and unmistakably clear
- Audience looking in right place
  - Placement of a character in the frame
  - Object with different speed
  - Light and shadow
  - Camera position
- Focus on what is relevant
- Avoid unnecessary detail
- Present only one idea to the audience at a time

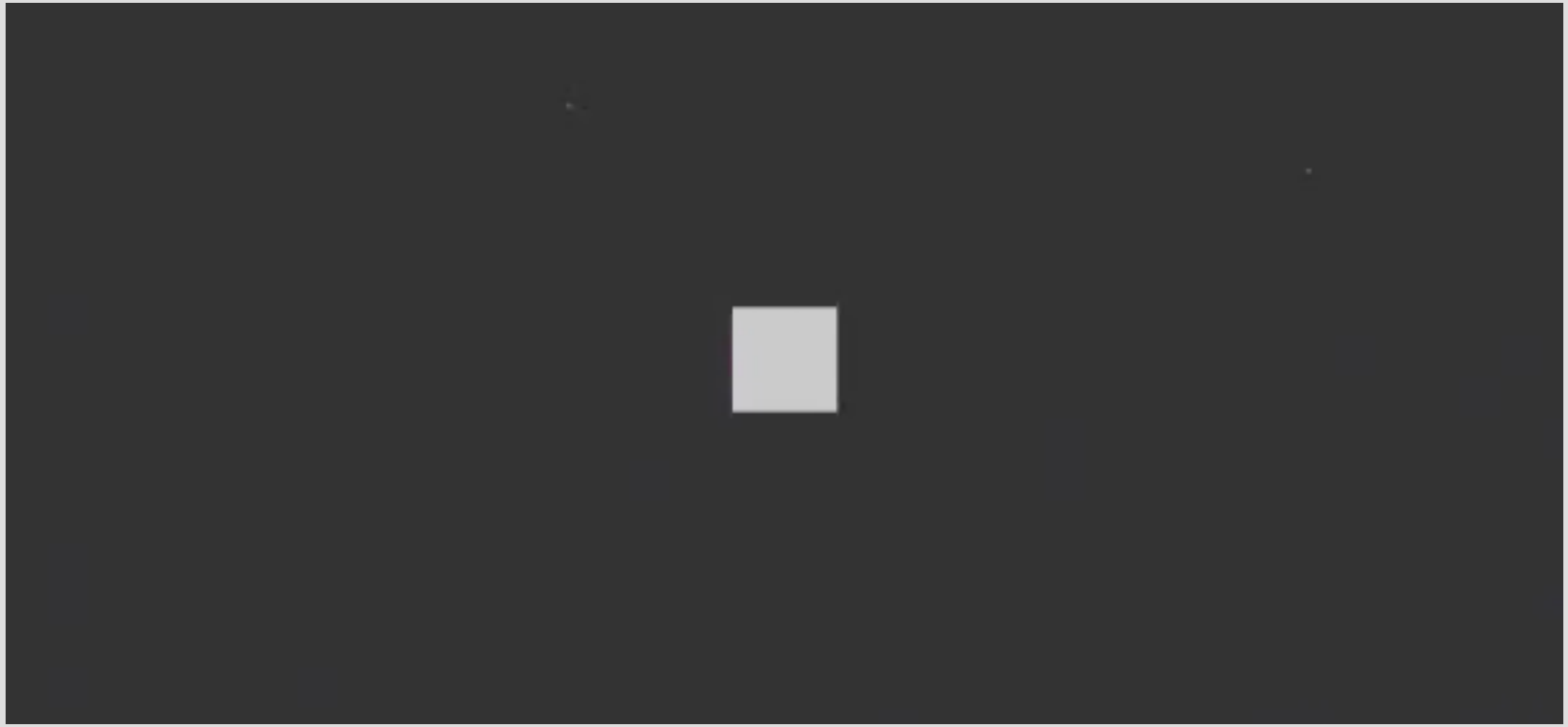


Staging

- A simple character can show a great deal of emotion simply through the pose of the body

