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Optimizing Methods and Analysis of Multicast Routing with using Deep Learning

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ABSTRACT
The machine learning technology has received increased attention in recent years in several vision tasks such as image classification, image detection, and image recognition. In particular, recent advances of machine learning techniques bring encouragement to image classification with convolutional neural networks. CNN has been established as a powerful class of models for image recognition problems and even in some cases they outperform humans. The main purpose of the work presented in this paper is the rise and development of machine learning, deep learning, CNN and to give an overview on using machine learning for image classification. At the end the comparison of CNN with traditional method is discussed.

Keywords: *convolutional neural networks, deep learning, neural networks*

I. INTRODUCTION

Artificial Intelligence in simple terms is defined as the ability of a computer to exhibit "intelligence". As per , john Mc Carthy the father of artificial intelligence it is "the science and engineering of making machines that are intelligent mostly intelligent computer programs. Artificial Intelligence is broad and important field of computer science that makes machines appear as if they have human intelligence. Artificial Intelligence is not any system, it is a field of study. Knowledge engineering is the heart and soul of AI research. Machines can be made to act and react like humans if only they have abundant information pertaining to the world.

1.1 Machine Learning

Machine learning is a sub-part of Artificial intelligence. Machine Learning is a field in Data Science, where machines have the capability to "learn" themselves, without the need of being explicitly programmed by humans. By breaking down the past information known as "training data", the Machine Learning model forms patterns and makes use of these patterns to learn and make future predictions. The precision of such predictions made by ML models is increasing every day. Machine learning has been benefiting us from the past decennary with self-driving cars, speech recognition, efficient web search and much improved understanding of the human order. Machine learning is so invasive these days, that one makes use of it in dozen of ways without knowing it. Many researchers also believe that it is the best way to progress towards human-level AI. Success of machine relies upon two components: To what extend the speculation of abstraction data take place, to what extend the machine is able to predict the future from its learning with due course of action. The objective of machine learning, firmly related with the objective of AI, is to attain a thorough understanding about the idea of learning process including the human learning and other types of learning, about the computational aspects of learning behaviours, and to induce the capability of learning in computer systems. The centre of success of artificial intelligence lies in machine learning with its applications in various areas of science, engineering and society.

1.2 Machine Learning Techniques

Machine Learning is widely used in every field these days, even though some of the uses may not always be noticeable. The main techniques of Machine Learning are:

1. **Classification:** relies on training data, having observations with recognized categories, classification works by predicting the category to which a new observation belongs to Eg: Predicting whether the price of a house would fall under any of these classes such as- very costly, costly, affordable, cheap or very cheap.
2. **Regression:** works by predicting a value from a continuous data set. Eg: Predicting the price of a house based on a number of factors such as location, time of buying, size etc.

3. **Clustering:** In this technique, a set of observations is assigning into subsets (i.e.clusters) so that the observations under same cluster are similar in some way. Eg: Netflix (An online movie company) has different clusters of viewers, people with similar viewing habits fall in the same cluster.
4. **Recommendation Systems:** It Uses Machine Learning algorithms to help users find new products / services based on data of the user or product / service. Eg: You Tube recommending a certain video based on watching patterns of the people or Amazon suggesting products based on popularity.
5. **Anomaly Detection:** Here such observations are identifying that do not belong to an expected pattern or other items in a dataset. Eg: An outlier (i.e. an anomaly) in credit card transactions could be a potential banking fraud.
6. **Dimensionality Reduction:** The process of decreasing the number of random variables under study to obtain a set of variables that is significant.

Broadly, there are 3 types of Machine Learning Algorithms.

Supervised Learning / Predictive Models: As the name suggests, Predictive model is used to predict the future outcome based on the available past data. In this algorithm, each training examples have pair consisting of input object typically, which is a vector, and a desired output value called as supervisory signal. There are various algorithms used to learn the mapping function between the input and output objects. There are two groups in supervised learning as Classification and Regression. Classification problem is when the output variable is category such as "white" or "black" and "dog" or "cat." Whereas, regression problem is when output variable is real value such as "rupees", "weight", "temperature".

