**Principles of Engineering System Design**
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Lecture – 09
Functional Architecture Development

Hello dear friends welcome back to another session on say engineering system design today we will discuss about the functional architecture of engineering systems. Basically we will be looking at the functions to be provided in the engineering system in order to provide the necessary output from a system, as you know there are different requirement for the system and these requirements need to be met in the system through functions provided in the system that these functions will convert this in the inputs to the system to their outputs. Basically the functions in a system are the blocks which actually convert the inputs of the system to outputs.

Here we will try to understand how do we identify the functions to be provide in the system based on these would be actually create a hierarchical function structure and then take these functions to the next level of physical architecture development.

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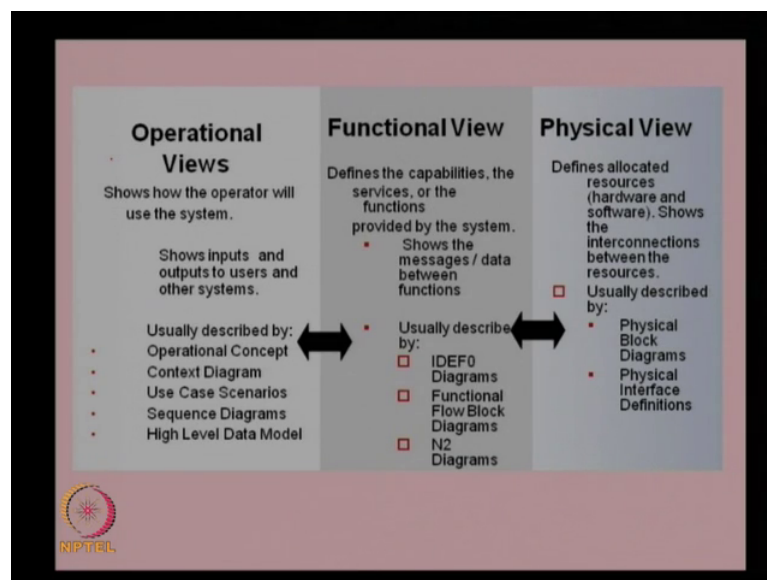
If you look at the system architecture you can see that there are 3 different views for a system. The first one is the operational view, the other one is a functional view and physical view. Any engineering system we can look at the system from these 3 different

perspectives. In the operational view what we try to see is that how the system will be used by a operator or by a consumer and it is described by the operational concepts context diagram use case scenarios sequence diagrams and data modeling.

In the previous lectures we discussed about these operational scenario and we identified the requirements through this operational concepts, context diagram and use case scenarios, input output trace and basically from this operational view we create the originating requirements, and these originating requirement will be documented for the next level of a design and the next level of is the functional view, from the operational views will develop a functional view of the system basically we will look at the stages in data between the functions. Basically it defines the capabilities, the services or the functions provided by the system it shows the messages and data between the functions and these are described by different methods. The one method is known is IDEF 0 diagram or there are functional flow block diagrams there are N 2 diagram. All these are used for representing the functional view of a system.

We will see 1 or 2 methods and then later on when we discuss more about the modeling techniques we will see the other methods also. The other view of the system is physical view; in physical view we look at how we convert these functions into structural blocks or the physical architecture or physical blocks. It actually defines the allocated resources that is the hardware and software and shows the interconnections between the resources. So, in the physical view we look at the actual hardware and the software and their interconnections and these are usually described by physical block diagrams and physical interface definitions. That we will see at a later stage. We will look at the functional view of the system and then how the functional block diagram or the functional structure of the system can be developed.

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As we discussed earlier we know that there are 6 functions of the design process and we refined that there are in system level design problem as the first one which we actually already covered in the previous lectures. The next is developing the system functional architecture that is what we are going to see in this lecture.

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What is a function of a system as you can see here the function is basically a relationship between the input and output of a system? It is a statement of clear reproducible relationship between the available input and the desired output of a system independent

of any form that is very important. We do not by discuss about the form or the shape or the hardware through which we can obtain the function, we basically define the relationship saying that what the relationship between input and output, and how do we convert the input to an output. What functions are needed within the system to do that we do not discuss about whether they will use a particular hardware or software to do that we define the function only or the relationship between the input and output over here.

As you can see here there are different needs or requirements or different purposes for defining the functional structure. Why do we need to the high of the functional modeling basically this is the logical way of caring forward the customer need. We are identifying the customer need. The logical way of taking it to the next level is basically converting these needs into function blocks. How do we provide these needs are basically the output from the system? How do we actually carry out this or satisfy the requirements and that is to be decided by the function block.

Functional modeling is basically a logical way of carrying the customer needs forwards and it gives a clear thinking at the concept level. We are studying the development of the system. We can get a very clear idea of what the system should do or what the system must do in order to provide the output and it exercise a design repository for future developments also.

Once you have these functional blocks for particular input and output, the same can be used for other systems also, these functional blocks basically acts as a design repository for future developments and of course, it for out can be used for 6 sigma design or easy identification of weakness and rectification. We can actually use it for identifying there are mistakes or the problems in the system design. We can actually trace the functions and then identify whether there is anything missing in the functional blocks. That also can be done using the a functional modeling of the system.

