How The Brain Creates Mind
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**Lecture - 12**
Cognition and Emotions-2

Welcome again with this picture of Tower of Babel.

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I think the human mind itself created the story of Tower of Babel, because how were different the various structures and various complexity, the geography, and history of brain may appear; it is still smart to find out it is own way of communicating, through chemicals, through electricity and with this all single neuron activity of electro chemical transmission of signal; the brain also so it involves cell assemblies, whatever wherever their situated they can always find together and then this huge network.

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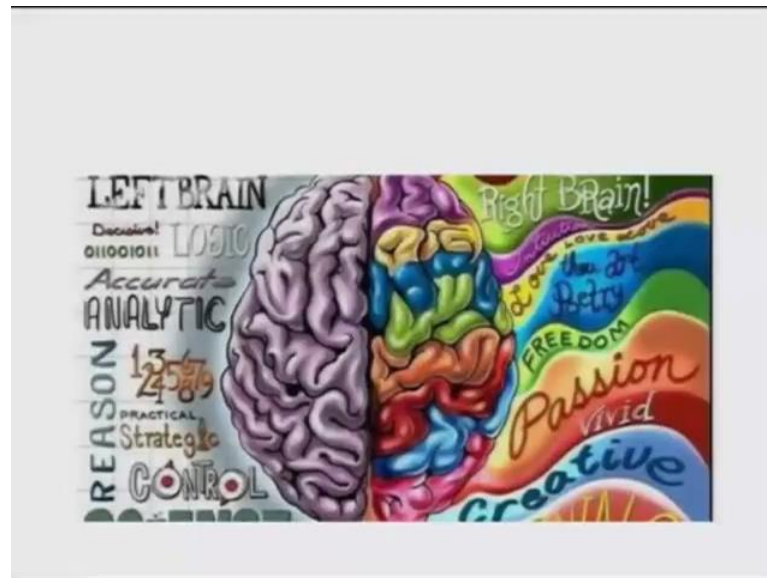
Let us see what more it can tell us. If you see this picture and just read this word if you can read some of them love, freedom, passion, creative, strategic, control, left analytical brain, right intuitive brain, that is what is understood, but this whole plethora of activity is created just by these networks and assemblies.

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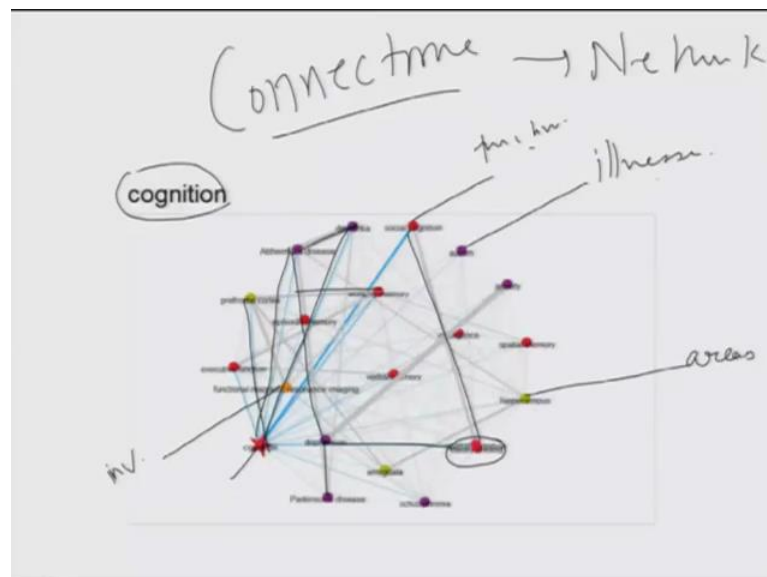
This is very interesting because it is just an example. How the networks of the brain, this is actually has involved the graph theory has become popular in Neurosciences research these days. And graph theory says that there are nodes, these nodes are interconnected
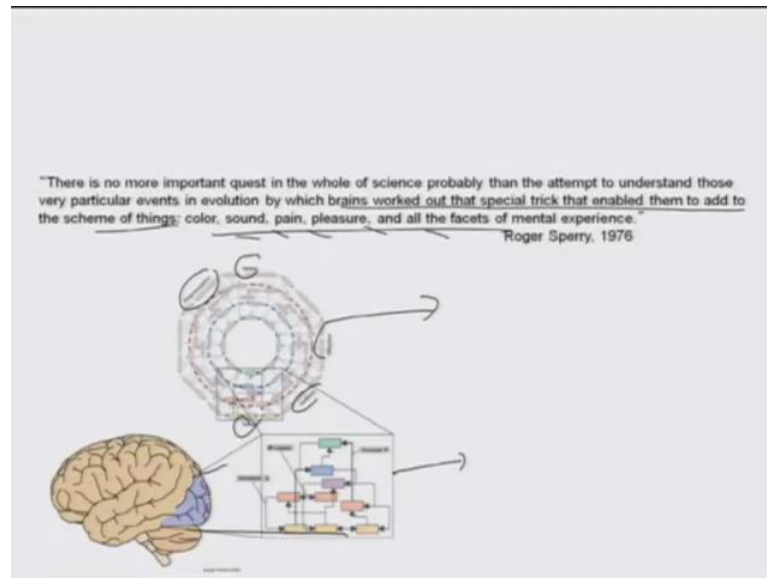
the various roots and various. So, somebody I think this is one of the sites, I do not remember I think it is called "brain scan" or something. They have tried to really see. So, you see this various colored things, all these red areas are basic functions of brain, mind. These greenish areas are the brain structures and these are illnesses, and this is how they are created and this is this oranges are this are investigative, these are areas, these are illnesses and these are functions. Social cognition is connected to cognition; executive function is again connected to working memory. Episodic memory is again connected to cognition. Prefrontal cottage is connected to working memory to cognition. Alzheimer's disease dementia is again connected to cognition.

