

Lecture 19

CSE 331

Oct 17, 2022

Project deadlines coming up

Fri, Oct 28	Counting Inversions  F21  F19  F18  F17 x ²	[KT, Sec 5.3] (Project (Problem 1 Coding) in)
Mon, Oct 31	Multiplying large Integers  F21  F19  F18  F17 x ²	[KT, Sec 5.5] (Project (Problem 1 Reflection) in) <i>Reading Assignment:</i> Unraveling the mystery behind the identity
Wed, Nov 2	Closest Pair of Points  F21  F19  F18  F17 x ²	[KT, Sec 5.4]
Fri, Nov 4	Kickass Property Lemma  F21  F19  F18  F17 x ²	[KT, Sec 5.4] (Project (Problem 2 Coding) in)
Mon, Nov 7	Weighted Interval Scheduling  F21  F19  F17 x ²	[KT, Sec 6.1] (Project (Problem 2 Reflection) in)

Some other stuff coming up

note 0282   

stop following  views Actions 

What's next?

Now that the mid-terms are done, hope y'all take some time to decompress! Some of you might have questions on how you're doing in the course, how you did in the mid-term exams and perhaps some of you think you'd like to come and chat with me.

I just wanted to give y'all some heads up on this:

- (As a tangent, note that HW 4 is already out: [0274](#))
- Our goal is to be able to finishing grading (both the) mid-terms by early to mid next week.
 - Your TAs also have mid-terms so we appreciate your patience as they grade your mid-terms!
 - Once that is done, as with the HWs, I'll release the stats as well as the grading rubric. The usual re-grade policy will apply.
- Once the mid-terms are graded I'll assign temporary letter grades to y'all (based on your scores of HWs 1-3, Quiz 1 and mid-terms) just so that y'all get a sense of where you stand in the course currently.
 - I'll put up a piazza post with the details once the temp. letter grades have been assigned.
 - Note that this will not be the same as the mid-semester grade that I need to submit to HUB by tomorrow (mainly because the mid-terms will not be graded by this Friday, which is when the mid-semester grades are due).
- Those who have a D+ or below in their temporary letter grade, I'll send email asking you to setup a one-on-one meeting (<= 12 mins).
 - Even if you have a better grade than D+ but want to chat about your performance, you can also sign up (but those with D+ or below will get preference for a slot)
 - I'll put up a piazza post with details once I finalize the meeting stats.

[mid-term](#) [grading](#)

[Edit](#) good note 

Updated 11 seconds ago by AMR Rudea

Ignore HUB mid-semester grade

note @284 stop following 2 views Actions

IGNORE the mid-semester grade on HUB

On HUB, you will now see a mid-semester grade for CSE 331. **Please ignore the grade.** I will be posting a more appropriate mid-semester letter grade (see @282) sometime next week. The mid-semester grade on HUB (which is only MS/MU) only takes HWs 1-3 and Quiz 1 into account. The more accurate mid-term temp. letter grade will also take your mid-term exam scores into account-- again as mentioned in @82, once I have computed that more accurate temp letter grade, I will post on piazza with more details.

UB requires that I submit a mid-semester grade by tomorrow. In previous semesters the deadline used to be after I assigned the temp. mid-term grade but UB moved up the schedule since last year, which is why I uploaded a cruder mid-semester grade for now (because I have to upload something now).

mid-term grading

Edit good note 0

Updated 20 seconds ago by Atri Rudra

Please pay attention to instructions

note @206

stop following 1 view

Actions

Pay attention to submission requirements (for Q1+Q2)

When we say you will get a zero if you do not follow an instruction, it is NOT a gentle suggestion. So please make sure you pay attention to the warnings. E.g.:

! Submit part (a) and (b) separately

You need to submit **two (2) PDF** files to Autolab: one for part (a) and one for part (b). While you can assume part (a) as a given for part (b), to get credit for part (a) you have to submit your solution for part (a) separately from part (b).

Make sure you submit the correct PDF to the correct submission link on Autolab. If you do not (e.g. if you submit Q1(a) PDF to Q2(a) or even Q1(b)), then you will lose ALL points.

We recommend that you typeset your solution but we will accept scans of handwritten solution — you have to make sure that the scan is legible.

and this:

! PDF only please

If Autolab cannot display your file, (irrespective of the reason) then you will get a zero (0) on the entire question.

Autolab might not be able to display files in formats other than PDF (e.g. Word cannot be displayed). **Note that Autolab will "accept" your submission even if you submit non-PDF file, so it is YOUR responsibility to make sure you submit in the correct format.** However, after submission, Autolab will try and display your non-PDF submission and it should give an error message then. Also the file size has to be **at most 3MB**.

