Computer Animation

Introduction

- Computer animation is the process used for generating animated images (moving images) using computer graphics.

- Animators are artists who specialize in the creation of animation.

- From Latin animātiō, "the act of bringing to life"; from animō ("to animate" or "give life to") and -ātiō (" the act of").

Applications

Video games

Cartoons

Mobile Phones

DESIGN OF ANIMATION SEQUENCES

Steps for designing animation sequences.

1. Storyboard Layout
2. Object definitions
3. Key frame specifications
4. Generation of in-between frames

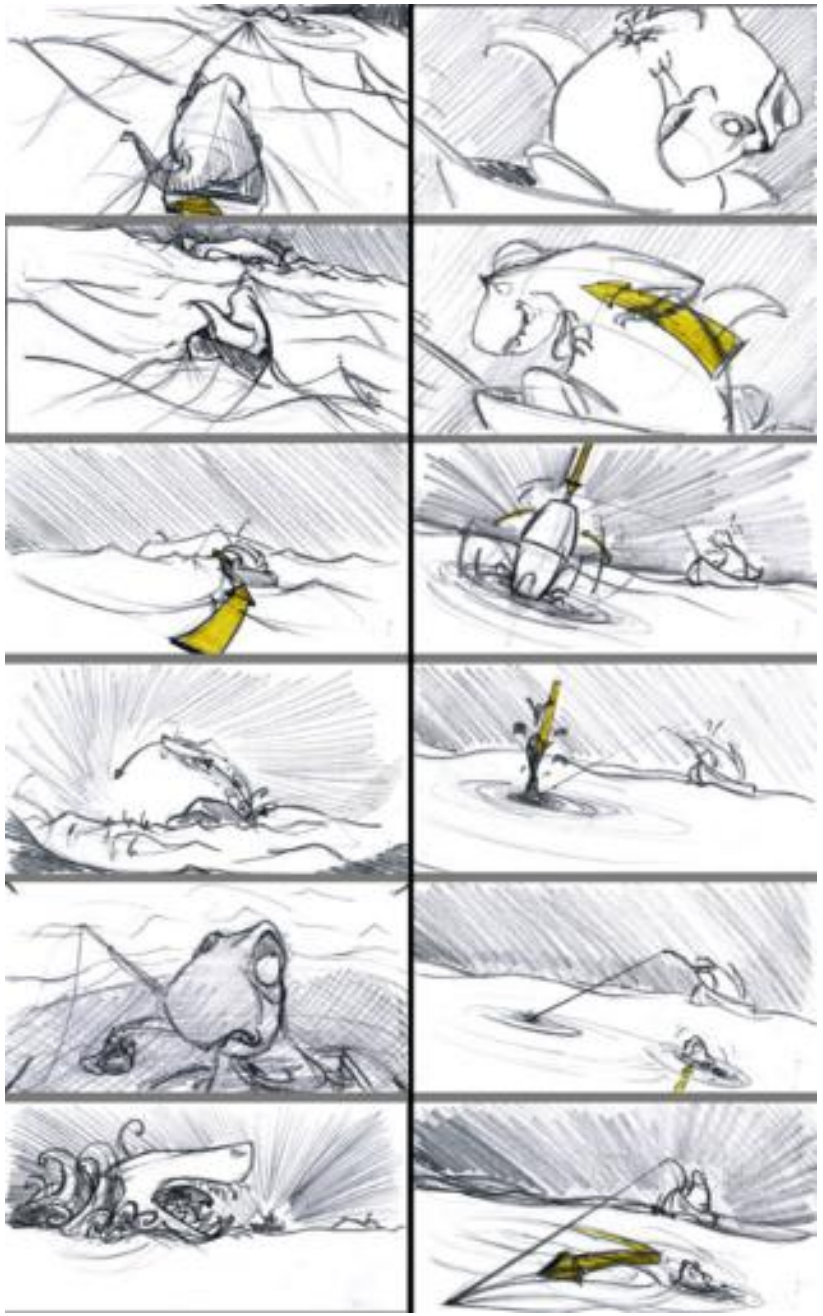
DESIGN OF ANIMATION SEQUENCES

This standard approach for animated cartoons is applied to other animation applications as well, although there are many special applications that do not follow this sequence. Real-time computer animations produced by Bight simulators, for instance, display motion sequences in response to settings on the aircraft controls.
And visualization applications are generated by the solutions of the numerical models. For frame-by-frame animation, each frame of the scene is separately generated and stored. Later, the frames can be recoded on film or they can be consecutively displayed in "real-time playback" mode.

Storyboard Layout

- It is the outline of the action. It defines the motion sequence as a set of basic events that are to take place.
- Depending on the type of animation to be produced, the storyboard could consist of a set of rough sketches or it could be a list of the basis ideas for the motion.