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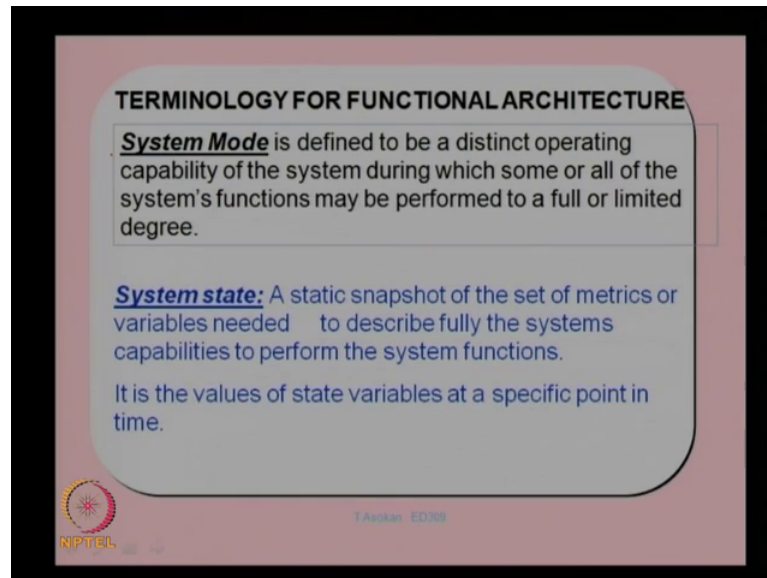
We will discuss few terminologies for a functional architecture because we were to develop the functional blocks. We need to define some of the terminology we commonly use in the system. 1 is known as the system mode the system mode is defined to be a distinct operating capability of the system during which some or all of the systems functions may be perform up to a full or limited degree. So, that is a system mode. It is a distinct operating capability of the system it is not the complete capability it is only a particular capability of the system or a particular operating modes for example, you can say that if you take the laptop then laptop has got different operating modes. We can say that one is a sleep mode is there and there is a shutoff mode and there is a booting up mode and there is a power saving mode. So, there are different modes for the system. These are known as the system modes or a particular operating capability of the system.

The system properties may change during these modes for example, in power save mode there may be a particular power given to the system or the screen brightness may be reduced. It will the system will try to reduce the power consumption in the power save mode in the sleep mode again the in the sleep mode some of the functions will be off and some of them will be active. If you want to bring it back to the normal mode you can actually click one simple a single button and then bring it back to the operating mode. So, there are sleep mode operating mode power save mode like that there are different modes if you take any other system you can actually see this kind of modes if you take the elevator for example, there is a what you call maintenance modes in maintenance

mode some of the functions may be there some of the functions may not be there similarly in normal operating mode all the functions will be present and in shutdown modes most of the functions will be terminated.

Like that you can see there are different operating modes for the system and the functions can actually be identified based on the system modes another terminology is basically the system state a system state is a static snapshot of the set of metrics or variables needed to describe fully the systems capabilities to perform the system functions. This is more like a static snapshot basically trying to find out what are the metrics which actually define that particular system mode; every system has got various performance metrics and other parameters.

We will take a particular mode and then try to see what the parameters for that particular mode are and that is known as system state for example, if you take the laptop example of power save mode. You can actually identify what is the power rating at that point what is the current drawn and what is the status of the memory what is the status of the process or what speed it is working and what is the status of the brightness of the monitor. Like that we can actually define this matrix and we take the parameters and that actually gives you the system state.

So, basically it is a snapshot of a matrix or the variables needed to describe fully the systems capability to perform those particular modes. It is a value of state variables at a specific point in time. If you take a specific point in time it actually gives the values of these variables.
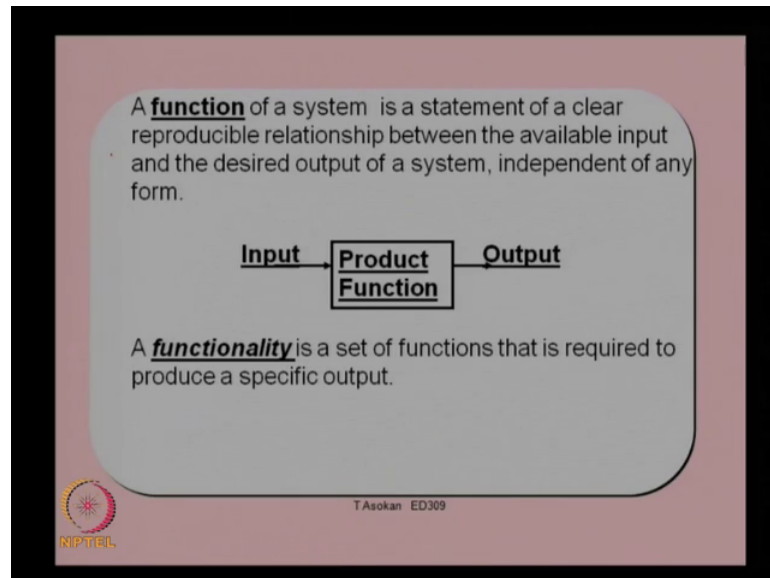
And then function we already describe this function. A function of a system is a statement of clear reproducible relationship where actually you can consider it as a block where the input is coming and then the output is going out, the relationship between this input and output is the product function.

And functionality is a set of function that is required to produce a specific output. If you want a specific output then the system need to have some set of functions and that is known as the functionality of a system. If you take the elevator if the elevator as to provide the service for transporting passengers just to provide many functions in order to give the specific output, there are multiple function need to be provided in order to get that the output and this is known as functionality of a system where it is a set of functions needed to provide a particular output.

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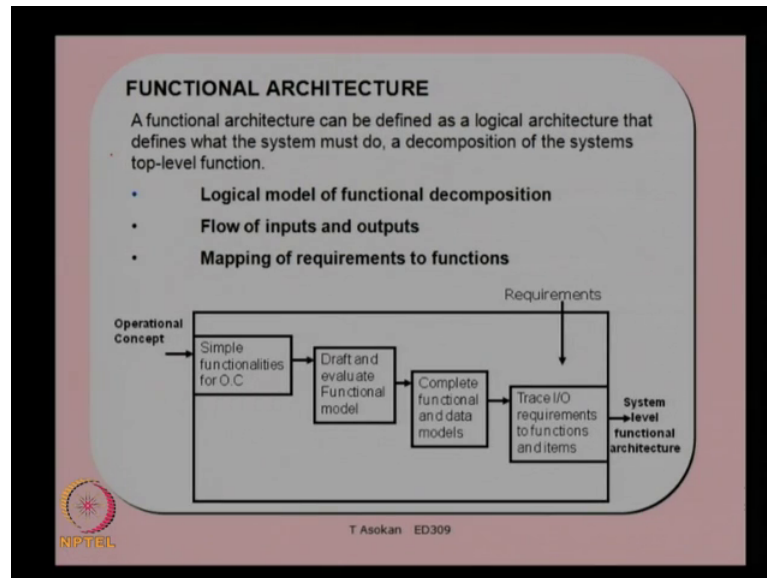
And the functional architecture basically can be defined as a logical architecture that defines what the system must do and decomposition of the systems top level function.

