Lecture 34

CSE 331

Nov 27, 2023

Next <= 2.5 weeks are brutal

Tue, Nov 28		(**HW 8 out, HW 7 in**)
Wed, Nov 29	More on reductions, P and NP F22 F21 F19	[KT, Sec 8.1]
Fri, Dec 1	NP-Completeness F22 F21 F19	[KT, Sec 8.3, 8.4] (**Project (Problem 3 `Coding`) in**)
Mon, Dec 4	The SAT problem F22 F21 F19	[KT, Sec. 8.2] (**Quiz 2**) (**Project (Problem 3 `Reflection`) in**)
Tue, Dec 5		(**HW 8 in**)
Wed, Dec 6	*k*-coloring problem F22 F21 F19	[KT, Sec 8.7]
Fri, Dec 8	*k*-coloring is NP-complete F22 F21 F19	[KT, Sec 8.7] (**Project (Problems 4 & 5 `Coding`) in**)
Mon, Dec 11	Wrapup	
Tue, Dec 12		(**Project (Problems 4 & 5 `Reflection`) in**) (**Project Survey in**)
Wed, Dec 13	**Final Exam**	(**12:00-2:30pm** in **NSC 201 (usual classroom)**)

Homework 7 reminders

Homework 7

Due by **11:30pm Tuesday, November 28, 2023**.

Make sure you follow all the homework policies.

All submissions should be done via Autolab.

! Note on Timeouts on HW 7 Q3

For this problem the total timeout for Autolab is 480s, which is higher the the usual timeout of 180s in the earlier homeworks. So if your code takes a long time to run it'll take longer for you to get feedback on Autolab. **Please start early to avoid getting deadlocked out before the feedback deadline.**

Also for this problem, `C++` and `Java` are way faster. The 480s timeout was chosen to accommodate the fact that Python is much slower than these two languages.

Our recommendation

- Either code in `C++` or `java` OR
- If you want to program in `python` then test on first five test cases and test for all 10 only if they pass the first five.

Hint

For part `(b)` convince yourself that one should always schedule a job on the last day and then use it. If in your solution you use the hint, you will also have to convince the grader why you are convinced if you choose to use the hint, i.e. just using the hint as given (without any justification) will result in loss of points.

⊘ Common Mistake

Students correctly state the recurrence for the optimal solution for part `(b)` but do not state the order in which to solve the sub-problems.

Sample final exam

note @503

stop following 3 views

Actions

Sample final exam

Since one of you asked for it, I figured I'll release the sample final exam in case it helps you plan better for the final exam:

- Sample final
- Sample final solutions

(These are also available under the "Sample Exams" dropdown menu from the banner on the 331 webpage. If you do not see it on your browser, refresh and/or clear the cache in your browser.)

Two comments:

- I would recommend that you not peek at the solution before you have worked on the sample final on your own.
- As with the sample mid-terms, do **not** try and deduce anything about the topic coverage in the actual final exam (I will post shortly on how to prepare for the final exam).
  - However, the sample exam was an actual final exam in one of the past years. Your final exam will be of comparable difficulty.

final

Edit good note | 0

Updated 12 minutes ago by Atri Rudra

Final exam post

note @505 stop following 38 views

Actions

Final exam post

I'll start off with some generic comments:

- The final exam will be based on all the material we will see in class up to NP-completeness of k-colorability (we'll finish that stuff by either Friday, Dec 8 or Monday, Dec 11).
  - In case you want a head-start we will cover Sections 8.1-8.4 and Section 8.7 in the textbook. For the rest the schedule page details what sections of the book we have already covered.
  - I know this does not give a huge lead time into the final exam but unfortunately since we are running one lecture behind previous years means less lead time than in previous years.
- Exam will be from **12:00pm to 2:30m** on Wednesday, **Dec 13** in class (**NSC 201**). Note that the exam will be for 2.5 hours and *not 3 hours* as it says on HUB.
  - ~~I will post the makeup final exam time (due to exam conflicts-- see @447) by Monday, Nov 20.~~ If you had emailed me about a conflict with the final exam time (see @447), I have emailed you back the details on the timing of the makeup final exam.
- **DO NOT FORGET TO BRING YOUR UB CARD TO THE EXAM** (@504)

Next are comments related to **preparing for the finals**:

