EE382N-20 Computer Architecture Parallelism and Locality Fall 2011, Lecture 1

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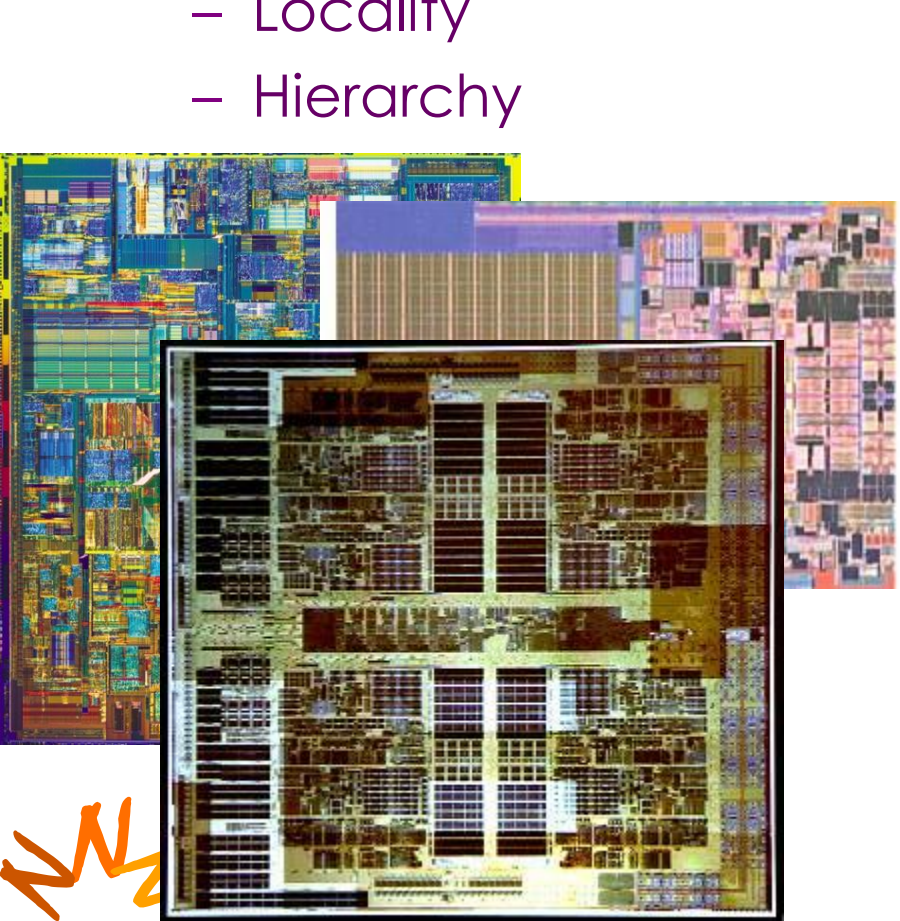
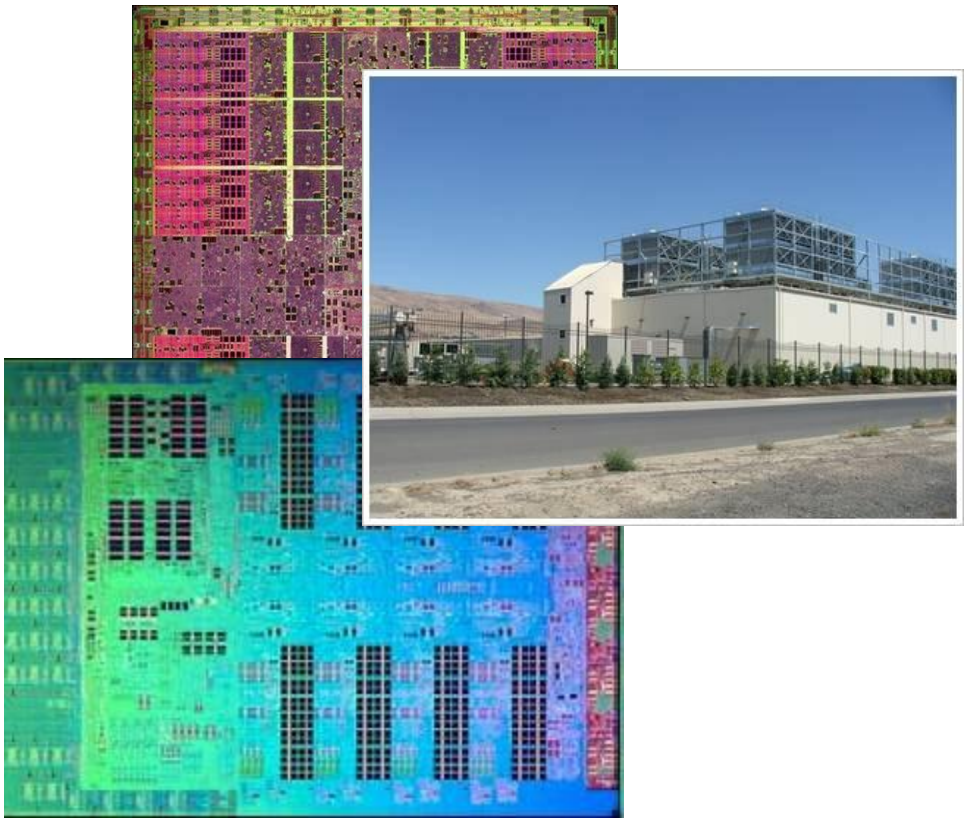
The University of Texas at Austin

