Geographic Information Systems
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Lecture – 25
Map Display and Visualization in GIS

Hello all, welcome back to the course. So, this is this particular lecture is on map display and visualization This is in terms of how do we actually look at the maps what are the ways that we have to use certain visualization techniques and I say visualization techniques, these are the symbols that we use in the maps, what kind of symbols that we use, how we use it, what are different styles that are there for representing different quantities,

What are the different measures that we use, so, all of this this things that we would learn in this particular lecture. So, now, we are actually the graduating in terms of looking at the how the practical aspects can be looked at from the real world perspective. So, please be careful in understanding each and every aspect. So, that when you are actually the doing it can practice it may be very easy for you to understand that one.

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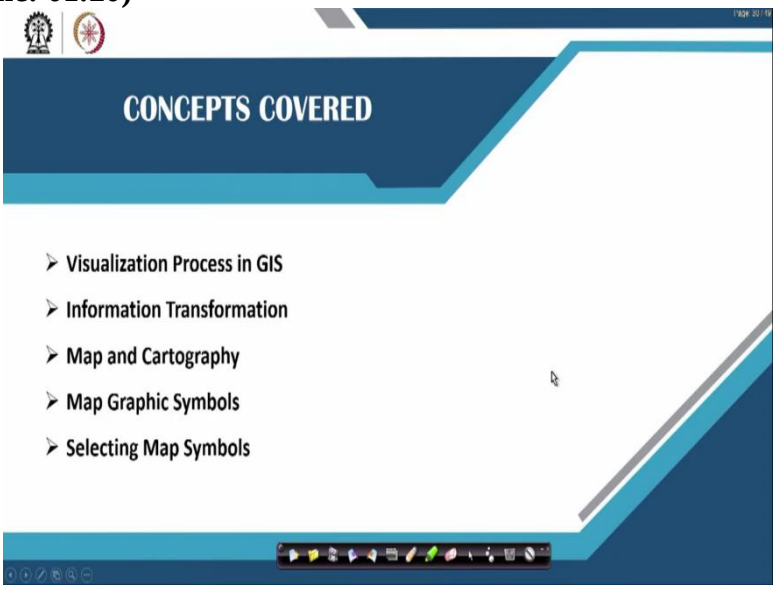

Ok. So, as I said in the concepts that we would covering this particular class on visualization, processing GIS information transformation, that how we transform information into the conveyable images, then look at maps and cartography, then map graphic symbols, what are the symbols that you use for different types of maps? Then how do we select? Why are there certain styles that through which you select your map symbols? So we look at all of these aspects. When we go on and in understanding different parts.

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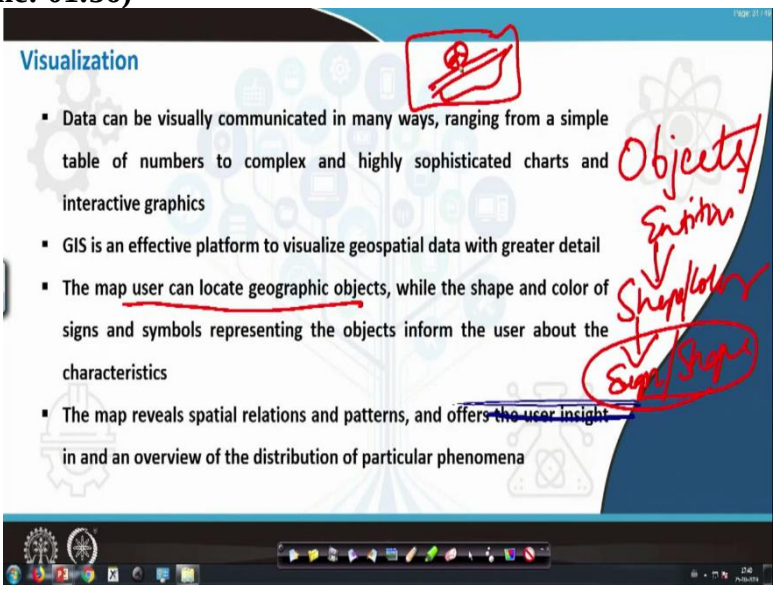

The first thing is visualization. So whenever I speak about visualization, most of them assume that I am trying to give some picture of maybe the model picture of 2030 and 2040 or 2050. So that the visualization does in it just mean that visualization means that whatever you are trying to communicate visually, it may be in any other way you are trying to puts in symbols you are trying to put in text you are putting it in colours.

So, how you are trying to convey the most complex phenomena in the most simplest language is that is what it means by visualization. So visualization me also means that very complex phenomena put in a simpler way, in most interactive graphics, can we even interactive a text, so, but it has to be extremely useful, just with one go people will understand what are different graphics. So that is what it means by visualization.

And in GIS the final portion of it when you deliver the data when you show the data when you are actually putting out the data. The thing that actually matters is how you have visualized your entire data set. It does it matter how you have created your data how you have done, but once you have some meaningful information, the final thing that people would look at from you is visualization. If you can put them in the most communicable way, then it is the best practice that you have followed.

Ok, so GIS is very effective in terms of visualizing geospatial data. So I am very specific it is not data with geospatial data with the greater detail with any greater detail site you may have the map user can locate geographic objects, while the shape and color of signs a color of

signs and symbols representing the objects inform them about the characteristics. So here you should, you should understand these aspect.

A map user can locate geographic objects, bar entities. Now, these entities would have certain shape, certain color of where it will be represented in a form of a sign bar shape, this these are representing the information to the user the signs, for example, you would have seen your Google map right so, when you look at your Google Map let as say you if you are trying to look at where is your airport if it is representing something like this is your this where your airport is.

