inst.eecs.berkeley.edu/~cs61c

UC Berkeley CS61C : Machine Structures

Lecture 44 – Summary & Goodbye

2007-05-07

Lecturer SOE Dan Garcia

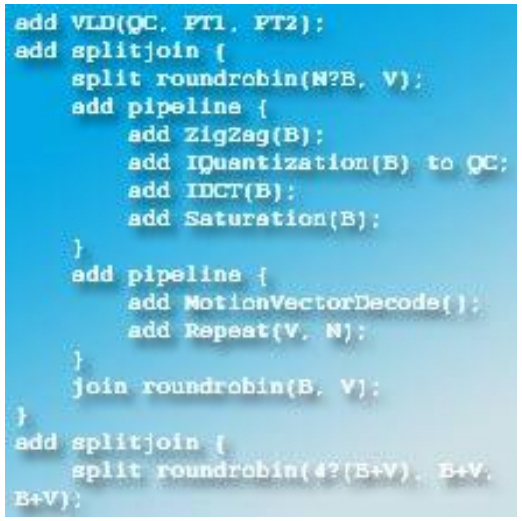
www.cs.berkeley.edu/~ddgarcia

Simple multicore API ⇒

MIT researchers say they have discovered a simple way to do parallel programming: Streamlt, based on data flow. A smart compiler splits across cores.

technologyreview.com/Infotech/17682/

technologyreview.com/Infotech/18597/



```
add VLD(QC, PT1, PT2);
add splitjoin {
    split roundrobin(N?B, V);
    add pipeline {
        add ZigZag(B);
        add IQuantization(B) to QC;
        add IDCT(B);
        add Saturation(B);
    }
    add pipeline {
        add MotionVectorDecode();
        add Repeat(V, N);
    }
    join roundrobin(B, V);
}
add splitjoin {
    split roundrobin(4?(B+V), B+V,
B+V);
```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Cool Stuff…the videos before lecture

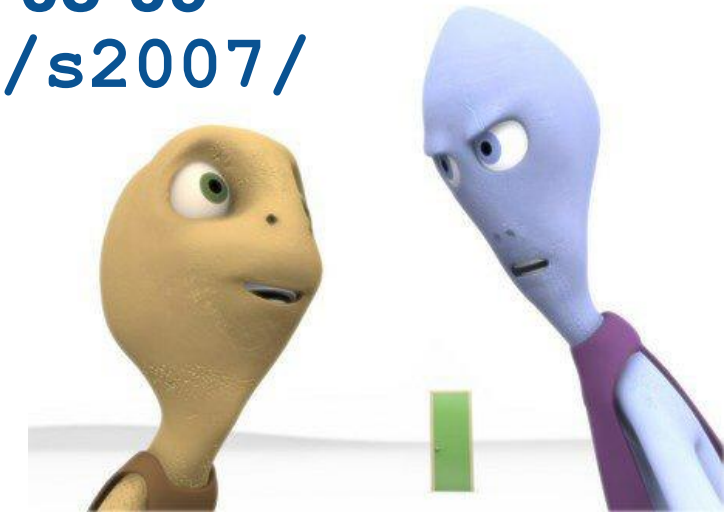
- **SIGGRAPH Electronic Theatre**

  `www.siggraph.org/publications/video-review/SVR.html`

  - **$40/video for ACM Members**

- **SIGGRAPH Conference in San Diego!**

  - **2007-08-05 ⇒ 2007-08-09**
    `www.siggraph.org/s2007/`



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Review

- **Parallelism**
  - Above the line (software, many machines) and below the line (hardware, multiple cores) both critical for computing's future.
  - Hard to write code that fully takes advantage of all available resources to maximize performance and get fully Nx speedup.
  - Distributed and Parallel computing
    - Synchronization hard, APIs help (MapReduce)
  - Hardware Parallelism
    - Cache coherence makes it difficult to scale!
    - Manycore, not multicore!
  - Berkeley EECS taking initative to make ~1000 core HW, put in researchers hands!

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CS61C: So what's in it for me? (1st lecture)

Learn some of the big ideas in CS & engineering:

- 5 Classic components of a Computer
- Principle of abstraction, systems built as layers
- Data can be anything (integers, floating point, characters): a program determines what it is
- Stored program concept: instructions just data
- Compilation v. interpretation thru system layers
- Principle of Locality, exploited via a memory hierarchy (cache)
- Greater performance by exploiting parallelism (pipelining, superscaler, MPI, Map-reduce)
- Principles/Pitfalls of Performance Measurement

