Geographic Information Systems
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Lecture - 63
Introduction to Web GIS and GeoServer

Namaste. Welcome you all to NPTEL online certification course on Geographic Information Systems. In this module we are looking at the demonstration of GIS as a software. And in this particular hands-on session, we will be giving an introduction to what is Web GIS and also we will be seeing what are different types of Web GIS and how we can use Web GIS in terms of GeoServer.

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In this particular hands-on session, in the initial slides we will see about data sharing, what are the different methods of data sharing, geospatial web services, Open Geospatial Consortium and what are the guidelines of Open Geospatial Consortium. Then we will also look at the advantages of GeoServer. And we will also look at the applications of GeoServer. What are the prerequisites that are required for installation of GeoServer.

We will also go in a step-by-step manner to see how GeoServer can be installed in your machine. Then, we will also see how to publish a vector data in GeoServer. For publishing a vector data first of all we need to create workspace and then we need to

add store and then we have to edit certain data source. So that also will discuss in the particular hands-on session.

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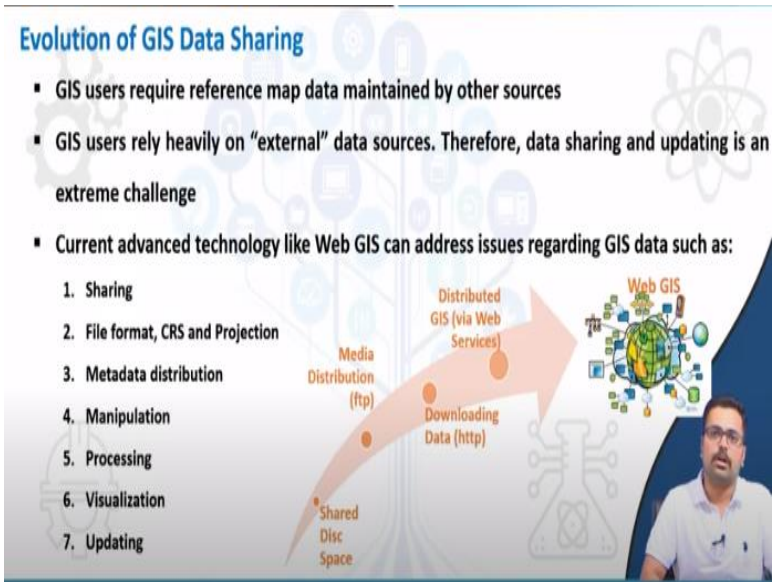

Coming to the evolution of GIS data sharing, as we all know that GIS data sharing in the initial days was done through shared disc spaces and then eventually we had media distribution in the form of FTP that is nothing but file text protocol and then we had downloading data from http. That is nothing but hypertext transfer protocol. And finally we had something called as distributed GIS via the web services.

And as of today we are signing a place where we can see the Web GIS has been taken over all the previous file sharing systems. And now file sharing or in particular, geospatial data sharing is very easy. As you all know, GIS users they require a lot of data sources and these data sources are all not every time it is a free or maintained by one particular website or a domain. It is there in different domains and we need to bring it together.

So current advanced technology like Web GIS has successfully addressed various issues and out of these, you can see the sharing is very easy. There is no worries about the file format or the coordinate reference system and projection issues. So you can do on the fly projection when you are looking at GeoServer or any kind of web GIS platforms. Then metadata distribution is easier.

You can easily manipulate whether it is a raster or a vector data you can easily manipulate it. And processing of spatial data itself has become very easy after the introduction of Web GIS and other technologies. So you can also visualize up-to- date maps, meaning to say if there is any flood hazard map that has been given out by ISRO that can be visualized very soon on your web pages.

So this is also one of the component of Web GIS. And finally updating of various layers is very easy the help of current Web GIS technology.

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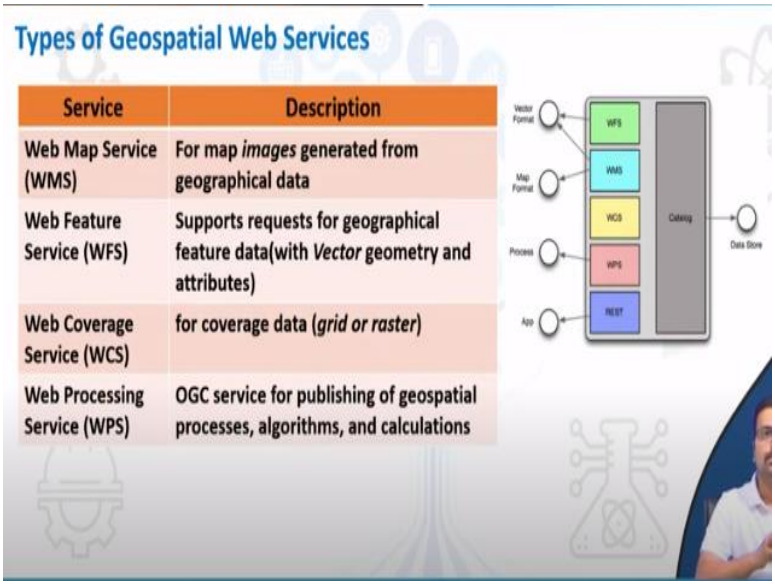

Now, when we are referring to geospatial web services, there are four important kinds of web service. The first one is web mapping service. Here what it does is this service is basically used for generating images from the geographical data. And similarly for the vector we have something called as Web Feature Service. This supports all kinds of geographical feature data, which has a vector geometry as well as attributes.

Then we have something called as Web Coverage Service. So coverage service is usually used for gridded kind of data or also this can be used for raster. And finally, if you want to process any kind of spatial applications or spatial analysis, this can be done with the help of Web Processing Service. So here you can easily bring in the algorithms or the calculation such as the raster calculator, or any kind of geospatial processors.

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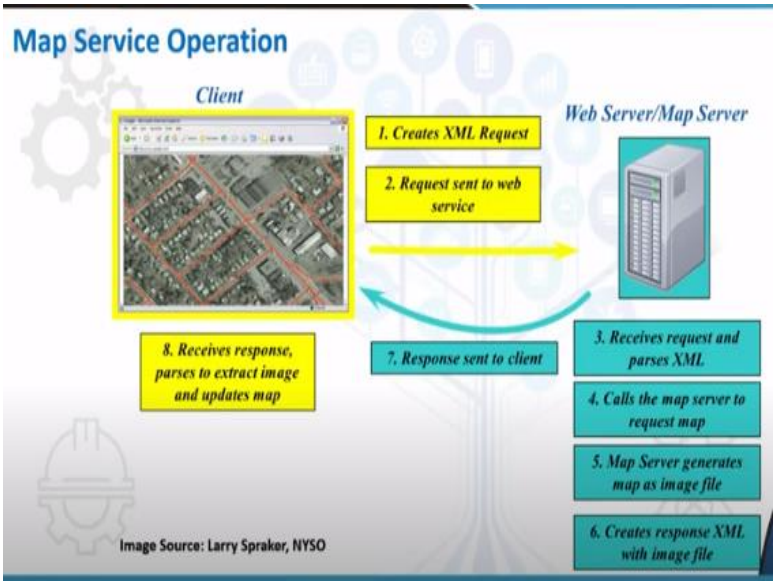

So when we look at the map and service operation, if what we are trying to look here is whatever we did in the previous lectures or hands-on sessions that is we saw the QGIS and it is working. So whatever the processes which we saw, whatever the styling or visualization, we did it in QGIS it is all easily available, and it can be all done in the form of web GIS. So how does this work?

So basically it is more or like it is famous as client server operation. So here what the client does is he request, he or she requests in the whatever the data they need. So it creates an XML request and that XML is sent to the, request is sent to the map server or web server. So web server has huge repository of data.

So that picks up what particular request the user is asking for and then it also goes into the data and searches for a particular data and then calls the map server to the request map so that the requested map and the fetched map from the DBMS is matching. Then the map server generates map as a image file. This is very important. This is where we saw various kinds of services.

So here if it is a image then directly It is nothing but web mapping service. So and then it creates a response in XML with the image file and finally that will be delivered to the client. So this is called as client and server operation in terms of Web GIS.