1. Take a look at the sample final (@503) and spend some quality time solving it. Unlike the homeworks, it might be better to try to do this on your own. Unlike the sample mid-term, this one is an actual 331 final exam so in addition to the format, you can also gauge how hard the final exam is going to be (your final exam will be the same ballpark). However as with the sample mid-term, you make deductions about the coverage of topics at your own peril (but see points below). Once you have spent time on it on your own, take a look at the sample final solutions (@503).
2. The actual final will have the same format as the sample final: The first question will be T/F, 2nd will be T/F with justification, the rest of the three will be longer questions and will ask you to design algorithms (parts of them might be just *analyzing* an algorithm.)
3. For the T/F questions (i.e. the first two questions), anything that was covered in class or recitations or piazza is fair game. If you want to refresh your memory on what was covered, take a look at the schedule page. If you want quick summaries of (almost all) the lectures, review the lecture notes or slides or videos.
4. To get more practice for the T/F questions, review all the T/F polls on piazza (@60)
5. For the remaining 3 questions, one will be on greedy algorithms, one will be on divide and conquer algorithms and one will be on dynamic programming. However, note that Chapter 2 and 3 in the book are basic stuff and almost any question in the final could fall under the purview of those two chapters. There will be **at least** one T/F and one T/F with justification Q for the NP-complete material so y'all should definitely focus on those as well but I will not ask any "proof based" Qs on that material.
6. In previous finals, like your mid-terms, there have been questions that are either straight lifts from homeworks or are closely related and this trend will continue in the actual exam (though to a lesser extend then the mid-term). This means that you should review your homeworks (all of them) before the exam. Also make sure to review the support pages and recitation notes.
7. If you are short on time and you are prioritizing the topics to study, keep points 5 and 6 above in mind.
8. Sections in the book that were not covered at all in the class but were handed out as reading assignments or recitation notes: I can also ask any direct questions from them. In addition, it might be useful to read them to get a better feel for the material. In any case once you have read the material covered in class a couple of times, it might do your brain some good to read some different material.

Bring UB card to final exam!

note @504 stop following 2 views

Actions

Assigned seating for final exam

Your seating for the final in NSC 201 will be assigned (and you won't be able to sit wherever you find a spot as it was for the mid-term).

I will release more details by Monday, Dec 11. In the meantime, two important things to remember:

- **You will HAVE to have your UB card on you during the exam**
    - A TA will come and verify that you are seated in the correct row
- To facilitate the TAs checking your UB IDs, **please keep your bag in the front of the room** (i.e. not with you).

final

Edit good note | 0 Updated 13 minutes ago by Atri Rudra

Makeup for final exam conflict

note @509

stop following 1 view

Actions

Final exam conflict makeup exam

If you had emailed me about a time conflict with CSE 331 final exam time (@447), then I have emailed you back with the time and location of the makeup final exam on Dec 12.

If you have not emailed me (the deadline was Friday), then I have assumed that you do not want to do a makeup final exam.

final logistics

Edit good note | 0

Updated 21 seconds ago by Atri Rudra

Course evaluations

note @526 stop following **0 views**

Actions

Incentive for filling in course evals

As I have done in the past few years, depending on the level of response on the official course evals, I will release come questions on the final exam. (See @503 to see what Q I mean below)

- If **>=85%** students submit the course evals, I will release **Q1(a)**
- If **>=90%** students submit the course evals, I will release **Q1(a) AND Q2(a)**

Some other relevant comments:

- I will post the current response rate in the comments section below every 3 days starting Monday, Nov 27 till the deadline
- The % is based on current number of students registered: i.e. it does not include students who have resigned
- I believe this is the link to the course evals: https://sunyub.smartevals.com/
  - But double check the email you might have received on this.

feedback

Edit good note 0 Updated 2 minutes ago by Atri Rudra

Reflection 2 grading post

note @527 stop following 1 view

Actions

Reflection 2 has been graded

Reflection problem 2 has now been graded and the scores and feedback released on Autolab! Hopefully the feedback is helpful as y'all work on your Reflection Problem 3.

PLEASE READ THE RUBRIC CAREFULLY TO SEE THE COMMON MISTAKES, which y'all should avoid making for future reflection problem submissions. *Also take a look at the feedback since in many cases I did not deduct points since this was the first submission where we have asked you to think about implications of your algorithm--the grading would be stricter reflection 3 onwards.*

Few common mistakes:

- *In argument for in favor vs not: not clearly stating why your algo idea leads to the claimed group being favored vs. not*
- *The algo idea not matching the code that was submitted.*

(Please see the re-grade policy as well as the grading rubric below before contacting us with questions on grading.)