Storyboard Layout



Object definitions

Each object participating in the action is given object definition, such as terms of basic shapes, such as polygons or splines.

Frame

It is one of the many single photographic images in a motion picture. The individual frames are separated by frame lines. Normally, 24 frames are needed for one second of film.

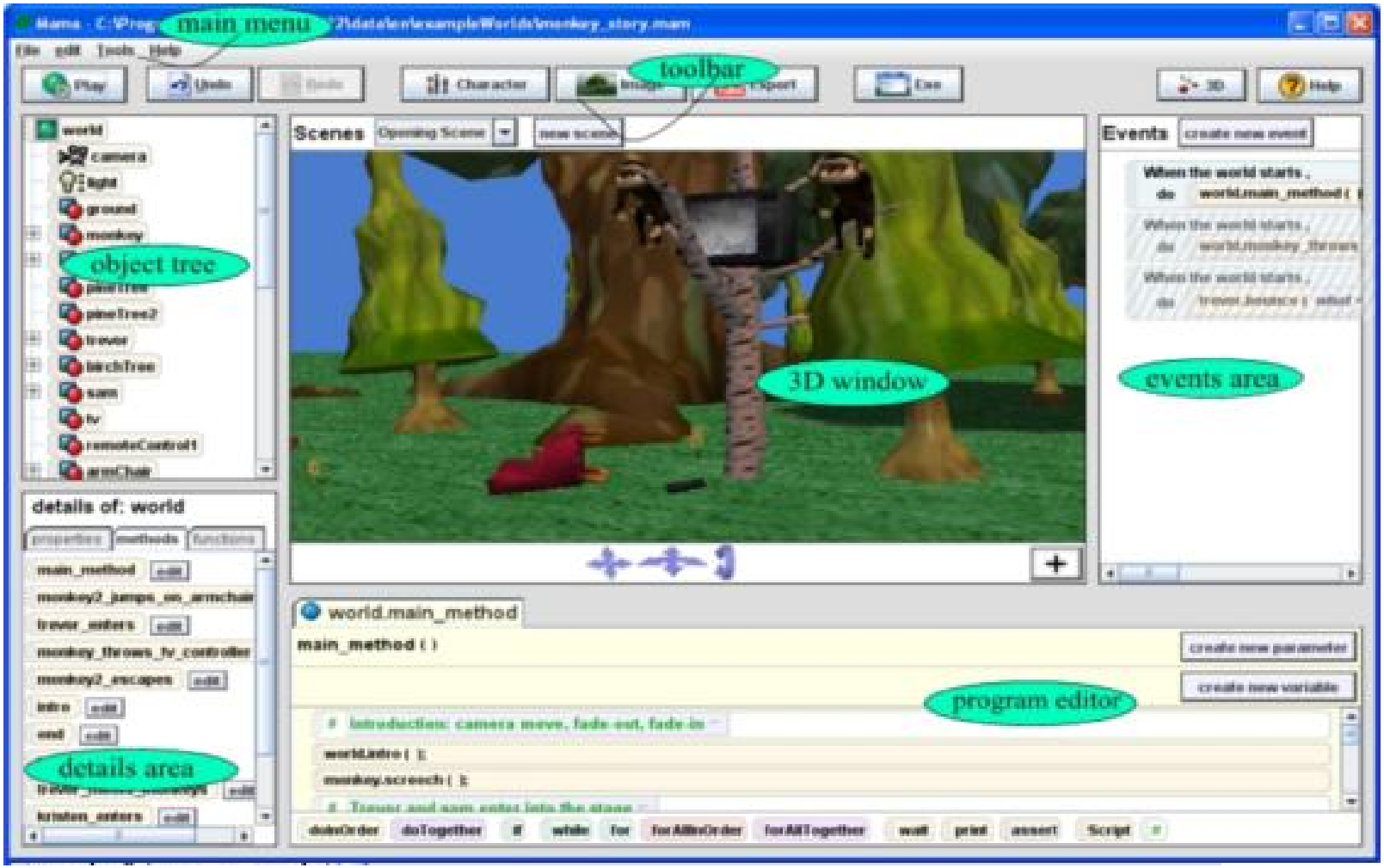
Key Frame

- A key frame in animation and filmmaking is a drawing that defines the starting and ending points of any smooth transition.
- A sequence of key frames defines which movement the spectator will see, but the position of the key frames on the film, defines the timing of the movement. 2 or 3 key frames can be present for a span of a second.

