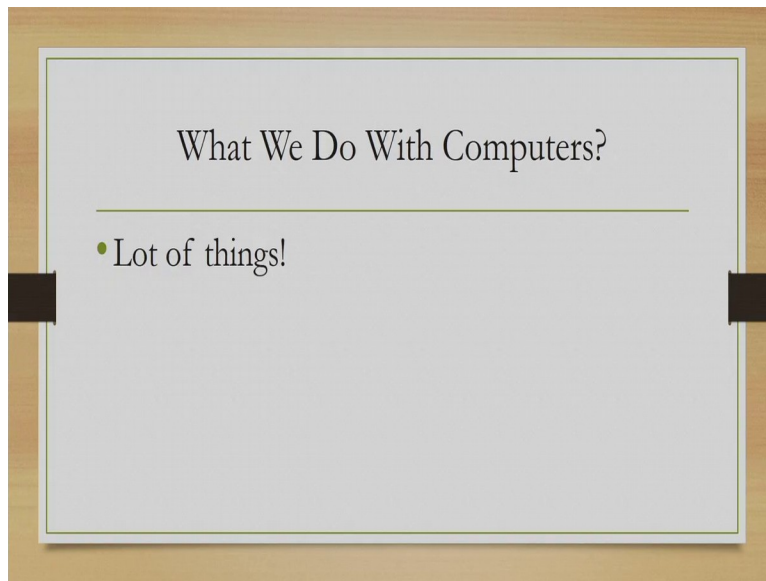**Computer Graphics**
Dr. Samit Bhattacharya
Computer Science and Engineering
Indian Institute of Technology, Guwahati
**Lecture 01**
Introduction to Graphics

Hello and welcome to the first lecture of the course Computer Graphics. In this lecture we will try to get an overview of the basic idea of graphics and what it means.

(Refer Slide Time: 00:50)

So, let us begin with a very simple trivial question, what we do with computers? I think most of you will be able to tell that we do lot of things. Let us see some examples, what are the things that we do with a computer.

(Refer Slide Time: 01:07)
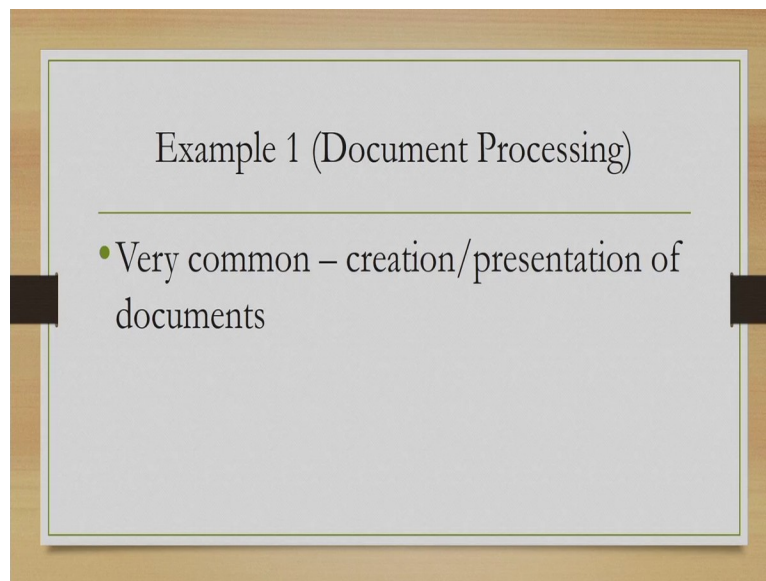
The first example that we will see is related to a document processing task. So essentially we are interested in creating document and let us see what we do there and what we get to see on the screen.
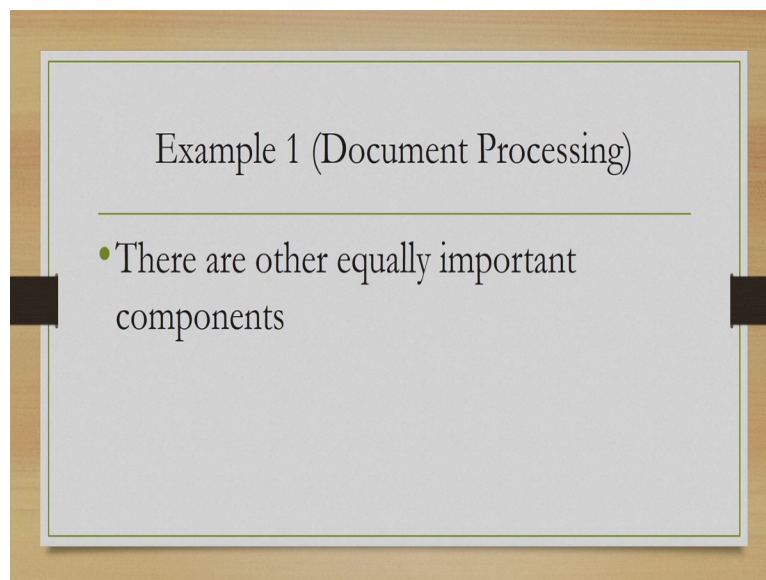
(Refer Slide Time: 01:29)
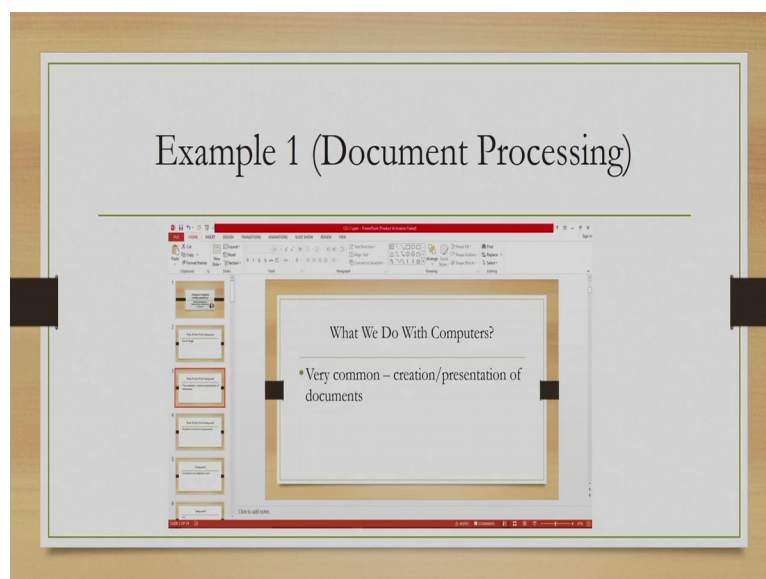
On the screen I have shown one example of a document creation going on, this is essentially the creation of the slides from which I am delivering the lecture. So, as you can see there are many things that are being shown on the screen. So, what are those things what are the components that we are seeing on the screen?

(Refer Slide Time: 01:56)
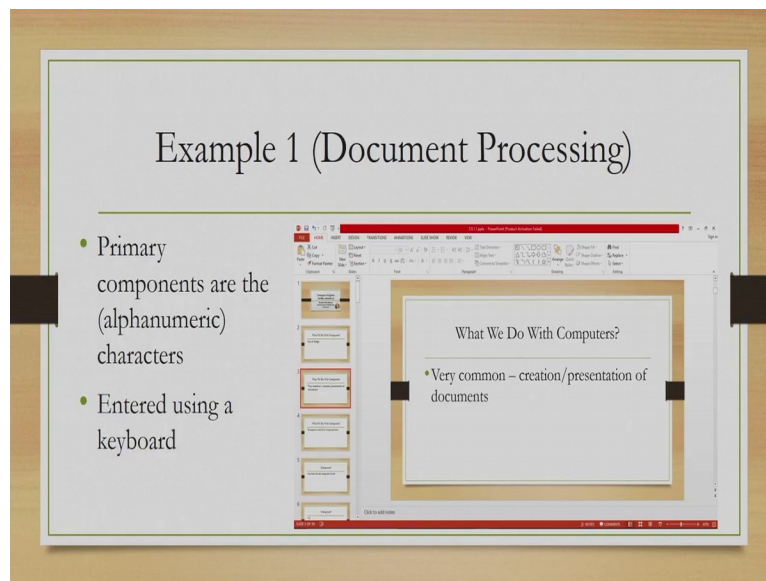
In fact there are large number of different things, the most important of course because we are talking of document processing activities the most important component is the alpha numeric character. So, there are many such characters the alphabets the numbers and how we enter those characters? By using a keyboard, either physical or virtual.
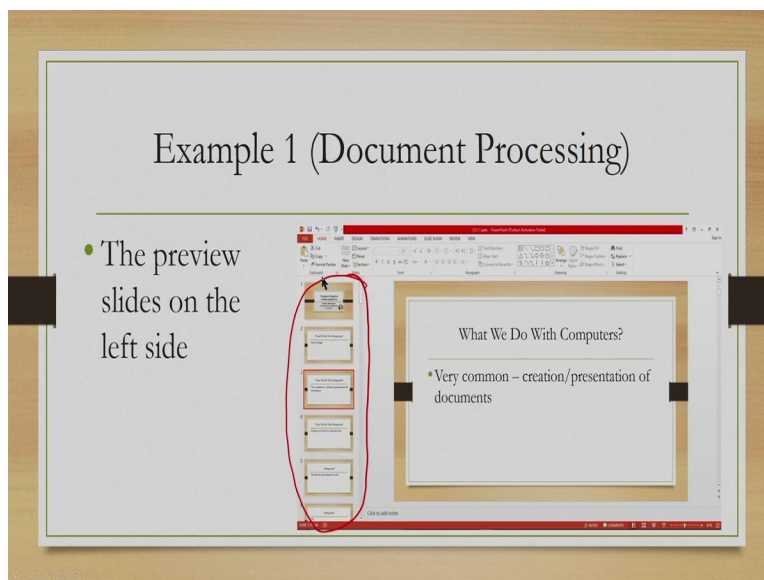
(Refer Slide Time: 02:32)

