3D ANIMATION PRINCIPLES

Agenda

- **Categories of Animation**
- **Principles of animation**
  - Squash and Stretch
  - Anticipation
  - Staging
  - Straight Ahead Versus Pose To Pose
  - Slow In and Slow Out
  - Arcs
  - Secondary Actions
  - Timing
  - Exaggeration
  - Solid Drawing
  - Appeal

Categories of Animation

Two main categories:

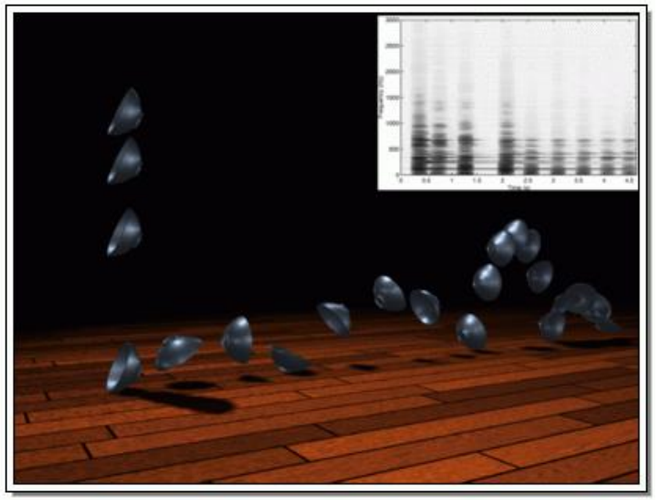
- **Computer-assisted animation**
  - 2D & 2 1/2 D
  - Inbetweening
  - Inking, virtual camera, managing data, etc

- **Computer generated animation**
  - Low level techniques
    - Precisely specifying motion
  - High level techniques
    - Describe general motion behavior

Computer generated animation

- Low level techniques
  - Shape interpolation (in-betweening)
  - Have to know what you want

- High level techniques
  - Generate motion with set of rules or constraints
    - Physically based motion

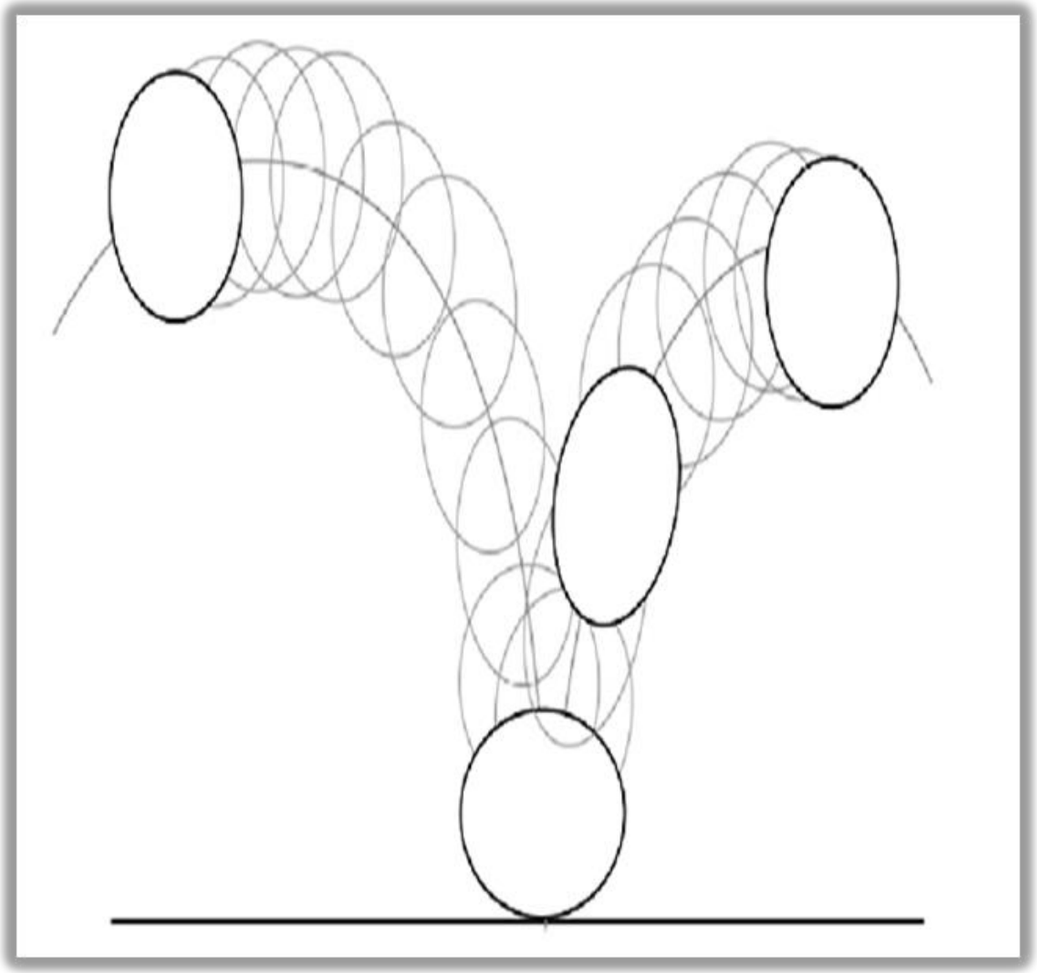


Principles of Animation

- During the late 1920’s through the 1930’s, Walt Disney worked to improve the techniques of his studio animators.
- Disney set up drawing classes for his animators at the Chouinard Art Institute in Los Angeles under Instructor Don Graham.
- Through these lessons and interaction between Disney and his staff, a set of twelve principles was developed.
- These principles were used in Disney animated productions including *Snow White*, *Pinocchio*, *Fantasia*, *Dumbo*, and *Bambi*.
- Walt Disney defined Twelve Principles of Animation.

