

Real Time Simulation of the Human Visual System and Artificial Neural Networks

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Abstract - For past few decades, people have been interested in finding out how the brain works. The outline of most Artificial Neural Networks for visual design acknowledgment usually resembles the tactics of deep learning models and neural science. Many scholars have proposed different types of analysis and simulations in the process of studying the human brain. The purpose of this paper is to describe distinct models of true simulations of human visual systems including the Forest Simulation Models, Arbitrary Visual Fields, Blue Brain Project. Also, the paper describes studied models of Deep Learning and Neural Network and the methods they follow.

Index Terms: Deep learning, Neocortex, Pattern Recognition, Convolutional Layers, Hierarchical Temporal Memory

I. Introduction

This session briefly describes about the Human Visual System. A study that is using various techniques to understand the operations of true simulations related to visual system [1]. The Human Visual system functions and parallel architecture are the source of visual processing. Few actual simulation models include arbitrary visual field; blue brain project and the forest visual simulation system depending on the human visual system are compared with machine learning and artificial neural networks system explained in this paper. Considering computer to exploit information implicit in an image to be the properties of surface, surface orientation, reflectance and depth by using some parallel algorithms, few studies have investigated in the details of Human Visual System(HVS) by computing and are been modified to computer, but there are more to explore[2].

II. Human Visual Systems

Eyes are the entry purposes of the light that convey the visual data about the onlooker's surroundings into the human visual system. The photoreceptors consumed the approaching light in the retina and

changed over to electrochemical signs, and these signs are transferred to the resulting systems of the visual pipeline. The photoreceptor cells change over light into electrochemical signals and are separated into two sorts, rods and cones, named for their shape. Rod cells are in charge of our night vision and react well to diminish light. Poles are discovered for the most part in the fringe locales of the retina, so a great many people will find that they can see better during the evening on the off chance that they center their look simply off to the side of whatever they are watching. Cone cells are gathered in a focal locale of the retina called the fovea; they are in charge of great keenness assignments like perusing, furthermore for shading vision. Cones can be subcategorized into three sorts, contingent upon how they react to red, green, and blue light. In the blend, these three cone sorts empower us to see colors.

The picture that falls onto the retina is not a precise of the accurate world picture; as in each optical framework, the eye twists the light while it passes through. The consolidated impact of the scrambling and diffraction inside the optical part of the human visual structure is alluded to as glare. The glare effect is most evident close brilliant light sources in generally dark scenes. The glare impacts are practically undesired in the sense that they confine visual sharpness.

Visual information's order and the last processing of the neural signs from the retina are kept up in the visual cortex. The fovea is in the back part of the visual cortex, and the most fringe areas of the retina are continuously in contact with foremost locales. Take note of that the zone of focal vision (i.e. the fovea) is represented over an unusually expansive part of the visual cortex. Contributions from the two eyes localize at the cortical level, making binocular vision conceivable.

There exist six ranges of the visual cortex ranging from V1, V2, V3, V3a, V4, and V5. V1 is the essential visual cortex and a primary structure. The neural signals of visual space including the frame, shading, and introduction of items are translated in

V1. A significant portion of the region is brought from the fovea. This mapping is called cortical amplification. Cortical Amplification is regular in the creatures that depend on the data from the fovea for survival.

V2 enforces the shading discernment and further frame translation when the signs are transferred to V2 from V1. As this symptom proceeds into distinct territories of the visual cortex, more acquainted procedures take place. The striate cortex (V1) have different ranges of the cerebral cortex which are included into the compound discernment. The movement of items, movement of self through world and spatial thinking is handled in the parts of the visual cortex, which make up the parietal visual cortical ranges. The acknowledgement of the items through elucidation of complex structures happen in these fields, including V5, which is considered the center, was the fleeting territory. The clearly non-visual areas of the mind sub serve the mental and perceptual experience of the vision, which incorporates parts of memory, desire, expectation, and interjection. [3]

III. Actual Simulations of HVS

1	Arbitrary Visual Fields
2	Blue Brain Project
3	Forest Visual Simulation System

Table 1: Contents of Actual Simulations of HVS

1. Arbitrary Visual Fields

There has always been considerable interest in gaze-contingent video displays. Utilization of such video display technique can be attained by image compression. The consistent resolution of the HVS can take a spill from the purpose of vision and diminish significantly. The resolutions of video images are distinct from the observable pathway of the standard visual assignment of a simple image. If these presentations are utilized as a part of conjunction with an eye tracker, they imitate the best results, and also they hold value with less refined computing devices and with algorithms for programmed systems to focus on a single object (fovea).