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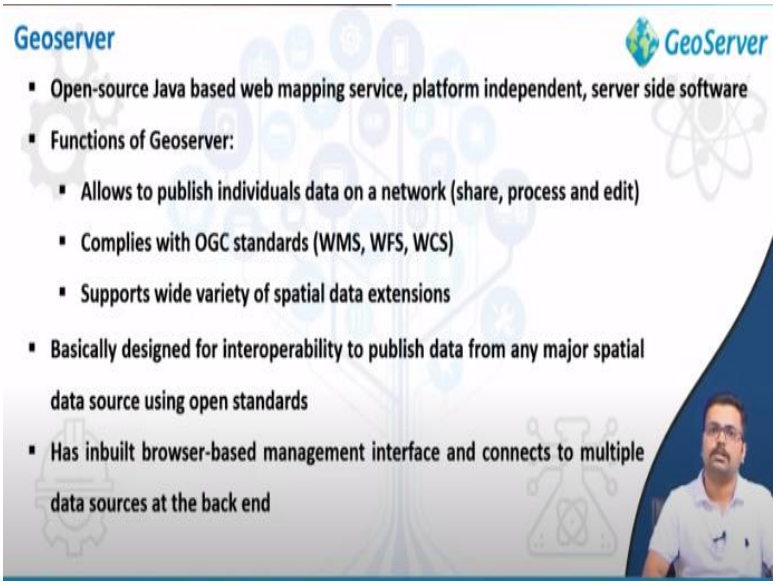

And if you see GeoServer is one of the important Web GIS platforms. It is an open source Java based web mapping service. It is platform independent meaning to say you can run GeoServer on any of your machines be it windows or whether it is Apple or any other machines. And this is basically a server side software.

So the basic functions of GeoServer is that it allows any kind of geospatial data, you can publish it on network, meaning to say you can share. One data if you have created let us take an example of a road, you have digitized the roads of Pune city. So one of your friend who is sitting in Mumbai has to see the Pune city data, then you can just upload that particular shapefile or the vector data into the GeoServer.

And that can be the link can be shared with your friend so that he can download the Pune data sitting in Mumbai. So the process of sharing, processing and editing will become very much easier with the help of GeoServer. And one of the greatest advantage of GeoServer is it complies with OGC standards. We will discuss what is OGC?

That is open Geospatial Consortium of all the three types of the services that is Web Mapping Service, Web Feature Service and Web Coverage Service. And it supports a wide variety of spatial data extensions, like whether it is .shp or .tiff whatever it is it supports. So basically GeoServer was designed for interoperability of geospatial data and to publish data in the form of major open standards.

And this particular GeoServer has inbuilt browser based management interface and system meaning to say whatever the tools you use to see in QGIS those are all available on the basis of browser interface. So which can handle various multiple data sets as well.

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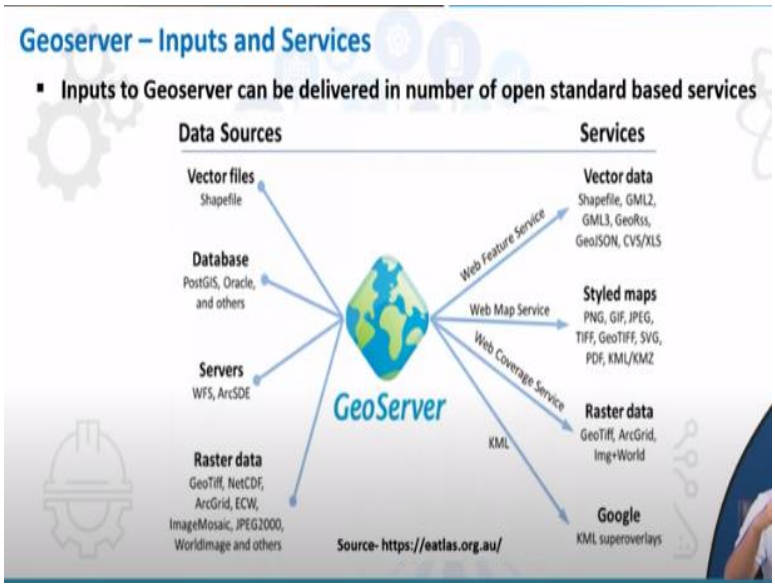

So if you carefully look at the GeoServer, input and various kinds of services, we can easily take any of our maps be it vector data or it is a raster to the GeoServer very easily. It has services of vector data in the form of web feature service. So you can bring in shapefile GML, GeoRss, GeoJSON or you can also bring in dot CSV or excel kind of format here. And you can bring in the styled maps whether it is in the form of PNG JPEG or TIFF anything.

And you can also bring in the raw raster data as such in the form of GeoTiff that is nothing but the Web Coverage Service. And finally, you can also bring in the Google data that is nothing but keyhole markup language that also you can overlay in GeoServer.

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So in the when we are talking about Geospatial Consortium that is nothing but Open Geospatial Consortium. So this is basically a nonprofit organization which encourages the development and implementation of open standards for all our geospatial data. It also encourages open source data processing and open coding and open sharing of the geospatial data. So OGC started a series of web based interoperability standards.

Meaning to say, if you are saving one particular let us say vector data in dot KML then that can be seen anywhere with the open data sharing and also the standards. So OGC standards comprises of more than 30 different formats covering all kinds of vector and raster and any other kinds of maps. So which basically fall in line with either of the any services like WMS, WFS or WCS, etc.

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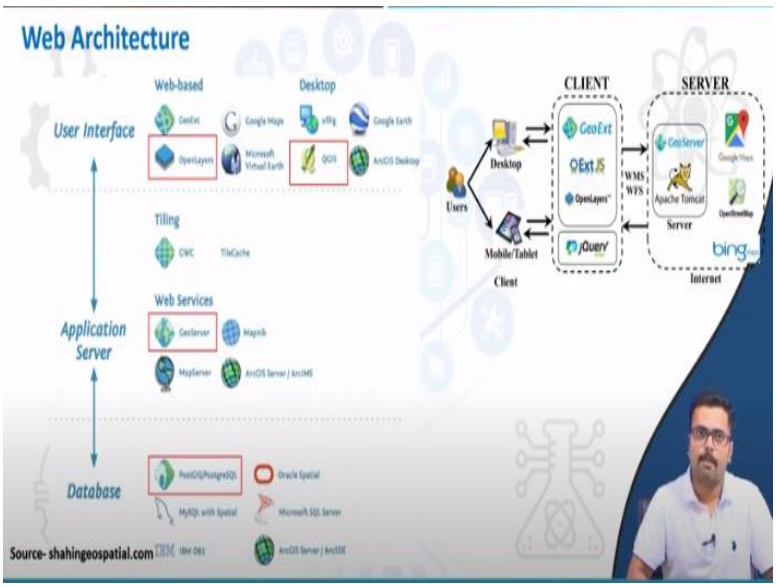

And, if you see carefully the GeoServer is GeoServer's web architecture, it is GUI that is nothing but graphical user interface, application server and database. These three are the main components. The graphical user interface can be two types. One is web based, the other one is desktop based. So far in the previous hands-on sessions, we have seen how the GUI looks in QGIS.

And if you come to the web-based then open layers is one of the major web-based user interface. Similarly on the application side, we have GeoServer. We are going to see how GeoServer works as an application server. And finally in the database, we have PostGIS, PostgreSQL. Also we have a lot of other proprietary databases like IBM or RGIS server.

But here I have highlighted what are the open source or openly available which is available for free, those kinds of user interface application server and database.

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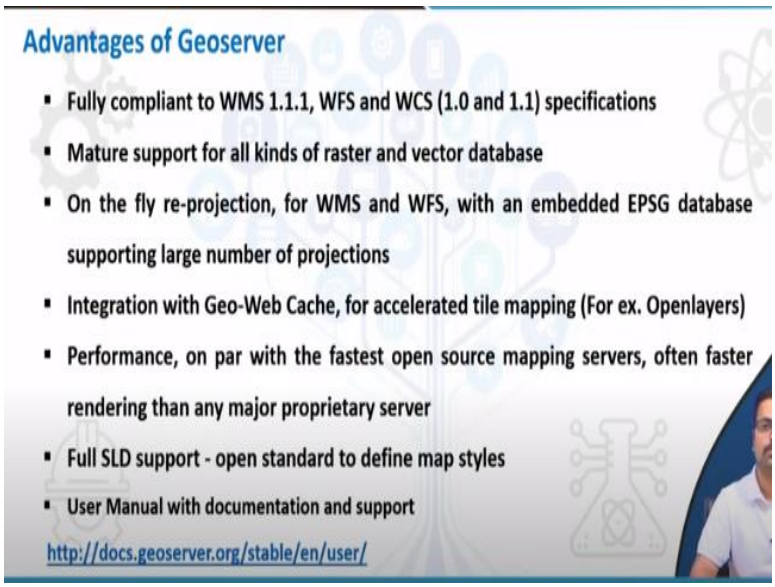

So if we look at the advantages of GeoServer, it is fully compliant with WMS 1.1.1 and WFS and WCS 1.0 and 1.1 specifications and it has a mature support for all kinds of raster and vector data any kind of raster dot TIFF or dot JPEG can be called into the GeoServer and it has on the fly or on the go projection or reprojection. Meaning to say if you have your data in geographic coordinates lat long system and if you want to see it in terms of UTM that is possible.

Because it has a large library of EPSG database. And this can be found within your GeoServer framework. And integration of Geo-Web cache which is **very,** very important for tiling, for accelerated tile mapping. Meaning to say every time when you zoom into a particular area, it would not take much time to load because previously only it will collect all the information at the first time and second time when you try to zoom into that particular area, it will take very less time wherein we can cut down the time.