1. Squash and Stretch

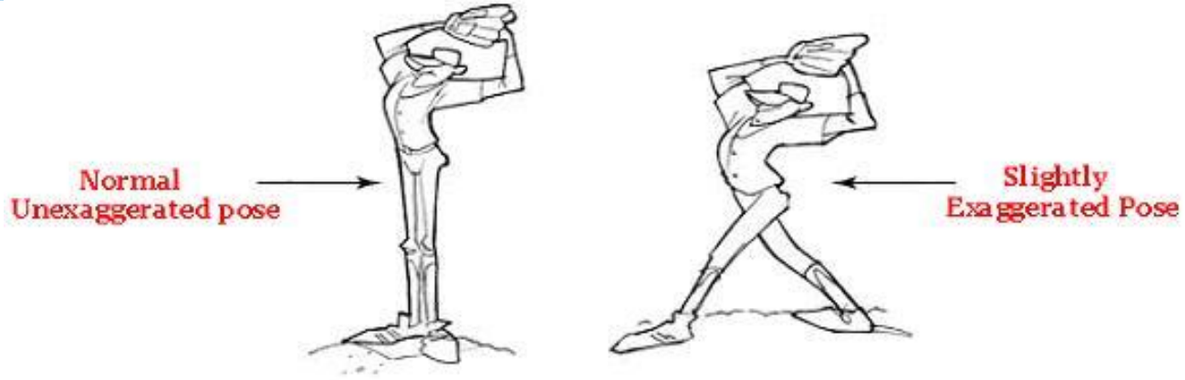
- Living flesh distorts during motion.
- Exaggerated deformations will emphasize motion and impact.
- Although objects deform like rubber, they must maintain volume while being squashed and stretched.
- A bouncing ball will squash or elongate on impact and stretch vertically as it leaves the point of impact.
- This is the most well known and often used principle.

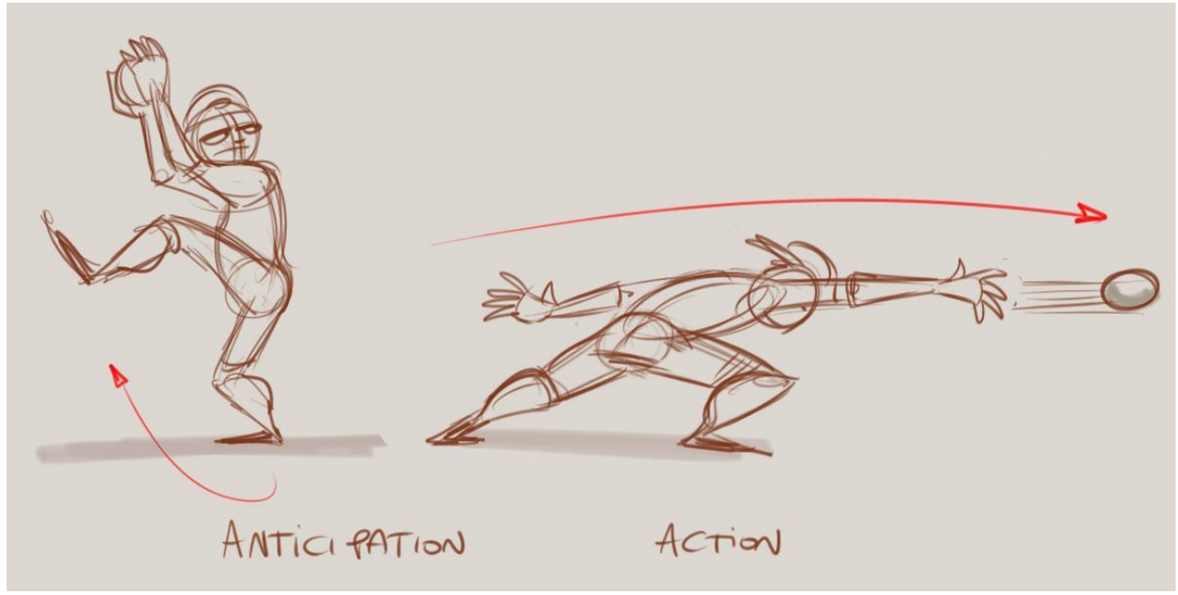


2. Anticipation

- Animation can occur before an action. Before you jump, you bend your knees.
- By exaggerating this action, the animator can guide the viewer’s eyes.
- The formula for most animations is anticipation, action, and reaction.