The exploratory research on the visual preparation is another area of application. In particular, the proportional data over the visual field can be controlled by the constant variable determination that also allows testing the hypothesis on the part of the edge and foveal vision in various procedures (for instance, visual search). Let's consider the methods.

a) Method 1: Variable Resolution Map

A resolution map determines the proportional resolution desired at every pixel area. The focus in this map has been moved on to the current vision. Regularly, the magnitudes of the map are double the dimensions of the display that allows the entire display to be rendered for any look inside the display area. Every pixel's resolution is indicated by a genuine 8-bit number, which comprises of zeros and ones. This map learning becomes crucial when it comes to robots as they acquire information from sensors that interacts with the real environment. The geometrical and topological maps simulate the variable resolution maps, which are quantitative and qualitative respectively. The geometrical maps are more prone to errors, and the other ones are less vulnerable to sensor errors as they only focus on the vital information.

b) Method2: Multi-Resolution Pyramid

This method focuses on convolving the image by utilizing the small portions. For instance, a 4*4 capacity pyramid is down sampled to a factor 3 to attain level 2 of the pyramid. This process is repeated, and in the result levels 3 of factor 2, level 4 of factor 1 and so on are obtained. Each level is blurred and down sampled to the next level in this process. If focused on a two-dimensional image this method is applied to rows and columns both. The picture at each level can be put together to full scale when the desired levels are achieved, and variable determination is done. Though, only some of the locals are controlled by the Variable Resolution Maps.

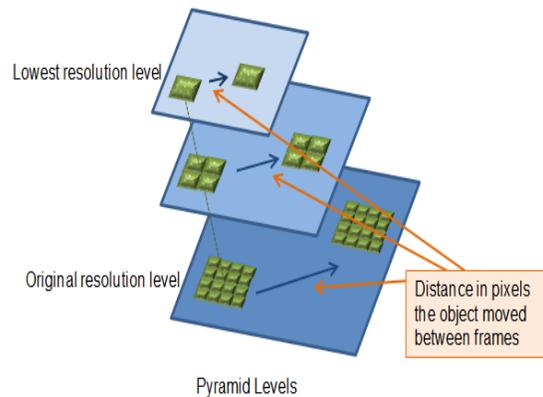


Figure 1. Levels of Multiresolution Pyramid

c) *Method 3: Blending and Up-sampling*

This process focuses on moving the resolution map to the current visual position obtained by some computing device or an eye tracker. The resolution at every pixel is rendered by combining distinct images in the pyramid where the proportional resolutions group the desired resolution. The weighted aggregation of the pixel values in each section of the image is included in this combination at each pixel.

d) *Method 4: Display*

Once the variable resolution picture is formed, it is transferred to the graphics card for the display on the screen. Considering the grayscale pictures, the 8-bit information is duplicated in the graphics memory. When it comes to color pictures, the process is done in standard YUC color space and then revised to RGB color space. This alteration is done before the replication of the 24-bit information to the graphics memory.

e) *Method 5: Calibration*

Calibration enables to set the mixed weights to achieve precisely required resolution at every pixel. Displays with high accuracy are critical for every product. An extensive variety of sinewave grating pictures and differentiation of outputs and inputs enables the computation of the transfer function for the entire procedure of low-pass filtering, down sampling, mixing and up sampling. Thus, a system as a whole exchange work for every conceivable estimation of the dissolution map between 0.0 and 1.0[4].

2. Blue Brain Project

The purpose of the Blue Brain Project is to understand the human brain and reproduce it at the cell level inside a computer model. The project was established in the year 2005 by Henry Markram at the EPFL in Lausanne, Switzerland. The primary objective of this project is to obtain complete knowledge in working of the brain and to equip superior and speedy evolution of brain disease medications.

