Software testing
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Lecture – 56
Testing of Mobile Applications

Hello there we are in week 12. Towards the end of the course kept week 12 open and I had asked suggestion from course registrations of what you would want to know about testing, and a few of you replied back in the form saying, please give us an overview of mobile applications testing. So, this lecture is oriented towards that, you I will give you an overview of mobile apps testing. Like all other testing fields this is heavily domain dependent, tool dependent, and given in that we are in the last week of the course and the focus of the course has been on algorithms, I will restrict myself to giving you a reasonably thorough over view, but we will not go delve into the details. So, this is a lecture on testing of mobile applications.

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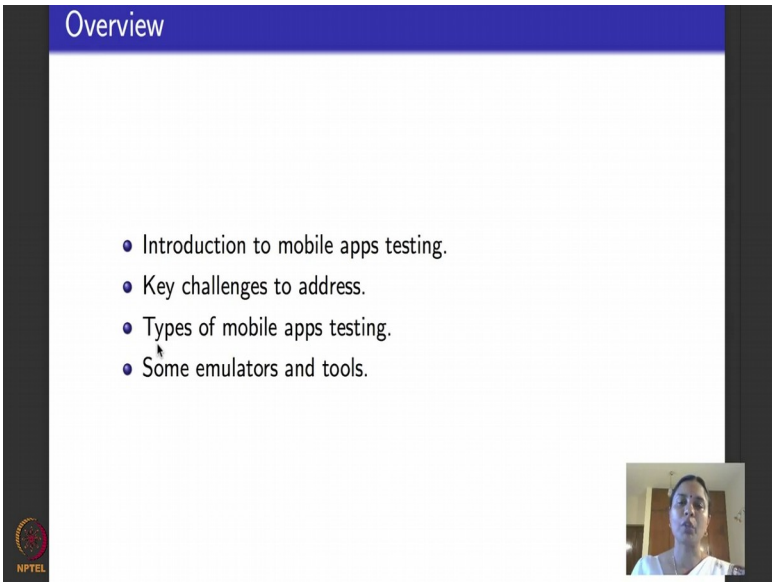

So, here is what we are going to do in this lecture, I will introduce you to mobile applications testing. We will understand what are the key challenges that is be that is being addressed when it comes to testing of mobile apps and what are the various types of mobile apps testing.

Mobile apps testing is based on entities called emulators and tools. So, I list lend the

course with giving you an introduction of some of the good emulators that are open source, that I know about feel free to try them out if you have your mobile app to test.

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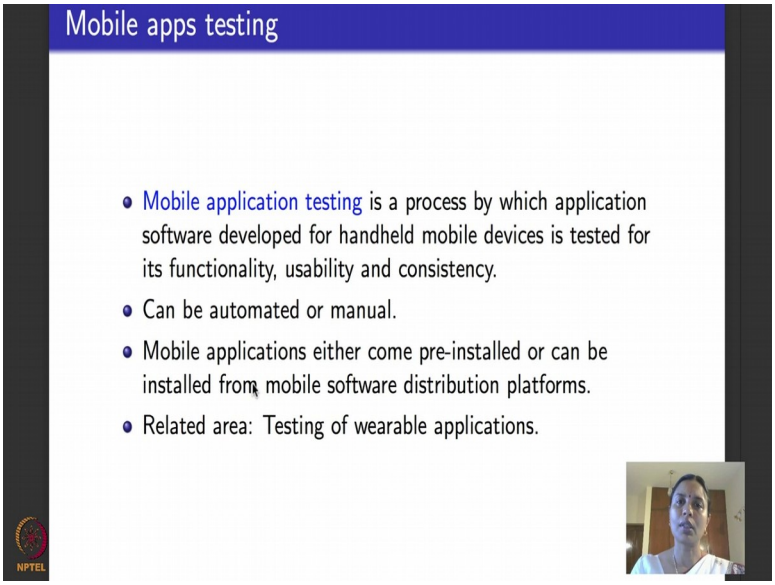

So, we begin with an over view of mobile apps testing, the challenges in mobile apps testing. So, what is a mobile application testing? So, like any other piece of software it is yet another software program. It is written in a particular programming language, meant to run a particular operating system, takes user inputs, produces outputs, it is like any other piece of software. But it is a mobile application, which means it is the software that is meant to run on these hand-held devices on a particular platform given by the mobile device, tuned to a particular operating system which is obviously, not as big as a large server or a desktop application.

So, mobile application testing is a process by which an application software like an app that is developed for hand-held devices is tested, for all the features. It should do what it is supposed to do, which is basically functionality and because it is mobile app it is usability factor must be very high, because it is important for the success of the app and it should be consistent. Consistent in the sense that it should be consistent across a Android platform, versus a windows platform versus a IOS platform also. Mobile application testing, like all other testing, can be automated can be manual also. Mobile applications, they are either pre-installed when you buy a particular mobile phone or device or they can be downloaded and installed from any of the mobile software

distribution platforms.

One of the biggest platforms that we are aware of is Google play. A related area of testing is testing of variable applications which are this fit bits, Google, apple watch Google glasses. All these wearable devices, which also have elementary computing power. Please note that we are not looking at testing of wearable applications, but some of the things that we will see today is also relevant to testing of wearable applications.