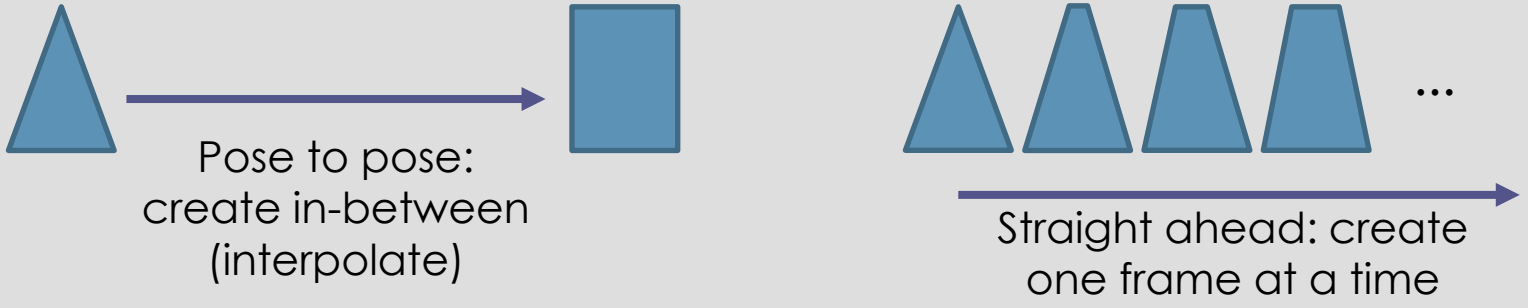


Staging

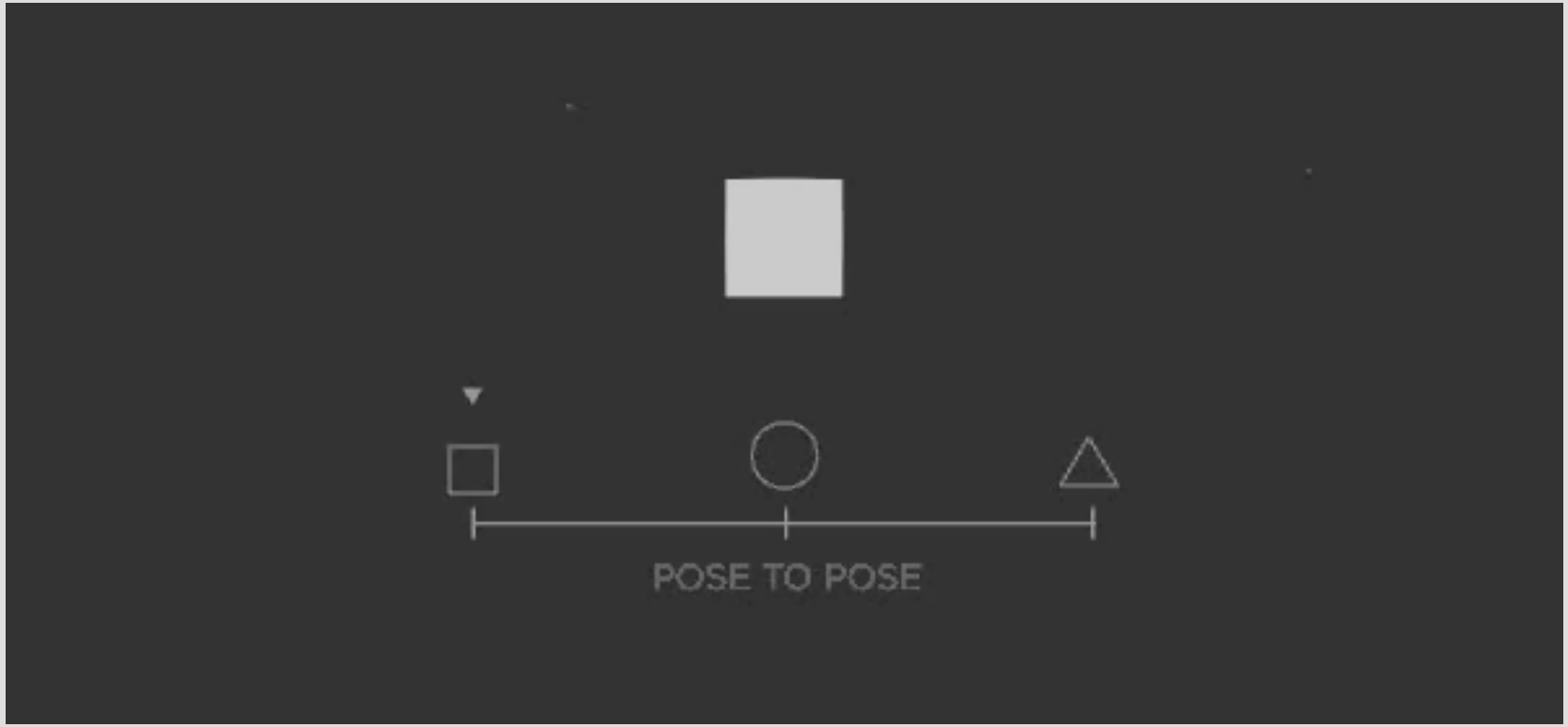


6. Straight ahead vs. Pose to pose

- 2 main approaches to traditional animation
  - **Pose-to-pose:** Setting up key poses & then creating in-between images
    - better for dramatic or emotional scenes
  - **Straight ahead:** Animator sets up objects one frame at a time
    - more fluid, dynamic illusion of movement, better for producing realistic action sequences
    - hard to create exact, convincing poses along the way

