COMPUTER GRAPHICS

INTRODUCTION

Introduction to COMPUTER GRAPHICS

Computer Graphics involves display, manipulation and storage of pictures and experimental data for proper visualization using a computer.

Typical graphics system comprises of a host computer with support of fast processor, large memory, frame buffer and

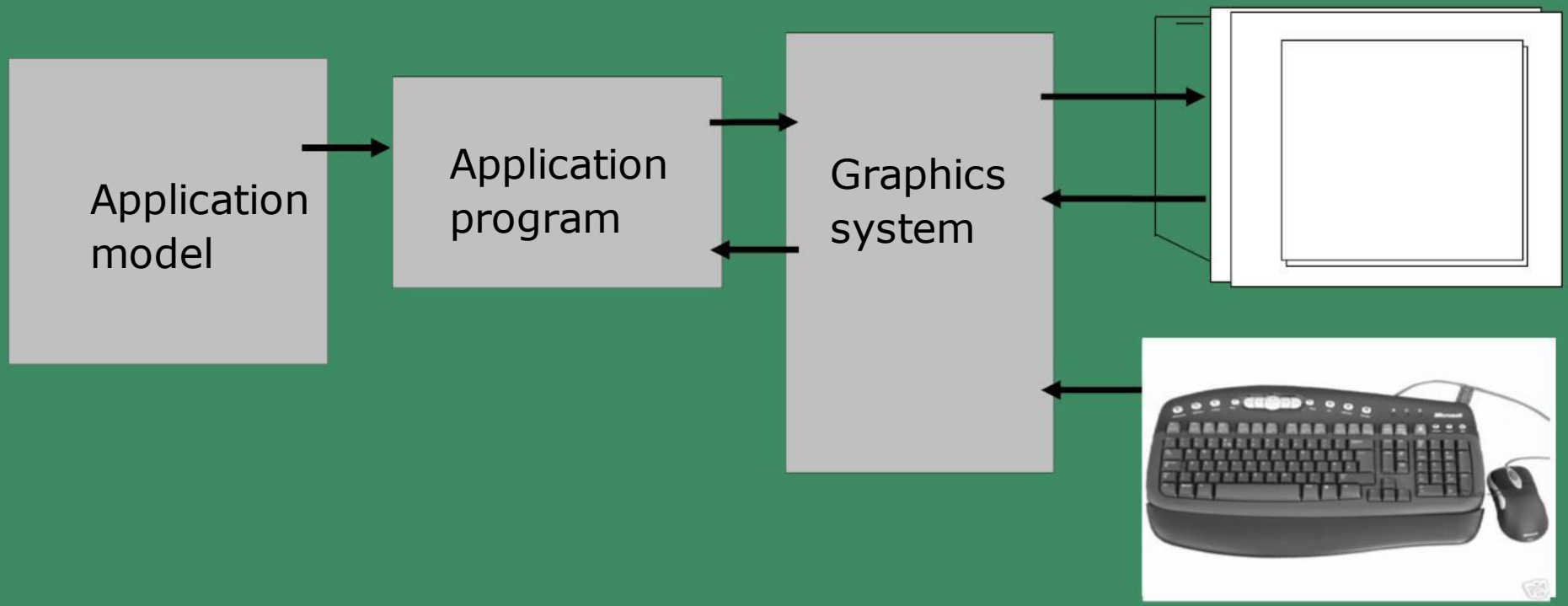
Introduction to COMPUTER GRAPHICS

- **Display devices** (color monitors),

- **Input devices** (mouse, keyboard, joystick, touch screen, trackball)

- **Output devices** (LCD panels, laser printers, color printers. Plotters etc.)

- **Interfacing devices** such as, video I/O, TV interface etc.



Conceptual framework for interactive graphics

Typical applications areas are

- **GUI**
- **Plotting in business**
- **Office automation**
- **Desktop publishing**
- **Plotting in science and technology**
- **Web/business/commercial publishing and advertisements**
- ***CAD/CAM design (VLSI, Construction, Circuits)***
- ***Scientific Visualization***

- Entertainment
  (movie, TV Advt., Games etc.)
- **Simulation studies**
- **Simulators**
- **Cartography**
- Multimedia
- Virtual reality
- **Process Monitoring**
- Digital Image Processing
- **Education and Training**

Various application packages and standards :

- Core graphics
- GKS (Graphical Kernel System)
- SRGP (simple raster graphics package)
- PHIGS (PHIGS - Programmer's Hierarchical Interactive Graphics System)
- OpenGL (with ActiveX and Direct3D)
- X11-based systems.