It refers to you by a symbol something like this. So, it is referring to an airport. So, it is actually telling you that that is a place where the airport is there. So, that is what is the characteristics of a GIS. The map the variable map reveals the special relationships, the patterns and offers an insight in an overview of distributions of a particular phenomenon.

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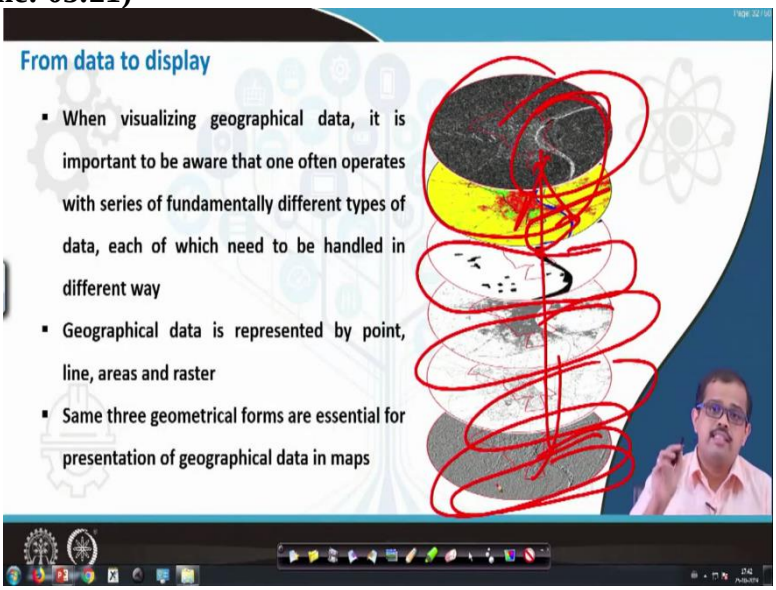

Now, so when you are looking at visualization you are looking at in the form of a data to display you take in data, you use the data and then display the data. When you are normally visualizing any of the geographical data, it is very important that you should understand there are series of fundamentally different types of data, it is not that only one data that you, as I said you can have data for example, whatever I have given here, you have 2 sets of raster data here.

This is a land use data and this is slope data that you have. And this is a hill shape map that you have. But this is the map that is has contains the number of polygons and points. There is again a raster map here and there is again a raster map so it is a collection of fundamentally different kinds of maps that are put together that has to be handled in a different way. The relationship that handles here is very different the way that you handle.

The land use map is very different from the way they you handle your slope map or where you have where you handle your hill shade map or the vector map each has a specific way of handling it. If you are not if you are trying to handle it everything is the same function then probably the error will login creep in, when geographical data is actually represented by the point line and polygons also there is also a raster that is what I mean in terms of geographical data in maps.

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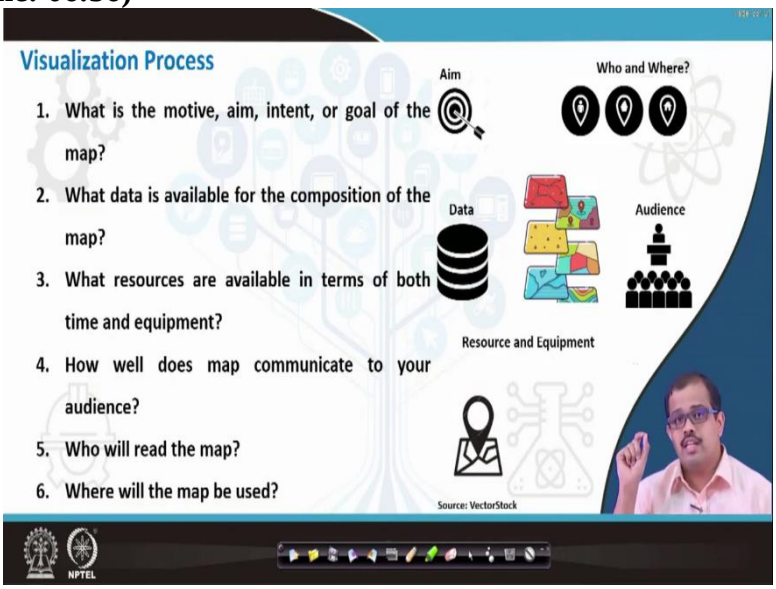

Now, when we look at the visualization process, as I had previously said, it is how you want to present your data. It may be in terms of symbols, it may be in terms of color, it may be in terms of the way certain maybe certain process or other phenomenon occurs. Let us you have to look at what is the motive of or the intent of your application, not every application, you use the same color set, same way of representation,

What is the motive of that particular application, the first thing, you have to analyze that first, then select what kind of symbols you need. So if you understand the motive, the aim the intent, or the goal of that particular map that you are generating, see, let us say that I have 100

or 150 data sets, it does not mean that I, I create 100 and 50 maps and just put it as put it in front of you showing that have created all of these maps. But what is the use of these maps?

The intent of any application is applicable only when you have certain useful maps. Now if I have if I am trying to look at the how the urbanization process has happened in Kolkata, why do I have to show everyone every map that is from the drainage network, to your rainfall to your urban data, to all your vegetative features, etc. Instead, if I can represent how the change of the urban areas happened from 90s to 2000 to 2010 on till 2019.

That is favourable enough for anyone to understand how the urban growth has happened that is exactly what I mean you have to understand the motive aim intent and the goal of a map, why are you preparing that particular map then what data is available for the composition of a map what kind of data that is there for composition in a map so, that you have to understand whether the data that you are using is extremely useful to compose a map or not, then what resources are available in terms of both time and equipment?

So, this is this may not be a real challenge in today is scenario, especially where you have high computing capability, but where there are no high computing capability especially in rural parts, then it may that this may possess a series issue, how well does map communicate to your audience. So, I have to give some message to my audience who are actually the consumers of the map that I have actually created.

