

CS602

Lecture No 01

1.1 Definition

Computers accept process, transform and present information.

Computer Graphics involves technology to accept, process, transform and present information in a visual form that also concerns with producing images (or animations) using a computer.

1.2 Why Study Computer Graphics?

There are certain important reasons to study computer graphics. We will discuss them under certain heads:

a. Visualization

I like to see what I am doing. Many a times it happens that you perform certain tasks which you cannot visualize; for example as a student of data structures, you implement trees, graphs and other Abstract Data Types (ADTs) but you cannot visualize them whereas you must be having an inner quest to see what these actually look like.

I like to show people what I am doing. Similarly at certain times you would be performing certain tasks which you know but it would be difficult for others to understand them so there is very important requirement of showing the things in order to make them understandable.

b. Graphics is interesting

We are visual creatures and for us a picture is worth a thousand words. If we can get rid of text based static screen and get some graphics; its always interesting to see things in colours and motion on the screen. Therefore graphics is interesting because it involves simulation, algorithm, and architecture.

c. Requirement

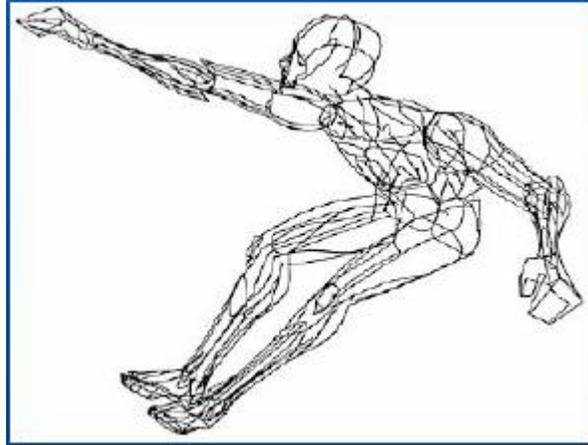
Well there are certain areas which require use of computer graphics heavily. One example is drawing of machines. It is required to prepare drawing of a machine before the actual production. The other heavy requirement is for architects as they have to prepare a complete blue print of the building they have to build long before the actual construction work gets underway. Autocad and other applications of the kind are heavily used today for building architecture.

d. Entertainment

Merely a couple of decades back, the idea of a 24 hours Cartoons Network was really a far fetched one. That was the time when one would wait for a whole week long before getting an entertainment of mere 15 minutes. Well thanks to computer graphics that have enabled us to entertain ourselves with animated movies, cartoons etc.

1.3 Some History

The term “computer graphics” was coined in 1960 by William Fetter to describe the new design methods that he was developing at Boeing. He created a series of widely reproduced images on a plotter exploring cockpit design using a 3D model of a human body.



Whirlwind: early graphics using VectorScope (1951)



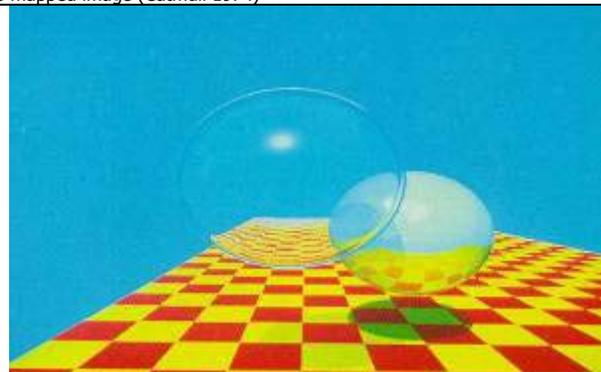
Spacewars: first computer graphics game (MIT 1961)



Early texture-mapped image (Catmull 1974)



First distributed ray traced image (Cook 1984)



First ray traced image (Whitted 1980)

1.4 Graphics Applications

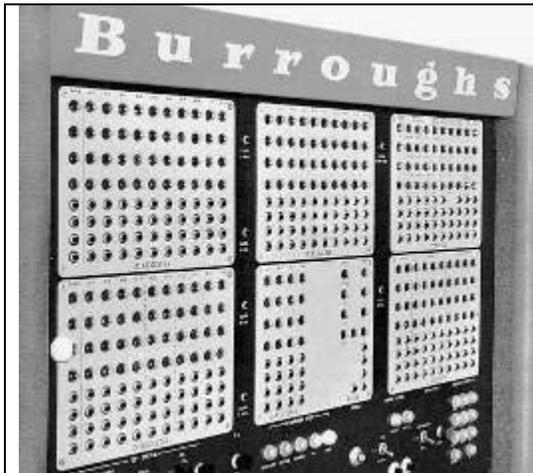
Due to rapid growth in the field of computing, now computer is used as an economical and efficient tool for the production of pictures. Computer graphics applications are found in almost all areas. Here we will discuss some of the important areas including:

- i. User Interfaces
- ii. Layout and Design
- iii. Scientific Visualization and Analysis
- iv. Art and Design
- v. Medicine and Virtual Surgery
- vi. Layout Design & Architectural Simulations
- vii. History and cultural heritage
- viii. Entertainment
- ix. Simulations
- x. Games

1.5 User Interfaces

Almost all the software packages provide a graphical interface. A major component of graphical interface is a window manager that allows a user to display multiple windows like areas on the screen at the same time. Each window can contain a different process that can contain graphical or non-graphical display. In order to make a particular window active, we simply have to click in that window using an interactive pointing device.

