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Research on Parallel Deep Learning for Heterogeneous Computing Architecture

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Heterogeneous Computing is one of the most important computing power cornerstones of Artificial Intelligence, Which focuses on the big data description, GPU cloud service, data training, task scheduling, etc. Over the past few decades, the Heterogeneous Computing Architecture has achieved great progress in both the theories and applications. A typical pattern recognition system is composed of a set of heterogeneous machines, high-speed networks that connect heterogeneous machines, such as a commercialized network or a user specially designed, and corresponding heterogeneous computing support software. Nowadays, there are many opportunities and challenges to the field of Heterogeneous Computing. We should seek new Heterogeneous Computing theories to be adaptive to Artificial Intelligence. We should push forward new Heterogeneous Computing applications benefited from Artificial Intelligence.

Deep learning plays an important role in machine learning field, and it has been widely used in the field of Heterogeneous Computing and machine learning. Especially, the Parallel Deep Learning has greatly affected the applications and developments of related fields, for instance, embedded cloudlet and multiple core systems in both academy and industry. It can be seen as a breakthrough to enhance or improve the Heterogeneous Computing Architecture. It is expected that the development and applications of parallel deep learning theories would further influence the field of Heterogeneous Computing.

The special issue mainly focuses on parallel deep learning for Heterogeneous Computing Architecture. We are soliciting original contributions, of leading researchers and practitioners from academia as well as industry, which address a wide range of theoretical and application issues in deep learning for Heterogeneous Computing Architecture.

The article titled “Modeling-Learning-Based Actor-Critic Algorithm with Gaussian Process Approximator” by Shan Zhong, Jack Tan, Husheng Dong, Xuemei Chen, Shengrong Gong, and Zhenjiang Qian presents a reinforcement learning method based on Actor-Critic algorithm to learn an optimal policy, where model learning and planning is used to learn the value function and the policy. The model takes Gaussian process as the approximator to capture the noise and the uncertainty. After being learned, it can be combined with the Actor-Critic algorithm to accelerate the convergence.

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The article titled "Multi-task Deep Metric Learning with Boundary Discriminative Information for Cross-Age Face Verification" by Tongguang Ni, Xiaoqing Gu, Cong Zhang, Weibo Wang, and Yiqing Fan, presents a multi-task deep metric learning with boundary discriminative information method for cross-age face verification. This article learns the hierarchical nonlinear transformations by integrating metric learning into the framework of multi-task deep neural network, such that a common shared layer shares the common transformation by multiple tasks, and the other independent layers learn individual task-special transformation for each task.

The article titled "Estimating CT from MR Abdominal Images Using Novel Generative Adversarial Networks" by Pengjiang Qian, Ke Xu, Tingyu Wang, Qiankun Zheng, Huan Yang, Atallah Baydoun, Junqing Zhu, Bryan Traughber, and Raymond F. Muzic, Jr., presents a novel generative adversarial network (GAN) model that organically incorporates ResNet, U-net, and auxiliary classifier-augmented GAN (RU-ACGAN for short) for synthetizing CT from given MR images. This proposed RU-ACGAN model proves the potential to robustly generate more accurate CT than many existing techniques only with a limited quantity of training data, even on the challenging body section of abdomen.

The article titled "Design and Implementation of Abnormal Behavior Detection Based on Deep Intelligent Analysis Algorithms in Massive Video Surveillance" by Yan Hu, propose an improved spatial-temporal convolution neural network. The algorithm firstly uses the aggregation channel feature model to process the surveillance image, and selects the suspected object region with saliency characteristics. The results show that most of abnormal behaviors can be detected and the alarming message can be timely transmitted in the real-time surveillance.

The article titled "Improved k-means clustering algorithm for big data mining under Hadoop parallel framework" by Weijia Lu, propose an incremental K-means clustering algorithm based on the basis of K-means algorithm. In order to improve the efficiency of the algorithm and reduce the time complexity of the algorithm, the distributed database was used to simulate the shared memory space and parallelize the algorithm on the Hadoop platform of cloud computing. The simulation results show that the clustering accuracy of the proposed algorithm is higher than that of the other two algorithms by more than 10%. Keywords Improved k-means.

The article titled "An anomaly data mining method for mass sensor networks using improved PSO algorithm based on Spark parallel framework" by Jingzhen Yuan, presents a Spark-based dsPSOK-means algorithm in this paper. The parallel framework and pseudo-code description of dsPSOK-means are given. The algorithm adopts the strategy of abandoning speed and adjusting the inertia weight dynamically by fitness value. So that the dsPSO algorithm has adaptive characteristics. The output of the dsPSO algorithm is used as the input of the K-means algorithm. So that the selection of the initial center of the K-means algorithm is intelligent and adaptive. It is generally in line with linear growth. When the amount of data is large, the efficiency of the algorithm can be effectively improved by cluster parallelization. In the execution process, the communication between nodes can be effectively reduced by the algorithm based on data parallelization. And the efficiency of data processing will be improved.

The article titled "Research on parallel adaptive Canopy-K-means clustering algorithm for big data mining based on cloud platform" by Dongliang Xia, Feifei Ning, Weina He. In this paper, based on the background of large data clustering analysis and the parallelism of MapReduce computing model, the parallel Canopy-K-means algorithm is optimized by adaptive parameter estimation, which solves the problem of parameter dependence on manual experience selection in Canopy process, and is implemented by using Spark cloud computing framework. The implementation of algorithm based on MapReduce computing model of Spark cloud computing framework enables the program to run efficiently without being affected by the size of data, and ensures the efficiency and reliability of the algorithm.

The article titled "Load Balancing Algorithms for Big Data Flow Classification Based on Heterogeneous Computing in Software Definition Networks" by Yang Ping, the paper begins with software definition network architecture and load balancing algorithm for heterogeneous computing, and gradually improve the real-time and reliability of heterogeneous computing. On the one hand, the heterogeneous computing data of fog node and cloud computing system are distributed. The centralized service of software-defined network combines with distributed computing of mobile edge terminal and its subnet. Experimental comparison compared and evaluated the Load Balancing with big data stream (LBBS), Load Balancing with Heterogeneous Computing (LBHC) and the proposed LBBHD. Compared with the other two algorithms, the proposed algorithm

improves workload skewness, throughput and load balancing error respectively about 2.1%, 1.96%, 2.9%, 2.2%; 5.57%. 2.51%.

The article titled "Detecting Cryptomining Malware: A Deep Learning Approach for Static and Dynamic Analysis" by Hamid Darabian, Sajad Homayounoot, Ali Dehghantanha, Sattar Hashemi, Hadis Karimipour, Reza M. Parizi, Kim-Kwang Raymond Choo, this paper proposed the potential of using deep learning techniques to detect cryptomining malware by utilizing both static and dynamic analysis approaches. To facilitate dynamic analysis, this paper establish an environment to capture the system call events of 1500 Portable Executable (PE) samples of the cryptomining malware. We also demonstrate how one can perform static analysis of PE files' opcode sequences.

The article titled "A Robust and Accurate Particle Filter-Based Pupil Detection Method for Big Datasets of Eye Video" by Mahdi Abbasi, Mohammad R. Khosravi. The present paper suggests the use of genetic algorithms in the sampling step of the particle filter technique. As a result, in each frame, the variety of particles required for predicting the pupil position in the next video frame is maintained and their uniformity is reduced. Finally, the speed and detection rate of the proposed method, as well as the basic particle filter method in predicting the pupil position in video frames are calculated and compared for various populations. The experimental results indicate that, in comparison with the basic particle filter algorithm, the proposed algorithm detects the pupil more accurately and in a shorter time.