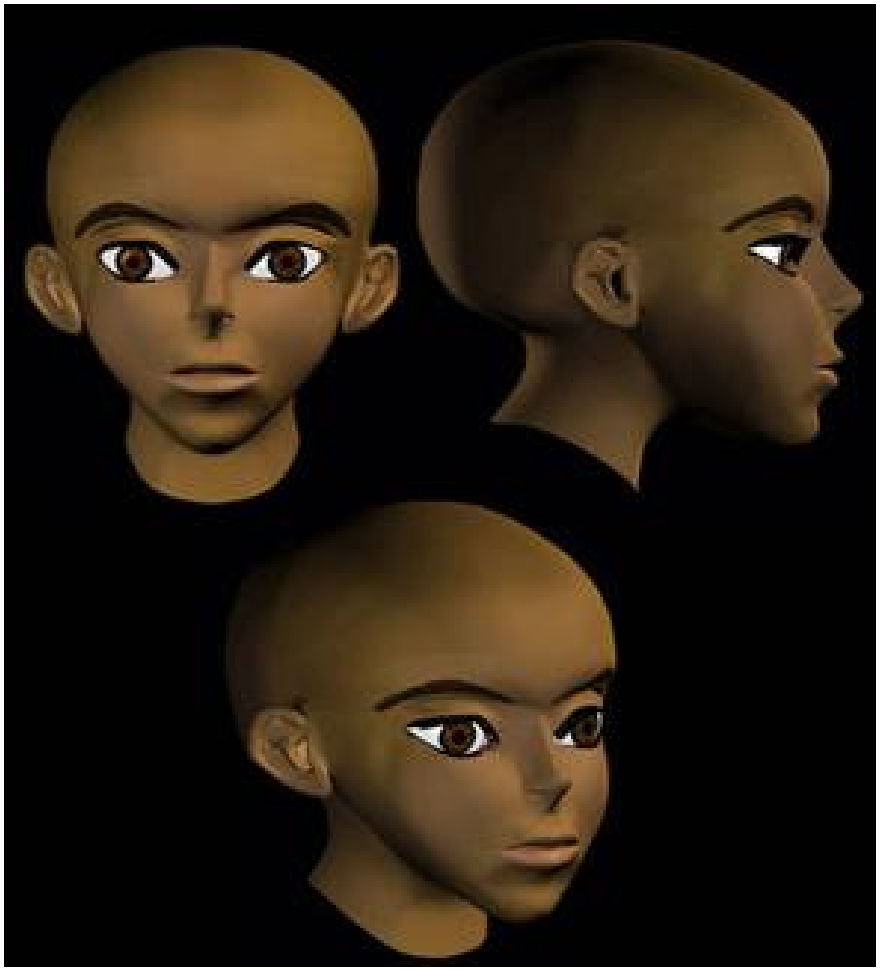
In-between

- It is a process of generating intermediate frames between 2 images to give appearance that the 1st image evolves smoothly into the second image. In – betweens are the drawing between the key frames which help to create the illusion of motion.
- Film requires 24 frames per second and graphics terminals are refreshed at a rate of 30 to 60 frames per second.