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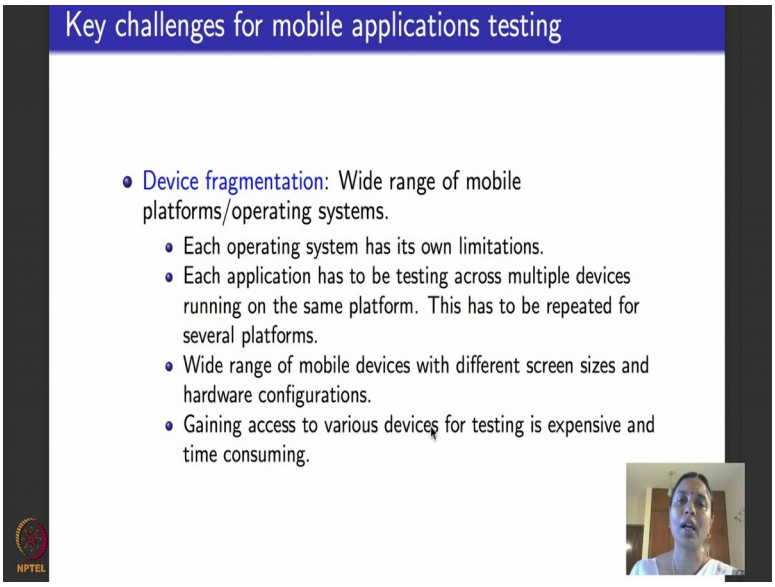

So, we will begin with what are the challenges when it comes to mobile applications testing. So, as I told you a mobile application is another piece of software written in a particular programming language. So, it goes through all the stages of development; unit testing, software integration testing. For unit testing software integration testing, you can do all that we did in the past. You could model it as a graph, you could use logical predicates, you could use mutation any of the things that we learned can be used.

When it comes to now after integration testing, we are talking about system level testing which is an app for working on a phone, after being downloaded and installed and being made available on a phone, which is system level testing for a mobile application. That is what we are going to focus on. So, when it comes to the system level properties or system level testing of a mobile application, what are the key challenges that are there? The biggest problem is what is called is device fragmentation problem in this area. So, what is it mean? It basically means that there are so many mobile phones right, so many

different mobile phones, very very expensive phones very very cheap phones. Phones that are feature rich, phone that have a good camera, phones that are very cheap and so on. Huge range of operating systems, platforms and phones. So, the problem is each operating system has it is own limitations and each application that I develop, right. If I have to develop a particular app it could be a gaming app, it could be something, it has to work across platforms. There are of course, apps that are specifically tune for working on an IOS or an Android. But most of the common apps that we develop we expected to work across platforms, across operating systems and it has to be tested across multiple devices running on the same platform. If I take android which is by and large the most common mobile platform mobile OS, there may be a 100 different kinds of devices, that use android each with it is own limitation and capability. So, a particular app needs to be tested across each of these devices, the other big problem is when you say you have to test particular app across each of these devices, a difficult to implement strategy would be to go and buy that device.

Every day there is a new phone coming in the market, how are you going to go on buying devices? If you have a particular app tested across each kind of device even across manufacturers, there are so many different phone manufacturers, it is very difficult to actually buy the phone and test it. So, that is why we resort to these things called emulators, which we will see later in this lecture. So, each of these mobile devices what are their problems? They have different screen sizes, different resolutions, they have different memory, different hardware capability, different battery capability, everything is different in each of them.

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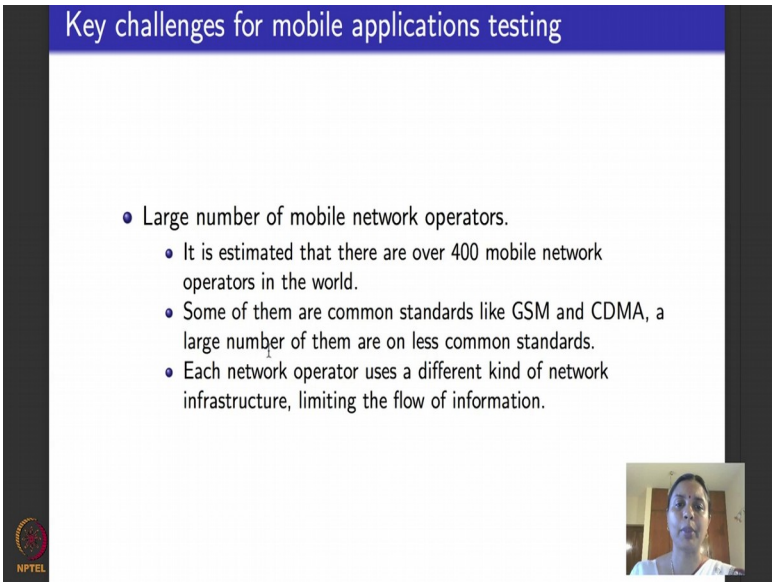

So, the next big challenge for mobile application testing is the very large number of network operators. It is believed that there are about 400 mobile network operators across the world. It looks like a small number, but from the point of view of testing, it is a large number. Some of them use common standards that you might be aware of like GSM, CDMA and all that, but if you see a good number of them are also on less common standards.

So, when somebody operates a mobile network, it could be an Airtel or it could be a Jio or whatever it is if that company is using a common standard, then you say I test the mobile network as per that standard. But a good number of the network operators use less common standards. So, across the networks that the operating you have able to be able to test your app, they use a different kind of network infrastructure. So, there is a challenge about how information flows from one network to the other, all these things matter a lot.

