Introduction to Cognitive Psychology

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Lecture – 16
Models of Semantic Memory

Hello friends, welcome back to the second lecture on semantic memory. Now in the last lecture, we discussed; what is semantic memory? And how it is arranged? What are the properties of semantic memory? And how long term memory is divided into both the semantic type and the episodic type?

We also looked at what is stored in semantic memory? The kind of information facts, knowledges, arithmetic rules, certain kind of information related to everyday world activities; everyday world knowledges all are stored in semantic memory and so, there is it is a kind of memory which stores most kind of information that people use in everyday life. We then discussed a distinction between the episodic semantic memory and we looked at what is the main differences.

And so, some of the main differences, I will repeat here is that episodic memory is basically time dependent or temporarily arranged whereas, semantic memory is arranged according to meaning we basically means that as you and as a episodic memory unfolds, it unfolds in time you can see yourself in time whereas, if an semantic memory unfolds, it unfolds as a meaning.

Now what do I mean by this? The meaning of this is that; when you unfold an episodic memory like let us say your prom night or may be your graduation night. So, every event is arranged in terms of time from morning to afternoon to evening, what happened during the whole day; whereas, if you ask questions like if you think about the acts like arithmetic rule of how addition subtraction progresses, you really do not need to know the time of the day when you learned or how they progressed in terms of time.

The other differentiation between the episodic and semantic memory is in episodic memory it is when. So, remembering when it the incident happened, but in terms of semantic memory it is more about what happened. So, what is the content of it and. So, this is one distinction between episodic and semantic memory and. So, is the focus of the

memory. So, episodic memory the focus is the self. So, everything arranged in episodic memory is around self you as a person can see everything going around and you can watch this thing as a third person observer, but in semantic memory that is not possible what really happens is that you get gather information and you are not the self the self is not the centre stage of this memory, but rather world knowledge is the centre stage.

So, knowledge is basically what comes out of semantic memory. So, this is something that we saw in the last class now we also saw two models of memory semantic memory that in the last class, one model was called the hierarchical semantic network model where we looked at how semantic memory arranges concepts and a world information and we saw that it arranges the world information in terms of nodes.

So, there are several nodes and so, nodes are basically concepts and these nodes two nodes which are similar together or even if they are dissimilar they are connected by a pointer or a link between them and so, these pointer node kind of a thing which is very similar to programming in c is what happens in the hierarchical semantic model.

We also looked at some of the basic interesting facts about semantic; the hierarchical semantic model and we also looked at a criticism of how it does not follow the cognitive economy on how the concept of hierarchical structure is basically violated. So, that kind of thing is what we saw in the last class. We also saw the feature integration model or the feature model of semantic memory, we saw that there are two kinds of features.

So, most information is arranged in terms of features and. So, there are 2 basic kinds of features that is available with any word concept or knowledge and so, one of these is called the defining feature the other is called the characteristic feature we also saw a model of how these features are tested.

So, that is a another interesting thing that that has to be there. So, what really happens is that in the beginning to start with the feature model takes off in this way the first at first we start comparing the characteristic features and if the characteristic feature of 2 objects or a characteristic feature of a new event is similar to a proposed concept the more similarity, it is the quicker a person decides the newer instance to be a part of the concept if the feature is very low we can go ahead and say that this particular new concept which is in front of us this particular new item which is in front of us is not a member of the concept and. So, we can delete this thing.

Now, if the characteristic feature is neither very high nor very low. So, we proceed to combining or testing the defining features and. So, when we looked at the defining features this is the next step the in this case only the defining. So, if characteristic features are neither high nor very low or the defining features are tested and when the defining features, we get a match of the number defining features yes answer comes in then the new item or the new entrant is basically matched to the concept and yes signal is given or if the defining features number of defining features are very low in the new item as compared to the concept it a new or no signal is outputted and basically it is rejected that the item belongs to this concept.

And so, this is how the idea of feature integration model really works we also looked at some of the interesting things about the feature integration model for example, how it progresses and what are the how it solves the hierarchy problem or it a goes ahead and solves category problem. So, what it basically says is as category increases more and more abstraction comes in and so, with the increase in category the; or increase in the size of the category this process of similarity matching become more and more difficult.

Now, in today's class, we will look at some of the newer models which are there. So, the more models which are there and then further on will look into something called how beside the model the concept of model how is semantic memory supposed to store information. So, we will start with model proposed by Collins and Loftus in nineteen seventy five and.

So, Collins and Loftus they basically went ahead and they proposed a model which is very similar to the hierarchical semantic model and so, what the basic of this model is it is an elaboration of Collin and Quillian's 1969 model; as I said it is in extension of the original model proposed by Collins and Quillian and so, basically this model also states that semantic information or world knowledge is basically integrated together or world knowledge is stored into the semantic network in terms of nodes where nodes is the concept and pointers the pointers are the links between this concepts.

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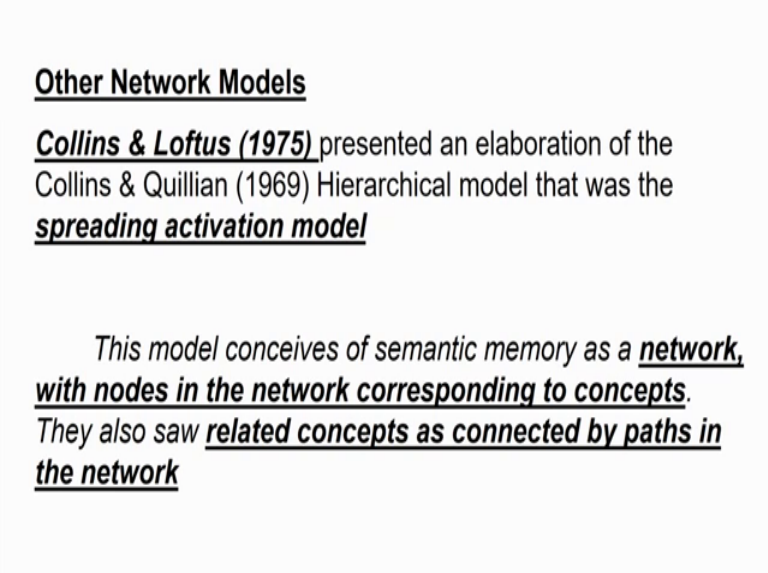

So, hierarchical model the only change that this model brings about is that in this model the concept of spreading activation is is the centre point or is the central feature of this model. So, then what does this model basically say the model conceives of semantic memory as a network with nodes in the network corresponding to concepts.

So, what this models says is that the semantic memory or semantic information world information is arranged in terms of a node or in a network of nodes and so, in this network the nodes which we are talking about the central point from which communication occurs these are called the nodes and nodes are the concepts and basically, the nodes the which stores the basic features of the concepts or the the nodes are always the sub super ordinate super ordinate nodes. So, concept storing nodes are always the super ordinate nodes also they saw related concepts are related by connected in paths of the network.

So, if 2 concepts are related together they are connected by some kind of a pointer or some kind of a link and this link is basically called the pointer now the more similar two nodes are the more similar 2 concepts are the higher the weight between these links. So, basically if 2 concepts are similar; they the path running between these concepts or the pointer running between these concepts will have a higher weight, then if 2-2 concepts are connected which have very dissimilar properties or very dissimilar features. Now how do we think about this. So, for example, let us think about fire and sunset now both

fire and sunset they are not connected together they should not be connected together because fire relates to some other concept some other network and sunset is related to another network, but then there is a one feature of fire and sunset which are similar and that is the colour red.