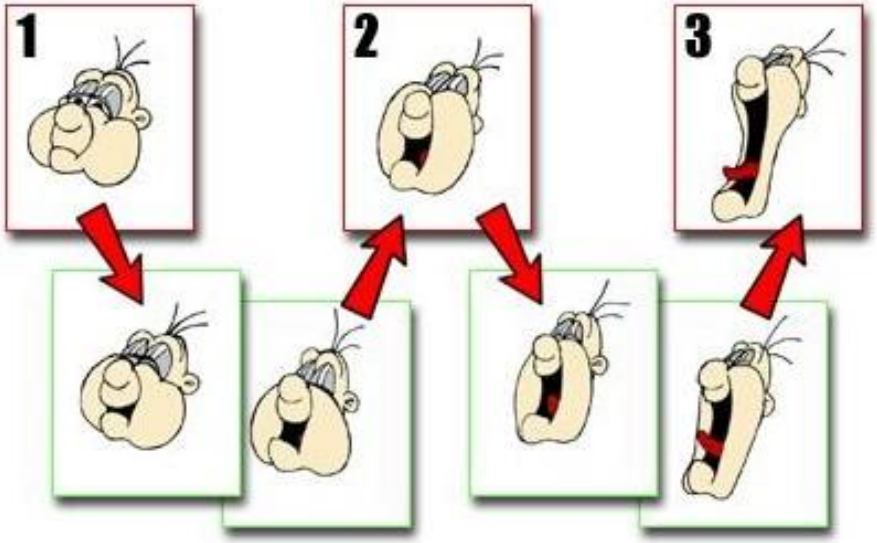
Frames


main menu
toolbar
object tree
3D window
events area
details area
program editor

Frames

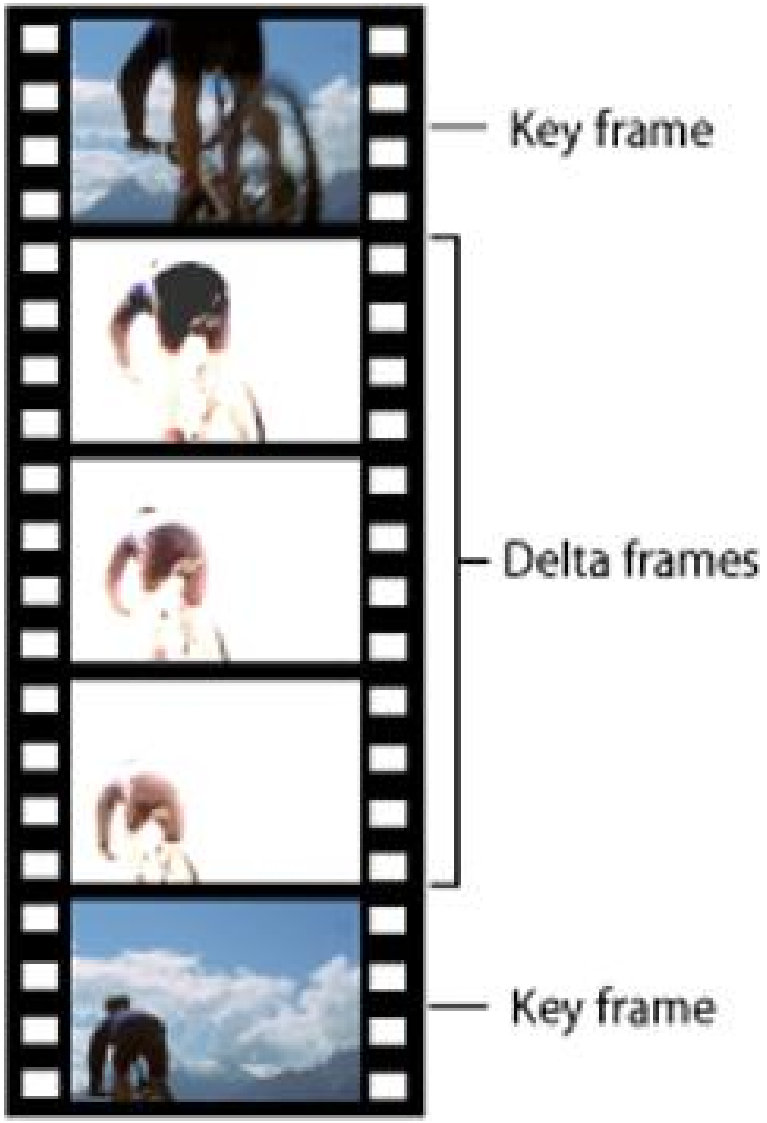


Key Frames



Series of key frames

Key Frames



General Computer Animation Functions

- Animation packages, such as wave front, provide special functions for designing the animation and processing individual objects.

- Some steps included in the development of animation sequence are
  1. Object manipulation and rendering
  2. Camera motions
  3. Generation of in – betweens

- One function available in animation packages is provided to store and manage the object database (object shapes and associated parameters are stored and updated in the database)

General Computer Animation Functions

- Other object functions include:
  1. Object motion generation (2-D or 3-D transformations)
  2. Object rendering

- One function to simulate (observe) camera movements:
  1. Zooming
  2. Panning (rotating horizontally or vertically)
  3. Tilting

Raster Animations

- On raster systems, we generate real – time animation in limited application using raster operation.
- Such as 2D or 3D transformations on objects.
- We can also animate objects along 2D motion paths using the color – table transformation.
- The pixel values at successive positions along the motion path of an object are stored in color – table and the pixel at 1st pixel is set on, we set the pixels at the other object positions to the background color.

Computer Animation Languages

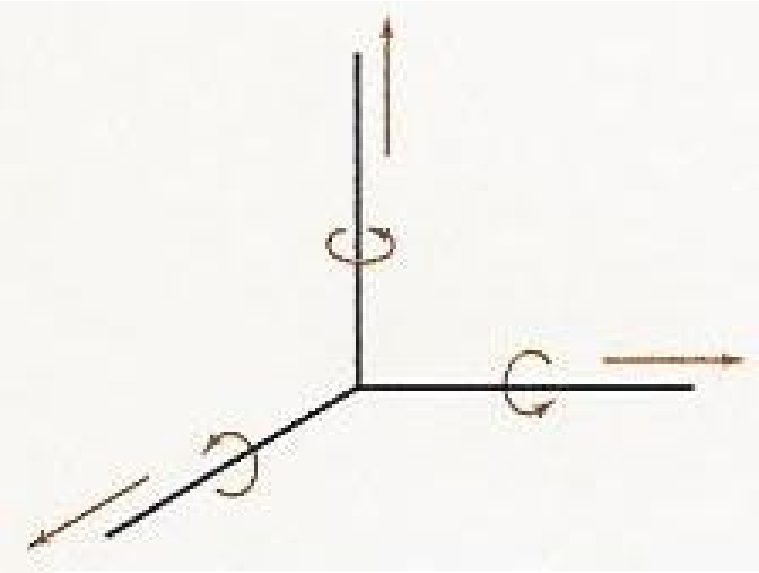
- A general – purpose language, such as C, LISP, Pascal, or FORTRAN, is often used to program the animation functions.
- Animation functions include a graphics editor, a key – frame generator, an in – between generator, and standard graphics routines.
- A graphics editor allows us to design and modify object shapes.
- A typical animation specification is scene description. It includes where to position objects, light sources, camera parameters, etc.

