Geographic Information Systems
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Module No # 01
Lecture No # 02
Introduction (Continued)

Hello and Namaste to everyone so this is the lecture 2 of the geographic information system where we would understand what do you actually mean by geographic information system how the process of information is flows through relationship through different attributes how the information is derived what information can be stored and who are the users and how it can be used.

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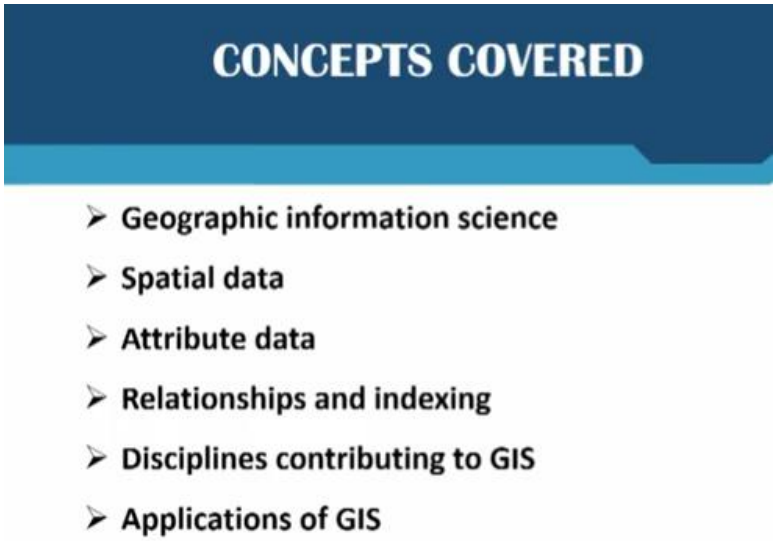

So this schedule is to understand what do you mean by science? So what we learnt in the previous class is information system now we will understand what do you mean by geographic information science? Science is different from system how it is different and why it is different so that is what we understand in this particular class then we would look what do you mean by a spatial data? People used term spatial data what do you mean by spatial data how it is spatial?

When you add certain things it becomes a spatial data so we will look at what is a spatial data? Then we will look something called as attribute data spatial data can have huge amounts of information connected to it. So what are those information are called attribute data so how and

how do you add an attribute data how much attribute data can be there I will give you some examples of how the attribute data is? Then once you have understood this then you need to know what is the relationships and how the indexing happens in geographic information system for which you have to understand what do you mean by attribute data? What is the mean by spatial data? How the relations are built and this is how the geographic information is been applied.

So that is what is meant by geographic information system using science to system then it discipline that actually contribute to GIS. So it is not that specific may be a computer engineer uses GIS it is every other engineering background it may be people from diploma it may be people from various other backgrounds can use GIS and develop GIS. So it as not limited to only specific disciplines it can be over through every discipline on the earth surface who is trying to describe meaningful information from data.

Then finally look at applications of GIS which how where GIS can be used in today's world there is not a single instance where GIS cannot be used. It can be used everywhere and every applications at you may think on. So let us look at which are the application areas I would not go into details of what application how it is used but I just signify what are the different applications that can be used using GIS.

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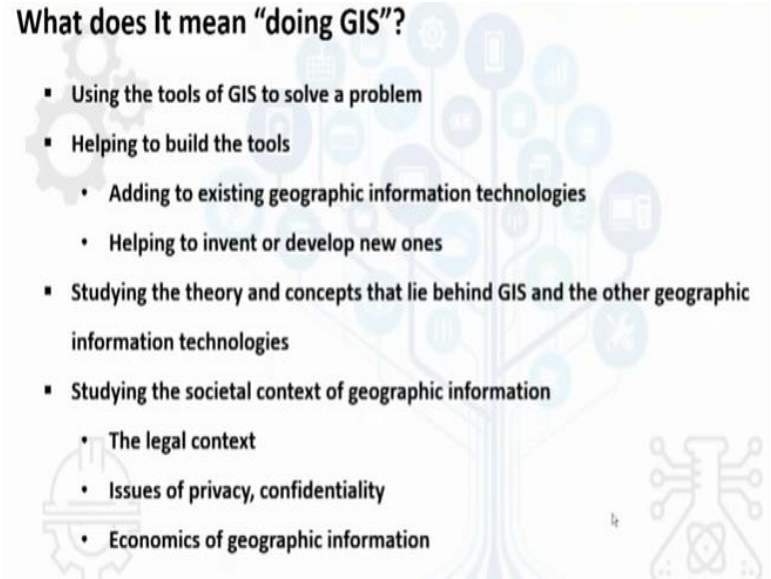

Now someone comes to you and says I am doing GIS what does it mean by I am doing GIS. So does it make sense to say that I am doing GIS? Yes, it means to say that person actually developing tools of GIS to solve certain issues it is not that every tool as already develop but certain issues needs tools to be developed over a period of time or may be modified to suits certain context it means to say that person is working on specific science to develop the tools.

