The Future Is Now

- wired
- tired
- expired
- open hardware
- open source
- open standards
- 2010
- 2000
- 1990
Open Standards

- Writing requirements is hard
- Properly implementing is hard
- Want to do it only once
  - for interface
  - for data format
- Standardization is hard
- Open standards solve many of the standards problems
Open Source

- Community idea
- Seed prototype
- Reqs, design are *in the code*
- Development heavily uses
  - SCMS
  - wiki
- Team uses
  - email, IRC
  - phone, conference
- Continuous
  - release
  - eval
- Users as developers
Open Hardware

- What it is
  - Open circuit / chip designs (not relevant to this discussion)
  - Open “code” for configuring FPGA's
- FPGA: F—— Programmable Gate Array
  - Data flows through; parallel
  - Slow, but powerful
- This is very like SE
module cordic_stage( clock, reset, enable, xi, yi, zi, constant, xo, yo, zo);
  parameter bitwidth = 16;
  parameter zwidth = 16;
  parameter shift = 1;

  input     clock;
  input     reset;
  input     enable;
  input [bitwidth-1:0] xi, yi;
  input [zwidth-1:0] zi;
  input [zwidth-1:0] constant;
  output [bitwidth-1:0] xo, yo;
  output [zwidth-1:0] zo;

  wire z_is_pos = ~zi[zwidth-1];

  reg [bitwidth-1:0] xo, yo;
  reg [zwidth-1:0] zo;

always @(posedge clock)
  if(reset)
    begin
      xo <= #1 0;
      yo <= #1 0;
      zo <= #1 0;
    end
  else //if(enable)
    begin
      xo <= #1 z_is_pos ?
        xi - {{shift+1{yi[bitwidth-1]}}, yi[bitwidth-2:shift]} :
        xi + {{shift+1{yi[bitwidth-1]}}, yi[bitwidth-2:shift]};

      yo <= #1 z_is_pos ?
        yi + {{shift+1{xi[bitwidth-1]}}, xi[bitwidth-2:shift]} :
        yi - {{shift+1{xi[bitwidth-1]}}, xi[bitwidth-2:shift]};

      zo <= #1 z_is_pos ?
        zi - constant :
        zi + constant;
    end
endmodule
SMP Parallel

- Multiple CPUs, “shared” memory
- Cheap CPU's + fast interconnect
- Programming these is hard
  - “Linear speedups” wanted
  - Traditional languages wanted
  - Hard model to understand
- “Nothing can withstand the Attack of the Killer Micros” —Eugene Brooks
Grid Parallel

- Idea: if micros are so cheap and fast, and network hardware is cheap and fast, use “the network as the computer”
- Cluster vs grid computing
- Programming is hard
  - spare cycles hard to get to
  - reliability is hard
  - latency is a pain
Chip Parallel

- Moore's Law *must* have limits; right now, fast sequential is hard
- Idea: “multicore” = SMP on chip
  - Hardware is parallel
  - Lower latency, complexity
- Programming problems remain
  - Still locking, etc
  - Still horrible languages
Getting stuff right

wired

tired

expired

static analyzers

formal methods

testing

sociologist

MBA

psychologist
The Limits of Testing

- Contrast
  - “giant test org”
  - “no testing”
- Lots of evidence that neither works
- Controlled testing vs “user testing”
- User frustration with “tested systems” drove changes
- No “design for testability”
Formal Methods

- Formal methods are awesome
  - Hugely serious improvements in
    - product
    - process
    - people
  - Complement test and inspection
- Just too hard, too expensive
  - or at least perceived that way
Static Analysis

- Fully automated formal checks of automatically-chosen properties
  - Coverity (Stanford)
  - Internal tools (IBM, Microsoft)
  - Sparse (Triplett)
- Some of the benefits of formal methods, but easier than testing
- Points at proximate cause well
The Guru

wired

sociologist

MBA

psychologist

tired

expired
Psychologist

- Ironically, used to have larger teams but smaller focus
- Since humans make mistakes, a psychologist should help with root cause of mistakes
- Fascination with differences in programmer productivity
- *Weinberg, Egoless Programming*
MBA

- Legal, tech changes led to software as a business explosion
- Smaller team sizes, higher productivity
- More measurement, “process”, modeling after related industries
- Disconnect from engineering
- Bill Gates, The Microsoft Way
Sociologist

- Bemusements of the new era
  - Massively multicultural SW
  - Open Source
  - Organizational dynamics
- Sociologists study this stuff
- Too early to tell whether this is more of a success; signs are mixed
Outstanding Issues

- **Lead, follow, or get out of the way**
- **Integrate with rest of CS**
  - programming languages
  - artificial intelligence
  - systems work
- **Integrate with rest of community**
  - mathematics and other depts
  - industry and govt