So, one relation between fire and the sunset is red, but this since they are not related together the pointer running between fire and sunset should have a lesser weight, but then if I am talking about bread and butter although or king and queen when I am talking about king and queen these two nodes or these two items in a in a particular network are originating from two different network, but since king and queen are connected by also through a intermediate network or intermediary pointer and so, each time when I say king or queen really comes in or the answer the in a paired associated testing the queen is the answer to king most of the time or if you ask people king.

And then ask them to say the first word that comes to mind that is queen is what the comes in and what really happens is these two concepts are connected by at pointer which has very high weights similarly pointers connecting bread and butter or pointers connecting between shoe and shoe laces are very high weights then pointers which are dissimilar pointers connecting a desk and an aeroplane. So, although they would be related or they would be fully related, but the pointer which connects these two nodes or these 2 items will be very weekly return. So, that is what this model says.

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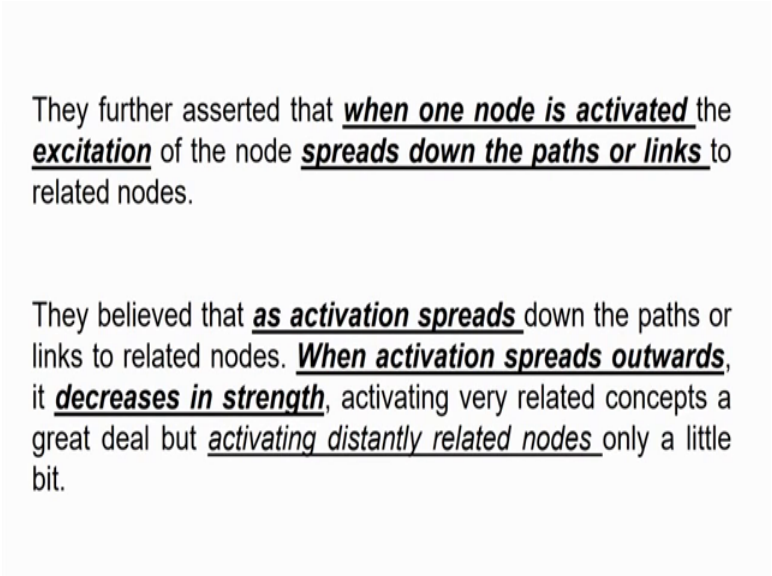

They first further asserted that. So, in this particular model further said that when one node is activated the excitation of the node spreads down paths or links of related nodes. So, what happens is it is similar to the concept of spreading activation and. So, what taking back from the idea of spreading activation what this concept says is that as soon as a node is activated as soon as are some energy is provided to a node this energies spreads down through not only through this node, but all connected nodes all connected links.

So, if I am activating the animal node what would happen is the energy will spread down to all kind of animals which are there it could be birds it could be mammals it could be reptiles it could be all kind of animals and. So, from there it will further a process down or it will spread down to other within mammals, it will be spread down to all kind of mammals which are there.

So, it may be lion tiger and so on and so forth in terms of reptiles. It will spread down to snakes to alligators and to so on and so forth in terms of birds it was spread down to different kind of birds whether it is a feathered bird non feathered bird and so on and so forth. So, basically this is how the idea is what this model says is that when an energy is provided to a particular node this energy spreads down through all connected and all linked nodes.

Now, they this particular theories or this theorists they believed that as a activations activation spreads down the path or links to a related node. So, the activation spreads outwardly and decreases in strength it basically what it means is that as the node as the energy it moves down a node what happens is this energy since it channelized it gets channelized into.

So, many other nodes the energy becomes decreased in strength. So, if two nodes are fared apart if 2 connecting items or 2 connecting nodes are far apart from each other in terms of a number of pointers or fourth or fifth or sixth level relation the in the on the sixth level relation the energy which starts from the top the node will be very very decreased.

So, when activation spreads outward it decreases in strength and as I said that both aeroplane and desk are related, but they have weekly related because the energy which is activated when I say or when I activate the concept of an aeroplane or any flying object

should be the highest concept with the under which aeroplane bit fall. So, when that is activated although desk full be activated in some way, but the energy spread will be very low because somehow somewhere they will be related.

But since they are so, further out related the weights are very low and the energy that reaches to desk from an aeroplane will be very very low and so, what they I also say is that activating related concepts when an activations part when the spreading activation when any activation or when a node energized it activates very related concepts with high amount of energies and distinct concepts are or distinct nodes are activated with less energy and that is what suppose to be right.

So, nodes which are related together or semantically or perceptually or any kind of relations are there between nodes they would be very closer together and. So, when energy when particular node when the top node is energized then similar nodes since they are very close to each other they will receive maximum energy, but those nodes which are further apart or which are very dissimilar to the particular node in question then the energy which is the which is which is coming to these nodes will be very less or it will be very low. So, think of this in this way. So, let us say that we have a node of animal.

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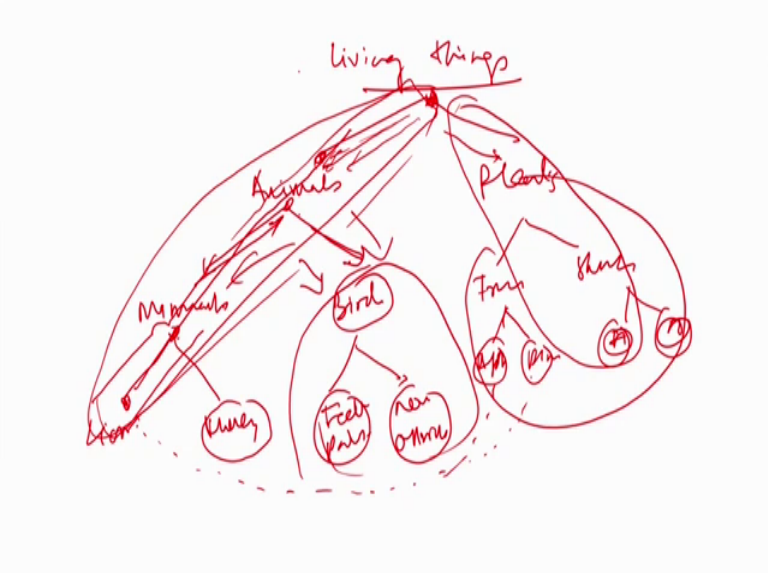

And so, within animal or let us say I have a node of living things. So, I have a top order node of living things and so, within living things I will have 2 or nodes which are

animals and plants and within animals; let us say I will just put 2 categories I will have mammals and birds and within plants I will have trees and shrubs and so, within mammals; I will further have let us say lion tiger is one category and the other mammal is a monkey orangutan within birds I will have the feathered birds.

So, I will have something like a parrot or I will have a non feathered bird. So, I will have something like an ostrich and within this also. So, within trees I will have an apple tree or I will have a pine tree and shrubs similarly let suppose I have a n b s.

Now, what does this model explain and how does this model quite an explain. So, let us say if living thing is the node and these are the pointers to the nodes. So, remember these are the nodes and this is the pointer which shows the spread of energy. So, what is says is when any node is activated energy spreads down equally to this nodes right and. So, when an node, let us say if a node lion is activated now somewhere across this lion will be related to this apple tree or this tree right some kind of connections would be there.

So, lion lives in forest and forest has trees and. So, they will be connected somehow on the Sather, but what this model particularly says is that when this is energised and if lion is the node which is energized and this is how the energy is moving then concept which are closely related together for example, lion mammal animal and living things, they will have a stronger connection stronger weight and. So, more energy will be spread here or more of them energy is invested into this node then further plants although plants are living things, but since the lion node in energized and. So, energy will be spread to these nodes.