The science behind the tool is what is expert in so he is developing those science into the tool so that anyone who is using the GIS software can may be used for a applications without knowing much about how and why the tool is being built but you should know the procedures. Now not knowing much about why and how what are the mathematical formulation etc., may not be needed.

So he or she is basically looking at the tools developing tools to solve a problem so when I also say I am doing GIS it means to say that he or she may be helping to build a tool. So developing a tool is very different from building a tool so now it may be building a tool in terms of adding existing geographic information's technologies it may be that you need 2 or 3 technologies together in order to develop a tool.

So that is that means to say you are building a tool okay so it will be also helping to developing a new one's which may be out of current research issues that you may come across for example if someone finds out that this particular issues that not been address over a period of time in research with research output you can develop a new tool then it becomes a contribution. So if it is an open source so it will become the contribution to (()) (05:17). So where people can use it over a period of time then studying the theory and concepts that are behind GIS and other geographic information technologies is also means that I am doing GIS.

So it means to say that now anyone who is taking this course is actually doing GIS you are studying the concept where understanding the concepts where understanding the technologies behind it understanding the science behind it and probably you are getting more information about specific aspects of GIS it also means you are using GIS. It also means you are studying societal context of geographic information system.

If you derive meaningful information that can help society in much larger context then you are actually also doing GIS it may be in legal context it may be issues of privacy confidentiality economics of geographic information. So all of these are using GIS for societal context so for example if you are trying to develop maps of a particular region where degraded region of a forest and trying to see how the forest was in 1960's, 70's, 80's, 90's and how it has change over a period of time in 2019 or 2020 it means to say that you are trying to understand the benefit the forest had versus it when it as completely degraded it does not have.

So you are trying to look at issues who can look at the legal context of how the forest who as degraded the forest and who is responsible for it. So all of this can be if you trying to do then you are doing GIS okay.

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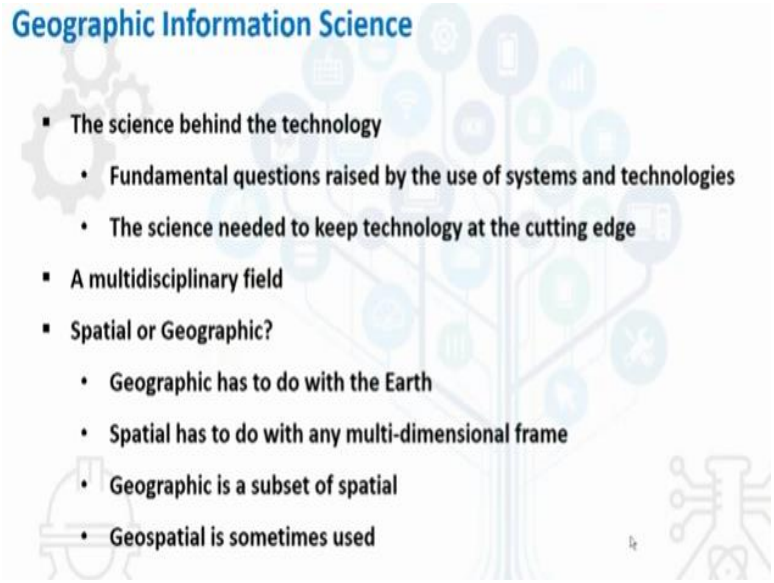

So when we look at this whatever we have learnt a hardware or a software is nothing but technologies systems but when we say geographic information science this is the science behind that technology this is the science that is driving that technology which means these are the fundamental questions that are raised by use of systems and technologies. So when I say system it is a hardware and a software you use a software to derive meaningful information using an hardware.

Now in order to have that software you need to have a collection of tools, that tools are governed by science this science is governed is developed using certain may be some research some

usually known problems. So this is where you need to have science so the science drives technology so technology is embedded into an software which actually drives the entire process of converting the data into meaningful science or meaningful information.

It is basically a multidisciplinary filed it cannot be set that there is someone who is developing a tool is from particular discipline very important concept of geographic information science is information about whether it is been spatial or geographic when I say geographic when I mention it as geographic it has to do something with the earth surface process on the earth surface when I say it as spatial it has to do with any multidimensional frame it can be anything on any you are connecting any object to anything so that is GIS.

For example when someone is trying to find out how many Pizza store are there in this particular city then you are trying to find out that in a spatial region how many pizza's stores are there. But if you trying to find out how do you drive from your house to that particular pizza store you are actually giving the geographic information about the earth how you have to move? Either on walk or a bicycle or in a car?

You are actually defining what is a geographic part of it so that is the difference between a spatial part and a geographic part if I am just giving a I mean for example if I say I am Dr. Bharath Aithal from SIDM RGCSIDM. So it is actually saying that I am from this department in this institute it is only giving you the spatial information but when I say my pin code is 721302 it is actually giving you a geographic information.

