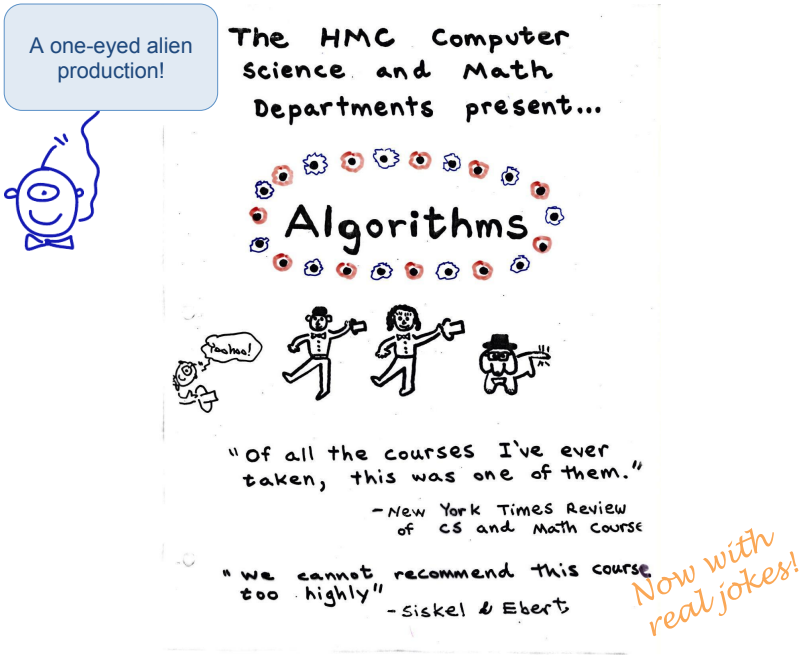


Who are you?

- Your (preferred) name
- Something that you'd like to learn about in this course
- What are your thoughts for life after college? (If it exists!)
- A random fact about you!

Welcome to Algorithms

5 Handouts Today:

- Syllabus
- Lecture notes
- HW 1a
- How to Write Proofs by Induction
- Blank worksheet

Learning Objectives

- Given a challenging computational problem:
  - Design an efficient algorithm for it
  - Derive its worst-case running time
  - Prove the correctness of the algorithm
- Get comfortable using a number of major design paradigms and techniques:
  - Divide-and-conquer, greed, dynamic programming
  - Amortized analysis
  - Graph algorithms
  - NP-completeness and approximation algorithms
- See some "advanced topics" to get a sense of the breadth and depth of the field

Why Study Algorithms?

Algorithms add up to big business

These computational recipes drive much of the way we and business use computers

Amazon hires algorithm guru

By Margaret Kane
Staff Writer, CNET News

Related Stories

Amazon.com has named a former chief scientist at Yahoo as its chief algorithms officer.

stackoverflow Questions Tags Users Badges Unanswered Ask Ques

Why are so many algorithm problems asked in interviews?

Turing Awards

(2011)Pearl, Judea
(2010)Valiant, Leslie Gabriel
(2009)Thacker, Charles P. (Chuck)
(2008)Liskov, Barbara
(2007)Clarke, Edmund Melson Emerson, E. Allen Sifakis, Joseph
(2006)Allen, Frances ("Fran") Elizabeth
(2005)Naur, Peter
(2004)Cerf, Vinton ("Vint") Gray Kahn, Robert ("Bob") Elliot
(2003)Kay, Alan
(2002)Adleman, Leonard (Len) Max Rivest, Ronald (Ron) Linn Shamir, Adi
(2001)Dahl, Ole-Johan *Nygaard, Kristen *
(2000)Yao, Andrew Chi-Chih
(1999)Brooks, Frederick ("Fred")
(1998)Gray, James ("Jim") Nicholas *
(1997)Engelbart, Douglas ("Doug")
(1996)Pnueli, Amir *
(1995)Blum, Manuel
(1994)Feigenbaum, Edward A ("Ed") Reddy, Raj
(1993)Hartmanis, Juris Stearns, Richard ("Dick") Edwin
(1992)Lampson, Butler W
(1991)Milner, Arthur John Robin Gorell ("Robin") *
(1990)Corbato, Fernando J ("Corby")
(1989)Kahan, William ("Velvel") Morton
(1988)Sutherland, Ivan
(1987)Cocke, John *