2. Anticipation (Cont’d)

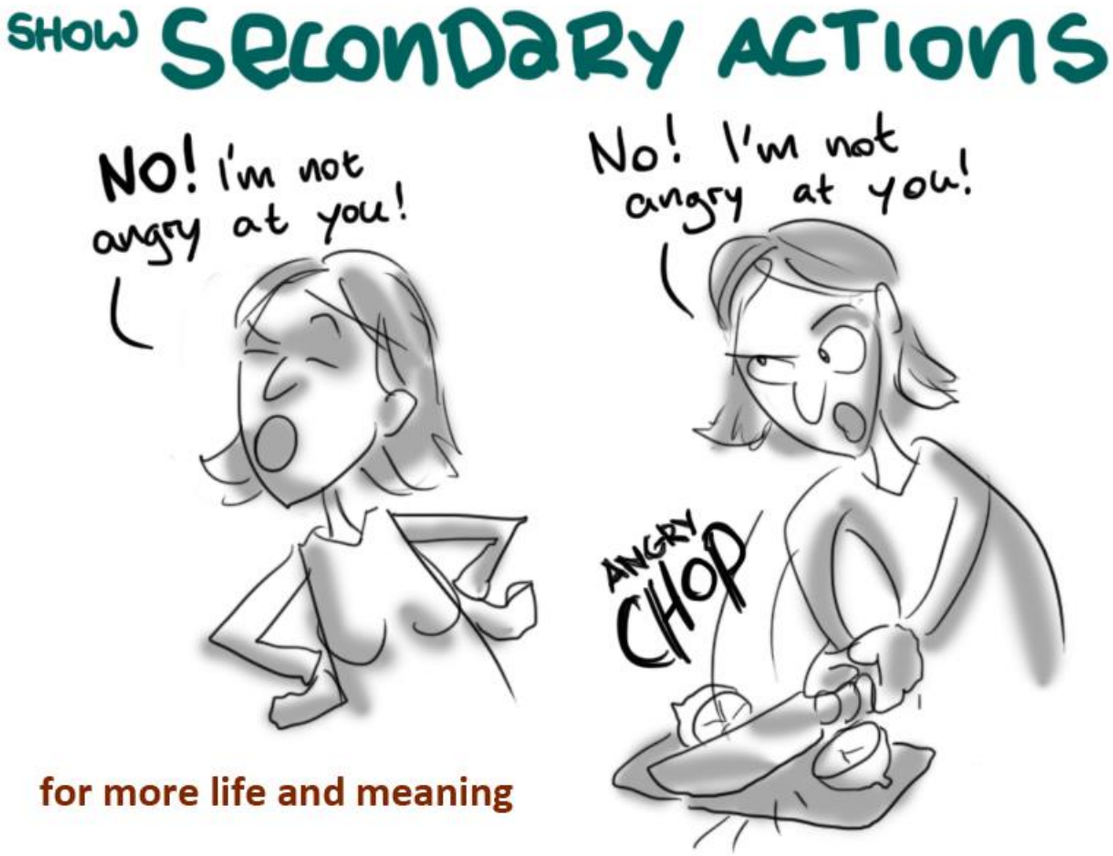




3. Staging

- Staging is the clear presentation of an idea.
- The animator can use the camera viewpoint, the framing of the shot, and the position of the characters to create a feeling or strengthen understanding.

3. Staging (Cont’d)

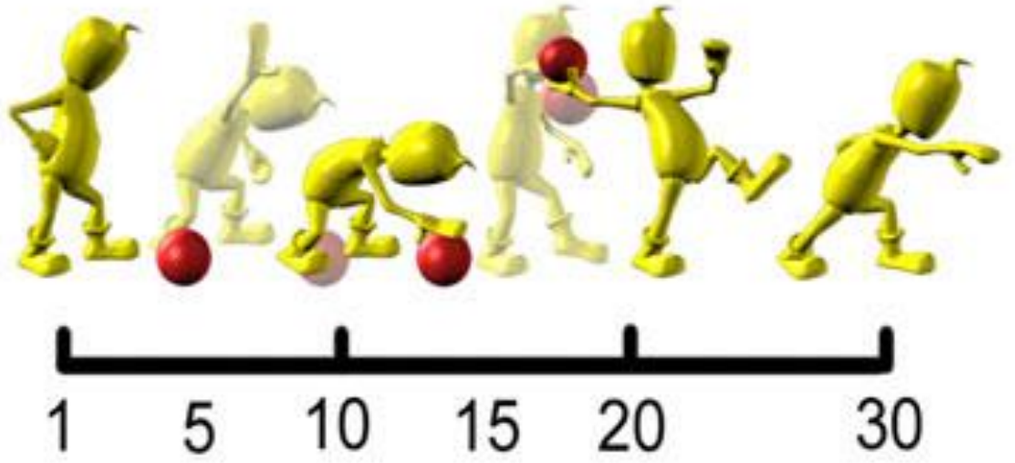


4. Straight Ahead Versus Pose To Pose

- Straight Ahead animation means drawing the frames in sequence. This leads to spontaneous motion. It works well with abstract animation.

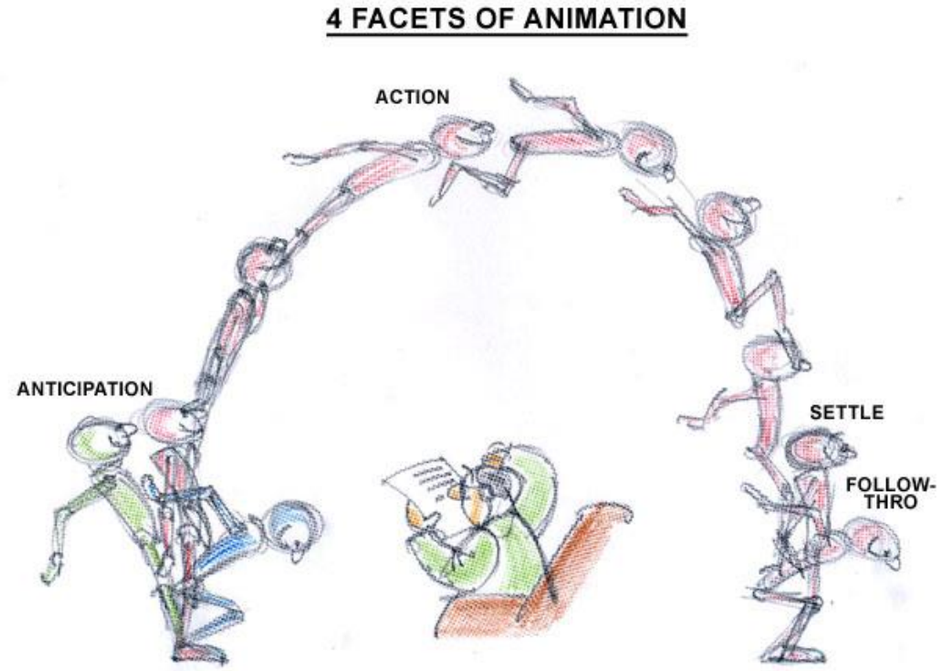
- Pose To Pose is the more often used animation technique. It requires the animator to create strong posed (keyframes) first and add the in-between frames later.