What is this class about?

- Computer architecture
- Principles in computer architecture
  - Parallelism
  - Locality
  - Hierarchy





What is this class about?

- Computer architecture
- Principles in computer architecture
  - Parallelism
  - Locality
  - Hierarchy
- Advanced class computer architecture
  - Problems
  - Principles
  - Solutions
- Get some original research started

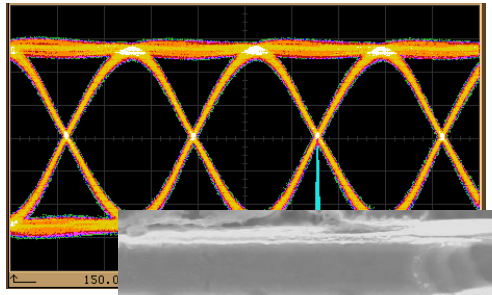
Outline (for today)

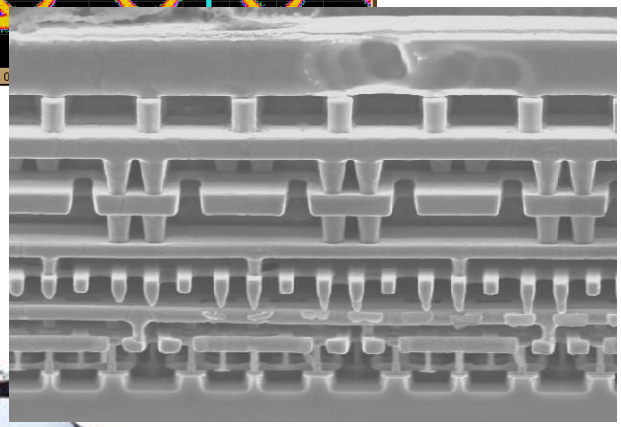
- Quick intro to computer architecture
  - What is it
  - What are the main challenges today
- What are parallelism, locality, and hierarchy
  - Why are they principles
  - How do they address the challenges
- Topics we'll cover in class
- Class procedures and expectations
- Other technicalities

What is Architecture?

Form follows function **Louis Sullivan**

Computer Architects Match Hardware Technology with User Requirements





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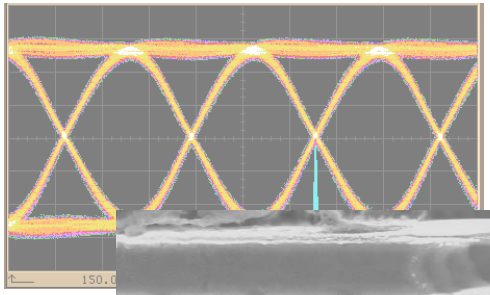