But apart from that there are other equally important components.
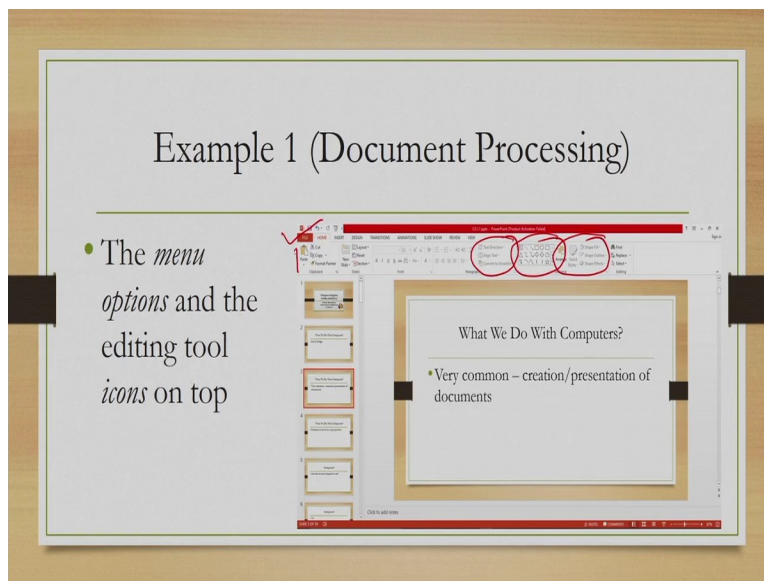
For example, the menu option that we see here on the top side of the screen. As well as the icons various icons representing some editing tools that we get to see on the top part of the screen. So, here or here in fact all these components are essentially editing tools and the icons representing those tools.
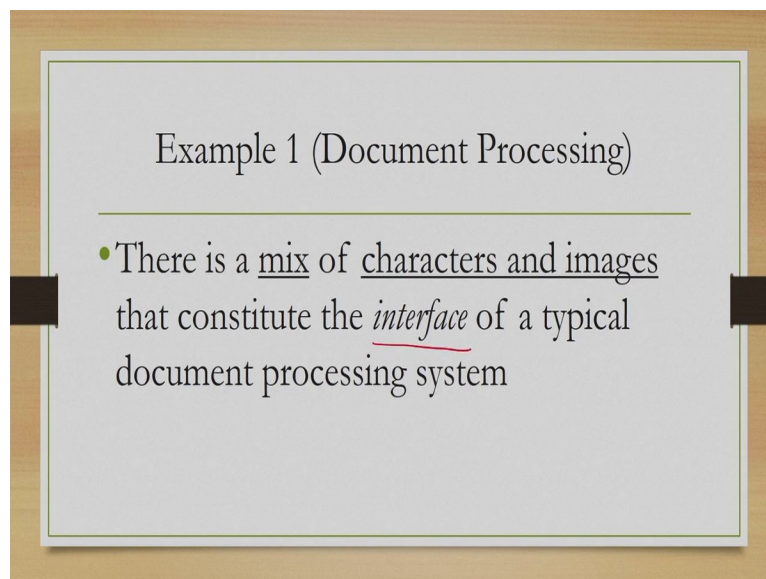
We also have the preview slides on the left part which is another important component.
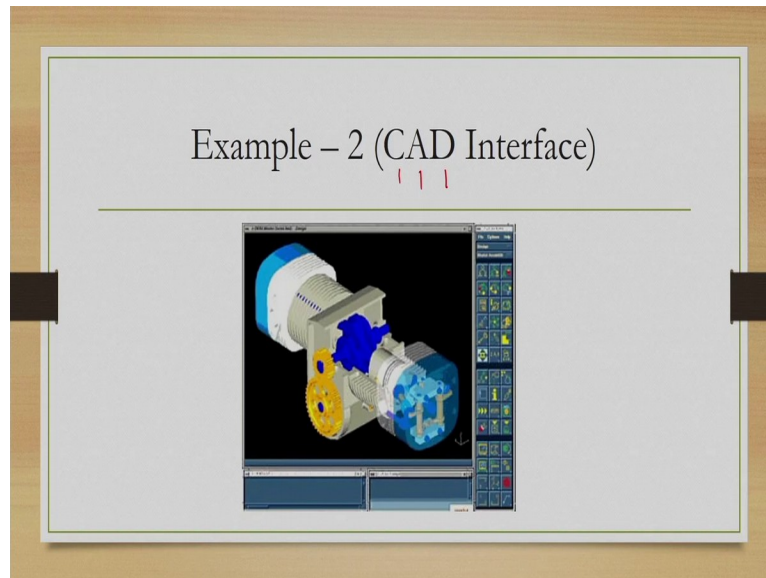
(Refer Slide Time: 03:28)
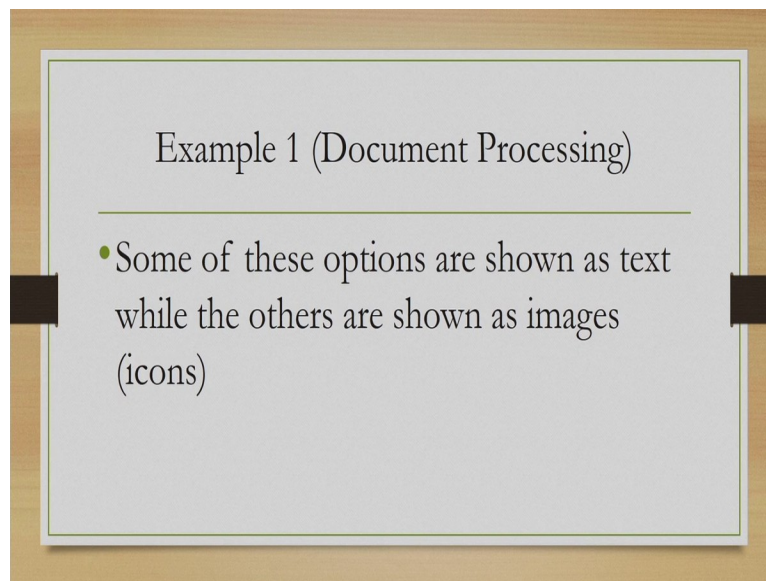
So, if you have noted some of these components are shown as text like the alphanumeric characters and the others are shown as images like those icons.
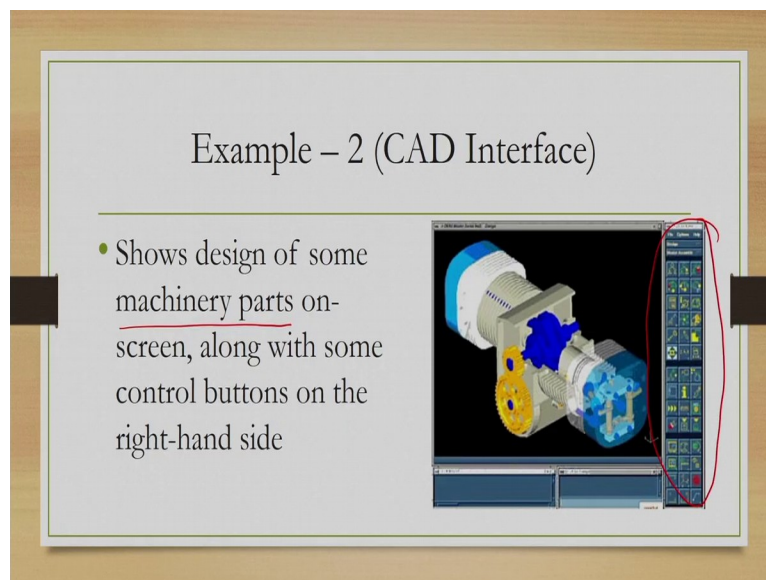
(Refer Slide Time: 03:41)

So, essentially there is a mix of characters and images that constitute the interface of a typical document processing system.