So, birds will receive lesser energy similarly the monkey will receive lesser energy similarly feathered and non feathered birds will receive less energy also the no question of energy distribution here a very less energy distribution here, but the most energy distribution will be to the node lion mammal animal and living things and this is what this model says.

So, if first of all energy spreads it moves down and it moves down its spreads out. So, energy will be basically moving to all directions right and so, here the less energy is in invested in these parts then in this part and that is what the basic proposition of this model is also as I was talking about.

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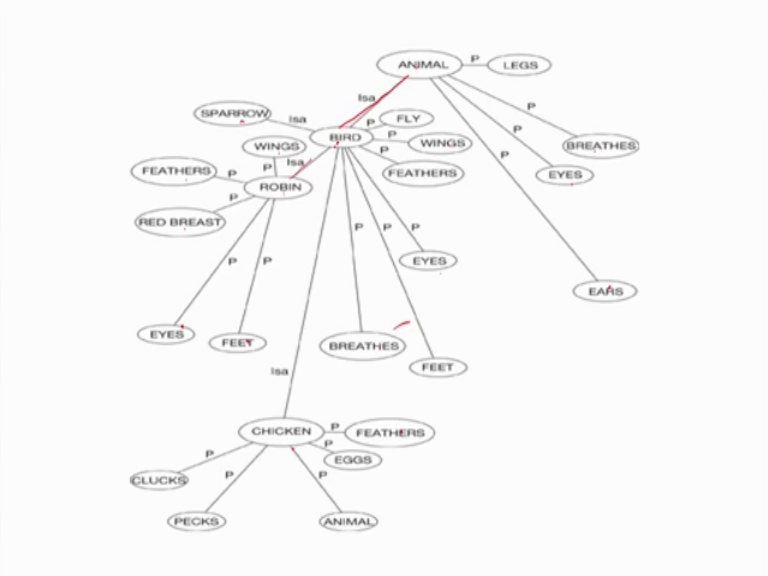

So, this is how the model looks like. So, if this is the animal node this is the bird node this is the chicken node and so, within the bird node you have the chicken node and. So, you'll look into it. So, let say if feet or if robin is activated then this particular node will be energized and. So, high energy will be or more energies spread into these node then the nodes with chicken or the nodes with I feathers and so, these also nodes these are also certain nodes which are they which are connected to pointers. So, these nodes will not receive and enough sufficient energy, but these nodes will receive sufficient energy and so, will these nodes because they are connected to robin also these nodes which are there legs breathe eyes ears and so on and so forth will not be receiving energy and so that is what the model talks about and this is a way of it.

So, basically this model is just an extension or the hierarchical semantic model; now only difference is that it talks about this spreading activation of how energy spreads when it starts when it activated at the top and how it filters down or it how it moves down from there.

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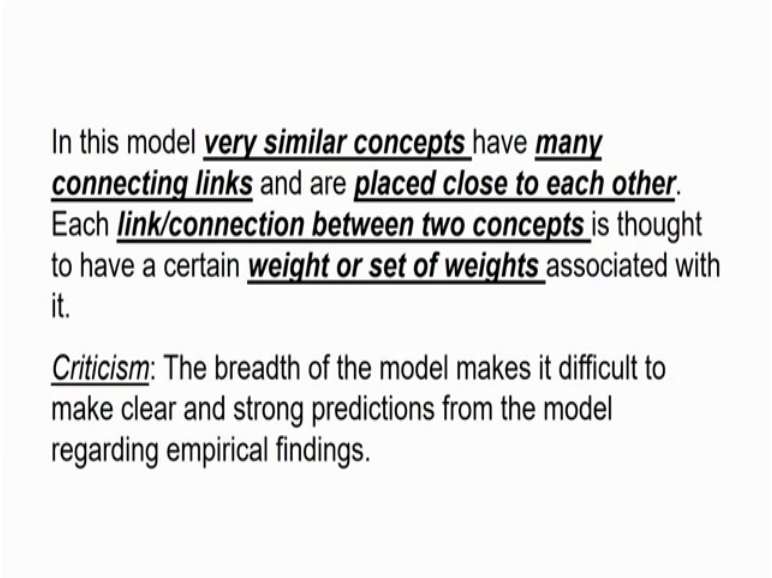

So, in this model the idea is that very similar concepts have many connecting links and are placed close to each other. So, what this model says is that similar concepts; concepts which share certain features certain distinctive features with each other they are placed together or they are blocked in some kind of a block which are which have very close proximity with each other right.

Now, or each link can connection between two concept is thought to have a certain weight or set of weights and as I was explaining now since two concepts are related to each other or they are placed in close proximity to each other; these links will have very higher weight.

So, as 2 links the more similar two links are more similar two nodes are the stronger the weight between them and the more energy or more energized they will become then two nodes which are dissimilar with each other now the criticism to this model the criticism is that the model is the breadth of the model the breadth of the model is. So, huge that it is difficult to make clear and strong predictions from the model regarding empirical findings. So, the model is so huge; it talks about that everything is connected to everything and there is there is this weight the idea of weight and the idea of how it is connected to each other and another problem with this model is what makes to concept similar.

So, this similarity concept or this idea of similarity has not been explained by model and so, it is a difficulty the genuine difficulty with this model of how do we encompass or how do we study this similarity that we are talking about what do we call similarity. So, are we talking about the defining features are we talking about the characteristic features what makes similarity similar and. So, this is one thing or one problem with this model and. So, in a position to this model not exactly direct opposition to this model another interesting model was proposed for semantic memory and this is called the Andersons ACT or ACTR model.

So, what is this model it was proposed by John Anderson in 1976 and it is called the adaptive control of thought model of memory it is also known as ACT; ACT star ACTR and so on and so forth. So, those of you who do modelling or who do computational modelling will be very familiar with the ACTR structure the adaptive control of thought now that.

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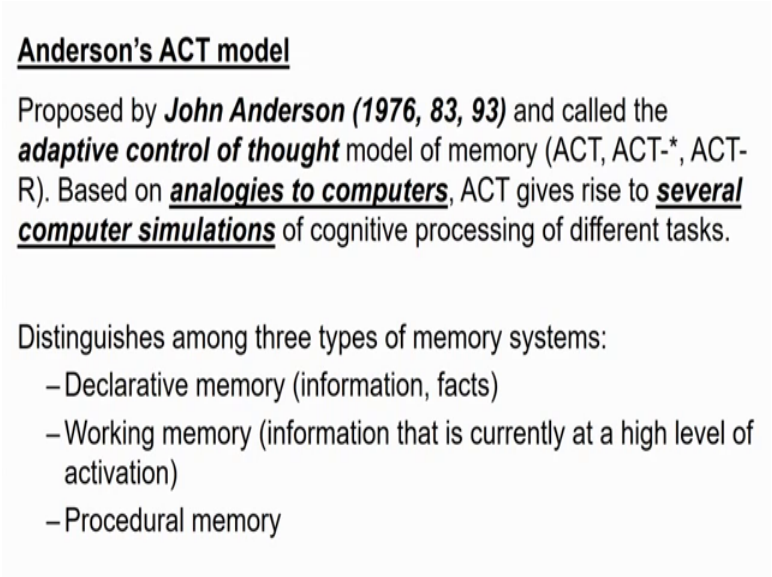

So, basically what it is a process model; it is a process orientation model and. So, this process or intension model basically it is a kind of a box point of model remember the first class that we did we talked about 2 kinds of model the box and pointer model and we also talked about the connectives model where we have unit a input link an a output link an a and hidden links.

So, the next model that we talk about the connectives model is basically of that type now this is a box and pointer model and. So, what does this model say? So, based on analogies to computers ACT gives rise to several computers simulations of cognitive processing in different task. So, basically these model has certain conceptualisations of how information in is stored in our memory basically world information or commonsense information with implicit knowledge is stored in all memory.