However, this algorithm used various other approaches like SVR (support vector regression), GPR (Gaussian process regression), neural networks, naive bayes, support vector machine, etc

Some of the popular application of supervised learning are, image classification, identity fraud detection, weather forecasting,

Unsupervised Learning / Descriptive Models: The unsupervised learning problem is inferring a function to describe the unlabeled data, in this data classification or categorization is not included in the observation. When the provided learners example are unlabeled, there is no accuracy in the output of relevant algorithm, which is one of the way distinguishing unsupervised learning from supervised and reinforcement learning respectively. Further grouping of unsupervised learning are clustering and association. Clustering is about inherent groupings of the data, such grouping can be heights of student in class or school. Whereas, association rules are about to establish interesting relationship between variables and datasets. Some real world applications of unsupervised learning are, NASA remote sensing, mini UAV, Nano camera fabrication technology etc.

Reinforcement Learning (RL): The reinforcement learning is one the mostly popular study in the field of Artificial Intelligence, this algorithm is part of machine learning is very much different from supervised and unsupervised learning. The supervised learning gives feedback instantly whether the work has been done is right or wrong similarly the case is with unsupervised learning, on the other hand reinforcement learning learns everything from the past experience where it recognise stuff what it have learnt in past without any cumbersome coding. The reinforcement learning is part of human behavioural psychology, which use agent to act accordingly with situation to maximize the rewards.

1.2 Deep Learning

Deep Learning is coupled with machine learning algorithm (Artificial Neural Network). It uses the concept of human brain to assist the modelling of arbitrary functions. ANN requires immense amount of data .This algorithm is highly flexible in case of modelling multiple outputs simultaneously. Deep learning has been around for a couple of years now it's no longer a new concept. But nowadays with all the attention, deep learning is emerging. Deep Learning is an area of Artificial Intelligence that produces life-changing results. Deep Learning means neural networks with a large number of hidden layers. It is an effort to imitate the functioning of a human brain. Since the exact functioning of a human brain is unknown, in the same way not much is known about the precise working of Deep Learning too. It is like a black box, i.e. the input and output can be seen and are known, but the internal working remains a mystery!. It is Interesting to know that, Data Scientists believe that if we get to know the working of Deep Nets, we will be closer to the working of human brain. Deep learning is a form of machine learning that achieves huge power, adaptability and knowledge to constitute the world as an order of settled ideas characterized in connection to more straightforward ideas, and more conceptual representations registered in terms of less abstract ones." "Deep Learning is a new field of Machine Learning research, brought in with the aim of achieving the original goal of Machine Learning. Deep Learning is about training multi layered artificial neural networks to bode well out of data such as images, sound, and text." Two key aspects of deep learning are: 1) models having multiple layers or stages of processing information in a nonlinear way. 2) methods for supervised or unsupervised learning of representing features at successively higher, more abstract layers.

1.3 Overview of CNN Architecture

CNNs are feedforward networks in that information flow takes place in one direction only, from their inputs to their outputs. Just as artificial neural networks (ANN) are biologically inspired, so are CNNs. They are comprised of neurons that have learnable weights and biases. Every neuron receives some inputs, the input is multiplied with the corresponding weight is then run through the activation function [16]. The entire system still expresses a single differentiable score function; from the raw image pixels on one end to class scores at the other. And the loss function is still there on the last layer all tips and tricks we used for learning NN still apply. The visual cortex in the brain, which consists of alternating layers of simple and complex cells (Hubel & Wiesel, 1959, 1962), motivates their architecture.

CNN architectures come in several varieties however, in general, they comprise of convolutional and pooling (or subsampling) layers, which are assembled into modules. Either one or more fully connected layers follow these modules as in a standard feedforward neural network. Modules are often stacked on top of each other to form a deep model. Figure illustrates typical CNN architecture for a toy image classification task [16]. An image is input to the network, and this is followed by few phases of convolution and pooling. From that point , representations from these tasks feed at least one fully connected layers. In the end , the last fully connected layer outputs the class label. Despite this being the most popular base architecture found in the literature, several architecture changes have been proposed in recent years with the objective of improving image classification accuracy or Deep convolutional reducing computation costs[16].

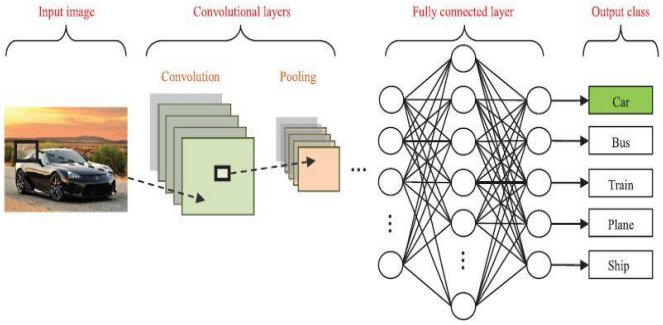

Figure1: CNN image classification pipeline [16].