(Refer Slide Time: 03:52)

Now, let us see another example which you may or may not have seen but it is also quite common that is essentially CAD interface or Computer Aided Design Interface. So, CAD stands for Computer Aided Design. And this is an example of the interface so there are many difference system with different interfaces what I have shown here is one such example.
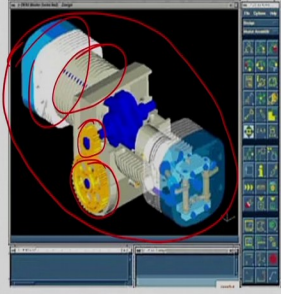
(Refer Slide Time: 04:21)

So, what this systems do, essentially with this system, someone can actually design machinery parts and there are some control buttons to do various operations on this parts.

(Refer Slide Time: 04:46)

And as you can see the overall part that is the entire image is constructed from individual components like this smaller gears or this cylinder, this cubes smaller components. And these smaller components are having some specified properties for example dimension.

(Refer Slide Time: 05:31)

So, with this interface then what we can do typically engineers use such interfaces to create machinery by specifying individual components and their properties and try to assemble them virtually. On the screen to check if there is any problem in the specifications. So, clearly since everything is done virtually the engineer does not require any physical development of the machinery, so it saves time it saves cost and many other things. So, that is example 2.

(Refer Slide Time: 06:08)

Now let us see one more example another interesting example of computer graphics, this is related to visualization or trying to visualize things that otherwise is difficult to visualize. So, under visualization we will see a couple of example the first one is visualization of a DNA molecule, now DNA as you all know stands for Deoxyribonucleic acid is essentially kind of your genetic code present in every cell and it is not possible to see it with our bear eyes as we all know.

But it will be good if we can see it somehow in some manner, and application of computer graphics known as visualization makes it possible, like it is shown here. So, this type of visualization is known as scientific visualization where we try to visualize things that occur in nature but we cannot see otherwise or difficult to see.

(Refer Slide Time: 07:23)
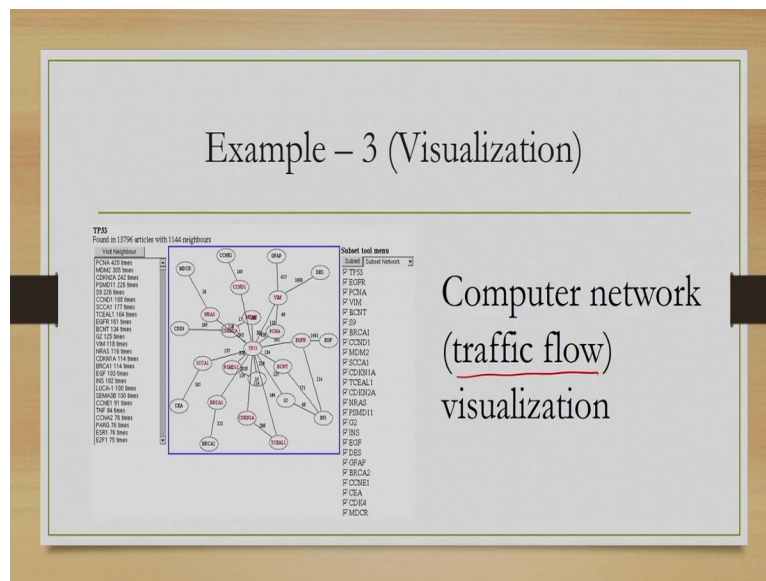
There is another type of visualization, let us see one example, suppose we want to visualize a computer network how traffic flow happens in the network, here by traffic I mean packets the packets that are being moved in the network, in any case we are not in a position to visualize it with our eyes but computer can help us with computer we can actually create a visualization of the network traffic flow.
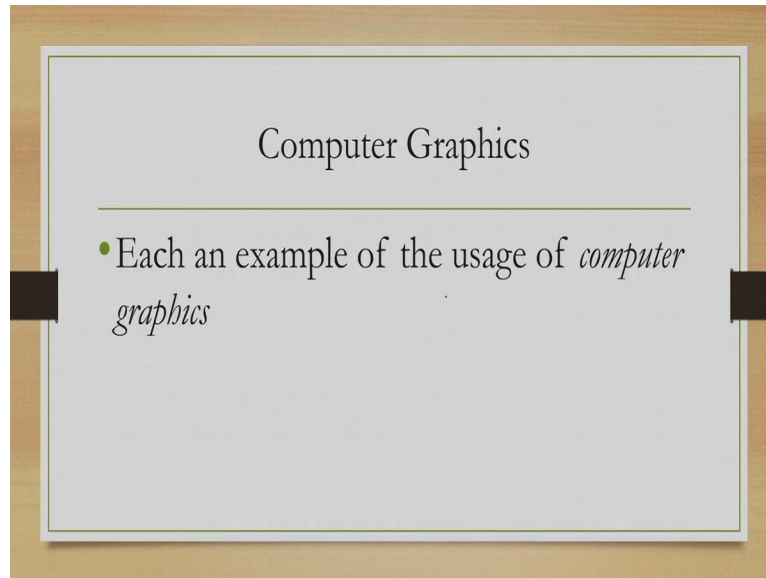
(Refer Slide Time: 08:06)
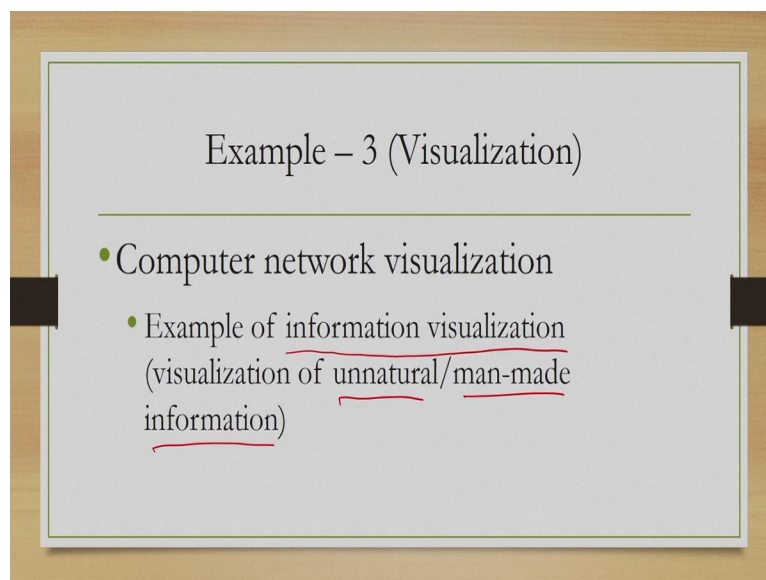
These type of visualization are known as information visualization, here we are not dealing with natural objects instead we are dealing with unnatural or man-made information and we are trying to visualize that information. So, we have two types of visualization: scientific and
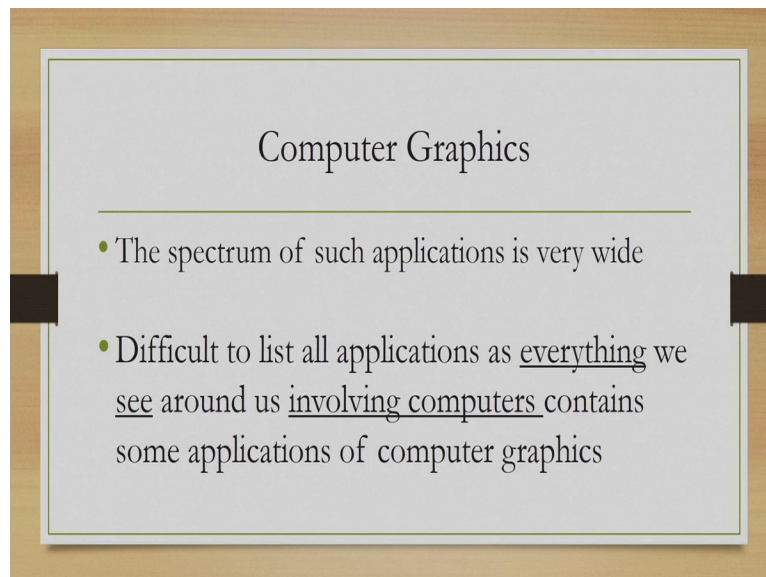
information. And these are applications of computer graphics that help us perceive that help us understand things that otherwise we will not be able to perceive.

