The future of computer architecture

- Computer architecture has come a long way in a short time
  - Dramatic improvements in design
  - Dramatic improvements in device performance
  - Where does it go from here?
- What will all those transistors be used for?
  - Prediction: chips will soon have a billion transistors on them
    - At least 100 million transistors, if not a billion…
  - What can be done with all that space?
    - Ever-larger L1/L2 caches?
    - Multiple threads on a chip?
    - Larger register files & vector units?
    - Multi-function integration on-chip (display, I/O, etc.)?
    - Programmable logic on-chip?

Bigger & better processors & storage

- Ever-faster CPUs
  - The Dept. of Energy wants 10 TFLOP machines within five years
    - Factor of 200 faster than current small-scale 50 GFLOP machines!
  - Programming these machines is already difficult!
  - How can we scale up systems to 10 TFLOPs?
- Large-scale storage
  - All of this computing power must be accompanied by ways to store all the data
  - Computing becomes more decentralized => storage may become *more* centralized
    - Storing data for the long-term is difficult: computing cycles are fleeting, but data is forever
    - Losing a few cycles isn't a big problem, but losing data can cause lots of trouble

Ubiquitous computing

- It's been said that a technology has truly arrived when we're not really conscious of using it
  - Telephone
  - Television
  - Automobile
- When will computing be so cheap that it's fully integrated into our lives such that we can't imagine living without it?
  - Computers in every device!
  - All of the computers exchanging information
- What form will it take?
  - Require as little explicit user direction as possible
  - Make it as invisible as possible