And the performance is on par with fastest open source mapping servers. Often sometimes we have also seen that GeoServer beats any of the major proprietary servers in terms of rendering or processing. And it has a full SLD support. SLD means style layer descriptor. Any kind of styling can be done that **come** comprises to the open standard. And if you want to see the user manual it is available for the GeoServer in the GeoServer website.

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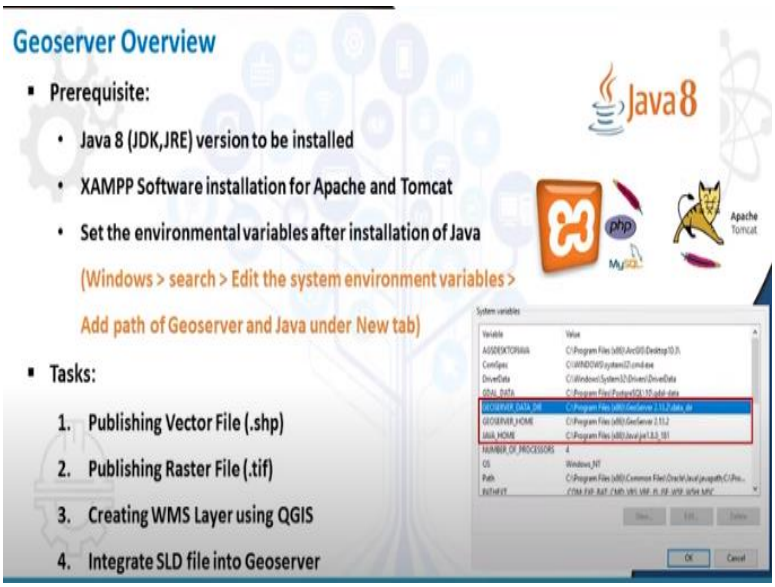

So what are the prerequisites for getting a GeoServer? If you want to run GeoServer on your machine first of all you need to have Java 8 version to be installed and if you are very familiar with Apache and Tomcat you can install it separately or if you are not familiar with that you can install a software called as XAMPP that is nothing but XAMPP. So you can install that software which has already inbuilt Apache and Tomcat.

And once Java 8 and Apache, Tomcat are installed, you are ready to go with the GeoServer. But before that, you just have to make sure that you have to set the environmental variables after the installation of Java, which you can get in the windows search tab. You can just say edit the system environment variables. In that you need to add a path of GeoServer and Java under this particular tab.

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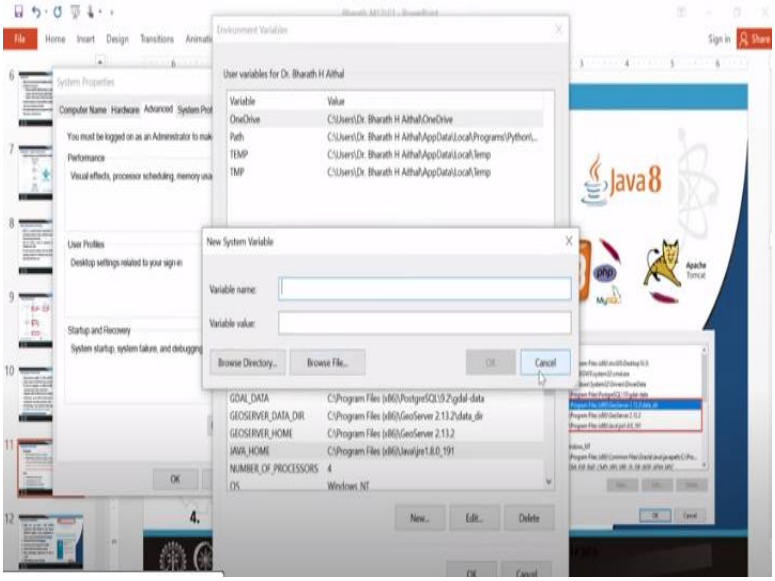

So we can see this here if I go for system variables, system environment variables, just type environment variables, it will take you to the edit system environmental variables. So here you can see if you go to the settings, environment variable settings, here you can see what are different system variables and where your GeoServer data directory and all these things are installed.

First of all, I want to show you where the Java is set up. Here you can see Java is set up in C drive and I am using the version Java 1.8. So like this, you can set up the environment variable. If you have not installed Java and if you are installing Java for the first time, then you can click on new and here you can set the environmental variable and just you can browse to which path where you have installed the Java and set the environment variable or system variable.

So once this is done then you are ready to launch your GeoServer application. So in this particular hands-on we are going to see four different tasks. The first one is how to publish a vector file. And the second one is how to publish a raster file that is in .tif

format. Then we will also see how to create a WMS layer that is nothing but Web Mapping Service using QGIS and how to create an SLD.

That is nothing but style layer descriptor outside GeoServer that is in QGIS. And then how to bring that particular file into GeoServer that also we are going to see.

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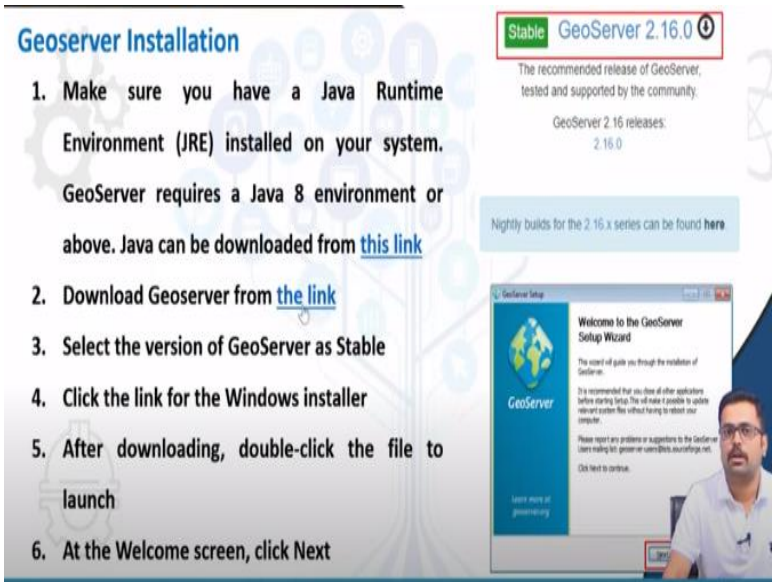

So I will just run through the basic installation of GeoServer. So here first of all, you need to make sure that you have the Java environment. You can download the Java from this particular link or Java website. And once the Java is installed, then you can also go for the GeoServer website.

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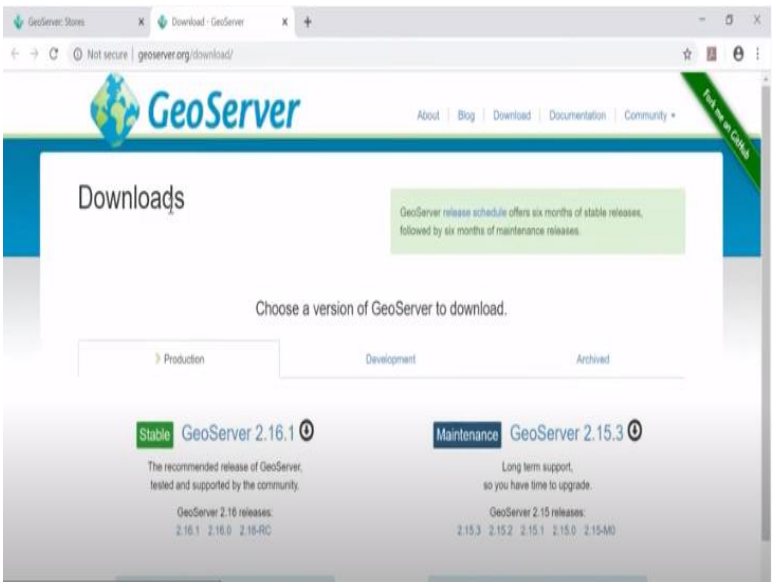

So here I will just demonstrate how the GeoServer website looks. This is the GeoServer website. So here you have GeoServer 2.16.1. And this is table. So you need to download this particular application. Once the application is downloaded, then you can go directly for the installation. And here, when you click on that particular file GeoServer Welcome Wizard opens. You have to press next.