(Refer Slide Time: 08:55)

So, as I said each of the examples that I have discussed earlier is an example of the use of computer graphics.

(Refer Slide Time: 08:57)

But these are only three examples in fact the spectrum of such applications of computer graphics is huge and everything that we get to see around us involving computers are basically applications of computer graphics and it is definitely not possible to least all those applications.
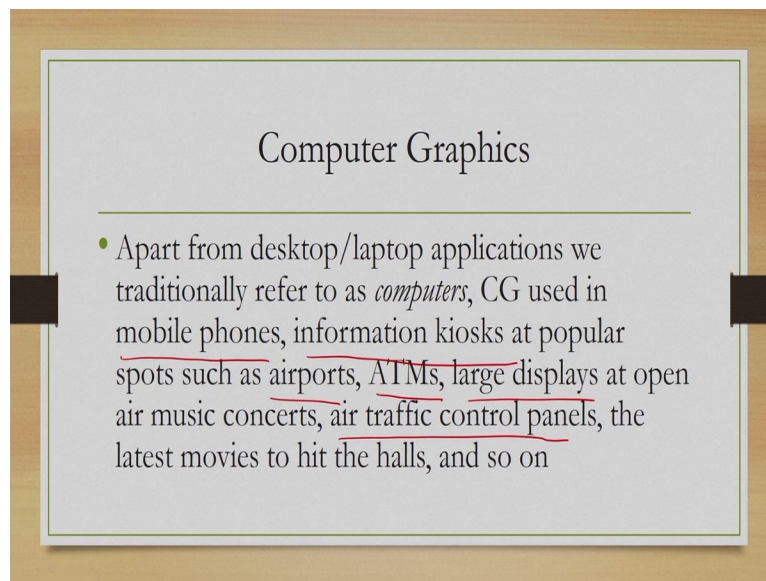
Also we have to keep in mind that not only desktop or laptop screens we are here talking about a pleather of other types of displays as well that includes mobile phones, information kiosks at popular spots such as airports, ATMs, large displays at open air music concerts, air traffic control panels even movie screens in the theatres all these are some kinds of display and whatever is being shown on this displays are mostly applications of computer graphics.

So, we have two things one is large number of application second is application on all possible displays.

(Refer Slide Time: 10:26)
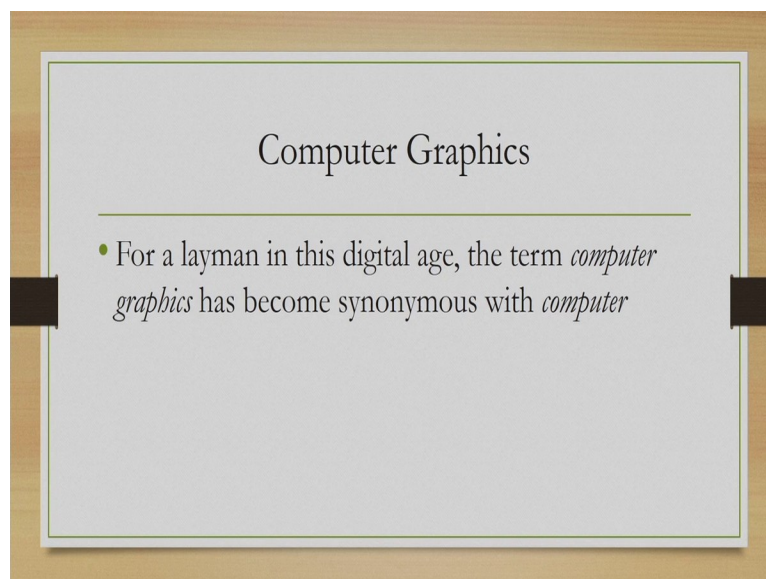
And as I have already mentioned earlier those who are not very conversion to the inner working of a computer for them whenever we use the term computer essentially the thing that

comes to the mind of such lay persons is the display whatever is being shown on the display. So, essentially the display is considered as computer by those who are not very well-accustomed with the inner workings of a computer.

(Refer Slide Time: 11:04)
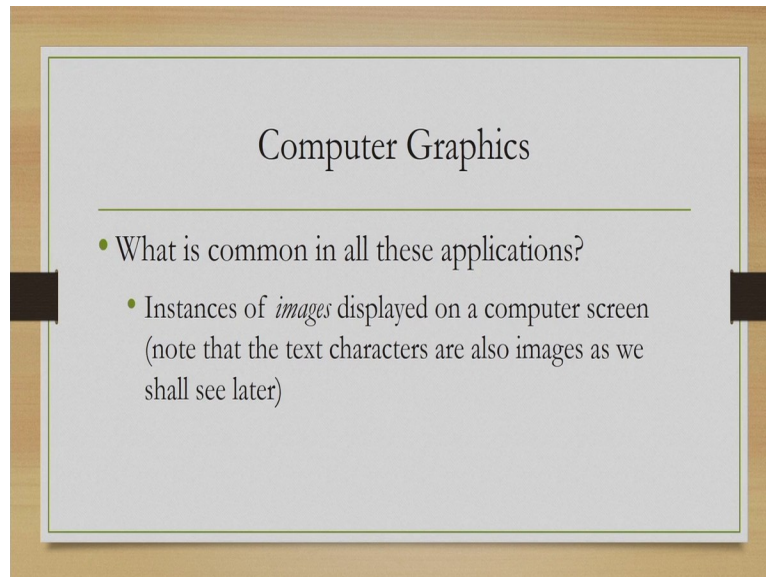
Now, what is the common thing between all this applications, instances of images that are displayed? Now, here by image we are refereeing to both text characters alpha numeric characters as well as actual images because texts are also considered as images as we shall see in our subsequent lectures.

(Refer Slide Time: 11:19)
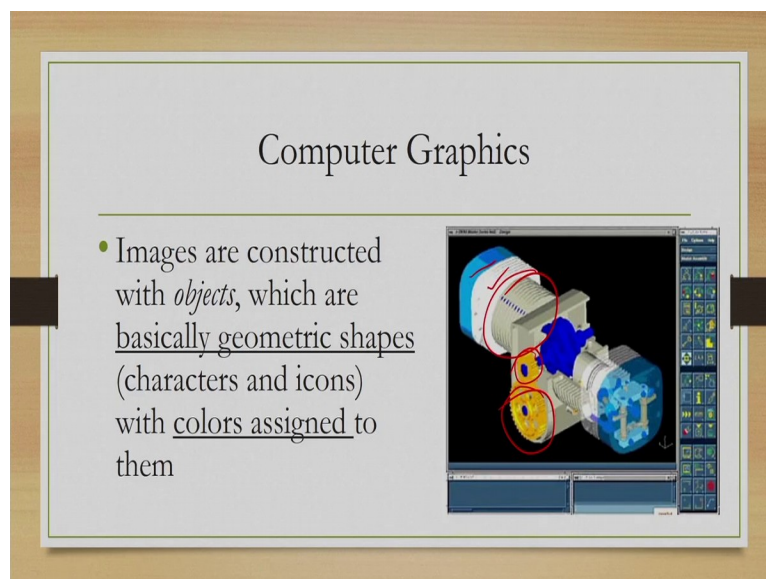
And these images are constructed with objects components of the objects like we have discussed in the CAD application like there are individual objects as we have seen earlier,

now these objects are essentially geometric shapes. And on these objects, we assign some colors like the yellow color here or the blue color here or the white here. So, colored geometric objects are there which are used to create the overall image.

(Refer Slide Time: 12:08)
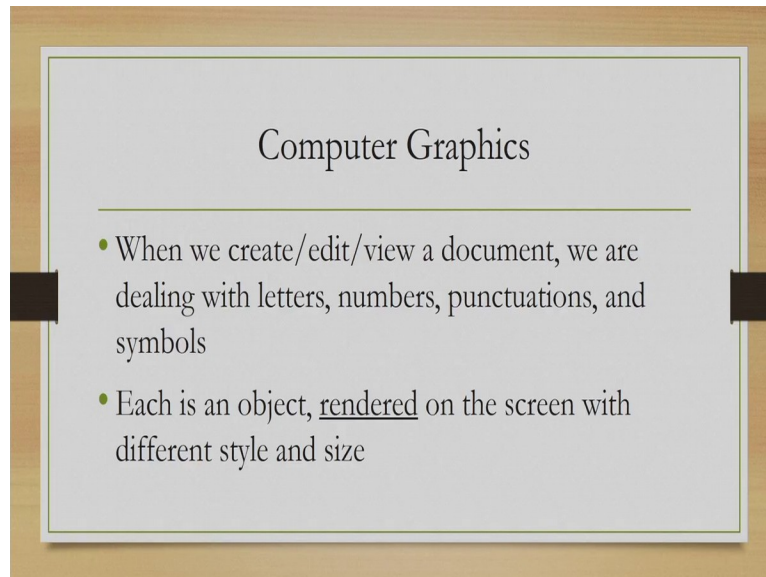
Along with that there is a one more thing when we create edit or view a document we are dealing with alphanumeric characters and each of these characters is an object. Again, we shall see in details why characters are considered to be objects in subsequent lectures. And these objects are rendered on the screen with different styles size as well as color. Like the typical objects that we have noted in the previous case.