So, what are these conceptualisation the these model says now the first conceptualisation the this model talks about is that it distinguishes between the 3 type of memory systems it says that the human memory system is basically arranged in 3 different types or 3 different ways of looking into it it is arranged in terms of declarative memory.

Now declarative memories is that memory which will have more all information facts knowledge arithmetic rule world knowledge everything into it and so, there is no distinction of the episodic and the semantic here and so, this model looks at declarative memory is the store house of all kinds of information whether it is personal information whether it is self related information or event related information or fact related information.

So, first conceptualisation of this model is that they something called declarative memory and this declarative memory has all kinds of information that should be present or that is present in this world also there is a conceptualisation of working memory which is information that is currently at the highest level of activation. So, it talks about working memory a working memory is that kind of memory according to ACTR or adaptive control of thought model which we are using right now.

So, although declarative memory stores a lot of information it has a lot of information and. So, I will explain to you the how this declarative memory really works. So, basically declarative memory is conceived as a model with node the similar to the hierarchical semantic model and. So, there are nodes and these nodes are connected by weights and these weights are determined by the strength of the pointer or the similarity between two nodes.

So, basically that is how declarative memory stored, but declarative memory cannot on its own do anything and. So, there is a conceptualisation of working memory working memory is that part of memory or that kind of memory which is active at any point of

time. So, when I am accessing declarative memory the kind of memory which is accessing and doing all operations on to declarative memories called the working memory it is memory at the highest level. So, information access and information processing are all those operations which are doing the information processing and accessing memory from declarative store is basically what is called the working memory.

So, think of working memory as a part of declarative memory, but it is that part which is active which is doing the processing or which is running the operations or the rules of the game which it is running is what is the working memory and next weight is the idea of procedural memory.

So, procedural memory is a kind of memory which is procedure based, but it works onto or it works something like in terms of production rules. So, there are certain production rules we will come to explain that also. So, there are certain production rules there are certain ways of doing things and the procedural memory is basically a kind of memory which follow these rules and does a particular kind of an ACT right.

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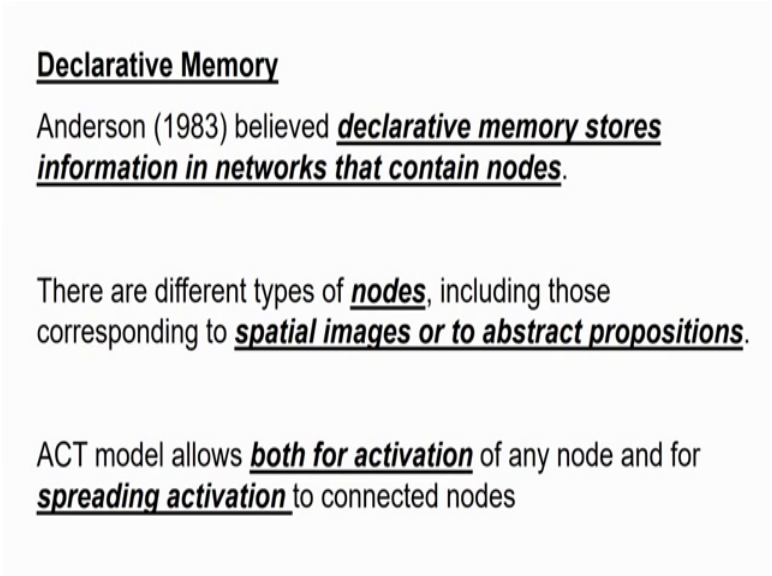

So, basically then this memory talks about declarative memory in this way; so, Anderson 83 believed that declarative memory stores information in network that contain nodes as I said before what declarative memory generally tends to do it has a large vast network and these networks has concepts which are stored as nodes and so, all concepts which have similar features or similarity base kind of matching is there. So, those concepts

which are similar are clubbed together and these have the highest weight and they the weight is basically the strength of how close two concepts and so, these have higher ways and they are connected by some kind of a pointer.

So, this is how declarative memory is all about now there are different type of node including those corresponding to spatial images and abstract propositions. So, basically instead of the conceptualisation of working memory by Allen Bradley where he thinks about there is something called the a Visio spatial sketch pads and phonological loop Anderson's model talks about declarative memory as network of nodes and these nodes are of two specialised variation one is spatial image; so, space related information and because this model is a conceptualisation of a computer program.

So, it has to define spaces and. So, that one way of looking into declarative memory is space information or space images basically what in a problem space how does somebody moves. So, use have to you have to know the boundaries of the space and the kind of a problems in a space and that is why the idea of spatial image or space image is there. So, nodes in declarative memory are of two types, either it is space related nodes which tell you the boundaries or the kind of problems or the kind of hindrances that you get while self solving a problem and so, that is space relation information or you have a abstract propositions.

So, abstract propositions are basically how things are related to another what is the proposition or what is the kind of rule which relates to information together. So, basically abstract propositions are how two rules are related to each other because these rules will define how a particular information is accessed. So, a rule a and rule b how they are related to together; for example, let us look at simple rule. So, if a infers b and b infers c which not necessarily means that c infers a. So, this backward propagation is not there and. So, similarly these kind of rules of what relates to what or kind of its part of a set theories.

So, how these rules are there how these propositions really work is what is stored in a particular node now also ACT model allows for both activation of any node and for spreading activation of concept. So, it basically encompasses or it basically includes activation of node and spreading activation to be true. So, if any node is active the node will pass this activation on to related nodes and non related nodes together, but related

nodes will have higher energy and non related nodes will have lower energy and that that is why it also agrees with the idea of excitation passing over to nodes and the idea of what spreading activation is all about.

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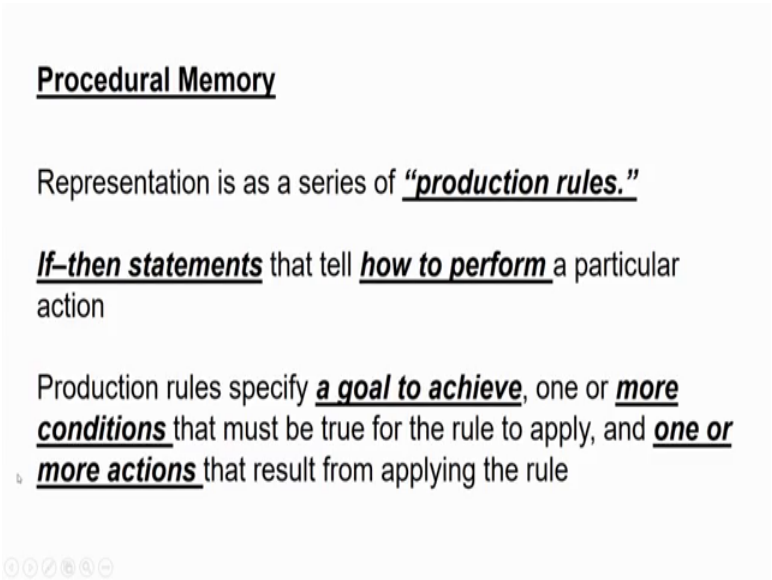

Further this concept the ACTR the adaptive control of thought it talks about procedural memory. So, what is procedural memory it is representation of a series of production rules. So, basically the procedural memory works in this way. So, there are certain production rules of how an act should be done now these production rules generally have a goal it has a starting a goal and certain kind of conditions a certain kind of goals to be followed. So, basically it goes in this way that if you start somewhere now this start and then there is a goal state.

