



Sr Lecturer SOE
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inst.eecs.berkeley.edu/~cs61c
UCB CS61C
Great Ideas in Computer Architecture
(aka Machine Structures)

Register your clickers!

**Lecture 40 –
Summary & Goodbye**

TOP 10 BREAKTHROUGH TECHNOLOGIES (MIT TR)

- Agricultural Drones**
Precision farming allows for advanced sensors and imaging capabilities to guide farmers in crop care, irrigation, and pest control.
- 3D-Printed Structures**
3D printing of large-scale structures allows for rapid prototyping and construction of complex shapes.
- Brain Mapping**
Advances in brain mapping allow for a better understanding of the brain's structure and function, leading to new treatments for neurological disorders.
- Nanorobotic Chips**
Nanorobots are tiny machines that can be used for a variety of applications, including drug delivery and tissue repair.
- Gene Editing**
CRISPR-Cas9 allows for precise editing of DNA, leading to new treatments for genetic diseases and improved crop yields.
- MicroLED 2-D Printing**
MicroLED printing allows for the creation of high-resolution, high-contrast displays and sensors.
- Mobile Collaboration**
Cloud-based collaboration tools allow for seamless teamwork and productivity across different devices and locations.
- Quartz 8K**
8K video allows for ultra-high resolution and immersion, providing a more realistic and detailed viewing experience.
- Alpha Robots**
AlphaGo is a computer program that can play the board game Go, demonstrating advanced artificial intelligence capabilities.
- Smart Wind and Solar Power**
Smart wind and solar power systems use advanced sensors and algorithms to optimize energy production and storage.

www.technologyreview.com/lists/technologies/2014/

6 Great Ideas in Computer Architecture

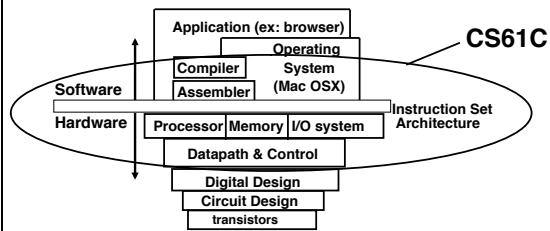
1. Abstraction
(Layers of Representation/Interpretation)
2. Moore's Law
3. Principle of Locality/Memory Hierarchy
4. Parallelism
5. Performance Measurement & Improvement
6. Dependability via Redundancy



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We learned Old-School "Machine Structures"



Coordination of many levels (layers) of abstraction



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...and New-School Machine Structures
(It's a bit more complicated!)

- Parallel Requests
Assigned to computer
e.g., Search "CS61C"
- Parallel Threads
Assigned to core
e.g., Lookup, Ads
- Parallel Instructions
>1 instruction @ one time
e.g., 5 pipelined instructions
- Parallel Data
>1 data item @ one time
e.g., Add of 4 pairs of words
- Hardware descriptions
All gates functioning in parallel at same time

We made HW/SW contact!

```

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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Upcoming Calendar

Week #	Mon	Tue	Wed	Thu	Fri
#14 Last week o' classes	I/O Disks	VM + I/O	GPU Coding	Open Lab	Today Summary
#15 RRR Week			Review 12-3pm 155 Dwinelle		
#16 Finals Week		Final Exam 11:30-2:30pm 1 Pimentel			



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Administrivia: Become active!

- **Final Exam details**
 - Only bring pen(cil)s, two 8.5"x11" handwritten sheets (writing on both sides) + green sheet.
 - Leave backpacks, books, calculators home!
 - Everyone must take ALL of the final!
- **If you did well in CS10 or 61[ABC] (B or above) and want to be on staff?**
 - Usual path: Lab Assistant ⇒ Reader ⇒ TA
 - Reader/TA/LA forms: www.eecs.berkeley.edu/Scheduling/ta_applications.shtml
 - I strongly encourage anyone who gets an B or above in the class to follow this path...



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Taking advantage of Cal Opportunities

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

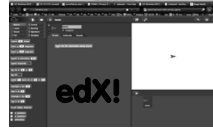


- **Why are we one of the top Univ in the WORLD?**
 - Research, reseach, research!
 - Whether you want to go to grad school or industry, you need someone to vouch for you!
 - ...as is the case with the Mob
- **Techniques**
 - Find out what you like, do lots of web research (read published papers), hit OH of Prof. be a go-getter!
- <http://research.berkeley.edu/>
- <http://researchmatch.heroku.com/>



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Dan's Research Projects

- **CS Illustrated**
 - 
- **Improve CS10/Snap!**
 - 
- **Ensemble**
 - 
- **Game Theory!**
 - 

Opportunities Next Semester

- **CS150 (Digital Systems Design Techniques)**
 - If you liked SDS, this is a great follow-on course!
- **CS9 series (learn a second language)**
 - I would recommend Python next, CS9H
- **GamesCrafters DeCal (Game Theory R & D)**
 - Develop SW, analysis on 2-person games of no chance. (e.g., go, chess, connect-4, nim, etc.)
 - Req: Game Theory / SW Interest
- **MS-DOS X DeCal (Mac Student Developers)**
 - Learn to program Macintoshes.
 - Req: Interest. Owning a mac helps, not required.
- **UCBUGG DeCal (Recreational Graphics)**
 - Develop computer-generated images, animations.
 - Req: 3D interest



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Penultimate slide: Thanks to the staff!

- **TAs**
 - Head TA Alan Christopher
 - Jeffrey Dong
 - Kevin Liston
 - Roger Chen
 - Sagar Karandikar
 - Shreyas Chand
 - Sung Roa Yoon
 - William Ku
- **Readers**
 - William Huang
 - Ryoko Janlie
 - Neal Lawton
 - Jerry Lung
 - Matthew Griffin

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

The Future for Future Cal Alumni

- **What's The Future?**
 - **New Millennium**
 - Ubiquitous & Quantum Computing, Nanotechnology, 10 M "volunteer" CPUs, the Parallel revolution...
 - Rapid Changes in Technology, Post-PC Era!
 - Arguably World's 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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