(Refer Slide Time: 12:42)
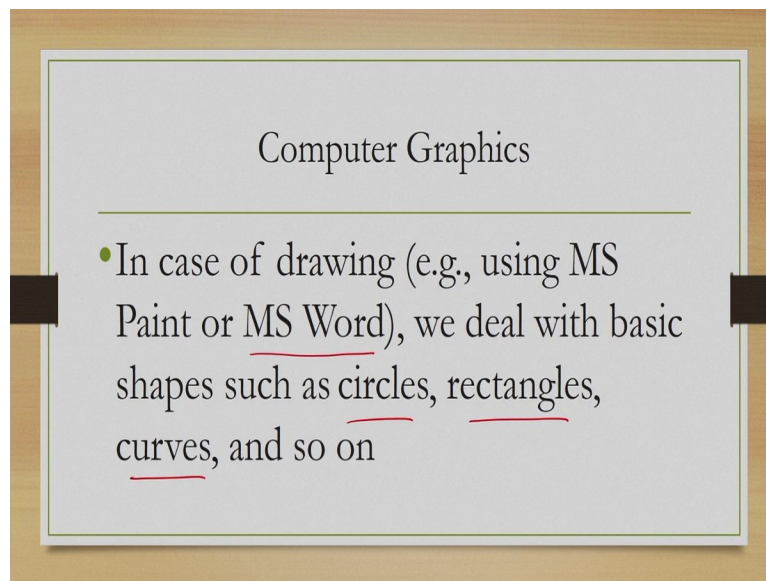
Similarly, if we are using some drawing application drawing package like MS paint or the drawing application of MS word, there we deal with other shapes such as circles, rectangles, curves, these are also objects and with these objects we create a bigger object or bigger image.

(Refer Slide Time: 13:12)
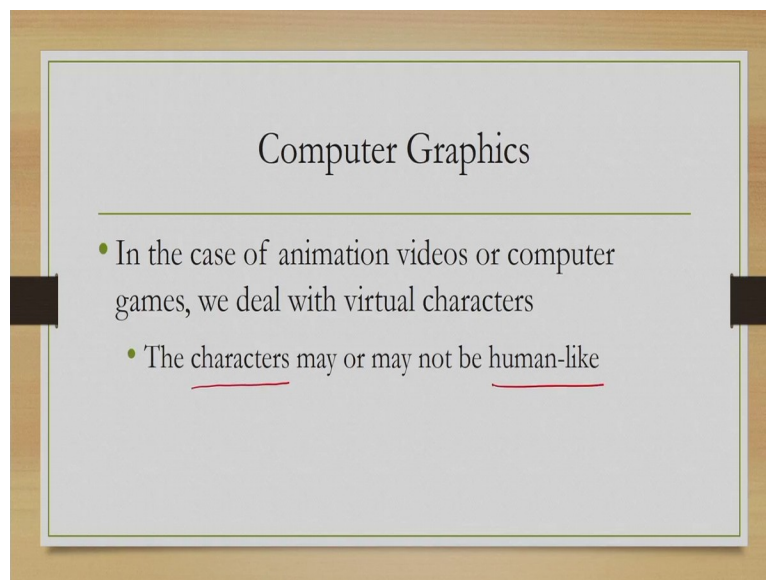
Finally, in the case of animation videos or computer games which involves animation anyway. In many cases we deal with virtual characters. Those are essentially some artificially created characters which may or may not be human like.
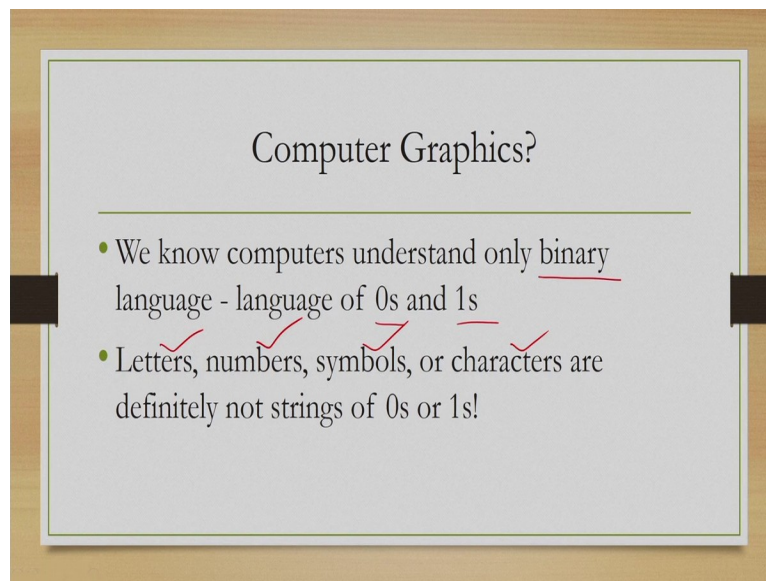
(Refer Slide Time: 13:31)
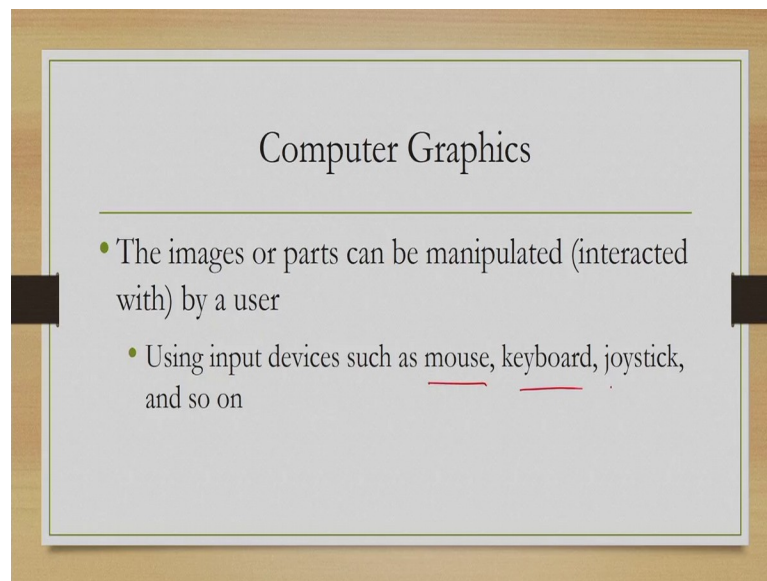
And all these images or their components can be manipulated because nowadays most traffic systems are interacting. So, user can interact with the screen content and manipulate the content. For that input devices are there such as mouse, keyboard, joystick and so on.