Computer Animation Languages

- Another standard function is action specification, that involves the layouts and motion paths for the objects and camera.
- Key – frame systems are specialized animation languages designed simply to generate the in – betweens. Also explains about degrees of freedom of an object.
- As an example this arm can have a total of 12 degrees of freedom.
- The human body, in comparison, has over 200degrees of freedom.

Parameterized systems

- Allow object – motion characteristics to be specified as part of the object definitions Object motion characteristics



Key frame systems

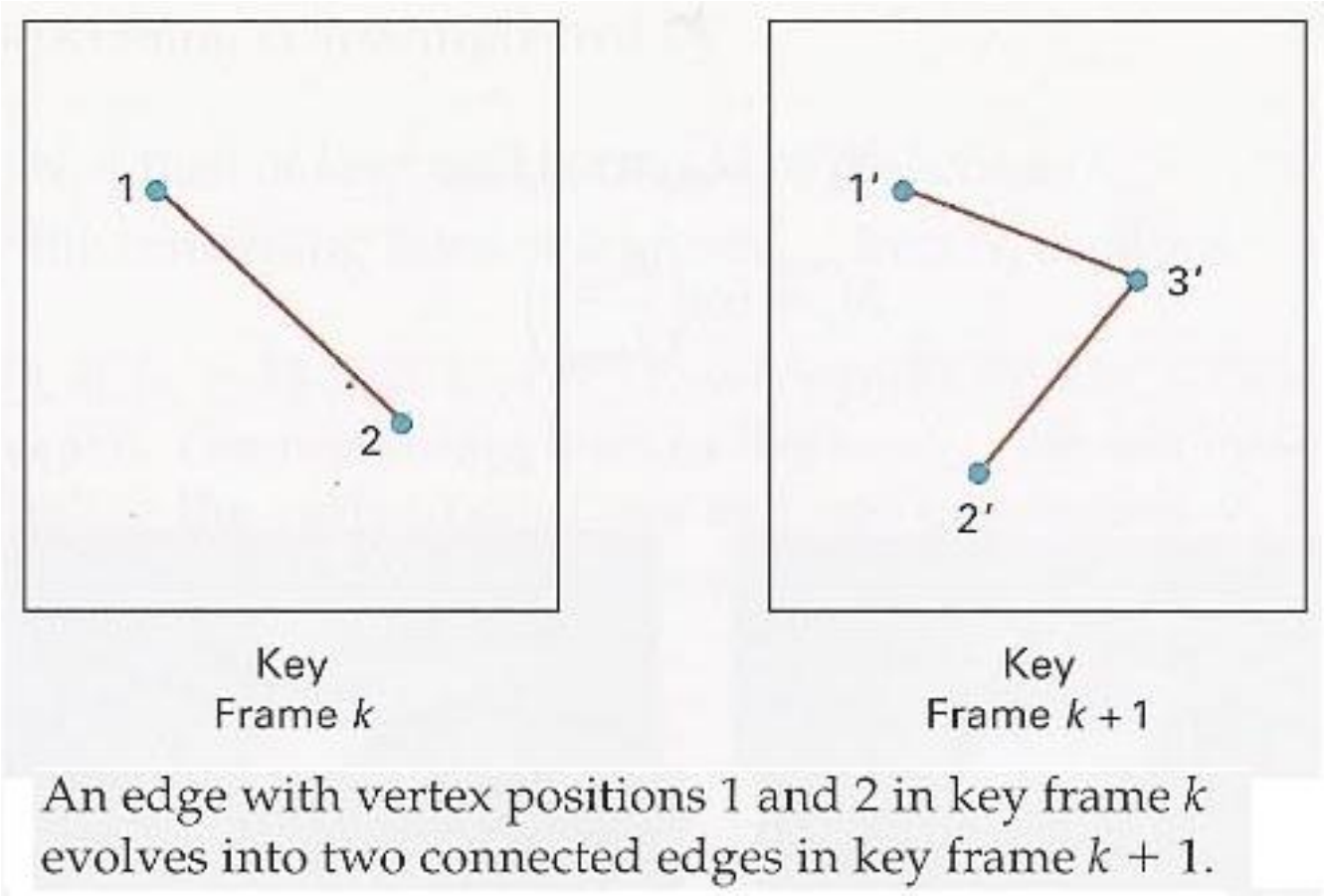
- For complex scenes, we can separate the frames into individual components or objects called cels. Given the animation paths, we can interpolate the positions of individual objects.

