1. **What is Computer Graphics?**

Computer graphics provides a set of tools to create pictures and to interact with them in natural ways. The tools consist of both hardware and software with a strong graphics capability. Data are presented visually through shapes, colours, and texture. Words and numbers are replaced whenever possible by pictures.

2. **Terminology**

2.1 **Application/Application Programmer**

An **application** is a computer program that applies the resources of a computer to specific task. For example,

- **Word processor** — Microsoft Word, WordPerfect, WordStar
- **Database package** — Microsoft Excel, FileMaker Pro, MS Access, MS SQL Server, Oracle

**Application programmers** are the people who write applications.

A **graphics application** is designed to produce graphics — visual representation in the form of pictures, slides, and so forth.

Graphics package consists of paint or drawing.

- **Paint** — dealing with bits such as PaintBrush, SuperPaint, Adobe Photoshop, Paint Pro
- **Drawing** — dealing with lines such as MacDraw, Designer, Macromedia FreeHand

2.2 **The User**

The user runs the application, directs its sequence of actions, and observes the fruits of its labours. Users often know little about the internal logical of the application or about programming. They “know” the applications only through the user’s manual, the “interface” presented while the program is running, and the experience they gain from trying it out. Users often become experts without even knowing how the program operates, the language in which it was written, or who wrote it. Thus it is essential to provide an understandable and visually accessible interface to the users, and graphics offers the tools to do this.
2.3 Display Device

A display device presents text and pictures to the user. There are several ways to categorise display devices, such as hard-copy versus soft-copy, monochrome versus colour, or character versus graphics displays.

When text or pictures are created on hard-copy device, a permanent record of the image is created. The most familiar example is a printer. Laser printers can place dots very closely — at densities of 300 or more dots per inch (dpi) — and so can produce very high-quality graphics.

Some example printer are:
- Epson LX80: — 240 dpi horizontally and 72 dpi vertically
- Apple LaserWriter, HP LaserJet III, HP DeskWriter — 300 dpi
- SunSPARC Laser Printer — 400 dpi
- HP LaserJet 4, Apple LaserWriter 600 — 600 dpi
- Linotroni — 300 to 2540 dpi (Magazine Quality)

Another common hard-copy device is the pen plotter, such as HP7475A. A pen travels over the paper, leaving a trails of coloured ink. Some plotters have a carousel that holds several pens which the program can exchange automatically in order to draw in different colours. There are also drum plotters, which the paper rollers back and forth on a drum to provide one direction of motion such as HP7580. film recorder is another type of the hard-copy device which the picture is dawn directly onto photographic film for later development. Image can also be directly “drawn” on videotape with a video tape recorder, again providing a hard copy. (Hard Copy Program on Channel Seven)

There are also various types of soft-copy display whose pictures are not permanent but last only until the display is overwritten with a new picture or is turned off.

The most common display surface is the screen of a TV-like “video monitor” such as VGA monitor, SunSPARC Screen, Apollo Terminal and Apple monitor.

The important distinction in displays is between monochrome and colour video displays. A monochrome display uses a single electron gun and a single type of phosphor, and so it can draw only one colour, although different parts of the picture can have different brightness.

A colour display has three guns and three types of phosphor which consists of red, green and blue colours (RGB).

The character displays is called alphanumeric displays which show only alphabetic characters, numbers and a few punctuation marks. Character displays are the most common and least expensive computer terminals available. When you login cabsav from PC Lab (D662), you use the VGA monitor as a character displays monitor. You can edit your program and send email, but you cannot display the drawings.

Graphics displays, on the other hand, can draw a rich variety of lines and other shapes. The two main types of graphics displays are line drawing and raster. Line-drawing displays can draw only lines. (see Figure 1.7 on page 7.) it receives simple end-
point coordinate information, \((x_1, y_1)\) and \((x_2, y_2)\) and produces the corresponding line. Raster displays define pictures by a rectangular array of dots called pixels. When sent the proper patterns of pixels, raster displays not only can draw lines, they also can fill in regions of the screen with some colour.

