Citation

For significant contributions in the field of parallel computing, especially to the research and development of compiler technology and productivity tools.

Dr. David J. Kuck

Positions and Organizations :
    Intel Fellow
    Professor Emeritus, University of Illinois, Urbana-Champaign

Degree : Ph. D. in Engineering (Northwestern University, 1963)

Date of Birth : October 3, 1937

Brief Biography :
    1959 BSEE University of Michigan
    1960 M.S. Northwestern University
    1963 Ph. D. in Engineering, Northwestern University
          Postdoctoral Fellow, Ford Foundation
          Assistant Professor, Massachusetts Institute of Technology
    1965 Assistant Professor, University of Illinois at Urbana-Champaign (UIUC)
    1968 Associate Professor, UIUC
    1972 Professor, UIUC
    1979 Founder, Kuck and Associates (KAI) (Acquired by Intel in 2000)
    1984 Founder and Director, Center for Supercomputing Research and Development, UIUC

Main Awards and Honors:
    1987 IEEE Emanuel R. Piore Award
    1992 IEEE CS Charles Babbage Award
    1993 ACM-IEEE CS Eckert-Mauchly Award
    2010 ACM-IEEE CS Ken Kennedy Award
    2011 IEEE CS Computer Pioneer Award

Fellow of IEEE, ACM, and AAAS.
Member of NAE (1991)

Main Achievements :

Dr. David J. Kuck is one of the most influential figures in parallel computing, especially in the research and development of parallel technology and productivity tools for parallel programming. Parallel computing is a type of computation in which many calculations or the execution of processes are carried out simultaneously. It operates on the principle that large problems can often be divided into smaller ones and then be solved at the same time. Currently parallel computing is a frequently used programming solution and every compiler in use today incorporates techniques pioneered by Dr. Kuck. Now he is considered as the father of parallel compilers.

He was a Ford Postdoctoral Fellow and an assistant professor of electrical engineering at the Massachusetts Institute of Technology. He joined the University of Illinois, Urbana-Champaign (UIUC) in 1965 as an assistant professor in the Computer Science Department, was promoted to associate professor in 1968 and professor in 1972; since 1986 he had a joint appointment as professor of Electrical and Computer Engineering. While at UIUC, he developed the Parafrase compiler system in the 1970s; Parafrase was the first testbed for the development of automatic parallelization, vectorization and related program transformations.

From 1965 to the early 1970's, he was involved in the development of ILLIAC IV at UIUC, which is regarded as the first parallel supercomputer. Among other initial hardware-oriented team members, he was the sole software researcher and was responsible not only for developing initial ideas for parallelism but for training many people in the field around the world. As the first large system to employ semiconductor primary memory (from TI), ILLIAC IV (built by Burroughs) was fully operational in 1975 and was among the world's fastest computers at the time. During the 1970s he developed many new compilation and architecture ideas with his graduate students and incorporated them into the Parafrase system.

In 1979 he founded Kuck and Association (KAI) (with B. Leasure and M. Wolfe) to build industry-standard optimizing compilers that ranged from supercomputers to workstations. KAI was acquired by Intel in March 2000, and the KAI products formed the core of Intel parallel SW tools. He currently serves as an Intel Fellow. His current research is in HW/SW codesign using equations and fast simulations for detailed resolution modeling of performance, power and energy. The resulting models can be used in SW tools as well as high-level system simulators.

In 1984, he founded the Center for Supercomputing Research and Development at UIUC (with Profs. E. Davidson, D. Lawrie, and A. Sameh) and led the construction of CEDAR, a hierarchical shared-memory 32-processor completed in 1990 (today's multicore SoCs have similar architectures).

Contributions (1970s -1990s)
Program analysis and transformation algorithms – Parafrase System
    Estimated number of concurrent operations in programs.
    Theoretical time and processor bounds on program constructs.
    Array data-dependence testing.
    Loop transformations including: I/O and cache array blocking, distribution and fusion, re-indexing, interchange.
    Scheduling of multiprocessor computations: doall, doacross, guided self-scheduling.
    Vector compilation.

Parallel architectures
    Parallel interconnection network theory and designs.
    Burroughs scientific processor (Ph.D. graduates + consulting drove design).
    Alliant FX computers (UIUC papers + consulting drove design).
    Cedar multiprocessor (modified 8-core Alliant nodes + UIUC hierarchical shared memory).
    Cray XMP (Ph.D. graduates drove design).
    Perfect Club (first industry-wide HPC benchmarking).

Kuck and Associates SW products
    KAP commercialized and extended Parafrase ideas.
    Designed and led OpenMP initiative across industry, extended to TBB.
    Parallel numerical libraries, thread correctness checking.

He is the author of books *High Performance Computing: Challenges for Future Systems* (Oxford University Press, 1996) and *Structure of Computers and Computations* (John Wiley & Sons, 1978).

Over the past four decades, he has influenced a wide range of areas including architecture design, compiler technology, programming languages and algorithms. His innovation and achievements had innumerable influences in the era of multi-core architecture as many programmers try to adapt and rewrite software to use new hardware effectively. For his outstanding contributions, he has received several prizes including the Eckert-Mauchly Award from IEEE and ACM in 1993, Kennedy Award in 2010 and the Computer Pioneer Award, the most prestigious prize awarded by IEEE Computer Society in 2011. He is a fellow of IEEE, ACM and AAAS and a member of the NAE.

For significant contributions in the field of parallel computing, especially to the research and development of compiler technology and productivity tools, Dr. David J. Kuck is hereby awarded the Okawa Prize.