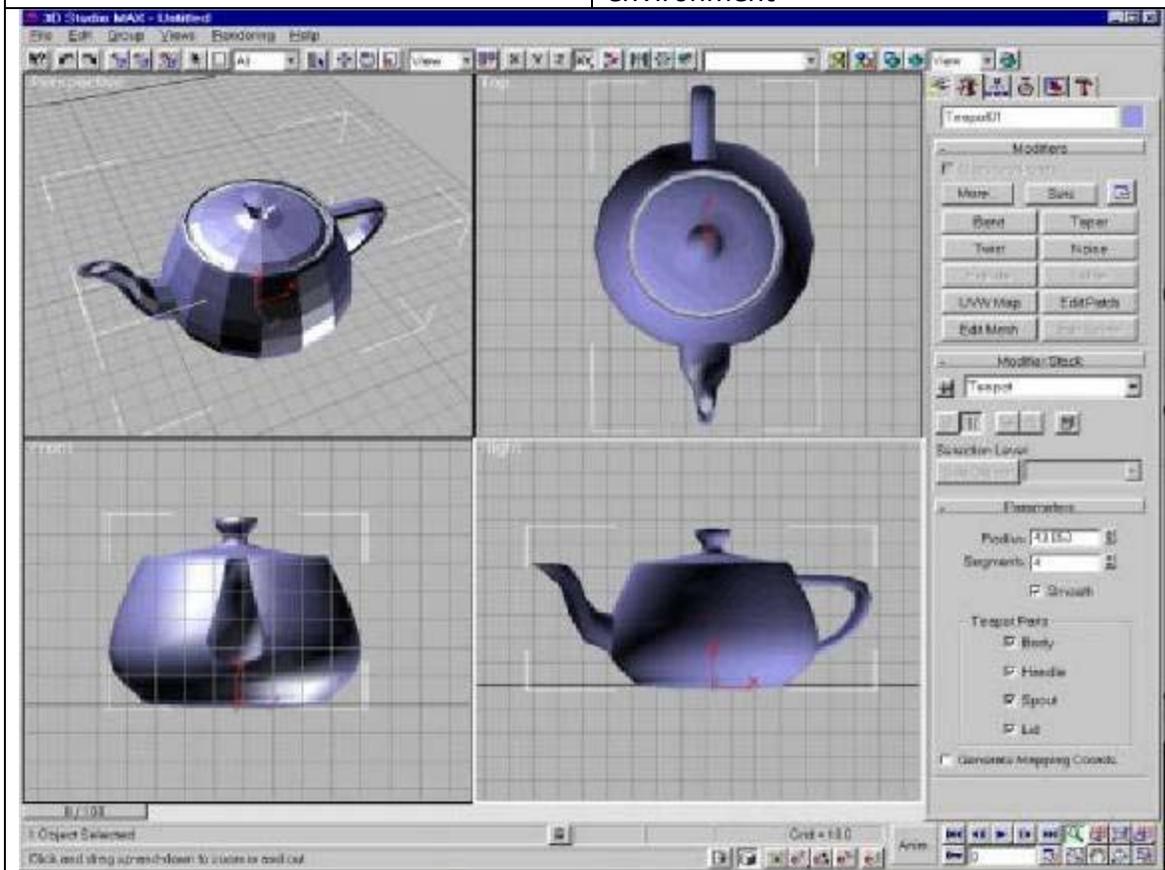
Graphical Interface also includes menus and icons for fast selection of programs, processing operations or parameter values. An icon is a graphical symbol that is designed to look like the processing option it represents.