(1986)Hopcroft, John E, Tarjan, Robert (Bob) Endre
(1985)Karp, Richard ("Dick") Manning
(1984)Wirth, Niklaus E
(1983)Ritchie, Dennis M.*Thompson, Kenneth Lane
(1982)Cook, Stephen Arthur
(1981)Codd, Edgar F. ("Ted") *
(1980)Hoare, C. Antony ("Tony") R.
(1979)Iverson, Kenneth E. ("Ken") *
(1978)Floyd, Robert (Bob) W *
(1977)Backus, John *
(1976)Rabin, Michael O. Scott, Dana Stewart
(1975)Newell, Allen *Simon, Herbert ("Herb") Alexander *
(1974)Knuth, Donald ("Don") Ervin
(1973)Bachman, Charles William
(1972)Dijkstra, Edsger Wybe *
(1971)McCarthy, John *
(1970)Wilkinson, James Hardy ("Jim") *
(1969)Minsky, Marvin
(1968)Hamming, Richard W*
(1967)Wilkes, Maurice V.*
(1966)Perlis, Alan Jay *

Staff

- Professors: Jim Boerkoel (Mudd)
  Tzu-Yi Chen (Pomona)
- Grutors: 12 friendly grutors

+ `min` is  tion

"Everything" is on Piazza!

- Homework assignments
- Lecture notes
- Discussions
- Q & A with Instructors and Grutors
  (instead of e-mail!)
- Collaboration policy

Coordination with Pomona

- More grutors / office hours

Please read the syllabus

In a nutshell…

- HWs due Tuesdays and Thursdays (60% 100 pts/week)
  - Hand in at beginning of lecture
  - First three weeks, use LaTeX (resources in Syllabus, source code provided for each problem)
  - 3 bonus days: may submit a problem 24 hours late up to 3 times
  - Participation: in-class, office hours, Piazza
- Two midterm exams (10% each)
- Final (20%)
- Grading on "fixed scale"

Homework and Exam Objectives

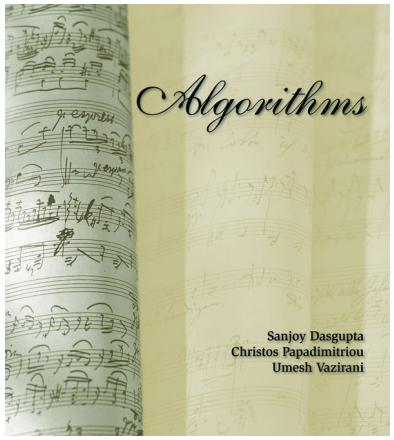
- Homework problems are challenging and open-ended, developing good problem-solving skills needed both in practice (e.g., work) and theory (e.g., research).
- Exam problems are more like job interview questions – not as hard or rich as homework problems but require using the skills that you've developed by doing the homeworks.

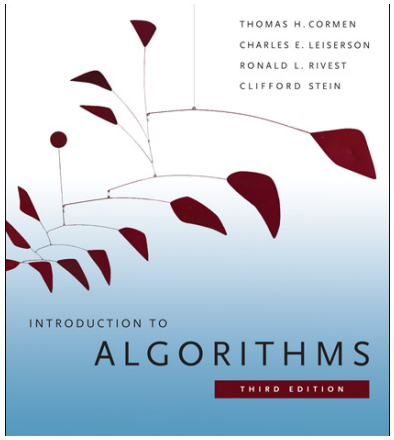
In theory, there is no difference between theory and practice. But, in practice, there is. - Yogi Berra