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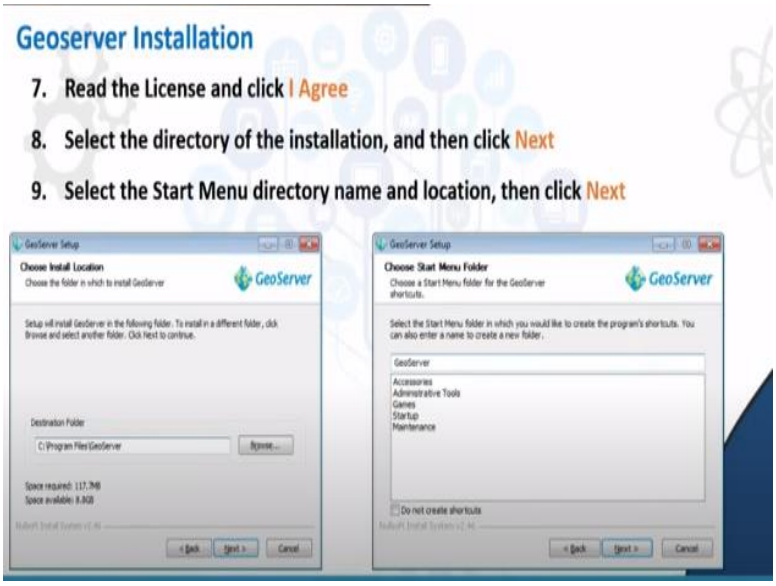

And then once you give the designation or destinated folder, in C drive or D drive or any of your drives, you just click on Next.

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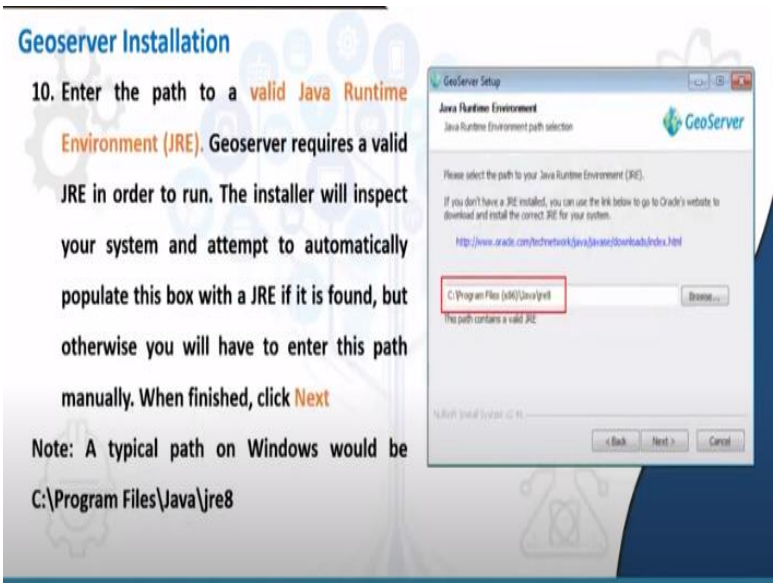

And this will take you to the main GeoServer installation. And also it will ask for the JavaScript or where the Java environment is located. You just need to browse to the C directory and just browse to the folder where you have kept the Java JRE 8 file.

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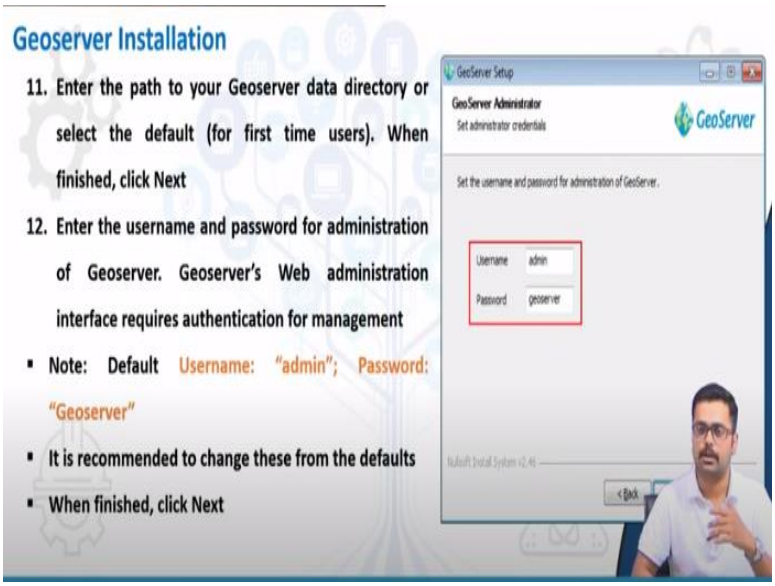

So once this is done then you can it will take you to the next tab wherein it asks for GeoServer username and password. So by default, the username and password will be admin and Geoserver. If you want to change you can change this username and password as well, it is recommended to change.

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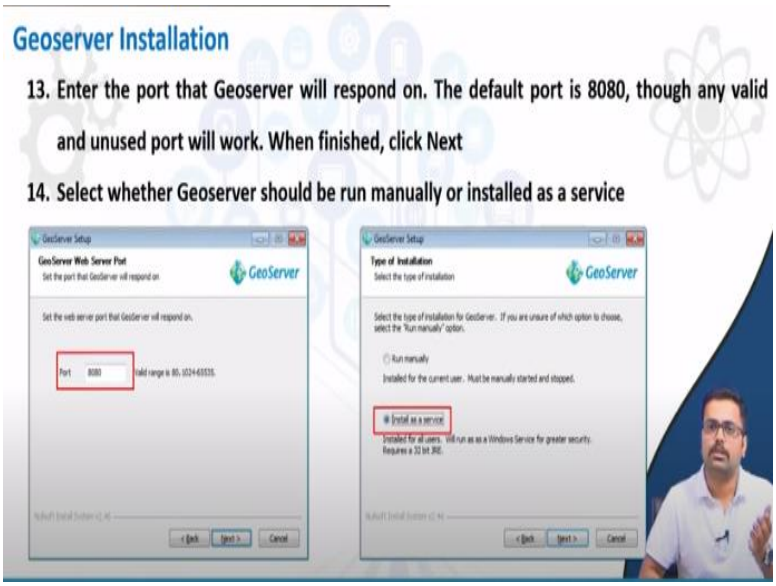

So once this is done you can just press on finish and it will take you to the port tab. Here you need to specify on what port you need to run the GeoServer. So by default it can be 8080 or 8008 or any of the port which you like to give you can give it. So once that is done you can just select the option it is called as install as a service.

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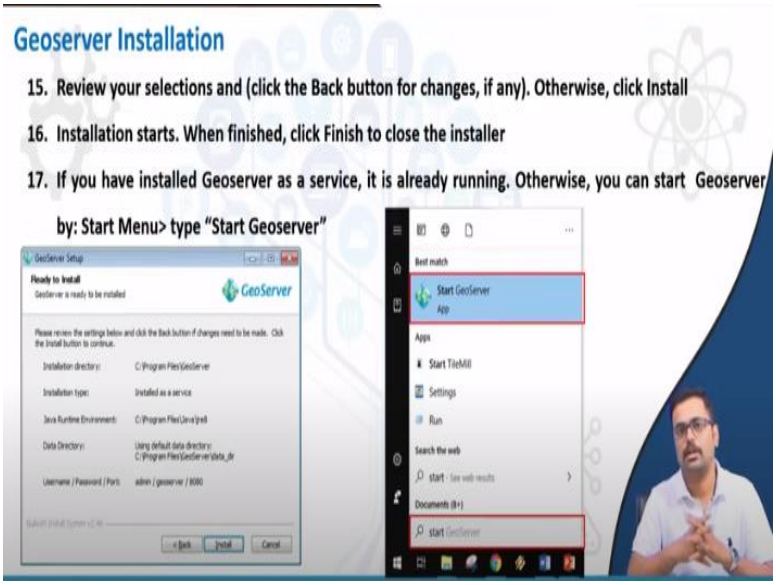

And then you can press next and then say install. So your GeoServer will start installing. So once all these kind of installations are done, you can just finish it and before starting the GeoServer you need to go to Start.

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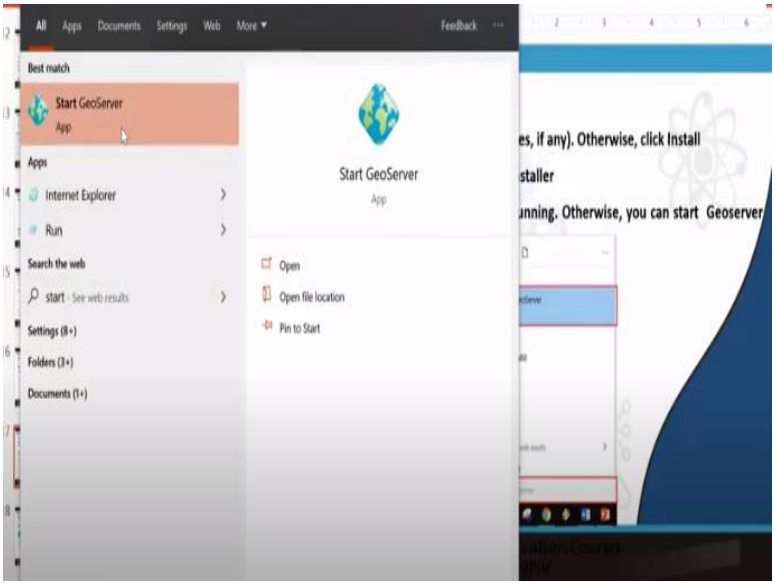

And here, you just need to type start GeoServer. So you can see here on to the left there is start GeoServer app, you have to click on that.

