

# Human Intelligence and Memory Recall in Artificial Intelligence

G. Krishna Lava Kumar<sup>1</sup>, K. L. Anusha<sup>2</sup>, D. Shanthi<sup>3</sup>

<sup>1</sup>Assistant Professor, CMR Institute of Technology, Medchal, Hyderabad, TS, India

<sup>2,3</sup>Assistant Professor, Sreenidhi Institute of Science and Technology, Ghatkesar, Hyderabad, TS, India

**Abstract**— There is a tremendous research in AI in the area of artificial representation of the human brain that tries to recall the things needed from the past. An artificial neural network (ANN) is often called a "Neural Network" or simply Neural Net (NN). In this paper, I provide the information that impressed me few facts to choose my area in my research. i.e. The brief study of human brain, human intelligence and memory recall that can be used in artificial intelligence.

**Index Terms**— Human Brain, Human Intelligence, Memory Recall.

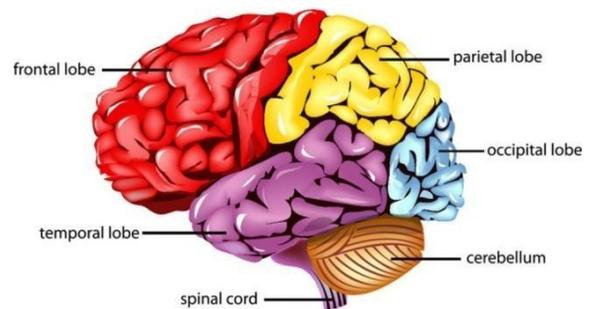
## I. INTRODUCTION

In any domain, either profession or education, intelligence plays a curious role. Intelligence is the capacity to learn experience and ability to adapt to different contexts. Intelligence is the act of thinking about thinking. We must have heard the words like Artificial Intelligence in contrast with human intelligence. Technology is growing day by day; Scientists are more and more interested to found something innovative. AI is usually defined as the science of making computers do things that require intelligence when done by humans. Robots are by default termed as "intelligent" as their application is used in real-time, and with the use of Artificial Intelligence (AI), intelligent robots can be developed. Its major function is to add some human like qualities in robotics. We can identify this analogy in some of the applications like game playing, general problem solving, Expert Systems, Natural Language Processing, computer vision, Robotics, Education and others. There are other forces that are in favoring of combining these two sources in order to have complete product. To know the difference between Artificial Intelligence and Human Intelligence, let's dig out the roots!

Intelligence has been defined in several ways including as one's capacity for logic, self-awareness, emotional analysis, developing, innovative and ability to solve problem. It can be more generally described as the ability to perceive information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context. In this paper we getting a brief idea of human brain, nervous system.

## II. HUMAN BRAIN

### Parts of the Human Brain



The human brain is the command center for the human nervous system. The study of the human brain has been called the last frontier in science

*Facts about human brain:*

- The human brain weight is approximately 3 lbs
- The cerebrum is the major part of the brain that comprises three-fourth of brain's weight
- The brain's gray matter is built of neurons that collect and send signals.
- The white matter is built of dendrites and axons that create a network by which neurons transmit their signals
- Your brain is 60% white matter and 40% gray matter.
- The brain is built with three-fourth of water.
- Your brain consists of about 10000 crore neurons
- There are anywhere from 1,000 to 10,000 synapses for each neuron.
- There are 1 million miles of blood vessels in the brain.
- The human brain is the hefty organ in the body that comprises of at least two-third fat.
- Your brain stopped growing at age 18
- Your brain uses one-fifth of total oxygen from your body

Cerebrum is the prominent part of human brain which is categorized into two hemispheres. Brainstem is in the bottom of the brain and cerebellum in the end.

Cerebral cortex, the exterior layer of cerebrum consists of four lobes: the frontal lobe, the parietal lobe, the temporal lobe and the occipital lobe.

Forebrain, Midbrain and Hindbrain are the three logical sections that the human brain contains which contains ventricles. The forebrain is into the cerebrum; the midbrain turns out to be part of brainstem; and the hindbrain connects between cerebellum and brainstem.

Human brain can recollect the required memories on need. During recall, the brain "replays" a pattern of neural activity that was originally generated in response to a particular event, echoing the brain's perception of the real event. Remembering and the act of thinking have no much difference in reality.