The investigation includes focusing on pieces of living brain tissue using microscope and patch clamp electrodes. Data is gathered in a wide range of neuron types. The information is utilized to assemble naturally realistic models of neurons and systems of neurons. The evolutions are done on a Blue Gene

Supercomputer constructed by IBM. Therefore this project is named "Blue Brain," this growth programming is based on Michael Hines 'Neuron', together with other specially produced parts[5].

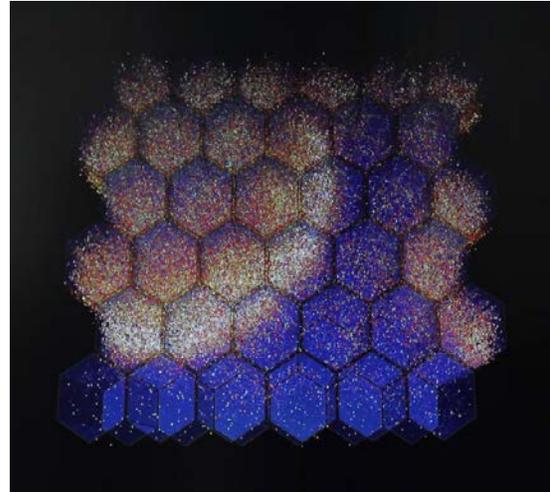


Figure 2: Cortical Mesocircuit Simulation

The simulation repeated a scope of previous inspections made in analyses on the brain, approving its natural precision and giving new bits of knowledge into the working of the neocortex. The project has announced the full arrangement of trail information and the advanced remaking, in an open web-based interface, permitting different specialists to utilize them.

The three most important steps to building the virtual brain:

- a) Data Acquisition
- b) Simulation
- c) Visualization of results

a) *Data Acquisition*

Data Acquisition includes taking pieces of brain tissues studying them under the microscope and measuring the shape and electrical action of neurons. Various types of neurons are deliberated and classified by this means. The neurons are written morphology, electrophysiological conduct, area inside the cortex and their population density. These perceptions are converted into numerical calculations which portray the frame, capacity and situating of neurons prepared for reenactment.

The electrophysiological conduct of neurons is concentrated on utilizing a 12 patch clamp instrument. This instrument was produced for the

Blue Brain Project, and it shapes an establishment of the exploration. The Nomarski microscope improves the difference of the unstained examples of living neural tissue. Carbon nanotube- covered cathodes can be utilized to enhance recording.

Around 200 distinct sorts of ion channel are found in the cell membranes of cortical neurons. There are varieties of neurons having distinctive blends of channels adding to donate in their electrical conduct. The qualities of these channels are cloned at the laboratory, over expressed in refined cells, and their electrical behavior is recorded. More than 270 classes are known to be connected with voltage – gated ion channels in the rat.

b) Simulation

The imperative programming utilized by the Blue Brain Project for neural simulation is a collection called neuron. This was produced at the beginning of 1990's by Michael Hines at Yale University and John Moore at Duke University. It is composed of C, C++, and FORTRAN. The software is continuously under progressive improvement starting from July 2012; it is at 7.2 version right now. It is a free and open source programming, both code and binaries are unreservedly accessible on the site. Michael Hines and the Blue Brain Project group teamed up in 2005 to port the package to the parallel Blue Gene Supercomputer.

In 2012; model of one cortical session (~10,000 neurons) keeps running around 300 X slower than the real time. One second of the simulation time takes about five minutes to finish. The simulations indicate linear scaling, are multiplying the extent of the neural system, and pairs the time required to reenact. At present, the essential objective is biologically valid. Once acknowledged, the elements are biologically critical for a given impact. It may be conceivable to trim segments that do not contribute to enhancing the execution.

The simulation time step for the numerical reconciliations is 0.025 MS and the time step for composing the yield to circle is 0.1ms.

The simulation step includes integrating virtual cells by utilizing the calculations that were found to depict certain neurons. The algorithms and parameters are balanced for the age, species and malady phase of the creature being reproduced. Each and every protein is simulated, consisting a billion of these in one cell.

Initially, a system skeleton is worked from all the various types of the orchestrated neurons. At this point, the cells are associated together as indicated by the tenets that have been discovered tentatively. Further, the neurons are functionalized, and the reproduction enlivened. The examples of emergent behavior are seen with perception programming.

