ICS370 Computer Graphics

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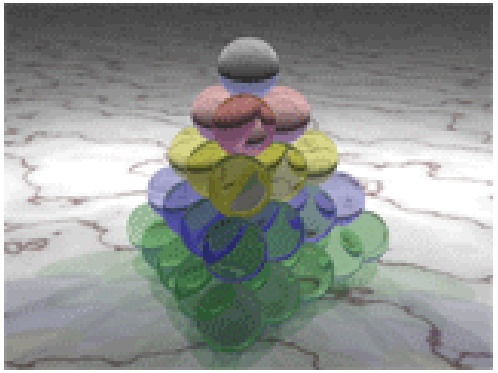
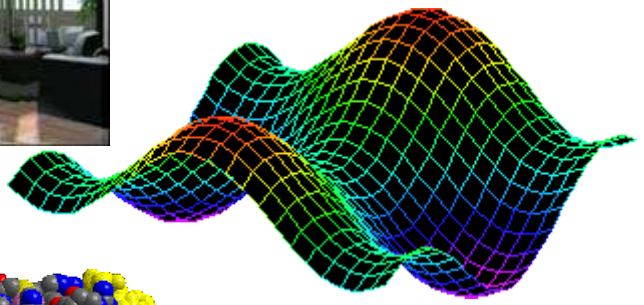
Lecture 8



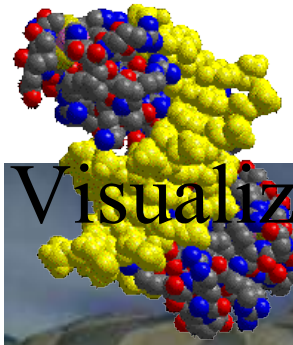
Computer Animation

- Computer animation is the art of creating moving images using computers. It is a subfield of computer graphics and animation.
- Increasingly it is created by means of 3D computer graphics.
- 2D computer graphics are still widely used for low bandwidth and faster real-time rendering needs.
  - Question: what low bandwidth medium can you think of?
- Sometimes the *target* of the animation is the computer itself, sometimes the target is another medium, such as film. It is also referred to as CGI (computer generated imagery), especially when used in films.

Uses of Computer Animation



- TV Logos & Advertising
- Architecture Walk-through (VR)
- Molecular Modelling & Scientific Visualization
- Video, Cartoons, Film
- Web, phone animation