So, reaching to the goal state I will basically within the goal state and the start state are certain hindrances and certain rules that you have to follow and if you follow these rules and overcome this hindrances you will reach the goal stage let us try and explain to you what this really means. So, let us say that it is a festival which is going on and. So, just near where you live in your hostel rooms or wherever you live the place near that everybody is singing in a very good mood, but then you know that there is an exam right.

So, the idea is that tomorrow you have an exam you are living where you are living and just beside the window of where you are studying in your home lies or in your hostel lies a program where people are shouting and marrying together or they are making merry

now the thing is that the goal is to pass the exam with good marks the starting point is a position where you where you are sitting right now and then there are rules and there are hindrances to it the hindrances is if you are there, then basically there will be so much sound that you cannot read and the certain and the rules are that you should not disturb them. So, you have to follow a rule the rule is that certain rules have to be followed.

So, basically you have if there is a lot of people. So, you cannot stop them by rule they are free to do whatever they are to do, but the rule also says that there are certain possibilities which are here production rules is there are certain possibilities here for example, one part one solution to this problem is going to the library, but it also has the rule that the library starts at 9 p m. So, wait for 9 p m then follow the rule of the library were my rule of the library nobody can shout there.

So, even you people want they cannot shout there and so, one way to reach your a goal is to and to get out or get away from this hindrances is pack your bag after 9 p m go to the library study there till the rule permits come back and pass the exam nicely. So, this way you have enjoyed till 9 p m whatever is happening after 9 p m move out of there follow certain rules get rid of certain obstacles go to the library which is the solution to it and then pass the exam and the; so, this is basically achieving the goal state following certain rules and certain hindrances.

So, basically these production rules or this procedural memory generally if then statement which tells how to perform a particular action; so, if this happens then this is the kind of thing which is there that kind of a thing. So, if you want to study for a exam together to for yes for tomorrow, then you have to find a place which is silent if to have to find a place which is silent then you have to do this.

And so, there are certain rules hindrances goals and four part system which is there we will talk about this into problem solving into when we come to the section of problem solving also production rule specify a goals to achieve one or more conditions that has to be true for the rule to apply and one or more actions that result by applying the rules.

So, as the I explained to you there is a goal to be achieved there are certain conditions that should be fulfilled. For example, if you go to the library that will be silent and the rule says that it has to be silent then. So, you have to go there and then these are the conditions pre conditions and one of more action the action is getting your books going

to the library studying there and then coming back and so, this is how the conceptualisation of working memory or the idea of ACTR really talks about in terms of procedural memory.

So, basically in terms of ACTR it is about three memory systems which interact with each other and they lead to the formation or storing of memory data into the human brain now basically then this is how a simple ACTR model will work and so as you see this is the declarative memory.

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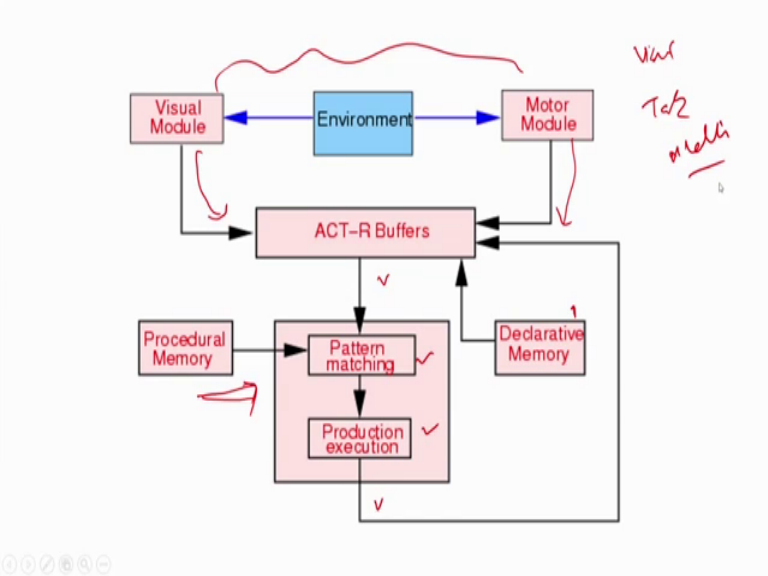

So, you have both the motor module and the visual module. So, 2 modules are there and these collect information from the environment the motor module contain special information the visual module contains those proposition abstract proposition which are there and combine to something called the ACTR buffers ACTR buffers then also gathers information from procedural memory because the procedural memory will tell you how to exactly go about to the procedure of doing certain things; so, basically how to go about the storing things.

So, declarative memory is these 2 parts are the declarative memory and this information comes to ACTR buffer the ACTR buffer then talks to procedural memory which tells you the procedures which tell you what is to be done and. So, the 2 procedures are pattern matching and production execution and based on that you will come to again to the ACTR. So, this is the input and this is the output and the output is again fit to the input

and this kind of a change goes on and on. So, basically any module or any kind of information which comes here is processed through this kind of a thing and this here it is a simple visual task matching program that are designed and so, as you can see this is how this model really works the ACTR model really works.

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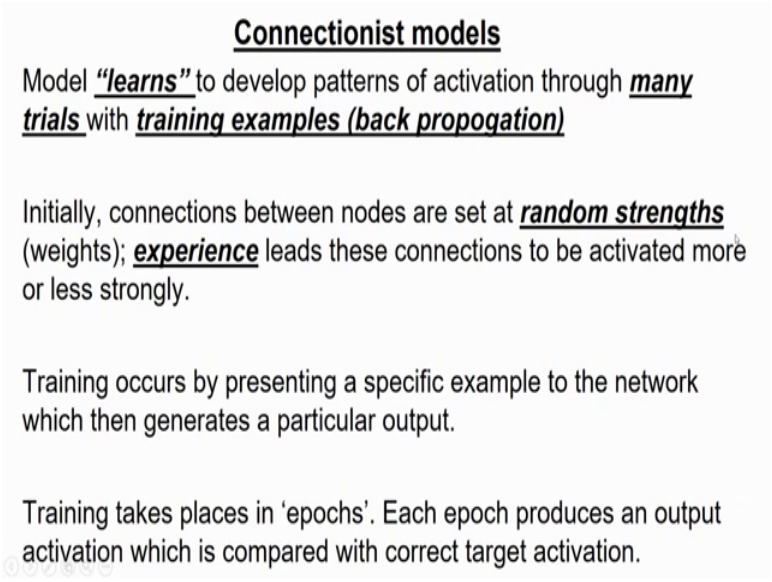

Now, in addition to the ACTR model interesting another model which has been proposed is called the connectionist model now what is this model? It is a very interesting model and this model does not conceptualise the way the we thought about how things are stored either is networks or memories or in terms of concepts or in terms of knowledge network of knowledge or in terms of three kinds of memories they do not conceptualise this in this way.

So, what connectivist model think about is that what is stored they say that what is stored in the memory or what is stored as world knowledge is basically a set of changes in the instruction of neurons which send to each other affecting the pattern of activity that can be constructed from a given input what does it really mean it says that what is stored first of all it; it is kind of a copy from the biological model.

So, as we saw in one of these classes I explained to you how memories stored as memory is stored as interconnection between neurons and so, what really happens is memory is basically a connection or it is a basically a path from one neuron to the other neuron and. So, what this model says is that what is stored between 2 neurons is not knowledge or

concepts what is stored in the memory is not knowledge or concepts; it is set of instructions which are stored and which has passed on from one neuron to the another what are these instructions these instructions tell a particular set of neuron which are connected to each other to process how to process data and. So, there are certain modes of processing and so, these instruction basically ask neurons are basically instruct neurons in processing.