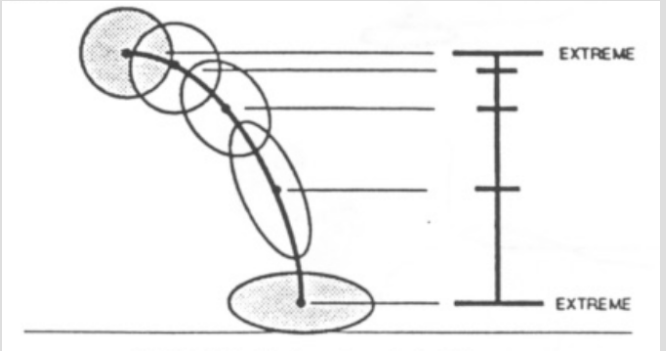


Straight ahead vs. Pose to pose



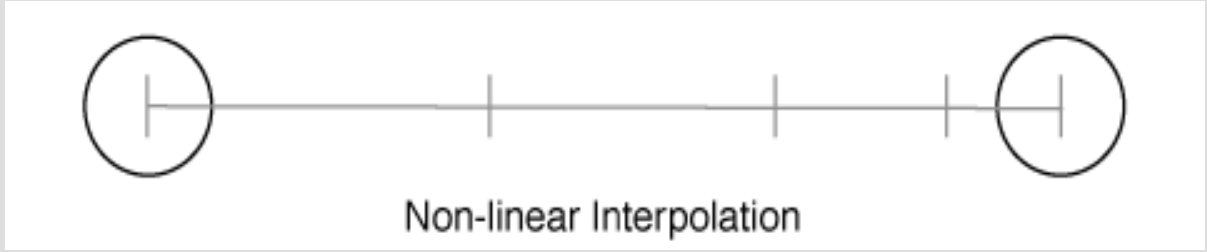
7. Ease-in and Ease-Out

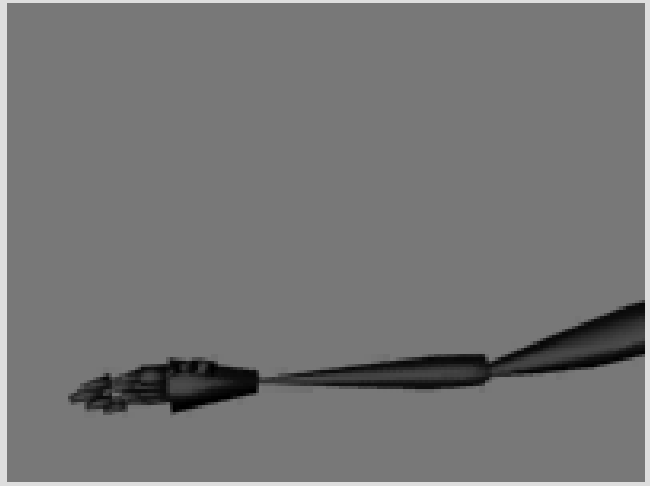
- Also called "Slow-in and slow-out"
- Deals with the spacing of the in-between drawings between the extreme poses
- In early animation everything was slow or fast
- Grouping in-betweens closer to each extreme achieves a very spirited result
- Animator indicates the placement of in-betweens, with a timing chart

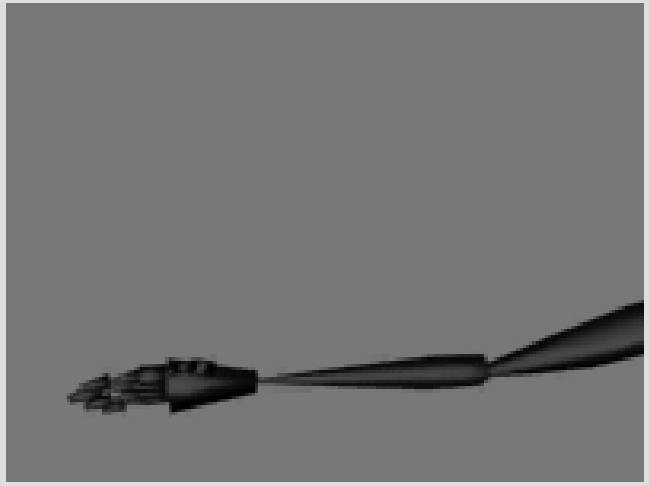


Ease-in and Ease-Out

- Movement doesn't start & stop abruptly.
- Also contributes to weight and emotion
- Stops limbs from looking too stiff /mechanical