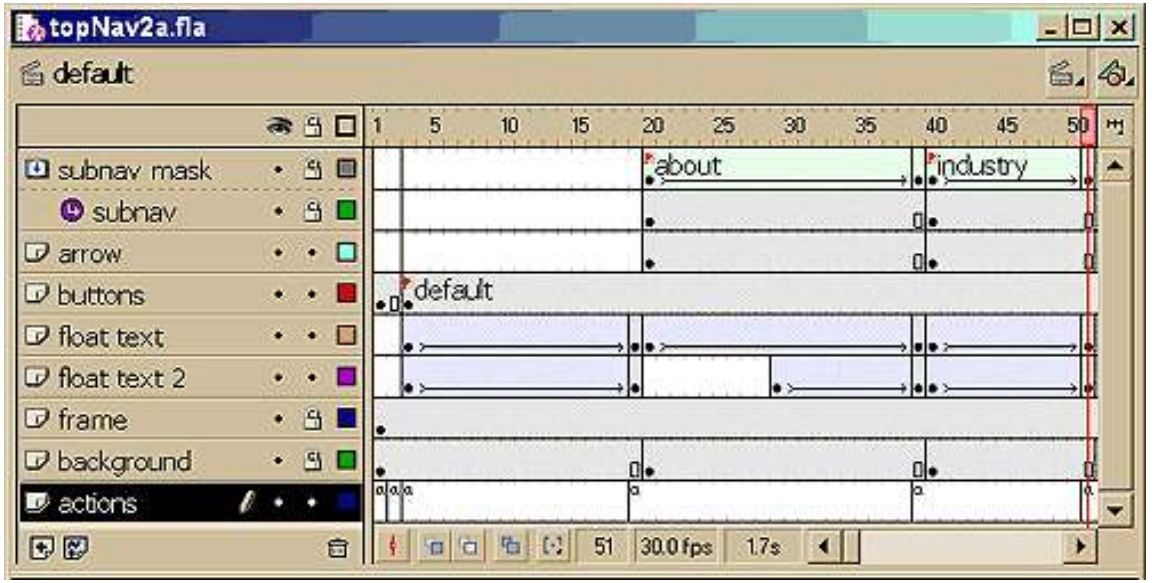


Animation Concepts

- We know from experience that animations don't actually move, they merely give the illusion of movement.
- In traditional animation, individual images are drawn on acetate and modest changes in moving parts of the drawing are introduced from frame to frame. Then they are photographed and displayed sequentially while superimposed on a static background picture.
- When played back in sequence, the minor changes in the drawings from frame to frame merge and appear to move.
- The ***flicker fusion threshold*** is defined as the frequency at which an intermittent light stimulus appears to be completely steady to the observer.

Time line & FPS

- Most computerised animation uses applications that are based around a time line.
- The time line is broken down into individual frames that are then played consecutively one after the other.
- The faster the frames are played, the smoother the animation appears.
- In general the lowest frame rate (measured in frames per second FPS) for computer animation is 12.

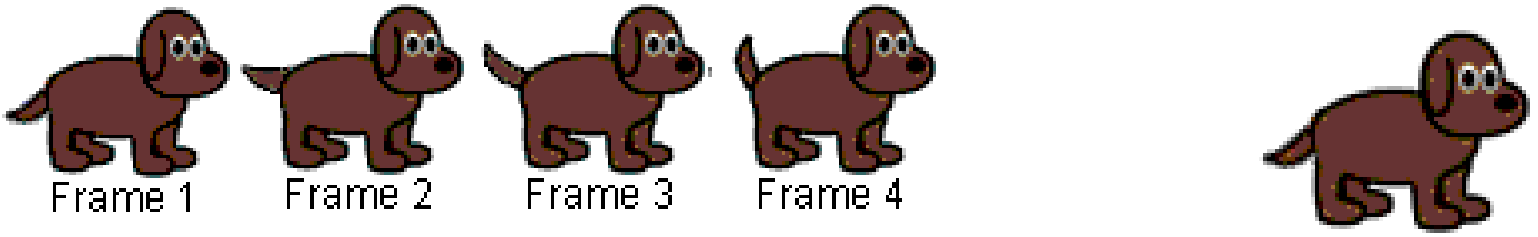


Digital Animation

- Digital animation can be classified as either:
  - fixed-path animation (pre-programmed)
  - data-driven (controlled by user input)
- There are three distinct types of digital animation:
  - Frame-based animation
  - Morphing
  - 3-D animation

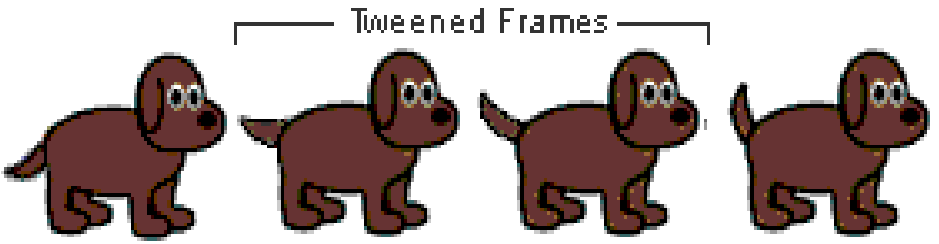
Frame-based animation

- Frame by frame (flip book) animation includes a succession of frames, each drawn by the animator.
- It is the electronic equivalent of traditional acetate cel animation techniques.
- This approach to animation is very labor intensive and comparatively expensive to produce, even for very simple animations.