So, let us look at I will briefly these define this model is a very huge and complex model for trying very briefly define this model for you. So, basically this model learns to develop patterns of activation through many trails with any examples for or example back propagation.

So, basically how this model links or how this model really works as there are certain input layer there are certain input features or input units now unit have has is a pattern is a unit is thought about as item which receives input from the environment and. So, this unit then passes this information on to a hidden layer or hidden unit or hidden related set of units which are there; for example, verifying robin is a bird if was very simple statement robin is a bird the robin as soon as the robin unit is activated it will unit it will activate all related units with the bird with it right.

So, things like bird has legs bird has feathers bird has beaks bird has a different colour and so on and so forth. So, all these units will get activated now how does this model really work. So, it has a input unit and this input unit when they get an input some of these hidden and there; there is a lot of hidden layer there is lot of hidden input which is there and so, what happens is the strength of activation or there is a number of inputs which are there, let us look into this model first of all. So, basically this is the connectionist model of a robin and so, this is a lot of inputs which is coming from the environment.

So, when you see robin for example, this is the bird that you are seeing and so, only when robin is activated all these things which are coming from the environment is deactivated that point of time only the robin mode is activated and this robin mode now; then connects to this hidden layer.

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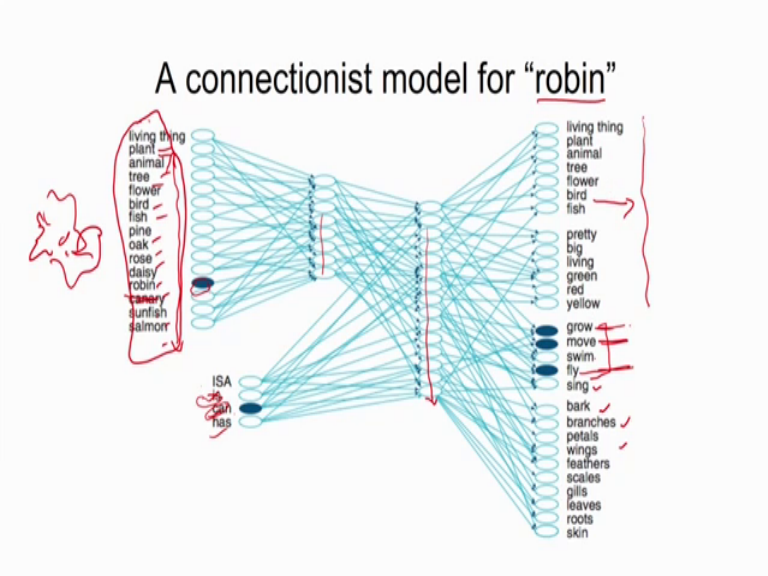

So, robin is; so, basically if I am activating the word robin; robin is basically a bird and. So, basically is has this is basically the kind of a connector to robin which can get activated basically robin is a bird robin can be a bird robin has a bird all kind of connectors are there and. So, robin is activated or can is activated and. So, this activations further linked to this hidden model or this hidden layer and this hidden layer then basically gets trained and from there the thing is now robin is a particular name and can is also a particular name.

So, what can robin do robin basically can be both a bird and a person right and so, when I see a robin in the environment the node which is activated is robin if I am saying this is activated and robin can. So, what can robin do if it is a man if it is a human thing it can do these many things, but if it is robin can also be an abstract thing and so, when it is an abstract thing it can have several other features with it.

But when it is a bird then it can do all these things it these nodes are activated because the bird can grow the bird can move the bird cannot swim in. So, this is not activated the bird cannot sing. So, it is not activated may be it should activate the bird cannot bark and. So, it is not activated the bird does not has branches and. So, it is not activated.

So, when a set of input node is activated these input nodes has a number of connecting nodes with it right. So, when I look let us assume an example where I look outside of my window and when I see several things I put my attention on to robin now this robin has a

bird these are bird and. So, there are certain features of robin which has to be activated and. So, basically this model then says that if robin is activated similarly will be activated the word can robin can and robin can do what. So, you see a robin or you see a bird which is on the on where your attention is followed, but there are several other things which are there.

So, there will be several other nodes which can get activated, but your attention is focused on the robin and so, what robin can do is it can grow it can move it can fly and these 3 things are the only one which should be activated bird could also be activated, but then other things are related to all other things that we have seen in the outside in environmental world and so, basically it will not get activated.

Now, how does this model really works? So, this model says is that the input layer basically it learns. So, when an input layer is activated it activates related layers with it related hidden layers with it and. So, it at the beginning of any input cycle the strength between the input node and the hidden node will be random weights.

Let us say, if 0 and 1 are the two liable weights which the in input layer and the hidden layer would have at the beginning of any propagation or the beginning any inputs signal the weights between the hidden layer and the in out layer would be 0.5. Now as I said there are number of factors or the number of items which compete with each other to start the input and since robin has started the input it will change its weight right. So, so the weight of robin will become 0.8 from 0.5 to become 0.8.

But all other weights for example, tree house all other things which have been captured at the same moment, but attention has not been put to this weights of these will change slowly change to 0.2 to 0.3, 0.1; 0.15 or so on and so forth; only the robin node is activated and so, the weight of this will increase it will increase to 1, 0.8 and so, the in hidden layer will learn this. Now hidden layer will also get some information both from the perceptual system as well as from memory system because robin is activated. So, the memory system will also feed in some information and so, for example, robin can robin has robin kind of a thing.

So, it is present tense and s, can would be activated and. So, can will have a higher weight that will the weights will change to 0.8 and similarly there are certain features of what robin can do now robin can fly robin can has a beak it, it can do these it can do sing

it can have colour and all those things will be activated not other ways will not be activated.

Now, basically this model then what it does is from an input it generates an output and with that input output system it starts learning right and. So, where how what is the meaning of learning each time particular input is selected and output is generated the connection becomes stronger and stronger more stronger the connection the more faster the learning and. So, this kind of model basically is a learning model. So, let us look at what this is a and so, this is how do we train this model.

So, first you show the model that robin is whatever it is. So, any bird you show the model any bird it can do these things and this can basically result in this kind of a feature and so, it is a training example from that training example show it the model or a bird now you have started with the idea of bird.

So, from robin change it to parrot and let see how the model behaves now parrot is very similar to robin. So, as soon he identifies that it is closer to the concept robin. So, it will then adjust the bed between it and the when the; in input system and the hidden system as zero point eight it will learn this and similarly output all the features that it is output for the concept a bird and it goes on doing this and so, training after training or time after time it will then develop that this is the feature of what should be of a bird. So, next time you present it a bird that it does not know which are not the training; example it quickly classifies this as a bird and then output and list of features that the bird is going to have.

So, initially connections between nodes are set a as I said this set is set at random which experience these connections to be activated more or less strongly. So, the more closely each time when it produces an output these output is compared to a set of true features this output is connected is basically match to what should what should be expected as an output and the closer the match the better the training. So, if is not closer then the medal model adjust the way it is accordingly and either deletes some of the features or increases some of the features and this goes on making the way. So, it goes on making the number of connections.

So, training occurs by presenting a specific example to the network with that generates a particular output. So, you start with let say parrot and you teach the model that if parrot occurs if parrot comes in these are the features you need to output next time you start the

training with say a sparrow this is what it is. So, slowly the model or slowly the input layer will understand that once something like this is presented something like a bird is presented because it gathers those features then these are nodes which has to be activated and so, the nodes which have to be activated then gathers a higher weight and then the output which it which it should present.

So, also tell it the output; so, when I show a parrot show me the output that it can fly it can wing it has wings it can do this it can do that that kind of a thing and also show me the ways for things it cannot do and. So, match it with this idea that parrots can fly. So, this is a verified sentence. So, this is a true sentence. So, verify with that.