II. RELATED WORK

2.1 The Discipline of Machine Learning

In this paper [5], they have given some insights of the machine learning and computers can be utilized to design the autonomous machines which can operate without the supervision of human beings. They have also described some of the application areas of machine learning, for example, speech recognition, bio-surveillance, computer vision, accelerating empirical sciences, and robot control. They have also discussed the role of machine learning in computer science. They have concluded by discussing the various challenges of the machine learning research.

2.2 Deep Learning at Scale and at Ease

Deep Learning needs to defeat two difficulties before it can be broadly embraced in multimedia and other applications[1]. One is usability, means the execution of various algorithms for training and modelling must be finished by non-specialists without much exertion, particularly when the model is extensive and complex. It ought to be simple decision for a user to pick the best model as various multimedia applications may benefit from various models. For instance, the deep convolutional neural network is appropriate for image classification, for language modelling we utilize recurrent neural networks and likewise deep auto encoders for multimodal data analysis. One more critical thing, it must not be required for a user to execute these models from the scratch as they might be excessively mind boggling and expensive. For instance, GoogleNet includes 22 layers of 10 different types.

The other is scalability, implies that deep learning system must have the capacity to arrangement for a huge demand for computing resources for training large models with massive datasets. Since massive datasets and bigger models are utilized to enhance the accuracy, therefore the memory prerequisite for training the model may effectively surpass the processing limit of the single CPU or GPU. For instance, it takes 10 days to train a deep convolutional neural network with 1.2 million training images and 60 million parameters utilizing one GPU. To address these difficulties we have planned a distributed deep learning platform called SINGA, which has an instinctive programming model based on the common layer abstraction of deep learning models. SINGA runs on both GPUs and CPUs, and we demonstrate that it outflanks numerous state-of-art deep learning

systems. Our inclusion with creating and preparing deep learning models for veritable intelligent sight and sound applications in SINGA shows that the stage is usable and versatile [1].

2.3 Machine Learning Techniques for Data Mining: A Survey

For knowledge disclosure, data mining is a mainstream learning acquisition strategy. Classification is one of the) strategies of data mining that classifies the data into the predefined class and groups. It is utilized to call group enrollments for a data instance. There are various fields where Data Mining is applicable to greater extends such as medical, advertising, telecommunications, stock etc. This paper indicates different classification methods utilized as a part of many fields, for example, Decision Tree, Bayesian Network, Nearest Neighbour, Support Vector Machine (SVM) [8]. By and large decision trees and support vector machines have diverse operational profiles, where one is extremely precise the other isn't and the other way around. Then again, decision trees and rule classifiers have a comparable operation profile. Different algorithms will be joined for characterizing the data set. This paper gives compressive outline of different classification techniques utilized as a part of various fields of data mining. This paper presents different arrangement strategies. In any field one classification technique is more helpful than another.

2.5 Big Data, Big Challenges

In this paper [11], they have presented some open difficulties confronted by data scientists in biomedical fields and the current approaches taken to handle these difficulties. Data complexity, scale, heterogeneity, and timeliness make data analysis a reasonable bottleneck in numerous biomedical applications, because of the pattern complexity and absence of measurability of the fundamental algorithms [11]. To address these challenges various boosted machine learning and data mining algorithms are being created. As with the size of the pattern space the complexity of the potential patterns may develop exponentially with respect to data complexity. To evade a thorough hunt through the example space, machine learning and data mining calculations normally utilize a greedy way to deal with scan for local ideal in the arrangement space, or utilize a branch-and-bound way to seek optimal solutions, and are often carried out as iterative or recursive methods. To enhance efficiency, these algorithms regularly feat the dependencies between potential patterns to increases the calculations in memory as well as use extraordinary hardware, (for example, GPU and FPGA) for increasing speed. These prompt to solid data dependency, operation dependency, and hardware dependency, and sometimes ad hoc solutions that can't be generalized to a broader scope [11].

2.6 An Introduction to CNN

This paper presents that with the development of the ANN, the demand for the machine learning is increasing day by day.one of the most impressive forms of ANN architecture is CNN. CNN was initially used to resolve image driven pattern recognition, started with simple architectures, to solve simple problems[12]. As compare to other forms of ANN, CNN primarily focuses on tapping of knowledge of specified input.