- Pose to Pose is used for animation that requires good acting, where the poses and timing are all important.



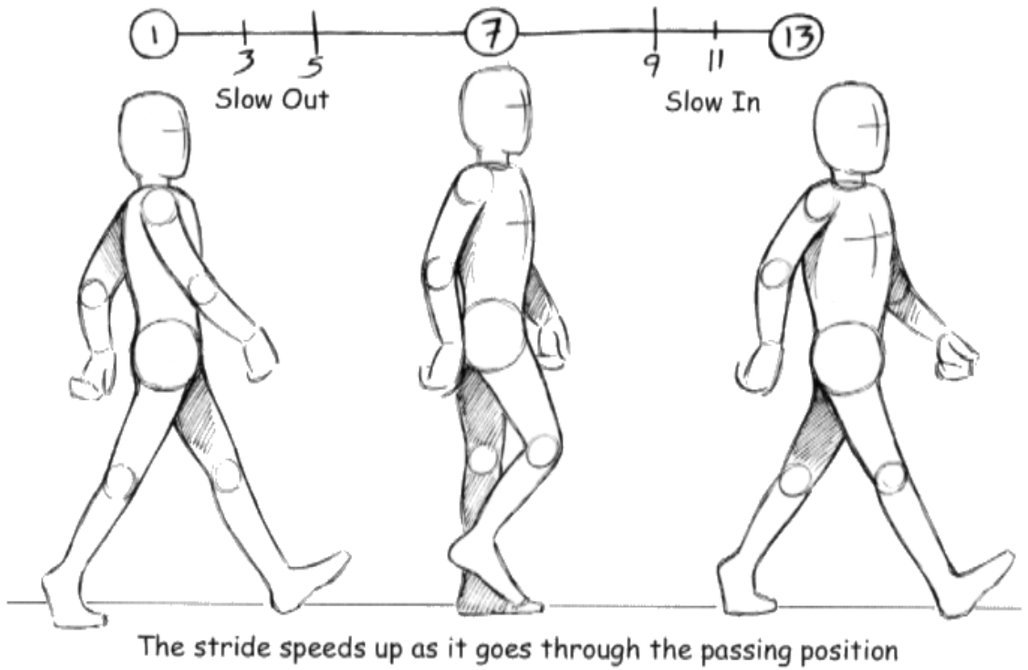
5. Follow Through and Overlap

- Follow Through is the action that follows the main action. It is the opposite of anticipation.
- When a baseball bat hits the baseball, it does not stop abruptly. A boxer does not freeze at the moment a punch lands.
- Overlapping actions means that all elements do not stop at the same time.
- Overlapping action also means that a new action may begin before the earlier action is terminated. When hitting a baseball, the legs may begin moving to first base while the bat is finishing the swing.



6. Slow In and Slow Out

- Also known as ease in and ease out.
- Most motion starts slowly, accelerates, and then slows again before stopping. Imagine a car that went 40 mph immediately when stepping on the accelerator and went to 0 mph when hitting the brake.
- Gravity has an effect on slow in/slow out. When a ball bounces, it increases in speed as it gets closer to the ground. It decreases in speed at the top of the arch.
- In many 3D applications, easing is created by setting the tension of a TCB spline to 1.0. To get the opposition effect from a keyframe, tension is set to -1.0.