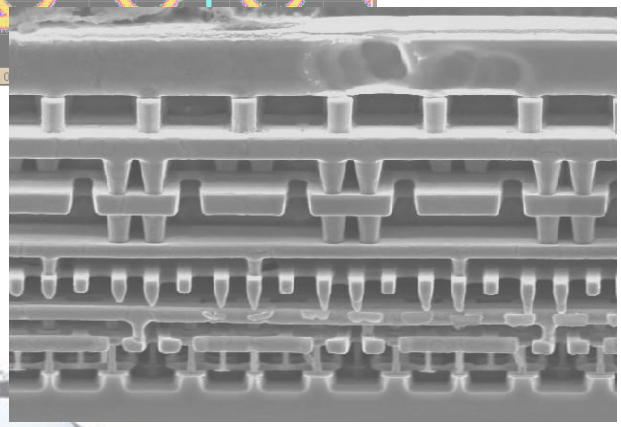

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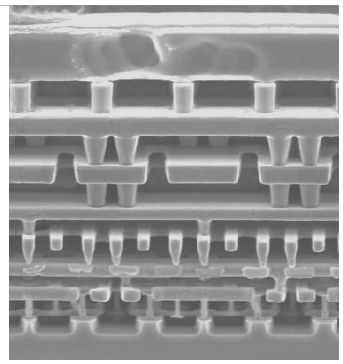

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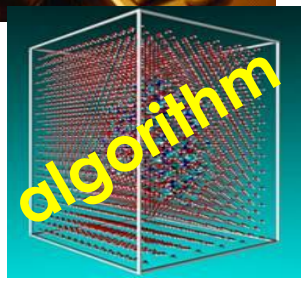

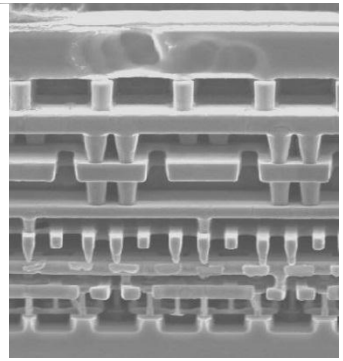

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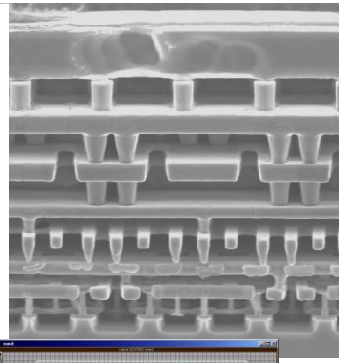

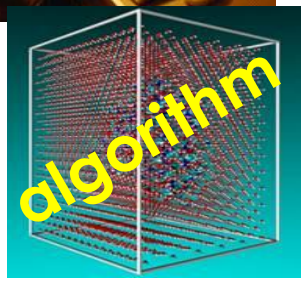

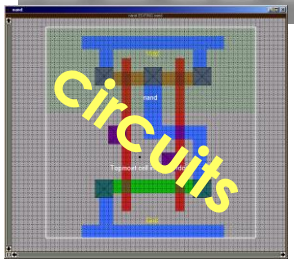

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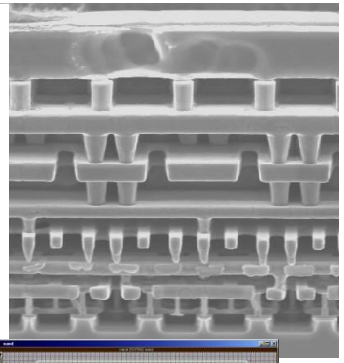

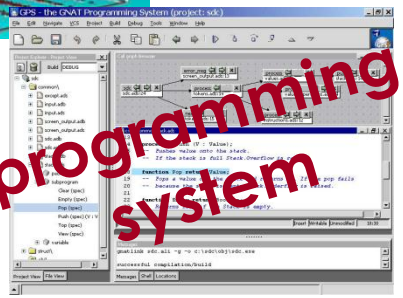

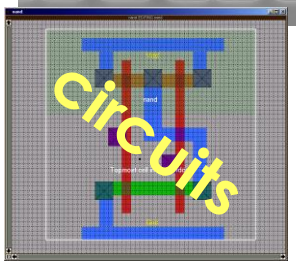

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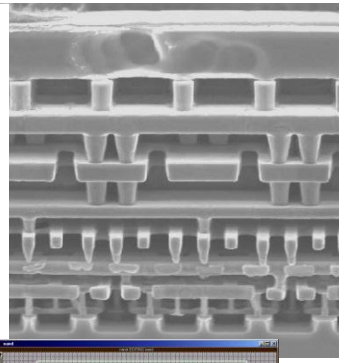