So to convey every detail of that particular map I have to put it in a proper shape. If I am representing the street after represent in a better way of representing the house, I am the representing in a way that it is more communicable maybe a house symbol, as I said, if I representing an airport in an airport symbol should be there. So the way that I want to communicate so if such symbols are there, it is easier for every audience to understand.

If I am trying to look at the academic audience who understands every aspect of this particular maybe the research aspect, so I don it need to put them in every aspect so I don it need to communicate to them as what is airport what is house but I need to ah communicate to them on what is the output of whatever I have done over for as far as urbanization is concerned.

So, that is where the intent and what is required for audience will meet in 2 different context, then who will read your map who will use your map. So, that is another very interesting thing, if you have to first thing who will actually consume or use your map for any purpose and for what applications so, in such cases only you will be able to look at the map intent. Then where will be the map be used, whether the map is used for certain purposes.

Certain issues or certain when are looking at certain phenomena or you for some just for a visualization purpose. So, based on that you will look at what kind of visualization you need.So, all of these has to be thought about when you are visualizing it, don it just put. So, you have some tool to visualize it just put some value some color some text and leave it. So, but please look at all of these aspects then only you will be able to visualize your GIS data properly, extremely well represented GIS data gives you a lot of information also the audience would like it because it would give the depth of knowledge in terms of what they are looking at.

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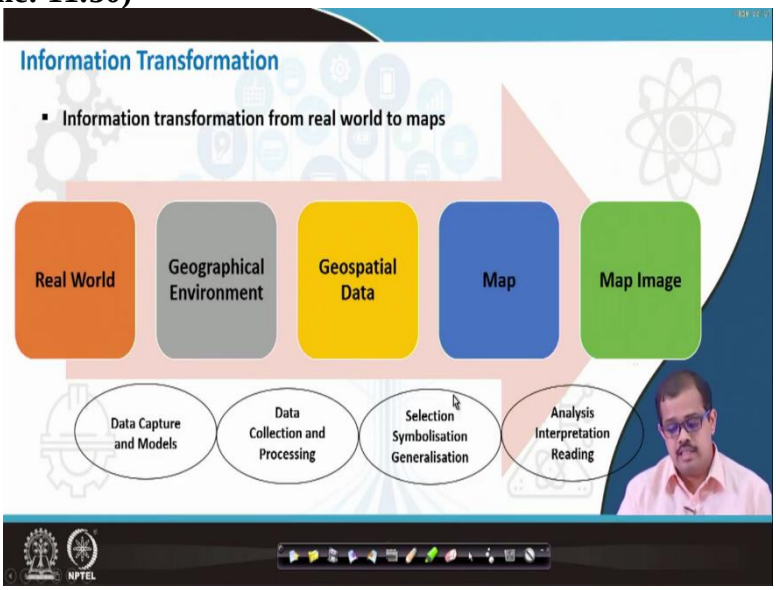

Ok, so, if I go back to my the first session, so I spoke about the information transformation that has from the real world to the map image or to the end user. We started with the real world, we looked at the geographic environment where you have the real world, we associated with the environmental data, and then you have a geospatial data that is spatial data along with the data model. So once you have captured the entire data model and you have worked on it.

You have done the editing and any other analysis using certain tools and science, then you create a map, the map is then presented to the end user as a map image. Now I am have transformed center process in a bit different way. So that you understand now we are since we are graduating towards how we actually represent a map a real word in terms of the data model, We are I am trying to graduate the entire aspects that what we have thought into an image resource that can be used by the end user.

So we looked at data capture and models, we looked at data collection and processing. Next is the selecting symbolization and generalization and finally, it is analysis and representation. That is what we are learning now.

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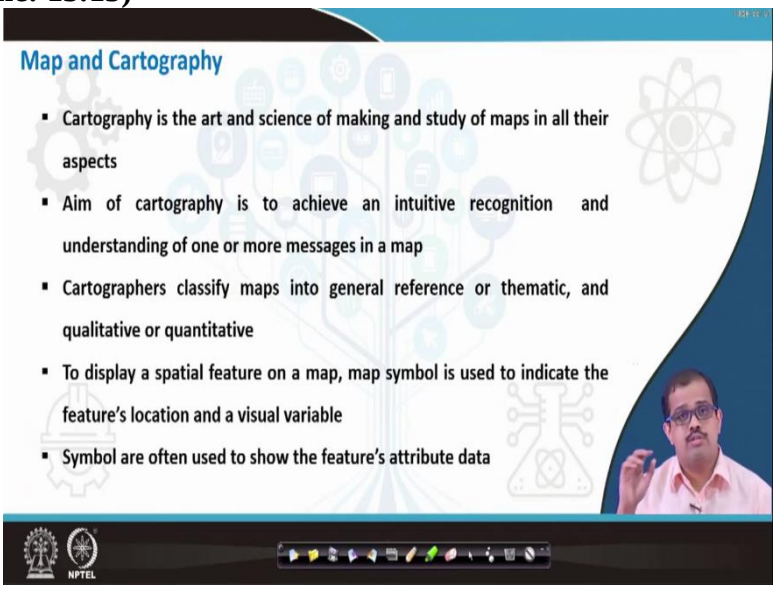

Ok, so, now, people you have would have heard about cartography? Cartography is actually a science of making and steady of maps or making of maps or even a steady of maps in all their aspects that is nothing but colonizer cartography it is art or science of making and study of a map in all they are all aspects of what that maps gives information about.

So aims of cartography is to achieve an intuitive recognition and understanding of one are messages are in a map in a particular map that is we are trying to use cartographers classify maps into a general reference are based on thematic reference. Now, most of now the cartographic maps are based on thematic references and qualitative and quantitative. So, you can have qualitative maps also you can have a quantitative maps.