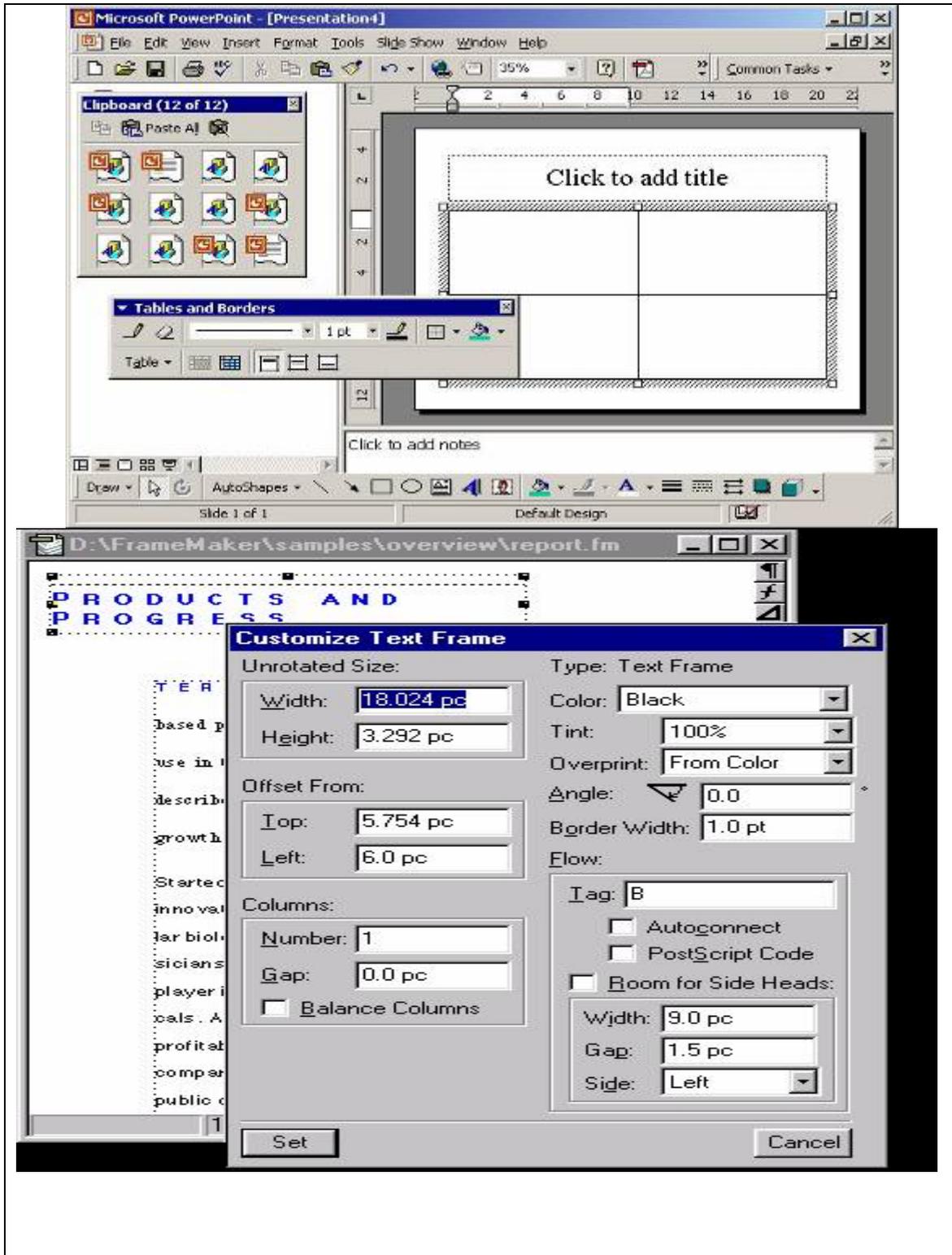
B205 Control Console (1960)



