CS61C - Machine Structures

Lecture 27 - The Final Lecture

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David Patterson

http://www-inst.eecs.berkeley.edu/~cs61c/

Outline

° **Quick review (did last lecture)**

° **Page quiz: More pages Book vs. 61C slides?**

° **Administrivia**

° **Cost, Performance analyses of Computer Science Bachelors of Science Degrees: Cal vs. Stanford**

° **Your Cal Cultural Heritage, including videotape**

° **HKN Evaluation**

From First Lecture

° **15 weeks to learn big ideas in CS&E**

- **Principle of abstraction, used to build systems as layers**
- **Compilation v. interpretation to move down layers of system**
- **Pliable Data: a program determines what it is**
- **Stored program concept: instructions are data**
- **Principle of Locality, exploited via a memory hierarchy (cache)**
- **Greater performance by exploiting parallelism**
- **Principles/pitfalls of performance measurement**

Rapid Change AND Little Change

° **Continued Rapid Improvement in Computing**

- **2X every 1.5 years (10X/5yrs, 1000X/15yrs)**
- **Processor speed, Memory size - Moore's Law as enabler (2X transistors/chip/1.5 yrs); Disk capacity too (not Moore's Law)**
- **Caches, Pipelining, Branch Prediction, ...**

° **5 classic components of all computers**

1. **Control** ⎫
2. **Datapath** ⎬ **Processor (or CPU)**
3. **Memory** ⎭
4. **Input**
5. **Output**

Online Notes

° **Guess Which has more: pages in COD (including Appendix A) vs. CS 61C online slides?**

° **Pages in COD 2/e: 837**

° **Total CS61C slides online: 977 (~35/lecture)**

Administrivia: Rest of 61C

- **Remaining events**

Sun	12/10	Final Review, 2PM (155 Dwinelle)
Tues	12/12	**Final (5PM 1 Pimintel)**
Mon	12/11	Beta test of Final

    Contact Sumeet (cs61c-tf) to find place, time

° **See TA ASAP about grade disagreements: scores should include lab6 as of today**

- **Except Steve V.'s section!**

° **Final: Just bring pencils: leave home back packs, cell phones, calculators**

° **2 sheets of paper, both sides, #2 pencils**

- **Will check that notes are handwritten**

Is UCB CS B.S. >> Stanford's?

° **97/98 Degrees: 242 (Cal) v. 116 (Stanford)**
  - **Cal: L&S Computer Science + EECS Option C**
  - **Stanford: Computer Science (C.S. Dept.) + Computer Systems Engineering (E.E. Dept.) + Symbolic Systems (Interdepartmental)**

° **Performance and Cost Benchmarks?**

Cal v. Stanford Cost-Performance

° **Performance?**
  - **Programming contest results**
  - **Computing Research Awards to Undergrads**
  - **Going to grad school**
  - **Going to industry**
  - **Your good idea here**

° **Cost is easy:**
  - **Tuition (or Tuition+Board) * 4.5 years**

ACM Programming Contests

Year	Regional	International
93	1. UCB, 5. UCB, 6. Stanford	6. UCB, ?? St.
94	1. UCB, 2. Stanford	2. UCB, 22, St.
95	1. UCB, 5. Stanford	1. UCB, ??, St.
96	2. Stanford, 4. UCB,	16. St., ??UCB
97	1. Stanford, 2. UCB,	11. UCB, 24St.
98	1. UCB, 2. Stanford	7. UCB, 38 St.

° Stanford wins regional 1/6 years, never won international

° Berkeley wins regional 4/6 years, Won international, 5/6 times ahead of Stanford

Outstanding Undergraduate Awards

° Started 1995, by Computing Research Association

° 2 Nominations / school / year: 2 Winners, few Runners Up, several Honorable Mentions
  - Total: 10 winners, 24 Runners Up, 49 Hon. Men.

° Number winners Total Named   Points (3/2/1)

40. Stanford (0)   22. Stanford (2) 22. Stanford (2)

5. MIT (1)   14. MIT (2)   11. MIT (4)

1. Dartmouth (2)   2. Cornell (5)   3. Darmouth (9)

1. Harvard (2)   2. Harvard (5)   2. Harvard (10)

1. Berkeley (2)   1. Berkeley (6)   1. Berkeley (11)

Going on to Ph.D. in C.S. Fall 99

° **Admitting School**   **Stanford**   **Berkeley**

° **Univ. Washington**   5   7

° **MIT**   3   6

° **Carnegie Mellon**   1   4

° **Stanford**   ??   6

° **Berkeley**   0   8

° **1997: About 25% of Berkeley EECS students go on for PhD, <5% of Stanford students go for PhD**

Going to Industry

° **Gordon Moore: "Lots more people from Silicon Valley from Cal than Stanford"**

° **"Berkeley B.S. degree is about equivalent to a Stanford M.S. degree"**
  - **Intel recruiter, several others companies**

° **1997-98 Starting Salaries B.S. in CS (according to Placement centers)**

° **Stanford: $41,000 to $56,000**

° **Berkeley: median $50,000 (know of $70,000 jobs)**

Cost Berkeley vs. Stanford CS Degrees

° **Cost Benchmark**
  - **Tuition Only: $22,100 (Stanford) v. $3,766 (Cal)**
  - **Berkeley cheaper by factor of 5.9**
  - **4.5 years * Tuition/Room/Books/Board**
  - **Stanford Cost: 4.5 * $32,444 = $145,998**
  - **Berkeley Cost: 4.5 * $14,598 = $65,691**
  - **Berkeley cheaper by factor of 2.2**

° **Cost-Performance: Any university anywhere close to Berkeley?**

What to Emphasize about Cal culture?

