Geographic Information Systems
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Module No # 01
Lecture No # 01
Introduction to GIS

Hello and Namaste I am Dr. Bharath Aithal today is the first module we will be looking at what do we understand by geographic information system.

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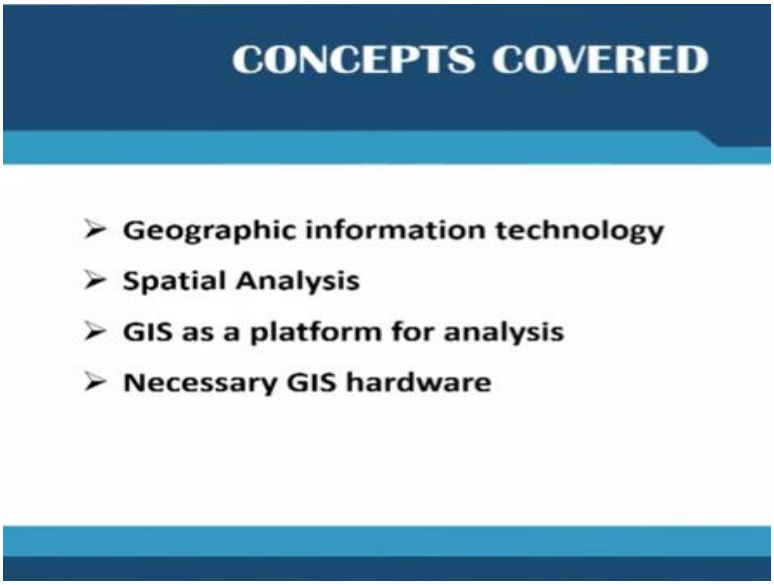

When I say geographic information system this particular thing we will look at a technology there is a technology that is driving the geographic information and how the systems work. So first will let us understand what do we mean by geographic information technology? The second thing what we would look at is the spatial analysis so there is a difference between a geographic information system and a spatial analysis.

So let us understand what do we mean by analysis what do we mean by science and what do we mean by system? Then the next thing that we would look at this point of (()) (01:11) is just as a platform for analysis. Which means how do we use GIS for analysis the last thing we would look at this today's lecture is what are the hardware that we need where if you want to use GIS in any of the applications you may need.

So that is the very important part without hardware GIS cannot be used in more effective manner so that would be last we would look at that at the end of this particular class.

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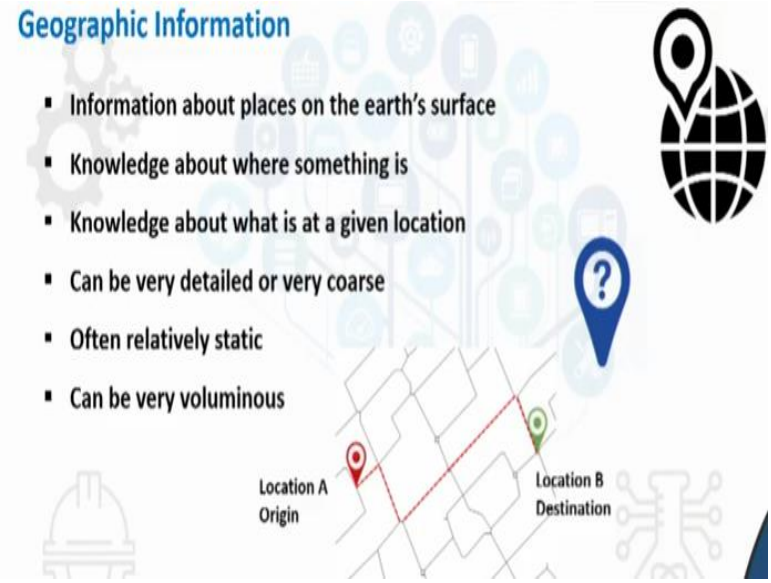

So let us look at first what do we mean by geographic information so let us say most of you would have used Google maps yes or may be some of you are I mean travel everyday with using Google maps. So Google gives you information about where you are is nothing but a geographic information or for example let us see that most of your let I mean if there is a letter that has been sent or if there is some may be a parcel from any of those services that you get.

So the parcel reaches your house or your office only through a just with the pin code why is that? Because it has a geographic information which ease the information about a place on the earth surface. So if I say 721302 is the pin code so it means to say that it is in Indian institute of technology Kharagpur. So that is actually the geographic information geographic information gives you the knowledge about places on the earth surface.

So it also tells you what is the knowledge about where something is which means to say that if you are locating a object or let us say let me give an examples something like this. Now when you do a speed post maybe from India post so it gives you a specific EWV number. So that number if you can track it on the web you can know where the post has reached it may have if I have posted from Kharagpur to reach Mumbai so from Kharagpur to Kolkata to Mumbai post

office and to that destination and it gives you every update of where the post is actually reaching on.

