Lecture 19

CSE 331

Oct 16, 2024

HW 4 out

Overall easiest HW of the semester!

Homework 4

Due by **11:30pm, Tuesday, October 22, 2024**.

Make sure you follow all the homework policies.

All submissions should be done via Autolab.

The care package on minimizing the maximum lateness problem would be useful for Q3 and *might* be useful for Q2(b) as well.

Question 1 (High Speed Internet) [50 points]

The Problem

We come back to the issue of many USA regions not having high speed internet. In this question, you will consider an algorithmic problem that you would need to solve to help out a (fictional) place get high speed Internet.

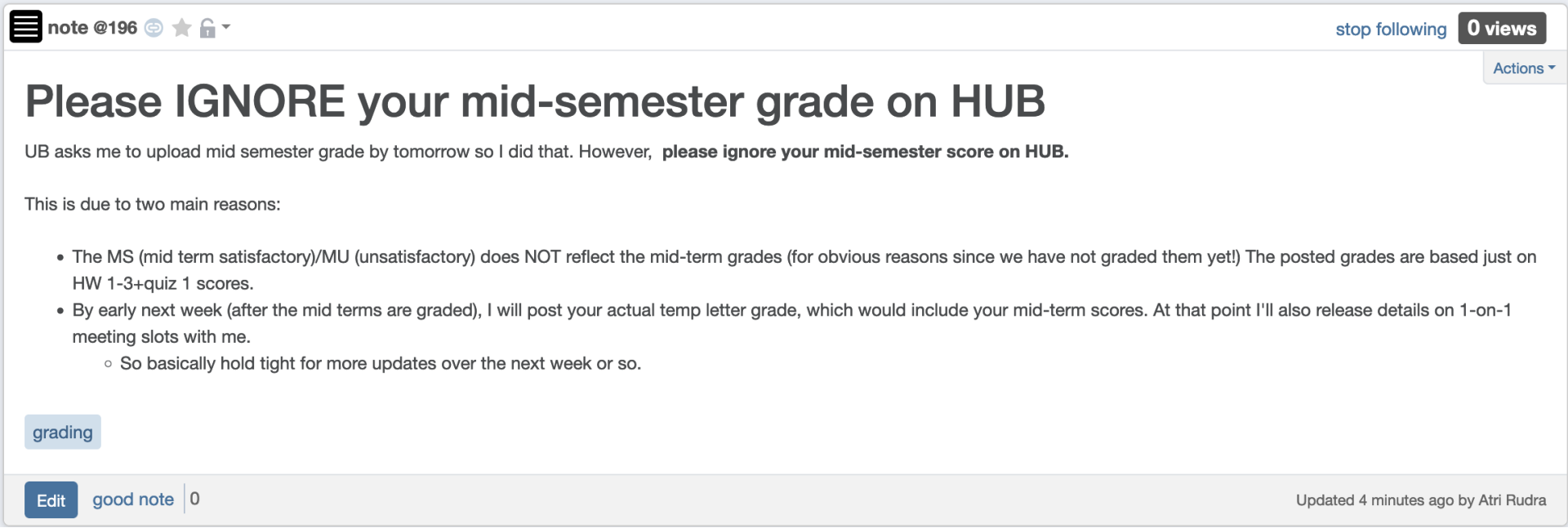
You are the algorithms whiz in the effort to bring high speed Internet to `SomePlaceInUSA`. After lots of rounds of discussions and public feedback, it was decided that the most cost-effective way to bring high speed internet to `SomePlaceInUSA` was to install high speed cell towers to connect all houses in `SomePlaceInUSA` to high speed internet. There are two things in your favor:

1. It just so happens that all of the n houses in `SomePlaceInUSA` are on the side of a straight road that runs through the town.
2. The above implies that you only need cell towers that only need to broadcast their signal in a narrow range, which means one cell tower can provide high speed internet access to all houses within 100 miles *ahead* (rather than the usual 45 mile range) on the road from its location (we are assuming that these cell towers will be on the side of the road). These cell towers are unidirectional so they can provide connection to only houses that are ahead of it.

Grading timeline

Mid terms should hopefully be handed back by tomorrow

Ignore HUB mid-semester grade



Your actual mid-term letter grade

note @195 stop following 1 view

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:

- Our goal is to be able to finishing grading (both the) mid-terms by Thursday (or so).
  - 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 HWs1-3, 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.
    - But as a heads up, the temporary letter grades will be curved (except for A) but since only 3 HWs have been graded, I will not be dropping the two lowest Q1/Q2/Q3 scores (as I will with the letter grade at the end of the semester). Again, more details forthcoming over the next week.
  - Note that this will *not* be the same as the mid-semester grade that I submitted to HUB @196.
- 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 (<=10 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 slots.