Cognition is connected to Alzheimer's disease, social cognitions connected to theory of mind. theory of mind is the way you I told you about mirror neurons, theory of mind is about thinking, about what the other person is thinking; that is how your brain perceives you cannot think what and this is very strange now that this word has come up we think that we think objectively, but if you look at it our thoughts most of time they are they arrive from what others are thinking. So, in English there is sayings, which say this small minds think about people, medium minds think about incidents, great mind thinks about ideas, but this is the myth, is a very difficult things is there because all our thinking, see there is no human endeavor in this world, which does not concern humans. Even if you trying to make a robot it is about humans, if you are trying to make weapons it is about human, you are trying to make some small utility, thing it is about humans.

Our brain has developed this theory of mind of what others are thinking. So, our brain what we think; we can think, or we think is abided in what the other is thinking, so lot of our self has been formed by others. So, we do not even have a solution, if he say this is me, my me, does not have only me, it will have so many input from my friends, from my parents, from religion, from everything which has gone in. So, I have derived from you. So, whatever philosophy and other people may argue, our mind does not work in isolation.

So, you see Parkinson disease is depression; they again go connected with this type of resource. This is the graph theory network, which is very popular and the lot of there is a guy called Olaf sporns, he has brought out a theory of what we call a "connectome" and it looks that network theory of brain.
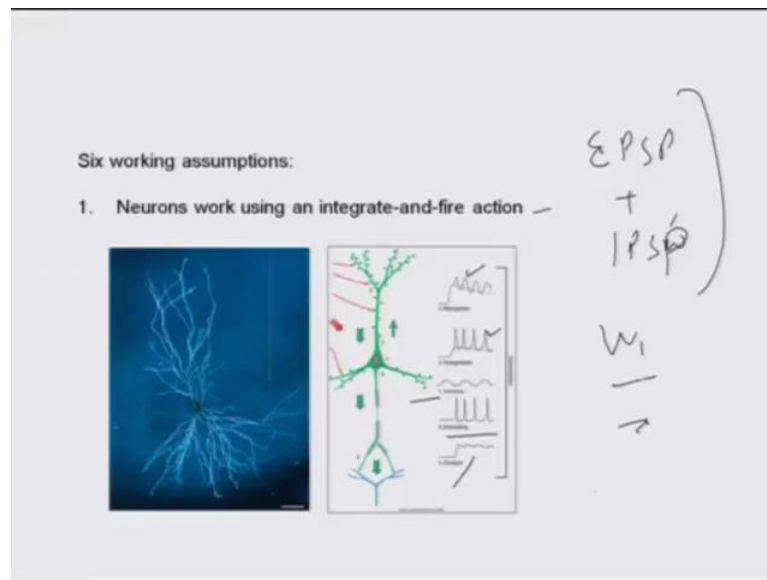
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"There is no more important quest in the whole of science probably than the attempt to understand those very particular events in evolution by which brains worked out that special trick that enabled them to add to the scheme of things: color, sound, pain, pleasure, and all the facets of mental experience."
Roger Sperry, 1976

So, you can read about it, there is lot of level on the net, there is E-books also available, or maybe towards than if you find time, we discuss this. So, there is no see, this again a representation of the type of network. There is a motor prop reception that is the (Refer Time: 05:30) is going from the joint, visual auditory (Refer Time: 05:33) and this is the type of network which connects with visual thing. There is no more important quest in whole of science, probably than the attempt to understand those events in evolution, by which brain worked out the special trick that enabled them to add to the scheme of things.

So, in the general scheme of things, the brain has evolved in a way where it has taken this all these things, and trying to integrate into a mental experience.

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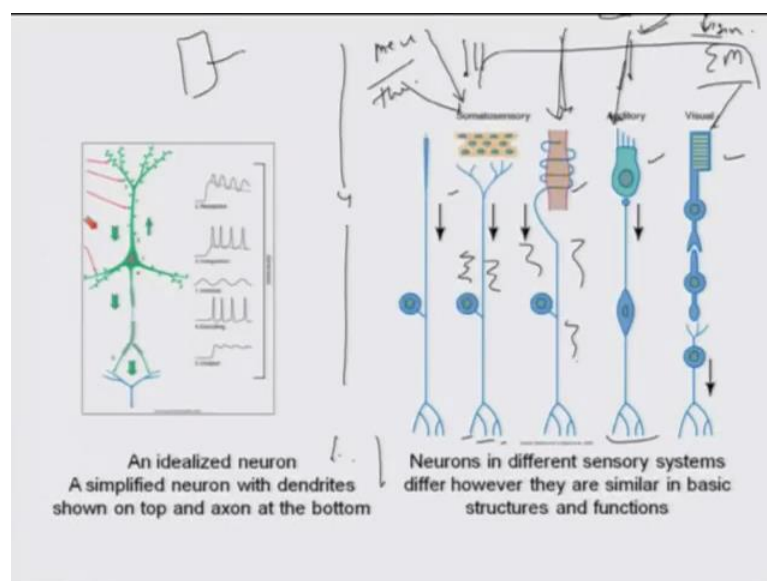
So, the big question still or maybe I will ask you the big question at the end of it, you know this and you know this the all thing we talked about it right. Is again these are different type of 50 type of neuron are there, these are some of them visual or auditory somato sensory why have they differentiated like this all also students should have idea because see all the somato sensory touch pain from joints, auditory is sound, visual is like vision, why are they different because from here everything maybe electrical energy, here everything maybe a chemical energy, but when it comes from the environment the energy transfer is different. These are sound wave's pressure waves, through which you
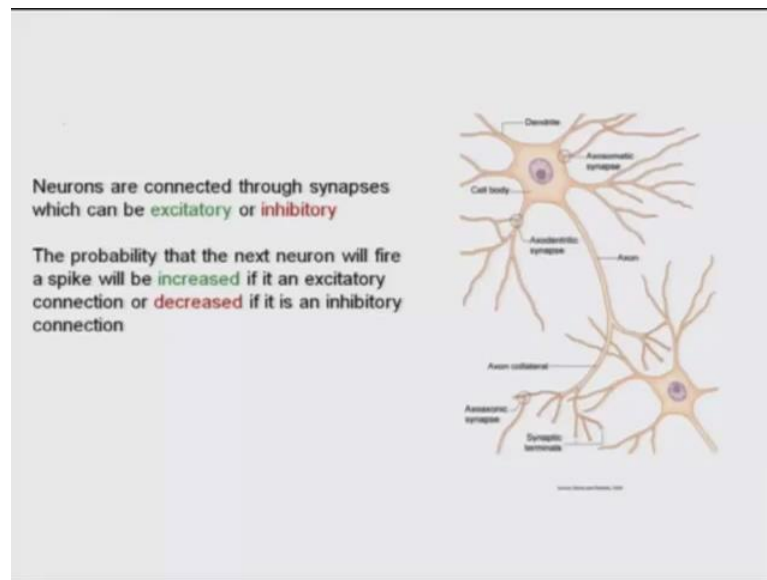
here. These are mechanical or thermal depending on heat and all that and this is electromagnetic.