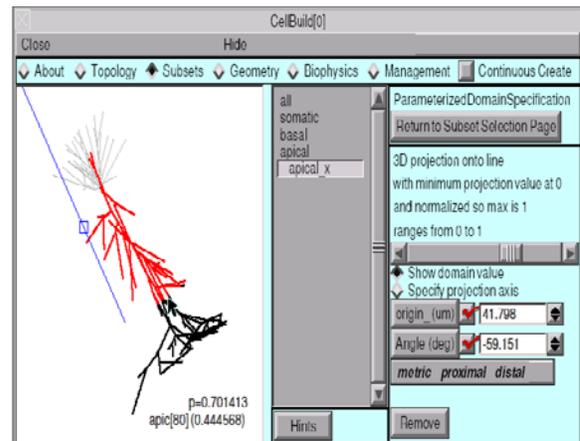


Figure 3: Neuron Cell Builder Window

A fundamental unit of Brain Cortex is the cortical segment. Every section can be mapped to one capacity. For example, in rats, one part is given to every whisker. A rodent cortical section has around 10,000 neurons and is the span of a pinhead. The most recent recreations as of November 2011; contain around 100 segments, 1 million neurons, and 1 billion neurotransmitters. A genuine rodent has around 100,000 sections altogether, and people have around 2 million parts.

The simulations represent perceptions that are found in living neurons. The arrangement is to construct a simulation apparatus, one that makes it simple to build circuits. There are additional plans to couple the brain simulations to symbols living in a virtual domain, and in the long run, it co-operates with robots in present situations. A final point is to have the capacity to acknowledge and replicate human consciousness.

c) Visualization Results

RTneuron is the primary application used in the visualization of neural simulations in the Blue Brain project. This was written in C++ and OPENGL and permits scientists to look at available possibilities that propagate through a neuron and between multiple neurons. The liveliness can be halted, begun and

zoomed, in this manner giving specialists a chance to collaborate with the model. The perceptions are multi-scale, can render single neurons or an entire cortical segment[6].

3. Forest Visual Simulation System

This model represents a visual generation structure that supports Geographical Information System (GIS) based on sensible displaying and ongoing rendering of forestry applications. It is a challenging task to provide the actual forest scenes based on real-world data. The models of trees are consequently created by the database with different format patterns. A consolidated picture and geometry representation technique for 3D tree model are given with a particular level of detail calculation for guaranteeing real-time frame rates. Displaying and constant rendering of forest scenes provided certifiable information from GIS is an imperative and challenging problem in forestry applications. In the field of computer graphics, modeling forest scenes have played a significantly important role.

The tree includes a primary trunk consisting of a variably curved structure similar to a cone. The length of a structure varies according to the type of trees forming additional curved structures. Further, branches are created from the trunk and can have same or different attributes from their parents. For example, a child branch's length is specified as half of its parent's period. In the future, these branches can have their sub branches. In the resolution requirements of simulation, the level of recursions can be maximized to three or four.

Particular trees have their unique shapes and these shapes result into the length of the primary branches according to the position of their trunk; for example, a tree having conical shape have larger branches at the base of the trunk. Some trees have branches that are curved in a vertical direction, up or down depending on the gravity.

The template model permits the clients to intelligently plan an agent geometric model for every plant species included in the applications. In this scheme, as parameters are changed, tree model can be previewed quickly. The parameters are used to produce a format show and the subsequent shape information; for example, tree tallness is spared as a template model file. At run-time, the layout show record will be stacked by the forest modeler part for producing a particular individual tree.

The representation of a 3D tree model can be isolated into two distinct parts: the stems, including various regions of a tree like trunk and branches, and the leaves. In the system, each of these parts has been dealt with an alternate way. The surface of a stem could be considered as a cylinder with a round cross segment of differing range. To create triangle portions of the stem surface for accurate rendering, a limited number of cross parts are assessed along the stem surface and connected. Every cross segment comprises of a small number of points.



Figure 4: Simulation of the Forest.