On various platforms, such as

DOS,

Linux,

SGI,

Solaris,

Mac,

Windows,

OS/2,

SunOS,

HP-UX,

DEC-OSF.

Various utilities and tools available for web-based design include: Java, XML, VRML and GIF animators.

Certain compilers, such as, Visual C/C++, Visual Basic, Borland C/C++, Borland Pascal, Turbo C, Turbo Pascal, Gnu C/C++, Java provide their own graphical libraries, API, support and help for programming 2-D/3-D graphics.

Some these systems are

- device-independent **(X11, OpenGL)**

- device-dependent **(Solaris, HP-AGP).**

Four major areas of Computer Graphics are:

- **Display of information,**
- **Design/Modeling,**
- **Simulation and**
- **User Interface.**

Four basic output primitives (or elements)
for drawing pictures:

- POLYLINE
- Filled POLYGONS (regions)
- ELLIPSE (ARC)
- TEXT
- Raster IMAGE

Computer Graphics systems could be *active* or *passive*.

In both cases, the input to the system is the scene description and output is a static or animated scene to be displayed.

In case of active **systems, the user controls the display with the help of a GUI, using an input device.**

Computer Graphics is now-a-days, a significant component of almost all systems and applications of computers in every field of life.

Some current areas of research in CG and VR

- Augmented Reality
- Visual Innovations
- Building Character
- Mobile reality
- Surface Reconstruction
- Interaction
- Video Techniques
- Hardware and Devices
- Immersive Reality
- Digital Art and Sound
- Collaborative Envmnt.
- Inflatable Structures
- Fabrication
- Rendering

- Wearable Computing
- Deformation modeling
- Simulating Nature
- Fluid simulation
- Collision modeling
- Motion Capture & Locomotion
- Haptics & Interaction
- Eyes, Nose, Mouth, & Body
- Texture & Gigapixel mapping
- Archeological Reconstruction
- STEM to STEAM initiatives
- Discrete Stochastic Microfacet models, Glints ;
- Performance Transfer and Character Articulation
- Aesthetically stimulating real-time live simulations
- Advanced MPM for phase-change and varied materials
- Visualization in HPC – Social networks, nature modeling
- Caustic Design; 3-D Hair styles; Tearing and Cracking;
- Games – Stunning visuals, game models, animation sequence

Haptics

Haptics (pronounced HAP-tiks) is the science of applying touch (tactile) sensation and control to interaction with computer applications

By using special input/output devices (joysticks, data gloves, or other devices), users can receive feedback from computer applications in the form of felt sensations in the hand or other parts of the body.

In combination with a visual display, haptics technology can be used to train people for tasks requiring hand-eye coordination, such as surgery and space ship maneuvers.

It can also be used for games in which you feel as well as see your interactions with images.

For example, you might play tennis with another computer user somewhere else in the world.

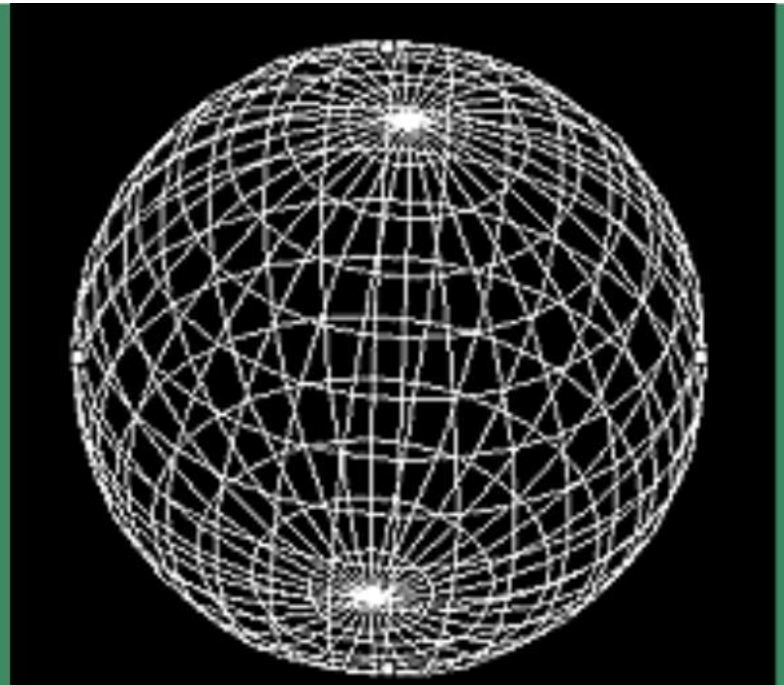
Both of you can see the moving ball and, using the haptic device, position and swing your tennis racket and feel the impact of the ball.