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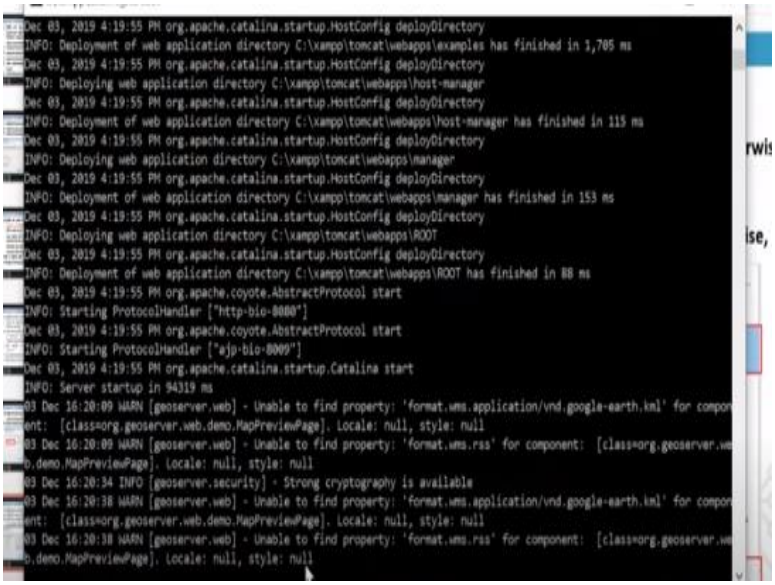

So once that is clicked on, you can see here, C Programming command tab will be open. And here at the backdrop the GeoServer will be running. So once that is up and active, then you can launch the GeoServer.

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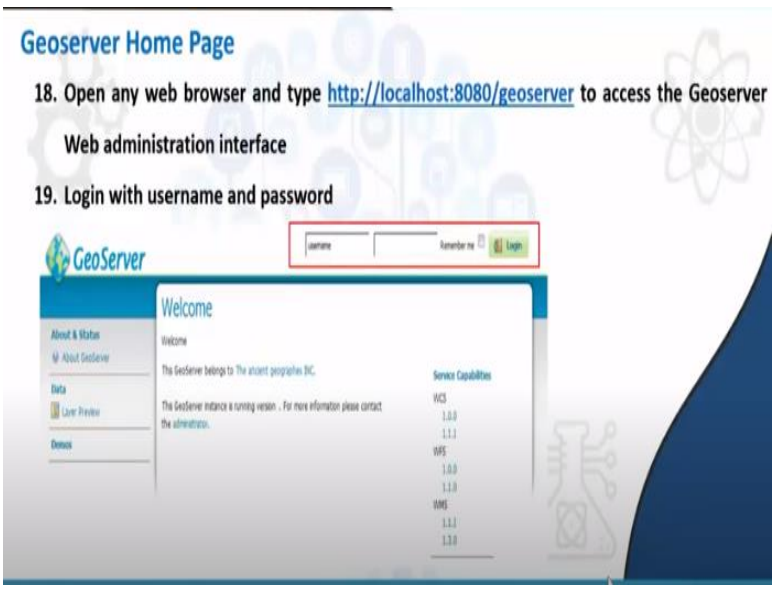

So this is how the GeoServer homepage looks like. Let us go to one of the web browsers and see how the GeoServer homepage looks like.

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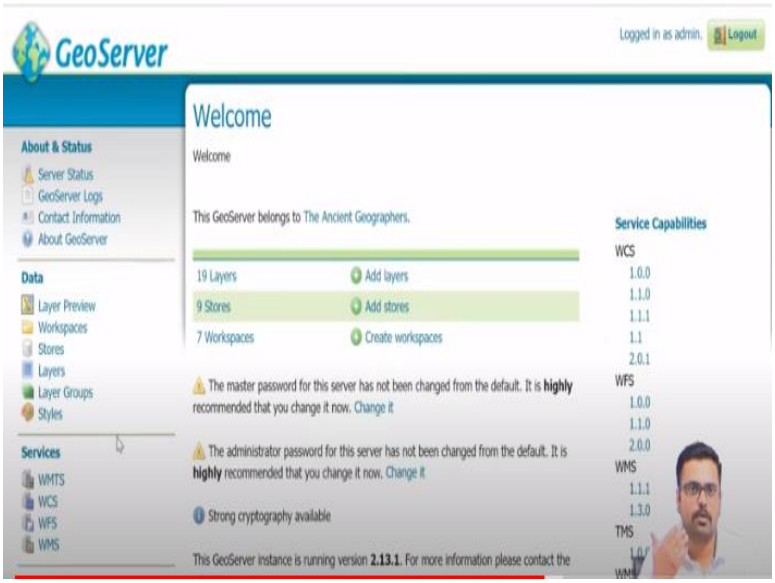

So this is the GeoServer homepage. You can clearly see as previously mentioned, you can directly enter the username as admin and password as GeoServer. And then you can say login. So once you log in into the GeoServer main screen, you can see various kinds of menu. So this is the menu bar. Here you have about and status, that is regarding the server status.

And then you have the data section which is very important. We are going to see what are the different kinds of data and how we can going to create a new layer, how we can create a new workspace, how to create a store, how to add a store, and how to create layer groups and finally, how to create various different styles. Then you have services that is nothing but the web mapping service, feature services etc.

And you have the global settings also. Tile caching can be used for requesting open layers maps. And then at the last you have various different kinds of security, wherein you can also change the passwords from this particular tab. Now let us start with our task one. Task one of our GeoServer is to publish a vector file into the GeoServer interface. Now in the previous session we have seen that we had various vector layers.

So let us try to bring in some of the vector files into the GeoServer. Now in the previous sessions we have seen one particular vector file wherein we had clipped the road according to Mysore district file. So how to add that. Before adding the vector first we need to create workspace.

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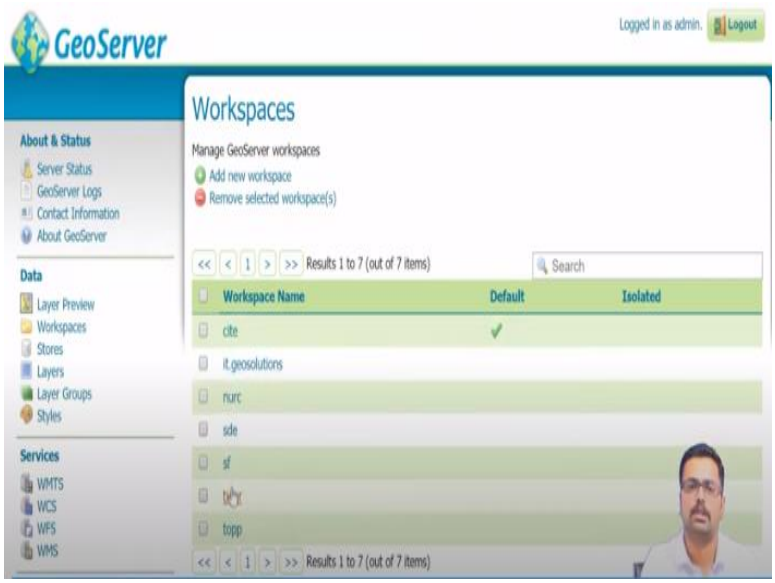

So I will go here on the workspace to the left. So once you click on workspace, then you have an option called add new workspace. Now before creating workspace you can also see here there are lots of other workspace, these are the default workspace. And if you go to the GeoServer homepage or the layer Preview.

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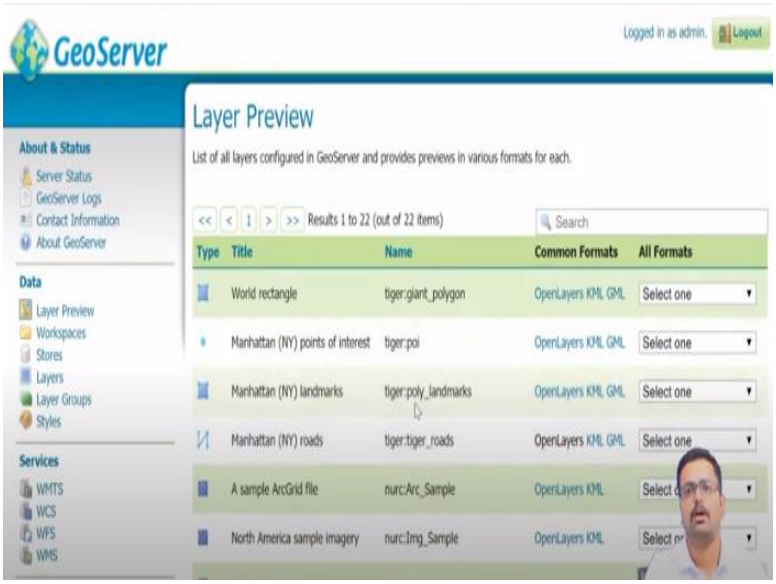

So here you can see, there are a lot of already existing layers. These are the default layers. If you want to just see this, it is possible just you can go on the common formats. Under that you can click open layers.

