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Project Report

“DOG BREED CLASSIFIER USING CNN”

Submitted by

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Under the Guidance of

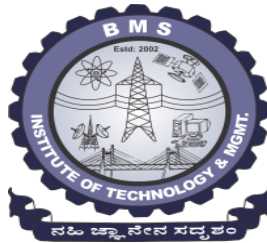
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By,

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ABSTRACT

Implementation of a convolutional neural network for classifying dog breeds from the given image using Python.

The project is able to recognise multiple dog breeds and also display them in descending order of confidence.

This uses the Dogs dataset to train various kinds of neural networks in order to classify dog breeds based on images. The code is written in Python 3 and Keras with Tensorflow backend.

The dog breeds this project can classify are –

1. French Bulldog
2. English Foxhound
3. Walker Hound
4. Toy terrier
5. Boxer
6. Pembroke
7. Eskimo Dog
8. Beagle
9. Irish water Spaniel
10. Toy poodle
11. Golden Retriever

INTRODUCTION

Machine learning is a field of computer science that often uses statistical techniques to give computers the ability to "learn" (i.e., progressively improve performance on a specific task) with data, without being explicitly programmed.

Machine learning is closely related to (and often overlaps with) computational statistics, which also focuses on prediction-making through the use of computers. It has strong ties to mathematical optimization, which delivers methods, theory and application domains to the field. Machine learning is sometimes conflated with data mining, where the latter subfield focuses more on exploratory data analysis and is known as unsupervised learning. Machine learning can also be unsupervised and be used to learn and establish baseline behavioral profiles for various entities and then used to find meaningful anomalies.

Within the field of data analytics, machine learning is a method used to devise complex models and algorithms that lend themselves to prediction, in commercial use, this is known as predictive analytics. These analytical models allow researchers, data scientists, engineers, and analysts to "produce reliable, repeatable decisions and results" and uncover "hidden insights" through learning from historical relationships and trends in the data.

Recent advances in deep learning made tasks such as Image and speech recognition possible. Popular techniques used in improving the accuracy of image classification are Convolutional Neural Networks (CNNs for short).

When the computer interprets a new image, it will convert the image to an array by using the same technique, which then compares the patterns of numbers against the already-known objects. The computer then allots confidence scores for each class. The class with the highest confidence score is usually the predicted one.

Instead of feeding the entire image as an array of numbers, the image is broken up into a number of tiles, the machine then tries to predict what each tile is. Finally, the computer tries to predict what's in the picture based on the prediction of all the tiles. This allows the computer to parallelize the operations and detect the object regardless of where it is located in the image.

Regression

Regression analysis is a set of statistical processes for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables (or 'predictors'). More specifically, regression analysis helps one understand how the typical value of the dependent variable (or 'criterion variable') changes when any one of the independent variables is varied, while the other independent variables are held fixed.

Most commonly, regression analysis estimates the conditional expectation of the dependent variable given the independent variables – that is, the average value of the dependent variable when the independent variables are fixed. Less commonly, the focus is on a quantile, or other location parameter of the conditional distribution of the dependent variable given the independent variables. In all cases, a function of the independent variables called the regression function is to be estimated. In regression analysis, it is also of interest to characterize the variation of the dependent variable around the prediction of the regression function using a probability distribution. A related but distinct approach is Necessary Condition Analysis (NCA), which estimates the maximum (rather than average) value of the dependent variable for a given value of the independent variable (ceiling line rather than central line) in order to identify what value of the independent variable is necessary but not sufficient for a given value of the dependent variable.

Regression analysis is widely used for prediction and forecasting, where its use has substantial overlap with the field of machine learning. Regression analysis is also used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. In restricted circumstances, regression analysis can be used to infer causal relationships between the independent and dependent variables. However this can lead to illusions or false relationships, so caution is advisable; for example, correlation does not prove causation.

Many techniques for carrying out regression analysis have been developed. Familiar methods such as linear regression and ordinary least squares regression are parametric, in that the regression function is defined in terms of a finite number of unknown parameters that are estimated from the data. Nonparametric regression refers to techniques that allow the regression function to lie in a specified set of functions, which may be infinite-dimensional.