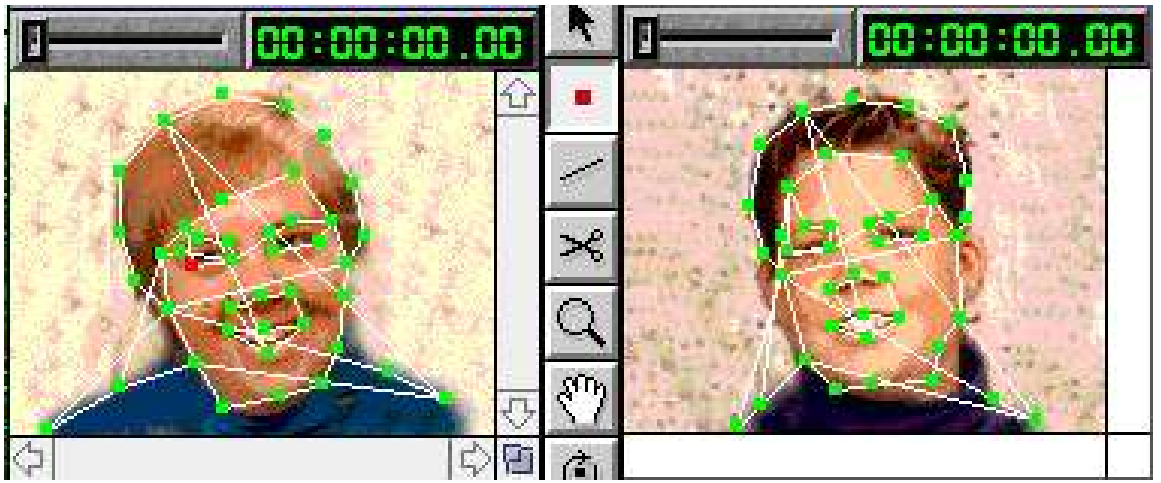
Tweening

- In order to simplify the production of frame based animations, most software allows the producer to use a process called "tweening" to automatically draw many of the individual frames.
- Tweening comes from the phrase ***in betweening*** - a concept in hand-drawn animation where the main animator would draw the key frames and his/her assistants would fill in the frames in between.
- The animator then defines the positions, orientation of the two frames, and specifies how many frames should appear between them. Software then determines the steps between the two existing frames, and creates a sequence of images between the two end points.



Morphing

- Morphing is an animation technique that gradually and smoothly transforms one object into another object, say the face of a small child into the face of an old man. It is an often used, and many would argue over-used, technique in commercial media.
- It requires the animator (or the software) to select "key points" that link various midpoints of the two shapes.

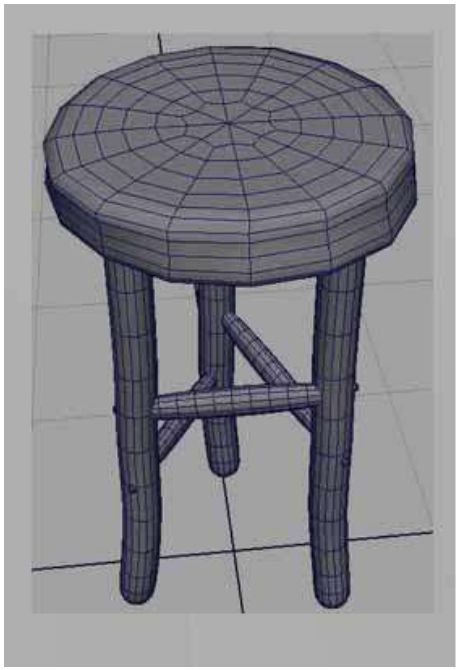


3D Animation

- Three-Dimensional animation gives more realistic results than an animator can accomplish with two-dimensional animation. 3-D animation can be used to produce even more realism by adding shadows and motion blurs and reflections that shift with the movement of the object.
- To accomplish 3-D animation, you go through five basic steps:
  - 1 modelling
  - 2 texturing
  - 3 scene building
  - 4 animating
  - 5 rendering

1. Modelling

- Modelling is the name given to creating three dimensional objects.
- Each element in a scene is an independent element. Modelling software is used to create primitives and extrusions (extensions of 2-D outlines into three dimensions.
- In most cases, 3-D programs display a model as a wireframe.

