

- ❑ Animated images are restricted to a 256 colour palette.
- ❑ images are losslessly compressed, which may conserve their quality, but does not provide much compression, a serious consideration that effectively prevents the use of this format for any extended animation sequences.
- ❑ each frame of an animated GIF is displayed by the browser as it arrives. Network speeds mean that there may be excessive, and probably irregular, delays between frames, making any frame rate that may be specified in the file irrelevant.
- ❑ if an animation is set to loop, once it has played through the first time it will have been copied into the browser's local cache (unless it is too big), and subsequent loops will play at a speed only limited by the user's processor and disk.
- ❑ Web page advertising is what animated GIFs are most often used for.

### **Digital Cel' and Sprite Animation:**

- ❑ Layers allow you to create separate parts of a still image — for example, a person and the background of a scene they are walking through — so that each can be altered or moved independently.
- ❑ The frames of an animated sequence can be made by combining a background layer, which remains static, with one of more animation layers, in which any changes that take place between frames are made.
- ❑ To create an animation, you begin by creating the background layer in the image for the first frame. Next, on separate layers, you create the elements that will move; you may want to use additional static layers in between these moving layers if you need to create an illusion of depth. After saving the first frame, you begin the next by pasting the background layer from the first; then, you add the other layers, incorporating the changes that are needed for your animation.

## Compression of Cel:

Using layers as the digital equivalent of cel saves the animator time, but, it does not affect the way in which the completed animation is stored: each frame is saved as an image file, and the sequence will later be transformed into a movie, an animated GIF, or any other conventional representation. Yet there is clearly a great deal of redundancy in a sequence whose frames are all built out of the same set of elements. Possibly, when the sequence comes to be compressed, the redundant information will be squeezed out, but compressing after the event is unlikely to be as successful as storing the sequence in a form that exploits its redundancy in the first place.

## Sprite:

- This form of animation that stores a single copy of all the static layers and all the objects (that is, the non-transparent parts) on the other layers, together with a description of how the moving elements are transformed between frames is called sprite animation, with the objects being referred to as sprites.
- Slightly more sophisticated motion can be achieved by associating a set of images, sometimes called faces, with each sprite. This would be suitable to create a 'walk cycle' for a humanoid character, for example . By advancing the position of the sprite and cycling through the faces, the character can be made to walk.

## Example: Spirit Faces of a walk cycle



## Sprite generated sequence:

We have described sprite animation as a way of storing an animated sequence, but it is often used in a different way. Instead of storing the changes to the properties of the sprites, the changed values can be generated dynamically by a

program. Simple motion sequences that can be described algorithmically can be held in an even more compact form, therefore, but, more interestingly, the computation of sprite properties can be made to depend upon external events, such as mouse movements and other user input. In other words, the movement and appearance of animated objects can be controlled by the user. This way of using sprites has been extensively used in two dimensional computer games, but it can also be used to provide a dynamic form of interaction in other contexts, for example, simulations.

### **Key Frame Animation:**

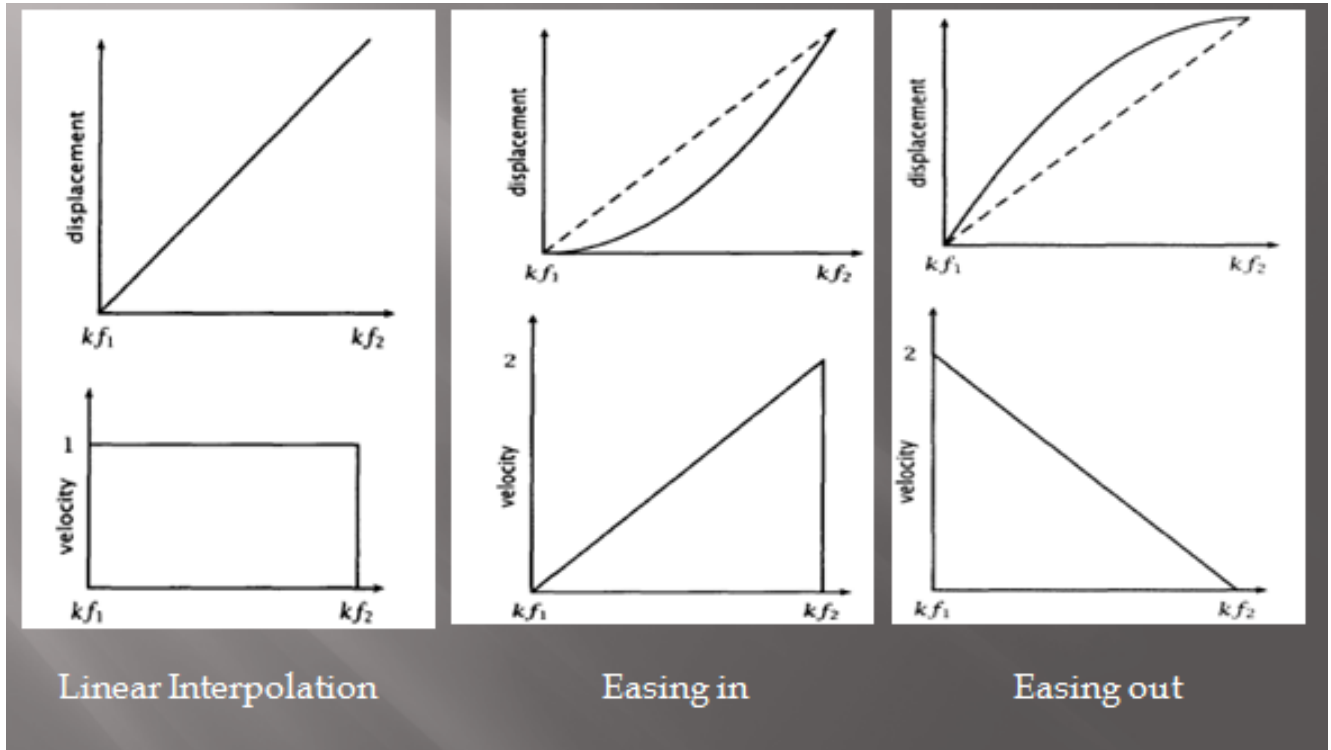
- ▣ key frames are typically drawn by a 'chief animator' to provide the pose and detailed characteristics of characters at important points in the animation.
- ▣ Usually, key frames occur at the extremes of a movement which determine more or less entirely what happens in between, but they may be used for any point which marks a significant change. The intermediate frames can then be drawn almost mechanically by 'in-betweeners'. Each chief animator could have several in-betweeners working with him to multiply his productivity.
- ▣ In-betweening resembles what mathematicians call interpolation: the calculation of values of a function lying in between known points. Interpolation is something that computer programs are very good at, provided the values to be computed and the relationship between them can be expressed numerically. Generally, the relationship between two key frames of a hand-drawn animation is too complex to be reduced to numbers in a way that is amenable to computer processing