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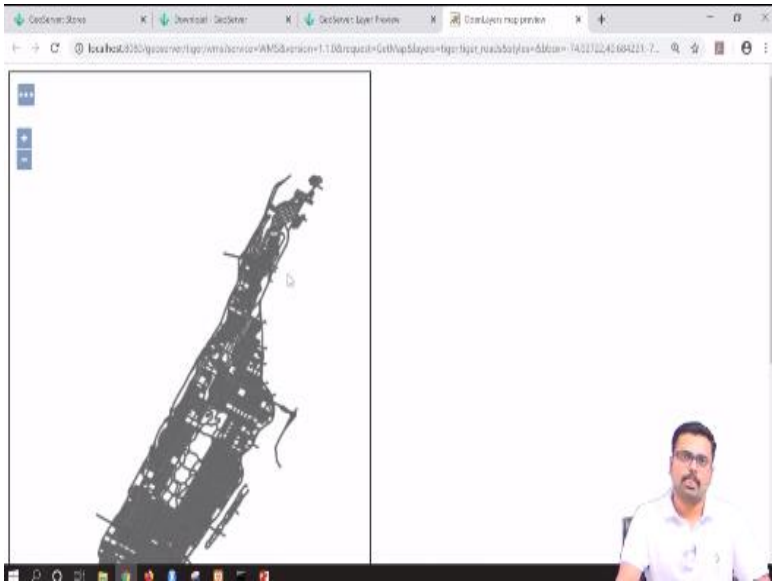

So it will take you to another tab. And here you can see this is New York roads. So this is already existing in GeoServer. Similar to this, let us now see how to add our own road layer. So for doing that I am going to workspaces. So here I will add new workspace.

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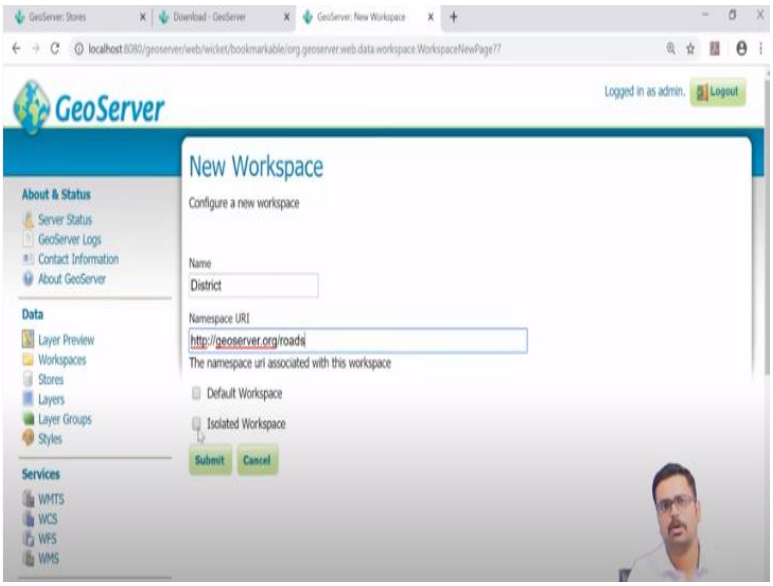

Here it is asking for a name. I will give the workspace name as district. I have given it as district. And it is asking for the URL. URL you can give it as http colon and forward slash geoserver dot org forward slash roads. So you can give any of the URL, it is not necessary that it should be the same you can give any of URL. Once you have given name and URL you can say Submit.

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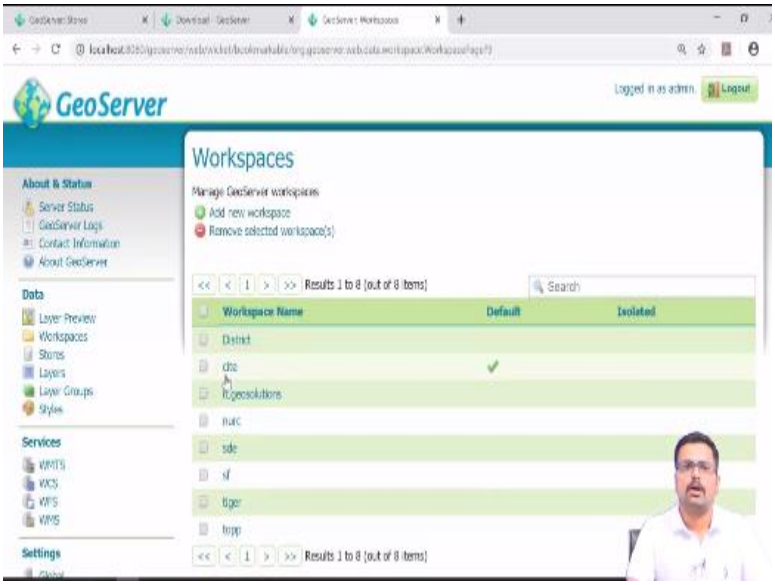

Now you can see under the workspace, our district workspace has been added. Now the second step is to create a store. A store can have all kinds of raster or vector or any other kind of geospatial data. So and the hierarchy is first is workspace. Under workspace you have a store and under stores you can add layers. So let us now see how to add a store.

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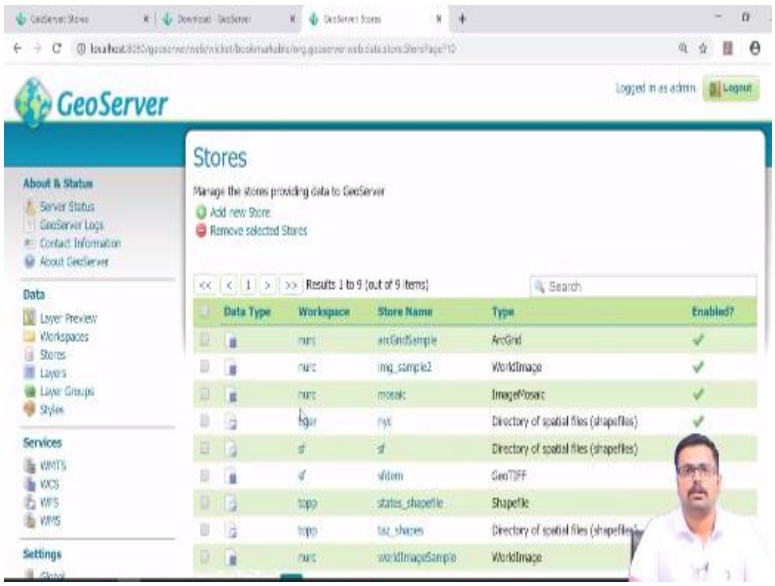

When you click on the store to the left it will go to the store tab. Here you can see by default, there are already several stores existing. Here I will go to add new store.

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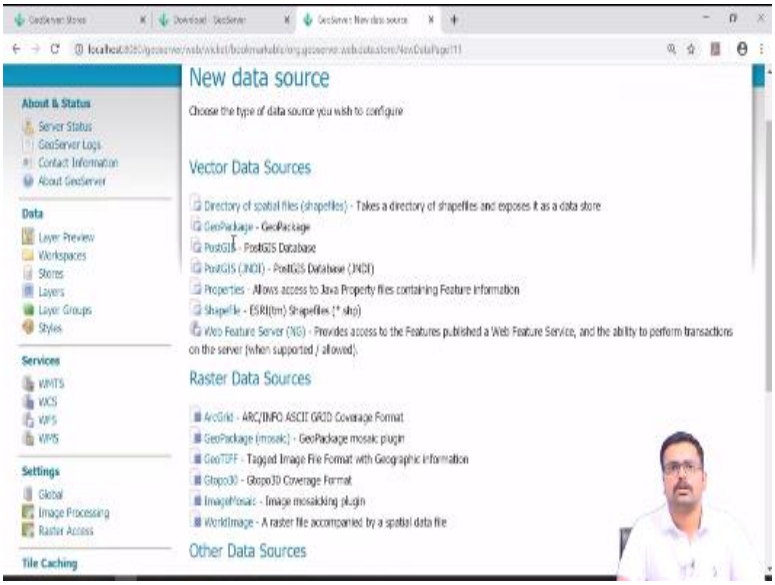

Now you can see new data source, maybe it is a raster data or a vector data or any other kinds of WMS or WMTS layers. So initially, what we thought is to upload our Mysore district road file. So that is basically a shapefile. So I am clicking on dot shp shapefile.

