Final Review

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; <u>OPT table</u>

(usually far superior to "memoization")

Examples

Dynamic programming

    Fibonacci

    Making change/Stamps, Knapsack

    Weighted Interval Scheduling

    RNA

    String Alignment

OPT function

Examples & Concepts

Flow and matching

Residual graph, augmenting paths, max-flow/min-cut, Ford-Fulkerson and Edmonds-Karp algorithms, (preflow-push), integrality,

reductions to flow

e.g. bipartite matching, "baseball elimination"

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, 3-SAT, circuit SAT, ~~vertex cover, quadratic Diophantine equations,~~ clique, independent set, TSP, ~~Hamilton cycle~~, coloring, max cut, knapsack

P $\subseteq$ NP $\subseteq$ Exp (and worse)

Reduction, incl. definition(s) of (polynomial time) reduction

SAT $\leq_p$ e.g., IndpSet, Knap, ~~Ham~~, 3color: how, correctness, $\leq_p$, implications

Definition of NP-completeness

NP-completeness proofs

2x, 1.5x approximations to Euclidean TSP

And see how relevant it is to your daily life!

Classic Nintendo Games are (NP-)Hard

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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.

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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 $17n*(n-3+\log n)$, or on code `{for i=1 …}}`

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

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

Reductions

NP-completeness proofs

Hell's library → 421 Final

Good Luck!

(And please take a minute to fill out the online course evaluation.)