### **Interpolation:**

- ▣ If we just consider interpolated motion in a straight line, this means that a symbol moves an equal distance between each frame, the distance moved being the total distance between its positions in the starting and ending key frames, divided by the number of frames in the sequence. Putting it more simply, the symbol moves at a constant velocity, which causes two problems.
- ▣ First, motion begins and ends instantaneously, with objects attaining their full velocity as soon as they start to move, and maintaining it until they stop. Nothing really moves like that. To produce a more natural movement, Flash

borrowed a technique from hand-made animation: the transition from stasis to movement is made more gradual by using smaller, slowly increasing, increments between the first few frames (i.e. the object accelerates from a standstill to its final velocity), a process referred to as easing in. The converse process of deceleration is called easing out.

### Example:



### Motion Graphics:

- ▣ Interpolation between key frames can be applied to bitmapped images. Since bitmaps do not contain identifiable objects, the use of layers to isolate different elements of an animation is essential.
- ▣ The analogy with cel animations is more or less complete — each layer is like a transparent sheet with something painted on it. Layers can be moved independently, so an animation can be constructed by placing different elements on different layers, and moving or altering the layers between frames. Where the movement or alteration is easily described algorithmically, it can be interpolated between key frames, just as in-betweeners interpolate between a chief animator's key frames. Typically, between key frames, a layer

may be moved to a different position, rotated or scaled. These geometrical transformations are easily interpolated, but since we are now concerned with bitmapped images, they may require resampling, and consequently cause a loss of image quality.

- ▣ spatial interpolation (motion path), is set by moving the layer in the window that shows the image.
- ▣ Temporal interpolation affects the rate of change of position with respect to time.

### **3-D Animation:**

The properties of 3-D models are defined by numerical quantities. Changing the numbers changes properties such as an object's position in space, its rotation, its surface characteristics, and even its shape. The intensity and direction of light sources and the position and orientation of a camera are also numerically defined. In order to animate a three-dimensional scene, therefore, all that is necessary is to set up an initial scene and render it as the first frame of the animation, make some changes to parameters, render the next frame, and so on. Because the values that are being changed are numerical, some kinds of change can be interpolated between key frames; a time line can be used as a convenient way of organizing the animation, and motion paths in three dimensions (often 3-D Bezier splines) can be used to describe movement.

### **3-D animation difficulties:**

There are several factors that make 3-D animation more difficult than it might appear:

- ▣ The first is the difficulty that most people have in visualizing in three dimensions. When we add time, there are four dimensions to be handled through the medium of a two dimensional computer screen.
- ▣ the second problem, which is the amount of processing power needed to render a 3-D animation. Advanced shading algorithms, such as ray tracing, take a long time to process a single image.
- ▣ In animation, we need at least twelve, and up to thirty, images to be processed for every second of completed animation.

**Animating 3D objects:**

- ▣ The solution that is adopted is to provide a rich interface giving the animator complete control over movement.
- ▣ One of the key approaches is to provide certain kinds of behavior that can be applied to objects, and the way they interact. A simple type of behavior consists of making one object point at another. This is most useful when the pointing object is a camera or light. If a camera is pointed at an object, it will maintain that object in its field of view, no matter where it moves; a spotlight pointed at an object will automatically follow it, as a real spotlight follows a dancer on a stage, for example. Actual objects in the scene can also be made to point at each other: a sunflower can be made to always point at the sun, for example. A variation on this behavior is to have one object track another, i.e. follow its motion at a distance.
- ▣ Some 3-D animation systems incorporate behavior based on the physical laws of motion. For example, they allow the user to specify that an object should accelerate from zero under the influence of an external force whose magnitude is specified as a parameter.
- ▣ Kinematics is the study of the motion of bodies without reference to mass or force. That is, it is only concerned with how things can move, rather than what makes them do so. In animation, it is most useful in connection with jointed structures, such as the limbs of human or animal figures. Because they are joined together, the various parts of your arm, for example, can only move in certain ways. To produce realistic movement, a 3-D model of an arm must obey the same kinematic constraints as a real arm: if the upper arm is raised, the lower arm and hand must come with it, for example.
- ▣ Despite what we said earlier, there are some types of 3-D animation that can be done effectively using simple interpolation of objects' properties.

**Delivering Animation:**

The three predominant formats for delivering digital animation are:

- ▣ Animated GIF