Impressive and Interactive 3D environment

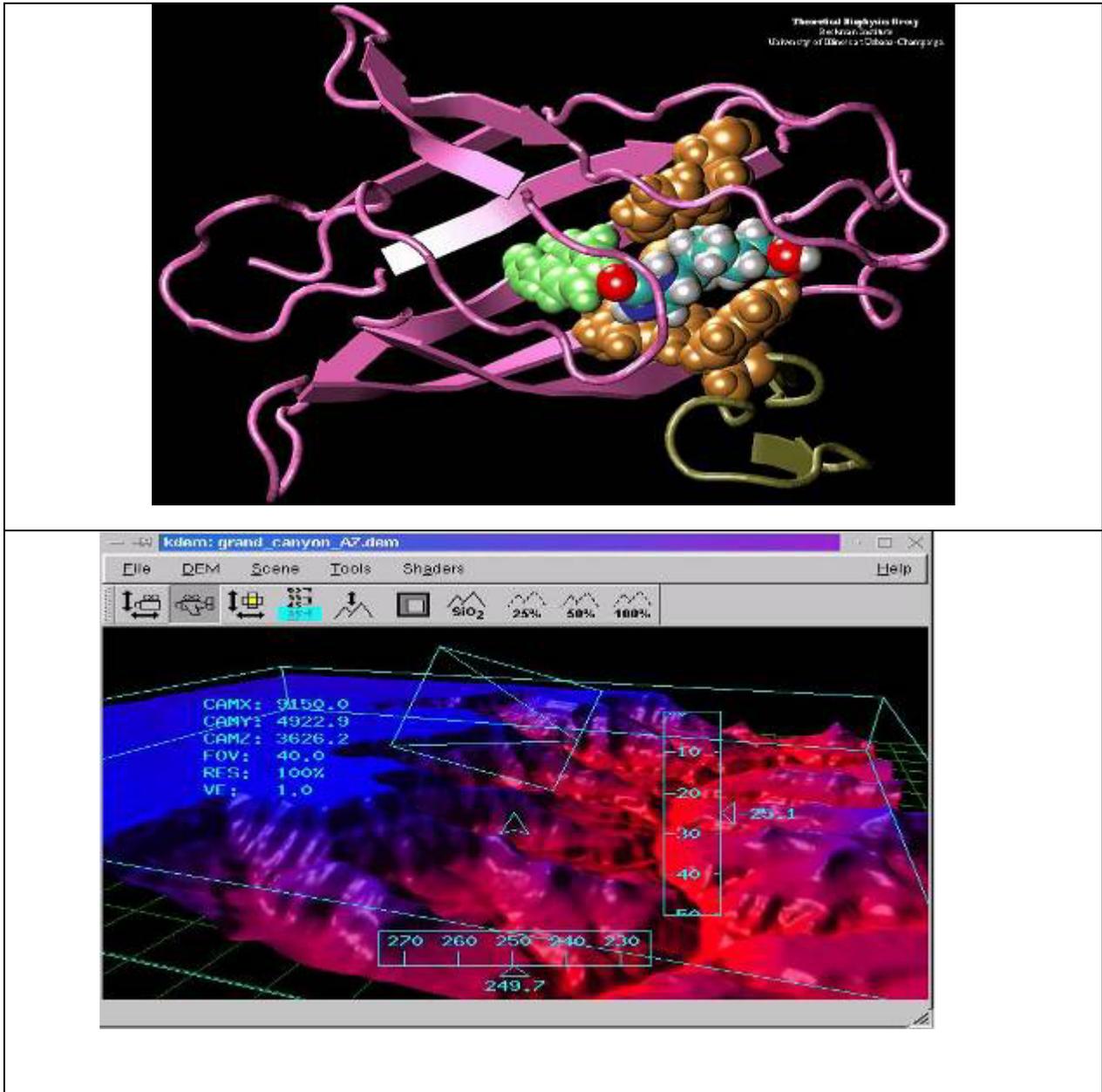


1.6 Layout and Design



1.7 Scientific Visualization and Analysis

Computer graphics is very helpful in producing graphical representations for scientific visualization and analysis especially in the field of engineering and medicine. It helps a lot in drawing charts and creating models.



1.8 ART AND DESIGN

Computer graphics is widely used in Fine Arts as well as commercial arts for producing better as well as cost effective pictures. Artists use a variety of programs in their work, provided by computer graphics. Some of the most frequently used packages include:

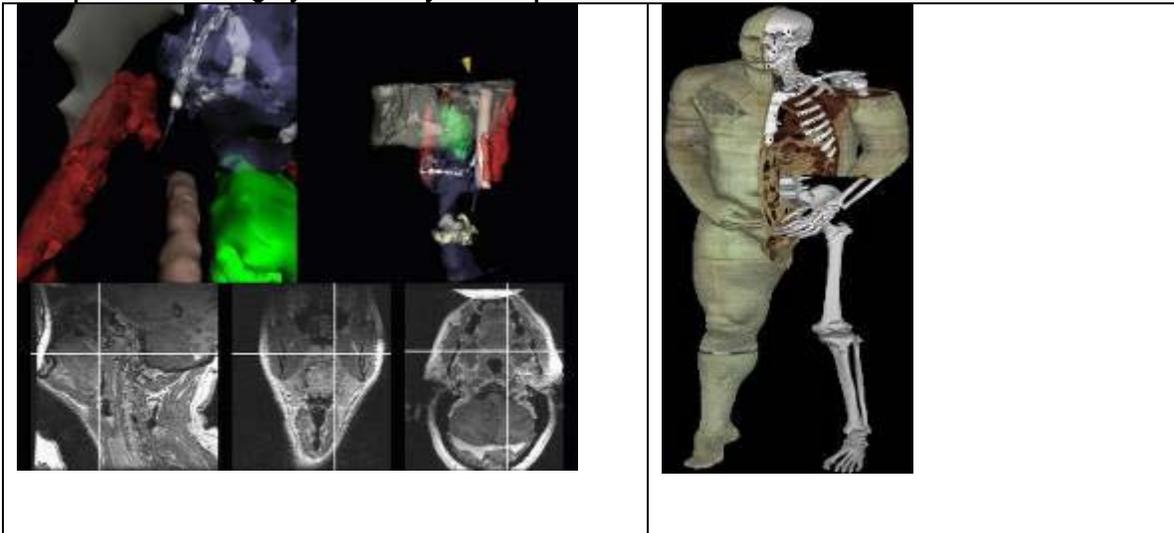
- i. Artist's paintbrush
- ii. Pixel paint
- iii. Super paint



1.9 Medicine and Virtual Surgery

Computer graphics has extensive use in tomography and simulations of operations. Tomography is the technique that allows cross-sectional views of physiological systems in X-rays photography. Moreover, recent advancement is to make model and study physical functions to design artificial limbs and even plan and practice surgery.