(Refer Slide Time: 14:01)
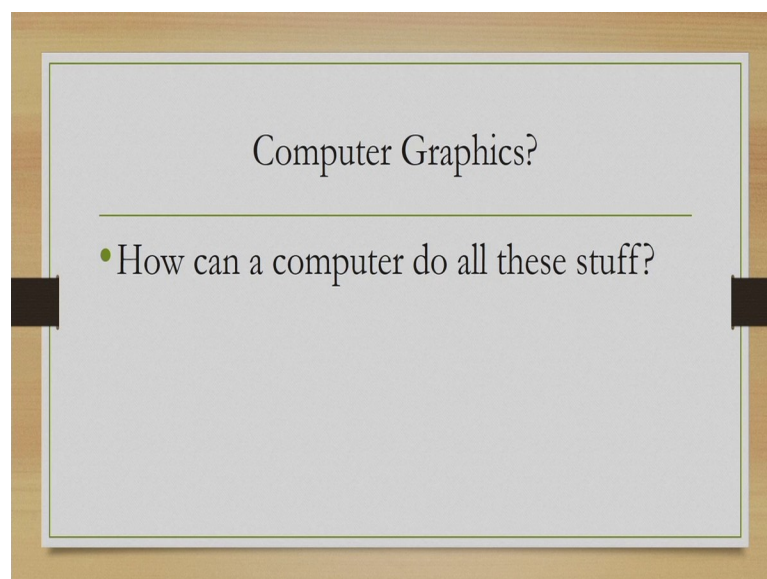
Now, how a computer can do all these stuff, all these things. What are those things? Let us recap again. Images consisting of components so we need to represent those components then we need to put them together into the form of a image and we should allow the user to interact with those components or the whole image through input devices as well as we should be able to create the perception of motion by moving those images. How a computer can do all these things?
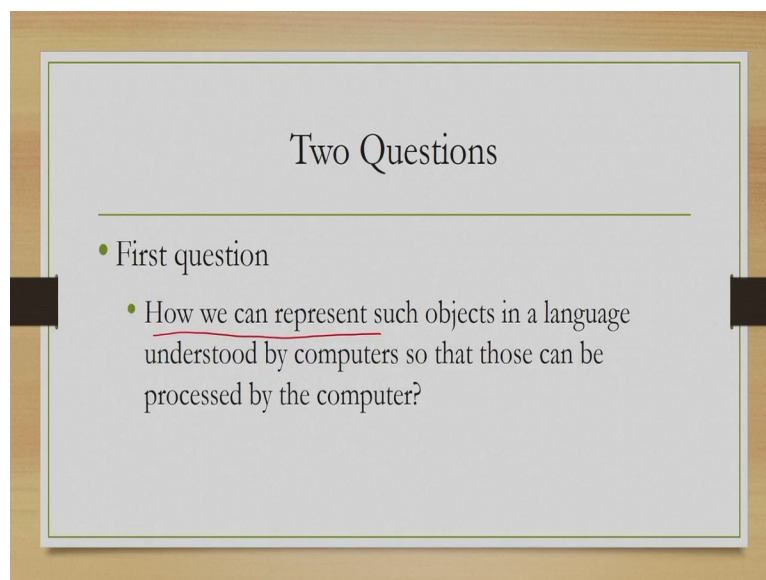
(Refer Slide Time: 14:42)

We all know you probably have already done some basic courses where you know that computers understand only binary language that is language of 0s and 1s, on the other hand in computer graphics what we have letters numbers, symbols characters but these are not 0s or 1s. These are something that we understand we can perceive we can understand. So, what is needed there are two questions related to that.
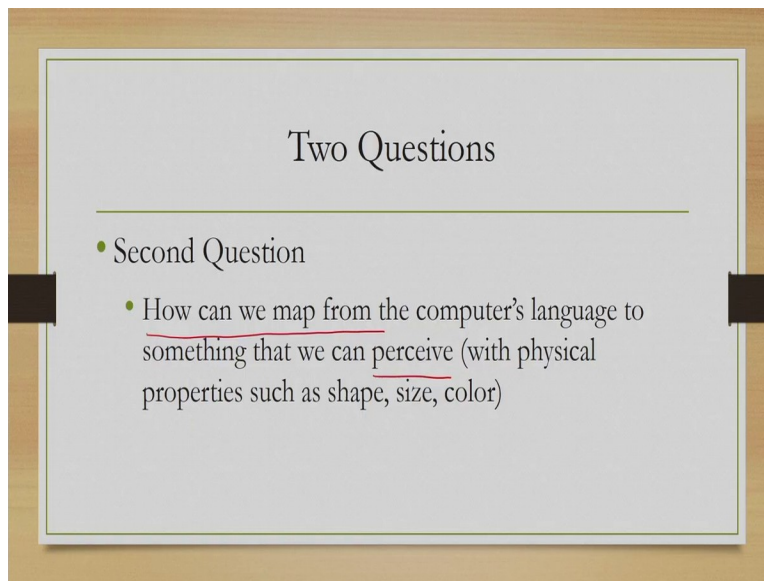
(Refer Slide Time: 15:23)

First question is how we can represent such objects in a language that the computer understands and the computer can process.
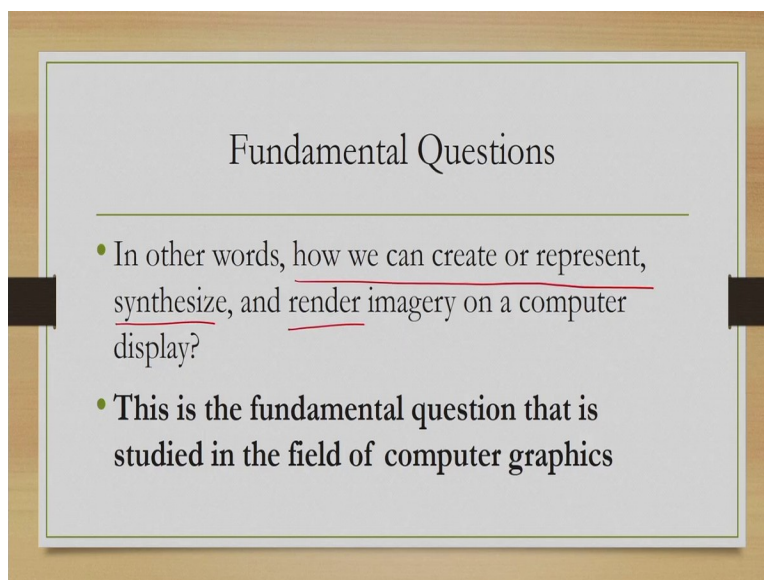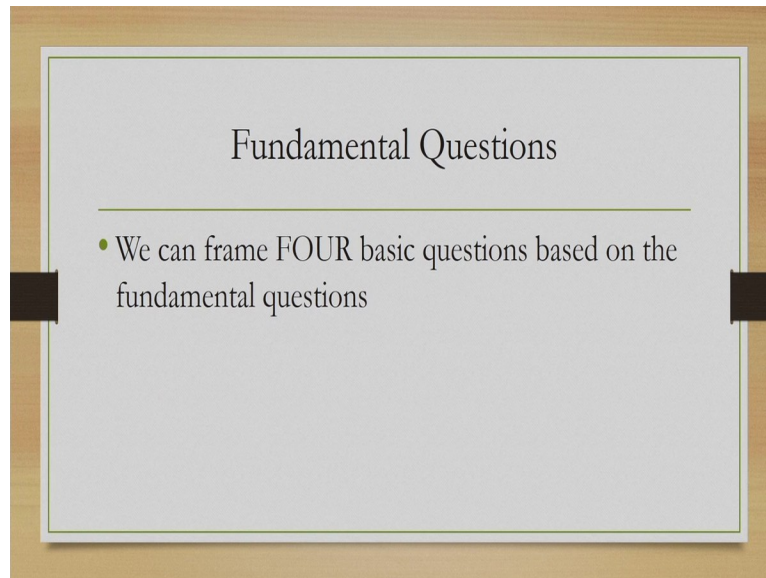
(Refer Slide Time: 15:39)

The second question is, how we can map from the computers language to something that we can perceived, so essentially with the computer output in 0s and 1s we will not be able to understand what that means. So, we want again in the form of those objects that we have mentioned earlier. So, one thing is mapping from our understanding to computers language and other thing is mapping from computers understanding to our language.
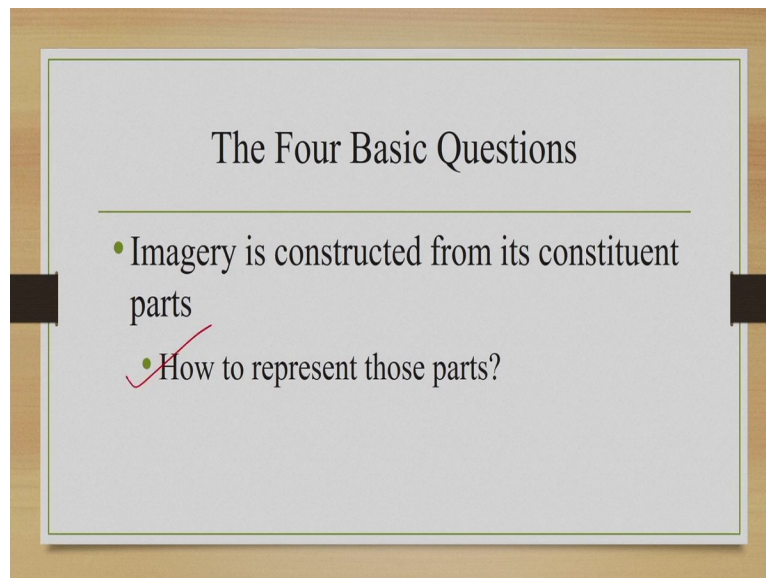
(Refer Slide Time: 16:06)