So this is exactly what is it geographic location it is saying what is something and where is something and exact geographical location of that particular parcel that is exactly the geographic information. So it can be very detail information it can be very coarse so it can even give you a information about what is inside the parcel what are the different aspect inside the parcel that has very detailed information but if the parcel is reaching you and you need only to track it then it is a very coarse information.

So just as a capability to handle both larger detailed information and also coarser not much detailed information also. So it is upon a uses prospective that how to use this particular system if some there may be huge number of users will be using geographic information system once it is designed there may be certain part of users whom may need a coarse of data some part of users who may need a very detailed data.

So it depends on the user how to use this data how they apply their data into their application feels and how they utilize this data to get a meaning information. So now what we understand a geographical data can also have meaning information which means how that is what we are trying to learn in the coarse how do we collect the data store the data and convert this information very important information and that can be useful for many.

Then most of the geographic information are very static now a days with various technologies that has grown though it has been projected as dynamic but normally a geographic information or is very kind of static and very importantly is that it is extremely voluminous. You have huge volumes of data and this understanding this kinds of data can be sometime very cumbersome that is where GIS gives you an extreme edge which means to say that it can handle a voluminous data.

Let us say that if someone is trying to understand what is urban growth in last 20 years? If he or she as set of maps all the maps staged upon one another in physical format physical maps. So it is very difficult for you to match each and every quantity on every map to understand what is the

change may have happened but if someone as a GIS as a software. Now he or she can easily use query to just give you a information just like a query that is done on Google.

So that is why the voluminous data can also become a meaningful information if you have technologies associated with it. So this is actually what a geographic information is about it gives you information about yourself it give information about where a particular phenomena location or any other aspect is there on the earth surface and it also tells you if it is something it gives you details about something that is what a geographic information is.

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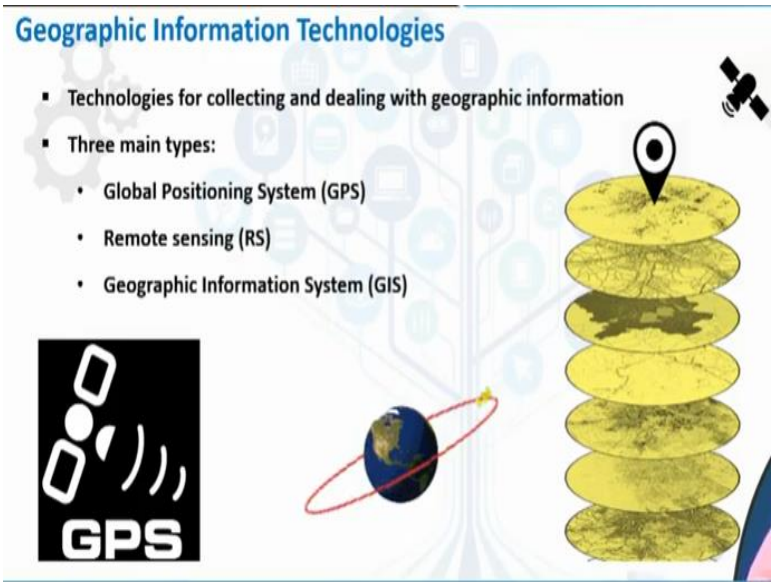

So now with geographic information if we have technologies when I say technologies you have various technologies that can add value to geographic information. The first technology that you can see is geographic information system itself so that is one of the very big technologies which can relate a system of technologies hardware and software assigns to geographic information. There is a technology called remote sensing which can give you the entire details of the earth surface without even being in contact with you.

For example when I am looking at you I am teaching this course so you are trying to understand the concept without being in contact with me. So you only look at the lectures, lectures schedule and the course that is being taught so which means to say that neither you nor me are in contact with each other physically which means you are remotely sensing this particular aspect wherever

you are from any part India or any part of the world that you looking at that is what is remote sensing.

And we have global positioning system you would have heard this global positioning system very often. So global positioning system is one of those systems where which can be a key input a key technology that drives geographic information system. So I would deal with what do you mean by global positioning system how does it work what are the different technologies that are involved India's (()) (08:37) way of looking at parallel part of global positioning system. Then looking at how a different data can be collected using geographic positioning system in may be in the week 6 or the week 7 of my lectures.