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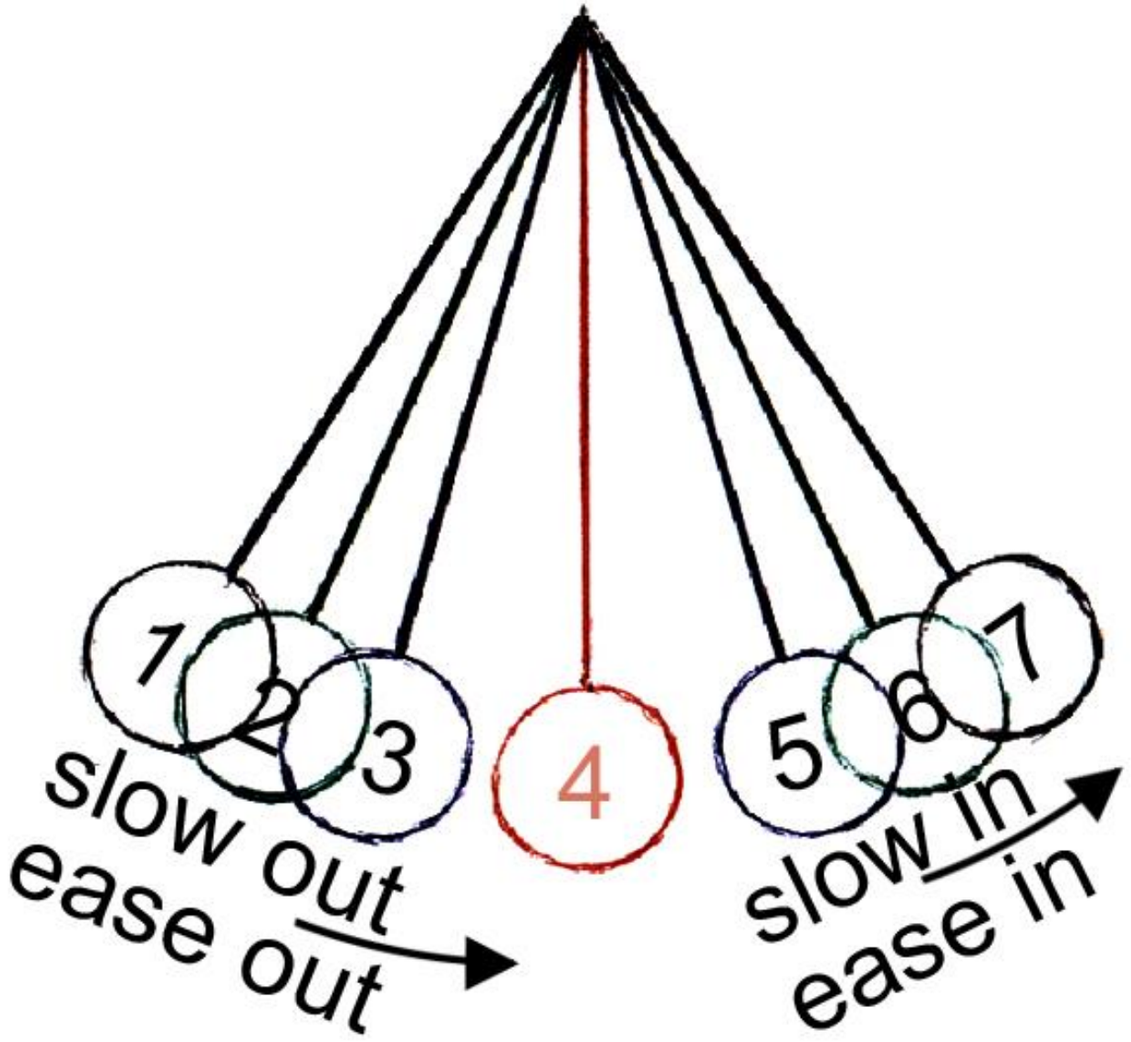
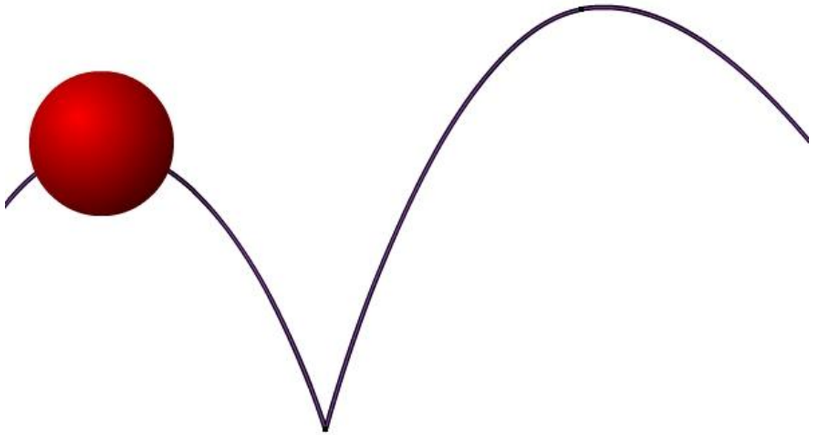
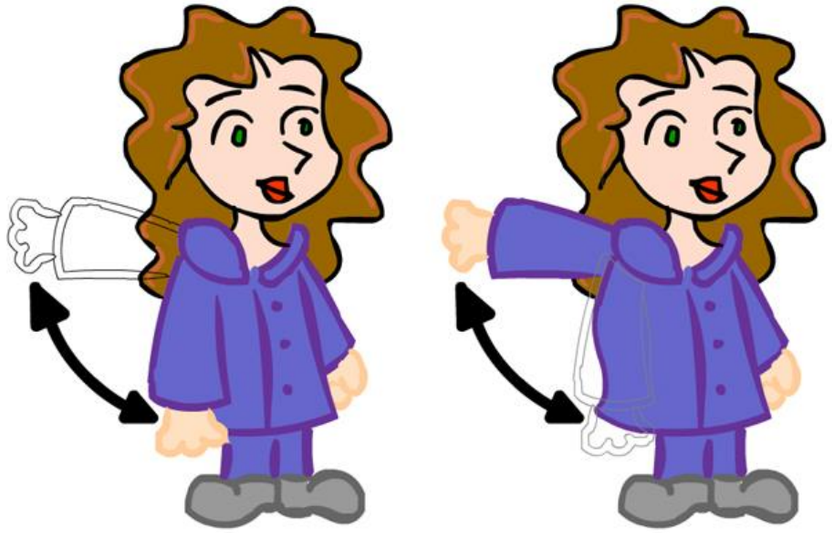


7. Arcs

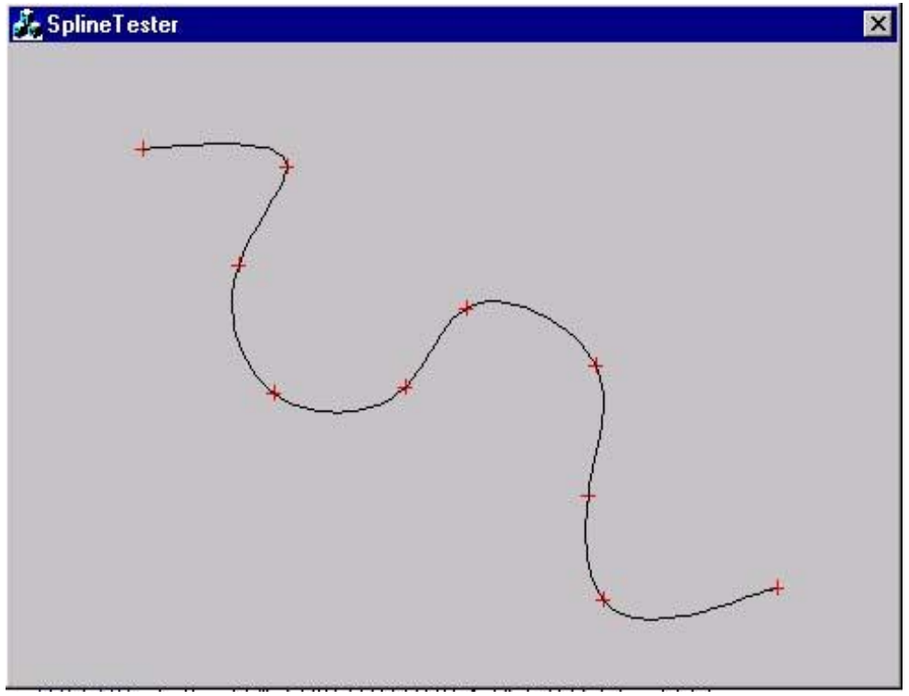
- Almost all natural motion is in some form of an arc.
- In 3D animation, a motion arc is usually created using a spline curve.
- Pivot points often define the arc. The pivot point for the thigh is the hip, and the pivot point for the calf is the knee.