So, brain is smart enough to evolve in a way that, this will catch the photon; this will move in respond to the pressure mechanical wave, this will respond and that is how you get all these things. Ultimately everything converts to electrical activity, getting transmitter through chemical activity. So, this energy converts to electrical energy, electrical energy converts to chemical energy, and maybe chemical energy again to electrical energy and once you have cortex decide. So, let me give an example, if somebody maybe shows you a fist. So, it is actually the electromagnetic thing which is going in the moment and goes after lot of processing in 200 milliseconds to your or within 100 milli seconds is a reflex action.
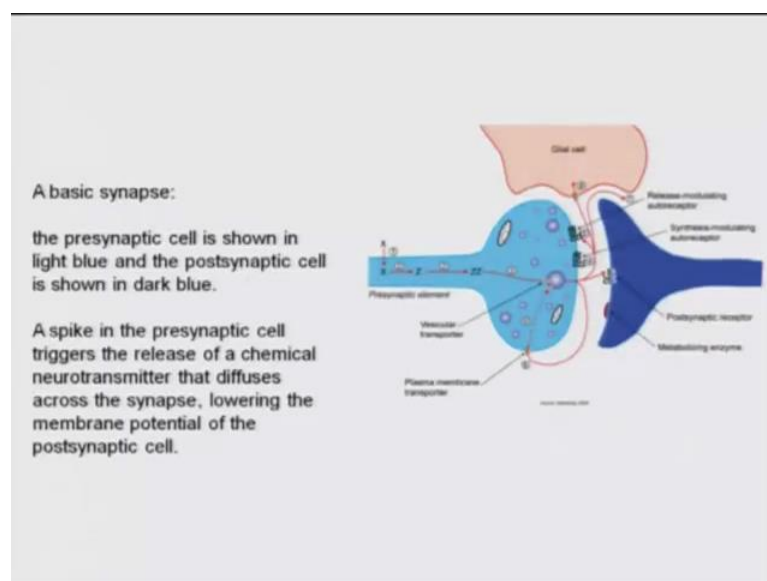
So, reflex action does not go to the conscious level, we will talk about it when it comes to it and you decide to punch him back like this. So, it is possible that this energy which is gone in, as undergone chemical electrical changes and finally, electrical energy is again converted to what to mechanical energy in pushing this, this energy cycle is complete or if it touches the heat goes in, changes to electrical activity goes to chemical, again to electrical and your hand pushes again that maybe that cycle is complete. If broadly look at energy transfer, but what if you do not if you do not move you suddenly think, then how does this electrical activity change to thought.

So, when you fearful then, how does this electrical activity change to emotion. What is that transfer, that is the biggest standing question of brain right now, and that is what David Chalmers a philosopher calls a heart problem of consciousness, we will talk about it when we talk of consciousness.

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Neurons are connected through synapses which can be excitatory or inhibitory

The probability that the next neuron will fire a spike will be increased if it an excitatory connection or decreased if it is an inhibitory connection

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A basic synapse:

the presynaptic cell is shown in light blue and the postsynaptic cell is shown in dark blue.

A spike in the presynaptic cell triggers the release of a chemical neurotransmitter that diffuses across the synapse, lowering the membrane potential of the postsynaptic cell.

So, this we know they are connected to synapse, excitatory inhibitory connections is a basic synapse again.

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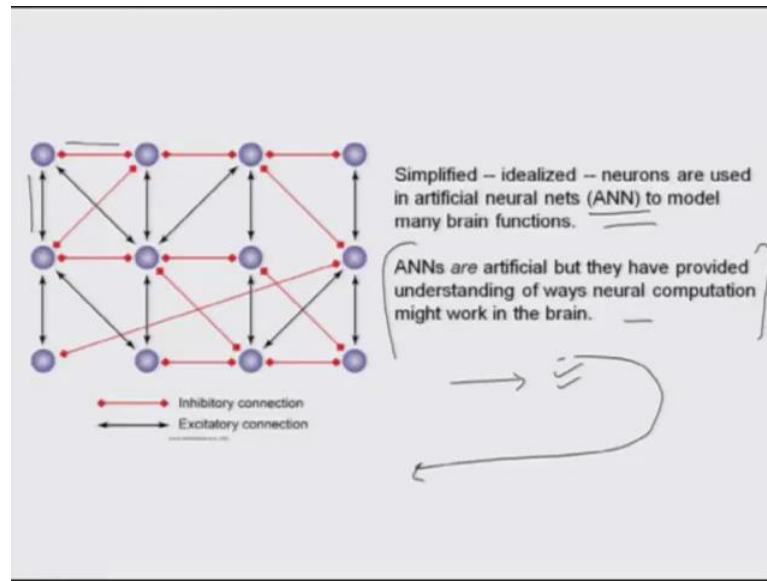
So, this simplified very idealized type of neurons are used in, artificial neural networks. Our activities to train the neural networks like brain, so, the whole ANN thing wants to stand that we want to make a machine, where neural networks will automatically become more intelligent, feel emotions, decide, but that probably it may come, it may come on it is own, but right now because we do not have full understanding of the brain as I told you the biggest question, the heart problem ANN are artificial, but they have provided and that is where the value lies.