These replays are not quite identical to the original, though - otherwise we would never notice the difference between the memory and genuine experience - but are composed with an awareness of the current situation. One corollary of this is that memories are not frozen in time, and new information and suggestions may become incorporated into old memories over time. Thus, remembering can be thought of as an act of innovative re-creation.

### III. HUMAN INTELLIGENCE

There are as many definitions of intelligence as there are many scientists working in the field of AI. In general, Intelligence can be described as the ability of an individual to acquire and apply knowledge.

According to Encyclopedia Britannica, it is the "ability to adapt effectively to the environment, either by making a change in oneself or by changing the environment or finding a new one". This is an intelligent definition, because it embodies learning, manufacturing, sheltering and migration. Intelligence is a multi-factorial entity, involving things such as language, thought, memory, imagination, reasoning, conscience (the perception of self), capacity for learning and integration of several sensory modalities. For adapting, all the above said functions must be used by the brain effectively. Therefore, "intelligence is not a single mental process, but rather a combination of many mental processes directed toward effective adaptation to the environment".

Recognizing what are the components of intelligence is very important in terms of assembling a "theory of intelligence". One of the most solid and interesting ones has been proposed by Sternberg (see box), and directly relates to what we know about its evolution.

He proposes that intelligence is made of three integrated and interdependent aspects: the internal world, the relationships to the external world, and experiences which interrelates the internal and external worlds.

#### *The Components of Intelligence*

The internal world: cognition	<ol style="list-style-type: none"> <li>1. processes for deciding what to do and for deciding how well it was done</li> <li>2. processes for doing what one has decided to do</li> <li>3. processes for learning how to do</li> </ol>
The external world: perception and action	<ol style="list-style-type: none"> <li>1. adaptation to existing environments</li> <li>2. the shaping of existing environments into new ones,</li> <li>3. the selection of new environments when old ones prove unsatisfactory</li> </ol>
The integration of the internal and external worlds through experience	<ol style="list-style-type: none"> <li>1. the ability to cope with new situations</li> <li>2. processes for setting up goals and for planning</li> <li>3. the shaping of cognitive processes by external experience</li> </ol>

### IV. MEMORY RECALL OR RETRIEVAL

Retrieval or recall of memory refers to the subsequent retrieving of actions or information from the past, which have been stored in the brain. In common parlance, it is known as remembering.

#### *Three major types of recall:*

*Free recall* is the process in which a person is given a list of entities to remember and then asked to recall them in any order. This recall type often displays evidence of either the primary effect or the recent effect and also of the continuity effect.

*Cued recall* is the process in which a person is given a list of entities to remember and then tested with the use of guides or cues. On providing cues to a person, they remember entities on the list that they have not originally recalled without a cue, and which were felt to be lost to memory. This can also take the form of stimulus-response recall, as when numbers or words or even pictures are presented together or in pairs, and the resulting combinations between any two items cues the recall of the dual item in the pair.

*Serial recall* refers to our ability to recall entities or actions in the order in which they happened, whether chronological orders in our autobiographical memories, or the order of differed parts of a sentence in order to make sense of them. Serial recall in long-term memory and serial recall in short-term memory differs such that a sequence in long-term memory is represented in memory as a whole, rather than as a series of discrete items.

*10-points guide to the psychology of memory and recall:*

#### *1. Memory does not decay*

Almost all of them might have experienced the dissatisfaction of not being able to recall a fact from memory. It may be somebody's name, the contact or where the keys are placed.

So it is a fact that memories get rotten like a fruit which the researchers doesn't support this fact. In fact many researchers believe that memory has an endless capacity. Everything is stored in memory but, without practice, it is difficult to access from memory. This proves that it is not the memory that is 'wearing off' it is the capability to retrieve it.

Instead what on earth is the point of a brain that remembers everything but can't recall most of it.

#### *2. Forgetting helps you learn*

Forgetting is an idea that helps you learn, but assume it like this: imagine as if you created a brain which could recall everything that it remembers. It is this wonderful and extremely powerful brain that tries to recollect the parking area where all the cars are parked in order to recollect where it parked the car.

In fact the only one that is of interest is the one that is more recent which is generally true with most of our memories. Recent events are generally much more important than that of those happened a long time ago.

In order to make your brain very much powerful, quicker and more useful in the real-world you must have to build in some system to discount old and useless information. Obviously, we all have one such super-brain with a discounting mechanism which we call it 'forgetting'.