Morphing

- Transformation of object shapes from one form to another is called as morphing. Given 2 key frames for an object transformation, we first adjust the object specification in one of the frames so that the number of polygon edges or vertices is the same for the two frames.

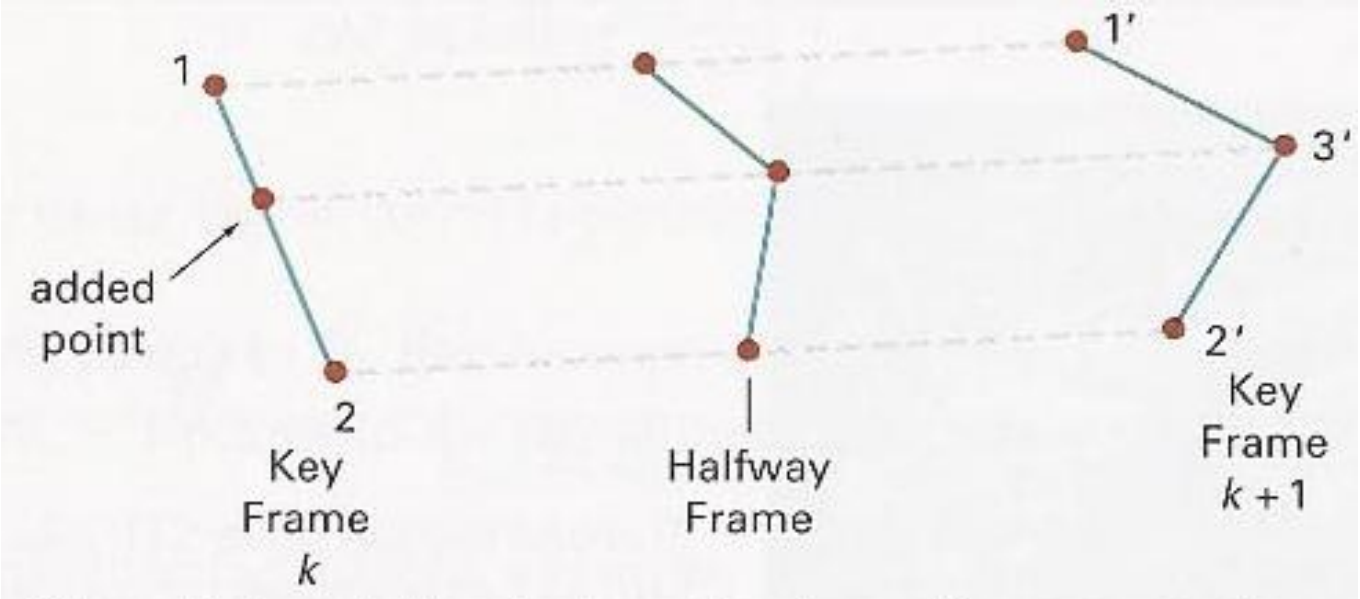
- Examples of morphing are in television advertising.

Morphing



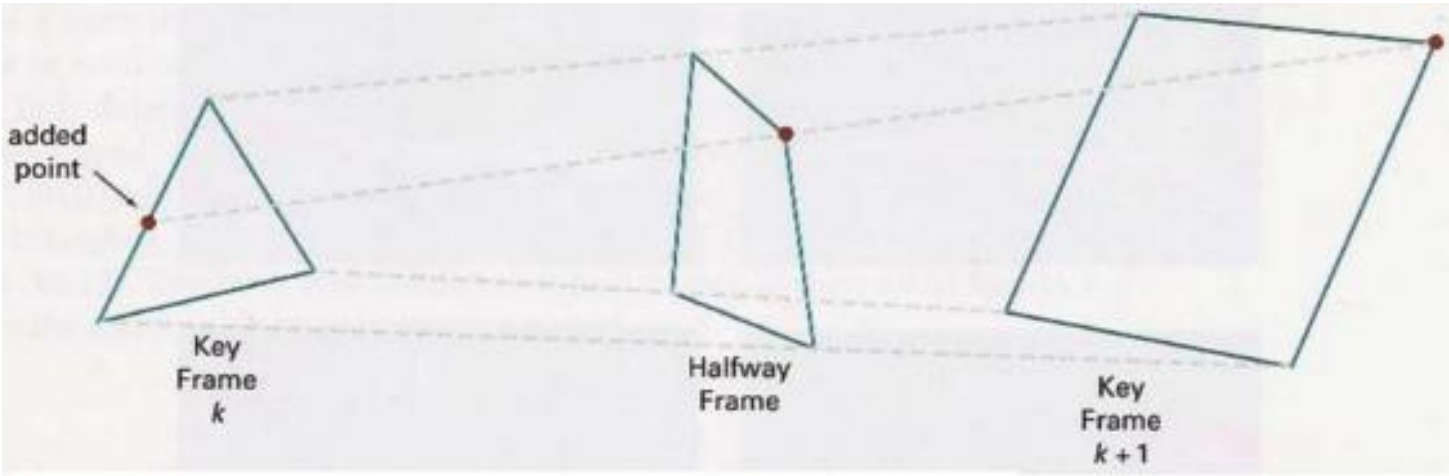
An edge with vertex positions 1 and 2 in key frame k evolves into two connected edges in key frame $k + 1$.