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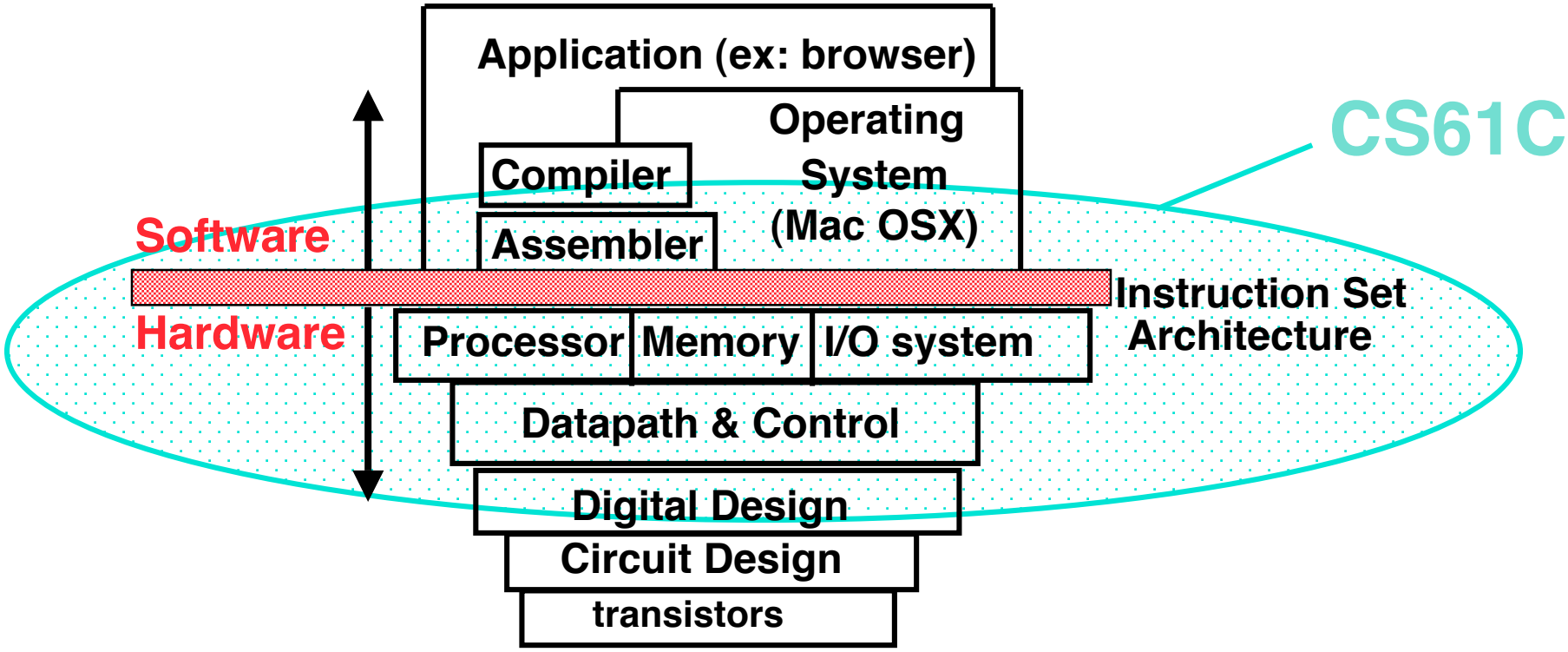
What are "Machine Structures"?