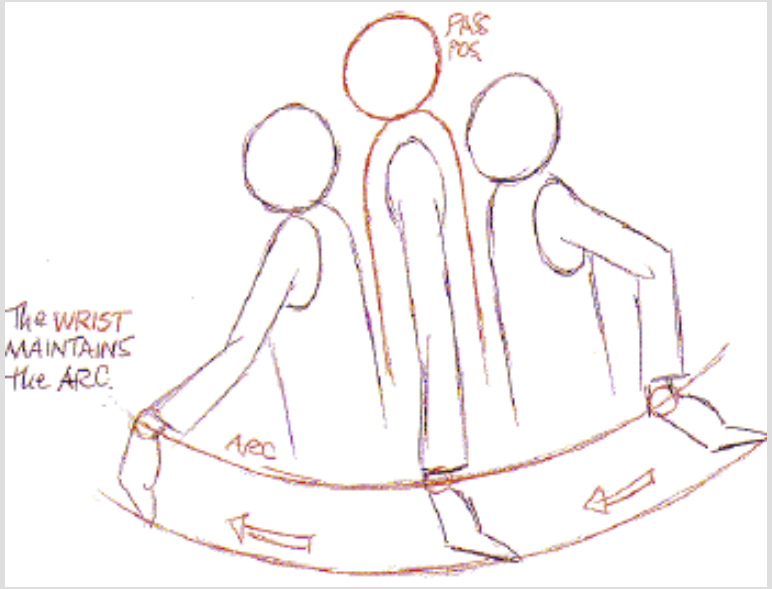


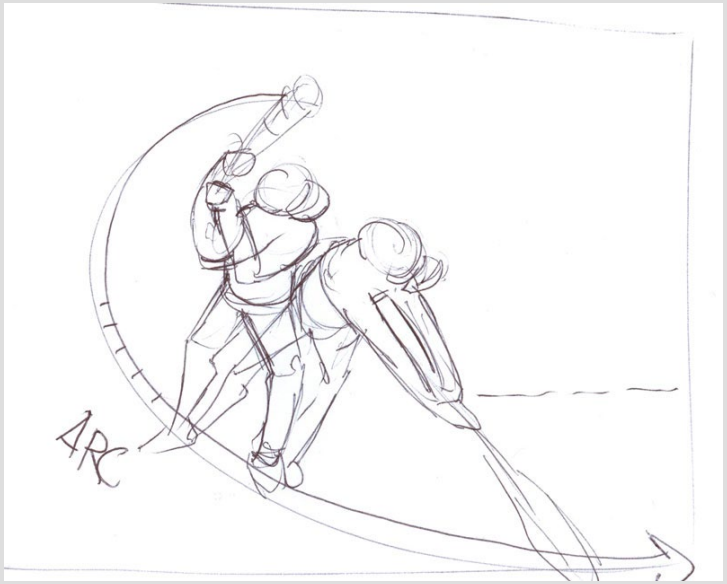


Ease-in and Ease-Out

8. Arcs

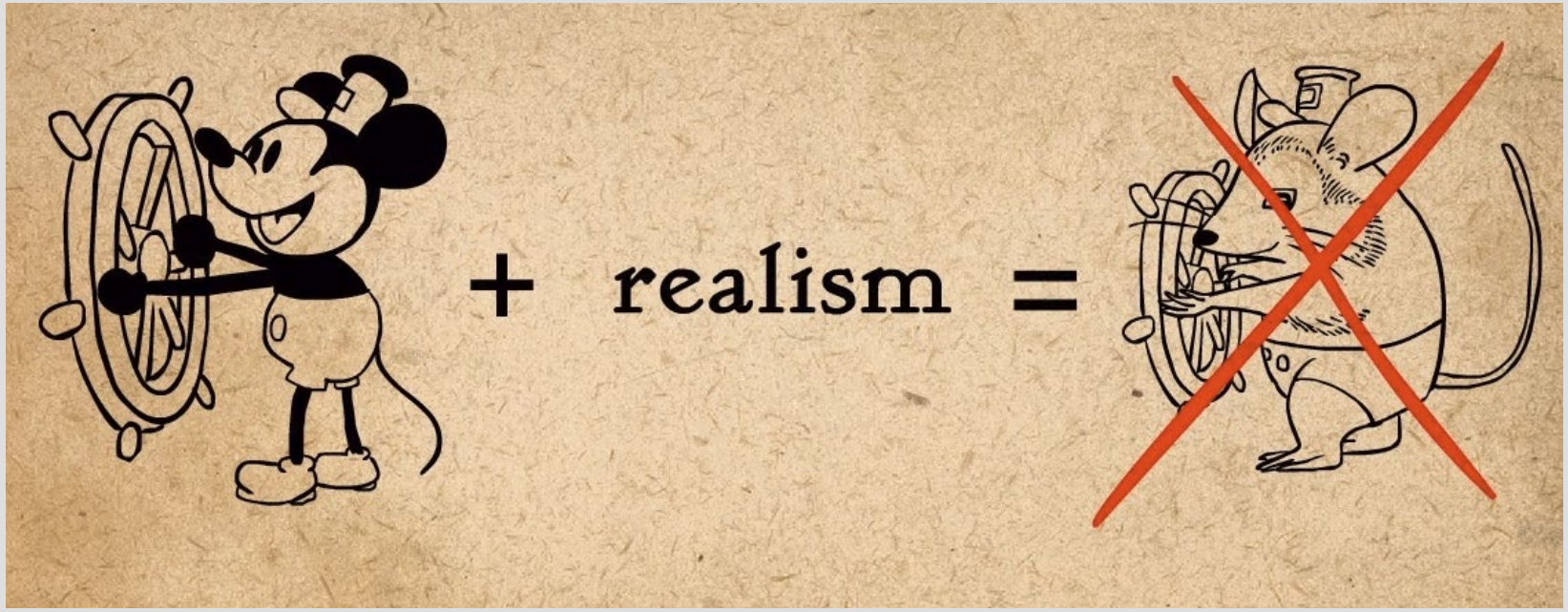
- Almost all natural actions move in arcs
  - Most economical route from one place to another
  - Motion follow curved paths rather than linear ones
- Stops motion from looking mechanical





