Teaching and Teaching Computer Architecture:  
Two Very different topics  
(Some Opinions about each)  

Yale N. Patt  
teacher, The University of Texas at Austin  

WCAE  
San Diego, June 8, 2003
Visions (Re: Education)

* **Distance Learning Produces Better Education, Not Cheaper Education**

* **We Pay Teachers Enough That Those Who Would Opt For This Career Don’t Opt For Medical School Instead**

* **We Teach High School English Teachers Enough English That Students At The University Can Write Two Consecutive Coherent Sentences**

* **We Get Past This Insane Preoccupation With Political Correctness, So We Can Get On With The Business Of Teaching and Learning.**

* **We Stop Canonizing The Use Of High Tech In Education. Bad Pedagogy Is NOT Good Pedagogy if Draped in Technology.**

* **We Stop Rewarding Memorization Ability, So Maybe Students Will Learn To Think, . . . And Perhaps Understand**
My Ten Commandments of Good Teaching

* **Know the Material**

* **Want to teach**

* **Genuinely respect your students and show it**

* **Set the bar high; students will measure up**

* **Emphasize understanding; de-emphasize memorization**

* **Take responsibility for what is covered**

* **Don’t even try to cover the material**

* **Encourage interruptions; don’t be afraid to digress**

* **Don’t forget those three little words**

* **Reserved for future use**
What is Important?

* Top-down design, Bottom-up learning for understanding

* Abstraction is vital, but...

* Not bottom-up, but “motivated” bottom-up

* Engineering is about DESIGN, first understand the components

* From Concrete to Abstract (Dijkstra notwithstanding)

* Cut through protective layers

* Memorizing is not understanding

* Students do better working in groups
High Tech

Some Uses

* Email
* Web site
* Power Point
* Document Reader
* Animations
* Plato, vintage 2003
* Clever attendance mechanism
* Other bookkeeping
* Text+Voice
  (WOW Factor, see Shriver’s CDROM)[3]

Some Caveats

* Baseline Power Point
* Cost
* Extemporaneous Effect
* Visual/voice disconnect
* Attendance vs. Participation
Some Fundamentals of Computer Architecture

* The transformation hierarchy
* Three parts of a Microarchitecture
* The DSI
* IPC vs. cycle time
* Partitioning
Problem

Algorithm

Program

Instruction Set Architecture (ISA)

Microarchitecture

Circuits

Electrons
Microarchitecture (The Requirement)

- Perfect I-Cache
- No Packet Breaks
- 100% Br. Pred.

- Perfect Data Flow

Irregular Parallelism

- Enough Functional Units
- Perfect Intraconnect

- Data when needed
Some Concerns

* Focus on Measurements

* Use of Simulations

* Real ISA vs. Concocted ISA
The Microprocessor Ten Years From Now (perhaps)

* the new data path
* internal fault tolerance
* asynch and synch co-existing
* different cycle times for different functions
* SSMT (aka helper threads)
* Block-structured ISA
* uarch support for CAD
* greater use of microcode
* greater impact of the compiler
* compiler/uarch communication
Problem

Algorithm

Program

ISA

Microarchitecture

Circuits

Electrons