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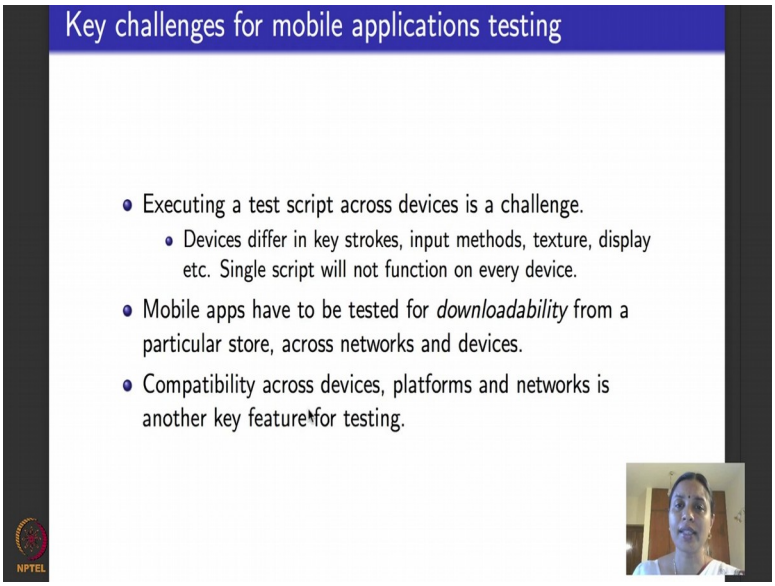

So, the next set of challenges are, as I told you, executing a, actually executing; suppose you have a test case that is developed and packaged as a test script, then you ready to test. So, you need to be able to execute it on a particular device. In a desktop it is fairly common, if you have a Windows desktop or a Ubuntu desktop, you can go ahead and write scripts configure tool like JUnit for example, to write test scripts, but that is not the same when you are executing a test script on a mobile phone.

Why is it not the same? Because each different kind of phone or a device differ in several things, they differ in their keystrokes, their input methods, their texture, their display, you cannot write a single script that will ensure execution across all phones even if the platform or the OS is common, it is very difficult. The other thing that is very specific to mobile apps, like web apps also, is that, they have to be tested for what is called and download-ability. From a particular store, if they are available let us say from Google play store, then it has to be down-loadable across networks across devices. So, that is a challenge that is very specific to mobile phones. The other thing that people test is what is called is compatibility which we discussed here right in this part. You have to be able to ensure that a particular app if you claim it is compatible across devices platforms and networks. So, these are the challenges.

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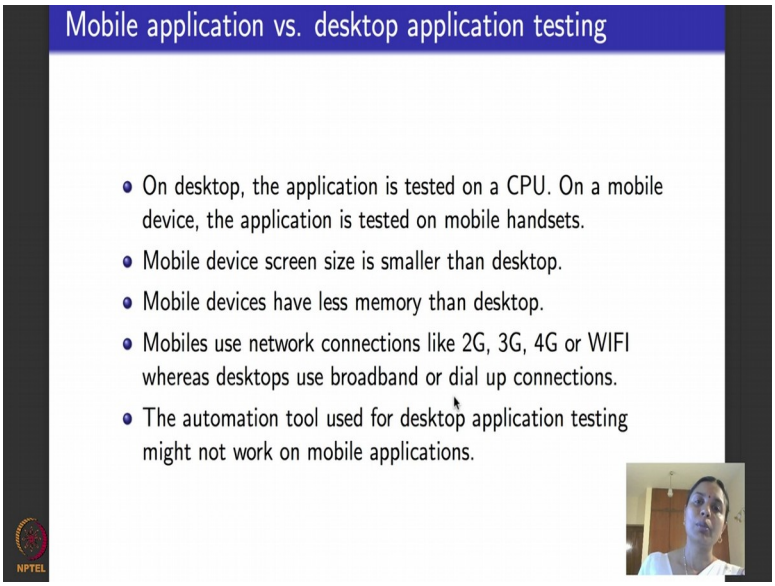

So, before we move on and look at how typically, what are the typical means system level features that mobile apps are tested for, let us look at what are the biggest differences between the mobile application testing and desktop application testing. On a desktop, the application is tested by using a CPU. We all know that. But on the mobile phone the application is tested on mobile handsets. Mobile device screen is usually much smaller than a desktop screen. So, as I told you test script execution across devices is a challenge. Similarly mobile devices have lot less memory than a typical desktop, that is also a challenge, apps have to be developed for working within that memory. So, memory testing is a very important feature, we will look at that also. Mobile uses, I told you different connections, 2G, 3G, 4G Wi-Fi whatever you want, desktop they use broadband or dial up or maybe Wi-Fi, they do not use anything else. Automation tool for desktop application testing will not work on mobile application, because the test script that is written for desktop is not easy to replicate to work on different kinds of mobile devices.

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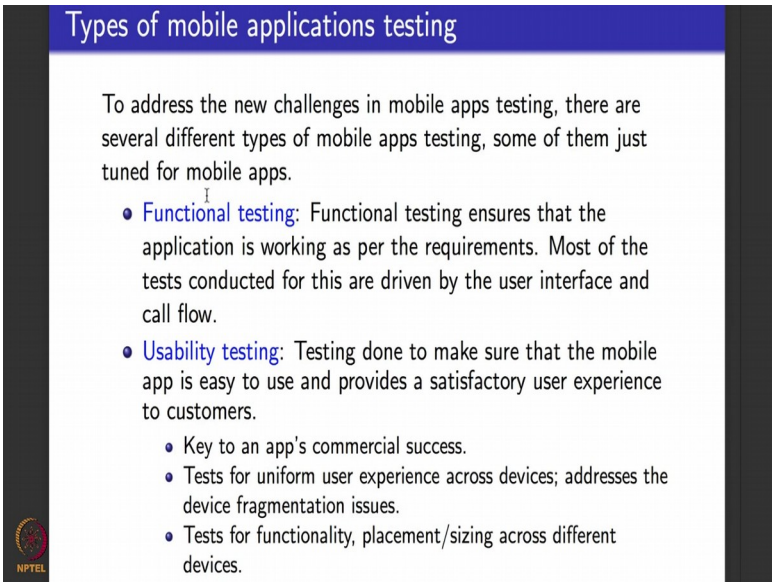

So, what are the main types of mobile application testing? So, when I go and talk to you about types of mobile applications testing, please keep one thing in mind, a mobile app is a piece of software as I told you a little while ago. So, it has to be written in a programming language, unit tested, integration tested and let us say you have it ready. Now I am considering system level testing, which is I am taking the app as a whole, packaged, ready to be put in a mobile device and tested for various aspects. So, that is the stage I am and when I discuss types of mobile application testing, that is what I am talking to you about. So, the usual thing we always do for every kind of software which is functional testing, we also do for mobile application.