There is a deep relation between the GIS modeling and visualization that operates together in an interactive computational environment. Virtual Reality signifies a framework, delivers the tools for users to interact with the simulated environment. The systems combine the spatial display potential of GIS and GIS-based modeling demonstrating overall environmental impact with high-performance visual simulation in a multi-channel graphics environment. Various landscapes are provided as perspective views using actual elevation and the data associated with land; it will be easy to depict the realistic scenery. The real-time visualization of forest scenes is essential in virtual reality systems, important in the forest industry like VR-based fire-fighting training.

a) Simulation of Forest Fire

Earlier, computerized fire growth models have been the subject of research for more than 20 years. However, there were many management applications, but this model is still considered as a part of the investigation. There are some problems associated with practical limitations mainly with the hardware and software of the computer. However, most of these difficulties are no longer limiting. In the recent years, advancement in technology and GIS no longer

disrupt the transfer of fire growth modeling technology to user applications. However, computers have a logical platform for a fire growth model that can be readily accepted.

In the forest fire model, fire simulation is one of the important models to be focused as this predicts the spread and intensity of forest fires. The fire area simulator simulates fire growth as a spreading elliptical wave. The central principle of Huygens' is to model fire growth, involves using the fire environment at each perimeter point to dimension and orient an elliptical wave using spatial data from GIS. Later, the fire front is projected at each step based on the dimension and the behavior of fire at different points. The shape and direction of the ellipse are determined by the wind slope vector, and size is plotted by the fuel conditions. The implementation of this model is very complex and called as an actual fire growth model. In the future, GIS-based forest simulation model can be developed that provides the predicted position of a fire front and forest landscape features[7].



Figure 5: Simulation of Forest Fires

IV. Machine Learning and Deep Neural Networks

1	Neocortex and Hierarchical Temporal Memory (HTM)
2	Convolution Neural Networks and Methods.
3	The Pattern Recognition Theory of Mind

Table 2: Contents of Machine Learning and Deep Neural Networks

1. Hierarchical Temporal Memory (HTM)

About three-quarters of brain's volume account on neocortex. It is also one of the parts of cerebral cortex containing whole six layers from I to VI where I is the outermost and VI is the innermost. Human's sensory perceptions heavily depend on neocortex. Also, it is responsible for other functions like languages and conscious thoughts, etc. To perform intellectual functions, neocortex implements the common set of algorithms.

The neocortex is a 2 mm thick sheet of neural tissues. Imagine neocortex as a hierarchy where regions are inter-connected, and some interpret senses directly, while others can only process them once they are understood by certain levels. Each of the six layers of the neocortex has cells which are structures into columns and are interconnected. The third layer is one of the primary feed forward networks. [8]

HTM - developed by Dileep George and Jeff Hawkins provides a theoretical framework, based highly on memory and time. Computer memory is more liberal if compared to HTM. HTM captures algorithmic properties of the neocortex and are comparable with the third layer of it. HTM can be seen as a hierarchical structure of regions, which are the principal units of prediction and memory. Tree structure from algorithms better represents HTM. As you go up in the hierarchy, the parent-child relationship is clearly visible. Multiple HTM networks can be combined easily as at the end all the branches are converging towards the top. For example, a system that is processing touch information and other processing the audio information.

HTM models are efficient because one does not need to learn the patterns repeatedly. For instance, let's consider audio. At the lowest level, the brain stores very central sections. These senses can be soft, loud, harsh, sweet, etc. This information is combined at the mid-levels. For instance, something which is sweet might be the sound of a music instrument or someone singing. The mid-level patterns can be connected with the high-level patterns such as the type of the instrument like guitar, key-board or type of music like classical, rock, etc. To understand the top level objects you don't adequately have to learn the components over and over.

Hierarchical representations also generalize expected behavior. For example, when you see a steaming hot

cup of coffee, you will easily predict that it can burn your taste buds. Inheritance is naturally represented in HTM. What amount of information you want to process at one level can be readily determined. HTM can conveniently have complex and larger representations. Highly active brains can easily handle complex information at single layers.

a) *Input processing*

HTM relies on spatial pooling and temporal pooling for the data inputs. This technique studies the frequently occurring patterns and their following predictions and performs the operations on the HTM column regions. The dendrite segments identify the cells that are becoming active together by analyzing the history of their activation patterns and by this synapses the cells may enter the predictive state indicating a new column activation coming up. Within a cell's learning radius, the dendrite segments have synapse connections which are helpful to validate the connection threshold. If the cell will enter the predictive state or not depends on the relationship of the dendrite segments and other active cells.