This paper covers the various layers used in CNN model, their explanation and usage to form a structure for image analysis. This paper clarifies the various misnomers about the complexity of the CNN models.

2.7 Using Convolutional Neural Networks for Image Recognition

The paper presents with increase in the popularity of CNN as compare to other techniques, the CNN are mainly used for pattern and image recognition and even in some cases they outperform humans. In this paper various challenges have been discussed to address the problem using traffic sign recognition as an example , and introduce various algorithms and implementation had been introduced which are developed by cadence that can trade off computational burden and energy for a mild degradation in sign identification rates. In this paper the challenges of using CNNs being used in embedded systems are outlined and present the fundamental characteristics of the cadence tensillica vision P5 digital signal processor (DSP) for imaging and computer vision. The hierarchical CNNs are developed for recognizing traffic signs in the GTSRB [13]. The algorithm is developed to calculate the performance verus complexity gets reduced by a factor of 86 for a CDR degradation of less than 2%. More than 850 traffic sign recognitions to run the DSP at 600MHZ. The tensillica vision P5 DSP from cadence has an relatively the perfect set of features to run CNNs.

2.8 Machine Learning Framework for Image Classification

This paper presents extraction methods and classification in case of image classification and recognition application. The paper presents different techniques and algorithms related to the machine learning framework for image classification. The performance of training models are exposed by varying classifier algorithms on Caltech 101 images categories[14]. For feature extraction we use SURF technique against global color feature extraction. Through experiments it was concluded that SURF local feature extractor method and svm (cubic svm) training classifier performs best average accuracy. The main work of this paper is to give the best machine learning framework techniques to recognize the stop sign images.

2.9 Deep Convolutional Neural Networks for Image Classification; A Comprehensive Review

This paper presents a comprehensive review of CNNs for image classification tasks. It categorizes their progression into their early development, their contribution to the deep learning renaissance, and their rapid advancement over the past few years[16]. In particular, it focuses on their advancement by deliberating and analysing most of the notable advances in relation to their architectures, supervision components, regularization mechanisms, optimization techniques, and computation since 2012. Despite successes in other domains, DCNNs have seen remarkable progression in image classification tasks, setting the state of the art on several challenging classification benchmarks and dominating numerous image-classification-related challenges and competitions. In fact, on several single label image classification benchmarks, their performance has surpassed human-level performance. However, the contemporary rise of DCNNs has led researchers to scrutinize their classification performance, robustness, and computational characteristics, resulting in the discoveries of several challenges and trends to address them. Accordingly, this review also recapitulates these open issues and their associated trends and, most significant, provides several recommendations and research directions for future exploration[16].

2.10 Comparison of Machine Learning Algorithms to Classify Web Pages

In this paper, various supervised learning algorithms are evaluated to determine the predefined classes among web documents. Several algorithms are; ANN, random forest(RF), AdaBoost to execute a equivalence of behaviour on the web pages classification problem. After testing, the accuracy of RF classifier was 87.26%, neural network was 84.82% and that of AdaBoost is 81.7%[18]. From the results it was concluded that RF algorithm is better in classification and provide more accurate results than the ANN and AdaBoost classifiers. The value of FI is greater than the others when classifying the pages. The ANN performs better when compared to AdaBoost. RF performs better on small data while NN architecture requires big data to generalize better, keeping the number of documents larger from a number of features. While in case of RF, even bunch of documents even with many features can give a proper accuracy.

2.11 Comparison of Different Classification Algorithms for Weed Detection from Images based on Shape Parameters

In this paper various classification algorithms are evaluated with centre focus on k-nearest neighbours, decision tree learning, and support vector machine classifiers for weed detection from images. For classification best subset of shape features are chose using data mining techniques. For the detection of weed and crop densities, image processing of bispectral images were used by considering shape features [22]. Classification is essential step in weed detection, the various classification algorithms are tested and their effect on the result is taken in consideration. The comparison was done by using manual densities for oil seed rape and barley. A simple class schema, one for each species and noise, can be classified correctly by all compared classifier. Due to the over segmentation or under segmentation, the subclasses of the species were introduced to take into account single image leaf segmentation and over laps of plants. The performance of the classifiers varies and can be measured by using cross-validation techniques for classification accuracy and by manually comparing the results with weed infestation. The model complexity of KNN and decision tree is not sufficient to separate the subclasses of HORVS.[22].