Overheard by a TA (in F19)..

I can't wait to be done with 331.....

then I can have a normal life again



Questions?

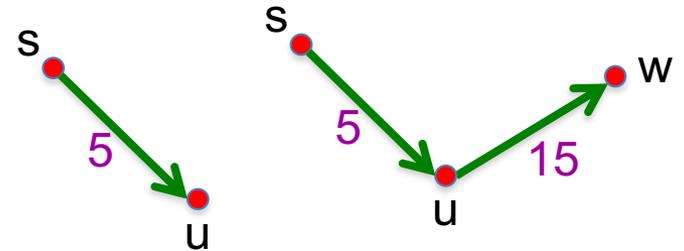
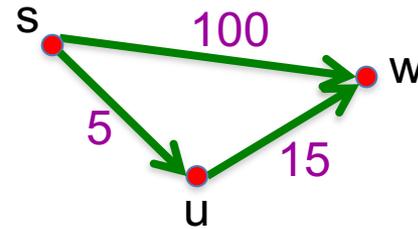


Shortest Path problem

Input: *Directed* graph $G=(V,E)$

Edge lengths, l_e for e in E

“start” vertex s in V

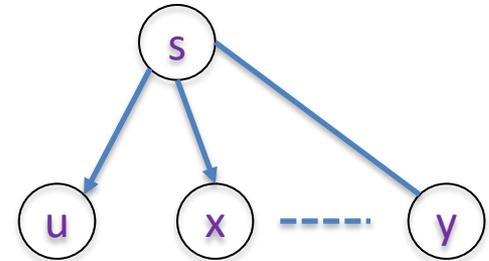


Output: Length of shortest paths from s to all nodes in V

Towards Dijkstra's algo: part ek

Determine $d(t)$ one by one

$$d(s) = 0$$



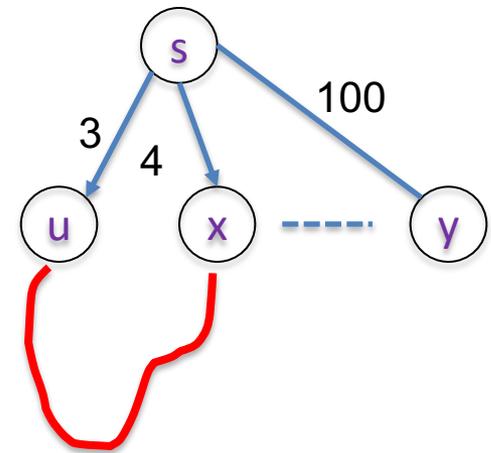
Towards Dijkstra's algo: part do

Determine $d(t)$ one by one

Let u be a neighbor of s with smallest $l_{(s,u)}$

$$d(u) = l_{(s,u)}$$

Not making any claim
on other vertices



Length of ~ is ≥ 0