Now, next after so many trails after say 50s or 100 trials when you show it may be different kind of bird for example, let us say crow and what does the model do when you show it a crow although you do not tell the model this is a crow the model adjust the way its accordingly and says that it has a beak it can fly and so on and so forth because these are the pruning programs.

So, you train it with some examples and then the model learns on its own and start adjusting the weight. So, it will also give you with the crow it will also give you inputs output like it is black in colour it has 2 eyes beaks these are the generic things, but certain other features also it will tell you also training place in epochs. So, basically these training they go about in epochs and each epoch produces an output activation which has compared to a correct target activation.

So, this how model really works and as I said these are number of things are these are number of input systems which are activated only robin is activated and. So, what will happen is only these connections are energized and all connections have starts having lower weights and. So, since this feature is related to this feature.

So, these features add on to this model and. So, only a b c as you can see is activated here and others are not and. So, when it gets training the in the next training round on the next epoch it will also learn that it is a bird it will also learn that it is red or green in colour it is also learn that it it has wings and feathers and so on and so forth and so, more number of outputs will be activated.

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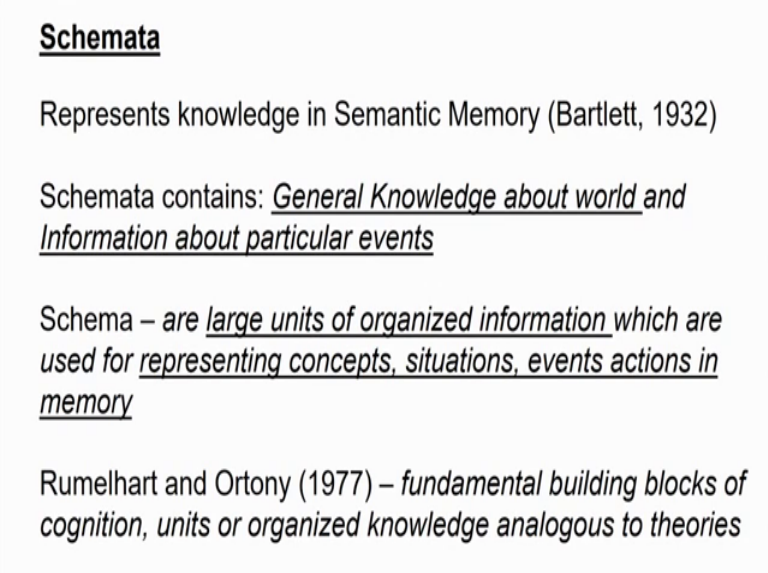

So, it is not only that through this models we can explain semantic memory there are 2 more concepts through which we can understand how semantic knowledge or world knowledge is arranged and so, 2 more of this concepts a one of the famous ways of doing that is what was proposed by Sir Frederic Bartlett and so, what Bartlett did was he did a very interesting study and he showed that there is a lot of reconstruction in memory and this reconstruction is how. So, what he says is that what semantic memories stores is not an exact representation of what happens, but a gist kind of a broken down version of the information that is what is stored in our memory.

And so, we and his experiments he presented something called a war of ghost a story to and the couple of people and the story was a complex story it has many relations and many kind of information into it they were so inter pieced and they were so, closer to each other that was very difficult to a break the story apart and.

So, this story was presented to a number of people and when these people who were presented they were asked to recall this story after a certain period of time back what really happen is that most of the people remember the gist of the story the main idea of the story, but they forgot the basic features or the basic some basic things about the story for example, names places these were mixed up, but the story the outline the story was what was there and so Frederic Bartlett says that there is a way of storing these kind of

information or general world knowledge information and that is what a schema and so, then look at what is a schema.

So, basically schema represents knowledge in the semantic memory that is what Bartlett's proposition is there is something called a schema. So, what is a schema then a schema contains general knowledge about the world and information about particular events. So, it is not only consisting of general knowledge about world, but it also has information about particular events. So, it has both declarative as well as semantic; semantic type of information on to it now schemas and large units of organised information which are used for representing concept situations events actions in memory.

So, basically a schema is kind of a huge it is a huge box kind of a thing we have lot of information could be presented into or could be put into and these information when they are put into the sort of act together or they sort of work together; for example, Rumelhart and Ortony in seventy seven they proposed that the fundamental building block of cognition is this schema.

So, this schema has information stored into it kind of a world knowledge it is kind of a guideline or what should be expected for example, the schema of let say a village now the schema for village basically says that these sings. For example, a bullocks fields green fields water bodies people farmers trees animals this should what should you expect in a village you should not or you cannot expect a car or modern building or an aeroplane in a village and so, these are the kind of things which is expected with the kind of which is not expected and those schema for village will have this kind of a information.

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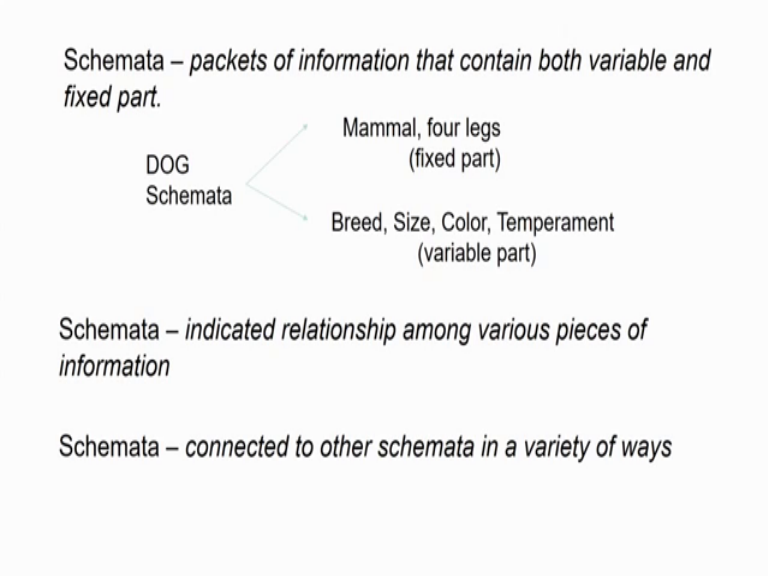

So, basically then schemas are packets of information that contains both a variable and a fixed part for example, if you look at the schema for dog the fixed part of this information is that it has mammals and 4 legs because the fixed part is sad across all instance of the schema. So, any dog we look into it will be a mammal and it will have 4 legs, but then most schemas also have a variable part and the variable part is where we where this feature they change across instances or change across variations of the schema and. So, things like breed things like size colour temperament these might change across dog.

So, you might have an also scent; you might have a Pomeranian you might have a scent Barnard or you can have any kind of dog which is there you could have a very light tempered dog a heavy tempered dog a highly coloured dog or non coloured dog a Chiwawa kind of a thing which has a very strange kind of a thing sizes.

So, as I said you could have great in which is very high in size you can have Chiwawa which looks like more like a cat and so on and so forth. So, within dog variations could be there, but then the fixed part is that all dogs have or all dogs within that particular category or that say schema should be same also schema indicate relationship among various parts of information.

Now, what do I mean by this if I am talking about a dog now the idea is that the dog should have a head and this head should have 2 eyes only the tail should not be coming

out of the head and or the nose. So, basically there are certain relations which are there among certain parts of the dog and that is what is; so, the rare of the dog should have the tail and the forward of the dog should have eyes and the colour of the dog should be in this variation the hand leg should be here the 4 leg should be here this kind of interpretation should be there.