In spatial pooling, the columns have summation value of synapses associated with the input data, and this is done through convolution of the input data in the receptive field of columns. The columns which have significantly low value might be related to some other inputs. This values can be boosted to see if it refers to another column in the neighborhood.

Temporal Pooling has a three-stage structure where phase three is processed in the initial learning stage itself. Phase one and two identifies if any of the cells are currently in the predictive state based on the previous steps which make the predictive activation of the cells smoother. It resembles the feed-forward pattern[9].

2. *Convolution Neural Networks and Methods*

Neural Networks can be better studied with convolutional neural systems. The association between the neurons of the convolutional network is vitalized by the affiliation of the animal visual cortex. Wide CNN studies have been able to determine the complex domains such as image recognition and depiction. Also, in the area of identifying objects, faces, traffic signs, the vision control of robots and auto driving cars CNN have certainly been a player. CNNs can be seen as a variation Multiple Label Switching where one network node transfers the data to the next based on the short path rather than getting

involved into multiple routes and longer address. In CNNs, the phones are pretty responsive to the receptive field which is a sub-local of the visual field. Combining sub-areas, the final output is the entire visual field. The cell types can be separated into two parts – simple cells, complex cells. These cells are responsive to particular smaller patterns in the visual field and the larger areas respectively. Considering the animal visual cortex the acutest visual composition, many of the artificial optical networks present today simulates its conduct.

The structure of a CNN consists of distinct subsampling and convolutional layers. CNN is complex infrastructure with entirely associated strata. The input to a CNN is an image of $a*a*m$ where “m” represents the quantity of channel, and the measures of height and width of the image are represented by “a.” For example, an RGB image often referred as the real color image has three as the quantity channel. The value of quantity channels can be simulated by a colormap matrix of an indexed image specifying the components of the single color. The CNNs divides the image into parts of $b*b*n$ images which are certainly smaller than the actual image. The images directly map the pixel values to the color values for comparisons. An image is subsampled into smaller images and is compared pixel by pixel to attain the final output. The final result is represented by the fully connected layer. Usually, the CNNs possess a distinct number of fully connected layers, and the intensely connected layers reciprocate layers of a standard multilayer neural network. The process will be discussed in the further sections. The image underneath represents the design of sublayers of the CNN[10].

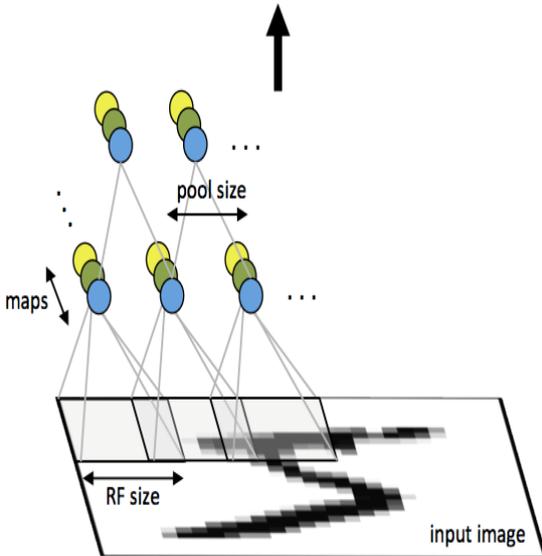


Figure 6: Sublayers Representation of the CNN.

Getting into a little detail of the steps include four main points.

a) Convolution

Convolution: Utilizing the small squares of the input data with image highlights, it conserves the association of pixels. As discussed above, CNNs examines the images into pieces. It looks for the pieces referred as features. Instead of coordinating the entire image, CNNs attempts to discover coordination between the similar positions (relatively smaller parts) into two images. Initially, the CNNs are not aware of the exact position where the elements will coordinate precisely, so it tries to match them all over the image in each possible position. A filter is made to comprehend the match to elements over the image. Every possible image patch feature is lined up that leads to exact match. The output from every convolution is taken, and the process is repeated some times. Finally, based on the location of the image patch it forms a two-dimensional array out of it.

b) Pooling

Pooling is another important layer of the CNN. Pooling replicates nonlinear down sampling. It performs pooling of an image and gathers the images separately on every depth portion of the input. The yield will have a similar number of images, though each of them will have less number of pixels. Consider an example of dealing with the computational load. Likewise, life can be made

considerably simpler for everything downstream by bringing an 8-megapixel image down to a 2-megapixel image. Interesting, isn't it?