In other words, how we can create or represent synthesize and render images on a computer display this is the fundamental question that we try to answer in computer graphics.
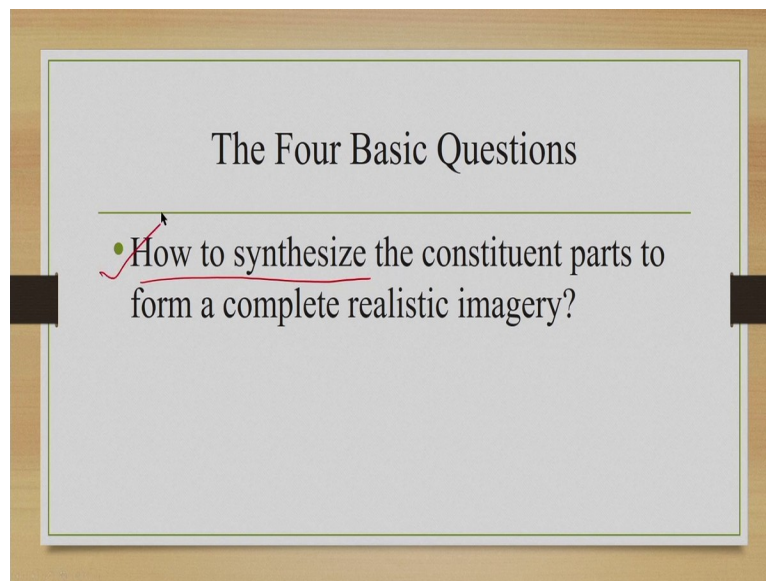
(Refer Slide Time: 16:23)

From this fundamental question we can frame FOUR component questions.
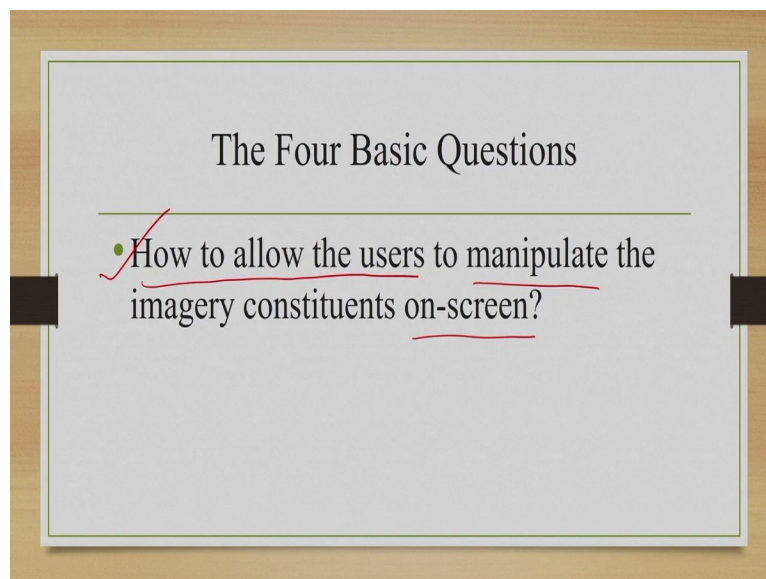
(Refer Slide Time: 16:29)

First one is as we have already said imagery is constructed from constituents parts. So, how we can represent those parts that is the first basic question.

(Refer Slide Time: 16:46)

Second question is how to synthesize the constituents parts to form a complete realistic imagery? So, that is our second question.
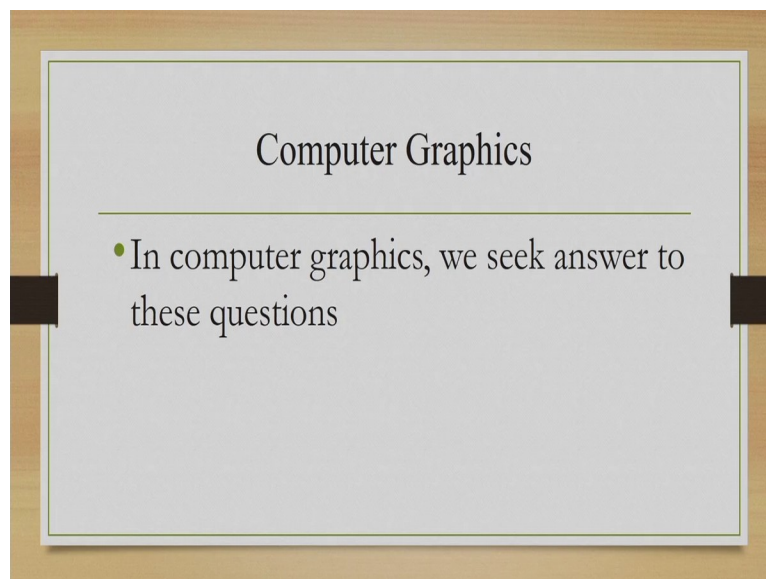
(Refer Slide Time: 17:01)

Third question is how to allow the users to manipulate the imagery or its constituents on the screen with the use of input devices. That is our third fundamental question.
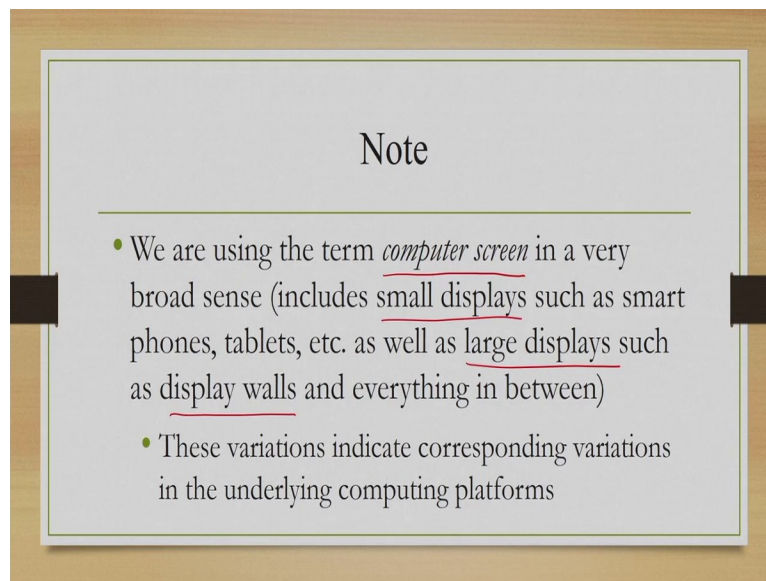
(Refer Slide Time: 17:22)
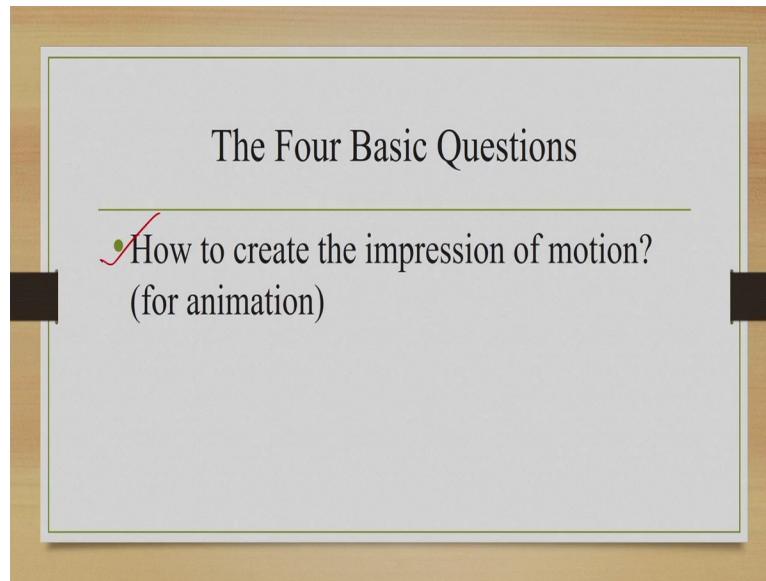
And finally, the fourth question is how to create the impression of motion to create animations. So, these are the four questions first is how to represent, second is how to synthesize, third is how to interact and fourth is how to create animation.