So it has geographic information is actually a subset of a spatial information which can be used for better information or outputs. Geo spatial you would have heard something called geo spatial technologies it is nothing but combination of geographic data and a spatial data combining both geographic and spatial data will give you geographic spatial information or geo geographic spatial information.

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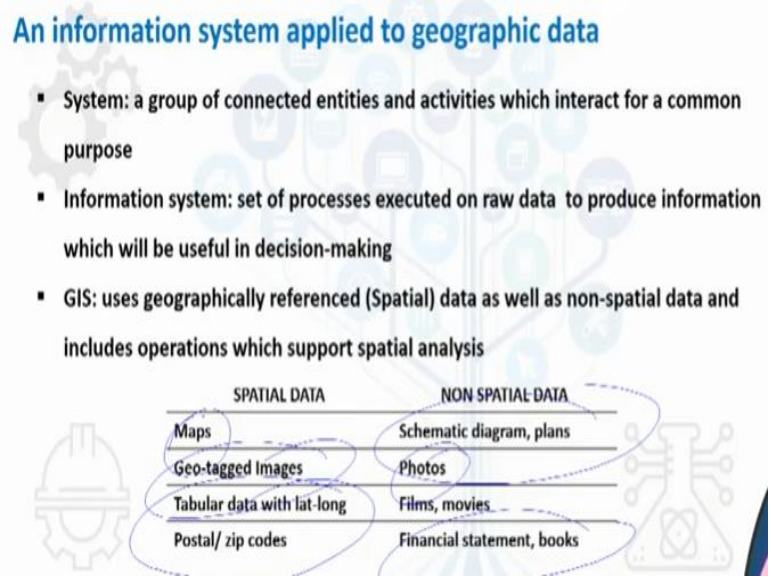

So when we are looking at this how can you apply a information system to a geographic data. Now what do we understand this we have certain things certain data which is relating to the earth surface so that means it is geographic data. So how can we apply how can we derive information from the system when I say system it is a group of connected entities, activities which interact for common purpose okay.

So when I am actually defining the number of different I am trying to derive different pizza stores in that particular region I am actually connecting all the activities in that particular region with entities which are nothing but pizza stores and using this as a effective system. The information connects for example if I am trying to drive from my house to that pizza I am trying to give certain information which can be processed from a raw data which is just a pizza store to give a decision making saying that this is how I am have to drive in this particular road in take a junction and then you reach a pizza store.

So that is what is the information that we can derive from the raw data if you have just pizza stores mark it means to say that I have just a raw information. So once you connect a information you derive what is the distance from all of this pizza stores which is a closest pizza store and how do you drive from that location to reach the pizza store then it becomes a meaningful information.

So that is nothing but a information system you have a system you have a information when you club it together it becomes a information system. So when I say GIS again is geographically reference please be very specific here it is geographically reference spatial data. So when I say spatial data it is information about object area of phenomena as well as a non-spatial data. Now if have not given any reference to any of those quantities where it is there okay.

So for example if there is let me give you example something like this let me explain what do mean by spatial data and a non-spatial data? When you look at it here the maps that you use here is the spatial data because it is actually referring certain things on may be geographically connected you have geo-tagged images which are actually defining geographically connected data.

You have tabular data with lat-long you have postal zip codes all this have spatial information's which are geographically connected. Now you have certain information you may have a plan which may not have the coordinates or I mean geographical information along it this becomes a non-spatial data a photo just a photo of a building. If you have a photo easily detention center of 1970's and today it is just a photo it gives you just a information that there is detention in center.

But it does not give you an information where it is located so it becomes a non-spatial data then films, movies and the financial statements, books all these are non-spatial data but when you have geographic coordinates along with them becomes a spatial data. So GIS can handle both spatial data and non-spatial data so it can be combined to derive a meaningful information for any analysis.

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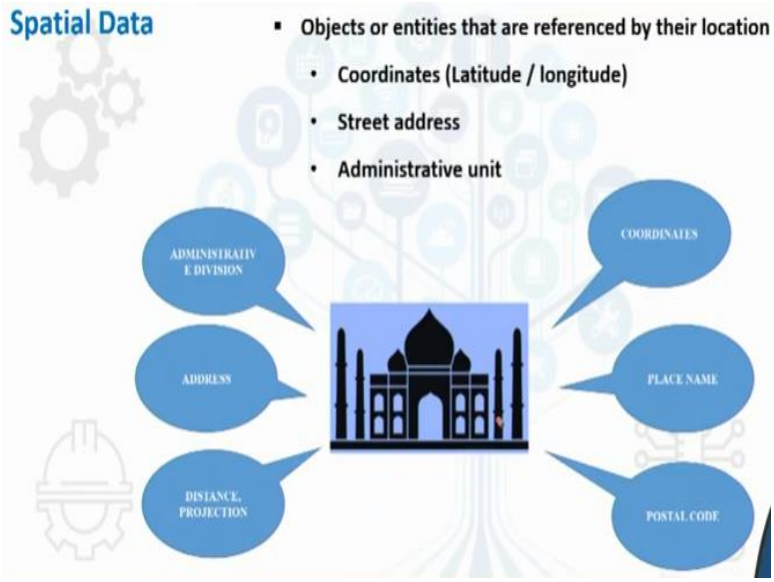

So when we look at special data very specifically for example when you look at this particular building, you have an administrative division, you have an address, you have a distance, you have coordinates, you have a place name where the building is located and you have a postal code. So these are nothing but your spatial data when you say that Taj Mahal is located at such a place you are defining the administrative location on the earth surface it becomes a spatial data.