What is functional testing do, it ensures that the application is working as per the specified requirements right. It may provide this main functionality; let us say you have an app that talks about the traffic, that it does tell you accurate traffic correctly. Most of the test conducted for this are driven by user interface and call flow. As I told you can use any standard testing tool to be able to functional testing. One another important system level testing for mobile app is that of usability testing. What does the word usability tell you? It is one of the quality attributes this is make done this is testing that is done to make sure that the mobile app is easy to use, and it provides a satisfactory user experience to customers. Most of us react that way right we say I do not like this app because it is UI is not good. UI is user interface, we say I do not like it is difficult to use, it is not pleasing, I don't like it and there is also a problem of native language UI right,

the same app that works here let us say a bank that operates across several different countries.

Let us say you know it mobile app for that bank which provide similar features has to be in English for a particular country, and has to be in the national language for another country, let us say it could be French or German or not it can even be in Hindi right. So, the same app has to be usable. Usability is it is to be easy to use it should be usable at all, and not really easy to use user was using it should be satisfied with the UI. So, this is very important because it is one of the key factors to an app's commercial success, and it should test for uniform user experience across devices. You cannot claim and say that I haven app that looked very good only on IoS, it does, its UI does not look very good on android, that kind of apps do not sell. It also, usability testing also tests for functionality. Because it is functionality of a mobile app is typical though interaction, it tests for placement and sizing that of the various things across devices.

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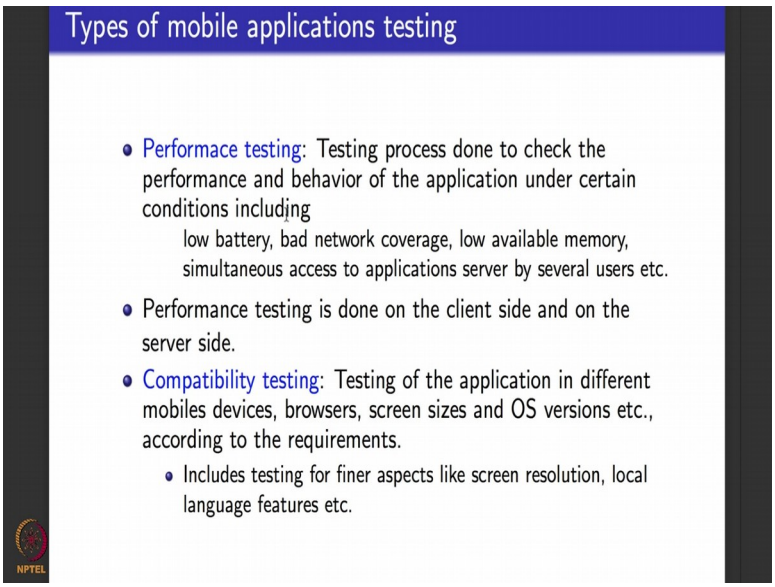

The next kind of important system level mobile app testing is performance testing. Here it does as always, testing, performance testing is testing done to check the performance and behavior of the application under certain conditions. What are conditions specific to mobile phones? One common conditions specific to mobile phones that we all would have encountered is low battery. At the drop of the hand mobile phones run out of battery. The next common problem that we all face is bad network; poor network

coverage; low memory available because there are several other applications running in parallel right, so that several others were simultaneously accessing the server. So, these are places that can slow down the performance of a mobile app.

So, performance testing for mobile applications focuses on these specific issues. It has be done both on the client side, which is a particular phone and on the server side which is the server where the application resides on it keeps and fetches the data. Like for example, of Facebook mobile app needs to talk to the Facebook server, Whatsapp mobile app needs to talk to the Whatsapp server, a bank mobile app need to talk to the bank server. The client is the phone the application on the phone the server is the database or the main server that application is talking to fetch data. Performance testing is dependent on both the client and the server and is tested on both sides. As I told you compatibility, Compatibility is, will in a mobile app work in different mobile devices across browsers, for several different screen sizes different mobile OS s. Will it have the correct resolution as I told you, will it have local language features, and so on, several different aspects have to be considered.

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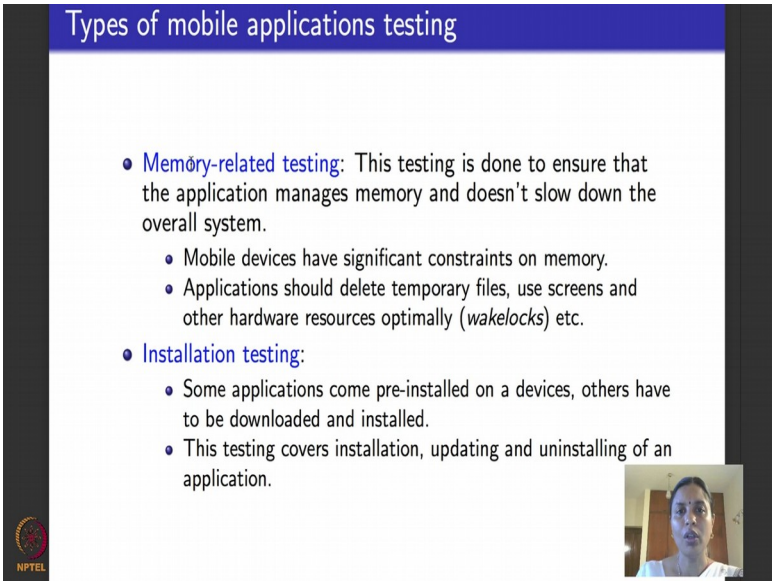