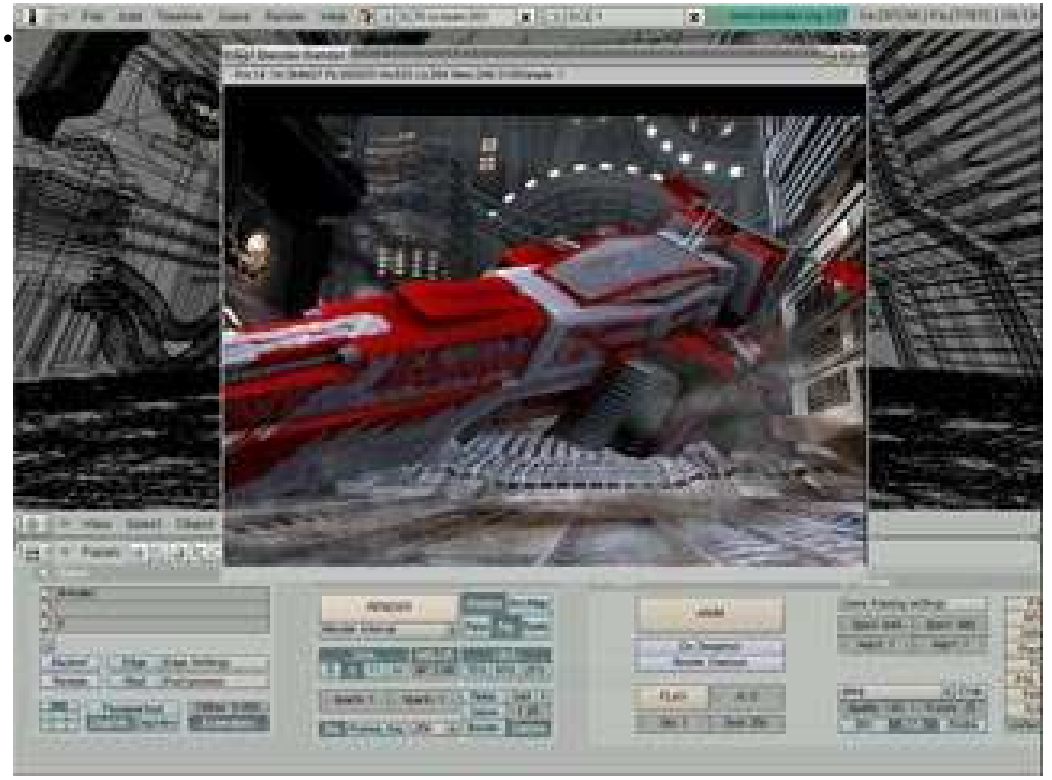


2. Texturing

- Texturing is the act of assigning surface attributes to objects.
- Most 3-D software comes with a number of predefined textures (e.g., wood, steel, water, granite) or you can create your own.
- Software also applies bump maps to the surfaces, which adds uneven spots, dents, gouges and differential grain, and improves on the "real" look of the objects.