(Refer Slide Time: 17:43)

Now, in computer graphics we see answers to these four basic questions.
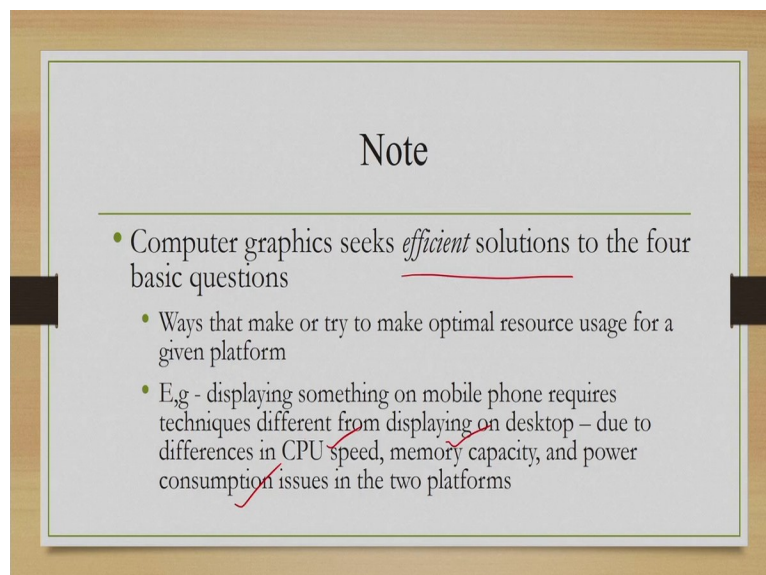
(Refer Slide Time: 17:47)

Here few things need to noted first of all when we are talking of computers screens, we are using it in a very broad sense because the screens vary in a great way as we all are aware nowadays from small displays to display walls to large displays and these variations indicate corresponding variations in the underling computing platform however we will ignore those things when we refer to computers screen will assume that we are refereeing to all sorts of screens.

(Refer Slide Time: 18:33)

Accordingly, whatever we discuss our objective would be to seek efficient solutions to the four basic questions for all possible platforms. For example, displaying something on mobile phone requires techniques difference from displaying something on your desktop, because the

underling hardware may be different. There is a difference in CPU speed, memory capacity, power consumption issues and so on. So, when we are proposing a solution to answer one of these question or all these questions we should keep in mind these underlying variations.

(Refer Slide Time: 19:23)
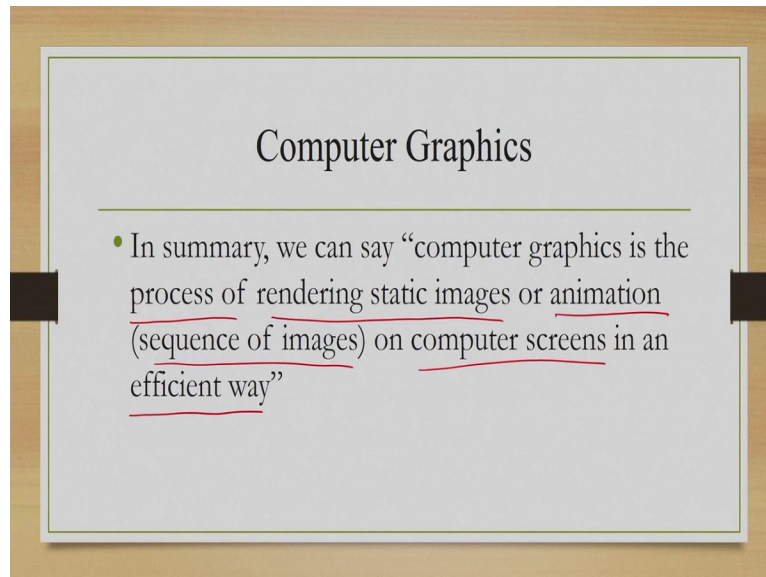
Now, in summary what we can say about computer graphics is that this is the process of rendering static images or animation which is a sequence of images on the computer screen, that to in an efficient way, where efficiency essentially refers to the efficient utilization of underlying resources.

(Refer Slide Time: 19:48)
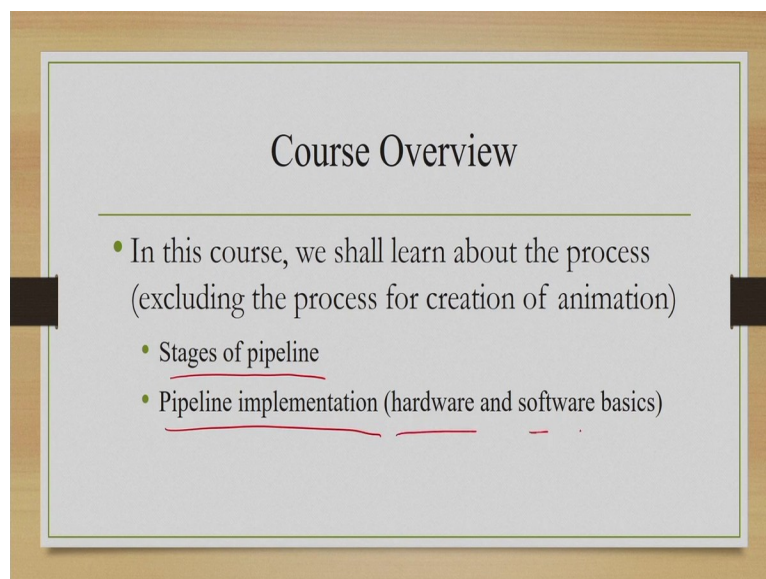
In this course we shall learn in details this process particularly the stages of the pipeline where the pipeline actually refers to set of stages which are part of this whole process of

rendering and pipeline implementation that is how we implement the stages, this involve a discussion on the hardware and software basics for a graphic system. However, we will not discuss the process of creation of animation which is a vast topic in itself and requires a separate course all together.

(Refer Slide Time: 20:31)
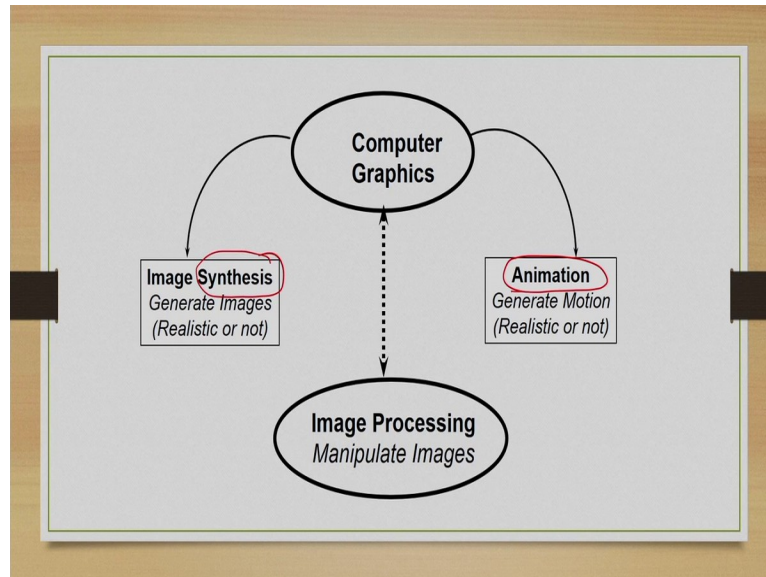
This is just for your information, that there is a related term probably some of you may have heard of it called image processing, now in image processing we manipulate images whereas in computer graphics we synthesize images and also we synthesis it in a way such that it gives us perception of motion that we call animation.

So, computer graphics deals with synthesis of image as well as animation, whereas image processing deals with manipulation of already captured images. And in many applications these two are linked but those things will not discuss in this limited scope of the course.

(Refer Slide Time: 21:17)
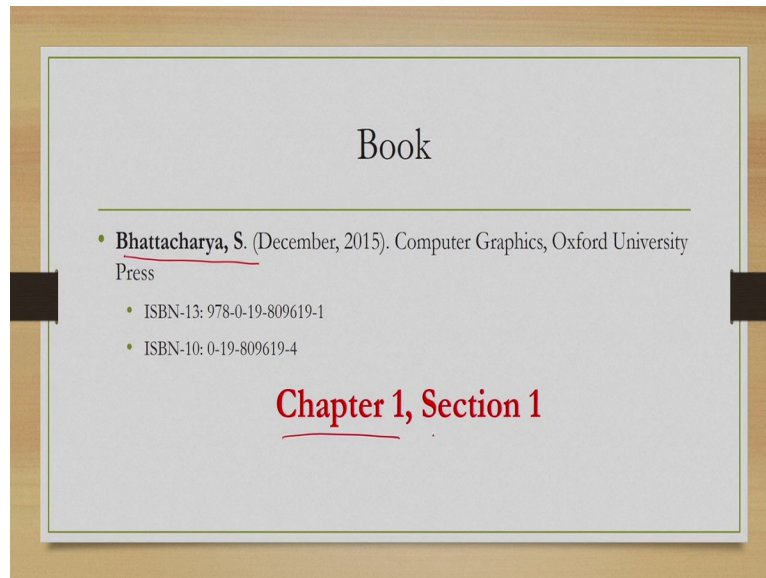
So, whatever we have discussed today you can find in details from this book more specifically you should refer to chapter 1, section 1 for the topics that we covered today. In the next lecture we will go through some historical evolution of the field followed by a discussion on the issues and challenges that are faced by workers in this field. Thank you and good bye.