Arcs

9. Exaggeration

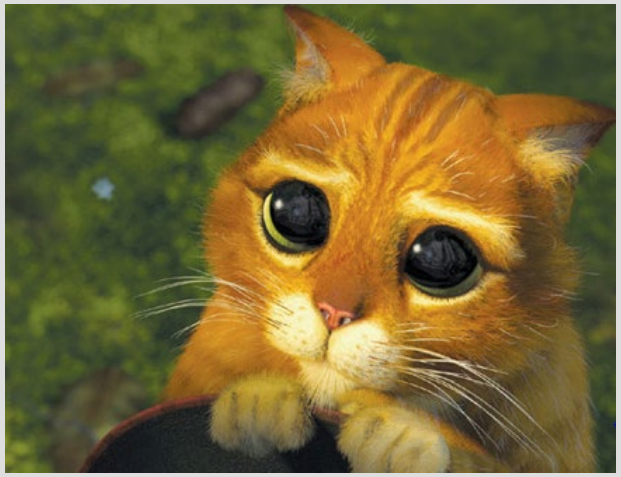


Exaggeration

Exaggeration

- Perfect imitation of reality
  can look static
  and dull in cartoons

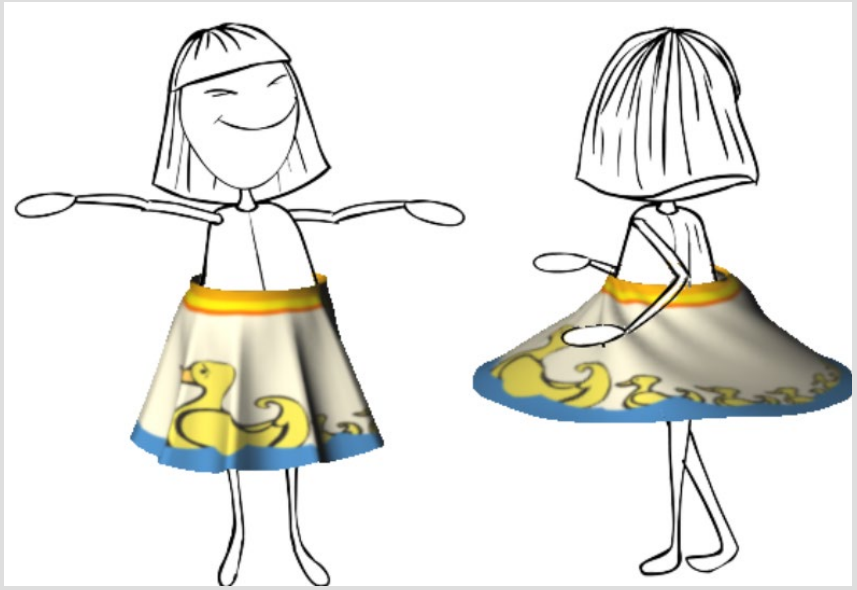
- Exaggeration
  - Helps make actions clear
  - Helps emphasize
    story points and emotion
  - Must balance with
    non-exaggerated parts



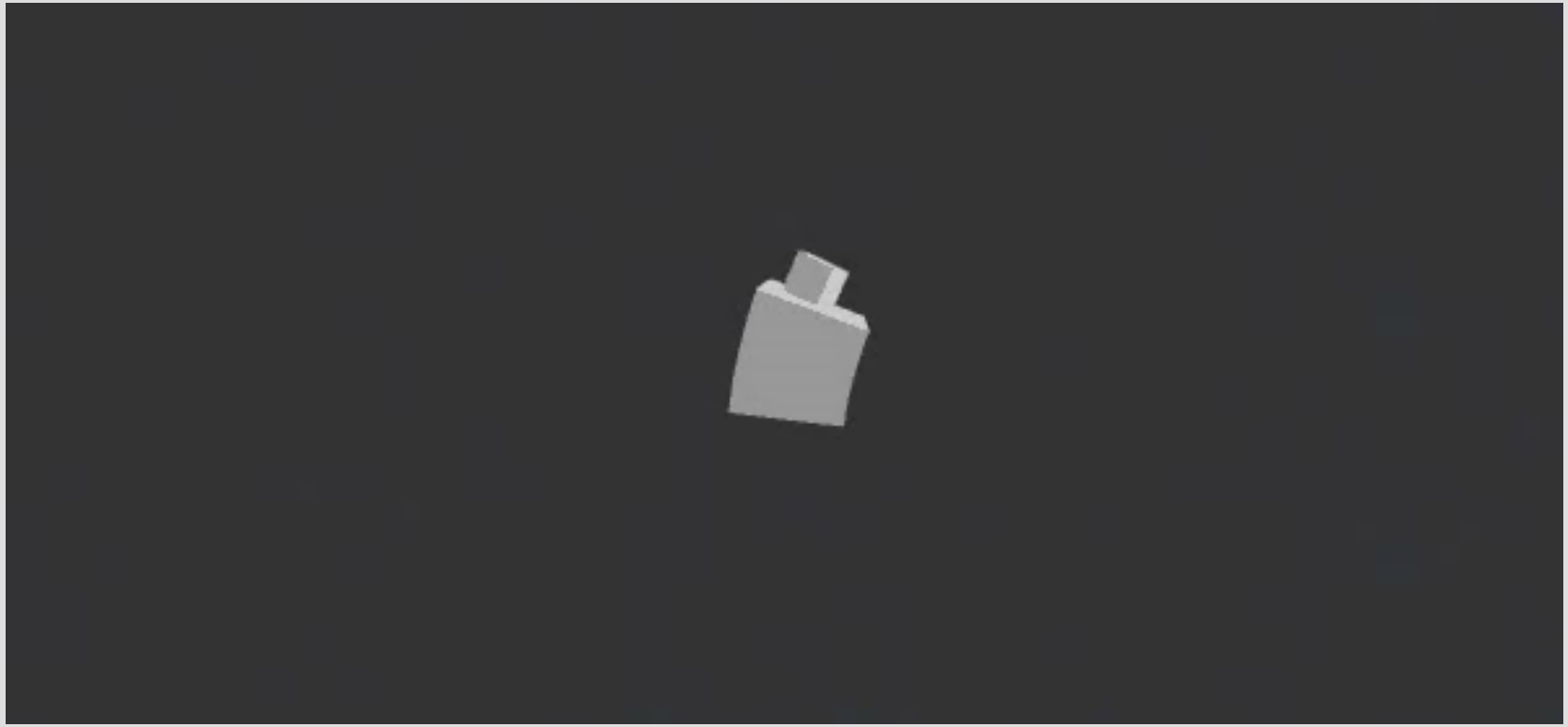
Exaggeration

10. Secondary Action

- Motion that results from some other action
- Needed for interest and realism
- Shouldn’t distract from primary motion