° **Faculty awards?**
  7 current Nobel Prize winners, 18 current "genius" awards winners (MacArthur fellows), 74 members of National Academy of Engineering, 124 members of National Academy of Science

° **Best public university for undergraduate education? (US News)**

° **Top graduate program, public or private, in the world?
(35/36 departments in the top 10; National Research Council)**

Cal Cultural History: ABCs of Football

° **Started with "soccer"; still 11 on a team, 2 teams, 1 ball, on a field; object is to move ball into "goal"; most goals wins**

° **New World changes the rules to increase scoring:**
  - **Make goal bigger! (full width of field)**
  - **Carry ball with hands**
  - **Can toss ball to another player backwards or laterally (called a "lateral") anytime and forwards ("pass") sometimes**

° **How to stop players carrying the ball? Grab them & knock them down by making knee hit the ground ("tackle")**
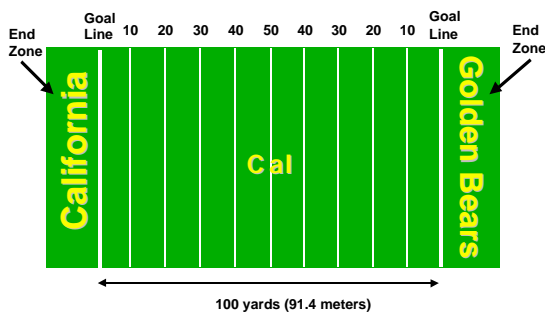
ABCs of American Football

° **Score by**
  - **moving football into goal ("cross the goal line" or "into the end zone") scoring a "touchdown" (6 points)**
  - **kicking football between 2 poles ("goal posts") scoring a "field goal" (worth 3 points, unless after touchdown, then its just 1 point: "extra point")**

° **Kick ball to other team after score ("kickoff"); laterals OK**

° **Game ends when no time left (4 15 min quarters) and person with ball is stopped (Soccer time only: 2 45 min halves, time stops play)**

Football Field

End Zone | Goal Line | 10 | 20 | 30 | 40 | 50 | 40 | 30 | 20 | 10 | Goal Line | End Zone

California — Cal — Golden Bears

100 yards (91.4 meters)

The Spectacle of American Football

° **Cal's archrival is Stanford; stereotype is Private, Elitist, Snobs**

° **Play nearby archrival for last game of season**
  - **Called "The Big Game": Cal vs. Stanford, winner gets a trophy ("The Axe") : Oldest rivalry west of Mississippi; 100th in 1997**

° **American college football is a spectacle**
  - **School colors (Cal Blue & Gold v. Red & White)**
  - **Nicknames (Golden Bears v. Stanford Cardinal)**
  - **School mascot (Oski the bear v. a tree(!))**
  - **Leaders of cheers ("cheerleaders")**

The Spectacle of American Football

- "Bands" (orchestras that march) from both schools at games

- March/play Before game, at halftime, after game

- Stanford Band more like a drinking club; (Seen the movie "Animal House"?)

- Plays one song: "All Right Now"

- Cannot march and play

1982 Big Game

- "There has never been anything in the history of college football to equal it for sheer madness." *Sports Illustrated*
  - "top 20 favorite sports event in 20th century"

- Stanford Quarterback is John Elway, who goes on to be a professional All Star football player (retired 1999)
  - greatest quarterback in college history?

- Stanford lost 4 games in last minutes of contest

- Stanford has just taken lead with 4 seconds left in game; Cal team captian yells in huddle "Don't fall with the ball!"; look at video

Notes About "The Play" (1/2)

- Cal only had 10 men on the field; last second another came on (170 pound Steve Dunn #3) and makes key 1st block

- Kevin Moen #26: 6'1" 190 lb. safety,
  - laterals to Rodgers (and doesn't give up)

- Richard Rodgers #5: 6' 200 lb. safety, "Don't fall with the ball."
  - laterals to Garner

- Dwight Garner #43: 5'9" 185 lb. running back
  - almost tackled, 2 legs & 1 arm pinned, laterals

- Richard Rodgers #5 (again): "Give me the ball"
  - laterals to Ford

Notes About "The Play" (2/2)

- Mariet Ford #1: 5'9", 165 pound wide receiver
  - Smallest player, leg cramps; overhead blind lateral to Moen and blocks 3 players

- Moen (again) cuts through Stanford band into end zone (touchdown!), smashes Trombonist

- On field for Stanford: 22 football players, 3 Axe committee members, 3 cheerleaders, 144 Stanford band members (172 for Stanford v. 11 for Cal)
  - "Weakest part of the Stanford defense was the woodwinds."

- 4 Cal players + Stanford Trombonist (Gary Tyrrell) hold reunion every year at Big Game; Stanford revises history (20-19 on Axe)

2nd to last 61C slide: First, Thanks to the TAs!

- Kurt Meinz
- David Oppenheimer
- Gagan Prakash
- Sumeet Shendrikar
- Daniel Silverstein
- Lan Tang
- Jonathan Tse
- Steve Tu
- Steve VanDeBogart

The Future for Future Cal Alumni:

- What's The Future?

- New Millennium
  + Internet, Satellites Imagery, …
  + Rapid Change in Technology
  + World's Best Education
  + Hard Work
  + Never Give Up

- "The best way to predict the future is to invent it" (Alan Kay, Xerox PARC)

- Future is up to you!