That is why forgetting helps everyone to learn: as less important information becomes inaccessible, we are by default left with the information that is very much important for our daily survival.

#### *3. 'Lost' memories can live again*

The other side to the fact that memories do not decay is the idea that even though memories might become less accessible, they can be revived.

In fact, the things that you have not been recalling over long time are still there, waiting to be woken. Several experimental results proved that the information that has not been long become inaccessible can still be revived. In general, it is such information revived much quicker than the new information.

This is something like you never forget how to drive a car, but it doesn't just apply to car skills, it also applies to recalling and memory.

#### *4. Recalling memories alters them*

Even though it is the guiding principle of recall and memory, the thought that recall alters memories seems reasonably wrong. How can recall to a memory can change it?

In fact, just by recalling a memory, it becomes harder in comparing with other memories. Let's understand this with an example. Just think back about one of your birthday's of your childhood days and you recall getting a remote control car. Each time you recall one such fact, the other things you received for your birthday on that day becomes weaker when compared.

The process of recall is factually constructing the past, or at least the parts of your past which you can remember for future use.

Even though this is only the beginning, fake memories can potentially be created by this process of falsely recalling the past. In fact, psychologists have experimentally proved in implantation of false memories.

This generates the interesting idea that effectively we create ourselves selecting which memories to be recalled.

#### *5. Memory is unstable*

The fact that the simple act of recall changes memory means that it is relatively not stable. Indeed people feel that memory is relatively stable: we generally forget that we have forgotten and so we think that we will never forget in the future which we now know.

This is what it means is that students, in particular, hugely underestimate how much effort will be required to commit material to memory but they are not the only ones required.

*6. The foresight bias*

Everyone must have experienced this at least once in their life. You have thought that is so great you think it is impossible that you will never forget it. So you don't feel to write it down. Within few minutes you have forgotten it and it will never come back.

We do see the same things in the lab as well. In one experimental study by Koriat and Bjork people were taught pairs of words like 'light-lamp' and then they were asked to estimate how likely it is they will be able to answer 'lamp' when later given the prompt 'light'. They are largely filled with over-confidence and the reason is this foresight bias. When they were given the word 'light', later all other kinds of things come to mind such as 'bulb' or 'shade' and the correct answer is not nearly as easy to recall as they predicted.

*7. When recall is easy, learning is low*

We think that we are clever when we recall something instantly and we feel that we are stupid when it takes long. But, one should feel the exact reverse in terms of learning. When something enters into mind fastly, we do not work to recall it and thus no learning occurs. When we must work strong to bring it to consciousness, then something cool happens and thus we learn.

When the memories of people are tested, the extra work that they did to construct, or re-construct, the target memory, the stronger the memory eventually becomes. This is the reason why testing is involved in proper learning, because just looking at the information is not just enough: learning needs fruitful recall.

*8. Learning depends heavily on context*

Did you ever notice that when someone learn something in one context, like the lab or lecture hall, it becomes harder to recall with the change in the context.

The reason for this is that learning depends hugely on how and where you use it: it depends on what is around you, who is there around you and how you are learning it.

In fact, it turns out that in the long-term people learn about any information at its best when they are exposed to different contexts in different ways. When learning is hugely dependent on the context, it does not stick as well or transfer well over the decades.

One of my friends in the University who believed that standing up against a wall or standing on a chair helped him to revive. Everyone used to criticize him for his actions but there was fruitfulness in his madness.

*9. Memory, reloaded*

If anyone wants to learn to play cricket, is it better to spend one week learning to field, the next week to bowl, the week after that to bat, and so on? Or should you mix it all up with fielding, bowling and batting every day?

In fact, it turns out that over the long-term retention, memories are much more easily recalled with mixing up of learning. This is just as true for both car driving, learning cricket, as it is for any other declarative memory, like what is the capital of India (just to save your time in googling: it is Delhi).

The difficulty is that learning something like this is worse to get started. If you first practice your bowling then quickly switch to the batting, you 'forget' how to bowl. So you think that things are going worse than if you just practice your bowling over-and-over again. Indeed, over the long-run this kind of bowl-and-bat learning strategy works best.

One genuine reason for why this works is called the 'reloading hypotheses. Each time we switch among the tasks we have to 'reload' the memory. This kind of reloading process strengthens the learning.