When you giving a zip code or postal code you are actually defining the spatial data when you actually gives a coordinates you are defining a spatial data. So you are defining something geographically on the earth surface is nothing but spatial data. Please understand that whenever you have certain things is that is when you give a reference to the earth surface pin pointing this is there on this point of earth surface then you are giving a spatial data okay.

So this spatial data there can be spatial data when you look at for example when you look at this particular building the color of the building there may be the material used in that building so all of this becomes a non-spatial data okay which are acting along with the spatial data to give a meaningful information.

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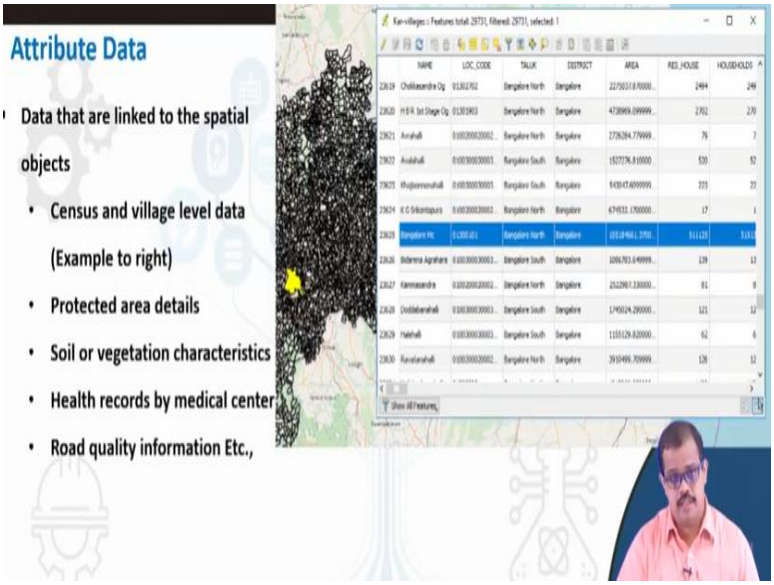

So when we look at this spatial data there is something called as attribute data which means to say that how the spatial data is actually is also has various non- spatial data where you can query and derive information. So for example what I am showing you on the right hand side is nothing but an attribute data so these are different can be districts can be regions in Karnataka in Bangalore the entire Bangalore districts which is the Bangalore districts you have Taluk's Bangalore north, Bangalore south etc.,

So you have various places in that region it has a location code it has a what is a area of each of this district then you have how many residential housing is there how many households are there? So this residential housings are there how many households are there attribute information that is added to the data for example when I am I was mentioning over the previous building information.

So you have a building you have postal code you have a coordinates you have a administrative boundary but you also have a associated information of what is a color of a building what is a material of a building those are the attributes of data that you actually collect on the ground. Any data to be meaning should have certain attribute information for example if you go to a field you collect certain data even if you collect certain geographic coordinates you should put in your database or add certain information in the database that can give more meaningful information to those collected data sets.

So attribute data is the data can be senses data can be village level data, can be protected area details. So any of those details which adds value into your main data set is nothing but an attribute data.

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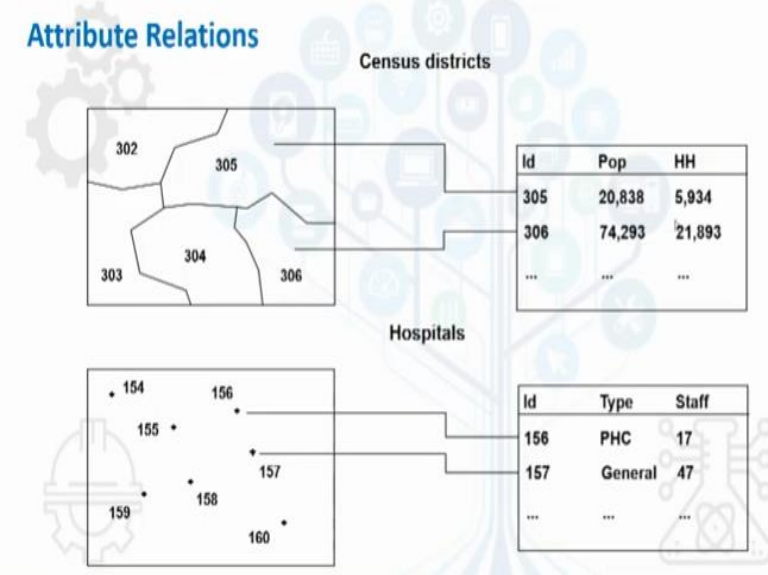

So this attribute data is has is also connected by certain relation for example when you will go into details of how the relation is felt what are the different relations available how we connect with the relations? How do we derive query etc., in further classes. But when we are looking let us look at as there are certain relations which actually characterize the main data with the attribute data these are called attribute relations.