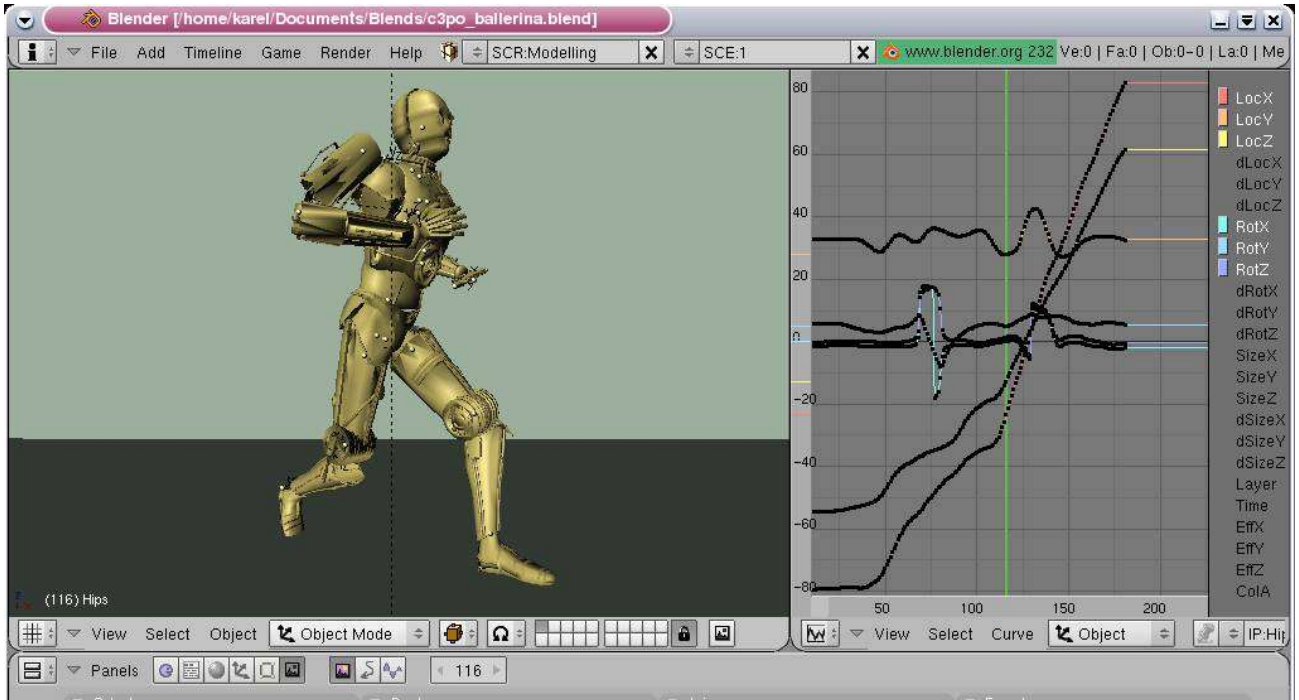
3. Scene Building

- Scene building is the act of assembling all of the elements comprising the animation.
- When building a scene, you choose a vantage point (camera), position the models and add lighting. From the vantage point of the camera, you can do things like pan and zoom on the objects, and you can control the types of lights cast on them.