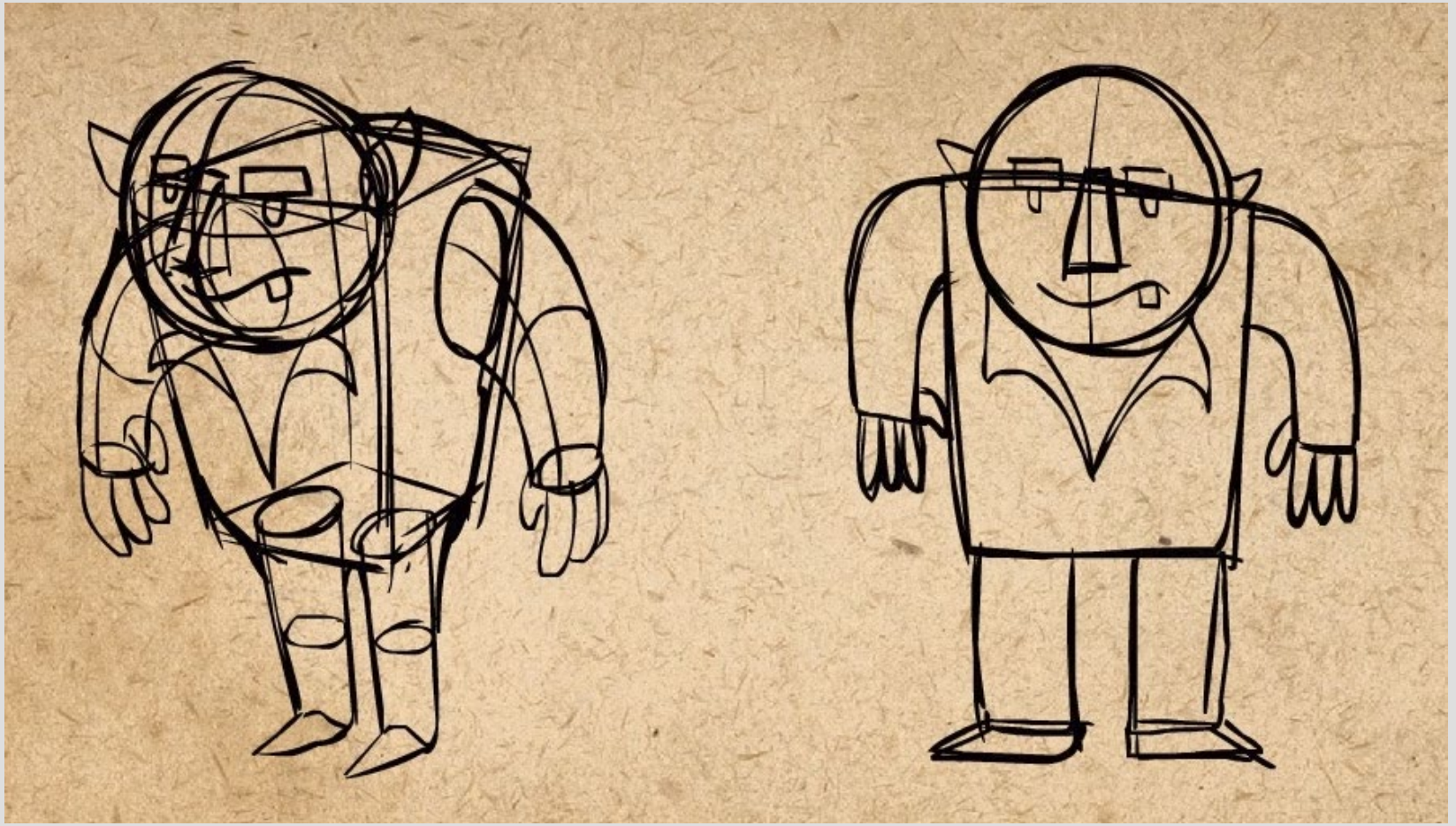
Secondary Action



11. Solid drawing

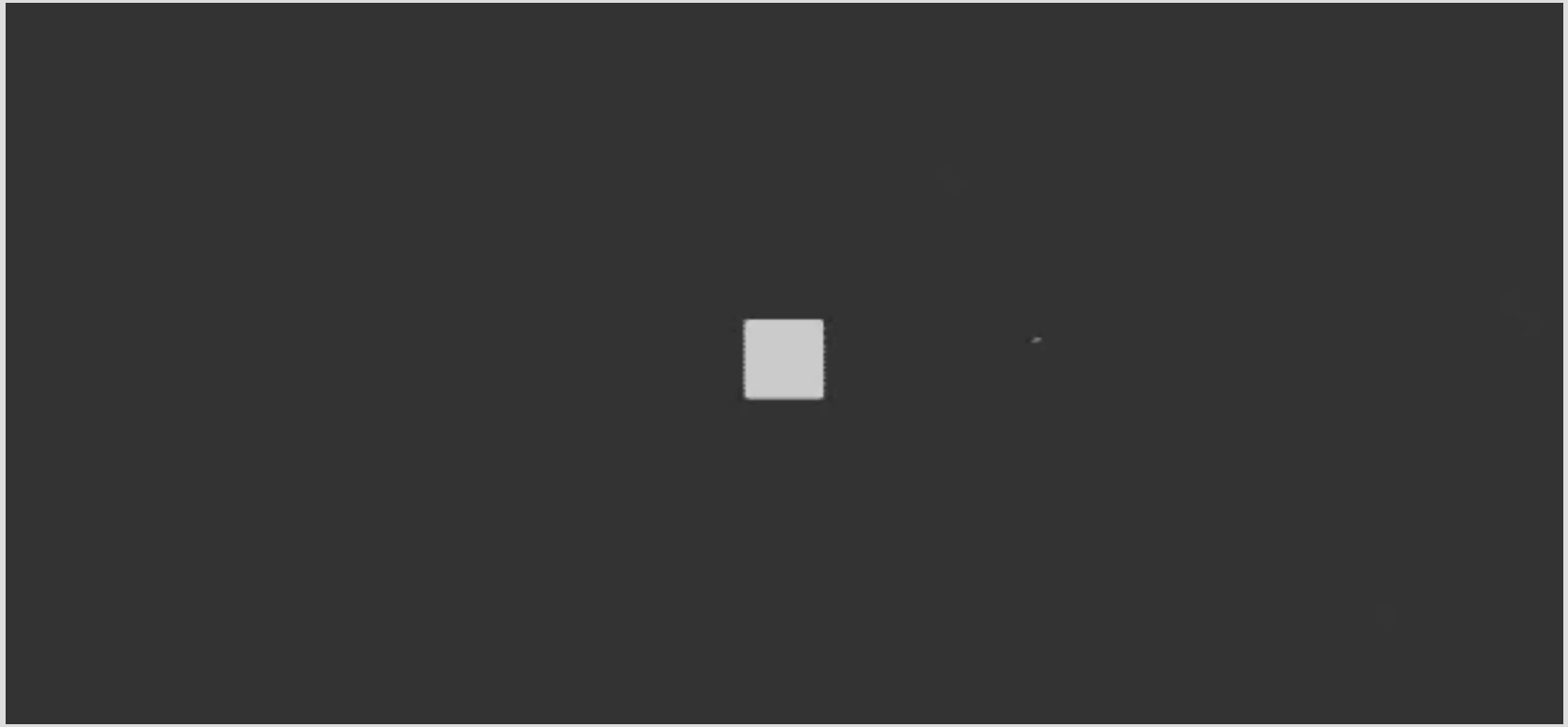
- Means taking into account form in three-dimensional space: give them volume and weight
- Need to understand the basics of three-dimensional shapes:
  - Anatomy,
  - Weight,
  - Balance,
  - Light and shadow,
  - Etc
- Graphics provides information about perspective

Solid Drawing



Youtube AlanBeckerTutorials

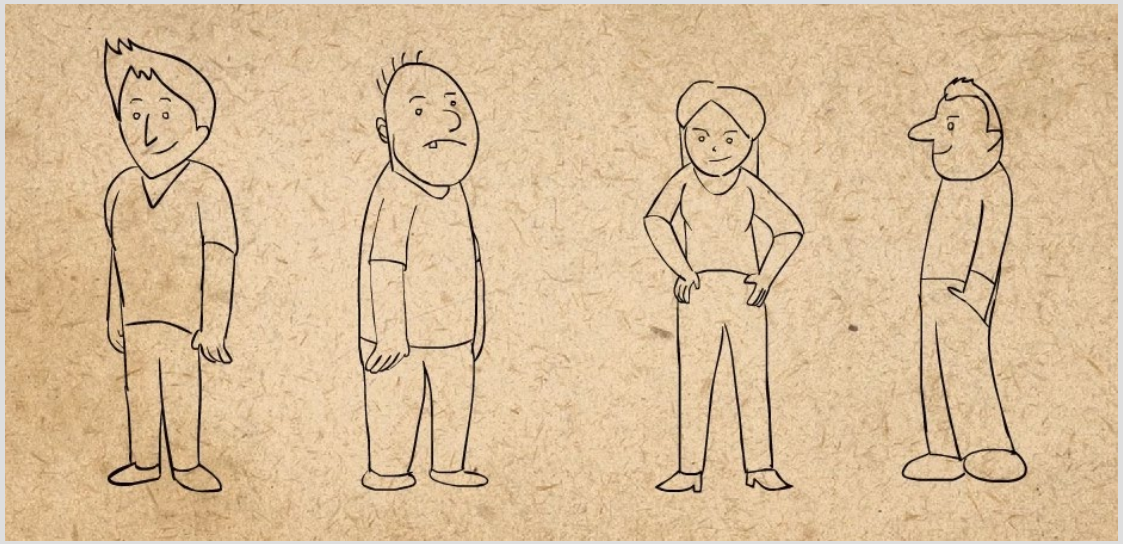
Solid drawing



12. Appeal

- Attractive to the eye, strong design
- Complicated objects can lack appeal
- Viewer feels the character is real and interesting, even villains
- Appealing poses aren't symmetric – avoid symmetries

Appeal – variety of shapes



Appeal – keep it simple

Symmetry

- Symmetry and “twins” usually create less interesting poses
  - E.g., relevant for Stagging, Solid Drawing, Appeal…

Character locked in a very symmetrical pose, full of twins, which is not very interesting.