Every system has got a top level function and then we need to identify how to provide this top level function and this can be done through many sub functions. A top level function can be divided into many sub functions and to when you write down all these sub functions in a proper format then that actually we will get the functional architecture of the system. This is a basically a logical model of functional decomposition. You decompose the main functional into small functions and actually it tells you the flow of inputs and outputs. How the input is flowing through the functions and getting into the output and then it can be used for mapping of the requirements to functions.

In the previous analysis we discussed about the requirements of the system. Once we have these requirements we provide the functions and then we can actually check whether these functions really meet the requirements of the system or not. Basically if you have a functional architecture we can identify the flow of inputs and outputs as well as we can map the requirements to function.

We can see whether all the requirements can be satisfied with this function or not or we need to add more functions in order to satisfy some of these requirement. That is the advantage of having a functional architecture. Basically a functional architecture gives you the sub functions and then helps you to identify the flows of inputs and outputs as

well as to help the map the requirements to the functions if you look at this diagram you can see that the input to this functional architecture development basically is an operational concept and the requirements yeah.

You can see here this is an operational concept. The operational concept and the requirements are the inputs to the system and the output is basically a functional system level functional architecture these 2 inputs will give an output and you have to provide that one we need to defined the symbol functionalities for the operational concepts the functionalities are basically the set of functions and then draft and evaluate the functional model and complete the functional and data models and then trace the input output requirements to functions and items. We are doing all these steps in order to get the functional architecture of the system.

We will go through all these steps how do you define the functionalities or how do you get the functional model and then how do you create the function architecture and then trace the input output requirements of trace the input output requirements to the function structure. We will go through these stages and see how to develop the functional architecture. So, here this is basically explained in with more clarity. As you can see here, this is the operational concept input and the requirements input over here.

These are the 2 inputs and then you have the simple functionalities for operational concept draft and evaluate functional model and complete functional and data models and trace input output requirements and once you do all this you will be actually getting the functional architecture or the functional structure of the system which will basically tell you the top level function as well as the sub function which actually provide you all the functionalities needed in the system or which will actually convert it will satisfy the requirements as per the customer demands.

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I know to get the functional architecture there are different methods to do this the first one is known as a decomposition or the top down approach in the top down approach, basically we will partition the system function at a level at a time that is we take the one function and then we divide it into sub functions and then take the one of the sub functions and divide it into it is sub functions and till we reach the lower level function which need not be defined or further which is need all function which need not be subdivided further. That is known as the top down approach for partition the systems at function level 1 at a time and it needs sound definition of all inputs and outputs.

Here every stage we need to define the inputs and outputs clearly the another one is known as composition or the bottom up approach and here, we define many functionalities that is the bottom level functions what we need in order to provide a particular system mode and then synthesize this function hierarchy from many bottom level functions. We combine these bottom level functions into a one function and then combine many of these functions in to get the top level function. That is known as the bottom up approach.

Here basically we should know the system modes and system functionalities then only we can get the bottom level functions and then go to the top level function, but in the case of top down we start with the top level function and then decompose it one level at a time and get all the sub functions or the top bottom level functions and the another 1 is

known as the both is basically the you combine both of this in some cases you take the top level function, but if you know some of the functionalities you can start with those functionalities also. Combine these 2 methods and you can get there the functional architecture.

Here what we will try to do is to look at the decomposition from the top down method. So, we will see few methods through which we can decompose the functions in a top down methods.

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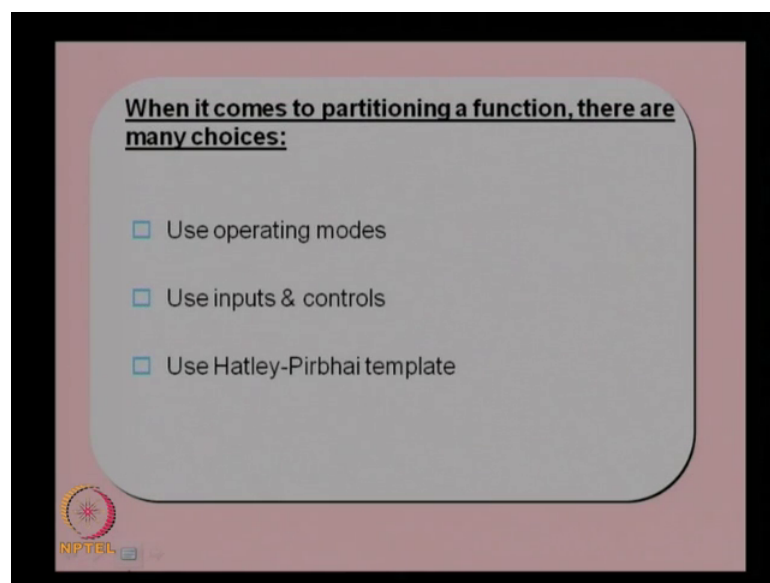
Look at partitioning of the functions in the top level function we will basically do the partitioning of function as I mentioned we consider the top level function and then take the top level function and decompose it into sub functions or partition them into sub functions and then keep on doing it one level at a time and till we reach the lowest level function. How do we do this partitioning of functions?

We have actually different methods of doing this. One is known as operating modes. You take an operating mode and find out the top level function for that operating mode and then start dividing that function into sub functions or you can use inputs and controls. You can take one input of the system and then see what is happening to this input and find out that function top level function which actually converts that input and outputs and then look at the control signals needed for that conversion and based on that we divide this into small functions or there is another method called a Hatley Pirbhai

template or known as hp template the hp template also can be used for converting the top level function into smaller level function. We can use any one of these methods for doing this hp template is 1 of the standard methods. We will discuss about this method and how we can actually decompose the function into a small lower level function you see hp template.

See in Hatley Pirbhai template the basic idea is that you take any function. Any function can be divided into 6 sub functions. That is the basic principle of hp template partitioning you take a function and then you divide that into 6 sub functions.

