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Augmentation of ANN in Medical Domain and other fields

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Abstract: Artificial Intelligence (AI) is the replication of intellectual in computers that are being trained to think and act like living beings.Artificial Neural Networks (ANNs) are one of the most fascinating and well studied disciplines of AI. ANNs are essentially computer-generatedmathematical algorithms.ANNslearnfrom standarddata and capture the information itcontains like,trainedartificial neural networksapproximate the functioning of a tiny biological brain cluster in a very basic way. They are a digital version of the biological brain consist ofnodes as a neuron that can recognize complicated non-linear interaction between dependent and independent variables in data that the humanbrain could miss. Computer technology has evolved enormously, and interest in the diverse uses of AI in medical and biological research hasgrown. ANNs are now frequently utilized in medical application through our many fields. Diagnosis, Electronic signal Analysis, Medicalpicture analysis and Radiology have all used ANNs extensively. In this paper we had critical analysis on Augmentation of ANN in Medicaldomainandinotherfields.

Keywords: ArtificialIntelligence,ArtificialNeural Network,MedicalDiagnosis,TypesofANNs,MagneticResonanceImage.

I. INTRODUCTION

When you realize what the solution should really be but nothow to get there, AI has a great potentiality to extract meaningfromfacts.Artificialintelligence(AI)hasthepotentialtoenhance human skills and transform exponentially expandingdata into insight, action, and value. Artificial intelligence is acomputersciencedisciplinethatcananalyzecomplicatedmedical data. AI is classified on the basis of functionality andCapability as shown(fig. 1). In many therapeutic contexts,their ability to exploit important relationships within a datacollectionmaybeemployedindiagnosis,therapy,andoutcomeprediction.

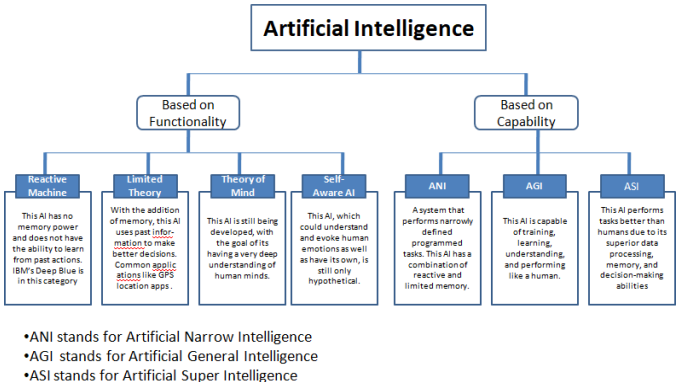


Figure1 Classificationofartificialintelligence

A computational learning system that employs a network offunctions to interpret and transform a data input in one forminto a desired output, generally in another form, is known as artificial neural networks. Human biology and the way neurons in the human brain work together to interpret inputs from human senses inspired the artificial neural network concept.

Intheactualworld,ANNshavealreadyfoundawidespectrum of uses. Their ability identifies and recognizes apattern has enticed researchers to use them to solve a widerange of therapeutic issues. As we become more aware thatdiagnosis,treatment,andoutcomepredictioninmanyclinical situations are dependent on a complex interaction ofmany clinical, biological, and pathological variables, there isagrowingdemandforanalyticaltoolssuchasartificialneuralnetworks(ANNs)thatcanexploittheintricaterelationships between these variables. This could be done byperceptron.Many versionsof the fundamental Perceptronnetworkhavebeendeveloped,butthemultilayerfeedforwardPerceptron(fig.2)hasproventobethemostpopular. These networks are made up of layers of neurons,typically an input layer, one or more middle or hidden layersand an output layer, each of which are fully connected toanotherlayer[1].

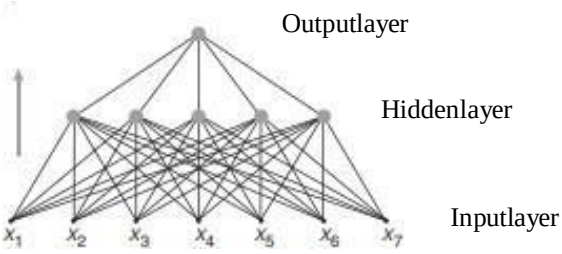


Figure2 Feed-forwardsystem.

The network presented comprises seven inputs, five hiddenlayer units, and one output. Because the input layer does notdo any calculations and is not counted, it is referred to as atwo-layernetwork[2].

