

NSF Workshop
**Electronic Design Automation
—Past, Present, and Future**

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Review the Success of EDA in the Past

- ◆ Successfully managed the exponential increase of design complexity
 - from 2,000+ transistors (Intel 4004) to the latest multi-core processor with over a billion transistors
- ◆ One of the first applied “computational thinking”
 - Building a complete computational prototype via modeling, synthesis, and verification/test
- ◆ One of the earliest to engage inter-disciplinary collaboration
 - EE for circuit design
 - Physicists and chemists for manufacturing
 - Math/OR for optimization
 - Theory for formal verification ...
 - Fully integrated in complex, highly automated EDA software tools

Understand the New EDA Challenges

◆ Many challenges

- Skyrocketing NRE cost (\$50M+ for each design)
- Higher complexity
- Nanoscale design/manufacturing problems
- ...

◆ National Design Initiative (NSF/SRC Joint Workshop 2006)

- System design science
- Robust optimization
- Interface to manufacturing

Exploring New Frontiers of EDA

- ◆ Extending EDA methodology to other fields/application domains
 - Synthetic biology,
 - In vitro protein diagnostics,
 - Nano-systems,
 - Future IT infrastructures, e.g. data center design/optimization
 - ...

Strengthen the Link with “Theory” Community

- ◆ Many papers in FOCS/STOC in 1980s (40+ in total). E.g.
 - Brent & Kung, “The chip complexity of binary arithmetic,” STOC’80.
 - Yao, “The entropic limitations on VLSI computations(Extended Abstract),” STOC’81.
 - Dolev, Karplus, Siegel, Strong, and Ullman, “Optimal wiring between rectangles,” STOC’81.
 - R.J. Lipton and R. Sedgewick, “Lower bounds for VLSI,” STOC’81.
 - Karp, Leighton, Rivest, Thompson, Vazirani, and Vazirani, “Global wire routing in two-dimensional arrays,” FOCS’83.
 - Leiserson & Maley, “Algorithms for routing and testing routability of planar VLSI layouts,” STOC’85.
 - Hall & Shmoys, “Approximation schemes for constrained scheduling problems,” FOCS’89.
- ◆ Mostly absent in FOCS/STOC in 2000s. Current topics are
 - Internet,
 - Game theory,
 - Quantum computing,
 - Probabilistically checkable proof, and Zero-knowledge proof

Participants

◆ Modeling

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◆ Synthesis and optimization

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◆ Software

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◆ Theory

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◆ Overview/keynote

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