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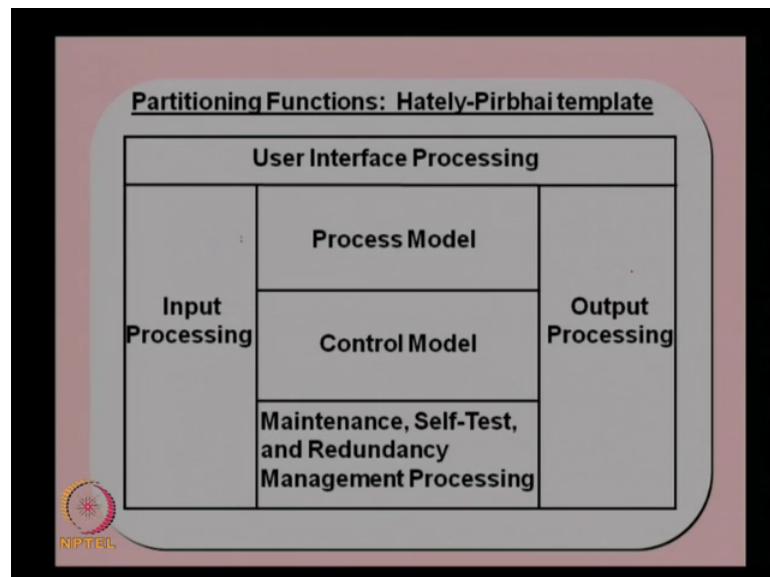
Can have this kind of a template, this is the template over here. As you can see here there are 6 blocks. The top there is a top line and then there is a 2 side blocks and there are 3 blocks in the middle, like this we can actually divide this into 6 sub functions you can see here this is the top 1 and this is the side 2 blocks and then you have 3 blocks over here now how do you do the actual decomposition what we do is basically we write down the functions into 6. First one is basically the input processing. Any function will be having an input and that the input data need to be processed as we saw that the function is basically a relationship between input and output.

Any function need to process an input data. That is the first sub function that is the processing of input data and the second one is output processing that is you process the output whatever is coming from the block and that data need to be processed as, that it

can be given as a proper output to the customer or to the next level function. The processing is basically how do we convert that an analog to a digital data or a digital data to a voice data or a visual data. That is the processing of data and then we have this user interface processing. For any system there will be some data provided by the user. How do we process that data or how do we actually interface the operator or the user with the system. That is the user interface processing and then we have this process model which is the main function which we are discussing.

If you want to define or decompose a function, this will be the process model here. This is the process model that is the function need to be provided over here and then this in order to provide this function we need to have the user interface processing you need to have the input processing and then you need to have the output processing also and apart from this we need some other functions basically a control model. How do we control the conversion of this input to the output? That is the control model and finally, we need to have a maintenance or self test or redundancy management within the system. Every function need to be a checked for it is consistency or it is proper functioning. Our maintenance of the functionality that also needs to be there in the system in that particular function, maintenance self test and redundancy also becomes one of the sub functions.

In effect says that, if you have a process model or a particular function to be a decomposed into sub functions you look at the interface processing first. What is the kind of interface need to be provided for the system in this case there is a user interface processing and then what is the input processing to be provided that is the input data how we actually convert this data input data or process this input data. That it can be converted in output or it can be controlled within the system in order to change it to an output.

Whatever the input is coming through the user interface there will be processed by the input processing we send through the control model will be converted this data into an output mode and then the output will be processed and it will be send it to the interface. That is the way how the functions are provided you convert this process model into sub functions and then go ahead with the subdivision of these functions. That is the basic principle of hp template as you can see here the process model can actually be divided

into 5 other functions or in order to provide one process model function we need to have 5 functions. We are actually dividing this function into 5 sub functions.

Now the advantage of hp template is that you can actually take any one of these functions you can take the output processing as a another process model and again divide this into 5 functions similarly, those functions can I further be divided to 5 sub functions and we can keep on doing this till we reach the last level of division of functions, hp template basically gives you a format through which we can divide the functions. Every function you take then divided into 5 sub function basically user interface processing input processing maintenance and self test and that output processing.

This way we keep on doing these divisions then we will be reaching the final functional architecture or we will be getting all the sub functions and the end of this processing will take one example and then see how to do this division or the decomposition of functions.

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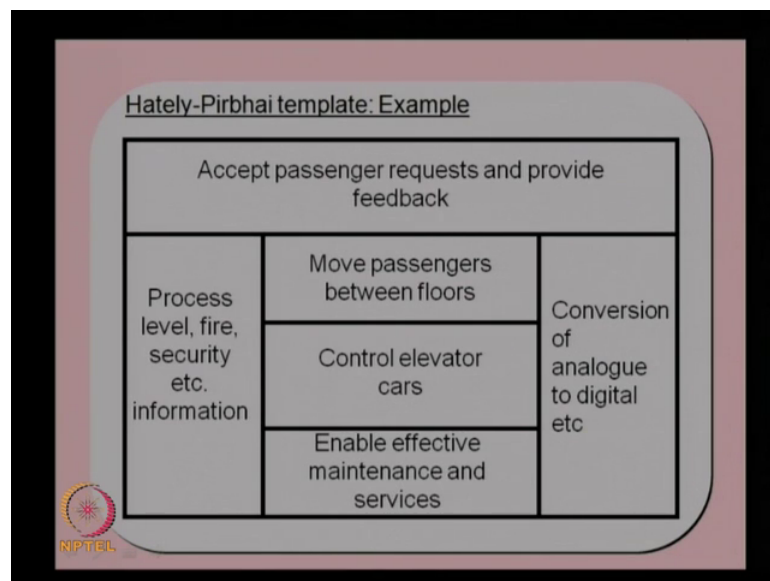
We will take the again take the example of an elevator. The elevator main function is to move passengers between floors. So, this is the top level function of the elevator therefore, this way we have different inputs and different outputs and different controls within the system. How do we actually divide this into sub functions is the main question here. The move passengers between floors are the main function which has to be decomposed into sub function.

We have to look at what are the other things needed. As you can see in hp template the first or the top level or in the stop block what we provide here is basically the user interface processing. Every elevator needs to have a user interface because users are giving some input to the system. We need to have a user interface for the system and that is provided here as the axel passenger request and provide feedback.