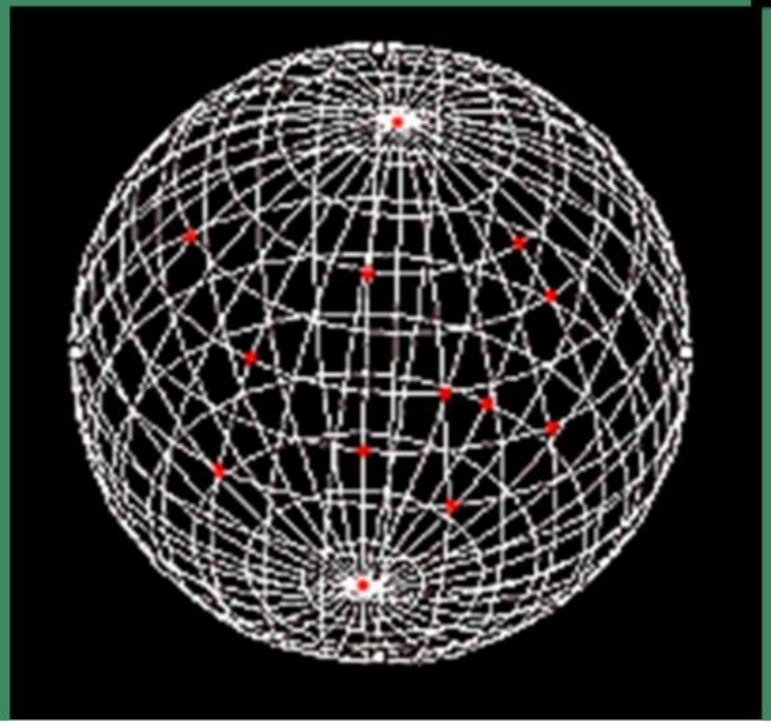
A number of universities are experimenting with haptics. The Immersion Corporation offers a joystick product that is used in laboratories and in arcade games. Haptics offers an additional dimension to a virtual reality or 3-D environment.

