

Computer animation

- Animation: make objects move or change over time according to **scripted actions** and/or (physical) **laws**

Outline

- Animation and animation types
- Traditional animation – Disney
- Computer role in animation
- Computer animation techniques
 - 2D vs. 3D
 - Object models
 - Motion models

Animation

- Animation is produced by the rapid display of consecutive still images
- Minimum frame rate (humans) for smooth transitions is about 15 Hz.
- For film/TV, 23 Hz to 30 Hz is normal.
- For a smooth visual effect, higher frame rates may be necessary, and timing of frame displaying is important

Types of animation

- Hand-drawn
- Stop motion
- Animatronics
- Performance animation (mocap)
- Virtual models
- Effects

Early animation

- Early 'real' animation: creating each frame of a real scene by hand = stop motion animation.
- Example: King Kong (1933), hybrid of animatronic and stop motion animation

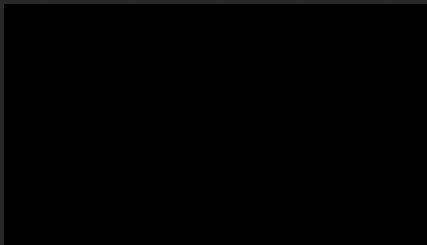
King Kong



Intermezzo: King Kong 1933 & 2005



Intermezzo: King Kong 1933 & 2005



Traditional Animation

- Animators work from storyboards
- Gross timing (usually) determined by dialogue soundtrack
- Older animation:
 - Static background
 - Characters painted on cels
 - Lead animator creates **key frames**
 - Second animator creates **in between frames** (inbetweens)



Traditional animation

- Many of the esthetic animation principles from traditional animation can –and often should– be applied in computer animation
- Computer animation tools enable just about anybody to make an animation
- Computer animation tools enable just about anybody to make a **bad** animation

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Traditional animation

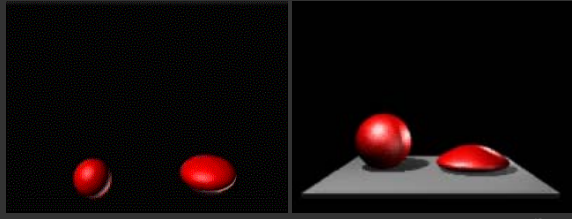
Fundamental principles of traditional animation (Disney):

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

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Squash and stretch: examples



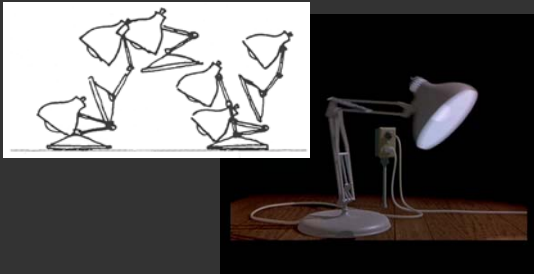
Squash and stretch

- Movement shows rigidity of an object – soft objects deform more
- Squashing and stretching emphasize natural movement, object rigidity and movement speed
- Squash and stretch should preserve volume
- Laws of physics may be broken (e.g. stretch before impact)
- Squash and stretch need not deform the object

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Squash and stretch

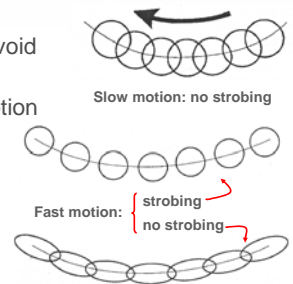
- Example without deformation



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Squash and stretch

- Squash and stretch helps avoid strobing effects
- (But adding motion blur is better)



Squash and stretch



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Timing

- No in-betweens - the character has been hit by a strong force and its head almost snapped off
- One in-betweens - the character has been hit by something substantial, .e.g., frying pan
- Two in-betweens - the character has a nervous twitch
- Three in-betweens - the character is dodging a flying object
- Four in-betweens - the character is giving a crisp order
- Six in-betweens - the character sees something inviting
- Nine in-betweens - the character is thinking about something
- Ten in-betweens - the character is stretching a sore muscle



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Timing

- Timing is the speed of an action
- Timing helps define an action (see example previous slide)
- Proper timing is critical to make the audience understand an action: time the phases (anticipation/action/reaction) so that the action is understood (not too short!) without losing attention (not too long!)
- Timing defines weight of objects (including characters)

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Anticipation

- Anticipation is the preparation for an action

Anticipation

- Often anatomical necessity; no anticipation gives an unnatural movement
- Prepares audience for an action - you know what is going to happen
- Draws the attention – action is not missed and can be faster