c) Deep Learning

With the contribution of every layer to the output, the layers can be stacked like Lego bricks. To make an arrangement of contracted and element sifted pictures, the crude pictures are separated, redressed and pooled. Every time, the items get to be more perplexing and bigger. In addition, the pictures turn out to be smaller. This lets the lower layers speak to the fundamental parts of the image i.e. splendid spots and edges. The higher layers can speak to progressively complex parts of the picture i.e. shapes and patterns. These have a tendency to be hastily conspicuous. For example, in a CNN on human faces, the most noteworthy layers speak to the patterns that are obviously more face like [11].

d) Fully Connected Layers

The high-level filtered images are translated into votes by fully connected layers. Fully connected layers serve as the principle construction base of the conventional neural network. Rather than treating the inputs as a two-dimensional array, they are treated identically as a single list. Each value gets its vote. However, this process is not entirely self-governing. Some values are better than others getting significant number of votes compared to others. The votes represent the connection strengths of every value and category. Like other layers, fully connected layers can be stacked because their output looks a ton like their data sources. Frequently, a few completely associated layers are stacked together. Mostly, the system gets a chance by each extra layer to learn perpetually modern mixes of components that help it settle on better choices by each extra layer[12].

3. The Pattern Recognition Theory of Mind

Even though the quality of human thoughts is quite good but complicated - Ray Kurzweil contends that the fundamental standards and neuro-systems which are in charge of higher order thinking are quite basic, and in fact completely replicable. For Kurzweil, our most refined AI machines are currently utilizing the example standards and are copying the same neuro-structures that are available in the human brain.

Starting with the Brain, Kurzweil contends that late advances in neuroscience demonstrate the neocortex

(more elevated amount thinking) works as indicated by a complex but clear design acknowledgment plot. This pattern recognition plan is leveled in nature with the end goal that lower-level patterns speaking to discrete bits of information (rolling in from the encompassing environment) consolidate to trigger more high level patterns that speak to general classifications are more conceptual in nature. The hierarchal structure is inborn; however the particular classes and meta-classifications are filled in by method for learning. Additionally, the heading of data travel is from the base up, as well as starting from the top, with the end goal. The enactments of higher-request examples can trigger lower-level ones, and there is criticism between the different levels. (The hypothesis that sees the brain working along these lines is implied to the Pattern Recognition Theory of the Mind or PRTM).

According to Ray Kurzweil, this pattern recognition plan is quite like the invention and the most complex AI machines are as of now utilizing. In fact, not just these machines intended to process data progress hierarchal; the innovation of these machines are utilizing is known as the various leveled concealed Markov model or HHMM, and Kurzweil was himself a piece of building up this innovation in the 1980's and 1990's[13].

Ray Kurzweil composes that the neocortex contains around 300 million extremely broad samples of pattern recognizers orchestrated in a hierarchy. For instance, to perceive a composed word there may be a few pattern recognizers for each extraordinary letter stroke: corner to corner, even, vertical or bended. The yield of these recognizers would nourish into larger amount pattern recognizers, searching for the example of strokes that shapes a letter. Finally a word-level recognizer utilizes the yield of the letter recognizers. At the same time flags encourage both "forward" and "in reverse". For instance, if a letter is darkened, however the rest of the letters unequivocally demonstrate a specific word, the word-level recognizer may propose to the letter-recognizer, which letter to search for and the word -level would recommend which strokes to look for. Kurzweil additionally talks about how listening to speech requires comparable various leveled pattern recognizers [14].

V. Simulations and Neural Networks Comparison

To start with, the simulations are inclined towards digital processes while human brain resembles

analogous process. In neural networks it is quite possible to perform the operation into lesser representations. For instance, any operation that is performed at certain layer can be processed with exact ease and convenience at a lower layer too while in the real computation of the simulations highly depend on the layer structure and number of layers. When it comes to human brain and neural networks memory decay is inevitable while the artificial networks has very well formed structure to store the data which can of course be lost because of some disasters but definitely not decay. Also, the brain addresses the memory which is content based and the computers addresses the memory which is byte based. Brain works as a high end search engine which gives awesome results with only few cues without any complexity. Of course, this can be achieved into true simulations too by building complex data indices and predictive models. Simulation rely on the processing speed and obviously the time factor is critical while human brain's neural networks does not have any fixed processing speed. When it comes to simulations, it is quite easy to locate the memory but it is very difficult to say what exact part of the brain manages which information. The synapses of human brains look simple but they are more complex than the artificial simulations because each synapse might add complexities to the upper or lower layer representation while the simulations have predefined patterns and proceedings. Unlike computers, human brain relies on same components to store and process the memory while computerized simulations has static units to perform each operations. Unlike human brains computers cannot self-organize the components and inputs.