Moving on, what are the other specific system levels testing corresponding to mobile apps? The other one I told you is this is one of the problems that we all face: runs out of battery very slow, slows down. So, that is what is called memory related testing. We know that mobile devices have significant constraints on memory, because that is the

best memory that is being provided at a particular cost is already been provided by the manufacturer. So, mobile related testing is testing done to ensure that the particular app manages memory, and does not slow down the overall system. What is it mean to manage memory? For a mobile app, when it is, say managing memory, it should mean that they have to delete temporary files, uses screens and other hardware resources optimally. What do I mean by optimally? So, if u developed a mobile app, you would have you would be aware of a feature called a wake locks.

Basically wake lock tells you what to keep active and what to suspend. So, for example, let us say you have Whatsapp running, and Whatsapp does not have to keep this screen on the screen brightness and it on all the time, for you to for it to be able to notify when a new message is coming. It will have a small thread running somewhere in the background inside your phone which will look for messages in your inbox, and when the messages come it will pop it. Whereas, let us say you have another application which is playing a movie right on your phone, then for that you need to keep the screen on. So, wake locks are things that you tried as a part of your mobile app, which tell you what to keep on in terms of the hardware resources, screen is on or off, volume is on or off, display is on or off brightness is so much and so on. So, managing wake locks is an important part of memory usage.

If you keep lot of things on that you do not need all the time then the battery phone and memory is going to drain and that is not good for the app's performance. So, more memory related testing tests for all these optimal usage of resources. The next is installation testing. As I told you when it comes to mobile apps, with some of them come pre-installed on a particular device, where as others to be download and install the particular device. So, this kind of testing covers installation updating of an app which we do very frequently periodically, both system level functionality and a particular related app and un-installing also is typically covered in installation testing.

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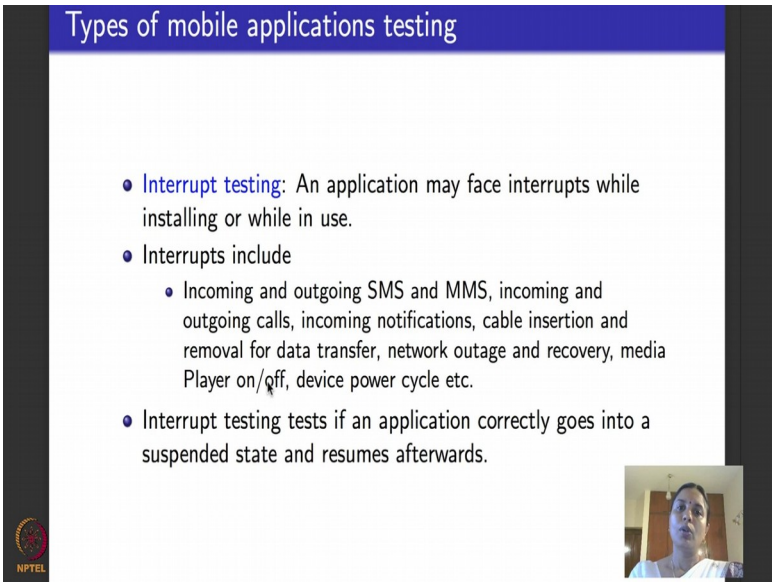

So, going on, interrupt testing is another kind of mobile application testing, what it does is that you know an application on an mobile app might face several interrupts while installing or while in use.

Remember when I told you about web based testing, I told you the interrupt that people do back and refresh buttons and so on. Similarly for mobile app what could be interrupts, there could be a sudden call or it could be a incoming call or you might decide to make an outgoing call or they could be a message, I could be an incoming notification, you might decide to remove the battery while you are running a particular app, you might decide to charge the phone while you are running a particular app, you might suddenly lose network so many other different problems could be thought of as interrupts. So, interesting basically consider the fact about a mobile app working correctly even if interrupts come, and in the worst case it test whether the mobile app correctly goes into suspend state and resumes afterwards.

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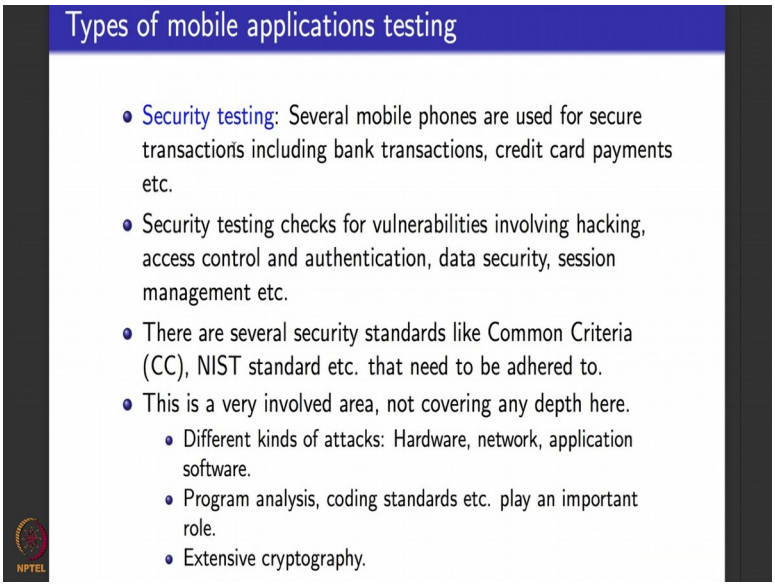

Security testing is very important for mobile apps, because we all a good number of us were smart phones not only use our phones to make calls and stay in touch with friends and family, but we also use it for several critical transactions like for example, we used for bank transactions to transfer amount to login securely into a bank account.