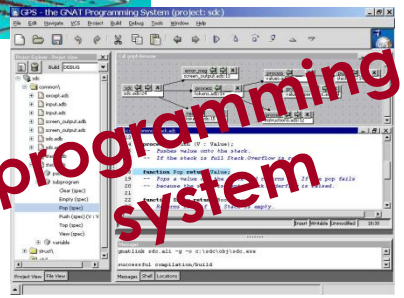

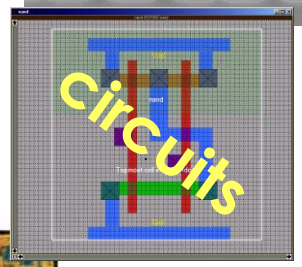

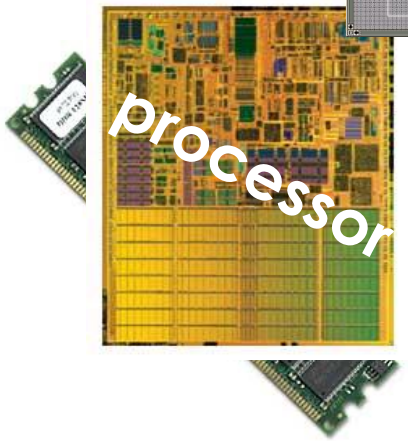

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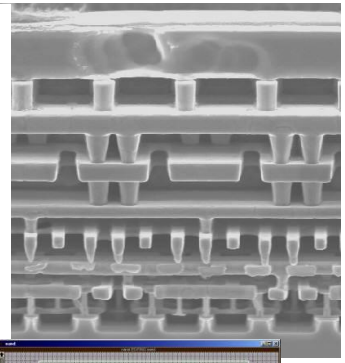

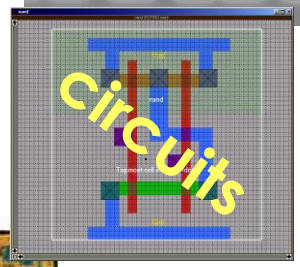

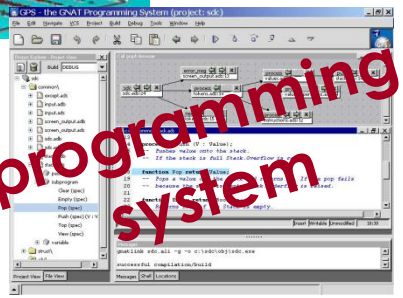

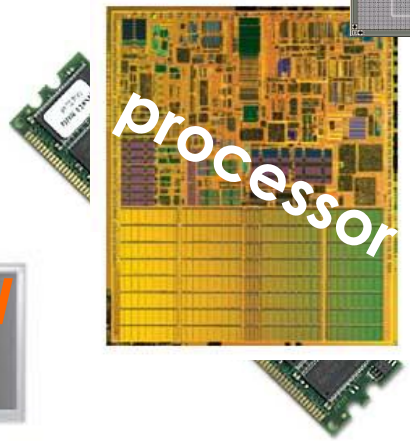

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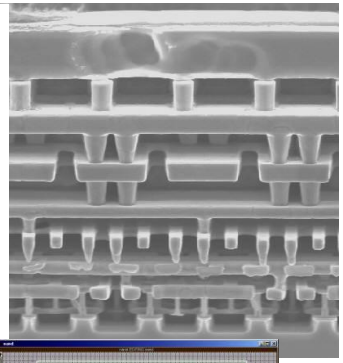