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Anticipation

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Staging

- Staging is presenting an idea so that it is unmistakably clear
 - Actions are staged so that they are understood
 - A personality is staged so that they are recognisable
 - An expression so that it's visible
 - A mood so that it affects the audience
- For good staging the audience's attention must be where it needs to be. Staging, anticipation and timing are crucial to leading the eye
- Stage only one idea at a time (or it might be 'upstaged')
- Contrast the object of interest with the rest of the scene

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Staging

- Staging is much clearer when done entirely in good silhouette

Good silhouette

Bad silhouette

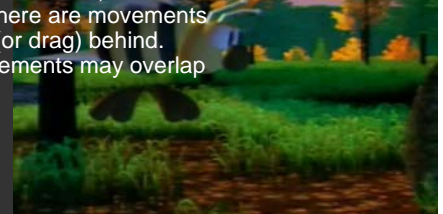
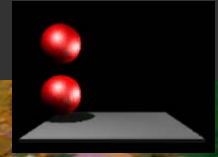
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Silhouette



Follow through and overlapping action

- Follow through is the proper termination of actions
- Actions rarely end suddenly
- Most movements in an action are not simultaneous; there is a 'lead' and there are movements that follow (or drag) behind. These movements may overlap in time



Straight ahead and pose-to-pose action

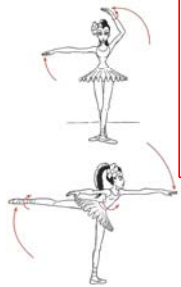
- The two approaches to animation:
 - Straight ahead: draw all the scenes in sequence from first to last

- Spontaneous, creative



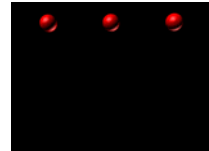
- Pose-to-pose: draw the main poses and fill in the inbetweens later

- Focus on acting, timing

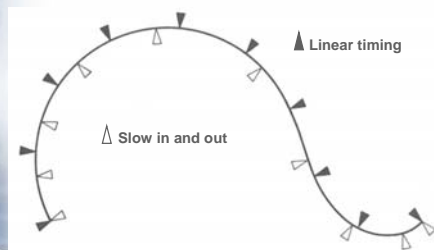


Slow in and out

- A movement between two extremes is usually presented best when the movement is slowest at the extremes
- May not be physically correct
- Allows the viewer a little more time at the (interesting) extreme poses
- Implemented by non-linear timing of the inbetweens

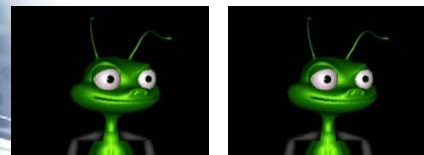


Slow in and out



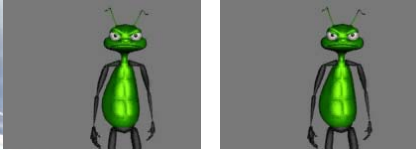
Arcs

- Movement of (parts of) objects is generally more interesting when the movement traces an arc (splines!) instead of a straight line



Exaggeration

- Exaggeration of the motions that identify an emotional state makes this state easier to see
- Do not arbitrarily distort object or actions, amplify only that which enhances the underlying reason for a motion



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Secondary action

- Actions have consequences. These should be part of the animation to enhance a realistic complexity
- Should in general be kept subordinate to the main action, to avoid detracting attention.



Computer role in animation

- Computer animation can assist the traditional animation process on many levels, e.g. by
 - Generating inbetweens
 - Automating cel layering
 - Generating images from models
- Computer enables many new applications:
 - animations in video games or other interactive media (i.e. without fully pre-scripted animation),
 - merging of film and animated models,
 - etc.

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Computer animated movies

- Example: production process at Pixar



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1. Write the main story



2. Write the text treatment



3. Draw the storyboards



4. Record 'scratch' voices



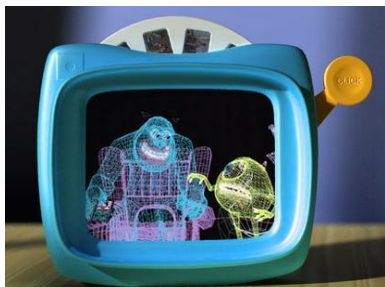
5. Make reels



6. Artists create look and feel



7. Models are created and articulated



8. Sets are built and dressed



9. The scenes are laid out



10. Scenes are animated



11. Shading is added



12. Lighting is added



13. Rendering



14. Add music and sound effects



Embedded graphics / animation example



Computer animation techniques

- 2D
 - Sprite animation
 - Morphing
 - Graphic embedding
- 3D, virtual world
 - Object model
 - Articulated model
 - Particle system
 - Deformable object
 - Hybrid
 - Rendering
 - Motion blur
 - Motion models
 - Keyframing
 - Kinematics
 - Procedural
 - Motion capture

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