Also that is based on the requirement that you have and the end user who is trying to use your maps and to display a special feature on a map. A map symbol is used to indicate feature location and a visual variable that you should remember. Then symbols are often used to show the feature attribute data, now I am trying to connect with the spatial data to an attribute data. If you want to represent an attribute data, then you show it in terms of symbols.

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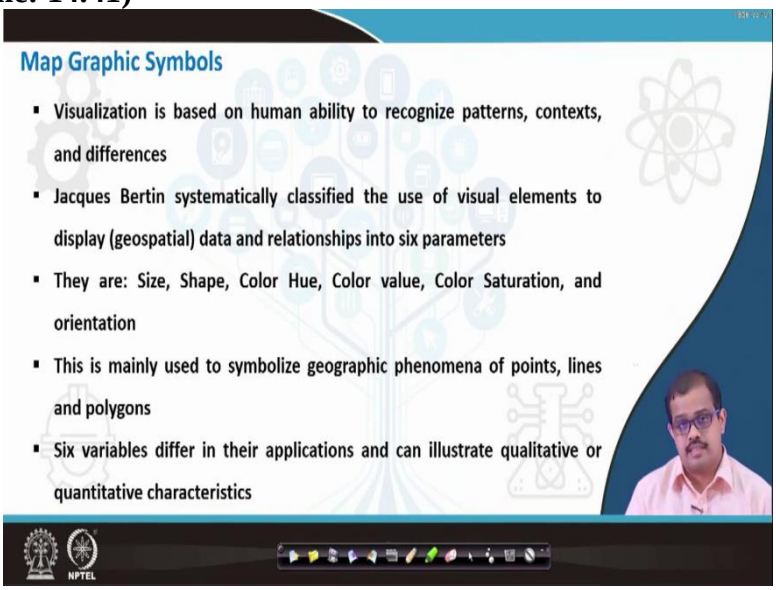

So when we look at map, graphic symbols, these are visualization that is for human ability to understand in terms of pattern, context and differences. So if you want to understand in terms of pattern, context and differences, then use map graphic symbols. So Jacques Bertin systematically classified the use of visual elements to display data and relationships into parameters.

So he explained how we can look at the visual elements and display any of those geospatial data that we have generated in terms of relationship and in different parameters. He basically took it into 6 parameters, the basic parameters that he looked at as size, shape, color, color hue, color value, color saturation, hue intensity saturation, this is basically the way you look at your information your data.

So, size, shape, color, color hue, color value, color saturation, and orientation. So, these are the 6 different parameters that he classified, where you can use your map graphic symbols for effective representation. So, this is mainly used to symbolize geographic phenomena of points, lines and polygons, 6 very variables they are differ in their application can be can illustrate quantitative or qualitative characteristics in terms of representation.

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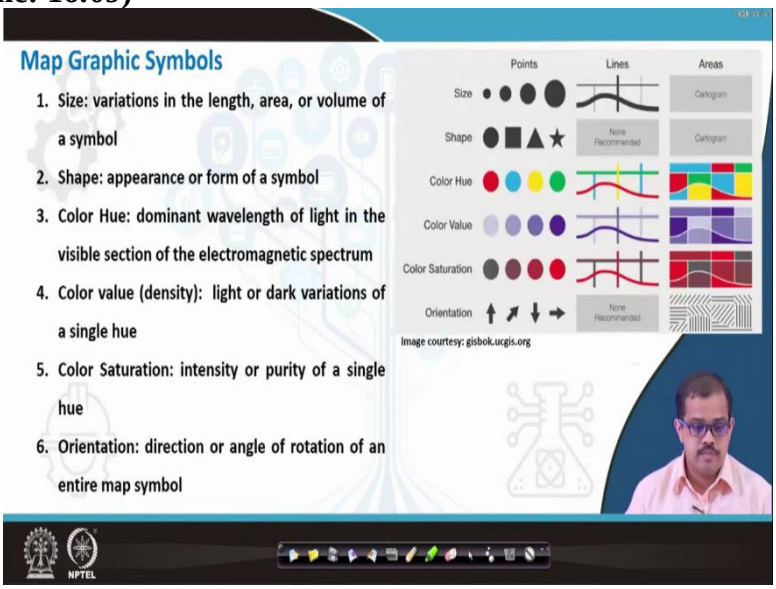

So, when we look at map graphic symbols, for example, if you have a size, so it can be something like this, it can be something like this. For example, you would have seen the population map of the globe the bigger the size of the symbol shows you the bigger higher bigger the population a smaller size will show you the smaller the population or you would have seen the urbanization.

If you have not seen please type in the urbanization across the globe, you will see very good graphics in terms of how we which area has the huge urban growth which is having the least urban growth. Well, the graphics will give you an estimation of where the urban growth is happening and where it is not happening that this is in terms of points, this is in terms of lines and as far as areas is concerned it is how it is actually now, I mean normally not recommended.

When you look at shape, it is appearance or form of a symbol for example, this has different symbols used for different purposes I give an example of usage of airport symbol usage of road symbols. So, these are some examples we normally use a shape in terms of representation of points and not for lines and polygons when you look at color hue decide dominant wavelength of light in the visible our selection of electromagnetic spectrum.

So, for different processes we use different colours maybe if you are we are looking at danger we use a red green, red blue green as the common color palette a that is normally used. For example, if you want to indicate danger was not dangerous. So you can look at these symbols

and these are for the similarly lines also can be represented and even the areas of the polygons you have color values which are light or dark variations of the single hue, maybe the density is less the density is more population density,

Which is more versus population density of that is less more means it has darker less means it is lighter. So similarly it can be applied for both lines and polygons. But normally very well used in terms of points color saturation intensity which is our purity of a single hue. So, this is what is for color saturation it can be used for all the 3 phenomena's are all the 3 vector, point line and polygons and orientation.