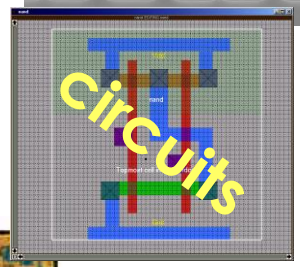

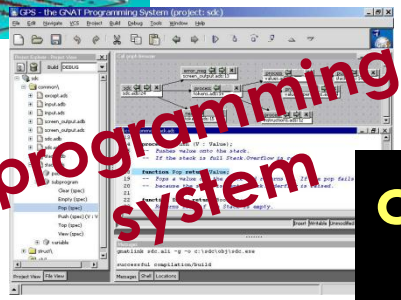

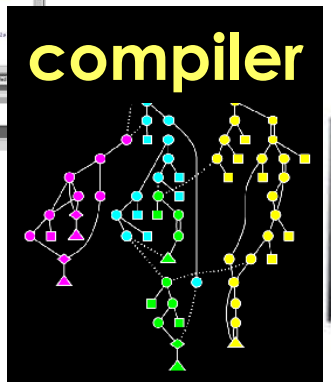

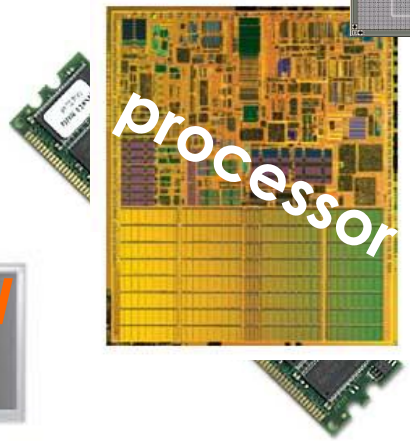

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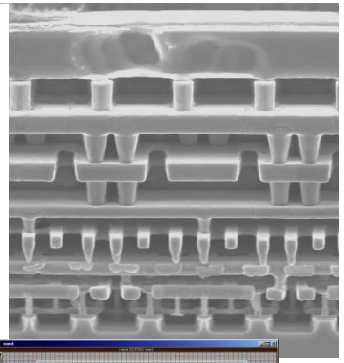
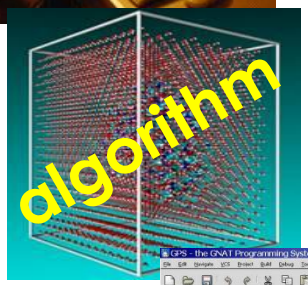
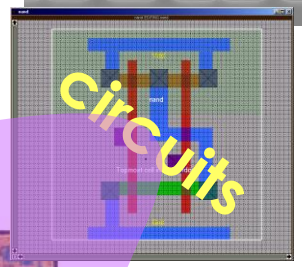
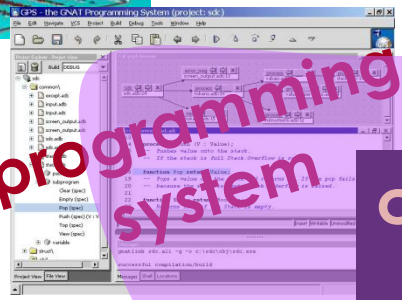
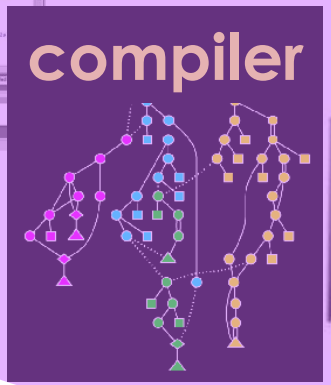
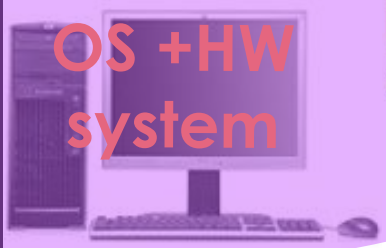


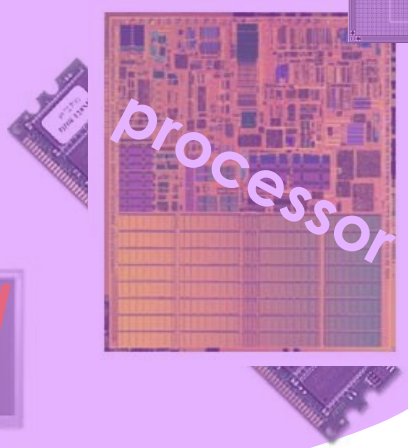












Five “major” Challenges for Computer Architects

“The number of people saying
Moore’s Law is dead
doubles every 18 months”

The Performance Challenge

Wireless communications
(3G, UWB, …)

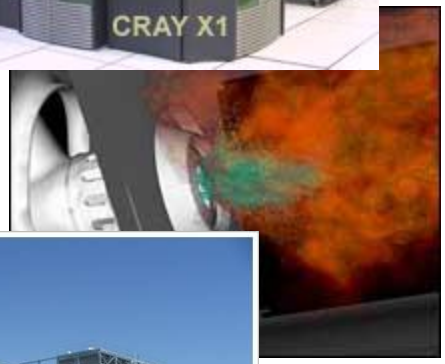
- Higher data rates
- More complex air interfaces

Workstations
(Games, CAD)

- Higher resolution
- Realism
- Accuracy

Supercomputers
(Scientific simulations)