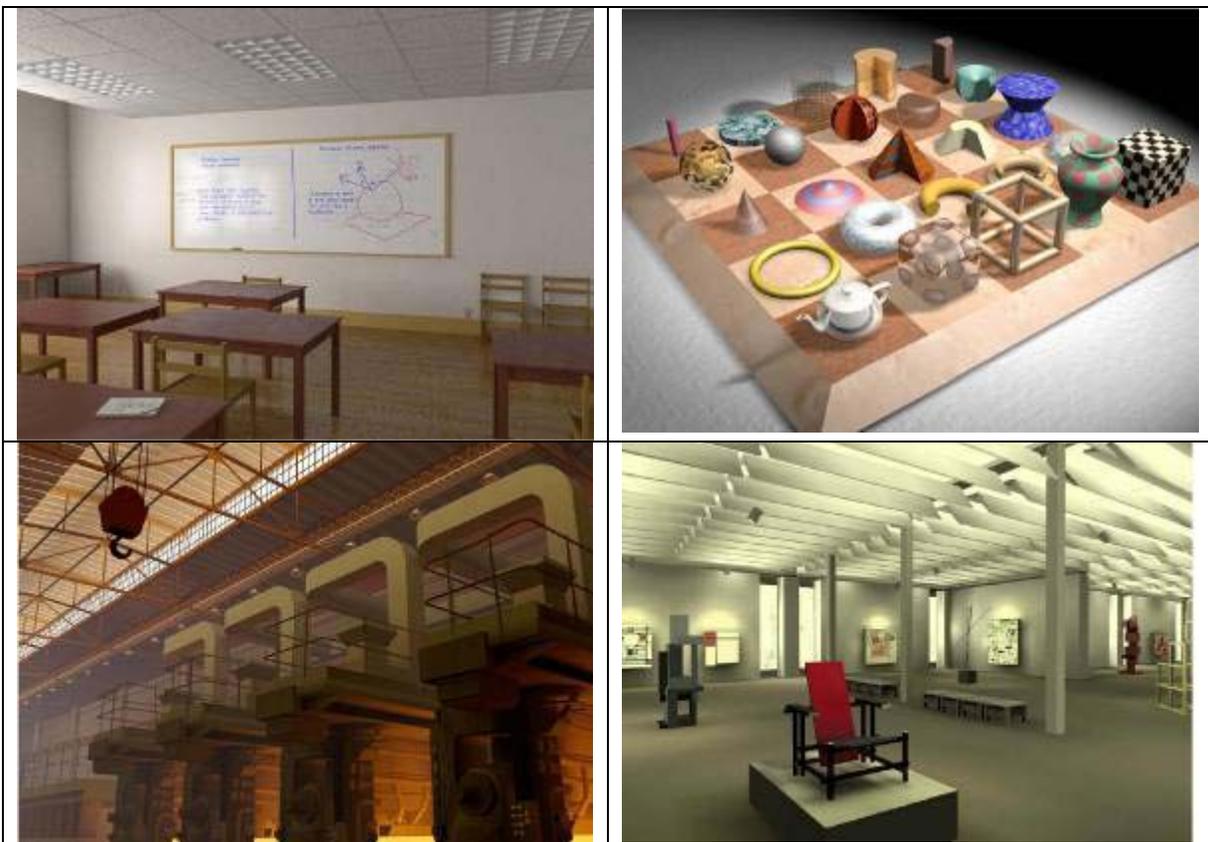
Computer-aided surgery is currently a hot topic.



1.10 Room Layout Design and Architectural Simulations



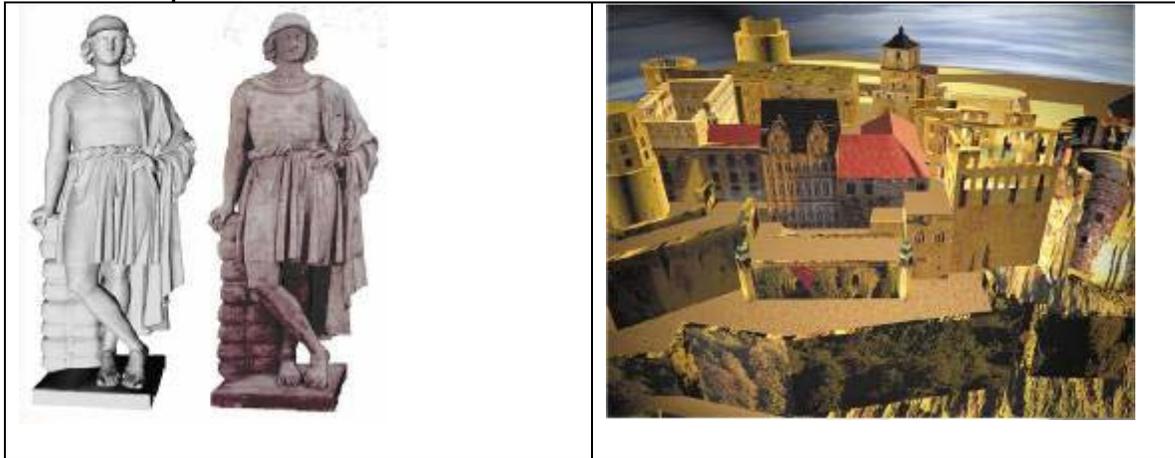
1.11 Layout Design & Architectural Simulations