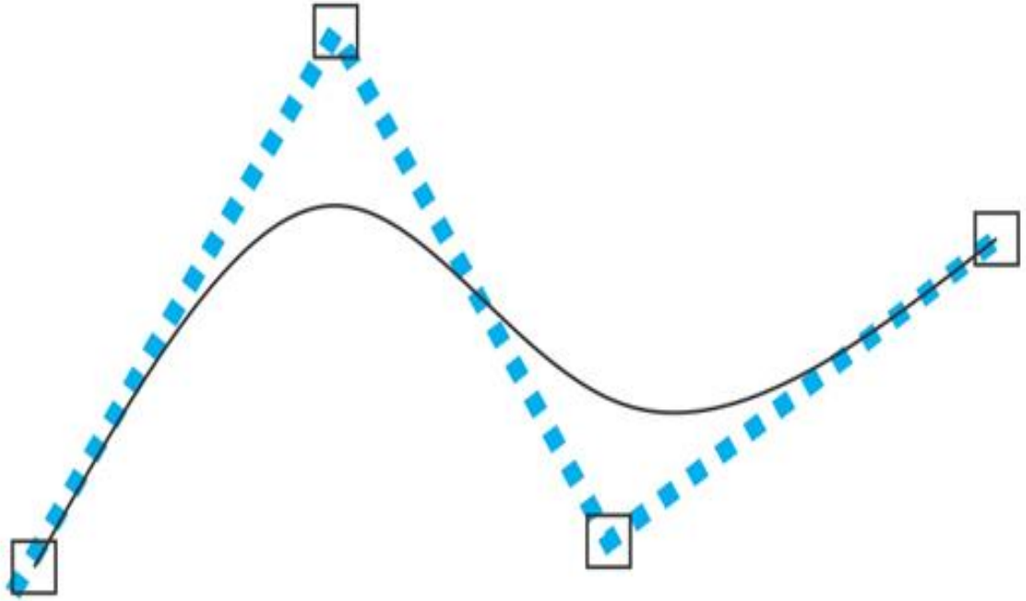




7. Arcs (Cont’d)

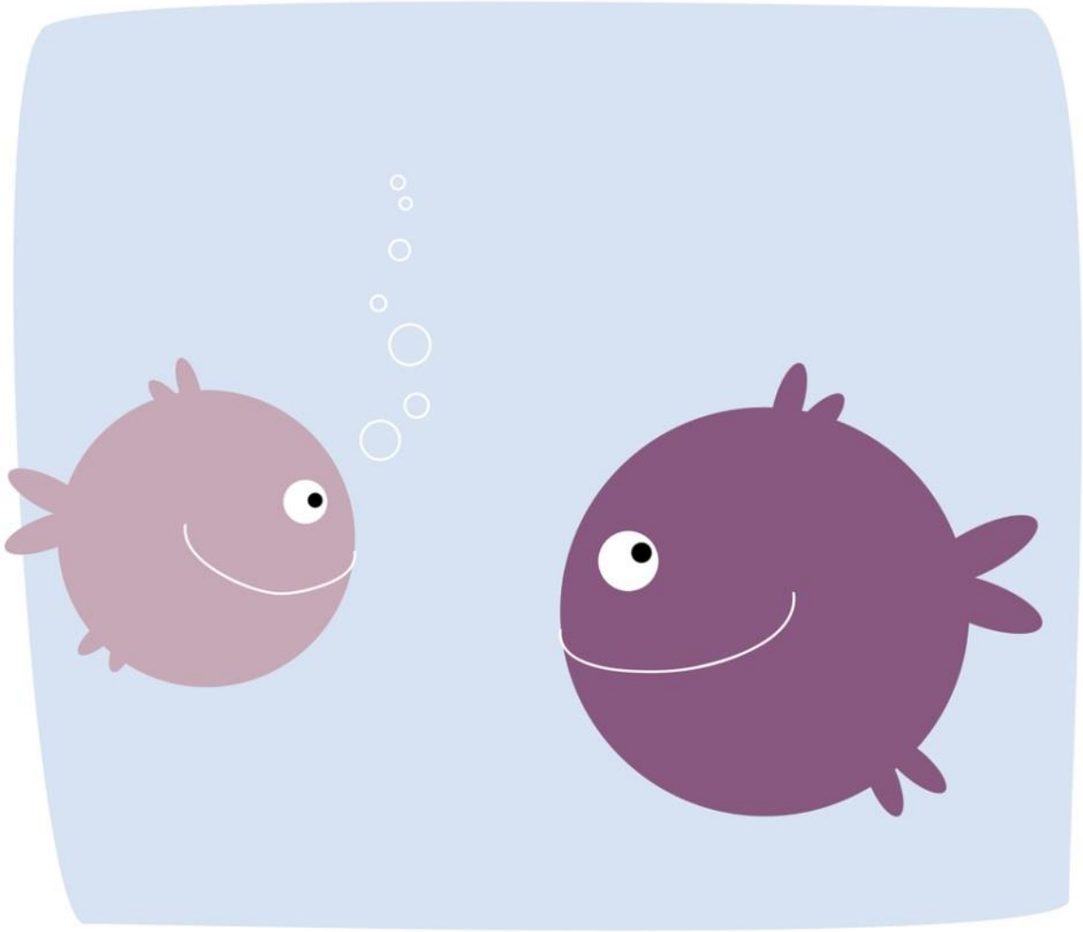
- Spline Curves
  - Piecewise polynomials with smooth connections