Coordination of many
levels (layers) of abstraction

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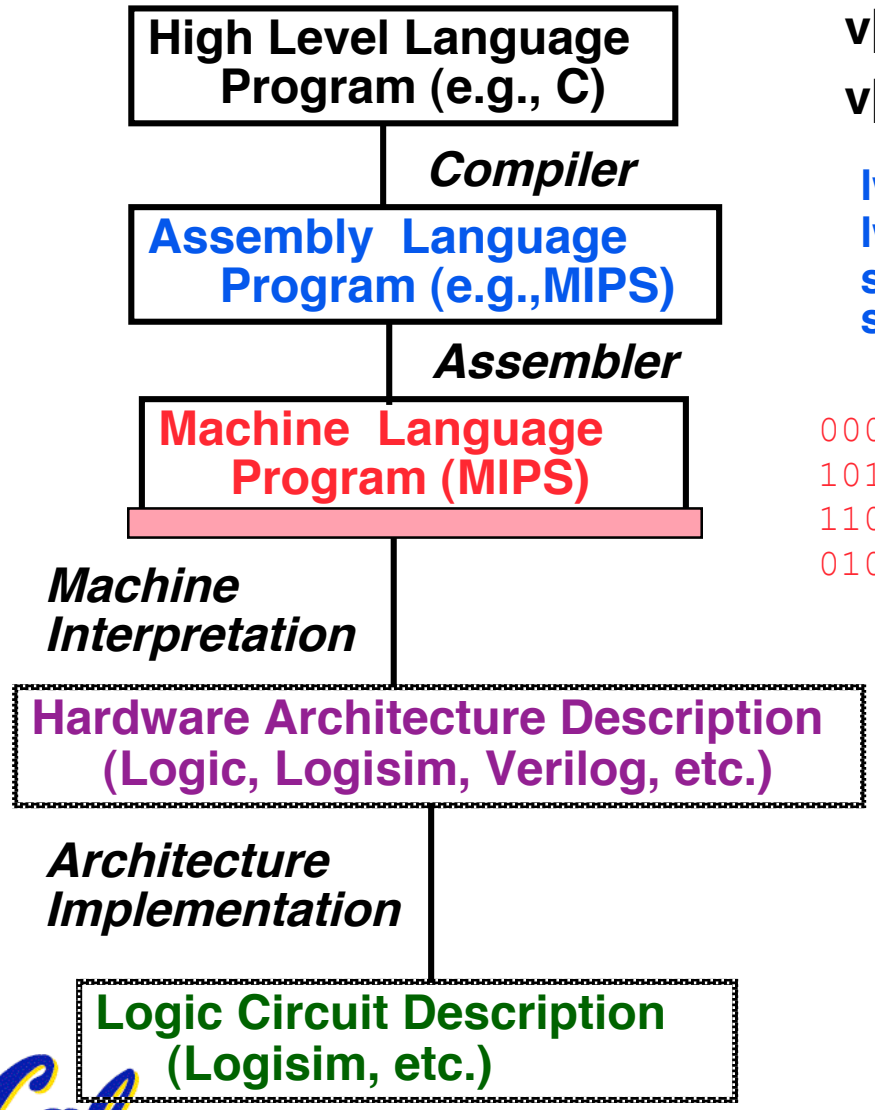
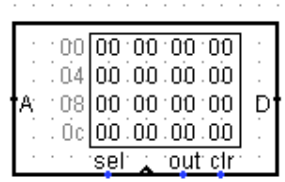
61C Levels of Representation

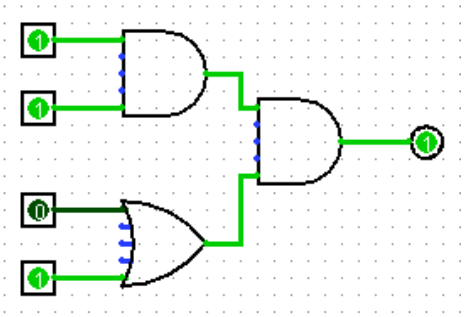



```
temp = v[k];
v[k] = v[k+1];
v[k+1] = temp;
```

```
lw   $t0, 0($2)
lw   $t1, 4($2)
sw   $t1, 0($2)
sw   $t0, 4($2)
```

```
0000 1001 1100 0110 1010 1111 0101 1000
1010 1111 0101 1000 0000 1001 1100 0110
1100 0110 1010 1111 0101 1000 0000 1001
0101 1000 0000 1001 1100 0110 1010 1111
```





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20th vs. 21st Century IT Targets

- 20th Century Measure of Success
  - Performance (peak vs. delivered)
  - Cost (purchase cost vs. ownership cost, power)
- 21st Century Measure of Success? "SPUR"
  - Security
  - Privacy
  - Usability
  - Reliability
- Massive parallelism greater chance (this time) if
  - Measure of success is SPUR vs. only cost-perf
  - Uniprocessor performance improvement decelerates

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Other Implications

- Need to revisit chronic unsolved problem
  - Parallel programming!!
- Implications for applications:
  - Computing power >>> CDC6600, Cray XMP (choose your favorite) on an economical die inside your watch, cell phone or PDA
    - On your body health monitoring
    - Google + library of congress on your PDA
- As devices continue to shrink…
  - The need for great HCI critical as ever!

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Upcoming Calendar

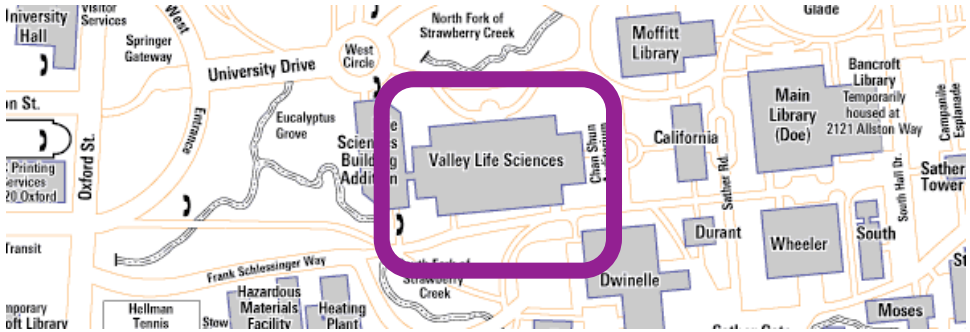
Week #	Mon	Tues	Wed	Sat
#16 This week	LAST CLASS Summary, Review, & HKN Evals	11:59pm Perf comp due today	2pm Review 10 Evans	FINAL EXAM 12:30pm-3:30pm 2050 VLSB

Final Exam

Only bring pen{,cil}s, two 8.5”x11” handwritten sheets + green.