One sub function of the main function that is the no passenger between floors is accepting passenger request and provide feedback. That is one of the main sub functions of this decomposition and another one is basically you control the elevator cars. That is the control function in the elevator you have to control the elevator car based on the passenger request and based on the other functionalities provided in the system. Control elevator car is the control function the sub function of this system similarly enable effective maintenance and services is another requirement that is the system needs to look at it is own health or the monitor it is own health conditions and ensure that elevator is in good condition to provide the main function of more passenger between floors.

These are the 3 sub function basically except passenger request and provide feedback control elevator cars and enable effective maintenance and services it can call it as the level 1 functions if you take more passengers between floors as the top level function then we have 3 level 1 function which are actually the sub functions of the top level function and apart from this we need to provide input processing as well as output processing also, it just to process the level fire security other information in order to provide the required service.

Once you have this is passenger request accepted, that data need to be processed apart from that data we have other inputs in the system like the present level of the elevator what is the security signals what is the fire signal. Based on this signals need to be provided and using this input data or processing this data it should be sent to the control elevator car function and that will be providing a output from this function that is the conversion of analogue to digital data as the output processing. The output processing there will be much information going from the particular function basically the customers or the passengers will be informed about the status of the elevator where it is and where the door is opening. All these information need to be provided to the passengers, that work is done by the block or the function conversion of analog to digital information and passed to the user interface.

As you can see here the top level function has been divided into 5 sub functions. Here sub functions are the accept passenger request process level fire security information control elevator car enable effective maintenance and services and conversion of analog to digital data. These are the 5 sub functions now these are only that level 1 function we need to actually divide these functions again into sub functions if you look at the one accept passenger request and provide feedback this can be considered as one function which can actually be further subdivided or you take control elevator cars again can be subdivided into sub function.

How do we do this again we need to go back to this hp template and instead of this function over here instead of move passenger between floors we write the accept passenger request and provide feedback as the process model and then divide that into sub functions and identify are the sub functions needed to provide that particular function and keep on doing this till we reach the last or the lowest level function. That is how we use the hp template to divide the functions into smaller functions or basically to decompose the functions into sub functions.

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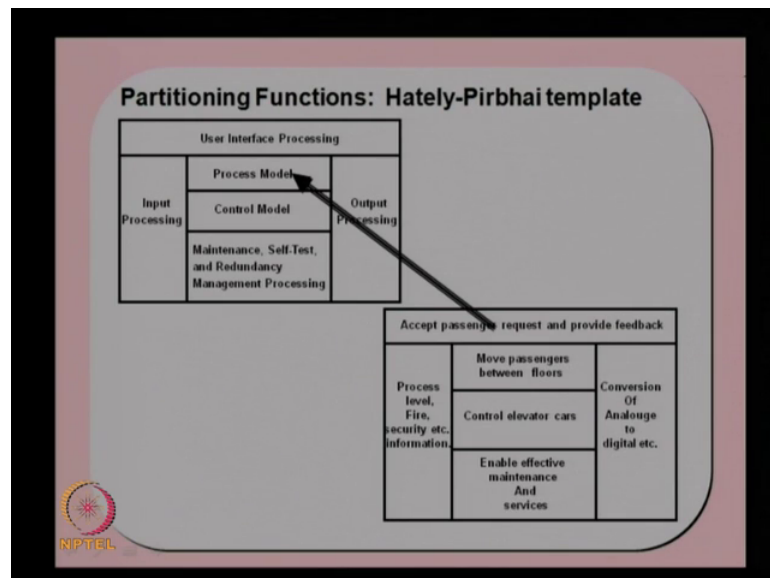
We look at how you actually do this you look at this block over here. Here we are seen that this the first one what we shown here the top level functional decomposition that is move passenger between floors were actually decomposed into 5 functions now suppose, I want to decompose the function except passenger equation provide feedback into sub

functions I will make another hp template like this and process model here will become the accept passenger request and provide feedback. Instead of one a process model of move passenger between floors the present process model will be the accept passenger request and provide feedback and again we will see what kind of interface processing is needed what kind of input processing is needed and what kind of output processing is needed.

These things will be identified and we will provide the function d composition this is the previous one where the move passenger between floors was decomposed into 5 functions and we will convert this into the sub function here. You can see here they accept passenger request and provide feedback has become the process model over here.

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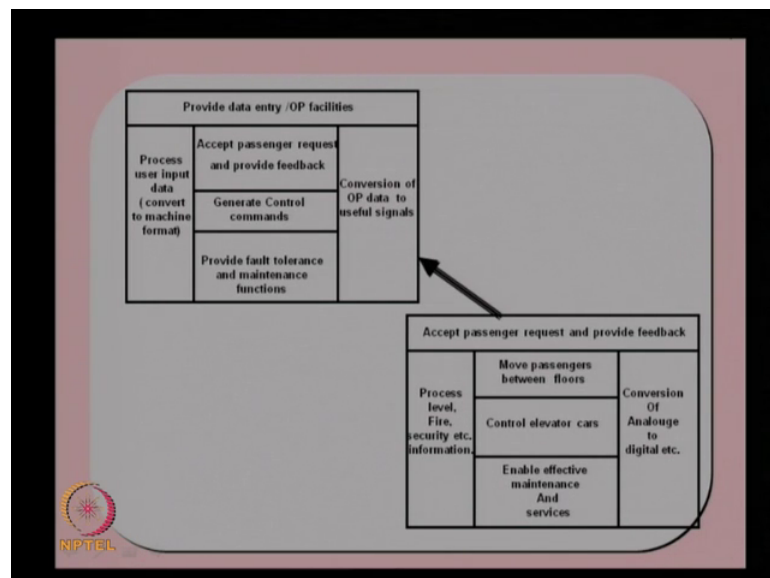
And then we will have try to identify the sub functions like provide data entry output facilities.

In order except the passenger request what kind of functions are needed as you can see that one is that provide data entry output facilities that is a customer should not have the facility to provide the data entry as well as to see the output from the elevator that is the one requirement of the interface processing for this function and then process user data inputs, user will be giving some data input. You process that data basically convert the input data to a machine format and then generate control command is the control model.

Based on the customer request you generate the necessary control commands to the machine control and then you provide the conversion of output data to useful signals.