2.12 A Comparison of Generic Machine Learning Algorithms for Image Classification

In this paper, for image classification several machine learning algorithms are evaluated including the approach that joins making of ensembles of highly randomized trees from the original images. The other methods include decision tree, bagging boosting, random forest and support vector machines .These methods are evaluated on four several classification problems for which test protocols were strictly specified. All these procedures are implemented directly on the pixel values with no feature extraction for the approach to be generic. On three out of four problems, the generic sub-window technique accuracy is best and is comparable to state of the art techniques of the paper, but slightly lesser than the best known results[19]. By our experiments, it can be said that the generic methods, particularly our sub-window algorithm, can come outstandingly close to specialized methods, keeping its generality and conceptual simplicity in consideration.

2.13 Image Classification using Convolutional Neural Network

CNN has been demonstrated as a powerful class of models for image recognition problems. This paper tried to predict the probability of an image getting high number of likes on Instagram. A pre-trained Alexnet Imagenet CNN model was modified using caffe on a new dataset of Instagram images with hashtag ‘me’ to predict the likability of photos. In this paper, a cross-validation of 60% and the test accuracy of 57% were achieved using different methods, even though this job is hectic because of inherent noise in the data[20]. In this paper we trained the model to identify certain characteristics of photos which result in more likes. The paper used the caffe CNN as the base model by default, though there are other models like VGG which are better by more than 10% accuracy.

2.14 Image Classification using Convolutional Neural Networks with Multi Stage Feature

CNN is now being widely used for image classification arrangements , and in most cases features from the upper most layer of the CNN are used for classification, but those features may not be powerful enough to predict an image correctly. As in some cases, the lower layer carries more powerful features than those from the top[21]. Therefore applying features from a particular layer only to categorize seems to be a process that does not require learned CNN's potential discriminant power to its full degree. This inbuilt property leads to the need for merging features from multiple layers in given CNN models. The CNN models that have already learned with the training images are reused to extract features from multiple layers. The proposed fusion approach is evaluated according to image classification benchmark data sets, CIFAR-10, NORB, and SVHN. This paper shows that the approach that is proposed improves the reported performances of the existing models by 0.38%, 3,21% and 0.13% respectively.

III. COMPARISON OF CNN WITH OTHER CLASSIFICATION ALGORITHMS

In practice the decision of choosing the classifier actually depends on the dataset and the general complexity of the problem. Setting deep learning is more tedious than using the other classifiers such as random forest, SVM's but it shines in complex problems like image classification, natural language processing , speech recognition. Even it makes us to worry less about the feature engineering. CNN are the neural networks which use an optimization method to train the network while generic algorithms are a class of optimization methods which can't learn anything. CNN are a specialized type of ANN which can either be deep or not depending on the type of model. Adding up the layer to the CNN network increases the model complexity on contrary no such method is available in svm to increase the model complexity. CNN is used when we large amount of data is available. SVM is used for less data[25]. CNN uses comparatively little pre-processing than the other image classification algorithms. The CNN has an inbuilt advantage over traditional methods to solve the computer vision problems that is learning hierarchical features i.e what features are useful and how to compute them. CNN is better than RNN in a way because CNN have filters which act like feature detectors which somewhat mimic the human visual system, in other words we can say the convnet is suited for image domain. Usually after training CNN it is very fast to classify or predict something.

IV. PROPOSED WORK

Fishing industries are among the largest food industries on the planet and one of the main pillars of economy for coastal countries. The approach is to develop a model using convolutional neural network to automatically detect and classify different species of fishes. To safeguard this fishery for the future, the organizations are using cameras to monitor the fishing activities. The video then will be sliced down into images and using these images as an input to the model.

V. CONCLUSION

The convolutional neural networks perform better than the other state-of-the-art methods on the larger dataset. It not only extracts the features automatically which reduces the workload of manual feature extraction but also classifies the images within the shorter amount of time. Classical decision tree, bagging, boosting, random forest, SVM, are other methods evaluated on different image classification problems. Random forest can classify more accurately but on a small set of data[18]. CNN is being advantageous since it is able to learn optimal features from images adaptively. Comparing with other image classification algorithms experimental findings revealed there is substantial increase in the accuracy using CNN[16].

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