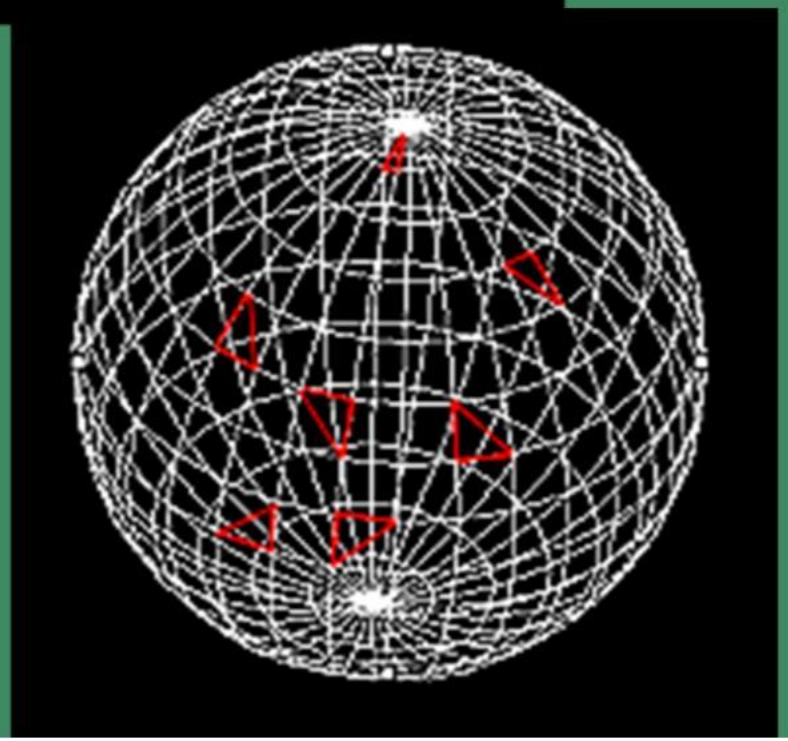
Some examples and illustrations

of Graphical objects

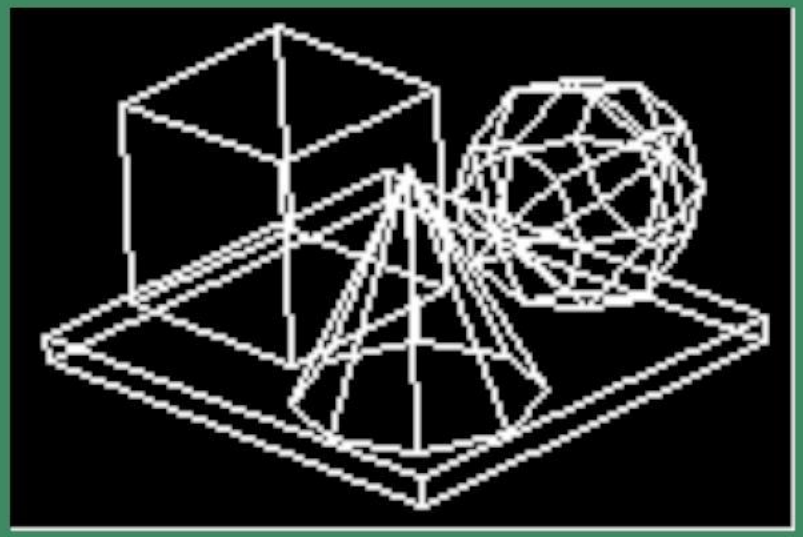
Wire-frame model of a sphere, using sweep representation