So, what they started in creating a brain like think, their work has given us some understanding of how the brain functions possibly, again I am not saying that all that is real. The success of technology does not mean always that the basic (Refer Time: 011:03) it may be below variables, which may work. So, this is a typical idealized thing this red ones are inhibitory and these are excitatory and this whole summation like we look at the pitch neuron on half field thing.

The 6 working assumptions with neural networks they use integrate and fire action, integrate what integrate EPSP IPSP right, and the weightage as my (Refer Slide Time: 11:35) says. So, is like this, this is a neuron, is a reception, integration right. This is an intrinsic firing going on, there is encoding and there is output. So, integrate and fire integrates whatever is coming to it, integrate that do all the summation.
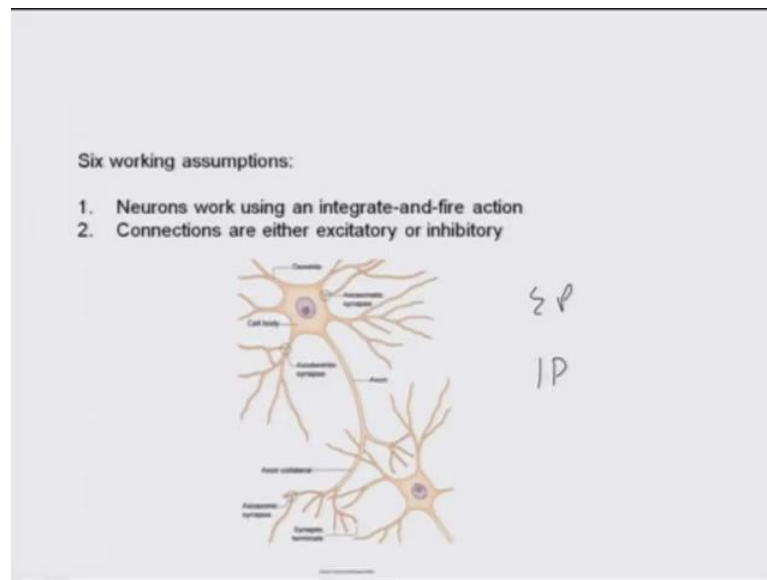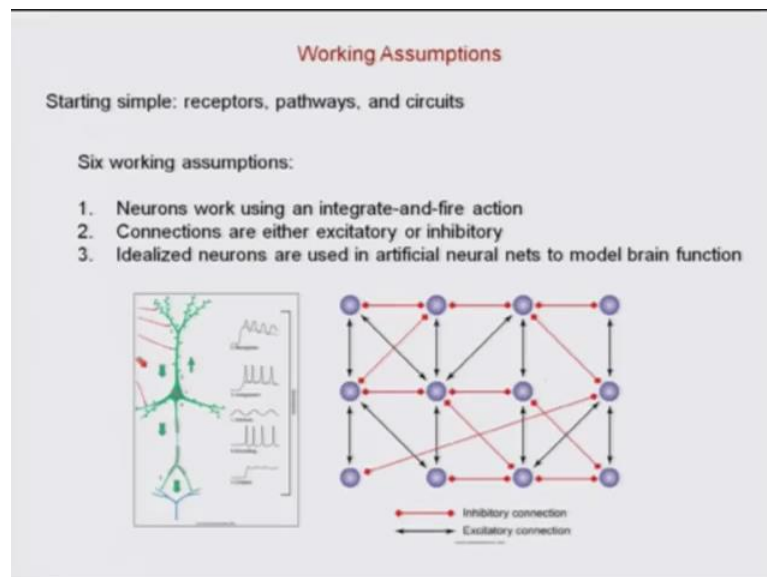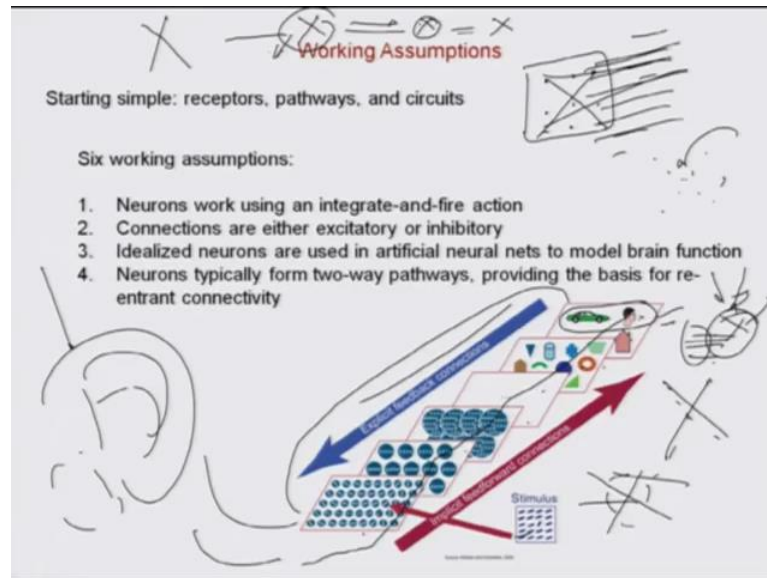
And fire connections are either excitatory or inhibitory, we know this EP or IP idealized neurons again as I said, neurons typically form 2 way pathways providing the basis for re entrant which is called a "feedback" thing it will not be always just the whole thing comes in fires it, goes output over.