Towards Dijkstra's algo: part teen

Determine $d(t)$ one by one

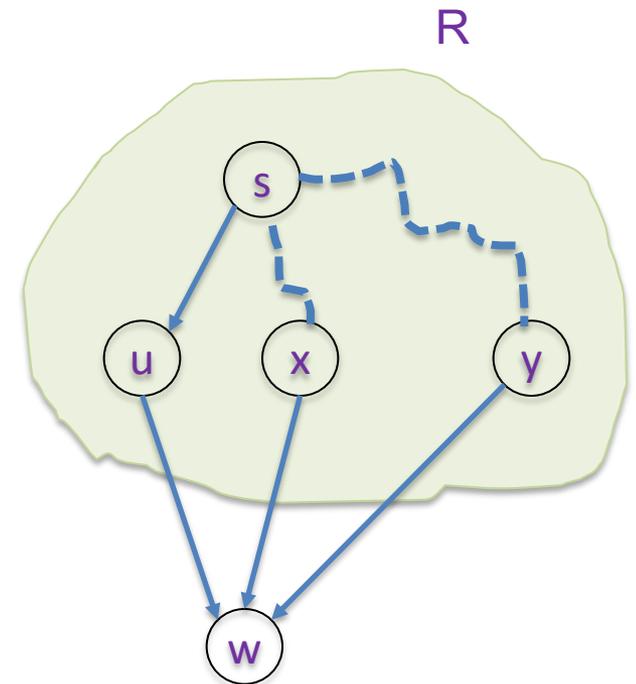
Assume we know $d(v)$ for every v in R

Compute an upper bound $d'(w)$ for every w not in R

$$d(w) \leq d(u) + l_{(u,w)}$$

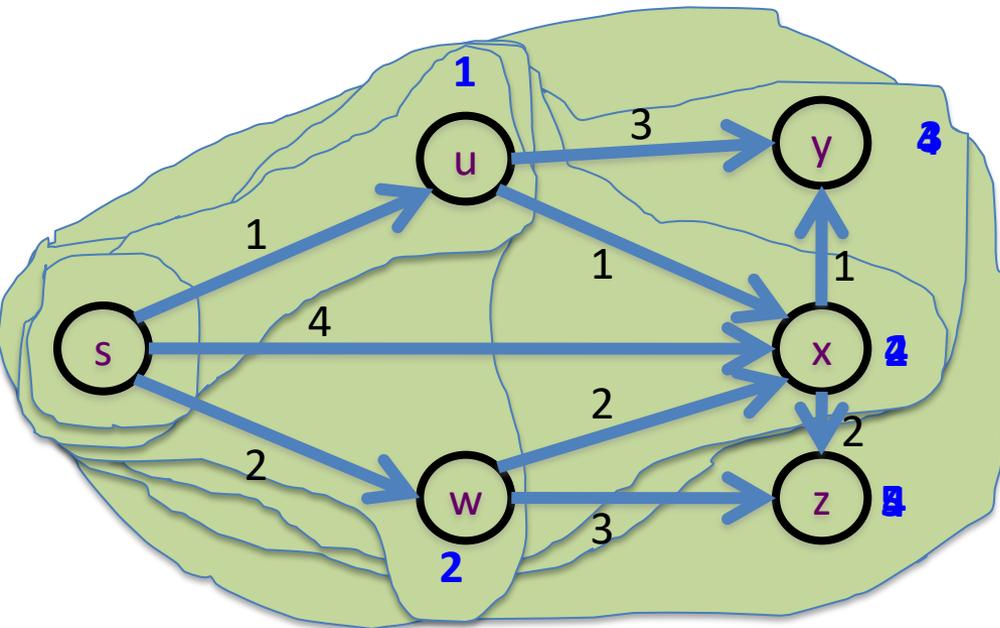
$$d(w) \leq d(x) + l_{(x,w)}$$

$$d(w) \leq d(y) + l_{(y,w)}$$



$$d'(w) = \min_{e=(u,w) \text{ in } E, u \text{ in } R} d(u) + l_e$$

Dijkstra's shortest path algorithm



$$d'(w) = \min_{e=(u,w) \in E, u \in R} d(u) + l_e$$

$d(s) = 0$ $d(u) = 1$
 $d(w) = 2$ $d(x) = 2$
 $d(y) = 3$ $d(z) = 4$

Input: Directed $G=(V,E)$, $l_e \geq 0$, $s \in V$

$R = \{s\}$, $d(s) = 0$

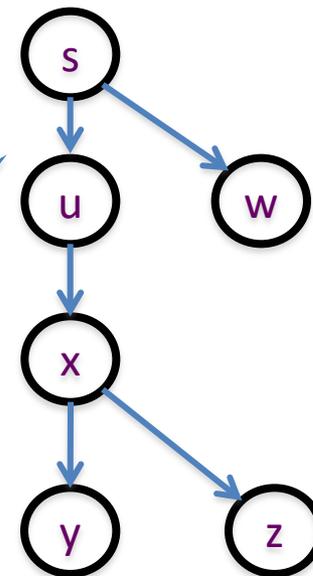
While there is a x not in R with $(u,x) \in E$, $u \in R$