Rotating the hips forces the spine to twist to maintain balance. This more asymmetrical pose makes the character look more natural

Symmetry

Pose symmetrical in almost every respect.
This is also boring in almost every respect.

Symmetry is broken in a number of place.
Both these poses are more interesting and more natural.

Personality

- Action of character is a result of its thoughts
- Must know purpose and mood before animating each action.
- No two characters move the same way.

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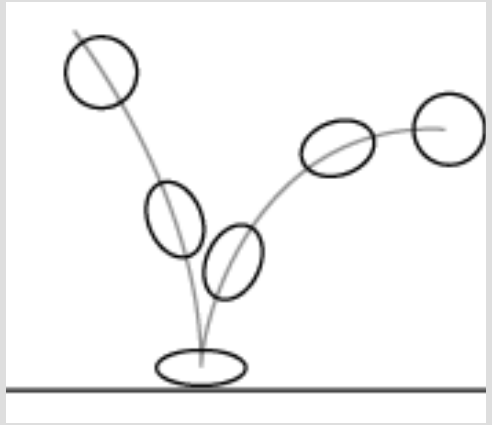
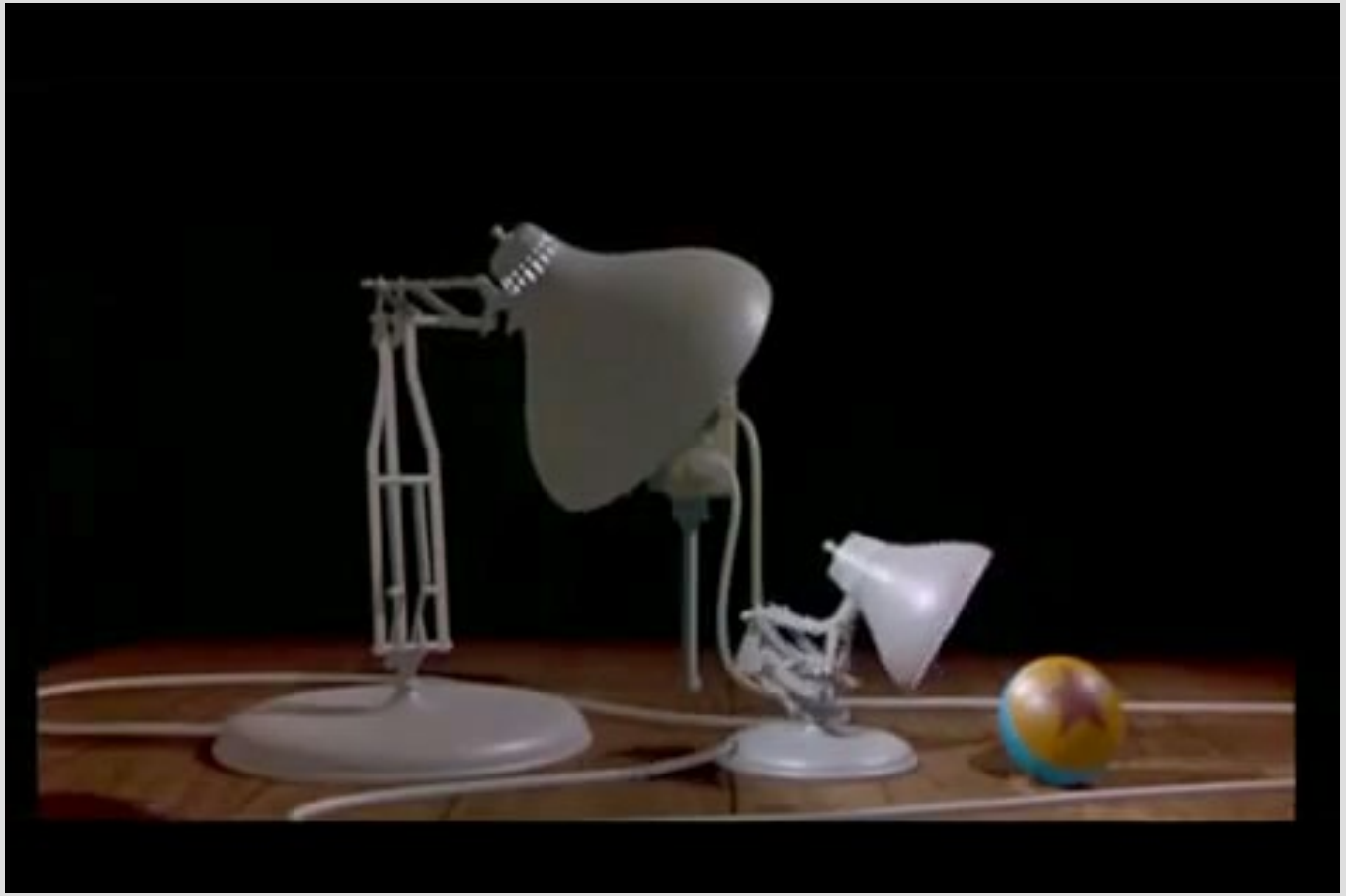


Principles of Animation
- a case study -

Luxo Jr. (1986)

- First pixar short movie



https://www.youtube.com/watch?v=6G3O60o5U7w