To increase their flexibility, graphics displays usually have a text mode and a graphics mode. In a text mode they act as ordinary character terminals. In a graphics mode they interpret the data they receive as commands to draw graphics. They can switched from one mode to the other by keystrokes or under program control.

In this subject, we will use Turbo C as the compiler to do the programming. Here are some of graphics system control functions:

2.4 Host Computer

The host computer is the processor on which the application runs. It may or may not be tightly coupled with the graphics displays. In some cases the host computer is a self-contained system such as a personal computer (PC or Macintosh), containing an interactive computer terminal with built-in microprocessor, memory, and mass storage.

At the other extreme, the host is a large, remotely located computer that communicates with the user’s terminal over some sort of communication line. The remote host system usually consists of a much faster computer with vast amounts of storage and many peripheral devices such as printers and plotters. Often, powerful and expensive software packages are immediately available after being installed.

The graphics display in such a system is loosely connected to the host. Graphics data must pass over the communications link that connects the terminal to the system. Some links, such as two modems connected by a telephone line, transmit data very slowly, causing graphics to be drawn at a frustratingly slow pace. Another limitation is that a remote host system often simultaneously serves many users and runs different applications and so may respond slowly to each user.

The networked configuration provides the best of the both worlds. The user or programmer works at an interactive terminal such a as personal computer. Both also can access to various servers over high-speed communicational processing at high speeds.

3. Example of Graphics Applications

We looks briefly at variety of applications that use computer graphics, demonstrating the range of situations that can benefit from graphics.

- Presentation graphics — slide production

A graphics editor applications that accepts data in list or table form and automatically formats them into the user’s choice is needed. For example, Freelance, PowerPoint, Persuasion and Cricket Presentation.
• **Paint System**

This kind of graphics editor is a **paint** system, an application that allows a user to act as an artist with the help of a computer. For example, Suitcases, MacPaint, SuperPaint and PaintBrush.

• **Scientific data presentation**

Scientific data are often complex, and relationships among the ingredients of an experiment can be difficult to visualise. A revealing display of scientific data also enhances the communication of ideas to colleagues. For example, MatLab, Mathematica and CricketGraph.

• **Interactive design**

One of the most important uses of computer graphics today is in **computer-aided design (CAD)**, in which a computer assists in the design process. A **simulation** software can be invoked to test how a real version would perform. For example, AutoCAD, versaCAD, ClarisCAD

• **Mapping and cartography**

Map making is an exciting activity because a huge amount of information and detail must be superimposed with great accuracy. The main task of a map-production application is to gather the proper data from the database and convert them into the desired line and shapes of the map. For example, Global.

• **Process control**

Processing plants and factories have become more and more complex in recent years, particularly as they have become more automated because of their complexity, they must be carefully monitored — there must be a “human in the loop” in even automatically controlled environments. The human operator must be given information on a **status display** that is current, precise, and instant interpretable.

• **Graphics in image processing**

Computer graphics and image processing are two closely related fields, and they tend to use the same hardware and many of the same software tools. Whereas computer graphics creates picture, often from an abstract model of objects, image processing changes already-existing pictures in order to extract new information from them, or for artistic effect. A picture is digitised and entered into the computer using an image scanner, and it is stored in memory as a large array of numbers. The user can invoke various software routines within the application to search for and highlight features in the image. Features can be displayed in different colours to bring out information that might otherwise not be noticed. For example, NIH Image, NCSA Image, Photoshop and Photoprefect.

4. **Graphics Software**

The focus of this subject is on writing graphics applications. The programmers are learning how to control graphics displays using Java programming language.

An example of an international logo “baby” presents some basic idea. The first job is to “see” what shapes the logo contains, that is, to interpret it geometrically. This logo can be decomposed into a collection of simple overlapping primitives: in this case, circles
and rectangles. Some places may be “painted” two or three times, but on most devices this equivalent to painting once.

Some sort of circle drawer and rectangle drawer are needed to draw the logo.