1.12 History and cultural heritage

Another important application of computer graphics is in the field of history and cultural heritage. A lot of work is done in this area to preserve history and cultural heritage. The features so far provided are:

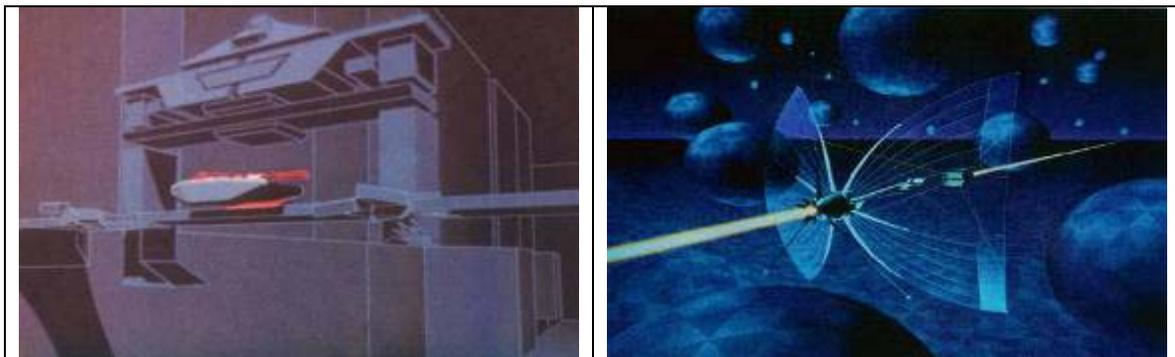
- i. Innovative graphics presentations developed for cultural heritage applications
- ii. Interactive computer techniques for education in art history and archeology
- iii. New analytical tools designed for art historians
- iv. Computer simulations of different classes of artistic media



1.13 Movies

Computer graphics methods are now commonly used in making motion pictures, music videos and television shows. Sometimes the graphics scenes are displayed by themselves and sometimes graphics objects are combined with the actors and live scenes. A number of hit movies and shows are made using computer graphics technology. Some of them are:

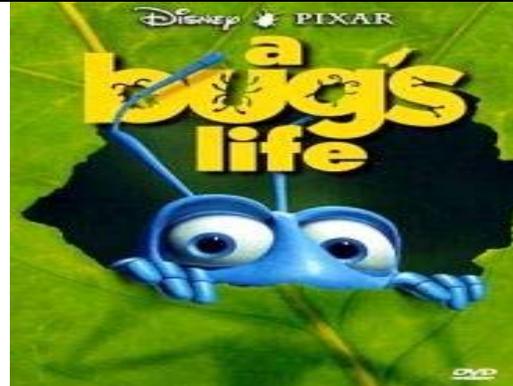
- i. Star Trek- The Wrath of Khan
- ii. Deep Space Nine
- iii. Stay Tuned
- iv. Reds Dreams
- v. She's Mad



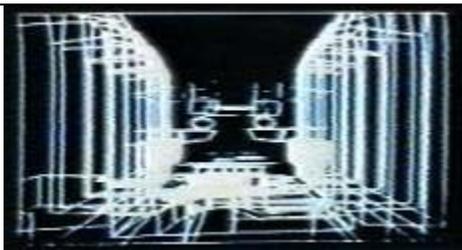


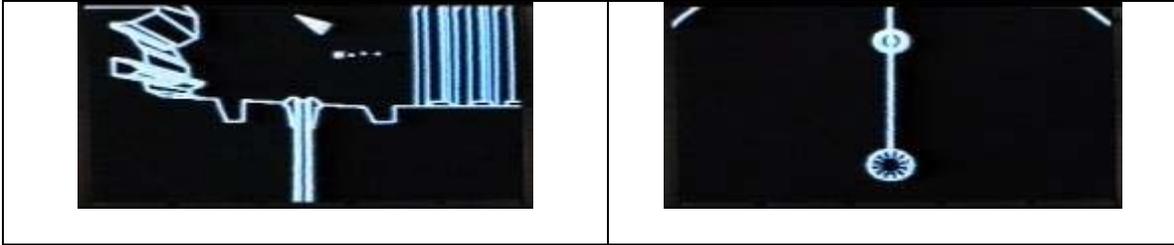
Tron (1980)

First time computer graphics were used for live action sequences.