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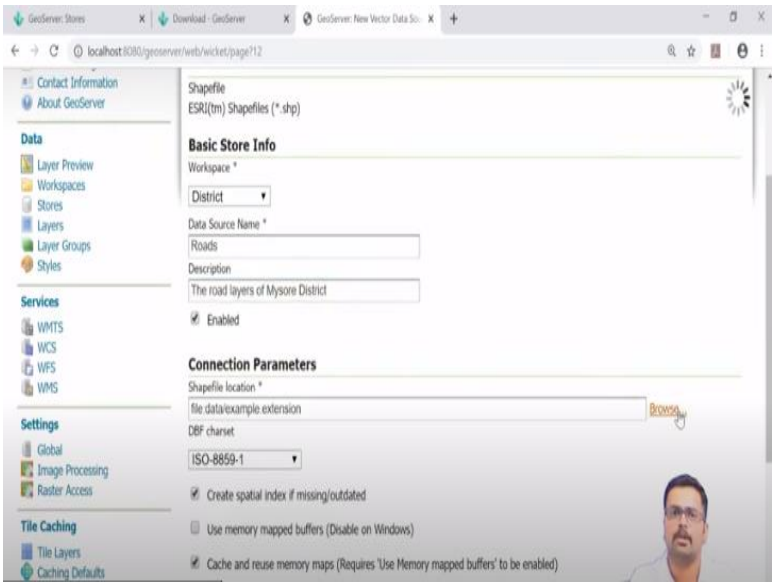

So it will now take you to new vector data source. Here you need to specify certain basic information. The workspace is district, I am selecting district. And data source name is nothing but we are going to enter roads, I am giving it as roads. Description, it can be the road layers of Mysore district. This you can give any description whatever you like you can give it here.

And then connection under the connection parameters you have to browse to the location where this particular shape file is kept. So here shapefile location I will go to browse.

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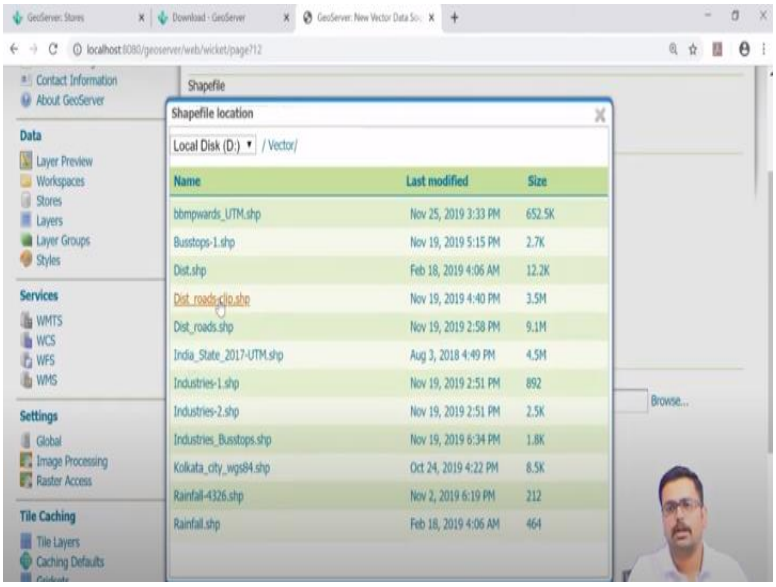

In the D drive I can directly go here and select D drive. So now you can see the vector has come. If you can go inside that, here we can see district roads clip. So this is nothing but the Mysore district roads which are clipped according to the district boundary. I will just take that and then say save.

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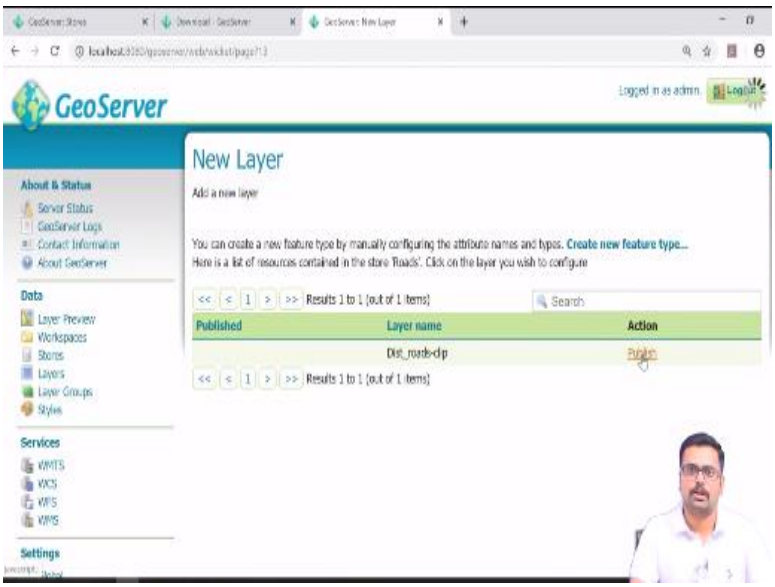

So now you can see the new layer, the new vector layer has been added to our GeoServer interface. If you want to publish that, you can click on action under the action, you can click on Publish button.

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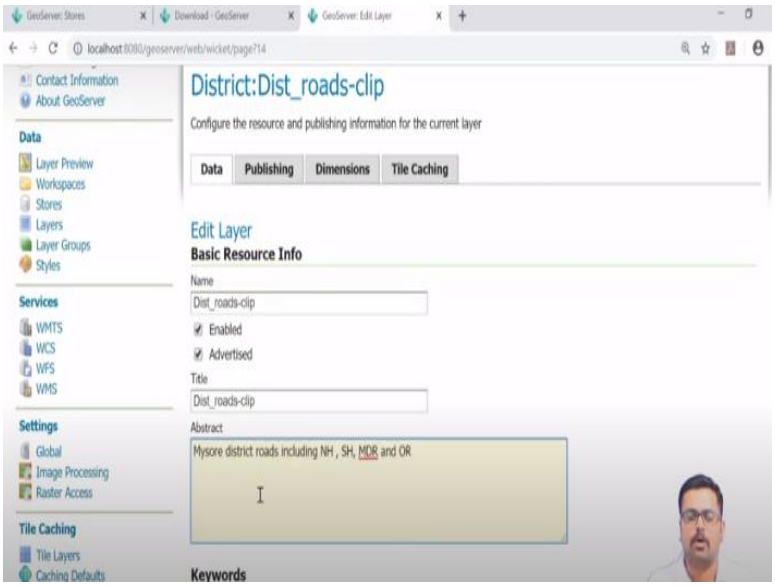

So once as soon as you press the publish button, it will ask further information. So here, in the abstract section, you can just type some of the information about that particular roads. Here I am saying Mysore district roads including NH SH MDR major district roads and OR that is nothing but other roads. So once you give this kind of abstract then the next important thing is to compute the boundary.

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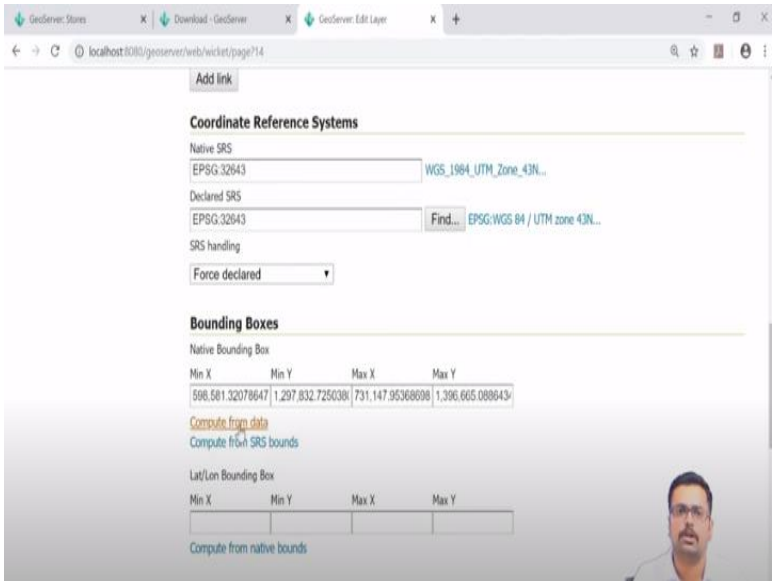

Meaning to say you have to go down and here under the coordinate reference system as you can see default it is taking 32643 because Mysore is belonging to 43 UTM zone north. And here in the next section that is bounding boxes, you have to give compute from data. That is you are specifying the minimum latitude and maximum

latitude. Similarly, you are also specifying minimum longitude and maximum longitude.

So these are nothing but the boundary extents. So you can just say compute from data so that it compute everything from the data available. Next lat long of the bounding box can also be from the native bounds, you can click on that.