In this case the output data depending on the control command output data will be generated and that data should be converted into useful signals and provided to the customers through the input output and interface or the output facilities and in addition to this function also needs a fault tolerance and maintenance function also. It should look for the fault tolerance or to reduce the errors in the system. The fault tolerance and maintenance functions also need to be provided in order to provide this function of accept passenger request and provide feedback.

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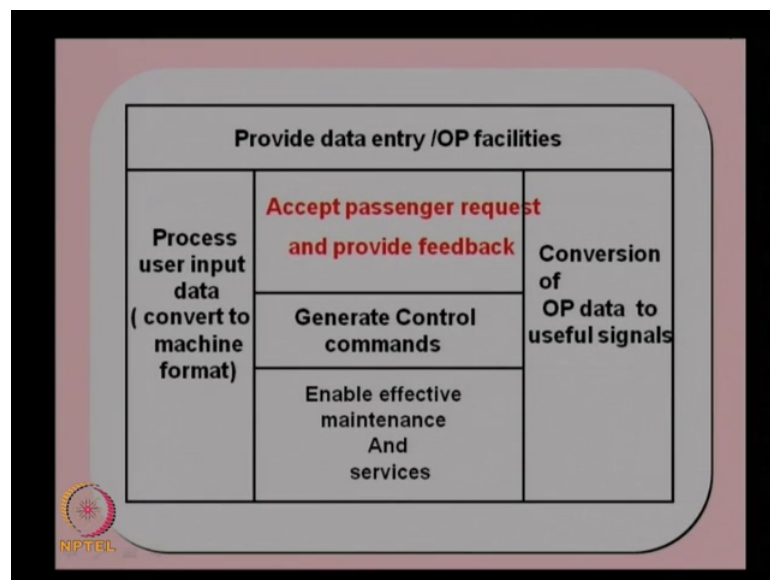
This is the decomposition of that particular function accept passenger request and provide feedback you can see there they provide data entry output facility is sub function of that and process user input data conversion of output data and generate control commands as well as the effective maintenance and services becomes the sub functions of this function. You can see we have divided the first function into 5 and then took one of these 5 functions again divided them into another 5 functions and we can actually do this further we can take one of these functions again like for example, if you take the generate control commands or provide data entry output facilities again we can subdivide them into another 5 functions and when keep on doing these we will get all the sub functions.

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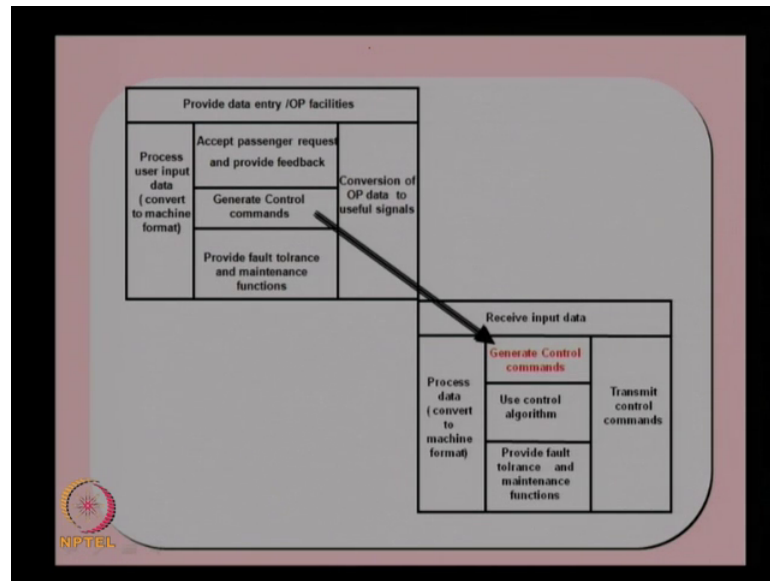
Again I am taking these generate control commands and then dividing them into sub functions using hp template. Again we use the same template here the process model will be the generate control commands instead of accept passenger request I will change that to generate control commands and again divide that into 5 functions over here, generate control commands becomes the process model and now I will try to identify what are the 5 sub functions in order to provide the function of generate control commands. That is how we divide this into sub functions and go on with the decomposition.

Receive input data, the controller should receive the input data coming which is in the machine format converter from the previous function. It receives the input data and then you say control algorithm. There will be a control algorithm based on which the signals will be generated. It will receive the input data use the control algorithm transmit control commands of course, it has to do the processing of data also.

The input data need to be processed in such a way that the algorithm can actually read the data or algorithm can accept the data. That is the processing data convert to machine format and use control algorithm and to convert that into output and the output whatever the output should be transmitted to the control commands and of course, the fault tolerance and maintenance functions algorithm you have to check whether the algorithm is working well and data conversion is taking place or the priority and other things are checked.

All those things are done by a function which is the fault tolerance. You can see that fault tolerance and maintenance become one of a part of almost all the functions and the one or we decompose the function. This is how we divide this, you can see that given a in a better way over here, you can generate control commands if you take that as a function generate control commands as a main function you decompose that into 5 sub functions as receive input data processed data transmit control commands use control algorithm and provide for tolerance this is the second level decomposition of the functions from the top level function we divided it into 5 functions and each function can be further divided into 5 functions.

As in the process we can actually go further with this method we can take the transmit control commands as a function again divide that into 5 functions and then go for these 5 functions and again divide them, like that we can keep on dividing or decomposing the functions till we reach the lowest level function and then that the actually completes the functional decomposition.