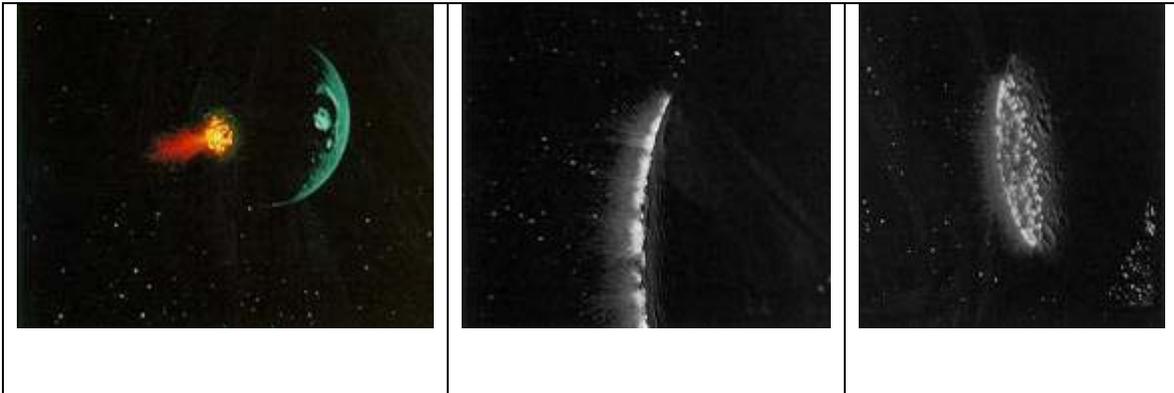


Fully computer generated animated features

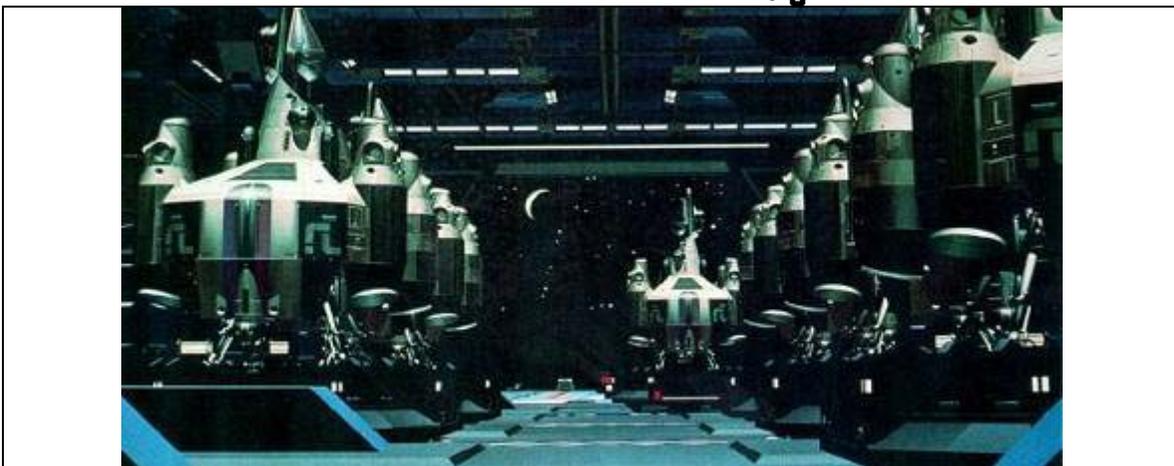




Star Wars (1977)



Star Trek II: The Wrath of Khan, genesis



The Last Star fighter (15 minutes) (1982)





Special Effects... in Live Action Cinema



“Traditional” Animated Features...

Some examples:

- Automating Key framing in many Disney-type animations
- The flocking behaviour of the wild beast in Lion King
- Non photorealistic rendering: 3D effects in Futurama