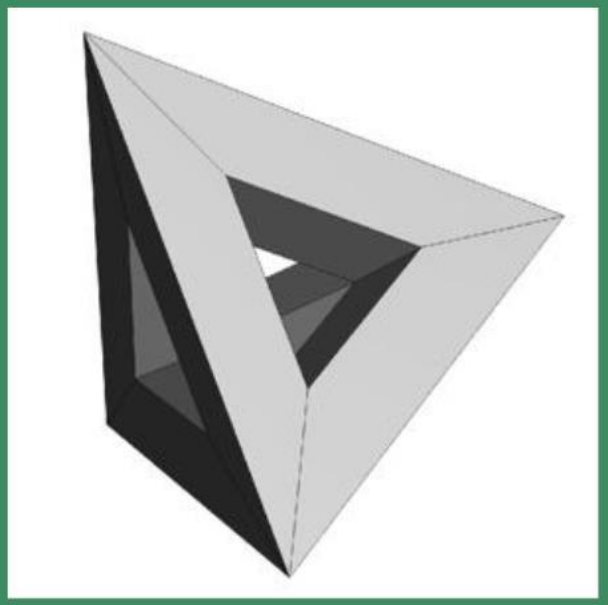


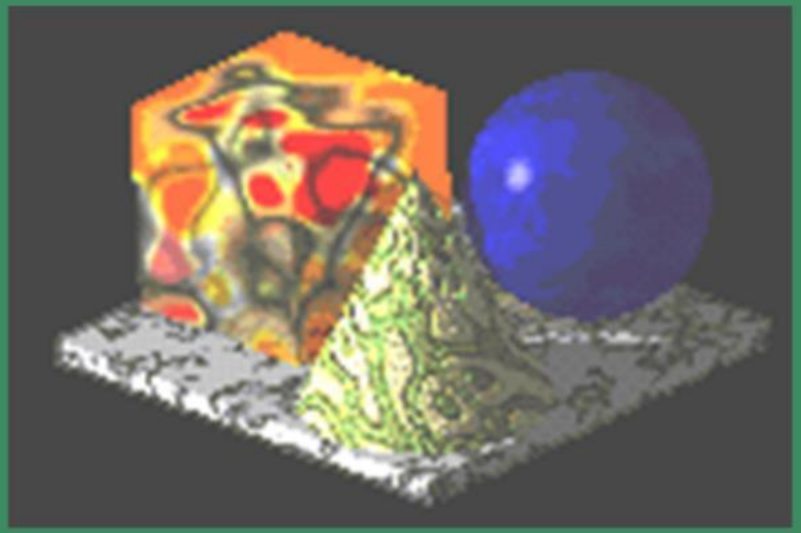




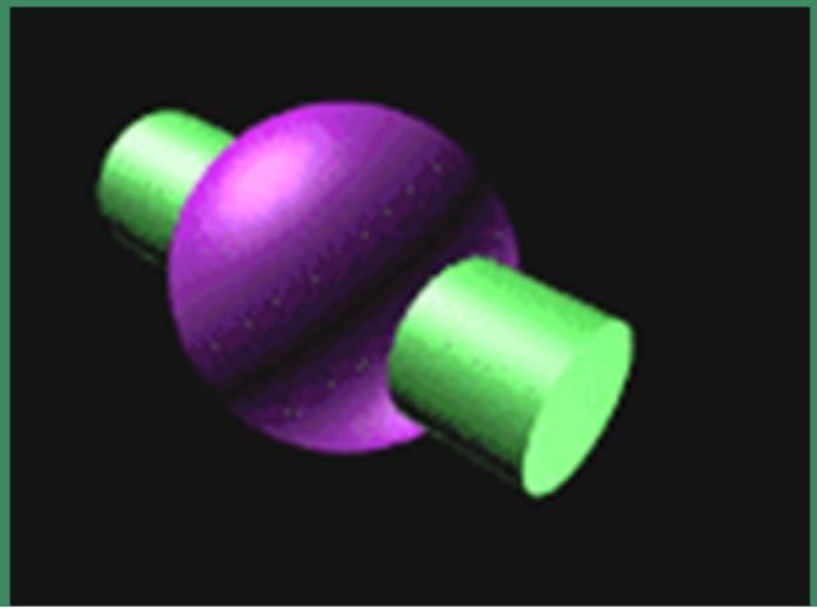
Simple 3D solid objects

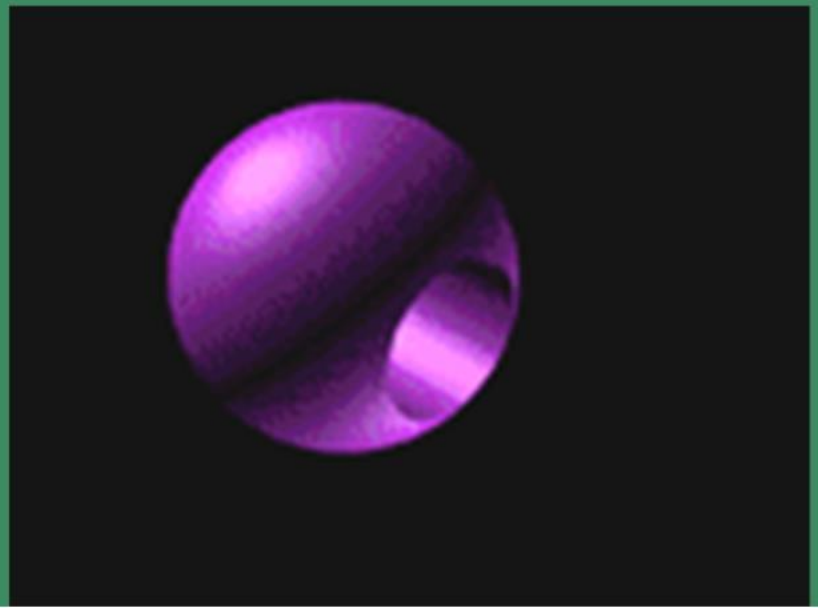