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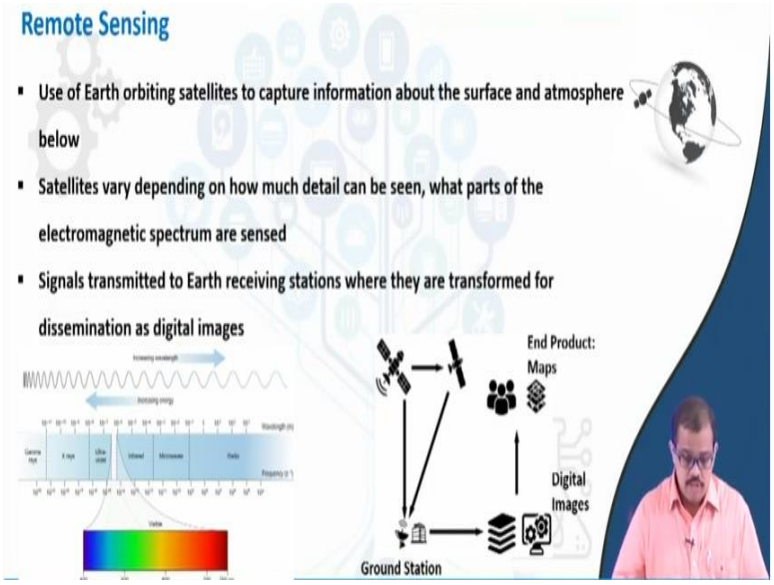

But let us understand what do we mean by remote sensing so when I say remote sensing in terms of earth prospective or geographic knowledge remote sensing using earth orbiting satellites or it may be even high altitude planes or a low altitude plane or even UAV etc., in order to collect information about images about the region, area or a phenomena which means that we are collecting information about phenomena of an object or an region without being in contact with it this makes it an extremely useful tool in understanding.

What the changes dynamic changes that are happening in the surface and this remote sensing data is today's contact with I mean department of defense going in a very big way in developing different satellites which can capture all this information we have huge number of satellites

which can gives you information from in terms of daily to monthly to an yearly. So when we look at this entire set it may be very useful for everyone to understand what do you mean by remote sensing.

So if we can understand what do you mean by remote sensing along with what is geographic information system that can help you do wonders in lot of applications that you may handle in future scenario's. So when we look at this satellites data is also dependent on what details you need for example if someone are working in how the urban growth is happening he or she need not get detail which is as which where a particular building is there what is the structure of building what is this size of the building etc.,

So he or she can have a medium resolution data or a coarse resolution data whereas if someone wants to go into details of a building what is a kind of a building height of a building size of a building etc., then you would have to look at something which is extremely precise extremely very good resolution detailed resolution. So which means you are looking at pixel by pixel almost closer to 30 centimeter, 20 centimeter data in a pixel.'

So that is where you need to choose what kind of data where you need whether you need prospect data which is coarser or whether you need a specific data which has very detailed information about certain issues. So the first step that wherever you are looking at any analysis is collection of data. What kind of data you need? How do you sample that data? How do you get that data? What are the different sources?

So that has to be understood very clearly and remote sensing can be one of the inputs if someone as looking at any of the earth related issues any of the change related issues and with the advent of UAV's so you can look at huge applications that can be applied in every field that you may think upon and how does this remote sensing actually works? You have a satellite can have it source of energy or can use this solar energy in order to transmit the data so it uses the energy and this energy becomes an input as a source of energy in order to use those senses on board each of the satellites.

So these satellites collects information's about the earth surface periodically and this data is then transmitted to the earth surface to any of this stations that are there on the earth surface. So once

this data is collected in the stations in the raw format is then rectified converted in the usable format there are various ways of distributing the data. So national remote center in India is in whole point in distributing the satellite data.

So if one is interested I would please look at national remote sensing centers website it gives you a detailed information of how do you acquire data there is a lot of data there is all satellite data that is available free of cost for any of the researchers also so I would also show you access this data how do you download this data may be in the next week or the coming weeks. So this is about what do you mean by remote sensing?

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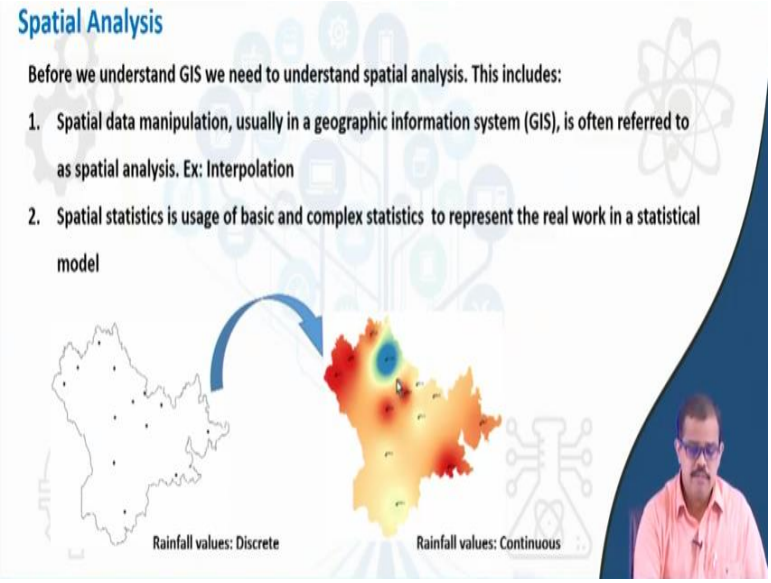

So now let us understand what do you mean by a spatial analysis? So when we look at remote sensing you are collecting a data about a area of phenomena or an object. So now when we look at it now you have collected a data you have data and data set with you so in order if you want to do certain analysis on this data you need to do a data manipulation data quires or using any of the geographical information system or science you try to understand the or make it useful in terms of what applications you need that is exactly what do mean by a spatial analysis that is how it is different from a geographic information system.