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It will keep giving feedback to the higher center, to the lower center, what that determines whether it is going to respond to it or not like, is explicit feedback connection, these are objects right, these are stimulus, these are stimulus which formulates here, it is from here it goes here and you finally, see this is a feed forward thing, feed forward means if you keep feeding in stimulus; all the stimulus, will keep getting integrated till they give you representation of the external world and the feedback again this representation of the external world in the brain, again goes back to the point where you are seeing it. You are seeing something, are you really seeing it in 1st place. Whatever is going in is a light from your eye or a sound from your ear; it gets converted to the same electrochemical signal.

So, do not get confused, this is the real state of Neuroscience is where we do not understand anything. Now suppose there is a structure like this and there is something called suppose X now this X has to be transmitted in your brain. Things go from here from here, from here, from here, these are this is all electrochemical activity and from each point this separate data is set is going maybe thousands of neuron, again within the brain these things are integrated to form this x thing over which intrinsic maps will also act.

So, what you are seeing is just a representation of this external acts, object formulated through the various integration. Now the big question is, will the neurons fire in the

pattern of x, only these when is neurons along this lines? No, it is very unlikely thing is, do neurons fire in this pattern and all the other neurons are invited by the side, what is your guess; take your guess. Is very unlikely because there will lot of thing which are going on from side also, so the chances are all clusters of neurons are firing from which this x has to be deducted and presented to whatever higher cortex. Internal imaginary and memory will also contribute to this. So, there is external object it is image, I told you left feel, I right feel there is internal image, which will compare with whether x is already existing, these will give a composite image to the higher cortex.

Now, if they are same it is wonderful, but if they are not; then the brain will always prefer the image which is relating directly to the external world, for survival. Suppose there is a lion's face which comes to your head lot of firing goes on feature extraction, your brain reconstructs a hazy picture of a lion, but your internal imaginary seeing your girlfriends face on that image. What is brain, going to prefer the brain will prefer the external imagery because that is the threat right. and this will be suppressed, take it vice versa that it is your spouse's face and she or he appears to like a lion, who is going to eat even then it will prefer, the brain will prefer, but this type of stuff goes wrong.

So, the internal image is suppressed by the higher center, but this goes wrong in something when hallucinations are happening. Hallucination is feeling a perception without the really stimulus outside. So, the whole thing will go like this because the brain starts believing the internal imagery and that is when you call it closing touch with the reality, we are in touch with the reality because we are in touch with the external stimulus. In hallucination we will lose touch with the reality, because the internal imagery super imposes or goes beyond the required intensity.
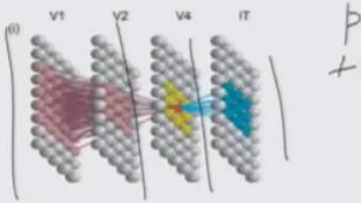
So, every second, every instance, lot of inputs are going. So, what happens? Brain keeps forming maps, of whatever is going on? These maps are like pain maps, like touch maps you remember that parietal lobe thing; your face is represented all those are maps actually, maps coming from the face, maps coming from the ditto, maps coming from this visual maps, auditory maps, tonotopic maps, so these are like layer, after layer, after layer, after layer, basic layer of networks, then there is a layer which of thought of layer emotion, experiential mapping it, they just grows in complexity.
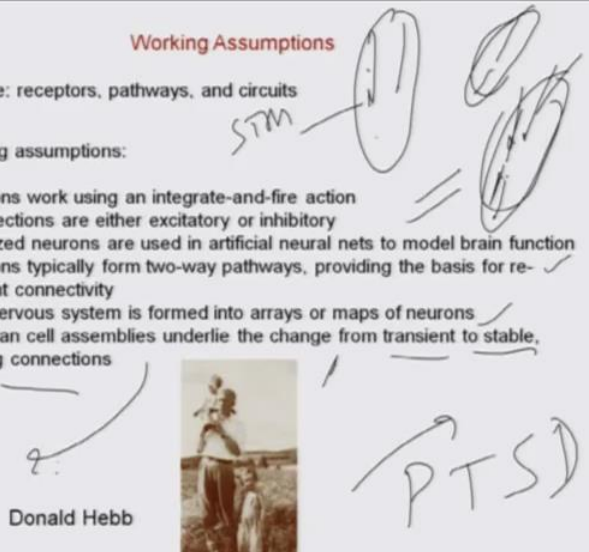
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And this is all what doctor have said which, so with the work in integrate fire, excitatory, inhibitory, neural networks, neurons and hebbian cell assembly, presynaptic force and presynaptic firing together, from transient presentation something comes it fires, it goes here. Now if this re firing does not appear, then it will be a transient thing, which will come and go you will not remember it.

So, presynaptic force when they fire repeatedly together again and again, it is transferred to stable lasting connection, so that repetitive re entrant firing is very important. Suppose one, something stimulates here, few cells and the postsynaptic also fires you forget it do not bother, but if it happens repeatedly that, how phobias are formed that. So, fear comes in or sometimes the repetitiveness will also not require. With the natural calamities like earthquake and if you are exposed suddenly in a short time with the huge amount of emotional stress, it can alter the synapse in one go.