And very soon in India you can use your phone for making as a credit card, you can use it to make payment is already there in the USA. Securities a very important part of certain kinds of app; security testing checks for vulnerability is related to hacking access control, authentication, data security session management and so on. There are several security standards that this mobile apps that deal with these bank transactions and credit card payment and all have to meet, one of the common called CC expanded as a common criteria, NIST in the USA several standards, this is actually quite a deep area you could have half a course on security testing and the part of good part of it could be on mobile app security testing. I am not going into the details I am just giving you a very very high level overview on just by telling you that this is an important area the needs to be considered.

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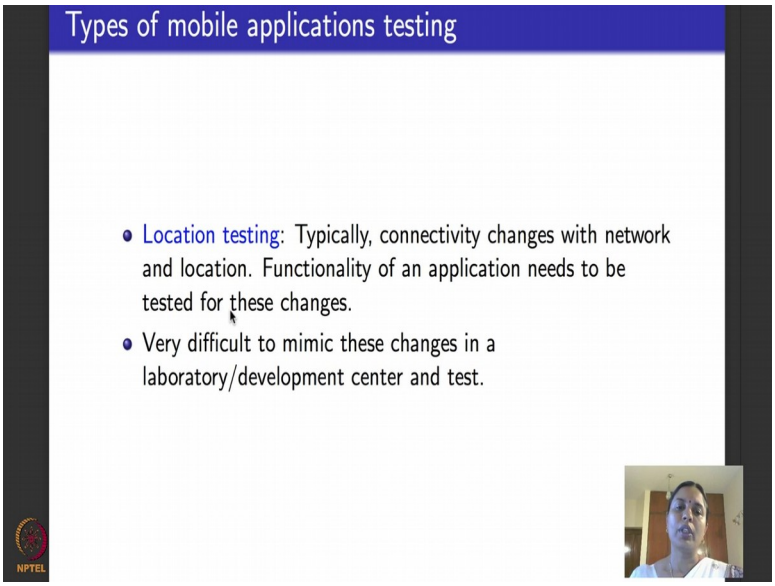

In the part of this weeks of lecture I will tell you little more details about security and performance testing that might be helpful, but by no means we are going in any depth these area please remember. So, the last one I would like to discuss about what is called location testing, which is again very specific to mobile apps testing you would have typical experience the connectivity changes with network and location, suddenly you have no signal, suddenly the signal strength will be very good. So, you have to be able to test the functionality of a mobile app for these kinds of changes also. The problem with this kind of testing is very difficult while you are developing an app inside your organization, in it is very difficult to recreate this kind of scenario to test it right typically this happens when you are traveling right when you lose signal signals drop, signals to come back for various reasons.

If you are going to sit in your organization in your testing lab, imagine how difficult it be to recreate sudden drop of signals sudden picking up a single. So, it is one of the difficulties that people face while doing location testing is they may not be able to accurately mimic the change in location of network or a signal, within the laboratory or development center at test.

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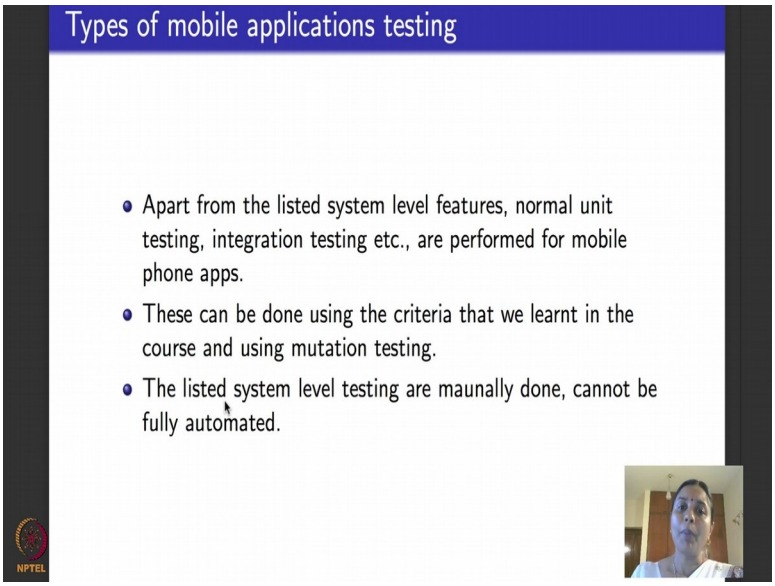

So, apart from the various system level features that we saw till now as I told you to do the normal unit testing, integration testing, everything it is just another piece of software, that can be done using any of the criteria that we latent earlier in the course. And what we looked at in the just past few minutes are system level testing features specific to mobile apps. So, here is a summary slide that I picked up from another website called software testing class, I thought I show you this slid because it gives a nice overview of the current state of the art mobile app.