You have a system which is used for to derive a meaningful information from a data that becomes your spatial analysis. So in order getting a from a raw data or the information is nothing but a spatial analysis and people use another terms which has called spatial statistics. So spatial

statistics is usage of basic and a complex statistics in order to arrive at certain outputs for example if someone is looking at may be rainfall in the region.

So if you look at rain gauge stations in the entire region you may have 10 or 12 rain gauge station it depends on where it the rain gauge station is located I just took an example of 10 or 12. So if you have 10 or 12 rain gauge stations and you want to see the entire phenomena of rainfall in a entire region so you use spatial statistics you use the spatial statistics in order to derive how the pattern of rainfall is there in the entire region.

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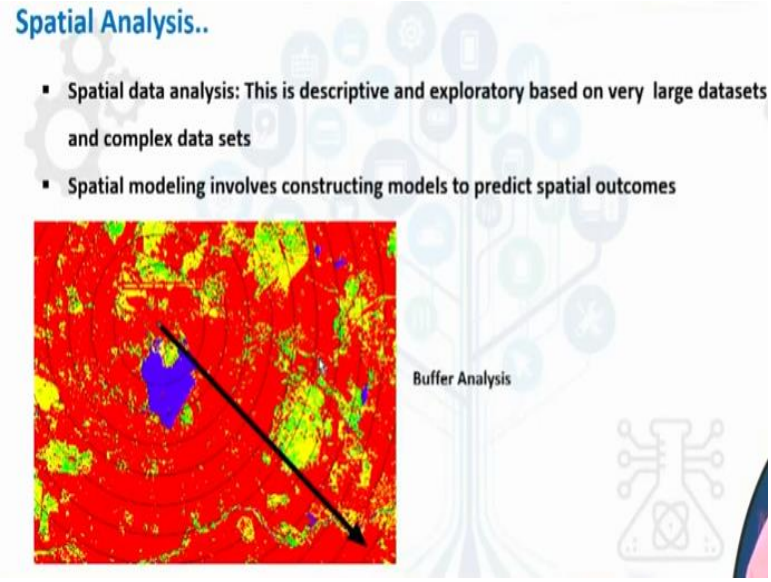

For example a image show here you can see that there is if you see this there are only rain gauge stations in these points where the rain gauge stations are located but when you look at it because usage of statistical technics we could understand what is a rainfall intensity in the entire region. So that is where you spatial analysis along with statistical knowledge can help you in understanding a meaningful data or have a meaningful information from the data.

So when we look at spatial data the first thing is this is a descriptive and exploratory based on a very large datasets and complex data sets. As I said GIS can handle a very complex data set whatever the size may be whatever however the data may be so which means to say that when we are looking at this complex data set it is highly descriptive and exploratory. So the data that I may need is may not be needed by someone else.

So this database as to be huge and it can be made huge by different methods and looking at how the data is acquired over a period of time. So using this spatial data this can use to this data is basically an input to the models. For example here in the image when you look at this particular image you can see this is actually a image of Hyderabad so this is an remote sensing image where you see I am trying to understand what may be the changes from the center to the city boundary.

So when you look at this is city core region you have a water body this have the urban region and you have a vegetative part also here so what I am trying to understand here is when you have a center core from the center core region how the urban density is actually changing where the urban density is high and where the urban density is low which means urban area any pave I have considered this as a any pave surfaces as an urban area using an paved surfaces divided by the total area will give you urban density.

With this I am trying to calculate in this circle how much is the urban density so which means to say that when we look at that aspect it is easier for us to understand in every buffer. For example if we take the first circle the second circle becomes a buffer or a neighborhood. So when we look at this we understand that how the changes has happening from the city center to the outskirts of the city so it means that it gives you a meaningful information about how the city is growing that is what you mean by spatial analysis.

So that is the difference between geographic information system and spatial analysis you need geographic information system in order to do such spatial analysis.

