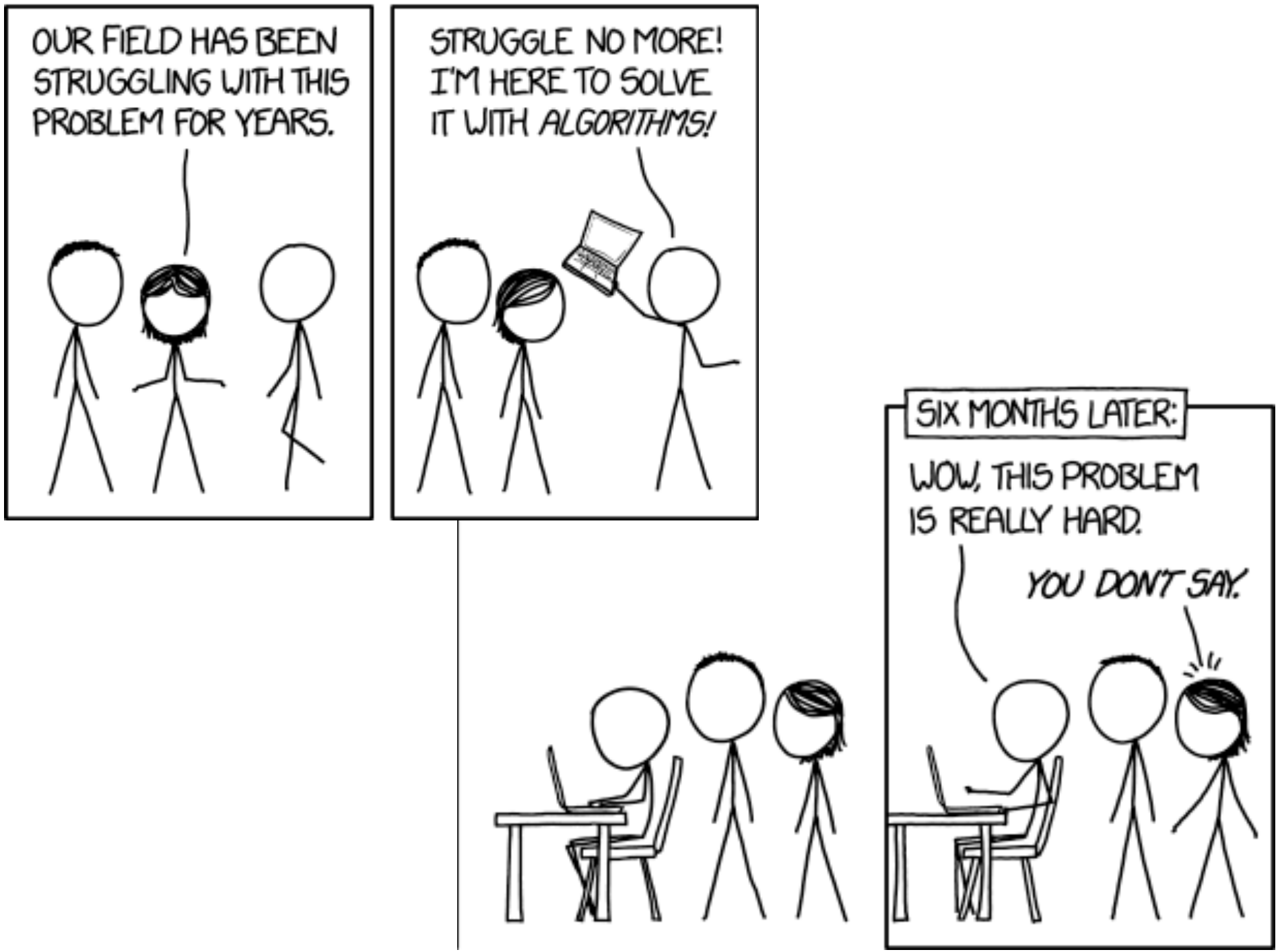
Final Review


OUR FIELD HAS BEEN STRUGGLING WITH THIS PROBLEM FOR YEARS.
STRUGGLE NO MORE! I'M HERE TO SOLVE IT WITH ALGORITHMS!
SIX MONTHS LATER:
WOW, THIS PROBLEM IS REALLY HARD.
YOU DON'T SAY.

Final Exam Coverage

Comprehensive, all topics covered
(but with post-midterm bias)

- assigned reading
- slides
- homework & solutions
- midterm review slides still relevant, plus those below

Design Paradigms

Greedy

emphasis on correctness arguments, e.g. stay ahead, structural characterizations, exchange arguments

Divide & Conquer

recursive solution, superlinear work, balanced subproblems, recurrence relations, solutions, Master Theorem

Dynamic Programming

recursive solution, redundant subproblems, few

do all in careful order and tabulate; OPT table

(usually far superior to "memoization")

Examples

Dynamic programming

- Fibonacci
- Making change/Stamps
- Knapsack
- Weighted Interval Scheduling
- RNA
- String Alignment

OPT function
OPT table

Complexity, II

P vs NP

- Big-O and poly vs exponential growth
- Definition of NP – hints/certificates and verifiers
- Example problems from slides, reading & hw
  - SAT, VertexCover, clique, independent set, TSP, Hamilton cycle, coloring, max cut, …
- $P \subseteq NP \subseteq Exp$ (and worse)
- Reduction, incl. definition of (polynomial time) reduction
- $SAT \leq_p$ Independent Set example
- $SAT \leq_p$ Knapsack example

how, why correct, why $\leq_p$, implications

- Definition of NP-completeness
- 2x approximation to Euclidean TSP

And see how relevant it is to your daily life!

Classic Nintendo Games are (NP-)Hard

Greg Aloupis* Erik D. Demaine† Alan Guo†‡

March 9, 2012

Abstract

We prove NP-hardness results for five of Nintendo's largest video game franchises: Mario, Donkey Kong, Legend of Zelda, Metroid, and Pokémon. Our results apply to Super Mario Bros. 1, 3, Lost Levels, and Super Mario World; Donkey Kong Country 1–3; all Legend of Zelda games except Zelda II: The Adventure of Link; all Metroid games; and all Pokémon role-playing games. For Mario and Donkey Kong, we show NP-completeness. In addition, we observe that several games in the Zelda series are PSPACE-complete.

Final Exam Mechanics

Closed book, 1 pg notes (8.5x11, 2 sides, handwritten)

(no bluebook needed; scratch paper may be handy; calculators probably unnecessary)

Comprehensive: All topics covered

- assigned reading
- slides
- homework & solutions

Some Typical Exam Questions

Give O( ) bound on 17n*(n-3+logn)

Give O( ) bound on some code `{for i=1 to n {for j …}}`

True/False: If X is $O(n^2)$, then it's rarely more than n^3 +14 steps.

Explain why a given greedy alg is/isn't correct

Give a run time recurrence for a recursive alg, or solve a simple one

Convert a simple recursive alg to a dynamic programming solution

Simulate any of the algs we've studied

Give an alg for problem X, maybe a variant of one we've studied, or prove it's in NP

Understand parts of correctness proof for an algorithm or reduction

Implications of NP-completeness

~~Hell's library~~ → 417 Final

Good Luck!

And please take a minute to fill out the online course evaluation:
https://uw.iasystem.org/survey/205848