So, these also are quite important in terms for example, if you are looking at the water flow, if you are looking at the slope aspect, the ratio etc. So, you need to look at the directions or angle of rotation of for the entire map so, that for to represent that you use something called an orientation that is a very good in representation of our point. But it is not recommended in the presentation of line whereas in areas it has very well established ways of looking at this particular symbol, graphic symbol.

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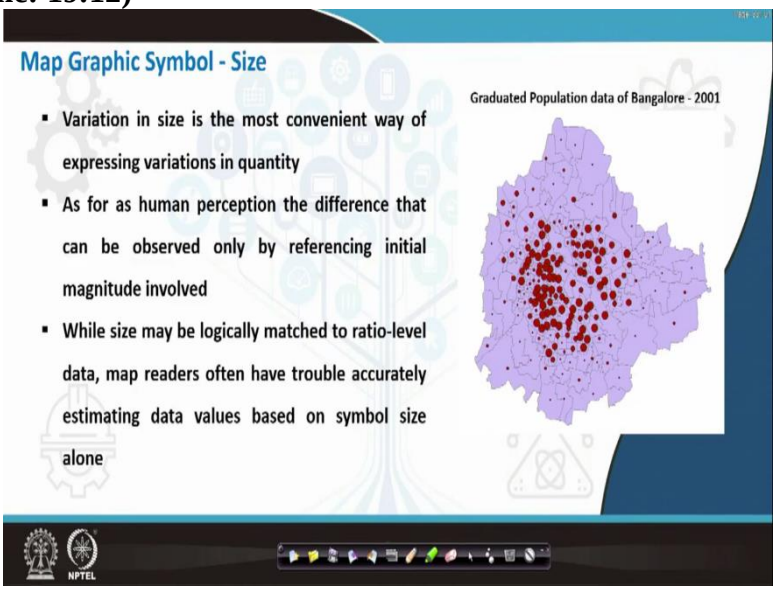

So, this graphic symbol I will go on with every symbol, the map graphic symbol for size. So this if you see on your right hand side you see a graphic symbol that is actually representing the graduated population. For example, the symbol is representing the population for every ward these black lines are representing what if you are I can just zoom in so that every one of you have a look at this particular map.

When you look at this particular map, see these black lines that you see here are nothing but your ward sections and these big circles represent higher population, small circle represents a lower population This is a population data of 1991 you can see that central area of Bangalore has very high population when compared to these regions, which have very less populations. So, this is how we represent symbol symbols in terms of size.

Ok, so this is basically very good for human perception. And when you look at size it is logically matched to the ratio level. It is not used for any other purposes but it is logically match using a ratio map readers often have trouble accurately estimating the data values it because it gives more of a qualitative data. It does not give you quantitative data, quantitative data is in a proper range. So, the quality is more of qualitative data on the range data that is represented here in the form of symbol size.

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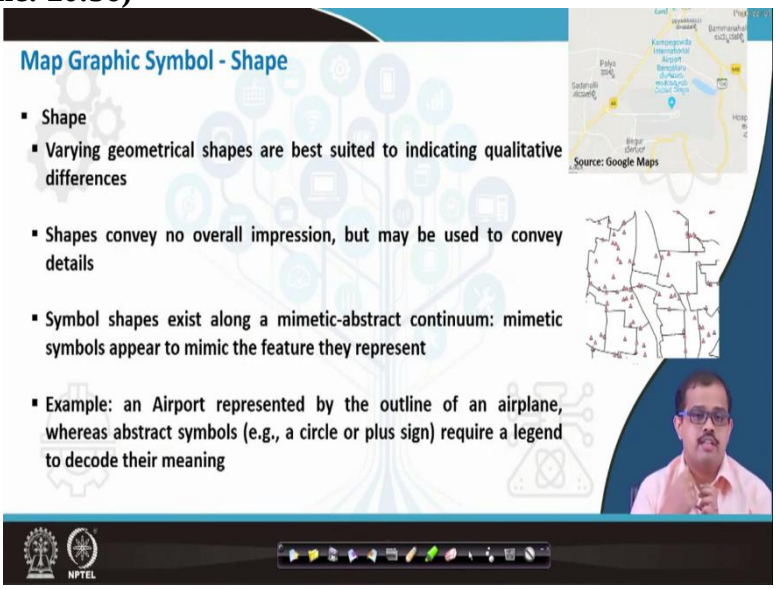

Ok, there is map graphic symbols that are also represented as a shape. So shape varying geometrical shapes are best suited for indicating qualitative differences in the images. So shapes convey no overall impressions but may be used to convey details, I explained you in a good example of the airport. Here. For example, there is an example of a airport in a Google Map. If this is an airport and it is showing the symbol here, which is shape here with actually representing a flight or a plane airplane or in a form of a point.

So, now that is the shape which is representing the most of the airports across the world. So, that is the best way of informing anyone who is looking at the map symbol shape exist along mimetic-abstract continuum, the mimetic symbols appear to be mimic the feature they

represent for example, they are you may have looked at Google Maps here, if you want to look at represented a restaurant, it represents in a form of you have a fork you have a spoon and you have a plate.

So, similarly, for every if you look at the hotels bit lodging facility, you have a bed you have a pillow. So, these are the symbols which actually mimic the real phenomena. That is where the map symbol is extremely useful for even for shapes. So, that I explained about the airport here. So, there is color hue color is divided into concept of hue intensity and saturation.