Leave backpacks, books, calculators, cells & pagers home!

Everyone must take ALL of the final!



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Administrivia: Become active!

- If you did well in CS3 or 61{A,B,C} (A- or above) and want to be on staff?
  - Usual path: Lab assistant ⇒ Reader ⇒ TA
  - Contact Jenny Jones in 395 Soda before first week of semester for LA signup…
  - Reader/TA forms: `www.cs/~juliea/`
  - I (Dan) strongly encourage anyone who gets an A- or above in the class to follow this path…
    - I'll be teaching CS61C in 2008Sp

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Taking advantage of Cal Opportunities

"The Godfather answers all of life's questions"
– Heard in "You've got Mail"

- **Why are we the #2 Univ in the WORLD?**
  So says the 2004 ranking from the "Times Higher Education Supplement"
  - **Research, reseach, research!**
  - **Whether you want to go to grad school or industry, you need someone to vouch for you! (as is the case with the Mob)**
- **Techniques**
  - **Find out what you like, do lots of web research (read published papers), hit OH of Prof, show enthusiasm & initiative**
- `http://research.berkeley.edu/`

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CS98/198 Opportunities Fall 2007

- **GamesCrafters** (Game Theory R & D)
  - Develop SW, analysis on 2-person games of no chance. (e.g., go, chess, connect-4, nim, etc.)
  - Req: A- in CS61C, Game Theory / SW Interest
  - Taught as a DeCal by GamesCrafters veterans
- **MS-DOS X** (Mac Student Developers)
  - Learn to program Macintoshes.
  - Req: Interest. Owning a mac helps, not required.
  - Taught as a DeCal by MS-DOS X veterans
- **UCBUGG** (Recreational Graphics)
  - Develop computer-generated images, animations.
  - Req: 3D experience, portfolio
  - Taught as a DeCal by UCBUGG veterans

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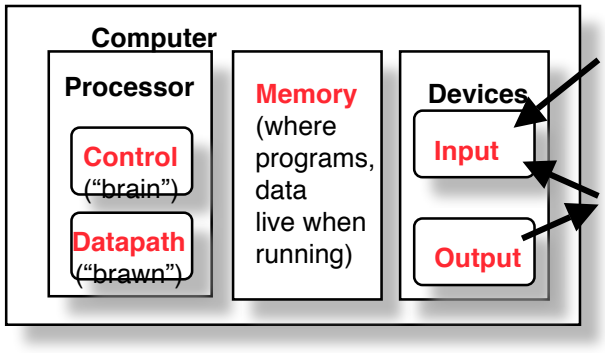
Peer Instruction

Strong or Weak AI? Strong AI: Machines that act intelligently have real, conscious minds...sentience Weak AI: Machines can be made to act as if they were intelligent.

In the future, what'll be the most important computer component?




```
  Strong AI
1: Control
2: Datapath
3: Memory
4: Input
5: Output

  Weak AI
6: Control
7: Datapath
8: Memory
9: Input
0: Output
```

Peer Instruction Answer

"Forget cloning. Forget TVs on your wrist watch. The biggest invention of the next 100 years will be the ability to directly connect your brain to a machine." – Dan Garcia

- A macaque monkey at Duke University can already control a robotic arm with thought.
- DARPA is extremely interested in the technology for mind-control robots & flying
- Virtual Reality could be achieved with proper I/O interfacing…

www.popsci.com/popsci/medicine/article/0,12543,576464,00.html

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Penultimate slide: Thanks to the staff!

- TAs
  - Head TA Michael Le
  - Alex Kronrod
  - Matt Johnson
  - David Poll
  - Aaron Staley
  - Valerie Ishida
  - Brian Nguyen
- Readers
  - Szehon Ho
  - Tim Wu
  - Keaton Mowery
  - Yang Xia
- TAs-in-Training
  - Pamela Lee
  - Alexander Zorbach
  - Omar Akkawi
  - Ofer Sadgat

Thanks to all the former CS61C instructors who have added to these notes…

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The Future for Future Cal Alumni

- What's The Future?
- New Millennium
  - Wireless, Nanotechnology, Quantum Computing, 10 M "volunteer" CPUs, the Parallel revolution...
  - Rapid Changes in Technology
  - World's 2nd Best Education
  - Never Give Up!

"The best way to predict the future is to invent it" – Alan Kay

The Future is up to you!

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