Here are the stats:

Problem	Mean	Median	StdDev	Max	Min
Algo Idea	1.4	2.0	0.7	2.0	0.0

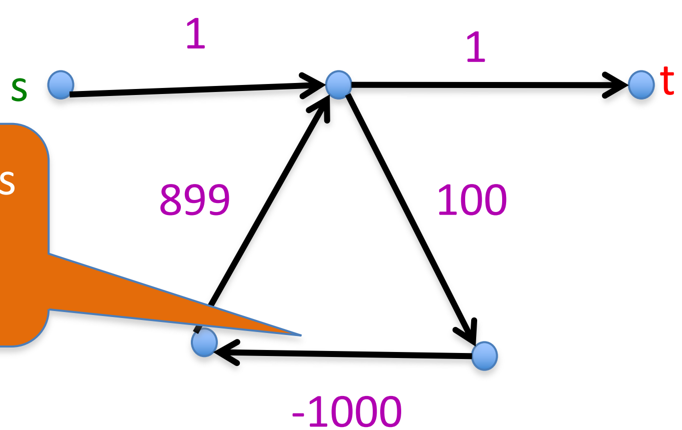
Questions?

Shortest Path Problem

Input: (Directed) Graph $G=(V,E)$ and for every edge e has a cost c_e (can be <0)

t in V

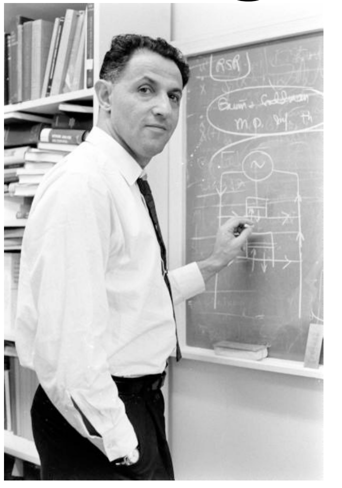
Output: Shortest path from every s to t



Shortest path has cost negative infinity

Assume that G has no negative cycle

When to use Dynamic Programming



Richard Bellman

There are polynomially many sub-problems

Optimal solution can be computed from solutions to sub-problems

There is an ordering among sub-problem that allows for iterative solution

Questions?

Today’s agenda

Bellman-Ford algorithm

Analyze the run time

Algo on the board…

The recurrence

$OPT(u,i)$ = shortest path from u to t with at most i edges

$$OPT(u,i) = \min \{ OPT(u,i-1), \min_{(u,w) \text{ in } E} \{ c_{u,w} + OPT(w, i-1)\} \}$$

Some consequences

OPT(u,i) = cost of shortest path from u to t with at most i edges

$$\mathrm{OPT}(u,i) = \min \left\{ \mathrm{OPT}(u, i\text{-}1),\ \min_{(u,w)\text{ in }E} \left\{ c_{u,w} + \mathrm{OPT}(w,i\text{-}1) \right\} \right\}$$

OPT(u,n-1) is shortest path cost between u and t

How to compute the shortest path between s and t given all OPT(u,i) values

Bellman-Ford Algorithm

Runs in $O(n(m+n))$ time

Only needs $O(n)$ additional space

Questions?

Reading Assignment

Sec 6.8 of [KT]

Longest path problem

Given G, does there exist a simple path of length n-1 ?

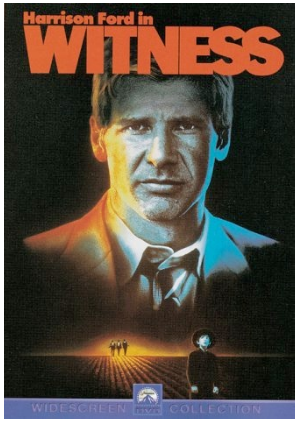
Longest vs Shortest Paths

Two sides of the “same” coin

Shortest Path problem

Can be solved by a polynomial time algorithm

Is there a longest path of length n-1?



Given a path can verify in polynomial time if the answer is yes

Poly time algo for longest path?

P vs NP question

P: problems that can be solved by poly time algorithms

Is P=NP?

NP: problems that have polynomial time verifiable witness to optimal solution

Alternate NP definition: Guess witness and verify!