Input layer: Also termed as input nodes, this layer providesthe model with inputs/information from the outside world forit to learn and draw conclusions from. The information frominputnodesissentfromthenextlayer,the Hiddenlayer.
Hidden Layer: The hidden layer is a network of neuronsthat performs all calculations on the incoming data. A neuralnetwork can have any numberof hidden layers. A singlehiddenlayermakesupthesimplestnetwork.
Output Layer: The model's output is obtained from all thecalculations conducted in the output layer. The output layermighthaveasingleorseveral nodes.

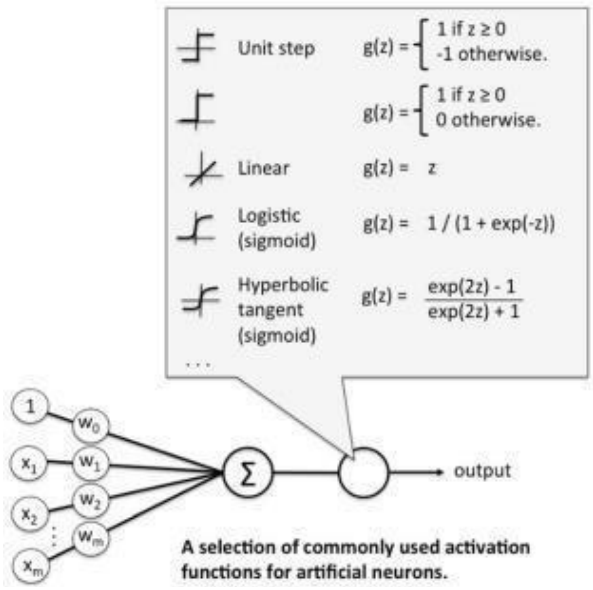


Figure 3 Functionsofperceptron

Links connect the neurons, and each link has a numericalweight assigned to it. A neural network 'learns' by adjustingtheseweightsrepeatedly.Oneofthemostessentialcharacteristics of ANNs is their ability to learn from theirtrainingexperiences[3].
Artificialintelligenceisattheintersectionofnewtechnologies with the potential to deliver cost-effective andappropriate health care in real time, manage effective andefficientcommunicationamongmultidisciplinarystakeholders, and address non-traditional care settings, theevolvinghealthcareworkplaceandworkforce,andtheemergence of new and disparate health information systems.There are a variety of technologies willing to tackle thesehealth care management concerns, thanks to the increasedadoption of artificial intelligence to make more complicatedjudgments across several sectors. However, there is a paucityof guidance on selecting appropriate methods tailored to thehealthcareindustry[4].
Clinicaldiagnosis,imageanalysisinradiologyandhistology, datainterpretationinintensivecare,andwaveform analysis have all employed ANNs. Stamey et al[5]. created the ProstAsure Index, a neural network-basedclassification method that can categories prostates as benignorcancerous.Abdominalpainandappendicitis,retained common bile duct stones, glaucoma,18 and back pain aresome of the other medically useful diagnostic uses of ANNs.There exists anurgent need forbrand new strategies that'snotonly economicalbuteffective to catchup withtheseprobablenewemergedoradaptativemoneychallenges[17].

II. TYPE OF ANNS

- **FEEDFORWARDNEURALNETWORK**
  A feed-forward neural network is one in which theoutputs of the neurons do not feed back towards theinputsthroughout thenetwork.
- **RADIALBASISNEURALNETWORK**
  Thesimilarityoftheinputtosamplesfromthetrainingsetisusedbyan RBFNtoaccomplishclassification.EachRBFNneuronholdsa"prototype," which is just one of the training set'sinstances.
- **MULTILAYERPERCEPTIONMODEL**
  A multi-layered perceptron, like the human brain, ismadeupoflinkedneuronsthatexchangeinformation,also referredasa"vanilla"neuralnetwork.
- **CONVOLUTIONALNEURALNETWORK**CNNsareimageprocessing,artificialintelligence(AI)systemsthatemploydeeplearningtodobothgenerativeanddescriptivetasks,frequentlyutilizingobjecttrackingthatincludesimageandvideorecognition, recommender systems, and naturallanguageprocessing(NLP).
  ACNNemploysamechanismsimilartoamultilayerperceptronbutwithlessprocessingneeds.
- **RECURRENTNEURALNETWORK**
  RNNs are a sort of Neural Network in which theoutput from the previous step is used as input in thenextstage.
- **MODULARNEURALNETWORK**
  It is a type of artificial neural network that consistsof a number of autonomous neural networks that aremonitored by a third party. Each individual neuralnetwork acts as a module, operating on its ownsetofinputstocompleteasubtaskofthetaskthenetwork isattemptingtocomplete.
- **SEQUENCE TOSEQUENCEMODEL**

