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”)

12
Examples

Dynamic programming
   Fibonacci
   Making change/Stamps
   Knapsack
   Weighted Interval Scheduling
   RNA
   String Alignment
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 ⊆ NP ⊆ Exp (and worse)
Reduction, incl. definition of (polynomial time) reduction
SAT ≤_p Independent Set example \[ \text{how, why correct, why } \leq_p \text{ implications} \]
SAT ≤_p Knapsack example
Definition of NP-completeness
2x approximation to Euclidean TSP
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 probably unnecessary)

Comprehensive: All topics covered

assigned reading
slides
homework & solutions
Some Typical Exam Questions

Give $O(\ )$ bound on $17n^*(n-3+\log n)$
Give $O(\ )$ bound on some code $\{\text{for } i=1 \text{ to } n \{\text{for } j \text{ ...}\}\}$
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
Good Luck!

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