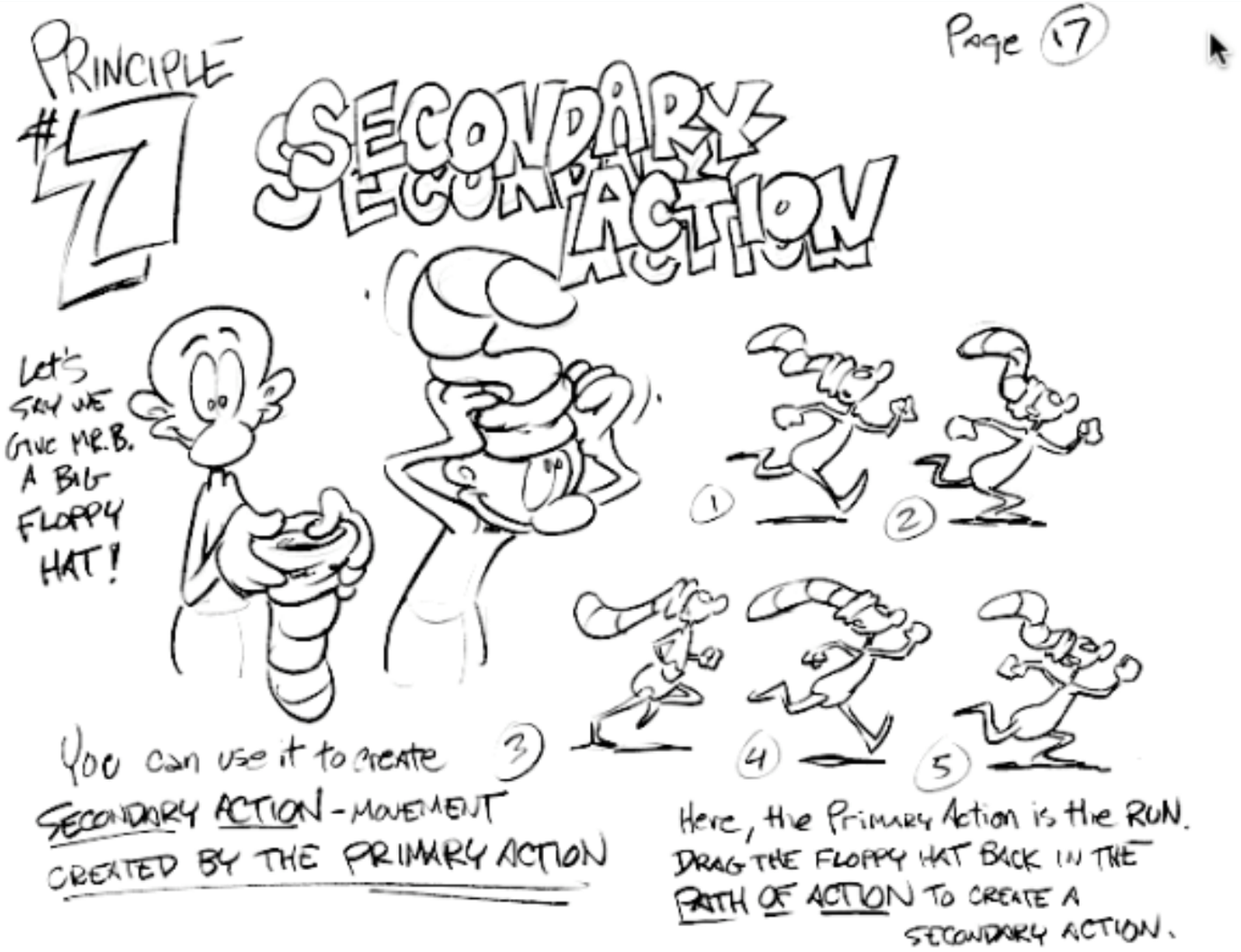


8. Secondary Actions

- Secondary actions are minor actions that occur due to a major action. Most people blink their eyes when they turn their head.
- Facial expressions are secondary actions.
- Secondary actions are also actions caused by the impact of another object. The movement of a ball that has been kicked is a secondary action.



8. Secondary Actions (Cont'd)



9. Timing

- Timing is the amount of frames between poses.
- Comedians and actors work with their timing to get the maximum impact from their lines.
- Timing can imply weight. Light objects have much less resistance and usually move much quicker than heavy objects.
- Speed can imply emotion. A fast walk may mean happiness and a slow walk may mean depression.