- Fidelity
- Time scales

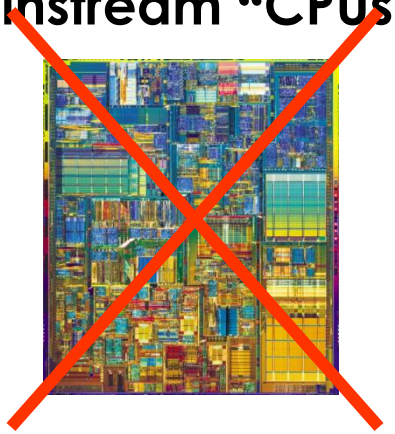


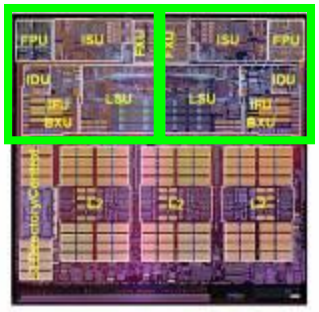
The Efficiency Challenge

Embedded

- Battery life and heat
- Commodity and volume

Mainstream "CPUs"



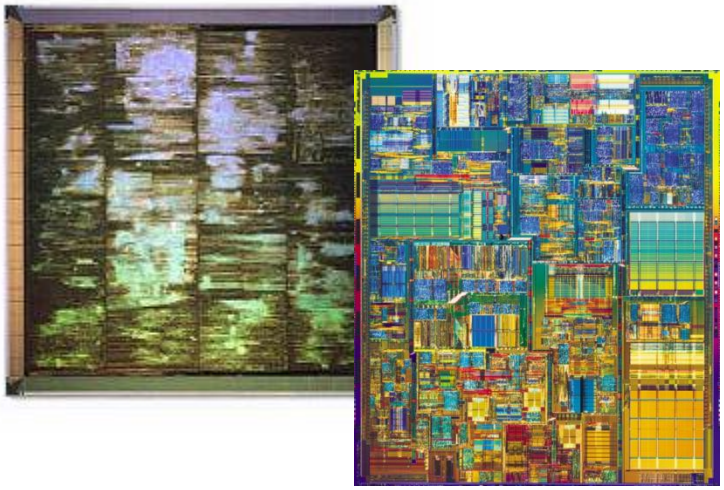


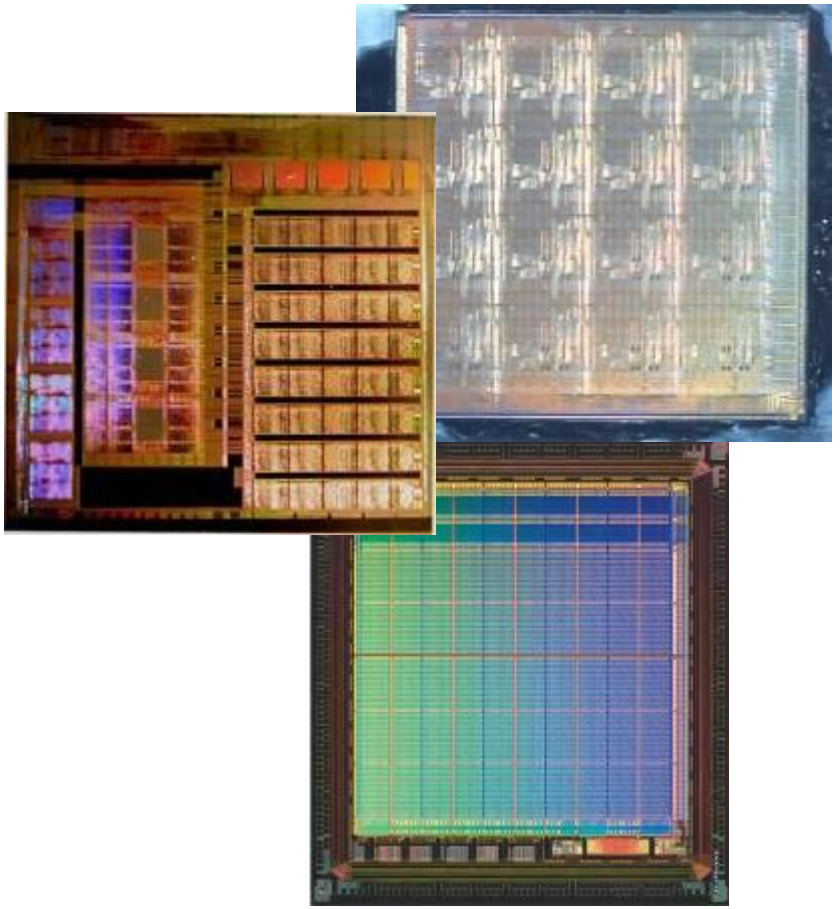
- Peak power
- Cooling

Supercomputers

- Energy bill (10 MW)
- Price/performance