For examples censes districts these are the different districts in this particular map now these are different ID's that actually differentiate each of the districts okay these may be district A, B, C, D that these are different ID's which actually defines this district. So with these if you go into these ID's will gives you spatial information it also gives you attribute information saying what is the population how many number of households are there?

So this becomes an attribute relationship these are the attribute relation in that particular dataset. So information about a spatial quantity in the meaningful way is nothing but your attribute data. So it gives you more and more information that is necessary.

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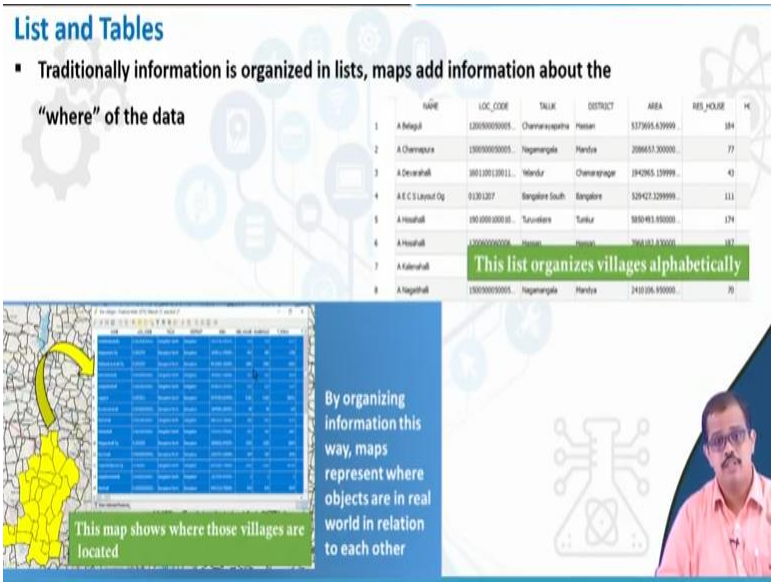

So these data can be stored in a form of a list and a table so when I say less always an attribute data is saved as a entire database if you look at here I have some of the districts here so it is these are the different districts there are district level these are Taluk's these are districts then you have geographic area then you have number of households. So these are in the table and a list always you have geographic information stored as a list or a table in order to derive meaningful information.

So using relations you get into the table you query data so you get information's this is exactly how may be your for example if you have looked at Google earth, Google maps etc., so that is how they give you meaningful information's.

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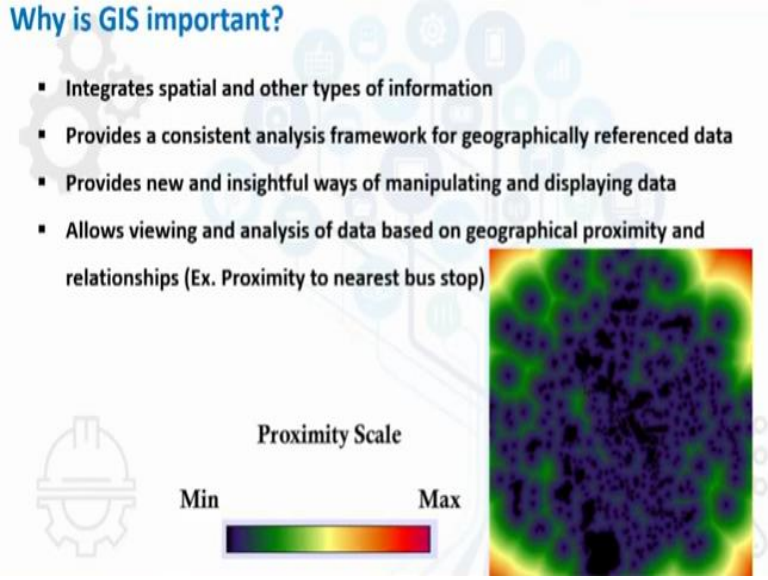

So having said this why is GIS important? GIS actually integrates your spatial and non-spatial data whatever data that is available it can be integrated otherwise you should have a lot of physical maps and drill down with information's. With GIS just with the query of a built in database it is possible for you to derive at any kind of information with bot spatial and non-spatial information. So you know where the process is happened and what are the different information associated with that process okay.