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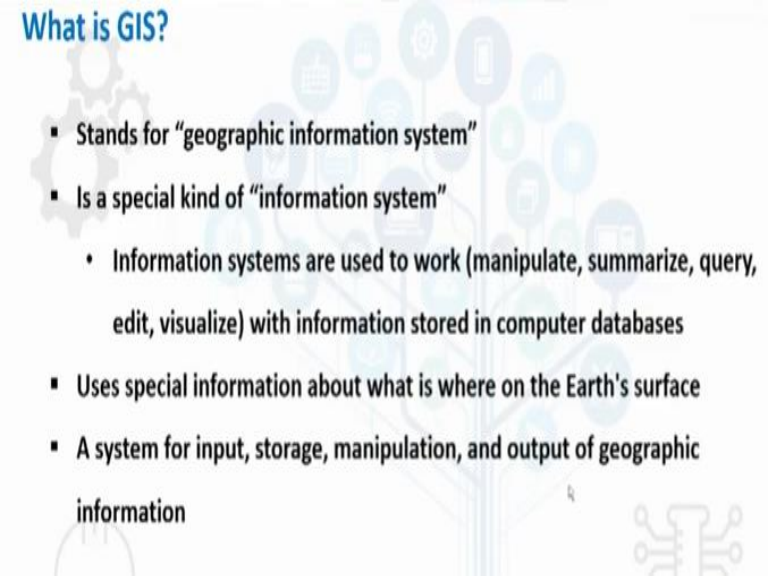

So we understood what you mean by geographic information system but if someone asks you what is GIS then? So when I say geographic information system is a spatial kind of information and system when I information this the derival of information or meaning data from the data that you are collected and can this can be manipulated, summarized, query, edited, visualized, modeled.

So this information in terms of usage of hardware or software becomes an information systems now this information system is extremely cannot be accessed by anyone if it does not have a geographic data because for example if whatever the map I did not show you in the previous slide if would not tell you that this is the map of Hyderabad you not have understood which urban density map is it actually what I am looking at.

So that Hyderabad is the geographic location in that particular information or whatever the information system is there remote sensing data is used to derive meaningful information through usage of GIS using a buffer analysis and the geographic location is derived as Hyderabad. So this is what is called geographic information system which means you have geographic coordinates of the earth surface locating where on earth is that particular piece of data that you have collected then the information that is the information about object area or a phenomena or a data that you have collected and the system that is actually capturing it.

The hardware and a software and all other system that we use is nothing but your geographic information system okay. So when we look at this it uses a special information about what is where on the earth surface that is what I have explained in my last example. A system for input, storage, manipulation and output of geographic information is nothing but a geographic information system. So from today someone ask you what is mean by geographic information?

It means geographic information system it means to say a system of input, storage, manipulation, output of a geographic information using hardware or a software is nothing but a geographic information system okay.

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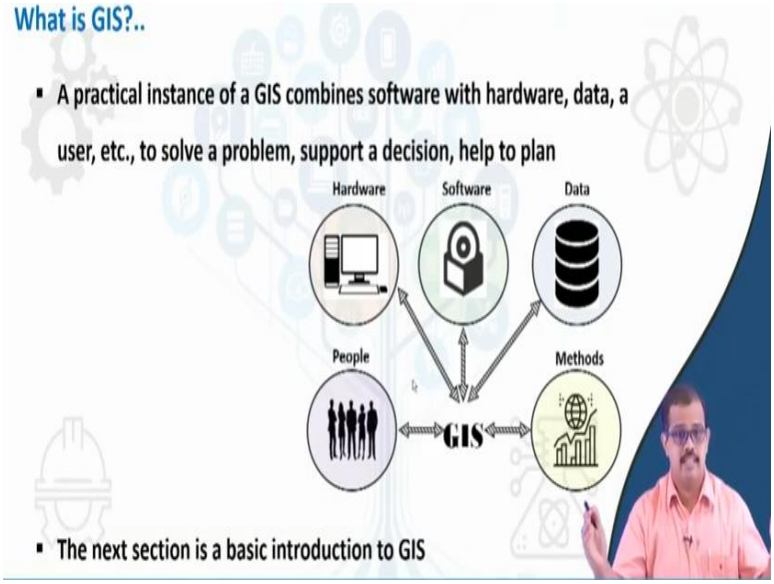

So if we have understood what is GIS if let us understand how the GIS can be made use of. For example this image gives you have practical representation of how GIS works GIS you have a data that is available that is fed into hardware which may be your computer system which may be your mobile phones which may be any of those systems that are available in today's world which have a computing capability.

Then you have software in order to analyze the software is a collection of tools which can analyze the geographic data to derive a meaningful information then you have data that you have already input I have input it into this software then you have different methods, different algorithms, different ways of looking at how a GIS data manipulation can be done for to derive meaningful information.

Then once you have done these analysis to derive a meaningful information you would put it out to the people so that the information can be used by people for various issues that is what is nothing but the entire process of how geographic information system works it tells you where you are what you are and it gives you some useful information about you. So that exactly says is the entire aspect of geographic information system.