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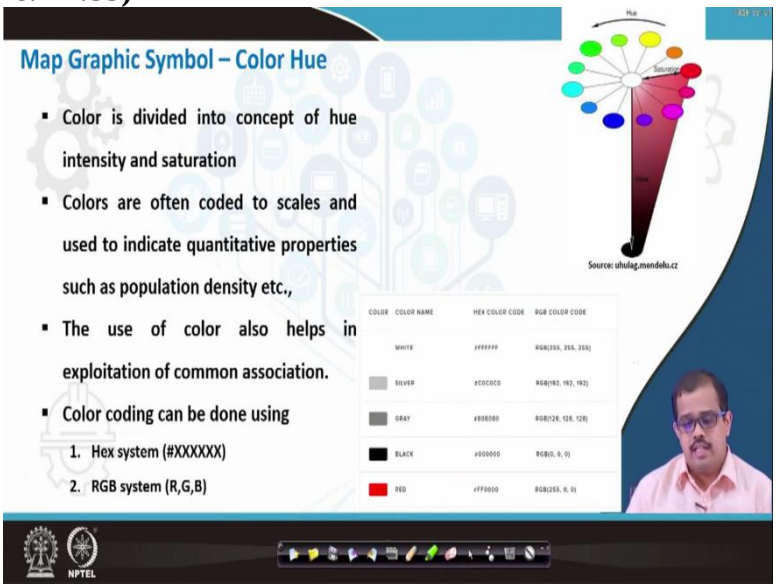

So, colours are often coded to scales and used to indicate quantitative properties such as population density. Normally urban density, population density rainfall intensity all of these are represented in color which are often coded using hue intensity and saturation. The use of color also helps an exploitation of common association. So, that is the very important aspect distinguishing aspect when you are using hue intensity and the saturation in terms of color.

Color coding can be done using a hex system or an RGB system normally it is done and RGB system, somewhere because most of most of us understand RGB system and say it is easier to interpret it is normally done in RGB system.

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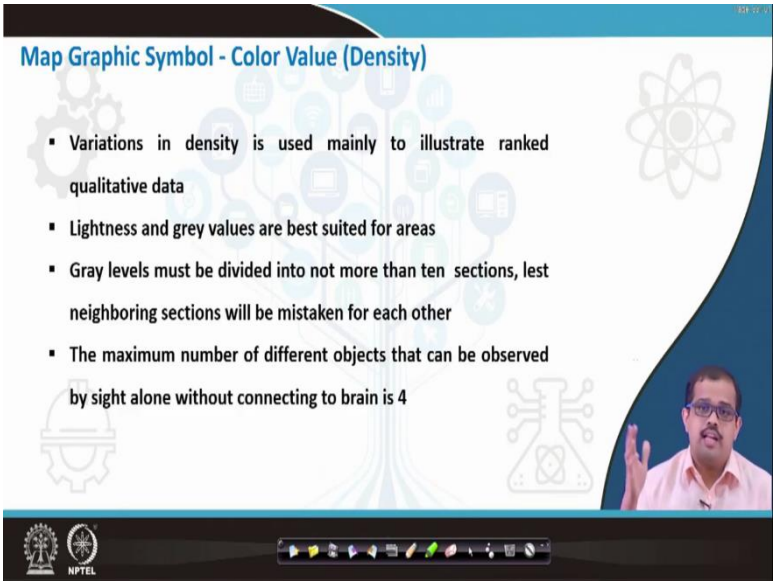

But can always use an hex system. So that if someone is more convenient using that you can use a hex system then you have color value that is based on density that is variation and density is used mainly to illustrate ranked qualitative data. Please be careful here, it is only rank data. We do not use just a qualitative data in terms of when you are looking at color value in terms of density, lightness and gray values are best suited for areas.

Grade levels must be divided into no not more than 10 sections, next a neighbouring sections will be mistaken for each other. So, normally, these are qualitative data which are rank which have very less sections are used in terms of color value or density value, or the higher the density gives a higher value. Lower the density use a lower value. So, it is only with very less number of different sections and maximum that people think that cartographers have tell us more most probably 10 sections.

And not more than that, the maximum number of different objects that can be absorbed by site alone without connecting to brain is only 4. So, when you are when you have 10 section says you have to connect to brain at least twice. So, if you are trying to look at this kind of classification, then it is better to use either 4 or 5 minimal classification in terms of density that is about density.

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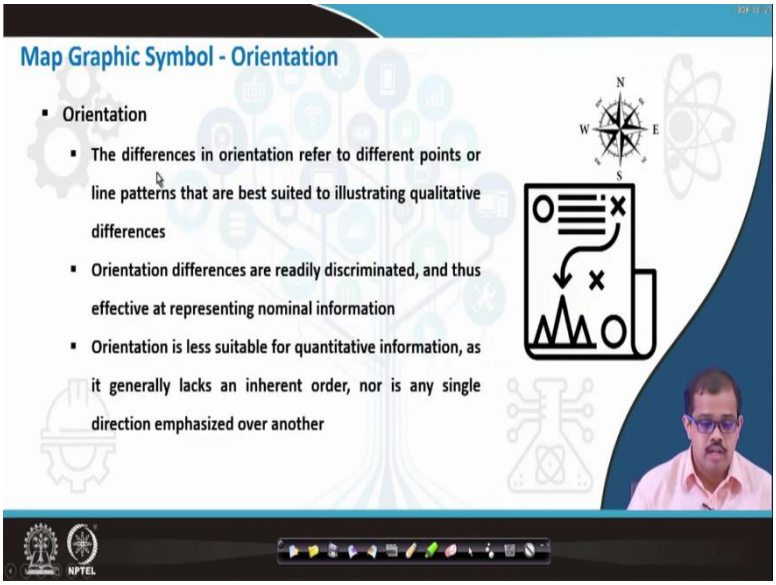

Then you have orientation. So, this many times people would have used in terms of regular the usage. So, the differences in orientation referred to different points or line patterns that are best suited to illustrate quantitative differences. If you have seen some of those Google Maps which actually shows you the flyover versus your lower junction road. So, the city road you can see that there are certain elevation difference in terms of representation of how your data towards a flyover it is actually given a different I mean direction.

