Cognition and its Computation
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Lecture - 01
Introduction

Hello and welcome to this course on Cognition and its Computation. Human thought has been always a point of interest to us humans for centuries together. How do we process information? How does information get stored? How do we have several thoughts together? Why do we select one kind of thought? Why does our mind wander? What exactly is the mind? All these questions have been disturbing us or have been bothering us for ages.

And humans from the early days have tried to explain this, phenomena of cognition in multiple ways. Now, this this idea about cognition has emerged from historical perspectives of the soul to the mind to thought and to specific units, individual units of information processing and these have been studied in different groups by different discipline's altogether.

So, as you can well understand the studies of cognition have is interdisciplinary and it engages multiple disciplines. Like mathematics psychology, physics, evolutionary biology, cognitive science, computer science AI, social sciences linguistics and the new psychology as I mentioned earlier and the like. Now these so the approach to studies of cognition have been different and these approaches have explained cognition as a representation of knowledge and processes or and processes underlying human thought and behavior.

With the core assumption that human cognition is a computational process. What do we mean by a computational process? That it can be calculated, it can be processed into single units. We can break it down to units and why so is because it is implemented by a neural hardware what does that mean that there is a neuroanatomical and a neurophysiological connection that brings this or that integrates into this process of human thought knowledge and behavior.

Now, these studies of cognition as I mentioned have also created multiple debates and cognition studies that the long-drawn debate on cognition is between the classical theories and neuro physiological theories. The classical theories on cognition draw a strong analogy between cognitive systems and digital computers.

These theories are termed as the connectionist theories and the term connectionism is primarily used for neural network models of cognitive phenomena constrains solely to behavioral data as opposed to neurophysiological data. A classical example of this this theory of the connectionist theory is the analogy drawn by Atkinson Shiffrin in 1968 to explain long term and short term memory. He uses the analogy of the computers to explain long term and short term memory.

By contrast the computational neuroscience is primarily used for understanding cognition from the neural basis. So, that is by creating the neural network models that are constrained to neurophysiological and behavioral data. So, instead of using computational mechanisms to explain the fundamentals of cognition, neuroscience tries to explain computation of the neural network models through the neurophysiological and behavioral data.

So, in our course here on cognition and computation we will be primarily focusing on this how to capture this neurophysiological data. So in fact, or rather I should say the basic units how to capture, the basic units of cognition or basic units of information processing from behavior from the human functioning. Now, this course is a 12 weeks course and we have divided the course into several modules.

So, I will just brief you today about the things that we shall capture or cover in this course. This course is a preliminary course on cognition and its computation. Many of you who are students of biology might find it a little lucid and we are always keen to provide you with extra information, but we will we will try and make it as informative and instructive as possible.

So, in the week 1 we are going to; so this is a blend with the two teachers and we shall be sharing the course my colleague Professor Sharba Bandyopadhyay is a neuroscientist, he primarily works on cognitive neuroscience and he is going to talk about the neurophysiological mechanisms.

I am a psychologist so I will be talking about from the perspectives of behavior and functional thought processes. Now, in as I said you know so this will be an intermingle between two disciplines trying to explain the same phenomena. So, in week 1, we shall be talking about and its going to be a basic introduction to cognition and the brain and we will be discussing about the history of cognition studies the evolution of brain and behavior.

And here we will be talking about the cognitive revolution, how it emerged and where we are now, how we have evolved from the studies of the soul to the mind to the brain and to single units or neurons of the brain, to the neurons and glial cells. Now, then we shall be talking about the brain anatomy and its the functions and focus a little more on the frontal lobes, because frontal lobes has been identified as a seat of cognitive processes.

So, we will be talking about the front loop and its role in decision making, planning and primarily other executive functioning. In week 2, we will be talking about the measures for cognition measurements of cognition and brain activity. And here we are going to talk about neuropsychologist measurements oculometry as a measure to the planning and coordination in through you know in cognition. And we will be talking about electro physiology through EEG of course we will also try and capture fMRI and MEG.

And then we will talk about single neuron measurements and single neuron imaging and manipulation of neural activity. In the 3rd week we will be talking about computation by neurons. So, how does the neuron capture information and how does it pass on that information? So, this we will be talking about, we will talk about synapse, synaptic, plasticity and move to the neural circuits in week 4 and week 5.

So, this is going to be a little detailed in week 4 we shall cover neural coding and we will cover the different sensory circuits in visual and auditory systems. And in week 5, we are going to talk about somatosensory systems, other systems like olfactory and gustatory systems. And finally, move from sensory circuits to motor circuits and here we will talk about the sensory motor integration and then move to reward circuits and executive circuits.

In week 6, we come back to behavior and here we will talk about the human, how does he attend to things, how does he focus on information, how does he perceive objects and

here we will be talking more about the from the perspective of cognitive psychology. So, we will cover attention, theories and processes, the different types we will cover the disorders of attention. We will speak about perception, object, depth, and movement perception and how does perceptual constancy happen. Does it help or is it a hindrance to perception and in this we will be talking also about illusions.

Then in week 8, we move on to learning and memory, both week 8 and week 9 we will be covering learning and memory. In week 8 we will be talking about the theories of learning and memory, errors in memory. So, we will discuss about forgetting and the other kinds of errors that one might have, like we will discuss in this perspective the eyewitness testimony and we will talk about learning and memory disorders.

In week 9, we move on to again the second part of learning and memory. Here we will be talking about the biological aspects which Professor Bandyopadhyay will be covering and he will talk about the biological neural networks and learning and different types of plasticity and he will be talking about also the disorders. Week 10, we will focus on speech and language and here we will have we will talk about the components of speech, speech production perception animal communication.

So, can the animals do animals have a language? How do they communicate? So, we will be also discussing this and we will talk about language and thought with an emphasis on speech and language disorders. In week 11, we move to emotion and decision making, here we will be talking about theories of emotion, the limbic system, problem solving, decision making and the role of the frontal cortex in decision making.

So, we spoke about frontal cortex and its anatomy in week 1 and we come back to frontal lobe and frontal lobe functions in a specific psychological phenomena that is or a cognitive function, that is decision making. So, we will be talking about the frontal cortex in decision making.

And finally, in week 12 we will be talking about topics in current research. So, we will pick up topics that are being talked about, now being researched now and how we approach these scientific, you know how we approach the simple processes, cognitive processes from a scientific perspective.

So, this, so we will also be talking about certain debates and controversies in these studies. So, this in a nutshell sums up what we plan to do in the next 12 weeks. So, do stay tuned in.

Thank you.