It will be so strong that, really happens that the disturbance will immediately be preserved, that will only happen when there is a huge threat to survival like it happens natural calamities; lot of people even after that probably that is the basis of illness called "post traumatic stress" disorder one earthquake and there be lot of people after months also in their dreams, they will be seeing the same thing, when they are I have not talked about sleep yet. What have we are talking about is immediate one of firing, viz a viz repeated firing, which establishes the connection between pre synaptic and that is the short time memory, how it is short time memory actually goes into long term connection, is a different state of mind, we will talk about it.
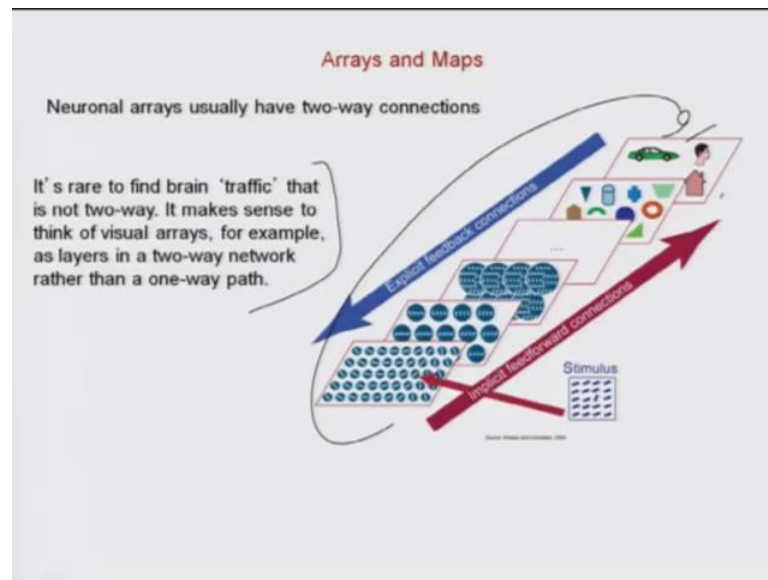
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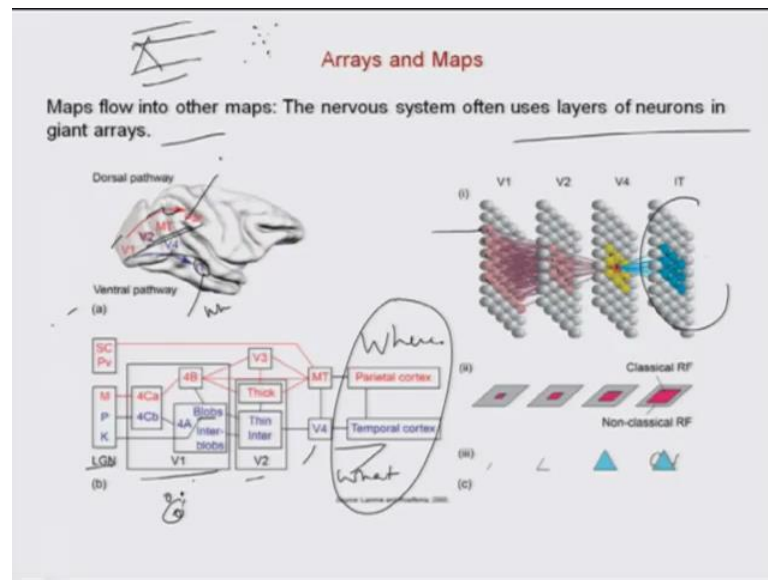
So, is like this see maps flow into each other, the nervous system often uses layer of neurons in giant arrays, this is just one example these are the areas of the visual thing, V1 V2 medial temporal v4 inferior temporal whereas, if you remember what where.

So, this is the type of lateral geniculate nucleus is where, all the visual input come where left right things are represented. It goes into V1 we are they blobs. Blobs are like these small areas, another between this are inter blobs. So, blobs may get activated the areas surrounding it may get animated, now you look at it what I was talking about x, the lot of a stuff may go in, but when it goes to cortex, it is still will form like this. These areas will activate which will form the pattern, then you go to V2 there is a certain area which judges moment color goes to temporal, which says what parietal says where, space and time. This is space, this is time. Temporal comes from it and this is the type. So, this is just arrow diagram, now look at it this is the type of stuff which goesV1 the huge data decreases, again this comes to this 2 way connection.

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It is very rare to find brain traffic, that is not 2 way. If you can make one way path way, you can still see, but what are you going to do when you see it, you have seen it there is nothing to give a feedback to after have seen it.

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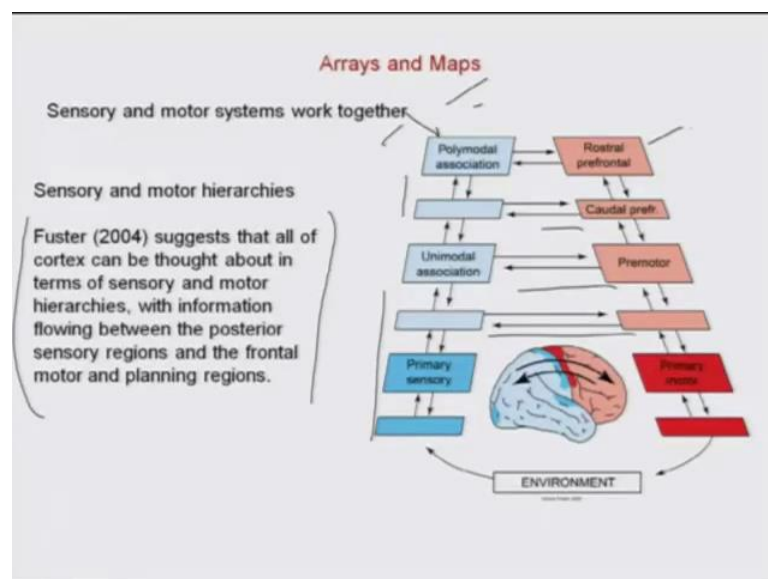
So, this higher cottage which is seeing it, will always give a feedback to the basic visual cortex from where stimulus is being coming or maybe to eye we really do not know.