So, that you understand that you have to have a slide right or slide left and move up. So, such orientation is very important to discriminate 2 objects for the same nature and thus. It is very effective in representing the nominal data set rather than any of the qualitative and quantitative data set. So, orientation is less suitable for any quantitative information as it generally lacks inherent order. They don it follow any order, nor is any single direction emphasized over that we do not have emphasis but it is just that a presentation that actually matters. That is why you need orientation kind of symbols.

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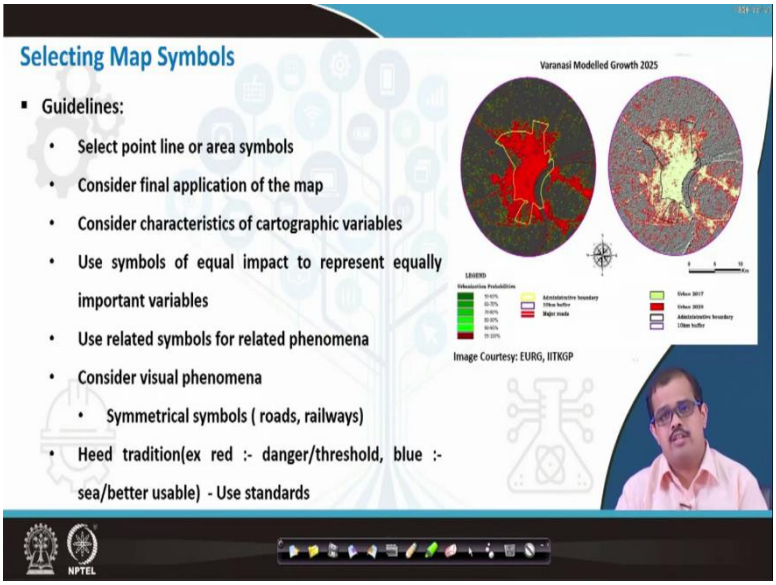

Now, when you look at selecting, so, you have so many kinds of ways of representation. So, for each you, you have understood now, for what you use, what kind of symbols are what may be represented what So, you are what kind of symbol So, you have understood all of these aspects, but there you if you are trying to select map symbols, there are certain ways that you have to look at, for example, when you are looking at the classification code NRSE has its own land use classification code that for Indian subcontinent.

So, we follow the NRSE color codes in order to do the classification, our land use classification. Similarly, when you look at the other guidelines, you have select point lines or symbol areas. These guidelines appear to consider the final application of the map. That is the first aspect that we have already spoken about earlier that what is application of the map who is the intended audience that you have to look at it consider characteristics of the cartographic variables.

So, now, for example, if you are representing let us say the population and you try to represent it in form of symbols, it may not be very effective instead if you represent it in a form of shape as I explained earlier, it will be much easier representation and gives you much more flavours. Now, for example, here this particular map is representing the urbanization possibilities if I had represented more gradations here with 50, 51, 52, 53, 200 .

Then it is very difficult to interpret what color is representing and what is the probability of that particular region to grow. So, that, that is exactly what I mean by when I have when I have to use cartographic symbols, this is representing a model data of for Kolkata, when, you

are using symbols of equal impact to represent equally important very it is only keep this in mind most of them when they are representing they make a mistake that if they have the equally important variables, they try to represent in different ways.

So, that leads to our is very similar way but that leads to a lot of confusion and also it may not represent the real world phenomena or it may not reach the intended audience use related symbols for related phenomena only do not pick up symbols actually like if you like certain set of symbols do not use it, but it is for the real world phenomena that you are representing use only those symbols it will be more effective. Consider visual phenomena symmetrical symbols for example, for roads for railways for airports, etc.

Heed tradition mainly for example, this is a tradition basically a red which is actually representing a danger or a threshold and a blue that us representing a C or better usable region. So, these standards if we can use the traditional standards, then it is very easy to communicate whatever you are trying to put out as data to the end user and to the audience.

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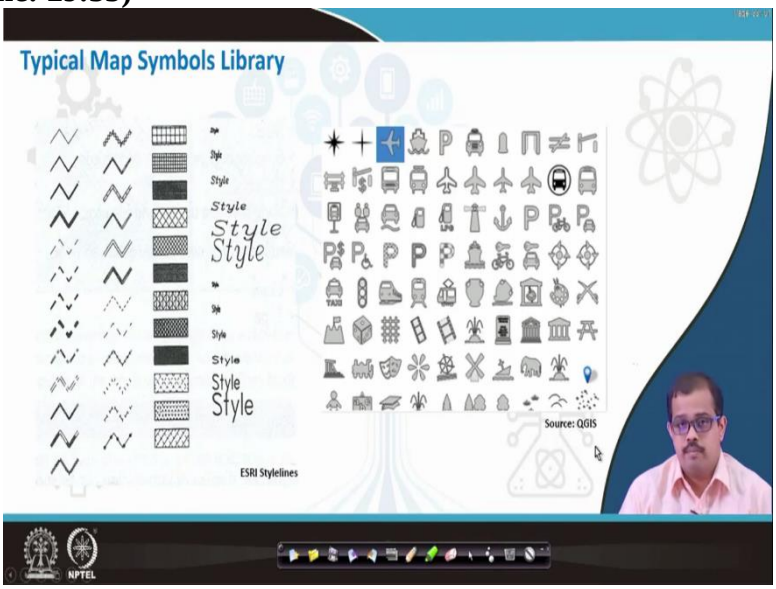

And when we look at typical map library. We have different set of symbols that you can use, if you go into your entire in QGIS, you will have huge amount of symbol libraries that you can always import and use it. For example, this is an ESRI style line were developed by ESRI, which is representing different symbols for example, this is your symbols for your line where it is representing different quality and quantity of representation here is representing a polygon with different styles.