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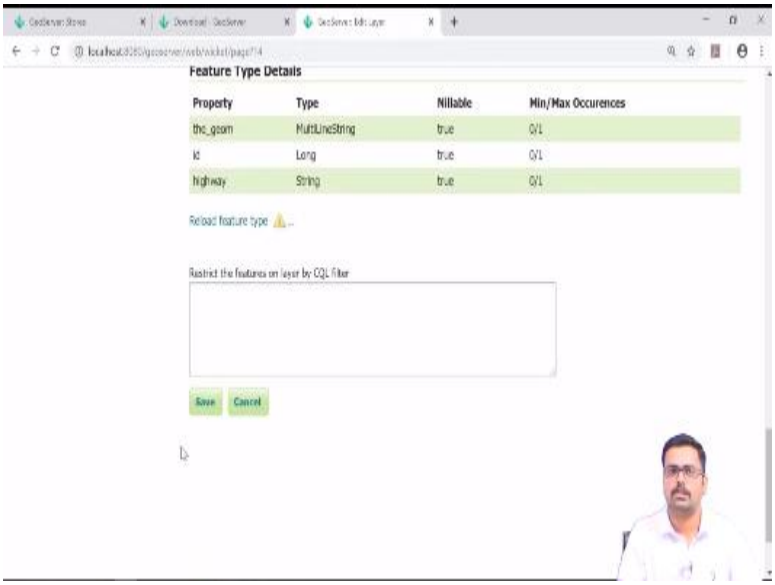

So once this is done, these are the basic information. Then you can say save.

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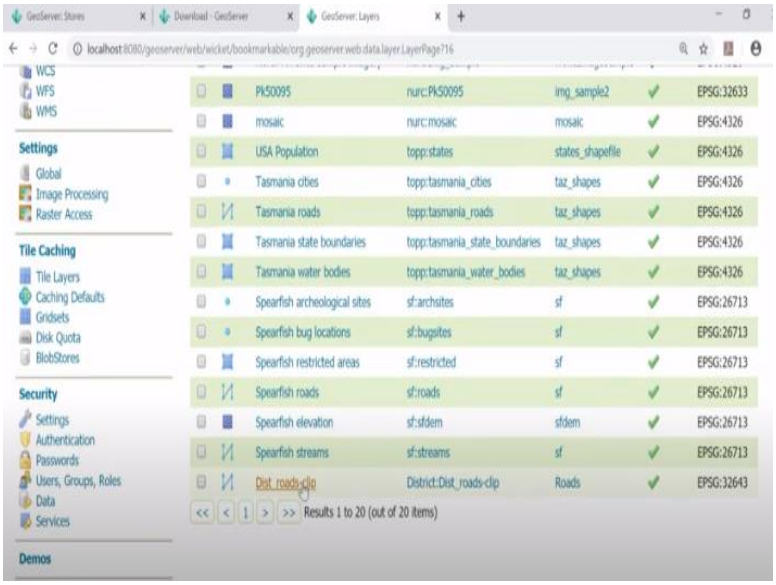

So now in the layers tab, you can see our under the district workspace, district roads has already appeared. Now at the last what we are going to see is how to preview this particular layer. So I will just click on the layer preview and here you need to select

that particular layer which we added just now. If you just go down you will see district roads clip. So here you can click on Open layers.

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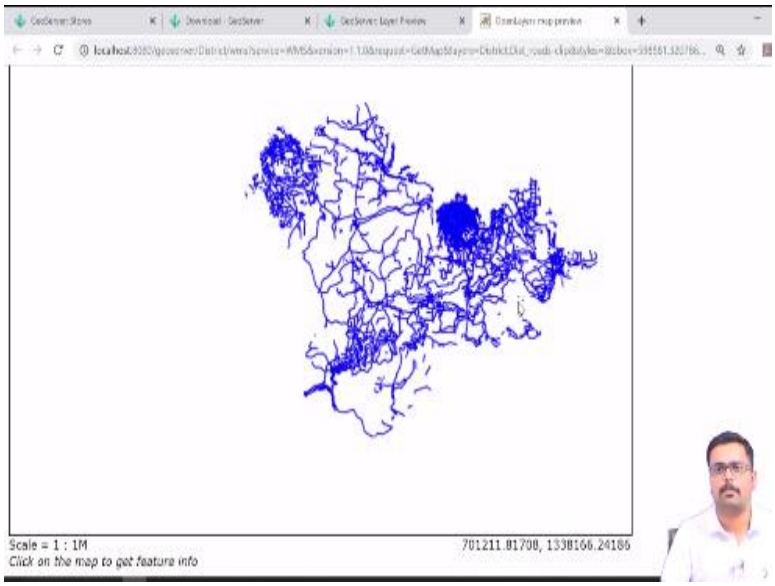

So this is our Mysore roads which is cropped according to the district boundary. So here at the bottom also you can see there are information that is nothing but the coordinate information in terms of UTM so meters and to the left you have scale. Now suppose let us say if you want to take this map to one of your websites, you can also do that by copying this particular address.

How to develop this in the web map, we will just see a small demonstration in the next class. So this is how we add a particular vector layer into GeoServer.

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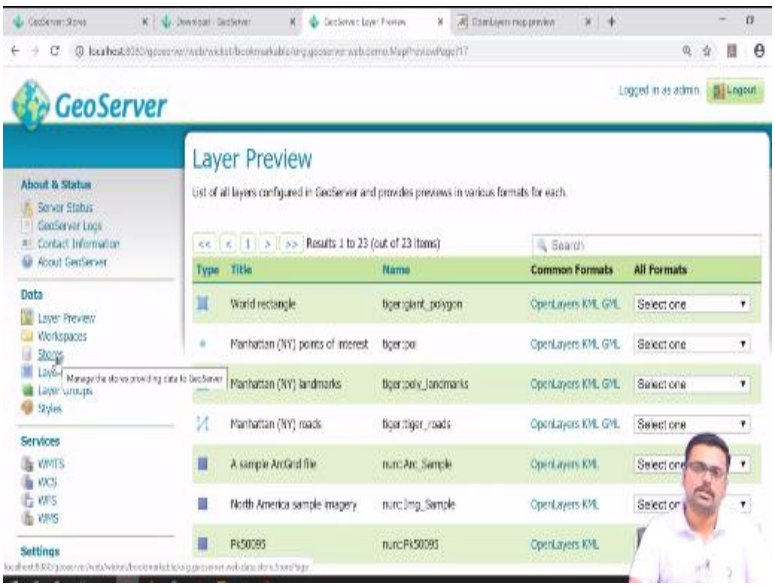

So to summarize, what we learned today is, in the GeoServer, we saw the layer preview, workspace, how to create a workspace, under the workspace how to create a store and from the store how to call in a vector or how to publish a vector data file is what we saw today.

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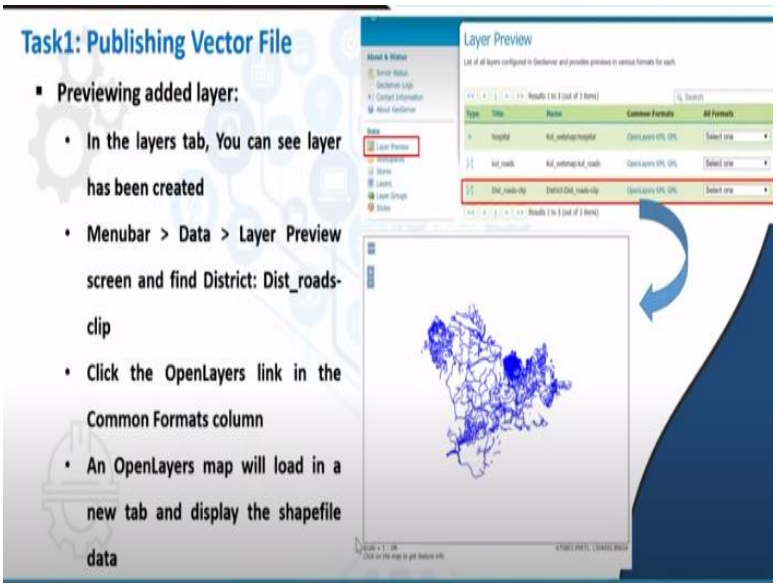

So from this, we also **we also** saw the vector **public** publishing the vector data that is nothing but the district roads.

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And initially, we started this class with data sharing. How the data sharing has emerged from disc space to distributed GIS, geospatial web services such as Web Mapping Service, Web Feature Service, Web Coverage and Web Processing Service. And we also saw GeoServer as the open source Web Mapping Service. And the one

of the important characteristics of GeoServer is it is confining to Open Geospatial Consortium standards.

And we saw the web architecture in which we had GUI that is nothing but graphical user interface, server, and a database. And finally, we also saw GeoServer advantage, how GeoServer sometimes it outperforms the proprietary servers and how various layer integration can be done. So we also saw installation of GeoServer. One basic thing is you should remember before running GeoServer you have to install Java, Apache and Tomcat.

And in the practicals we saw how to publish a vector data, creating a workspace, creating a store and how to preview the layer. So in the next session, we will see how to publish a raster data and how to integrate a style layer descriptor. Thank you very much.