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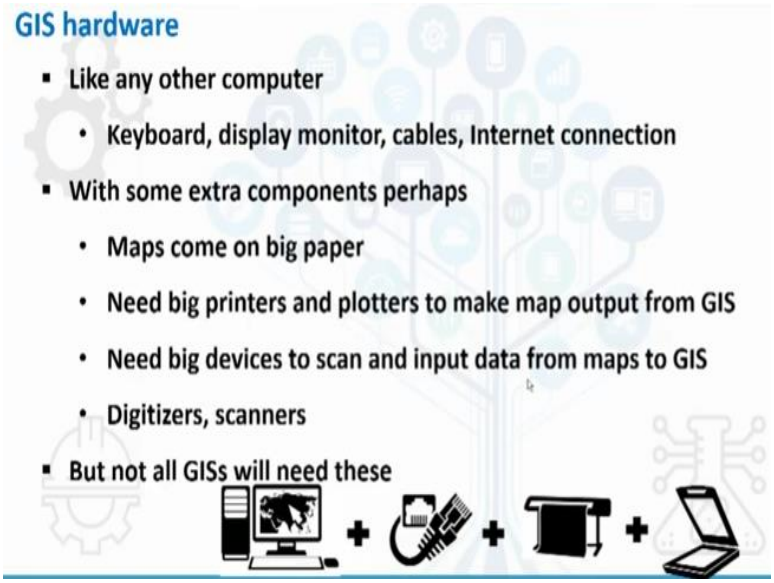

And if someone asks you how does it look like because until now we have heard it as geographic information system has hardware has a software. Yes, geographic information system is actually a real application which includes an hardware, data, software and people to solve a problem. So if you are trying to look at collecting data and supplying information then it is an hardware, a data, a software and it also has people who can actually take in this meaningful information.

And GIS also can be defined as an applications software if someone has a ready data that is available and someone has to just use certain tools to derive information and pass it on then it also as an application software you are developing certain tools in order to see how this particular geographic information can be derived that means that this is the second category of GIS where it may be someone who understand advance GIS in order to look at the applications.

So that is nothing but just a software okay so when we look at GIS it is both real applications it is also about just a software and if we think that GIS is an hardware what kind of hardware do you

need basically there is a first thing that every student ask me if I want to learn geographic information what are the different hardware that are present in this particular instance in order so that we have understand how geographic information system works.

So this as simple as this if you are just deriving some meaningful information from the data that is available so you may need just the data that is stored in the computing system that is it you need a computer basically. So you have data that can be either inputed through a CD- ROM's, your pen drives or any of the DVD-ROM's etc., So once you have put into your computing system you need a software which can be able to process the data using different tools that is already developed by various aspect and this tools can be used by you in order to derive information.

So which means you need a computing system a CPU and you need a display system in order to display this meaning information that you may have derived and possibly if you have a good internet connection it adds value into your data it because you can validate your data you can visualize the data against the real towards scenario will all we will look at these as examples may be when we look at how we do a hands on using through GIS.

So in case if you want to do an advanced analysis in GIS then probably you need something like maps. Maps on a very big paper okay you need maps that if you have maps as a data then you need scanners in order to scan this maps and provide it as a input probably some of them also need digitizers instead of scanning this maps they digitize the maps we will also see how the digitizers work may be in the further classes and we also need something like a plotter and printer.

So in order to print or the meaning information that has been derived in case you want to become a advanced user you may need all this things otherwise just a computing system with the display system good enough for any the GIS user and more over if you are with now the advent of mobile technologies probably you have the best hardware in your mobile phone itself that can be used as effective geographic information systems or technologies.

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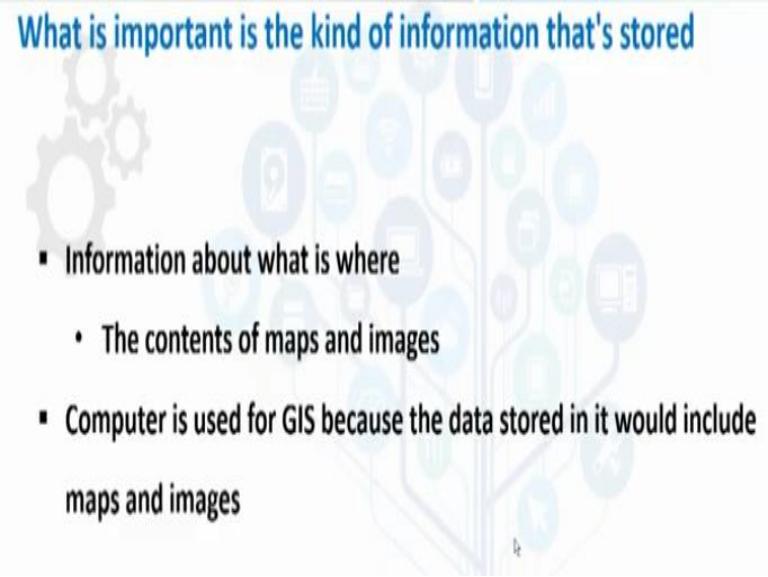

So the very important part of this is how the information told where are the contents of the maps and images. So if you have contents as maps and images it may be extremely useful if you have a compute at process this information because when you have images on maps this occupy a huge hardware space huge data space hence you need may be you need a computing stations in order to handle such information.