Office Hours and Grutor Hours

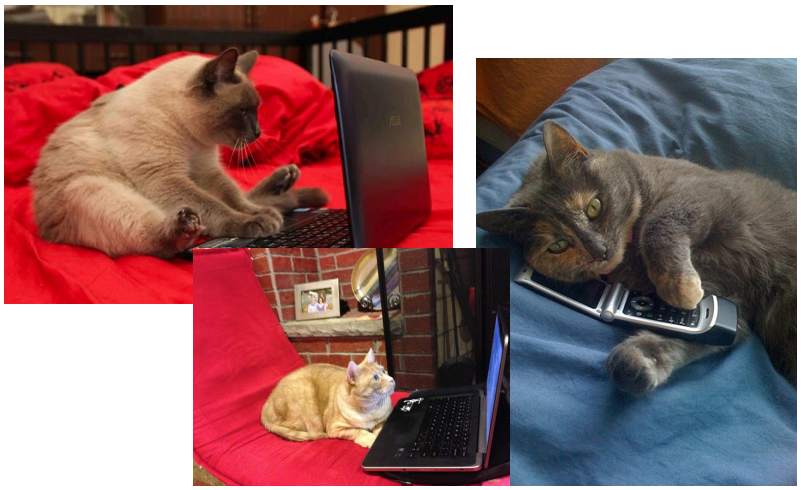
- Jim's office hours:
  - M, W: 4:00-5:30
- Yi's office hours:
  - M, W: 2:00-3:30
- Grutor hours:
  - Su, M, T, W, Th: 8-11 PM Beckman 134 (some hours at the Pomona CS lab too!)
- Short questions/clarifications using Piazza

Texts



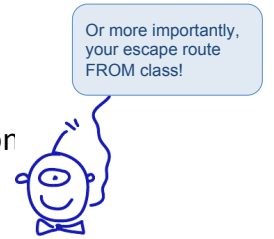


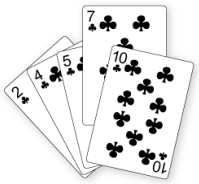
Pleze Not Use in Class…



Algorithms: The Untold Story

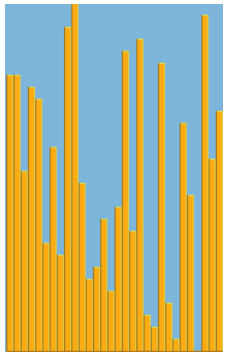
- Algorithms are all around you
  - Influencing your daily life
- Examples:
  - Helping you search for information
  - Selecting courses to take
  - Planning your route to class
  - ...even playing cards





Describing algorithms: pseudocode

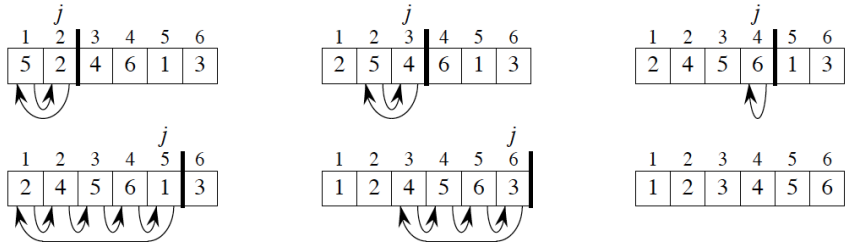
INSERTION-SORT(A, n)



Source: Wikimedia

INSERTION-SORT(A, n)

Example



But is it correct? Loop invariants

- An 'induction-like' proof of correctness where we need to show:
  - **Initialization:** property that is true prior to first iteration
  - **Maintenance:** property that, if true before loop, remains true after next iteration
  - **Termination:** show that once termination condition is reached, the invariant gives us a useful property that shows algorithm is correct

Insertion Sort Correctness

- Initialization:
- Maintenance:
- Termination:

Analyzing algorithms: complexity

Measure runtime in terms of primitive steps (arithmetic, data movement, control) as a function of the size of the input in machine-independent way.

```
INSERTION-SORT(A, n)                                   cost   times
for j = 2 to n
    key = A[j]
    // Insert A[j] into the sorted sequence A[1 .. j − 1].
    i = j − 1
    while i > 0 and A[i] > key
        A[i + 1] = A[i]
        i = i − 1
    A[i + 1] = key
```

http://www.sorting-algorithms.com/insertion-sort

For this Thursday

- Login to Piazza
- Read the syllabus
- Read the "Writing Proofs" handout
- Do HW 1a and format it in LaTeX
- Submit the (separate page for each problem) in class on Thursday

Next time:

- Divide-and-conquer!
- Big-oh!