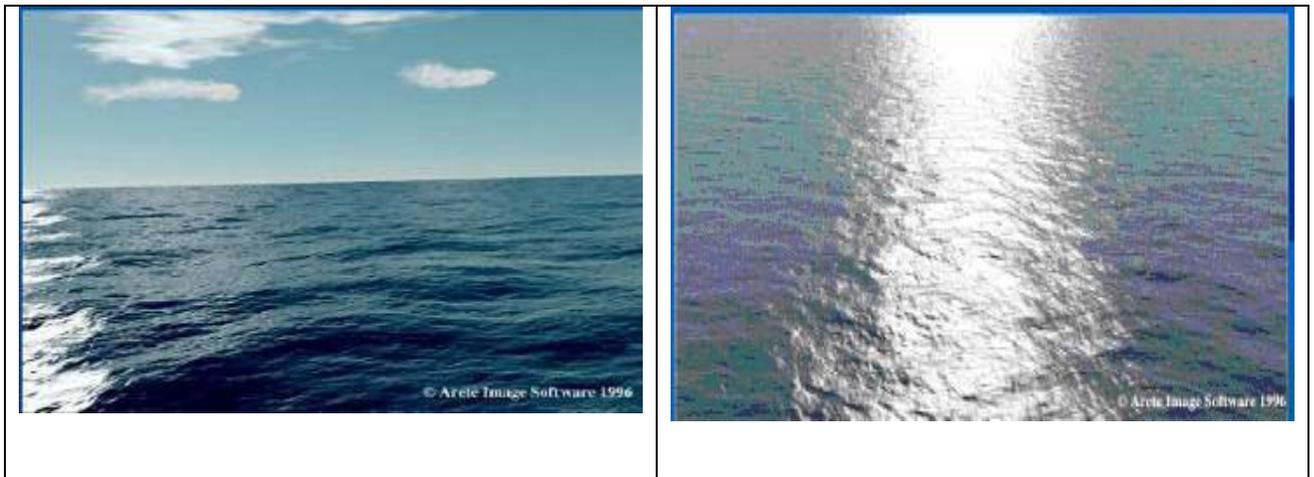
Behind the scenes on Antz Production

Number of frames in the movie	119,592
Number of times the movie was rendered during production	15 (approx.)
Number of feet of approved animation produced in a week	107 ft.
Total number of hours of rendering per week	275,000 hrs.
Average size of the frame rendered	6 MB
Total number of Silicon Graphics servers used for rendering	270
Number of desktop systems used in production	166
Total Number of processors used for rendering	700
Average amount of memory per processor	256 MB
Time it would have taken to render this movie on 1 processor	54 yrs., 222 days, 15 mins., 36
Amount of storage required for the movie	3.2 TB
Amount of frames kept online at any given time	75000 frames
Time to re-film out final cut beginning to end	41.5 days (997 hrs.)

1.14 Simulations

Simulation by all means is a very helpful tool to show the idea you have or the work you are doing or to see the results of your work. Given below is the picture in which you can see waves ripples on water; no doubt looking like original but is simply a simulation. A number of software packages are used for simulation including:

- i. Crackerjack Computer Skills
- ii. Keen Artistic Eye
- iii. Flash
- iv. Maya



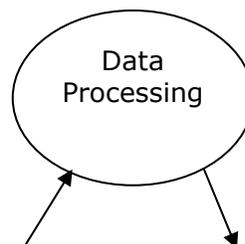
1.15 Games

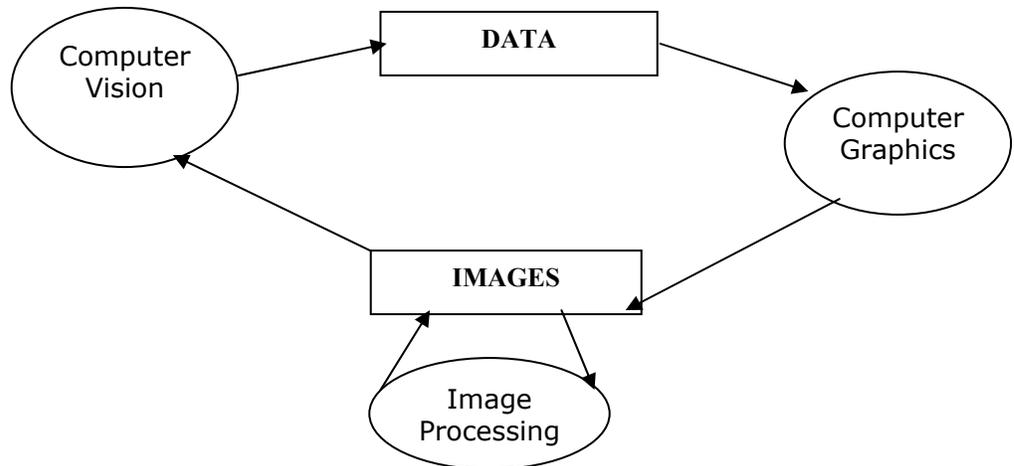
Thanks to computer graphics, real time games are now possible. Now game programming itself has become an independent field and game programmers are in high demand. Some of the famous games are:

- i. Quake
- ii. Doms
- iii. Need For Speed
- iv. Commandos



1.16 Related Disciplines





1.17 Interdisciplinary

- i. Science
- ii. Physics: light, color, appearance, behaviour
- iii. Mathematics: Curves and Surfaces, Geometry and Perspective
- iv. Engineering
- v. Hardware: graphics media and processors, input and output devices
- vi. Software: graphics libraries, window systems
- vii. Art, Perception and Esthetics
- viii. Color, Composition, Lighting, Realism