Morphing



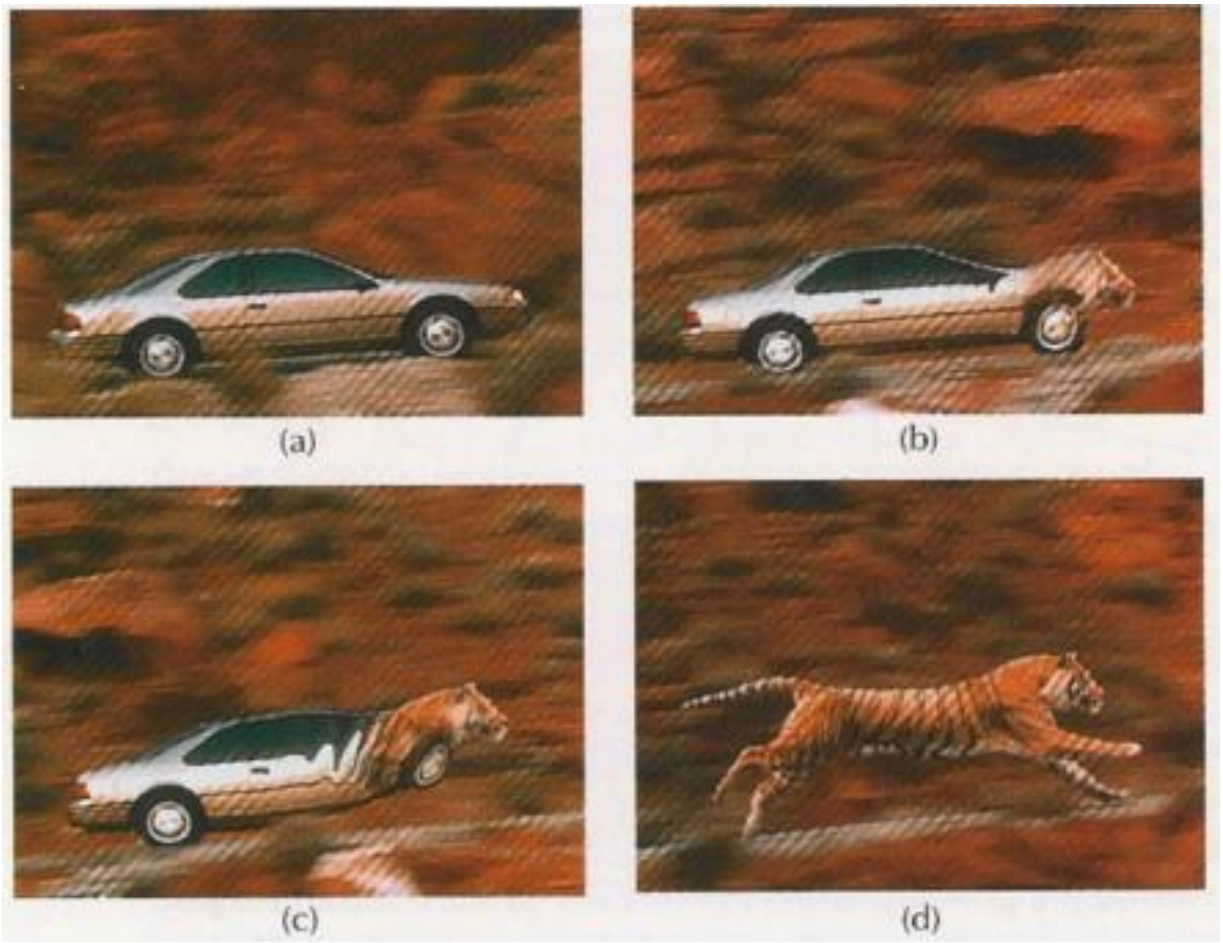
Linear interpolation for transforming a line segment in key frame k into two connected line segments in key frame $k + 1$.

Morphing



Linear interpolation for transforming a triangle into a quadrilateral.