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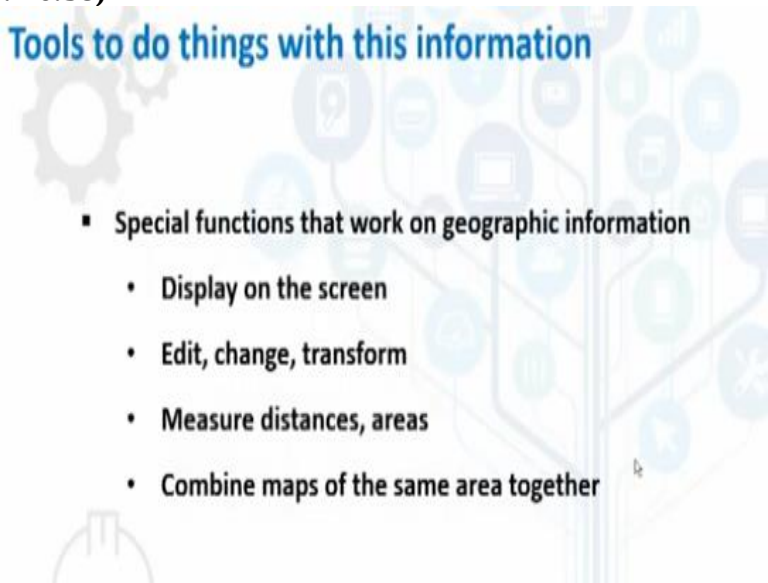

And when we look at this you have different tools to do things with the information it may be displaying on the screen, editing, changing, transforming. So with because of this it may not be possible in any of the small computing stations like mobile actually do it extremely effective way. Whereas if you have a system computing system it may be a laptop, it may be a any of the

computer CPU based configuration can help you in displaying on the screen, editing, changing, transforming this how do you transform the maps as a digital data will look at it in one of the practical classes.

Then how do we measure distances and areas? How do we combine maps of the same area together? So all of this can be done with using a GIS so all of this will look at each of them in one practical class.

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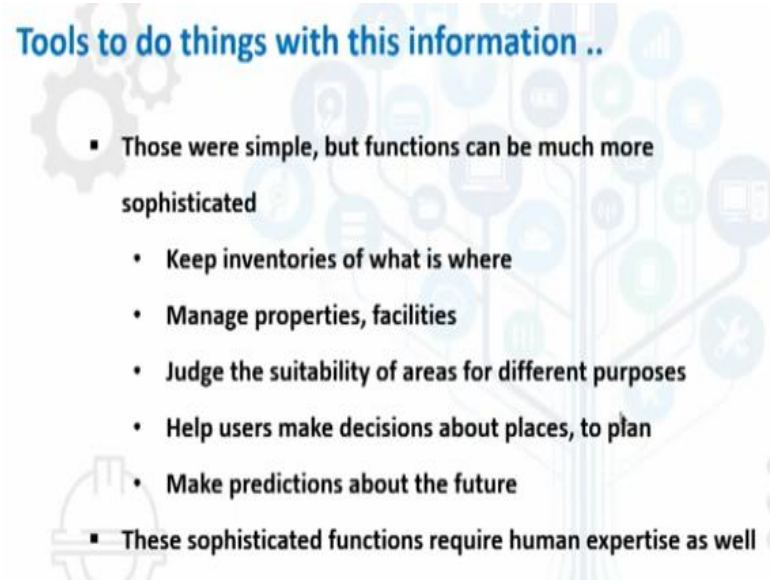

Okay so those are information can be simple it can be sophisticated so you can inventories may be for example if you are collected huge amount of data of the same area on various aspects you have a group of students who is actually collecting different information's. So they want us built up the entire database so you have different database you keep an inventory of the database of what is where that once you have a database that is in built and you have a geographic information that is inbuilt.

It is easy for any student sitting in the lab can access this data and derive meaningful information then manage properties facilities in particular region. So it is easier for you to give directions to a local authorities in order to derive information or give them directions just the suitability of areas for different purposes different issues. So it may be now it is very necessary in order to give geographic information when there is certain things that is being developed at a particular side.

So that can be done using GIS that is why it is being used as the very effective tool help users to take decision about places and to plan that is a very important aspects in order if you want to plan your city to become an green city or smart city you need to plan for a future may be next 20 years, 30 years, 50 years. So how do you do a plan so whatever the geographic data that you have collected over past 2 decades use it to plan it for next 5, 6 years sorry may be for 50, 60 years.