The Designability Challenge





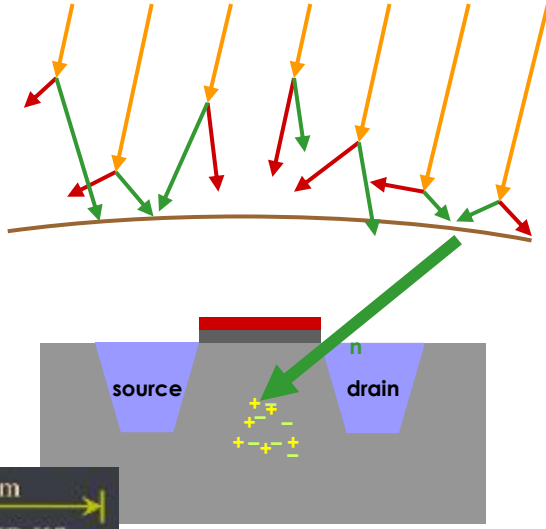
- Place & Rout billions of device?
- Verification?

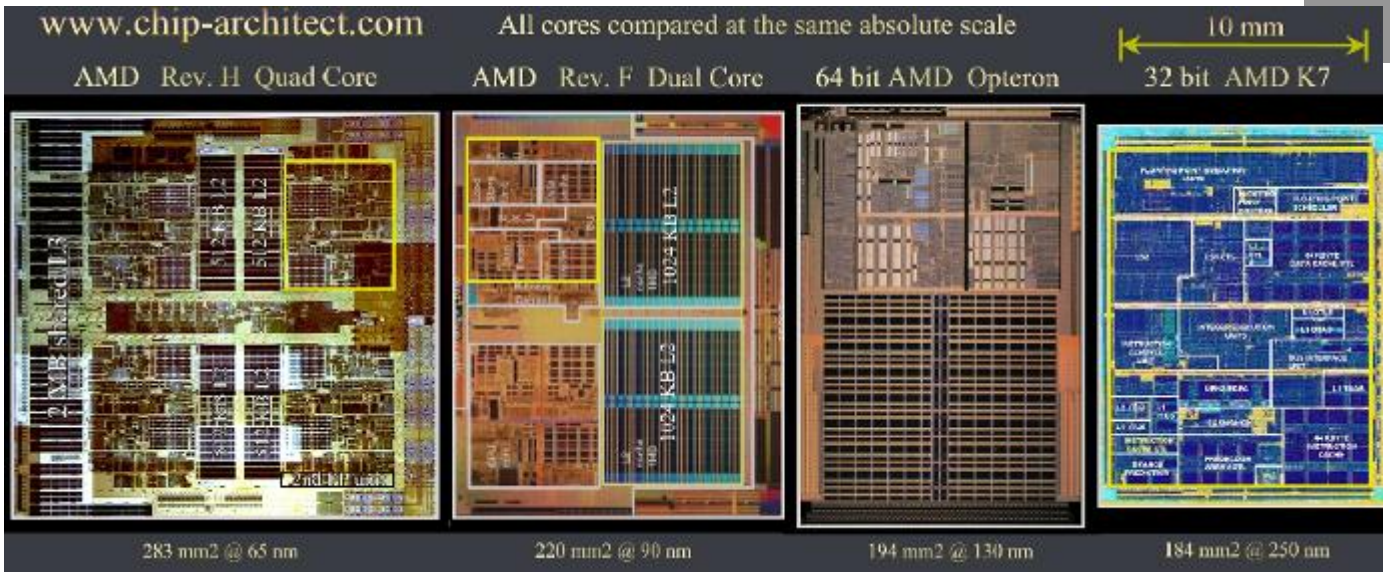
The Programmability Challenge

- Programmability reduces cost, enables adaptation, and improves time-to-market
  - Multiple modes
  - Evolving standards
  - Evolving features, differentiation
  - Design/tooling costs