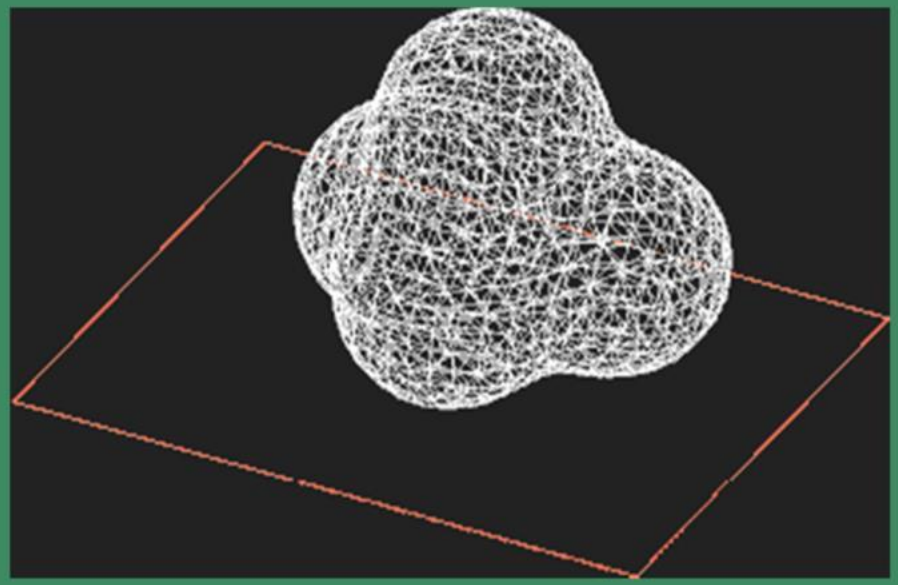


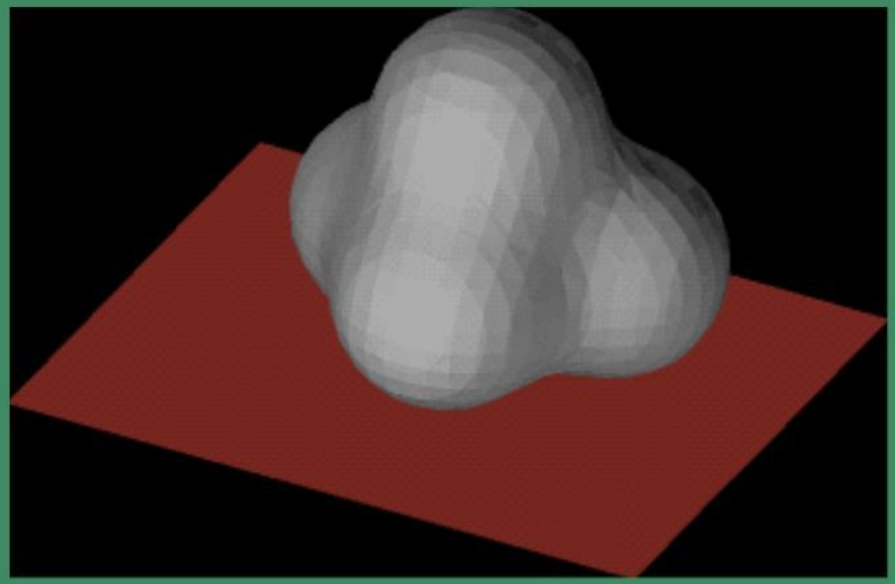
3D Solid object (with hole) generated using Constructive Solid Geometry