Proving P ≠ NP

Pick any one problem in NP and show it cannot be solved in poly time

Pretty much all known proof techniques *provably* will not work

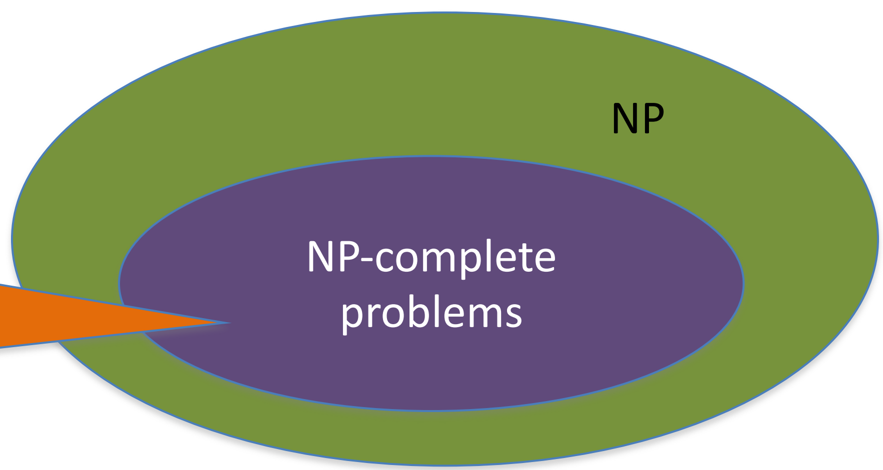
Proving P = NP

Will make cryptography collapse

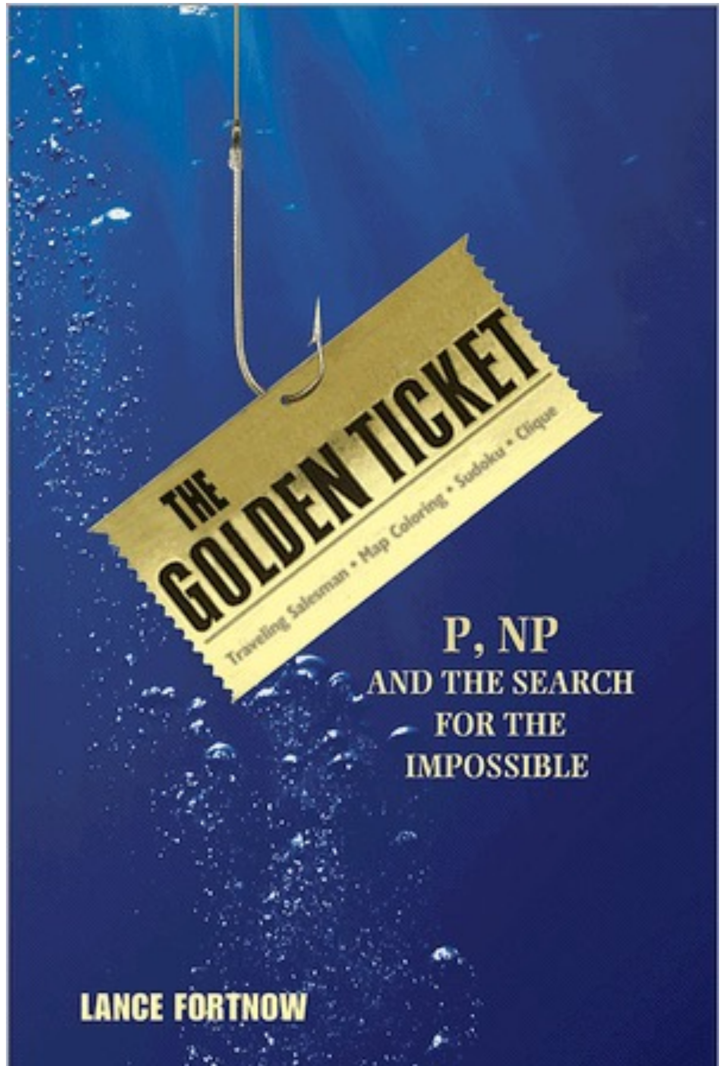
Compute the encryption key!

Prove that all problems in NP can be solved by polynomial time algorithms

Solving any ONE problem in here in poly time will prove P=NP!



A book on P vs. NP



Questions?

The course so far…

https://www.teepublic.com/sticker/1100935-obama-yes-we-can

The rest of the course…

https://www.madduckposters.com/products/megamind-no-you-cant?variant=13565168320556