So that is where GIS plays a very important point when you look at GIS as an important tool it provides a consistent analysis framework as a tool it as it gives you analysis you can all sorts of spatial analysis using a geographical reference data which means to say that you know where the spatial data is which location you are looking at spatial data and what analysis you are trying to do.

So correlating all this will give you meaningful information then it provides new and insightful ways of manipulating and displaying data. So I did mention that GIS is also a software which means to say as a software you can derive meaningful and insightful information's from it which you can derive new tools you can derive more datasets so that is how a GIS helps you it allows viewing analyzing of data. It means to say that already existing data the derived data and how different ways of looking at the data can be looked at with geographical proximity.

For example there is some map that is displayed here it is actually a proximity map now for example I have a this black regions are those which are signifying there is a but these are different bus stops in the city okay. So when you look at these bus stops I am trying to see at the proximity of these bus stops how the urban area has grown. So when I derive a proximity map so and over late on the urban area it is easier for me to say if there is a bus stop how this urban area and proximity is growing what kind of growth is happening and when did it grow?

With another view the bus stops where it was for the different region whether there are industries whether there are other such region is where which actually fueling the growth. So that is why you need a GIS.

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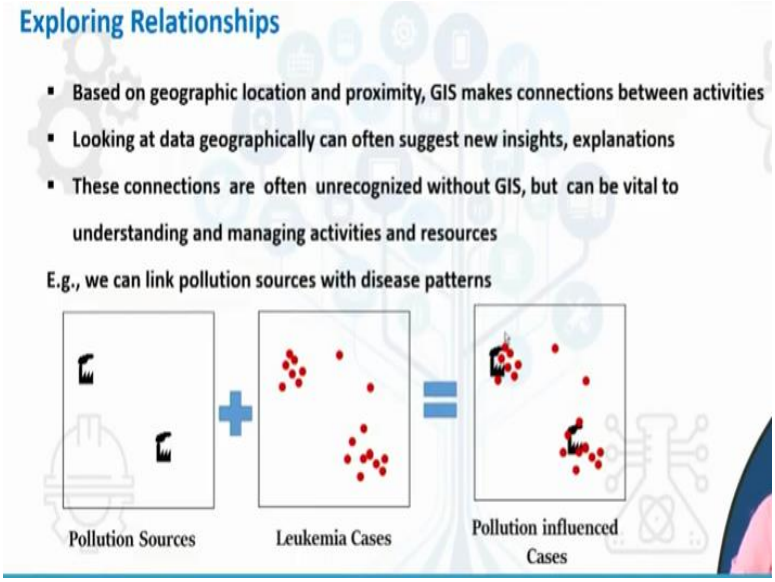

Now GIS can help you exploring relations for example let me take this example here you have an industry that is located here you have a industry that is located here without this probably you would have set there are two industries in Kolkata. So and there are certain Leukemia cases all around Kolkata so get those maps let us put it on it then you will look at what other relationship there is relationship exist or not.

But when you look at the geographic information you have this as a digitize layer it is digital layer in your computing system then you have a Leukemia cases as a digital layer. When you over lay both on this something like overlay both of them so you can find out if there is this kind of industry then there is lot of Leukemia cases around it. So it may be a decision support system

it can help you in making a effective decisions on where that particular issue is happening and what are the cost of that issue.

That is where it just helps you to explore relationships between various aspects so once you have data about entire city entire region you can derive meaningful information just by comparative analysis something like this.

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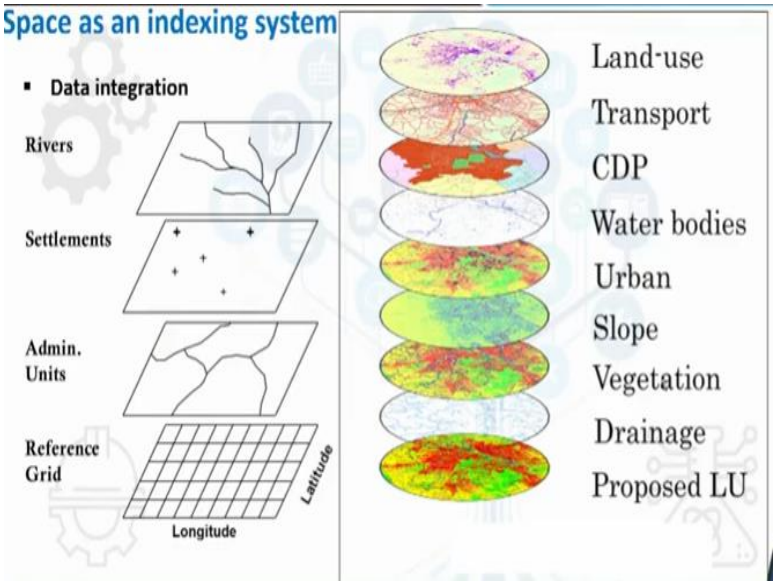

GIS can be a indexing system which means it can help you to index every information when you look at this for example the image on your right hand side you have a land used data here that have derived just land used data for Delhi then you have a transport layer the transport system that connectivity of Delhi then I have the city development plan of Delhi then I have the water bodies that is there.