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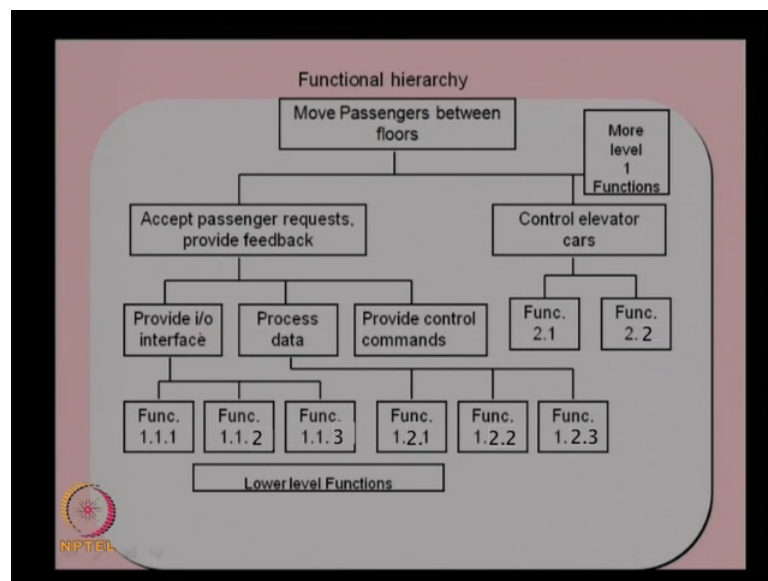
And once we have this functional decomposition what we will try to do is to create a functional hierarchy that is we take the top level function. We have these move passengers between floors as the top level function and then write down the level 1 functions. We divided if we found that 5 level 1 functions are there that is accept passenger request control elevator car provide interface and maintenance.

Like that that becomes the level 1 functions, here the level 1 functions are provided of course, all the functions are not shown here because of the difficulty in representing them on the screen. You can see this is first one move accept passenger request and this is control elevator cars and like that you can have 5 other sub functions. That becomes the level 1 function and then this accepts passenger request function was again divided into 5 functions using the hp template. That becomes the level 2 functions. The provide input output interface process data provide control commands again not all the functions are shown here can high n divided into 5 function. This becomes level 2 functions and similarly control elevator cars also were divided into 5 functions. You write down those function below the control elevator cars function 2.1 2.2.

So, like that you can see 2.2, 2.3 like that you will be getting functions and if you go to this function again and then again use the hp template and the divide you will be getting next level functions has function or 1.1, 1.1, 1.2 like that, like this you will be dividing this till we get the lower level functions and once you write all these you will be actually getting the functional hierarchy of the system. This is the final requirement or the final output of the hp template or the functional decomposition is getting the functional hierarchy of a system. You use the hp template divide the functions into sub functions and again take these sub functions and again divide into using hp template 2 sub functions till the lower level functions and write them on a hierarchical way you are getting the functional hierarchy of the system of the functional decomposition of the system.

This is what we expect from the a functional decomposition of any system one of the methods as I mentioned it is hp template, use the hp template to divide the main function or the top level function into 5 sub functions and take all these functions into again phi sub level functions and keep on doing this use hp template keep on doing this and then divide them into smaller functions and arrange them in a hierarchical order you get the functional hierarchy of a system. That is the way how we get the function architecture of the system.

This is actually explained more clear way over here you can see this is the top level function more passenger between floors and we take this into sub level functions the first top level one function has move passenger between accept passenger request and then provide the control elevator car says again another function and then divide this into sub

functions or level one functions provide input output interface process data provide control commands and similarly further you divide this into in sub functions provide input output interface can be divided into sub functions process data can be divided into sub functions control commands can be divided into sub functions and till we reach the lower level function we keep on doing this finally, will be getting the functional architecture of the system or a functional hierarchy of the system and each of these functions will be can some of these sub function may be combined to get a the functionalities or the system mode a particular system mode will be having some of these functions active and basically converts the inputs to the outputs of the system and which actually will be satisfying the customer requirements.

Using these functions we can actually develop the next level of physical architecture and do that we need look at whether all the functions are provider for the system or the these functions will really satisfy the requirements or not before going into that what will do will take one more example and then see how to develop the functional architecture using hp template.

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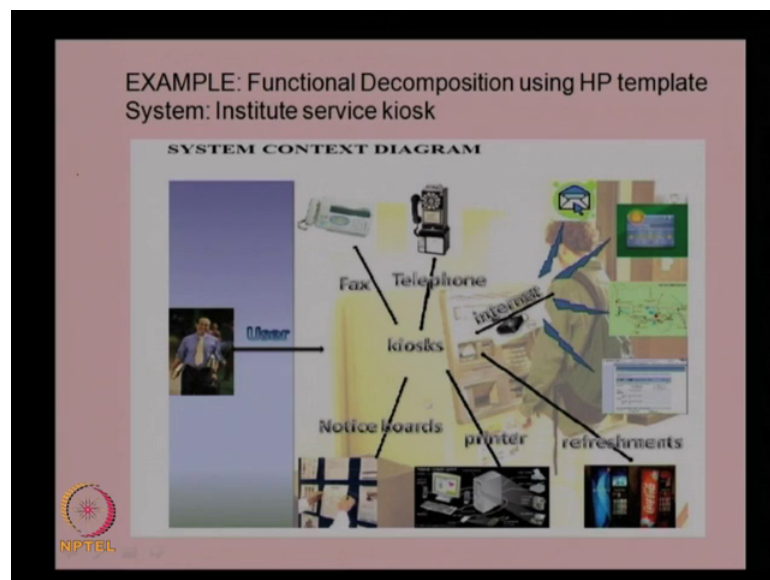
This is a example for functional decomposition and this is a system known as institute service kiosk.

Basically this is a system being developed or which is a problem where we need to have some service kiosk or terminals in the institute where the students can actually go to the

terminal and then use it for various purposes they can use it as a fax and telephone facility or they can use it for internet connections and emails they can use it for navigation purpose within the campus they can identify locate the place or those visitors who come to the campus can go through this and then find out the location of a particular building or it can be used for identifying the road map of the city or it can use it for purchasing some more drinks and other snacks and other things or can be used for getting the information the present and notices and other circulates from the department or the institute. It can be used for a multipurpose kiosk or a terminal.

As you can see here the context diagram shows a user will be coming to the system and will be using although facilities and we need to provide these functionalities in the system. How do we actually decompose this into a sub functions using hp template. You will not going through the complete decomposition just giving you one example of decomposition 1 particular function can be decomposed.