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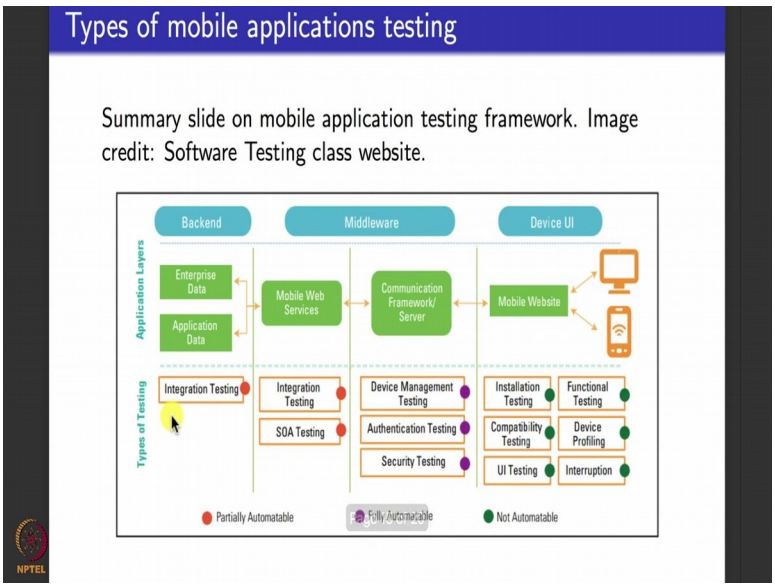

So, what are we will just focus on this part first it says types of testing. So, at the backend at the middleware or at the device user interface; backend of a mobile device middleware in the mobile device or at the user interface. At the backend when I am developing an app I do integration testing. I do integration testing at the middleware level also. At the middle level I also do authentication security testing, and device management testing, which talks about you know releasing keeping memory in tag releasing system hardware resources that you do not need and so on. But good number of system level testing happens at the device UI level, which is what we talked about installation, compatibility, user interface, functional testing, profiling of a device interruption all these things happen at the system level face and as this legend shows unfortunately good number of these cannot be automated.

So, it heavily relies on a person having knowledge about the mobile development environment, about the domain of the application about the mobile OS and then actually writing test cases to be able to pull out errors. The rest of it that these kind of stuff are heavily automatable there are tools, I will tell you about some of the tools that are available in open source.

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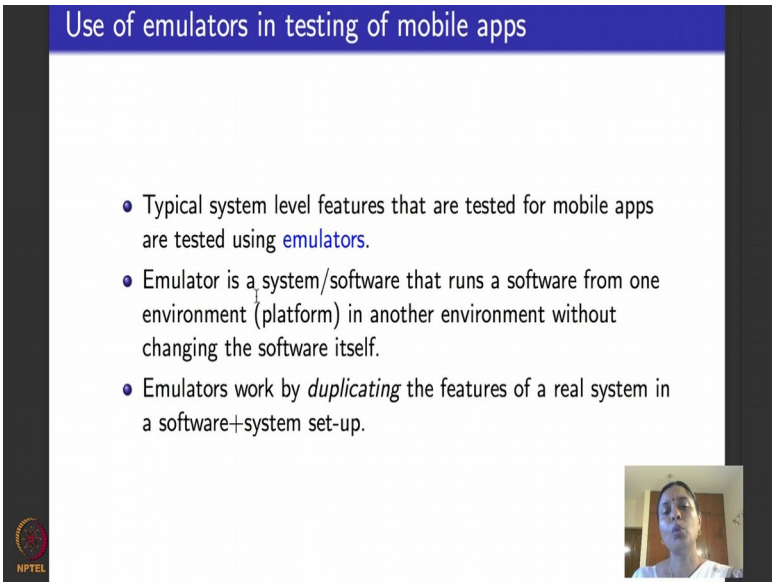

So, moving on to tools for testing mobile apps, as I told you very difficult to buy every kind of device available in the market do go around carrying your device waiting for network to become low battery drain out, we cannot do this things in a real environment.

So, what we do is we create simulated environments where these scenarios as depicted for a mobile phone, and a mobile phone functionality is tested. So, typically we used what are called emulators to do this, system level features that features that we discussed for mobile apps and tested using what are called emulators.

What is a emulator? An emulator can be thought of as a system, that again contains the piece software what is it do? It runs a software from one environment in another environment without changing the software. Like for example, you know using an emulator you could say you configure it for this particular device, that runs android operating system with this as the screen resolution and this as the display brightness, and this is how the parameters that touch screen coordinates in my screen looks like and then for the same app let say you want to test for I phone. So, you say you configure it for an IoS which is for this particular device; I phone device which has this screen resolution this kind of a display and so on. Emulator let us you do this configurations of a particular system software and hardware.

Such that you can run your app as if you are actually running it on the real phone, and test all the features of your app that you want to test. How do they work? They work by duplicating the features of a real system in a software plus system setup.

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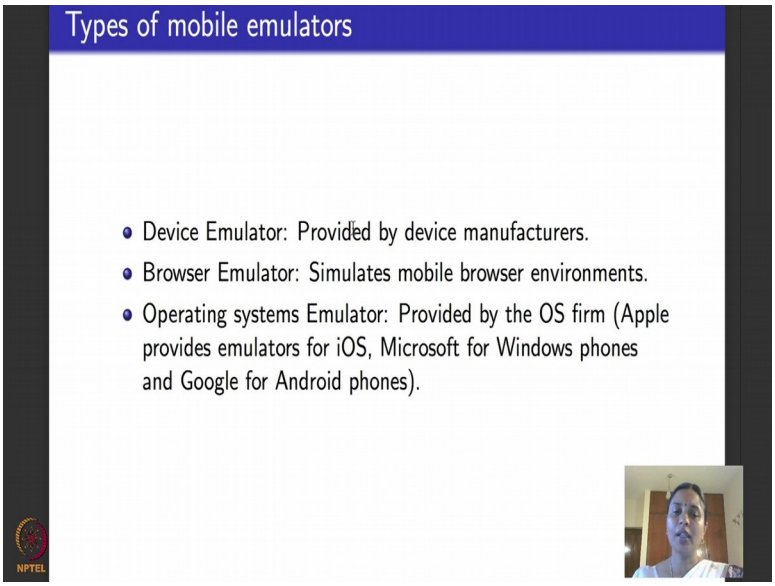

So, here are three kind of mobile emulator that are commonly known; first one is what called device emulator, this is typically provided by the device manufacturers themselves

if you want to develop an app or test an app. The second is browser emulator which emulates the browser settings available in a particular mobile phone, they as I told you it simulates mobile browser environments. Third is OS emulator which is again provided by particular firm that owns that OS apple provided for IoS Microsoft provided for windows phones, Google were provided for android phones so on.