Sequence to Sequence models is a type of RecurrentNeural Network architecture that is commonly used (but notexclusively) to address complicated language issues such asMachine Translation, Question Answering, Chatbot creation,TextSummarization,andsoon.

III. ANNINMEDICALSCIENCE

A. BraintumordetectionusingANN

Because of the diversity of potential forms,locations, and image intensities, segmenting brain tumors inmagneticresonanceimaging(MRI)isatoughanddemandingprocess.Itisthegoalofthisstudytoexaminetheapproachesofautomaticbraintumoridentificationusing MagneticResonanceImage(MRI)indifferentphasesoftheComputerAidedDetectionSystem(CAD):firststageispre-processingandpost-processingofMRIimagestoenhancementitandmake it more suitableto analysisthenused threshold tosegmenttheMRIimages[15].Existingapproachesareoftenclassifiedaseitherregion-basedorcontour-based.Thesearenormallyreservedforfullyamplifiedtumorsorcancersofacertain kind. For tissue segmentation, the quantity of resourcesnecessarytoexplainahugesetofdataissimplifiedandpicked.Toidentifybraincancers,researchersusedmodifiedimagesegmentationalgorithmsusing MRIscanpictures.AlsopresentedisamodifiedProbabilisticNeuralNetwork(PNN)
[8] model based on learning vectorquantization(LVQ) [8]with image and data analysis and manipulation techniques forautomated brain tumor classification utilizing MRI-scans. Theperformance of the improved PNN classifier is evaluated intermsoftrainingefficiency,classificationaccuracy,andcomputingtime.Thesuggestedsystemoutperformsthecomparable PNN system and successfully handles the processofbraintumorclassificationinMRIimageswith100%accuracy,accordingtosimulationfindings.

B. LungCancerdetectionusingANN

Lung cancer is a disease of uncontrolled cell growthin tissues of cells [9]. There are two forms of lung cancer: non-small cell lung cancer and small cell lung cancer [10]. Becausethe lungs are bigger, tumors can develop within fora longperiodbeforecausingsymptomssuchascoughingandexhaustion. The key to curing lung cancer is early detection,and this is a difficult challenge to solve since the structure ofcellsoverlaps,makingitdifficulttoidentifythedisease.Althoughthepatientsurvivalratewiththisconditiondiminishesasthepatient'sagegrows.Authorusedbackpropagation algorithms in two phases feed forward and backpropagation procedure [11]. It is used to assess whether thepatients have breast cancer and, if so, what form of cancer theyhave. The author first did a CT scan of the patients' pictures,then extracted characteristics from the CT scan photos, andthen used ANN to classify them. The categorization was basedonwhetherornotthepicturewasmalignant.Theinformationwassentfrominputlayerstooutputlayersduringfeedforward,a

nd the value of the outputlayers and the outputvalue were compared and the result determined during backpropagation.Wedeterminedthattheresultsweremoreaccurate than fuzzy neural networks in terms of sensitivity,accuracy, and specificity, and that the number of rules utilizedinhierarchicalneuralnetworksandfuzzyGaussianpotential [10]networkswasreduced.