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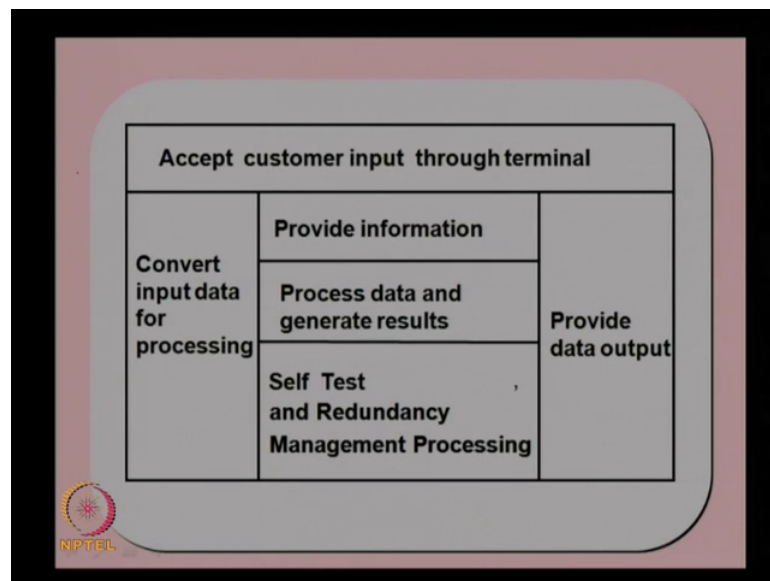
Give to get provide information to the user, user wants information. How do we provide this information or how do we divide this into a sub function.

Provide information is taken as 1 main the top level function then there is a accept customer input through terminate. Customer usually giving some input to the terminal, there should be a facility to accept input or provide output and convert this input data for processing. You data to be converted to proper format for reading by the machine and

process data and generate result which is the control part of the system and then data output or process the data output data. That it can be sent back to the customer terminal and apart from this there will be self test and redundancy management processing also in order to ensure that the system is in healthy condition and it can actually provide all the information needed by the customer that is the first level decomposition.

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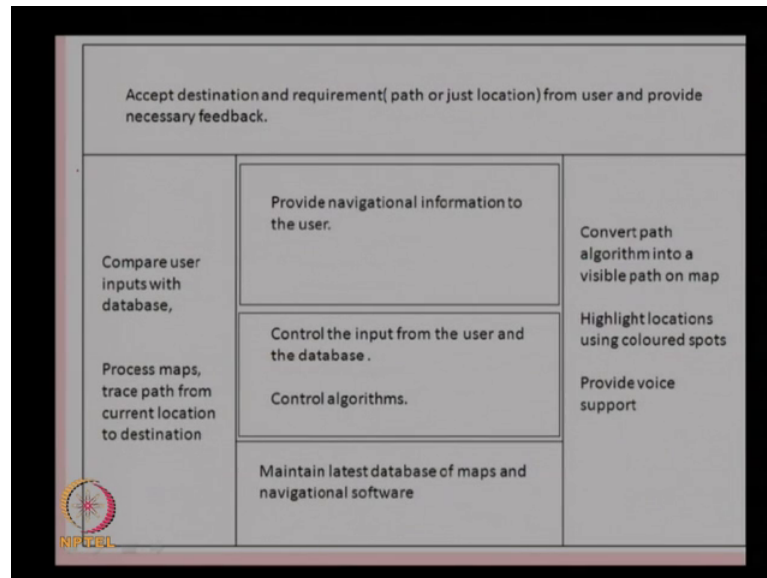
And then we go for the another function suppose the customer is asking for navigational information.
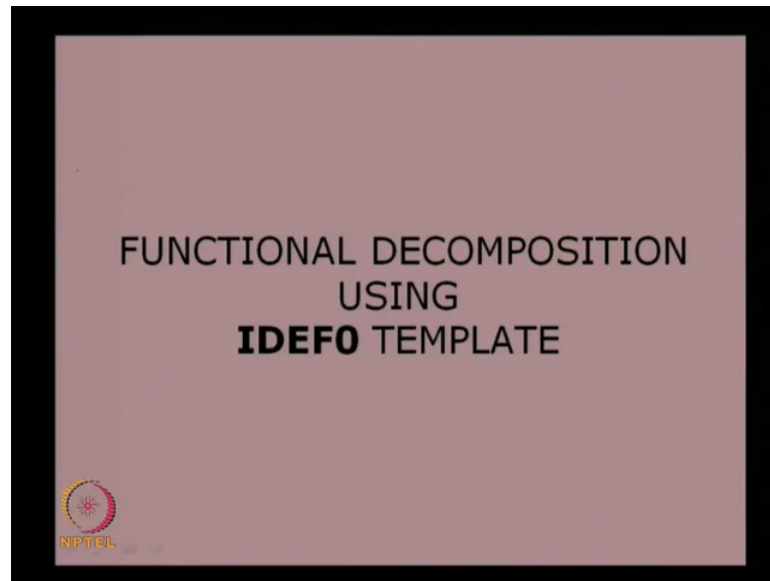
In this case provide navigational information to the user becomes one of the main function and you know to provide this there are additional functions needed like accept destination rent requirements from user and provide necessary feedback. The customer should be in a position to provide the destination and other requirements to the system.

The system should accept these requirements from the customer and then compare user inputs with data base and process maps trace path from current location. This is the input data processing, based on the input data it will be processing the input data and the control the input from the user and the database using control algorithm it will be searching for the output and that output will be provided to the customer through the output processing convert the path algorithm into a visible path on map highlight locations using colored sports or provide voice support and that will be provided as a output and the apart from this it will be maintaining the latest database of maps and

navigation software and doing checking for the health condition of the system also. This is the way how we actually decompose this into sub functions and once you decompose all these into sub functions we will be actually getting the functional hierarchy. You take all these sub function and put that on a map or a functional structure will be getting the functional hierarchy of the system.

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What this functional hierarchy it will be looking like this provide information service accept customer inputs provide customer services will be the top level 1 function and then provide input output interface process data provide control commands and other functions will be the level 2 functions and similarly navigational info academic information all these will be the sub functions in the provide customer service and then we having the lower level functions and continue with this you will be getting the complete functional hierarchy of the system. This is the way how we actually decompose the functions into sub functions using Hately Phirbhai template. There are other methods also.

We will discussed about this decomposition using another method called IDEF 0 and template and how do we actually decompose a function into sub functions and develop the functional hierarchy and this we will see in the next class till then goodbye.