Morphing



Motion Specifications

There are several ways in which the motions of objects can be specified in an animation system –

1. Direct Motion Specification:
   - We explicitly give the rotation angles and translation vectors. The geometric transformations are applied to transform coordinate positions.
   - We could use an approximating equation to specify certain kinds of motions like bouncing ball, with sine curve.

Direct Motion Specification:

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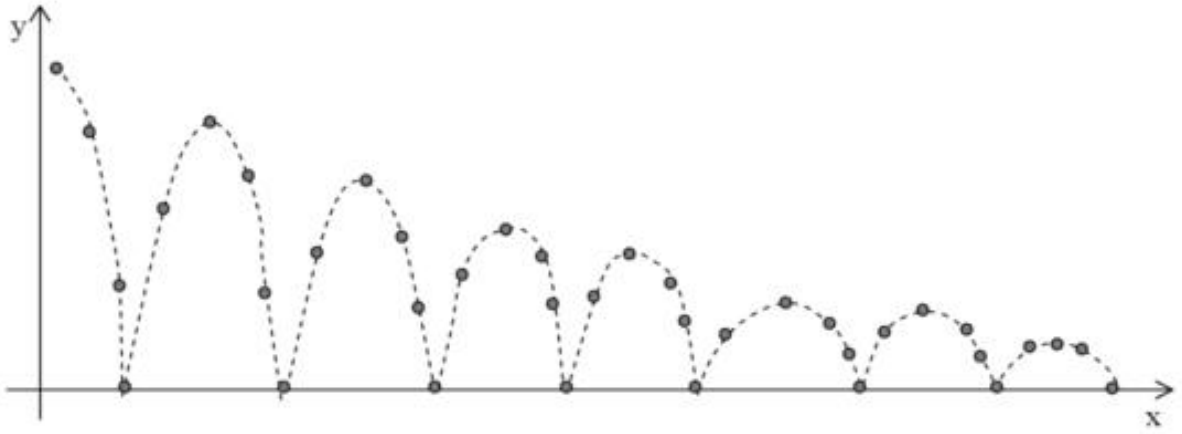
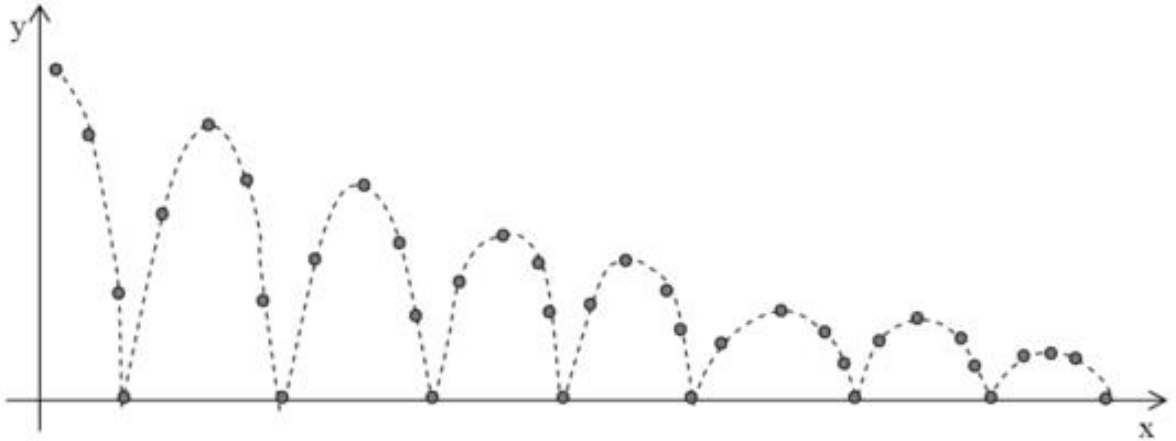


$$y(x) = A|\sin(wx+\theta_0)|e^{-kx}$$

where A is the amplitude, w is the angular frequency, θ_0 is the phase angle and k is the damping constant.

Direct Motion Specification:

We could use an approximating equation to specify certain kinds of motions like bouncing ball, with sine curve.



Motion Specifications

2. Goal – Directed Systems:

We can specify the motions that are to take place in general terms that abstractly describe the actions.

Example:

- We want an object to walk or to run to a particular destination.
- We want an object to pick-up some other specified object.

Motion Specifications

3. Kinematics and Dynamics:

We can construct animation sequences using kinematic or dynamic descriptions. We specify animation by giving motion parameters like position, velocity and acceleration parameters.

4. Inverse Kinematics and dynamics:

We can specify the initial and final positions of the object and calculations are done by the computer

References

1. Computer Graphics by Donald Hearn and M. Pauline Baker

2. http://www.eenadupratibha.net/Pratibha/Engineering-Colleges/Engineering-Jobs/cse_sem_com_ani_un8.html