Then the urban area the growth that is happened over a period of time then I have the slope of the region then i have the vegetation layer of that region then I know what vegetation has there then drainage network and the proposed land use. So for example when I am trying to understand an model how the urban growth has happened over a period of time I have used this layer in order you are proposed land use model.

Which means the rate of urban growth a rate of change in development of city it may grow into this vast city in 2025 or 2050 that is what I have proposed it here. Now with this proposal if you

have various layer with geographic coordinates that is connected it means it sits on each other you can over lay on all of these find out what are the issues that are there if the city grows like this and where the issues has to addressed where you have to provide basic amenities? What kind of basic amenities and how it has to be provided?

That can be easily located even without an (() (24:45) of doubt so for that you need to have precise information about the city. So once develop that entire data you can index the data and derive meaningful information from that. So for example a person who is working in transport may be very interesting in looking at land use and transport layer and may be a urban layer. So but a person who is working vegetative factor of city may be urban ecologist would may be look at the land use and vegetation part of it.

And also look at how the ecology of that particular region is actually changing with the growth of city or if someone is looking at hydrology part of it they would look at how the drainage systems are there how the drainage is choked and because of which how the urban floods are happening and why it is happening and how it may happen for the proposed land use change over a period of time may in 2025, 2050 or even later.

So it can you give you direction in order if you are trying to develop an model city it can give you directions on how and why a certain things as to be adopted in order to make good policy decisions.

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So when we look at GIS we have various alternative names GIS is also called as geographical information system it is also called as a spatial information system it is also called environmental information system. So I have geographical coordinates along with spatial information system it gives you some information about how spatially the geographical information is being put out so it is called spatial information system.

We are giving information about a land about a geographic of region hence it becomes a geographic information system. If you are looking at environment aspects of it as I described in my previous slide so you are actually giving information about environment of region it becomes as environmental information system. If you are looking at mapping if you looking a facility management then it becomes a facility management information system.

And as I said it is also geographical information science which is driving the system okay so but science is developing a tool or tool in the software so it may not be very apt in saying that it is a geographical information science. You can do spatial analysis you can look at desktop mapping so all of these are alternate names in when we look at GIS as a whole.

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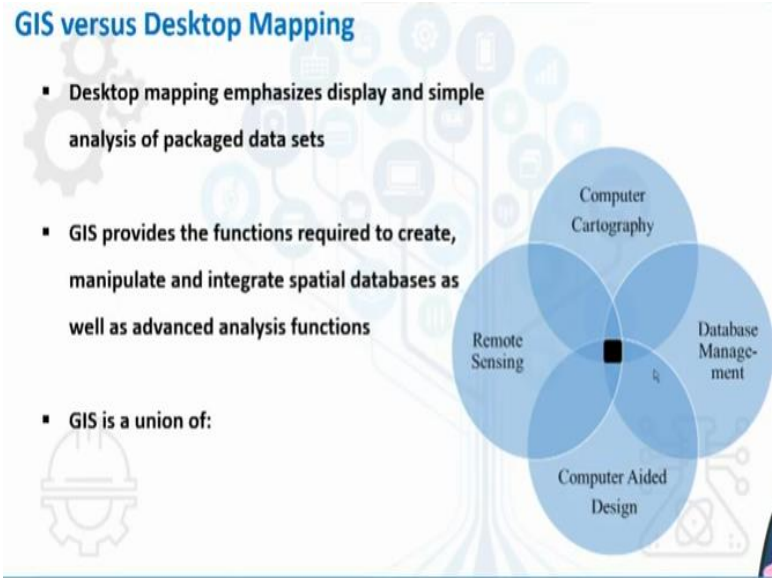

When we look at GIS so GIS when we look at desktop mapping if you just open up Google earth and try to map a few places so you may be limited to whatever that data which is actually available but when you have a entire GIS system. GIS system as I said it is a integration of remote sensing integration of computer cartography, computer aided design and database management system.

So with this as a union it provides an extensively effective tool when compared to desktop mapping. Desktop mapping can just give you certain information about a area or a phenomena but it does not give you the details that you expect on a larger scale which can done using a GIS. So it gives you a function that is required to create, manipulate and integrate spatial database. Desktop mapping can give you certain information which already there but not integrating the spatial databases.