So you can use these symbols in terms of representations. And there is this is a symbol that is used by QGIS along with these. So you have for example, airports you have ships you have north arrow you have car you have your parking. So, all of these symbols can be used in an effective way you have your railways here. So, this is a junction whereas, So, moving on track, you have a regular signal. So, all of these symbols are representing the real world phenomena. So, only thing is use them more judiciously, so that your map becomes more logical.

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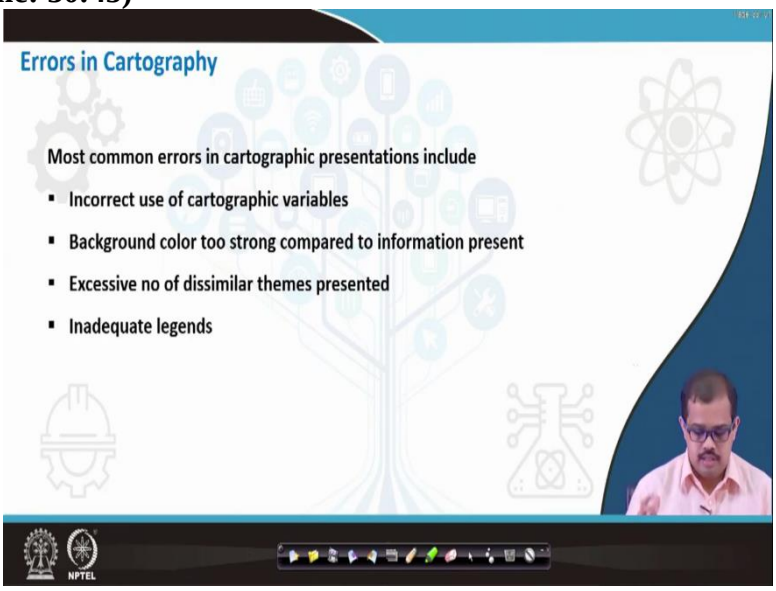

Errors and what are the if someone asks you, so, this is what this is a basic simple selection that we have to do, but there are again errors in the in usage of this symbols one is in first of all is the usage of the cartographic variables. So, how do you use all of these symbols, then background color sometimes is too strong compared to that of the information present. So, that has to be matched. In many places, most of the thing happens like this. So, you have to be extremely careful excessive number of dissimilar themes presented.

So, do not use just dissimilar themes presented have the same thematic representation for all the layers. So, it will be more pleasing to the eyes and even into interpreting it is much easier or if there is no way of representing it in a similar lines, then only go for the different way of representation. Inadequate legends. So, there are many places where their legends are inadequate.

You may have missed certain piece of information please look at it very carefully that is where the error comes as a as a part of cartography even your map data everything is ready,

there may be errors in this. So, you have to look at every part of when you are preparing a map using the GIS systems.

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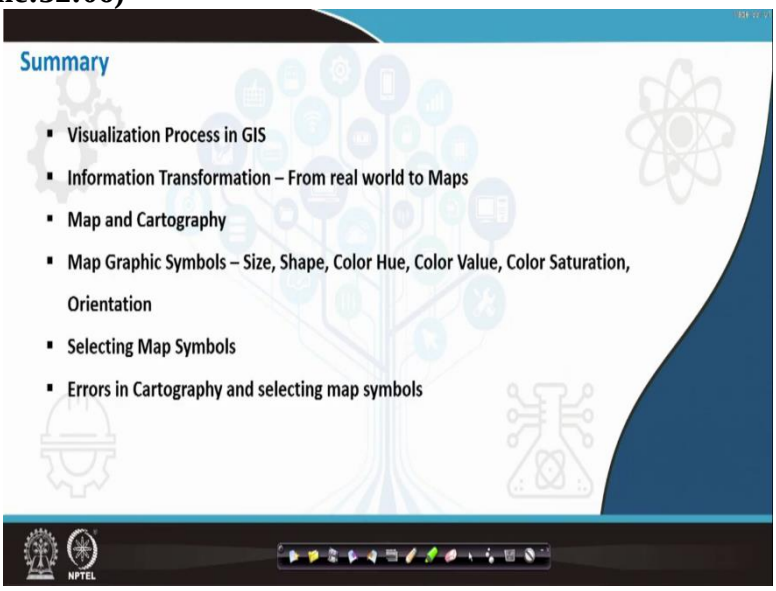

Ok, so, to summarize today's class, we have looked at what do you mean by visualization process and GIS to create visually more sensitive information that can be delivered to the user information transformation in terms of real world to maps. How do we converted from real world to match, we looked at cartographic symbols, we looked at graphic symbols like size, shape, color hue, color value, color saturation and orientation.

We looked at how do we select maps, map symbols, basically, then errors in cartography and selecting? How do we actually look at all of these aspects. So if we have understood this, then probably even creating a map and working on a map is much easier. So this is about how do you create cartographic information? Probably in the next week, we will look at what do you mean by geographic positioning system? How do we use a geography position?

What is the theory behind geography position, I have not go into the signal theory and how it works, how what are the different methods of capturing it, but I would give you a brief idea about what do you mean by a geographic positioning system. So once that would be the first 3 or 4 lectures and the last 1 or 2 lectures, I would in the next week I would look at the QGS software I would give you an introduction to QGS.

I and my TIS together will give you an introduction to what do you mean by how or what is QGS is how it was born, how it was a it has evolved over a period of time whether the tools

available and how you can utilize it where you can download etc. All of these aspects we will look at in in the next set of classes in the next module. Thank you very much till then have a nice time.