

Report of the 2017 Embedded Systems Week (ESWEEK)

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Embedded Systems Week (ESWEEK) is the premier event covering all aspects of embedded systems and software. By bringing together three leading conferences (CASES, CODES+ISSS, EMSOFT), a special IoT day, three symposia (ESTIMedia, RSP, NOCS), and hot-topic workshops and tutorials, ESWEEK presents attendees a wide range of topics unveiling state of the art embedded software, embedded computer architectures, HW/SW architectures and embedded system design. This year, ESWEEK had an all-time record of 537 registered participants. The joint IEEE CEDA-ESWEEK Opportunity Program as well as the ACM SIGBED Student Travel Grants enabled the participation of students from developing countries or those with a verified need.

For the first time, ESWEEK 2017 implemented a journal-integrated publication model for the conferences CASES, CODES+ISSS, and EMSOFT, where all journal-track papers are in the ACM Transactions on Embedded Computing Systems. To this end, the three conferences conducted the review process in a journal-like two-stage peer-reviewed process with the opportunity of minor/major revision before final decision. Acceptance rates have been about 25% for all conferences with a total number of 289 submissions to the journal track. In addition, the ESWEEK Proceedings contain the 37 accepted Work-in-Progress papers.

The tutorials on Sunday preceded the conferences. They have been an excellent opportunity to get in-depth knowledge in new trends and hot topics. Six tutorials covered a wide scope, from embedded neural networks and approximate computing via heterogeneous and real-time architectures up to energy harvesting in the Internet of Things.

Thursday and Friday have been the days for the symposia and workshops. Besides the two long-term members of ESWEEK, ESTIMedia (Embedded Systems for Real-Time Multimedia) and RSP (Rapid System Prototyping), the successful International Symposium on Networks on CHIP (NOCS) also joined ESWEEK 2017. Three workshops were organized in the important topics of embedded systems such as cyber-physical systems (CyPhy and DECPS) and embedded machine learning (HENND). The workshop HENND (Highly Efficient Neural Networks Design) was particularly successful with 140 participants as it addressed a highly interesting and timely subject. It included keynotes by Prof. Yoshua Bengio (Univ. of Montreal) titled "Towards End-to-End Trainable Hardware" and by Prof Hoi-Jun Yoo (KAIST) on "Mobile/Embedded Deep Neural Networks and Applications". It included the first Embedded Deep Learning Design Contest (EDLDC), i.e., a competition for the energy-efficient design of a deep learning application under a given set of constraints.

Tuesday was a special day on the topic of Internet-of-Things (IoT), focusing on the newest developments from an embedded systems point of view. A sequence of three sessions on "Machine Learning", "Providing guarantees", and "Energy Harvesting" was exclusively devoted to this subject with contributions from all of the three conferences.

Highlights of the ESWEEK program have been the three distinguished keynote talks by the most prominent leaders in academia and industry, covering most relevant trends for future embedded systems and providing deep insights into technology drivers. Kurt Keutzer from the Univ. of California,

Berkeley, covered efficient implementations of deep neural networks: “Small Neural Nets Are Beautiful: Enabling Embedded Systems with Small Deep-Neural-Network Architectures.” The talk addressed the design of computationally efficient Deep Neural Networks (DNN) by means of design-space exploration. The particular organization of the DNN is diverse enough to create a rich design space. Kurt Keutzer specifically talked about the following two central questions: What is the right DNN architecture? How do we find the right DNN architecture? His novel approach allows designing very small DNN architectures capable of fitting into even the smallest embedded systems. The results show that the resulting DNN structures save orders of magnitude in computation time and memory footprint while achieving a comparable classification quality.

Feng Zhao, Chief Technology Officer and Vice President for Advanced R&D from Haier, was the industrial keynote speaker at the IoT day with the title, “IoT from the Lab to the Real World.” The keynote speaker addressed business as well as technical challenges that come with the massive deployment of connected devices. He put a particular emphasis on a new user-enabling programming paradigm based on scenarios and the associated challenges such as safety of operation, security and privacy. He introduced interesting examples from Haier’s practices in smart home and connected factories.

Finally, the Wednesday keynote by Gernot Heiser from the Univ. of New South Wales, Australia, emphasized the importance and challenges related to the trustworthiness of embedded systems, i.e., security, safety and dependability: “Trustworthy Operating Systems for Critical Embedded and Cyberphysical Systems.” He pointed out that trustworthiness of non-trivial systems is critically dependent on the operating system (OS) enforcing isolation between components. Traditional OS technology fails spectacularly to provide such isolation. Gernot Heiser explained the underlying concepts of the seL4-microkernel. Specifically, seL4 has formal, machine-checked proofs of implementation correctness from a high-level functional specification to machine code, and proofs that the kernel is able to enforce spatial isolation, including provable absence of covert storage channels. He presented impressive examples of this technology in real-world scenarios.

The conference program concluded with the traditional panel on Wednesday afternoon focusing on “Machine Learning (ML) for Embedded Systems: Hype or Lasting Impact?” Top experts from academia and industry shared their controversial views on this topic. There was a hot debate among panelists and audience about how to satisfy the requirements on the guaranteed services such as timing, security, and reliability since these requirements seems in conflict with the use of ML techniques. The debate was ended with the quest for further researches and practices.

The next Embedded Systems Week (ESWEEK) will take place in Torino, Italy, on September 30 until October 5, 2018. See <http://www.esweek.org/> for more details.

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