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Transfer Learning in Computer Vision: Technique and applications

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Abstract: Transfer learning is a computer vision technique that allows a pre-trained model to be used as a starting point for solving a different but related task. It leverages the knowledge and learned representations from one task to improve the performance on another task. In practice, it is relatively rare to have a dataset of sufficient size to train an entire Convolutional Neural Network from scratch. Instead, it is common to pretrain a ConvNet on a very large dataset.

Keywords
Fine tuning, convolution, feature extraction, source and target domain, transfer learning, and deep learning.

1. Introduction

Artificial intelligence has enabled computer vision programs to perform amazing feats that are highly advantageous to society. Regression, clustering, classification, and other knowledge engineering domains have seen tremendous success with machine learning algorithms and data mining. The presumption that training and testing data originate from the same feature space or distribution underlies the operation of most AI and machine learning models. In the event that the distribution space changes, we will have to start from scratch and train a new statistical model with fresh data. In practical applications, this process is generally expensive and time-consuming.

2. Transfer Learning

A. Traditional ML VS Transfer Learning-

In conventional learning, knowledge is retained through the completion of a single task that is typically isolated. The particular dataset is used to train the models. Since information is not retained, knowledge cannot be applied to other models. Conversely, transfer learning allows for the utilization of prior model training knowledge regarding weights, features, labels, and other relevant information to train newer models. It also addresses the issue of insufficient data for training.

B. Definition-

The area of artificial intelligence known as "computer vision" focuses on giving computers the ability to comprehend digital photos or videos at a high level. It entails automating processes like image generation, object detection, and recognition that the human visual system is capable of performing. Computer vision, according to IBM, allows systems and computers to extract useful information from digital photos, videos, and other visual inputs and act or recommend differently in response. The study of computer vision trains computers to detect flaws and problems before they interfere with normal operations using machine learning and neural networks.

C. Transfer Learning Strategy-

In computer vision, transfer learning is a technique that enables a pre-trained model to be used as a basis for tackling a related but unrelated task. It makes use of the information and acquired representations from

one task to enhance performance on another. When a pre-trained model is refined on a new dataset to classify images, transfer learning is frequently applied in real-world image classification tasks. You can find a tutorial on computer vision transfer learning offered by PyTorch here. The tutorial explains how to use transfer learning to train a convolutional neural network for image classification. Additionally, it describes the two main scenarios for transfer learning: optimizing the ConvNet and applying the ConvNet as a fixed feature extractor.

D. Transfer Learning for Deep Learning

One could comprehend the idea of applying Transfer learning to Deep Learning by using the analogy that Deep Learning models are instances of inductive learning. Transfer learning is one efficient Deep Learning method. Transfer learning leverages the models' ability to learn new problems and can be applied to deep neural networks, making it possible to train them with little or no data. Since more labeled data is typically required for real-world scenarios, this discovery is especially significant for the field of data science. This article explores the complexities of transfer learning, clarifying its tenets and exploring how data scientists can apply it to solve complex problems with previously unheard-of effectiveness and efficiency.

3. Computer Vision Applications-

A branch of artificial intelligence called computer vision allows machines to recognize and process visual input such as images, videos, or other formats, and to take necessary action based on that recognition. If artificial intelligence (AI) allows a machine to think, then computer vision allows the machine to see and process visual inputs. Think of computer vision as the eyes of an AI system. The foundation of computer vision technology is the idea of teaching computers to process an image or other visual input at the pixel level and extract useful data from it.

A. Image Classification-

A computer vision technique called image classification is used to categorize images based on features like whether they show a dog, a person's face, or a banana. This means that we can precisely predict the class of an object present in an image using image classification.

B. Object Detection-

To locate and identify the objects in an image or video, object detection uses image classification. By using this kind of detection and identification method, the system is able to count the objects in a scene or image, pinpoint their precise location, and assign labels to each one. For instance, the object detection technique can be used to quickly and accurately identify the one person and one cat in a given image.

C. Object Tracking-

A computer vision technique called object tracking is used to follow one or more specific objects. In videos and real-world interactions, object tracking is generally used to track objects after they are first detected in order to obtain observation. Object tracking is used in applications like autonomous vehicles, where it's necessary to track real-time motion in order to prevent accidents and adhere to traffic laws, in addition to classifying and detecting objects like pedestrians and other vehicles.

4. Conclusion

Computers can now extract useful information from digital photos, videos, and other visual inputs thanks to the artificial intelligence field of computer vision. Computers are taught to detect flaws and problems before they have an impact on operations through the use of machine learning and neural networks. With the exception of human vision, computer vision functions very similarly to human vision. The benefit of human sight is that it has lifetimes of context to learn how to distinguish objects, measure their distance from one another, detect motion, and determine whether an image is faulty. Instead of using retinas, optic nerves, and a visual cortex, computer vision trains machines to perform similar tasks in a fraction of the time. It does this by using cameras, data, and algorithms.

References

[1] R. K. Kaushik Anjali and D. Sharma, "Analyzing the Effect of Partial Shading on Performance of Grid Connected Solar PV System", *2018 3rd International Conference and Workshops on Recent Advances and Innovations in Engineering (ICRAIE)*, pp. 1-4, 2018.

[2] R. Kaushik, O. P. Mahela, P. K. Bhatt, B. Khan, S. Padmanaban and F. Blaabjerg, "A Hybrid Algorithm for Recognition of Power Quality Disturbances," in *IEEE Access*, vol. 8, pp. 229184-229200, 2020.
[3] D. Sarkar, Towards Data Science, 2018, "A Comprehensive Hands-on Guide to Transfer Learning with Real-world Applications in Deep Learning."
[4] V. Kurama, "ResNet, Inception V3, and SqueezeNet: A Review of Frequently Used Deep Learning Architectures," blog.paperspace.com, 2020.
[5] Kaushik, R. K. "Pragati. Analysis and Case Study of Power Transmission and Distribution." *J Adv Res Power Electro Power Sys* 7.2 (2020): 1-3.
[6] Jain, B.B., Upadhyay, H. and Kaushik, R., 2021. Identification and Classification of Symmetrical and Unsymmetrical Faults using Stockwell Transform. *Design Engineering*, pp.8600-8609.
[7] Simiran Kuwera, Sunil Agarwal and Rajkumar Kaushik, "Application of Optimization Techniques for Optimal Capacitor Placement and Sizing in Distribution System: A Review", *International Journal of Engineering Trends and Applications (IJETA)*, vol. 8, no. 5, Sep-Oct 2021.
[8] Guru Saran Chayal, Bharat Bhushan Jain and Rajkumar Kaushik, "A Detailed Study of Electrical Vehicle with Improved Applications: A Review", *International Journal of Engineering Trends and Applications (IJETA)*, vol. 8, no. 6, pp. 31, Nov-Dec 2021.
[9] Sharma, Richa and Kumar, Gireesh. "Availability Modelling of Cluster-Based System with Software Aging and Optional Rejuvenation Policy" Cybernetics and Information Technologies, vol.19, no.4, 2019, pp.90-100. https://doi.org/10.2478/cait-2019-0038
[10] G. Kumar and R. Sharma, "Analysis of software reliability growth model under two types of fault and warranty cost," 2017 2nd International Conference on System Reliability and Safety (ICSRS), Milan, Italy, 2017, pp. 465-468, doi: 10.1109/ICSRS.2017.8272866.
[11] Sharma, R. and Kumar, G. (2017) “Availability improvement for the successive K-out-of-N machining system using standby with multiple working vacations,” International journal of reliability and safety, 11(3/4), p. 256. doi: 10.1504/ijrs.2017.089710.