Then make prediction for future today is the current state is like this in next 50 years what may be the change in using a GIS can be understood. So it has sophisticated functions it has advanced functions it has basic function it has up to the user to collect this information to understand this how this process is that and use this GIS as a meaningful tool.

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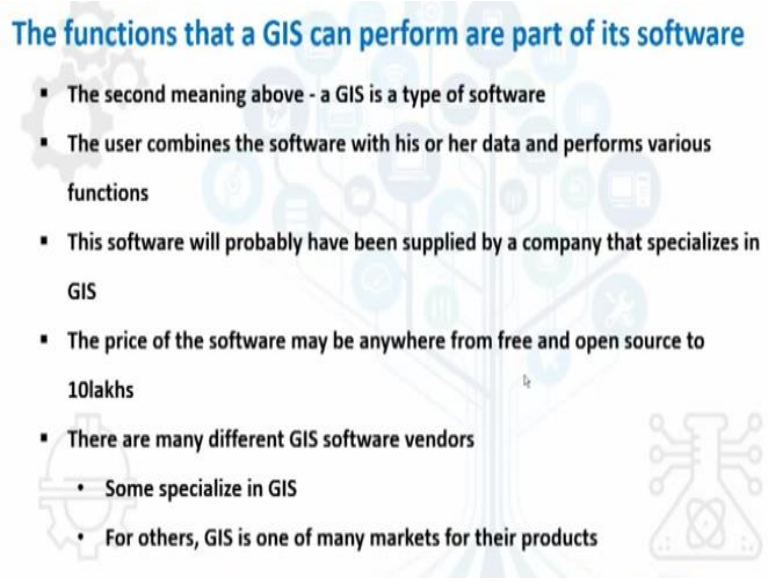

So GIS can perform lot of part of this software we look at all of these as when we go through how the software works what are the different specialization in GIS how probably how this has been supplied by. See there are various companies when we are looking at GIS software's if you have enough money to buy software's you have good software's like Arc- GIS which can give you extensive (()) (30:25) of at GIS.

But let us someone wants to use a free and open source software you have extremely good software's like grass and Q-GIS which have quite competitive which can give you diversified tools in order to understand and derive meaningful information. So you have both types the

today's context in this particular lecture schedule we would look at the free and open source software that is using Q-GIS how do we derive meaningful information that is what we are looking at may be in the seventh or eighth week of this course.

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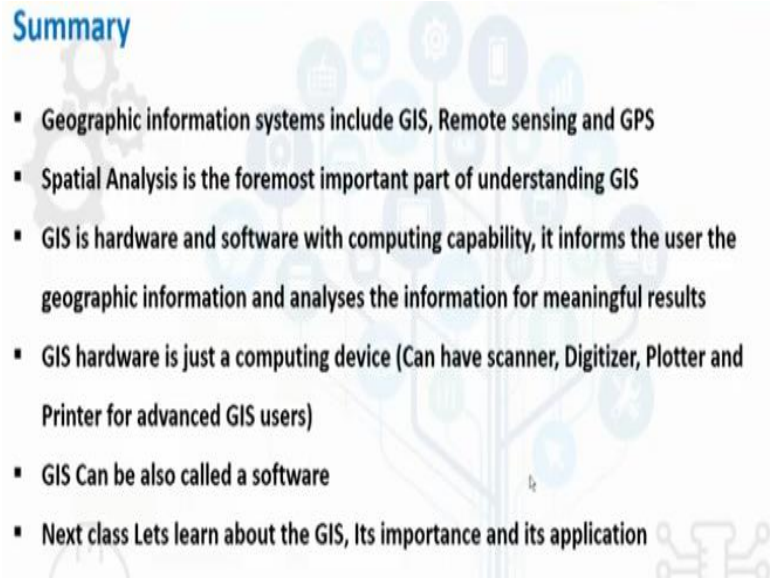

So to summarize today's class we learnt what do you mean by a geographic information system and it includes GIS remote sensing and GPS okay when we say information system includes GIS remote sensing and GPS and how spatial analysis is very different from geographic information system, spatial analysis is deriving information about a region, area etc., But whereas geographic information system is about handling that particular data to give you or it just a software or a hardware to give you meaning information.

Then GIS is an hardware just a computing device so you need basically a computing device to process the any geographic information to derive a geographic data to derive meaningful information. It you can have a scanner, you can have a digitizer, you can have a printer if you can afford if you want to become a advance GIS user. Then GIS can be called just as software it can be hardware it can be just as a software if you are trying to develop tools you have a geographic information then becomes a software.

So the next class we learn more about GIS we learn its importance and its applications so thank you very much let us meet in next class with more information about this subject thank you.