VI. Conclusion and Future work

The paper portrays simulations of HVS, deep learning neural systems and the procedures they depend on. The Blue Brain Project concentrates on the mind designing at small scale level. Utilizing the Blue Gene supercomputers, up to 100 cortical sections, 1 million neurons, and 1 billion synapses can be mimicked without a moment's delay that is generally proportional to the mental aptitude of a honey bee. People, by differentiation, have around 2 million segments in their cortices. Regardless of the sheer unpredictability of such an attempt, it is anticipated that the venture will be equipped for this by the year 2023.

In machine learning, future goals hold driverless cars for which the robots should be able to identify all

distinct objects including distinguishing between two distinct series of a car let's say Mercedes or BMW. Future holds computer vision to the level where it can process any visual data and just imagine if the data can be converted into human readable data. For instance, if an image can be explained to a blind person by means of sentences. In order to achieve this, more complex algorithms to understand impressive number of shapes and colors to a significant level of details is next thing in machine learning.

With HTM, Anomaly detection and effective predictions are easy to achieve. The Accuracy of HTM model is definitely reliable. HTM models are seamlessly good with noisy and irregular data as well. It would be really interesting to see if the hierarchical regions are extended and evaluated with same data what would be the effects on prediction accuracies. Also, direct comparison of HTM algorithms with machine learning algorithms can extend the study to an intriguing direction and would certainly lead to design machines which replicate human brains to a significant level.

VII. References

- [1] Inferring cortical function in the mouse visual system through large-scale systems neuroscience.
- [2].Parallel visual computation by Dana H.Ballard , Geoffrey E.Hinton & Terrance J. Sejnowski
- [3]A direct demonstration of functional specialization in human visual cortex S Zeki, JD Watson, CJ Lueck, KJ Friston, C Kennard and RS Frackowiak Journal of Neuroscience 1 March 1991
- [4].Real-time Simulation of Arbitrary Visual Fields by Wilson S. Geisler University of Texas at Austin and Jeffrey S. Perry University of Texas at Austin
- [5]Neuroscientists simulate tiny part of rat brain in a supercomputer <http://www.kurzweilai.net/a-major-proof-of-concept-for-brain-simulation>
- [6]Artificial Brains A quest to build sentient machines <http://www.artificialbrains.com/blue-brain-project>
- [7].A GIS-based Forest Visual Simulation System by Qizhi Yu¹, 2 Chongcheng Chen^{2,3} Zhigeng Pan¹ Jianwei Li^{2,3} State Key Laboratory of CAD & CG, Zhejiang University, Hangzhou 310027, China Spatial Information Research Center of Fujian Province, Fuzhou University, Fuzhou 350002, China Key Lab. of Data Mining & Information Sharing, Ministry of Education (Fuzhou University), Fuzhou, 350002, China
- [8] Hierarchical Temporal Memory Including HTM Cortical Learning Algorithms by Numeta
- [9] Hierarchical Temporal Memory for Behavior Prediction by David Bjorkman
- [10] Convolutional Neural Network by <http://ufldl.stanford.edu/tutorial/supervised/ConvolutionalNeuralNetwork>
- [11]Deep learning neural networks <http://deeplearning.net/tutorial/lenet.html>
- [12] The mathematics of Deep Learning <http://www.vision.jhu.edu/tutorials/ICCV15-Tutorial-Math-Deep-Learning-Intro-Rene-Joan.pdf>

[13] Kurzweil's Pattern-Recognition Theory of Mind – 1 <http://vinodwadhawan.blogspot.com/2014/03/125-kurzweils-pattern-recognition.html>

[14] How to create mind by Ray Kurzweil https://en.wikipedia.org/wiki/How_to_Create_a_Mind