So, if you remember there is the parietal lobe, there is the frontal lobe, there is the differentiation. So, sensory and motor system they work together. All cortex can be

thought about in terms of sensory and motor hierarchies, with information flowing between the posterior sensory is where all these things are come to frontal, there is a polymodal, polymodal means proper reception thermal this that and. So, the primary sensory areas here, the whole thing comes here, there is the different thing pre motor rostral prefrontal means from the front so this, if you all senses go, your brain will sit on all senses wait for it to decide it will not go it is not going to happen. All senses go because it has to decide whether you are going to move, you are going to do something, but you are not going to do something.

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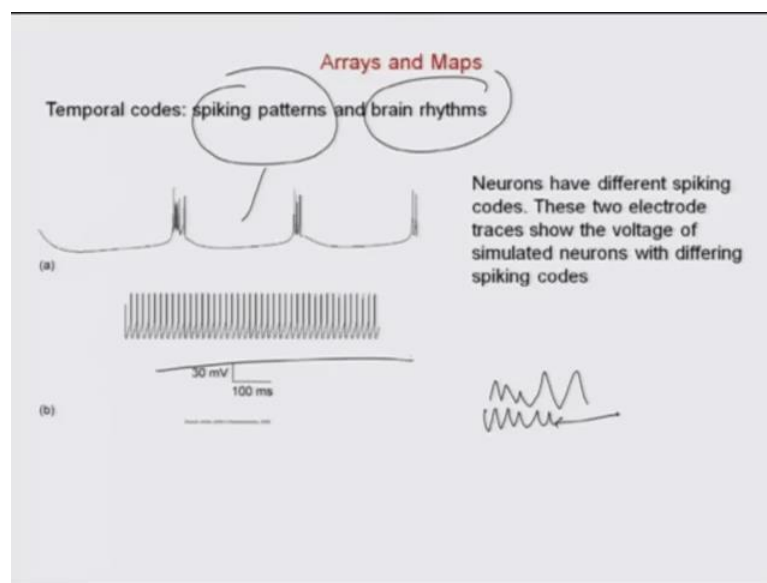
Now, now you can connect all these drama of network, maps, everything is going to happen through this spikes and brain rhythm. Now get back to your oscillations, where I told you that over and above this spikes are happening, these spikes ride over this existing patterns, to get integrate every new information and memory into the already x in one. So, I spike and rhythm, they are 2 most important things; you have seen this is Necker cube.

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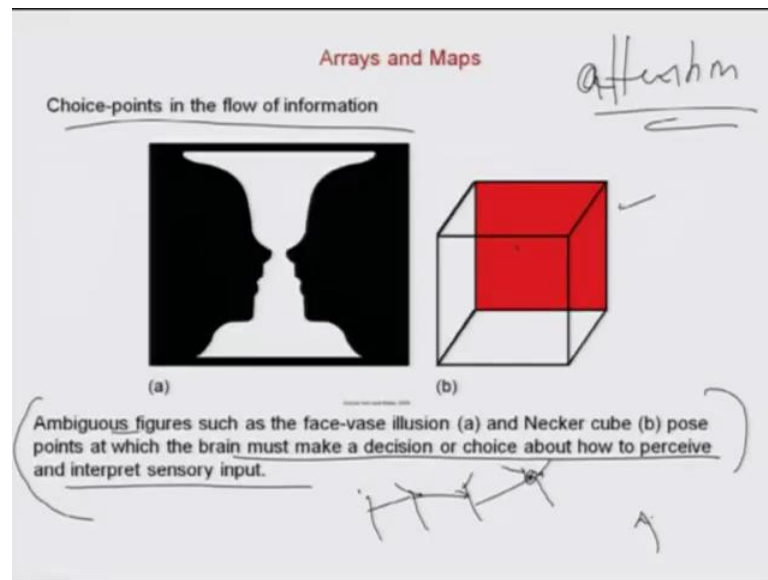
So, I told you about ambiguity, brain does not want ambiguity. So, ambiguous figures are point in which brain has to take a decision about how to interpret sensory input. So, the debate is whether brain has a well (Refer Time: 24:36) or whether brain has a conscious thing in it, whether brain has with do that is a philosophical debate is different, but whether they must be a will or intent, because will and intent decide; attention. Whether that will is free will is something is a different issue that will talk about when we talk of consciousness.

So, there is the choice points in the flow of information, even between this networks between 1 and 2, there is always a choice point. Now these choice points are decided by the unconscious firing of the brain or is there a conscious choice that is million dollar question still unanswered. whether I am seeing this vase or faces or whether I am choosing this, whether I am seeing it like this or whether I am seeing it the other way when the red comes out. So, this is what has said.
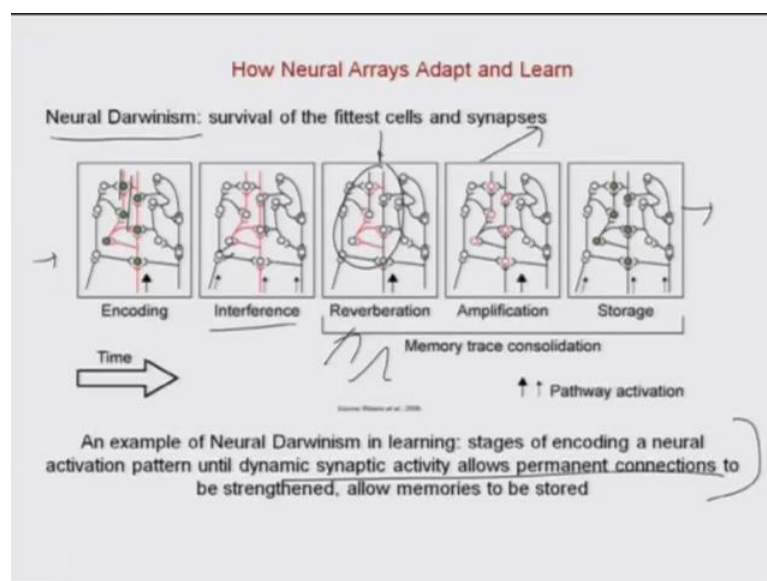
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So, now, the question is, if you go back that brain since set has been formed, when it was simple nervous system it has learnt; how does it transmit, it is still transmit's; how does the other next brain learns? How to do it; how does the memory brain learn about it? So, like Darwin brought out the concept of natural selection, that all the good things which help you survive, are retained in your genes and that is called survival of the fittest.