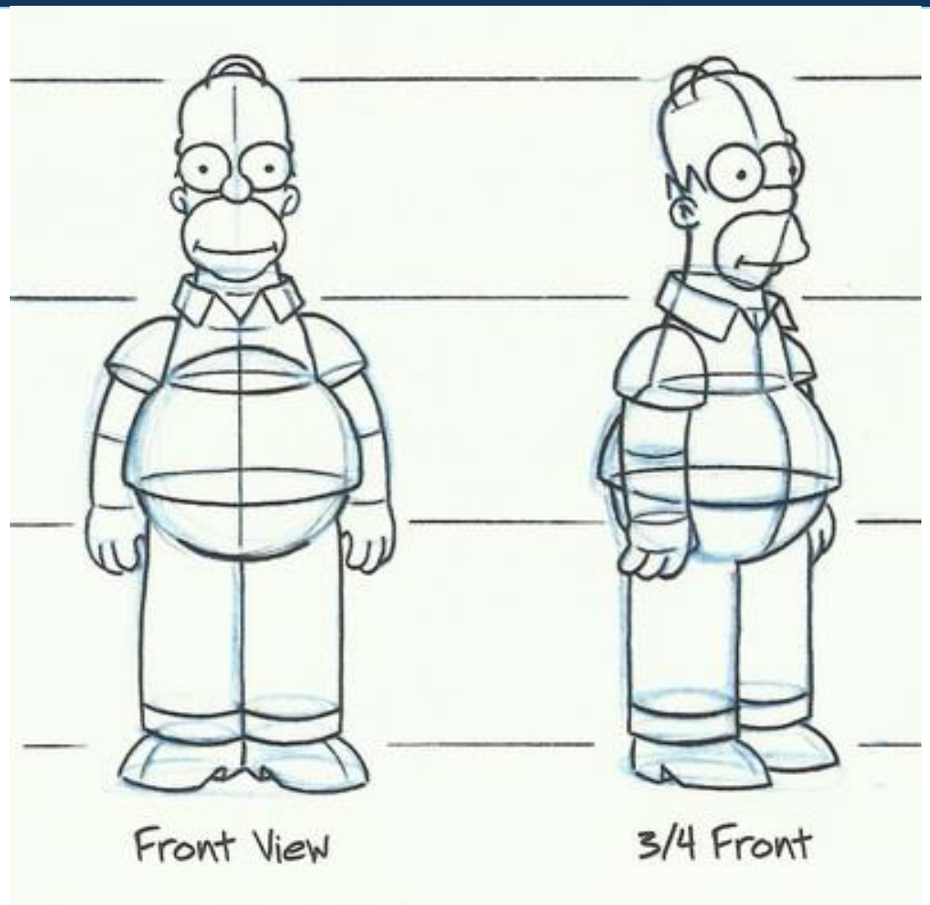
10. Exaggeration

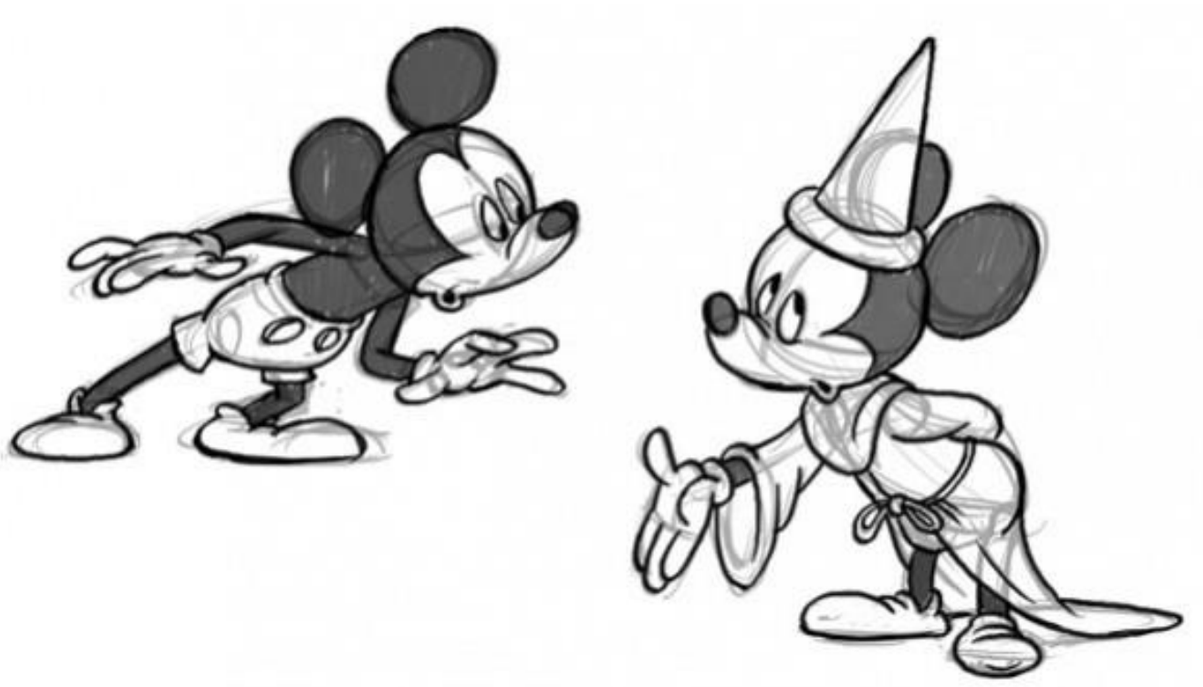
- Exaggeration is used to increase the readability of emotions and actions.
- Animation is not a subtle medium.
- Individual exaggerated poses may look silly as stills but add dramatic impact when viewed for a split second.
- Animators should be careful to use exaggeration to increase understanding of feeling. Be careful not to over-exaggerate everything.

11. Solid Drawing

- In 3D animation, this would be equivalent to Solid Modeling.
- To get maximum feeling from the audience, animated characters must be drawn or modeled precisely.
- Proper drawing and modeling can reveal a character's weight, character, and emotion.
- Proper drawing and modeling are needed to give the character proper depth and balance.

11. Solid Drawing (Cont’d)





12. Appeal (Character personality)

- Animated characters need to have a unique personality and have a wide range of emotions (happy, excited, fearful, embarrassed, angry, scared, etc.).
- Character flaws are actually a good thing. Audiences can be sympathetic to characters that have a flaw or two.
- Complex personalities and moral ethical dilemmas add to character appeal.

12. Appeal (Character personality)

Practical exercise

- Given the link bellow, please animate a cube using Blender software by following the instructions provided in the video. (10 marks)
- https://www.youtube.com/watch?v=CBJp82tlR3M
- Important keywords:
  - Timeline
  - Keyframe
  - Transformation (Location, Rotation & Scaling)
  - FPS (Frame Per Second)

Animation

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