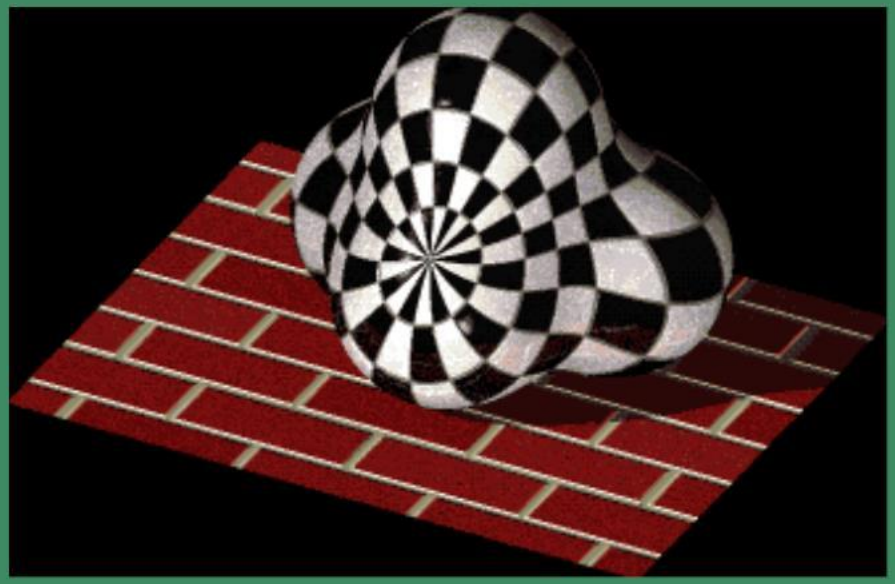




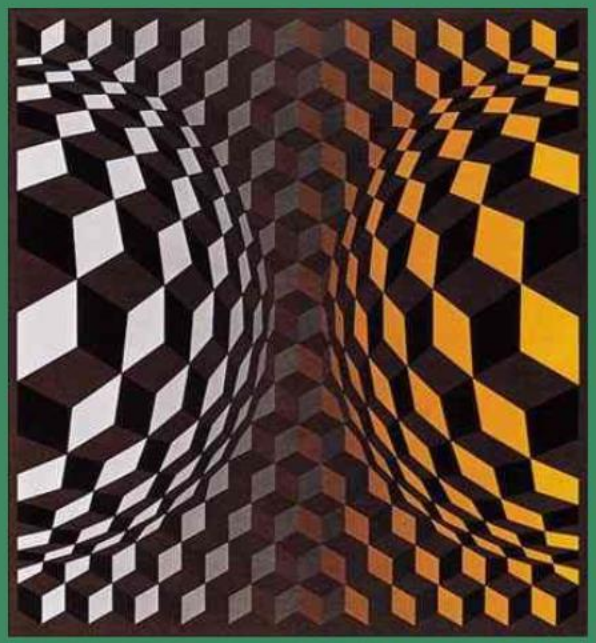
Shading effects, texture mapping and shadows





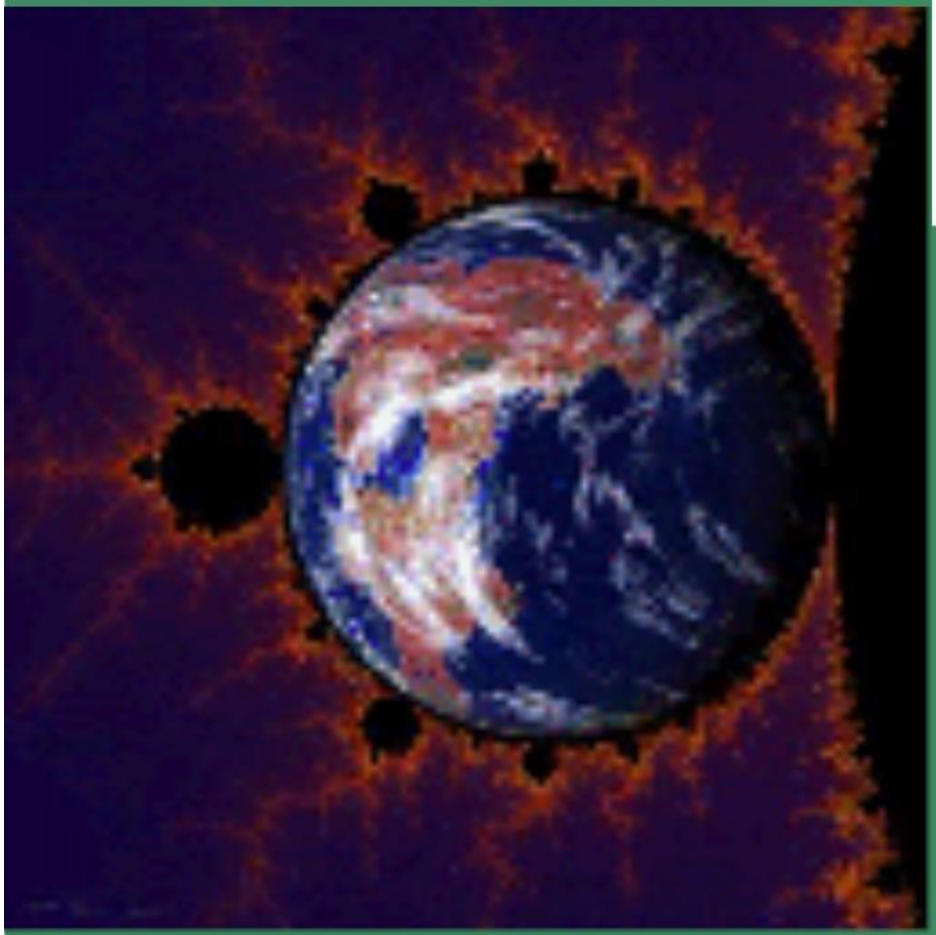


Textures help to visualize
shape and structure of 3D objects



Real world image of a texture (stochastic)

Texture synthesis using Fractals



A realistic scene implemented using:
NURBS (Non-uniform Rational B-Splines), image maps, bump maps, texture map, procedural noise and depth of field.

- Pixels
- Resolution
- Aspect Ratio
- Vector Graphics Vs Raster Graphics
- Graphical Primitives