Student-Centered Knowledge Distillation

MengChu Zhou, Ph.D. & Dist. Professor
Fellow of IEEE, IFAC, AAAS, CAA and NAI
New Jersey Institute of Technology

Abstract—Ensemble learning and knowledge distillation are widely studied as effective techniques in deep learning and gained such engineering applications as autonomous driving, Industry 4.0/5.0 and robotics. Their combination has achieved remarkable success in transferring various knowledge from multiple complex teacher networks to a simple student one. However, existing studies focus on classification diversity but overlook the crucial role of diverse dark knowledge in effective knowledge distillation. How to utilize such knowledge to improve the performance of a student network remains unexplored. To do so, we for the first time propose to apply diverse dark knowledge to sample-wise multi-teacher knowledge distillation. We train teacher networks on all samples to maintain accuracy and encourage diverse dark knowledge generation by applying constraints to the size and direction of output feature vectors. To reduce the impact of ensemble errors of teacher networks on the performance of a student one, we combine all teacher networks and their ensemble into multi-teacher networks. Furthermore, inspired by human educational experiences, we propose a relative confidence computing mechanism to select the optimal knowledge sample-wisely from each teacher network. The overall performance of the proposed method is verified by using it to perform multiple object recognition tasks and compare its results with the state-of-the-art ones.

MengChu Zhou received his B.S. degree in Control Engineering from Nanjing University of Science and Technology, Nanjing, China in 1983, M.S. degree in Automatic Control from Beijing Institute of Technology, Beijing, China in 1986, and Ph. D. degree in Computer and Systems Engineering from Rensselaer Polytechnic Institute, Troy, NY in 1990. He joined the Department of Electrical and Computer Engineering, New Jersey Institute of Technology in 1990, and is now a Distinguished Professor. His interests are in intelligent automation, robotics, Petri nets, Internet of Things, edge/cloud computing, AI, and big data analytics. He has over 1300 publications including 17 books, over 850 journal papers including over 650 IEEE Transactions papers, 31 patents and 32 book-chapters. He is a recipient of Excellence in Research Prize and Medal from NJIT, Humboldt Research Award for US Senior Scientists from Alexander von Humboldt Foundation, and Franklin V. Taylor Memorial Award and the Norbert Wiener Award from IEEE Systems, Man, and Cybernetics Society, and Edison Patent Award from the Research & Development Council of New Jersey. He is a life member of Chinese Association for Science and Technology-USA and served as its President in 1999. He is Fellow of IEEE, International Federation of Automatic Control (IFAC), American Association for the Advancement of Science (AAAS), Chinese Association of Automation (CAA) and National Academy of Inventors (NAI).