Press Release

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New fast, accurate and secure neural network HarDNet — Demonstrate amazing applications

The Ministry of Science and Technology sponsors long-term basic and applied research. In order to advance components, circuits and system integration technology, and in line with the "5+2 industry innovation plan" and the "chip design and semiconductor industry" policy, MOST promotes the "Intelligent semiconductor process and chip system research and development" Project (Project Moonshot)" to build Taiwan's independent research and development capabilities and cultivate high-level talents on forward-looking semiconductor processes and chip systems, promote industry-university linkages, and enhance the international competitiveness of the semiconductor industry. The team of Professor Youn-Long Lin from National Tsing Hua University undertakes the "Semiconductor Moon Shot" project to study advanced AI computing algorithms, new neural network architectures, and their implementations using various software and hardware platforms and promote industrial applications. Today they demonstrate many fruitful results.

HarDNet -- A new fast, accurate and secure neural network

In recent years, deep learning technology has shown amazing results in a wide range of applications such as image recognition, object detection, feature diagnosis, and speech processing. In order to popularize these applications, high-efficiency semiconductor implementation is the most critical. The research team comes from National Tsing Hua University (NTHU), National Chiao Tung University (NCTU), and Chung Yuan

Christian University. A total of 30 researchers led by six professors developed a neural network architecture that is most suitable for hardware implementation, named HarDNet. Compared with the well-known ResNet, HarDNet can achieve the same accuracy in only two-thirds of the computing time. HarDNet has excellent performance in image recognition, object recognition, object tracking, video semantic segmentation and other applications. The research team published the results in the top International Computer Vision Conference (ICCV-2019), and promoted it to global research communities through the GitHub open source network.

HarDNet also has strong immunity to malicious attacks. Studies have pointed out that adversarial attacks can make the trained deep neural network model misjudge the input data deliberately designed (called adversarial example), thereby threatening the security of the model. And cause doubts about use. Professor Ting-Chi Wang of NTHU advised students to conduct security analysis using license plate object detection as an example, and found that SSD-HarDNet85 has stronger attack immunity than other neural network models (for example: SSD-VGG). After training the defense mechanism of <adversarial training>, the detection rate can reach more than 90%.

Participate in international competitions and shine

The students of the research team used HarDNet technology to participate in the 2020 Low Power Computer Vision (LPCV) International Competition and won silver and bronze medals. One of them is to quickly identify the objects in a given photo on the FPGA hardware platform. The scoring criteria takes into account both recognition accuracy and execution time. The team under the guidance of Professor Juinn-Dar Huang of NCTU won the runner-up in the first trial. The backbone of the HarDNet neural network model greatly reduces the recognition time by optimizing the dynamic memory access and achieves the highest recognition rate. The second challenge is to design a small and beautiful neural network model and execute it on mobile devices with relatively scarce computing resources. The test platform has two smartphones, LG G8

and Google Pixel 4. Under the guidance of Professor Kai-Chiang Wu, the joint team from NCTU and NTHU, tied with the Massachusetts Institute of Technology team for third place.

The Institute of Electrical and Electronics Engineers (IEEE) has organized the international low-power computer vision competition since 2015. The participating teams come from all over the world, including the United States, Canada, China, Taiwan, South Korea and Russia. The winning companies and school teams over the years include Alibaba, Qualcomm, Amazon, Massachusetts Institute of Technology (MIT), Seoul University in South Korea, Chinese Academy of Sciences, Tsinghua University in China. There are two Taiwanese sponsors for this year's competition, namely MediaTek and Elan, which shows that the challenge is highly valued by industry, government, academics and research in the world.

Established a start-up company and adopted by well-known manufacturers

The research team has published many papers in top conferences (ICCV, AAAI, ICML, etc.) and applied for 13 (26 cases) Taiwan and US invention patents. A group of researchers have licensed some developed to spinoff a startup called Neuchips Corp., which has just been approved to enter the Hsinchu Science Park. A neural network accelerator developed by Neuchips has been adopted by well-known big manufacturer and integrated into a high-end intelligent voice processing SOC (single chip system), and is about to enter the volume production.

The PI and the team thanked the Ministry of Science and Technology for the support. They believed that the need for AI computing power is endless. Through comprehensive optimization research from the top to the bottom, it is possible to achieve results that cannot be achieved by ordinary methods. Open source software and international competitions can promote students to be world-class talents.

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