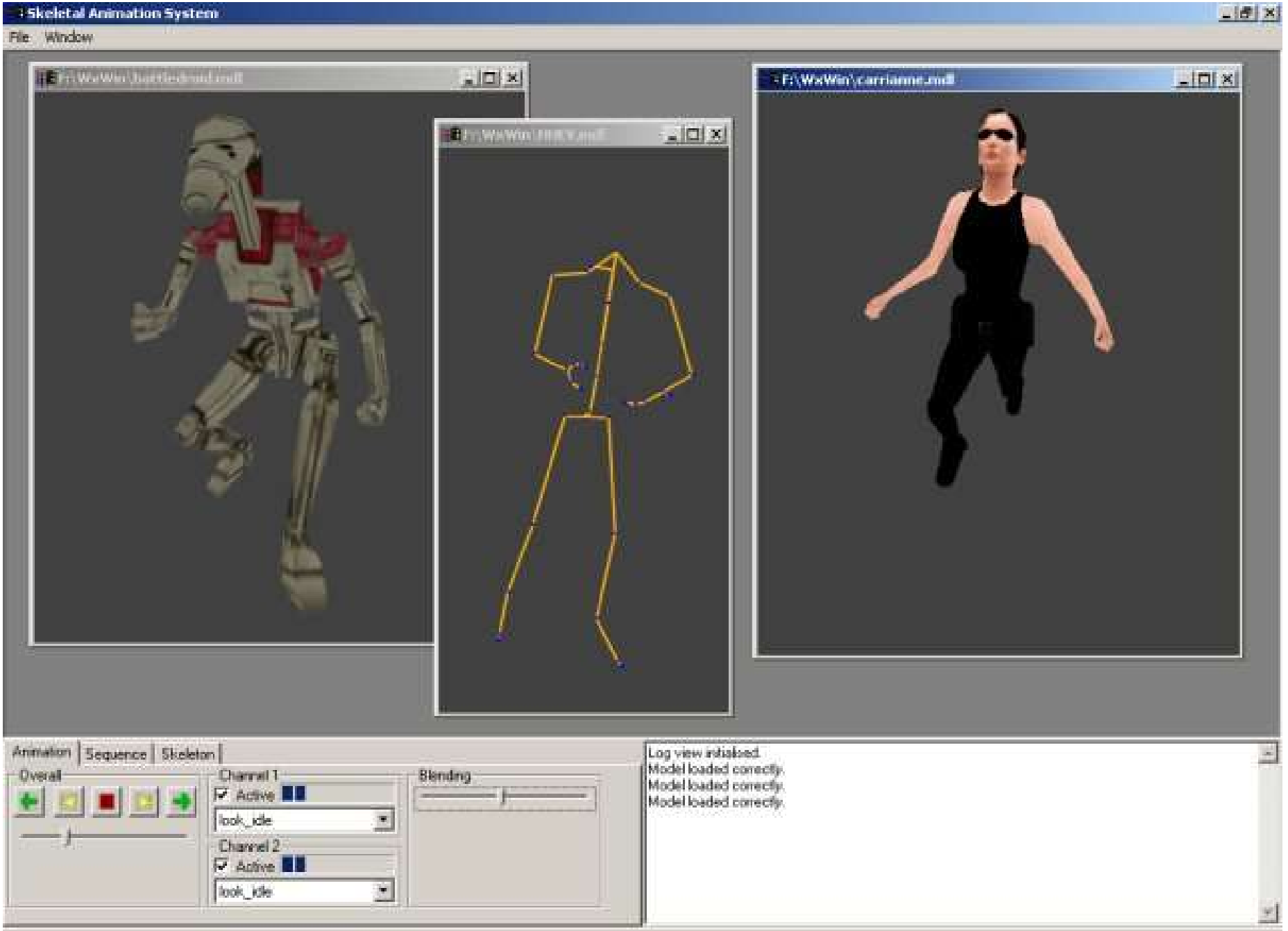
4. Animating

- To animate 3-D objects, key points are identified through which the objects will move.
- The software "tweens" the points in between to simulate continuous movement.
- Animation software provides tools for defining motion paths, animate the object's attributes (textures, size, etc.), move an object's position, and adjust the light falling on the object.



Skeletal animation

- Skeletal animation is a technique in which a character is represented in two parts
  - a surface representation used to draw the character (called the skin)
  - a hierarchical set of bones used for animation only (called the skeleton).
- Animation is therefore made much simpler: an animation can be defined by simple movements of the bones, instead of vertex by vertex (in the case of a polygonal mesh).
- The weakness of the skeletal approach is that it doesn't by itself provide realistic muscle movement. It is common in animation for the movie industry and increasingly in computer games to have special muscle controllers attached to the bones that mimic this effect.


Skeletal Animation System
File Window
F:\WxWin\carrianne.md3
Animation
Sequence
Skeleton
Overall
Channel 1
Active
look_idle
Channel 2
Active
look_idle
Blending
Log view initialized.
Model loaded correctly.
Model loaded correctly.
Model loaded correctly.

5. Rendering

- The completed model is ready to be drawn, according to the various decisions you have made.
- This process is called rendering, and it is an elaborate process that takes a long time to complete, even with a powerful and fast computer.
- And this is for a single picture -- animation will multiply the demands by 10 to 30 times for each second of animation.

CGI in film and television

- http://en.wikipedia.org/wiki/Timeline_of_CGI_in_film_and_television

- http://www.siggraph.org/education/materials/HyperGraph/animation/movies/particle75_1_89.mov

Render Farms

- A render farm is a computer cluster to render CGI, typically for film and television visual effects.
- The rendering of images is a highly parallelizable activity, as each frame can be calculated independently of the others, with the main communication between processors being the upload of the initial source material, such as models and textures, and the download of the finished images.

Particle Systems

- The use of Particle systems is a way of modelling fuzzy objects, such as fire, clouds, smoke, water, etc. These don't have smooth well-defined surfaces and are non-rigid objects, i.e., they are dynamic and fluid. Particle systems differ in three ways from "normal" representations for image synthesis:
  - 1. An object is not represented by a set of primitive surface elements, e.g., polygons or patches, but as clouds of primitive particles that define its volume.
  - 2. A particle system is not a static entity, its particles change form and move. New particles are created and old particles are destroyed.
  - 3. An object represented by a particle system is not deterministic, its shape and form is not completely specified. Stochastic processes are used to create and change an object's shape and appearance.

AI

- Artificial Life - herds, flocks and schools
- Flocks are a generalization of particle systems.
- In a flock, the particles are replaced by full geometric entities with an orientation. The behaviour of these particles is more complex, plus they interact with each other whereas simple particles don't.