Pick w that minimizes $d'(w)$

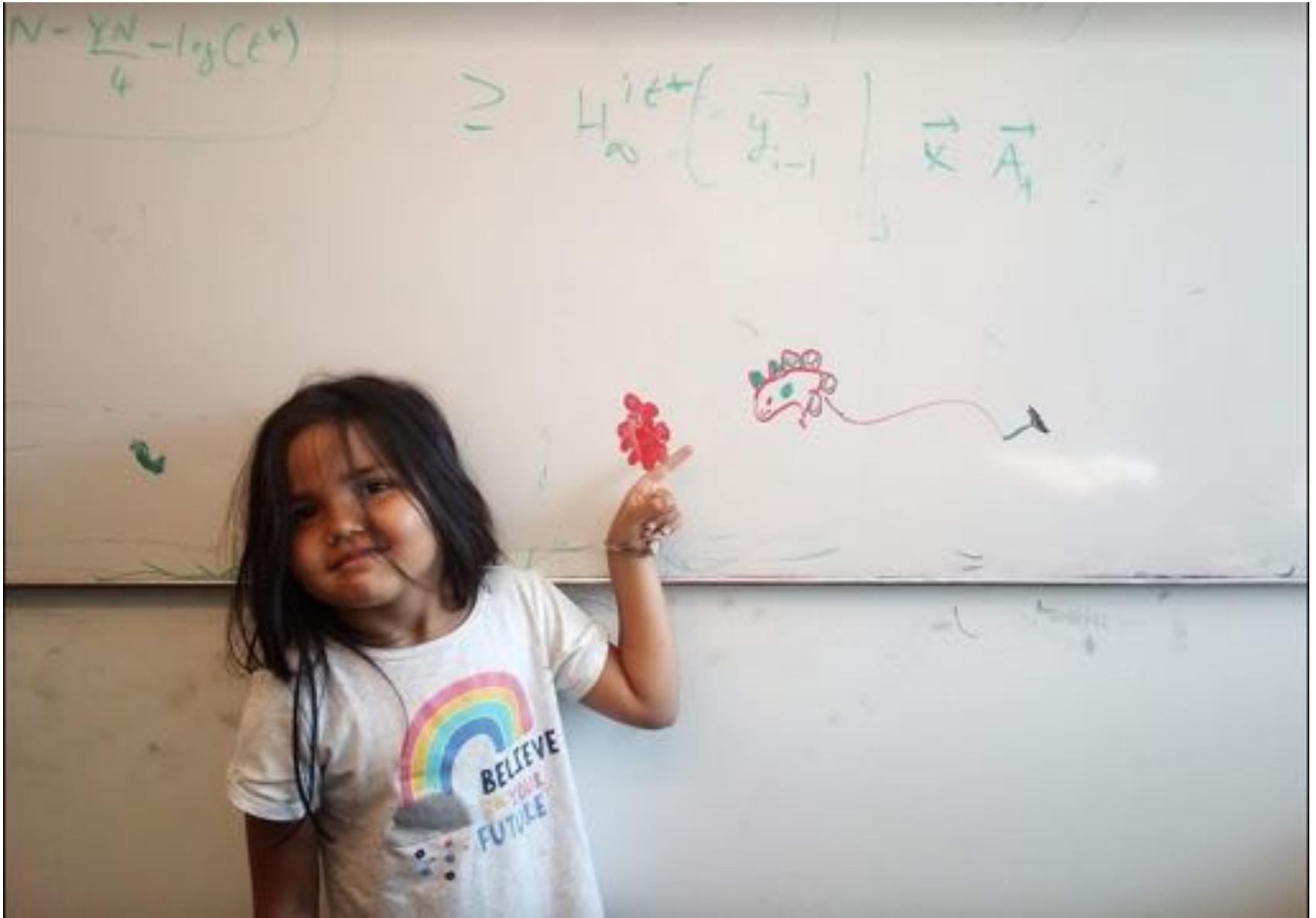
Add w to R

$d(w) = d'(w)$

Shortest paths



Questions/Comments?



Couple of remarks

The Dijkstra's algo does not explicitly compute the shortest paths

Can maintain “shortest path tree” separately

Dijkstra's algorithm does not work with **negative** weights

Left as an exercise

Rest of Today's agenda

Prove the correctness of Dijkstra's Algorithm

Dijkstra's shortest path algorithm

P_u shortest s - u path in "Dijkstra tree"

$$d'(w) = \min_{e=(u,w) \text{ in } E, u \text{ in } R} d(u) + l_e$$

Input: Directed $G=(V,E)$, $l_e \geq 0$, $s \text{ in } V$

$$R = \{s\}, d(s) = 0$$

While there is a x not in R with $(u,x) \text{ in } E, u \text{ in } R$

Pick w that minimizes $d'(w)$

Add w to R

$$d(w) = d'(w)$$

Lemma 1: At end of each iteration, if $u \text{ in } R$, then P_u is a shortest s - u path

Lemma 2: If u is connected to s , then $u \text{ in } R$ at the end

Proof idea of Lemma 1



Dijkstra's shortest path algorithm

$$d'(w) = \min_{e=(u,w) \text{ in } E, u \text{ in } R} d(u) + l_e$$

Input: Directed $G=(V,E)$, $l_e \geq 0$, $s \text{ in } V$

$R = \{s\}$, $d(s) = 0$

While there is a x not in R with $(u,x) \text{ in } E$, $u \text{ in } R$

Pick w that minimizes $d'(w)$

Add w to R

$d(w) = d'(w)$

At most n
iterations

$$\sum_{x \in V} O(\ln_x + 1) = O(m+n) \text{ time}$$

$O((m+n)n)$ time bound is trivial

$O((m+n) \log n)$ time implementation with priority Q

Reading Assignment

Sec 4.4 of [KT]