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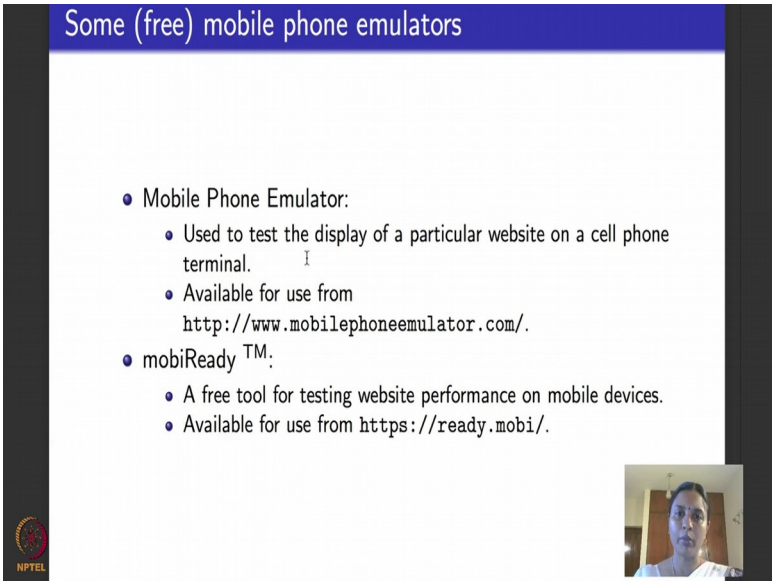

So, here are some free mobile emulators that I am aware of.

The first one is called mobile phone emulator, you can download it from this site, it is used to test the display of a particular website on a cell phone terminal right. As I told you suppose you have an bank thing bank Citibank online mobile app, that is available the way it is displayed on a iphone will be different from the way it is displayed on a Samsung phone. So, this emulator can be used to configure the display for these different different once, see how the particular display of a website looks like. Another emulator is mob ready, this a free tool for testing performance of a website on a mobile app you can pick it up from this site.

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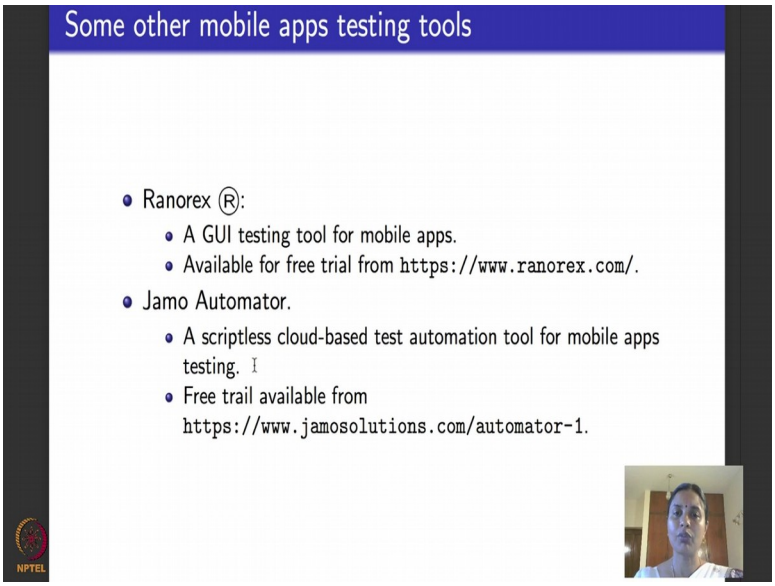

Then there is another tool called ranorex which provides g u i testing tool for mobile apps, this is not an open source tool you can download it for free time from this website.

Another tool that I am aware of is jamo automator which is again not an open source tool, but there are free trials available, this is script less cloud based mobile test automation tool.

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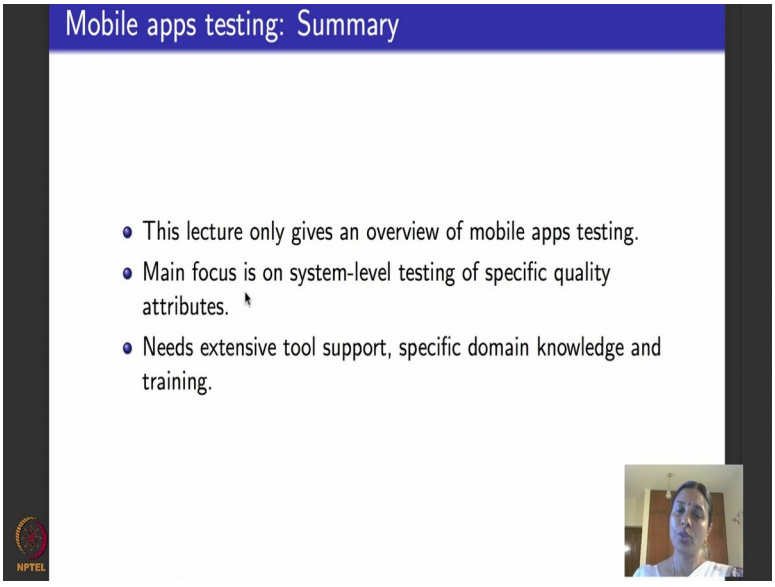

So, just wanted to summarize this lecture what I intended to tell you in this lecture in response to some of your request in the forum, was to give an overview mobile apps

testing I am I know means an expert in this area. So, I managed to give you an overview that includes important system level features that are tested for mobile apps. Please remember that it need extinctive tools of specific domain knowledge and testing to be able to test for mobile apps.

Thank you.