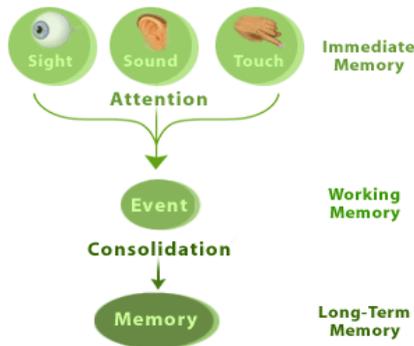
*10. Learning is under your control*

The reality of these facts about memory is that we often under estimate how much control we really have over our own memory and recalling something out of it.

In general, people feel that some things are harder to learn by their nature and so they generally give up before learning. However, techniques like using different tasks, switching between different contexts and strenuous reconstruction of memories can all help in boosting of retaining something for long.

People also feel that the past is fixed and gone that cannot be changed. But how do we recall the past and think about being changed. Recalling memories in different contexts can help us re-interpret the past and set us off on a different way in the future. In general, studies have proved that people can crowd out painful negative memories by focusing much more on the positive memories.

*Remembering a New Face*



Reinforcement is very important in forming the memories because it moves the relationship among memory from very short-lived categories to very long-lasting ones. For example, if you have met a man called Mr.X at a party, you would see his face, hear his name, and you would be aware of the social context of the event you attended. At first, this information is very lightly held in the immediate memory, just long enough for the event to play itself out. Immediate memories are in general held in various modality-specific regions of the brain which means that immediate visual memory is probably held in the visual parts of the brain, immediate auditory memory is in the auditory parts of the brain, and so on.

If you have paid attention during the introduction of the person, the relationship between the sight, sound, and the awareness is brought together into the working memory, somewhere in the foremost part of the frontal lobe of the brain. When the event moves from the immediate memory to the working memory, certain features are lost. You probably would not remember background conversations from the party, and you may not even remember the color of Mr. X's shoes. The loss of distracting information is one of the important features of human memory, and is very critical for efficient storage and recollection of several other experiences.

At this point you may rehearse the event by saying his name to yourself or by making up a mnemonic (Mr.X, who has a very big hook nose just like a bird). The mnemonic and the rehearsal will cause the memory to move from the working memory into the long-term memory, which is a change that starts in the brain's hippocampus.

This process of converting the working memory into long-term memory is called consolidation, and again, this is characterized by the loss of distracting information. After several days after meeting Mr.X you may not be able to remember what color his shirt was or whether he wore a bracelet, but you will be able to still remember his face, his name, and even the person who introduced him to you. The consolidation phase of memory formation is very much sensitive to interruption; if you are distracted just after meeting Mr.X, you might have trouble remembering his name later.

## V. CONCLUSION

We have presented in this paper about human brain, human intelligence and memory recall that can be used in the area of artificial intelligence so that these can be extended in the area of robots that can act wise and recall any valuable experiences(if any) in the past to deal in the future situations. It's my strong belief that this application is a driving path for research in the future, and a promising area for collaboration between researchers in more humanistic disciplines and researchers in AI.

Our memory and recall aren't as weak as we might think of. It might not work like a computer, but that's what makes it all the more fascinating to experience and understand.

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**AUTHOR'S PROFILE**



Mr. G. Krishna Lava Kumar did his B.Tech in CSE from Anurag Engineering College, M.Tech from JNTU College of Engineering, Hyderabad. He is currently working as Assistant Professor in CSE Department of CMR Institute of Technology, Hyderabad. His areas of interests are Artificial Intelligence, Network Security and programming languages. He is having 10 years of teaching experience and published 6 papers in various reputed national and international journals.



Mrs. K.L.Anusha did her MCA from Acharya Nagarjuna University, Guntur, Andhra Pradesh and M.Tech from JNTU College of Engineering, Hyderabad, Telangana. She is currently working as Assistant Professor in CSE Department of Sreenidhi Institute of Science and Technology, Hyderabad. She is having 5 years of teaching experience.



D.Shanthi did B.Tech and M.Tech in Computer Science and Engineering at Jawaharlal Nehru Technical University, Hyderabad, Telangana, India. She is the research Scholar in JNTU Hyderabad. She published many papers in national conferences and international conferences. She is currently working as Assistant Professor in CSE Department of Sreenidhi Institute of Science and Technology, Hyderabad. She is having 10 years of teaching experience.