The performance of regression analysis methods in practice depends on the form of the data generating process, and how it relates to the regression approach being used. Since the true form of the data-generating process is generally not known, regression analysis often depends to some extent on making assumptions about this process. These assumptions are sometimes testable if a sufficient quantity of data is available. Regression models for prediction are often useful even when the assumptions are moderately violated, although they may not perform optimally. However, in many applications, especially with small effects or questions of causality based on observational data, regression methods can give misleading results.

In a narrower sense, regression may refer specifically to the estimation of continuous response (dependent) variables, as opposed to the discrete response variables used in classification. The case of a continuous dependent variable may be more specifically referred to as metric regression to distinguish it from related problems.

Classification

classification is the problem of identifying to which of a set of categories (sub-populations) a new observation belongs, on the basis of a training set of data containing observations (or instances) whose category membership is known. Examples are assigning a given email to the "spam" or "non-spam" class, and assigning a diagnosis to a given patient based on observed characteristics of the patient (gender, blood pressure, presence or absence of certain symptoms, etc.). Classification is an example of pattern recognition.

In the terminology of machine learning, classification is considered an instance of supervised learning, i.e. learning where a training set of correctly identified observations is available. The corresponding unsupervised procedure is known as clustering, and involves grouping data into categories based on some measure of inherent similarity or distance.

CNN

In machine learning, a convolutional neural network (CNN, or ConvNet) is a class of deep, feed-forward artificial neural networks, most commonly applied to analyzing visual imagery.

CNNs use a variation of multilayer perceptrons designed to require minimal preprocessing. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared-weights architecture and translation invariance characteristics.

Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex. Individual cortical neurons respond to stimuli only in a restricted region of the visual field known as the receptive field. The receptive fields of different neurons partially overlap such that they cover the entire visual field.

CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters that in traditional algorithms were hand-engineered. This independence from prior knowledge and human effort in feature design is a major advantage.

Deep Learning

Deep learning (also known as deep structured learning or hierarchical learning) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. Learning can be supervised, semi-supervised or unsupervised.

Deep learning architectures such as deep neural networks, deep belief networks and recurrent neural networks have been applied to fields including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, machine translation, bioinformatics and drug design, where they have produced results comparable to and in some cases superior to human experts.

Deep learning models are vaguely inspired by information processing and communication patterns in biological nervous systems yet have various differences from the structural and functional properties of biological brains, which make them incompatible with neuroscience evidences.

Project to Program Outcomes (PO) Mapping

Project Name: Dog Breed Classifier

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
✓	✓	✓	✓	✓			✓	✓	✓	✓	

Program outcomes (POs):	
PO1	Engineering knowledge: Apply the knowledge of Mathematics, Science, Engineering fundamentals and an engineering specialization to the solution of complex engineering problems
PO2	Problem analysis: Identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using first principles of mathematics, Natural sciences and engineering sciences
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the Information to provide valid conclusions
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for Sustainable development
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10	Communication: Communicate effectively on complex engineering activities with the engineering Community and with society at large, such as, being able to comprehend and write effective reports And design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and Leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Project to Program Specific Outcomes (PSO) Mapping

Project Name: Dog Breed Classifier

PSO1	PSO2
✓	✓

Program Specific Outcomes (PSOs):	
PSO1	Analyze the problem and identify computing requirements appropriate to its solution.
PSO2	Apply design and development principles in the construction of software systems of varying complexity.

METHODOLOGY

Python : Python is an interpreted high-level programming language for general-purpose programming. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales.

Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

Python interpreters are available for many operating systems. CPython, the reference implementation of Python, is source software and has a community-based development model, as do nearly all of its variant implementations. CPython is managed by the non-profit Python Software Foundation.

We have used python 3.6.0 for this project. The web app has been implemented using the very popular Flask web framework which makes it easy to develop web apps using python.

The deep learning backend that has been used is Tensorflow along with Keras.

EXPECTED RESULT

The uploaded image will be displayed along with the breeds that the convolutional neural network determines in decreasing order of percentage of confidence will be displayed. This will enable the user to determine the breed of the dog in the image that was uploaded by the user.

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