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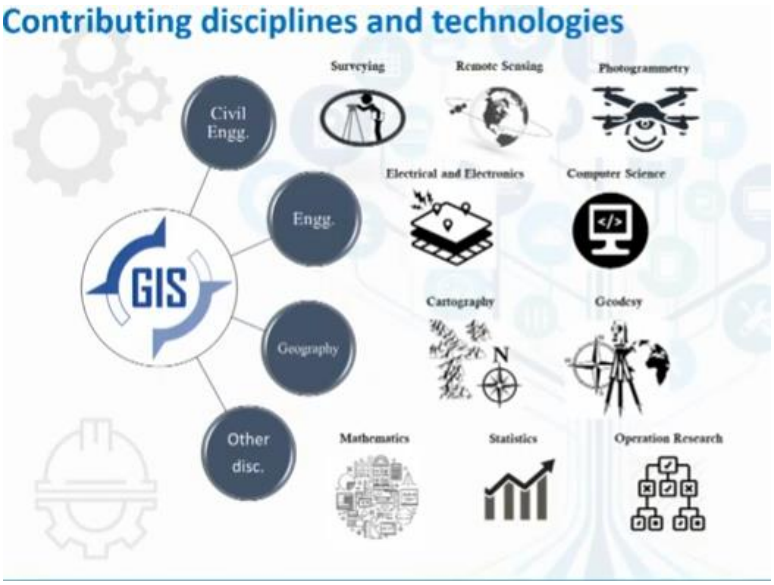

So this can be done using GIS so as I said GIS is not just one discipline it as various contributing disciplines anyone with any background can become a GIS user can be an advanced GIS user extremely useful for societal application. So as I said it may be anyone who is a surveyor, it can be a cartographer, it can be electrical electronic engineer or diploma holder, it may be a computer science engineer or anyone who is understanding the concept of (()) (28:49) statistics, Mathematics operation research. Any of these aspects can be used can be I mean can be applicative area when you look at GIS as a technology.

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So when you look at GIS application areas are everywhere so from utilities to marketing to transportation I have already shown you certain layers how it was built okay so using that layers

the analysis can be done. So it can be applied into transportation it can applied in urban issues it can be applied in health provision it can be applied in epidemiology, demography analysis, emergency response, disaster. If very good case of a disaster is ISRO website.

When during the disaster of Uttarkhand flood if you can seen the NRAC website they had in a near real time they depicted how the floods are moving over that region and how it is effecting the entire region in a much larger context. So that is exactly the applications of both remote sensing and GIS. They use the satellite data and derived meaning information so that it can be display it to the audience who may not understand remote sensing and GIS in the context.

Social science and Humanities is the very good application area people now have started with it natural resource and management an extremely effective tool is GIS, ecology, intelligence mapping, global climate change. Global climate change research is an very challenging aspect when GIS is considered oceanography, navigation, agriculture, drought management, famine management all of these aspects if you happen to visit Bhuvan probably you will get large data sets of most of these application areas in can used in certain aspects.

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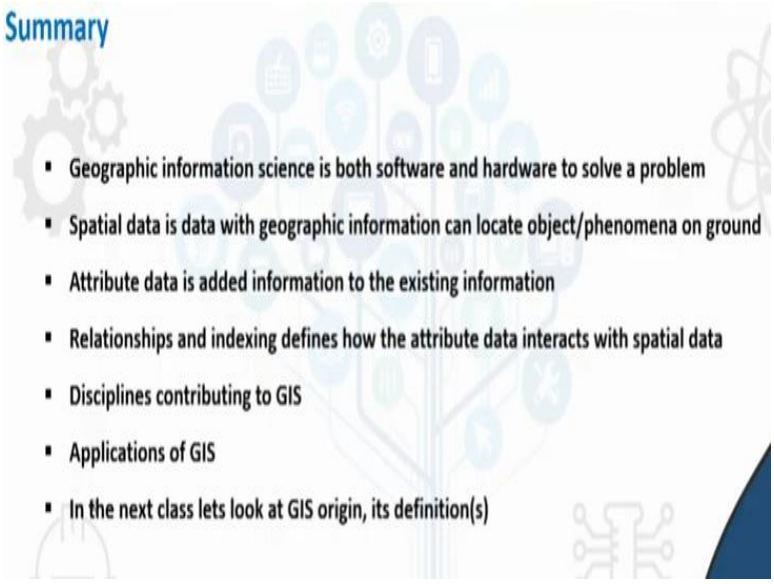

So to summarize today's class geographic information science is both hardware and software to solve a problem. When I say science it is a tool to it is science to develop the tool as a software now the spatial data is a data with geographic information that can locate object or phenomena

on the ground. Attribute data is added information to existing information as may be a spatial data.

Then relationship and indexing defines how attribute data interacts with the spatial data so we will learn more about what is relationships what you mean by indexing there are huge number of disciplines everyone who is doing this course can or everyone every engineer, every diploma holder or anyone who understands the basic of it can be effective GIS user then application of GIS can be in every field that you name.

So this is about the class but in the next class let us look at how GIS originated who was the first one to define GIS how it originated what are the definitions of GIS and who are the different GIS providers who are available in today's world. So different GIS software developer's software providers etc., we will look it at the next class thank you very much.