Adelman brought out this concept of neural darwinism, that once the brain has responded to certain thing, a certain way. And it has help it is survive, it will keep repeating that and

that is if you remember you can always attach it to pleasure and pain principle, reward and punishment. The sudden is a brain, which give you, which make you pleasurable feeling; when you are doing it. So, you will do all those things again, if you are having a painful feeling or a negative reinforcement, you will not do it.

So, always when a talk of people doing seen an addiction always they get a kick out of it. You may tell them it is bad. A bad brain is giving them a kick; it may have come out of conditioning. Conditioning means environment has worked down this neuron to train them again and again and again and again and that has passed on. So, this is encoding of any behavior in the brain, this interference from various other sources right. So, this red thing again keep firing in the so what is left, this is the encoding which is happening now interference has gone this is left, this will keep reverberating, firing again and again and again and the whole thing will amplify finally, it will (Refer Time: 27:30) storage this is neural Darwinism, stages of encoding a neural activation, pattern, until dynamic synaptic activity allows permanent connections to be strengthened and that is going to be passed.

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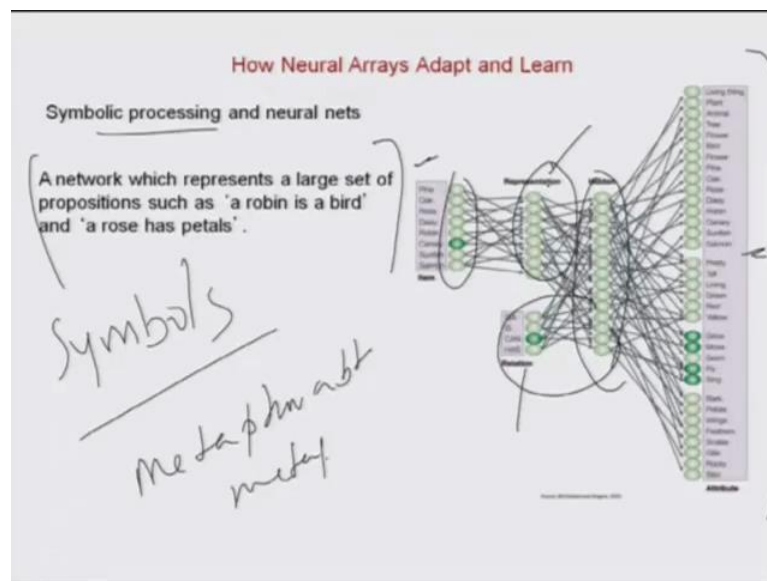
This is symbolic processing again. So, the brain represents a large set of propositions and. So, brain is actually if your (Refer Time: 28:00) handling symbols or you can call as metaphor about metaphor symbolic processing, this is a pen somebody what have started calling it a donkey, so you would have been calling a donkey, sometimes this word called pen has got associated with this thing. So, this is the type of thing, you see item

their representations, their relations and attribute. Rose is a flower, it smells good. This is the attribute, this is rose representation will be the petals with colors and then their hidden thing which are emotional.

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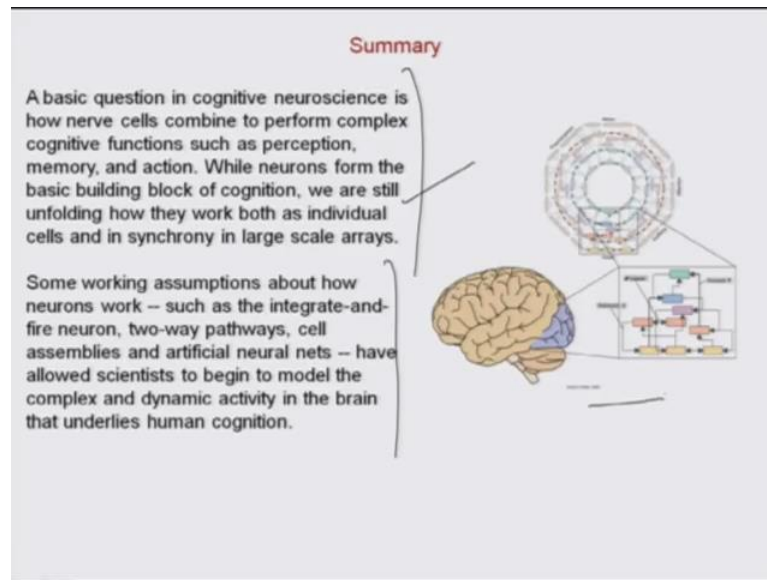
So, this is from a simple item, which attributes, representation everything really boils down to this huge symbolic representation in the brain. Somebody is how nerve cells combine to perform complex cognitive functions, they form the basic building block, but some working assumptions we know, but we still have to answer a lot and we will see and explore it in next few lectures. So, there will be more questions and they will be less answers. I will leave the questions to you so you can carry on the next 50-100 years of research, but I hope you got an idea how networks form and.

Thank you. I will see you in the next lecture.