IV. APPLICATIONOFANN

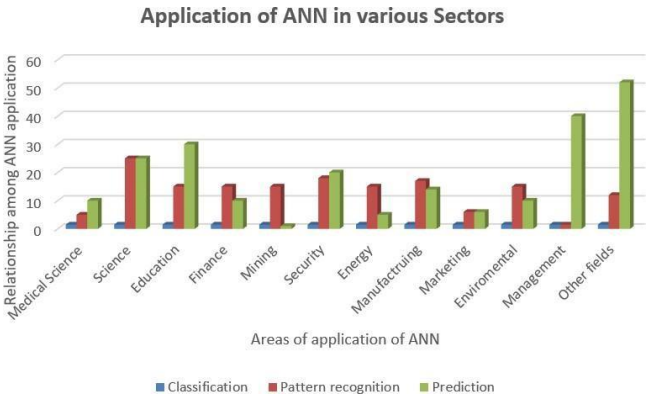
The capacity to learncomplicated nonlinear input-output connections, apply sequential training techniques, andadapt to the data are the primary properties of neural networks.Themostcommonlyusedfamilyofneuralnetworksforpattern classification tasks [13] is the feed-forward network,whichincludesmultilayerperceptronandRadial-BasisFunction(RBF)networks.Anotherpopularnetworkisthe Self-OrganizingMap(SOM),orKohonen-Network[14],which is mainly used for data clustering and feature mapping.The learning processentails modifying network designandconnection weights inorder fora network to accomplish acertainclassification/clusteringjobefficiently[12].Thepopularity of neural network models forpattern recognitionissues is growing, owing to their seeming minimal reliance ondomain-specificexpertiseandtheavailabilityofefficientlearning methods for practitioners to utilize. Artificial neuralnetworks (ANNs) are a novel family of nonlinear algorithmsfor feature extraction and classification (using hidden layers)(e.g., multilayer perceptron's). Existing feature extraction andclassification techniques can also be transferred onto neuralnetwork topologies for (hardware) implementation efficiency.Anartificialneuralnetwork(ANN)isadataprocessingparadigm inspired by the way organic nerve systems, such asthe brain, analyses data. The loss characteristic and hyperbolictangentcapabilitiesarethedeployedactivationfunctions,squareblundersaretakenintoaccount[16].Theuniquestructureoftheinformationprocessingsystemis acrucialcomponent of this paradigm. It is made up of several highlylinked processing components (neurons) that work together toaddress specific challenges. The inevitable existence of globalinformationinfrastructureineveryfieldhasforcedvirtualorganizationstogainimportanceasafittingmodelformaking a large-scale organization of distributed nature [18].Through a learning process, an ANN is tuned for a specificpurpose,suchas pattern recognitionordata categorization.Adjustments to the synaptic connections between neurons arepart of learning in biological systems. The NFT when pairedwithMetaverse,representsasignificantadvancementandrevolution in the realm of virtual reality and blockchain, givingartists a new avenue to express their unique and valuable work[19].

V. NEURAL NETWROK OVER MACHINELEARNING

AnyonecreatingamodelinconventionalMachine Learning either has to be an expert in the subject area they'reworkingonorpartnerupwithone.Designingandengineering features becomes more challenging without thisspecialized knowledge. The quality of a Machine Learningmodel is determined by the dataset's quality, as well as howeffectivelyfeaturesrepresentthedata'spatterns. Deep Learning algorithms take in a dataset and understand itspatterns, as well as how to represent the data using featuresthattheyextractthemselves.Thentheymergeseveralrepresentations of the dataset into a more abstract, high-levelrepresentation of the dataset, each one highlighting a certainpatternorattribute.Withoutmuch humanparticipationinfeature creation and extraction, this hands-off method allowscomputerstoadapttothedatamuchfaster.

VI. RESULT

The ANN outperformed the approaches in terms ofaccuracy. It's beneficial not just in medical science, but also inother domains such as industry, Marketing, Finance and othersectors. As a result, in the medical area, it identifies illness likelung cancer and brain tumors, while in the industrial domain, itassistsinpatternidentification andSOMmapping.



The connections between many domains show that ANNmay be used to subject of study and industry. The histogramshowsthathowANNisusedinsecurity,engineering, medicine,agriculture,finance,banking,education,environmental, energy, mining, and marketing and other fields.As a result, interested academics may investigate the use ofartificial neural networks in these and other growing areas forfuturestudyinordertofindbetterwaystoaddresstheirdomains.Becauseevery problemhasanalgorithm,model,scheme,andframework.

VII. CONCLUSION

Artificialneuralnetworksareusedinavarietyoffields,including medicine,business,agriculture,andclassification. The outcomes are more accurate, quantifiable,and error-free when artificial neural networks are used. Thereare several obstacles to overcome, including ANN training,implementation,neuralnetworkinterpretation,anddataacollection. Artificial Neural Networks can be used to treat andprevent lung cancer, detection of Brain Tumor, 3as well as inother fields of industry. The performance of an ANN may beenhanced by employing an appropriate optimization approach,suchasAntcolonyoptimization.

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