The Reliability Challenge

- More devices
- Smaller devices
- Greater variability

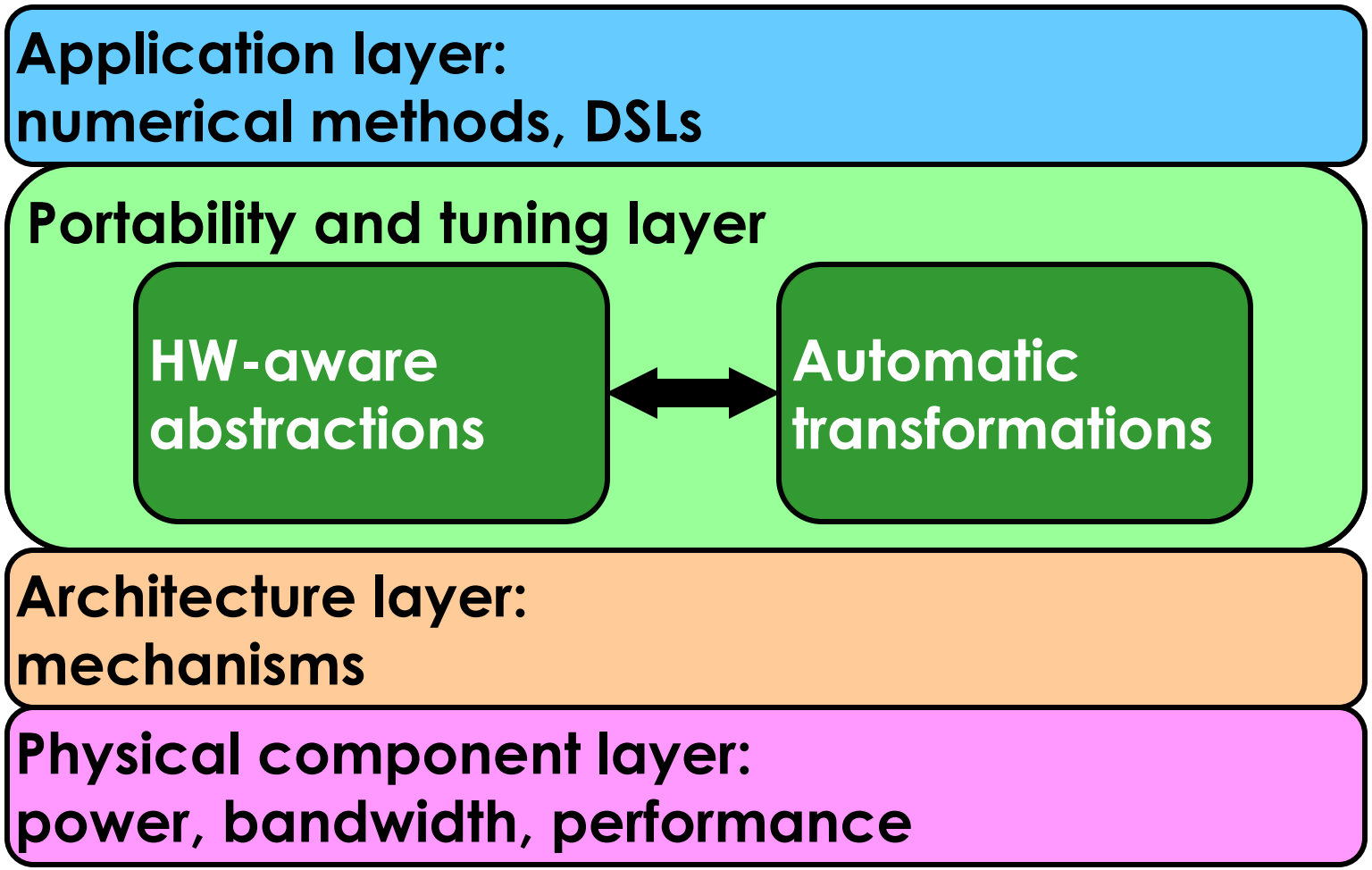




What can we do?

- Specialize more
  - But still innovate on algorithms
- Compute less and store less
  - Use better algorithms
- **Proportionality: waste less**
  - Different applications and scenarios have different requirements
  - Main ways to save: locality, parallelism, and hierarchy

Overall Approach



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Rest of class was on the whiteboard