So, schema indicates that the relationship among the various pieces of information should be there; what is the fixed piece and what is the variable piece and what is the relation to each other. So, dog which has legs coming out of the eyes is not actually a dog or instance of a dog, but a dog which has eyes coming out of the head is basically a kind of a dog and so, this is the relationship and so, the leg should be below the eyes and so on and so forth.

Also schemata connect to other schemata in varieties of ways. So, not just one schema and number of schemas can be connected to each other one schema of particular thing can also be connected to on the schema of some other things.

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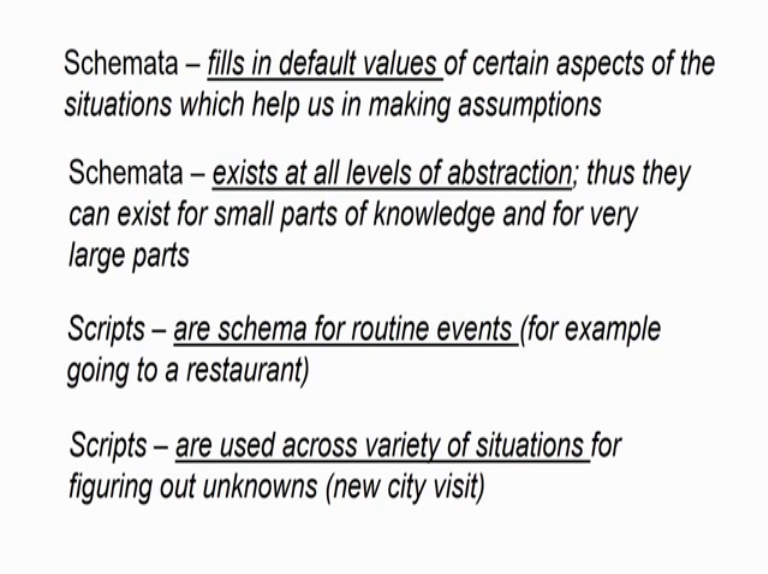

Now, schema has also used for filling on in default values of certain aspects of the situation which help us in making an assumption. So, basically this schema tells us as I said the schema tells us what is to be done in a particular situation. So, let us say if you are in an exam hall the schema says that or if I am telling you a story of how I met my roommate, school; class roommate for the first time I do not need to tell you that what is

my age because most people turn to school around 18-19 years and graduation school around 18-19 years. So, this can be out of filled that this is what your age should be and. So, when I am talking when I am referring to a friend as her you I do not need to tell the gender of this field. So, this can be out of filled our schema will provide this kind of a things.

So, when I was talking about a gender I am taking about my roommate is a her then the idea that this is the female is automatically comes in also schema exist in all levels of abstraction thus they can exist for small parts of knowledge also. So, basically what it means is that schemas can be for very small knowledge abstractions for example, certain letters written in certain kind of ink letters or it could be the schema could also exist for greater details for example, like the theory of relativity.

So, there are certain schemas in the theory of relativity for example, the fabric of time the idea the time dilation happens the idea that there is something called the space time were space meets time and then this variation. So, those schemas and also very small schemas of how a certain letters can when combined with each other give us a perception of a different letter. So, that basically a that level of abstraction also schema should work. So, right a in this way and it becomes a b or b in this way you have seen those letters right calligraphies or certain kind of letters and also they also are a certain level of schema identification.

Now, related to the idea of a schema is the idea of a script now script has schemas for routine events for example, going to restaurant. Now what is a script think of in this way when you go to a restaurant there is basically a 4 part meal system right you start with the soup or some kind of a beverage to start with, then there is a first course, then there is the main course, then there is a sweet and then you wash your hands you pay the bill and you move away and so, basically this is what a script is a script says how the schema moves in time how the schema moves across.

So, what is the production rule for a schema or what is a procedure of a schema or what is the procedure for routine event is what a script is all about now scripts are used across a variety of situations for filling out unknowns; for example, let us say that I visit a new city right. So, I visit some city, I am living in a some city in I am living in India and I go to the u s now when I go there I did not think what a restaurant should be and how

should a restaurant function because it know from India that this how a restaurant function.

So, most restaurant should function in the similar way it is not that in those restaurants something else will happen the same idea of what I have in India should be a capture of an incident there and. So, scripts certainly help us in organising information or filling up information or a basically how we can use it in different scenarios.

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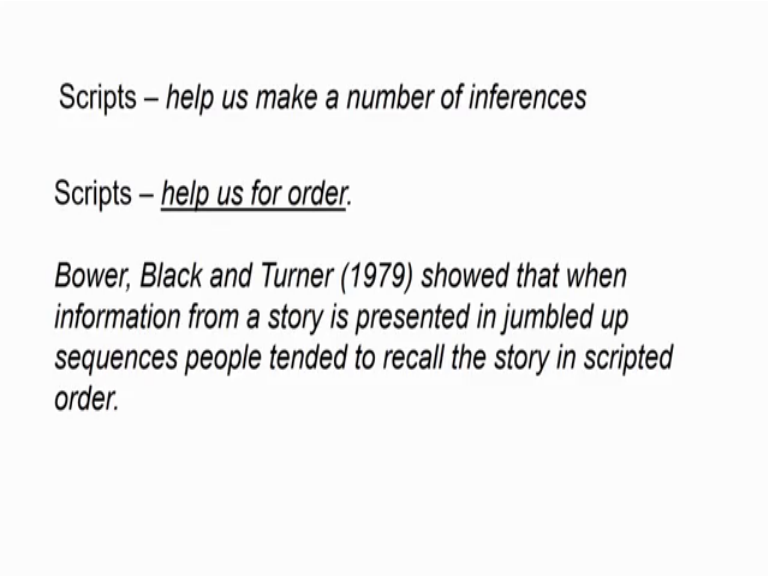

A schemas also scripts also help us in making a number of inferences now what do I mean by that when I say that you have you can get a number of inferences.

So, a particular script when defined it shows you that; what is the result of this particular thing. So, if a main course is there what is a result of this main course in a dinner what is the result of the or what follows for example? So, if I say that I i went to the restaurant and I ate my food and I came back basically you fill in your head that you might have paid the bill and that then you came back and. So, this filling it information that you arrived the restaurant with someone when into the restaurant sat at a place. So, when I say that I ate food in a restaurant today basically the all other ideas of you sitting in a restaurant having ordered the food eating itself is filled up.

And so, they this information this inferences can be made from it that you had paid the bill and come and you have not run away from the restaurant and come out and so, these

inferences can be help also lastly schemas help us in making an order and so, to this to test this particular thing how schema makes us the things perceive things in order this bower black and turner they did a particular study.

And so, in this study what they did was they presented a story and in this story the story was made in such a way that there was several concepts in the story and they way in a unordered form. So, some part of the story the climax of the story came before and beginning of the story was in the somewhere in the middle and the middle of the story was somewhere in the back and that kind of information was presented to people.

Now, when a recall was done most people remembered the story in the right correct procedure in the right scripted order. So, although the scripts was deviated people remembered in the right way for from how it began to what was the climax to what was the middle part to what was the climax and how it ended right. So, no matter if you inter mix the kind of sequences of a story or sequences of a particular event or routine event this schemas or this scripts will basically help us reorder these things together.

So, basically what we did in today's class is we looked at some other models of semantic memory or world knowledge memory into it how do they work and what are the pitfalls of some of this model criticism of this model we also the connectionist model which is a very interesting model. So, if you are looking up for taking up computation modelling you can either use ACTR or connectionist model as a these models are interesting models of how they product because these models also use for generating artificial intelligence systems or learning systems.

So, basically this; what we discussed there and then from there we also looked at another way of storing information in terms of scripts and schemas and so, this brings us to the end of this lecture.

Thank you.