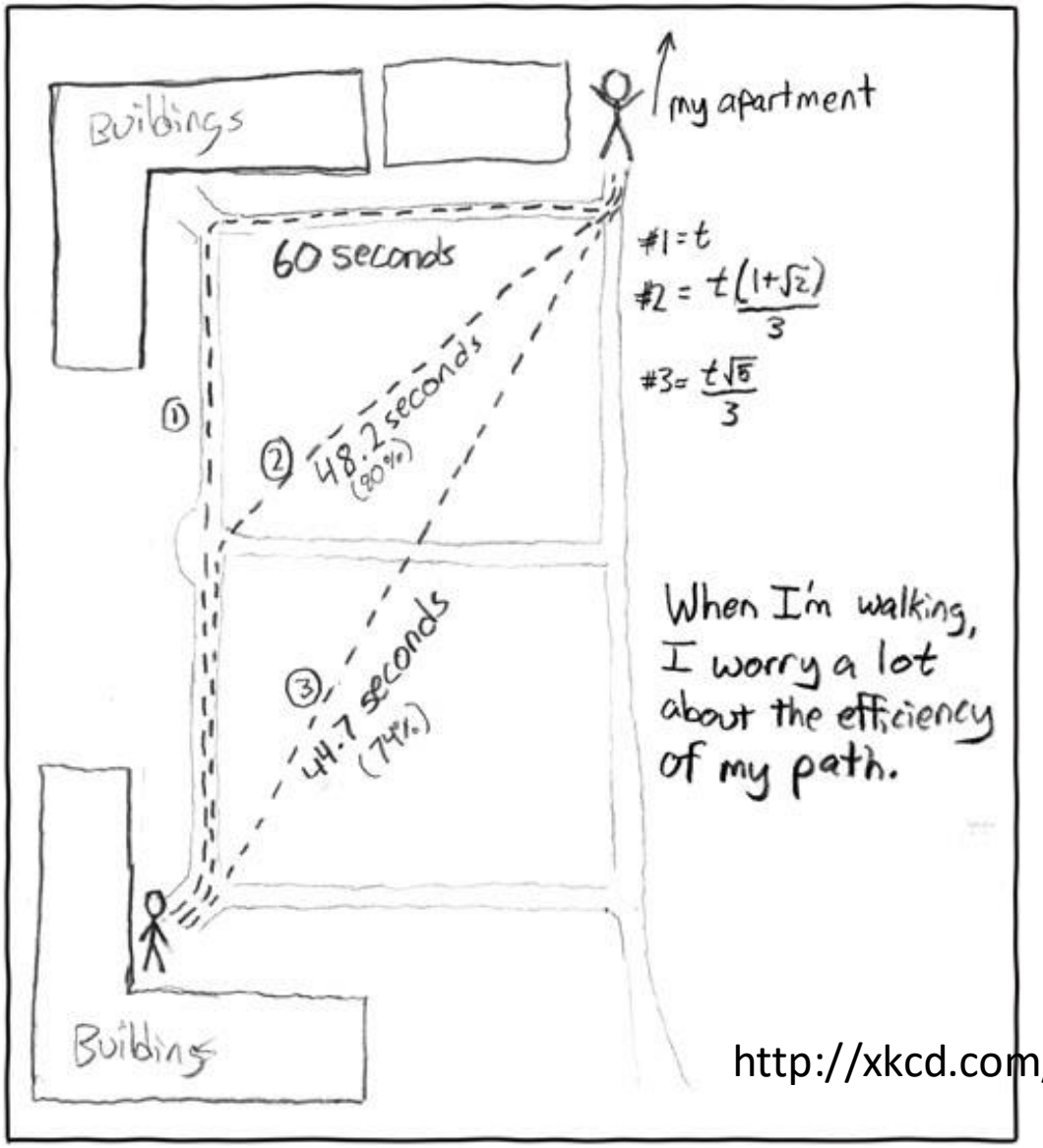
mid-term grading

Edit good note 0

Updated 1 minute ago by Atri Rudra

Questions?

Shortest Path Problem



http://xkcd.com/85/

Another more important application

Is BGP a known acronym for you?

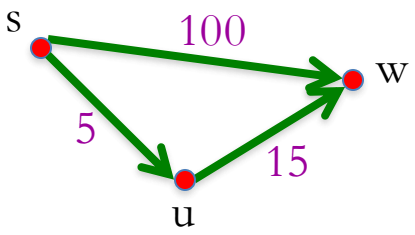
Routing uses shortest path algorithm

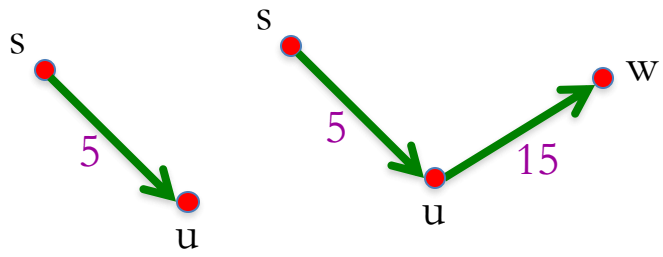
Shortest Path problem

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

Edge lengths, l_e for e in E

"start" vertex s in V

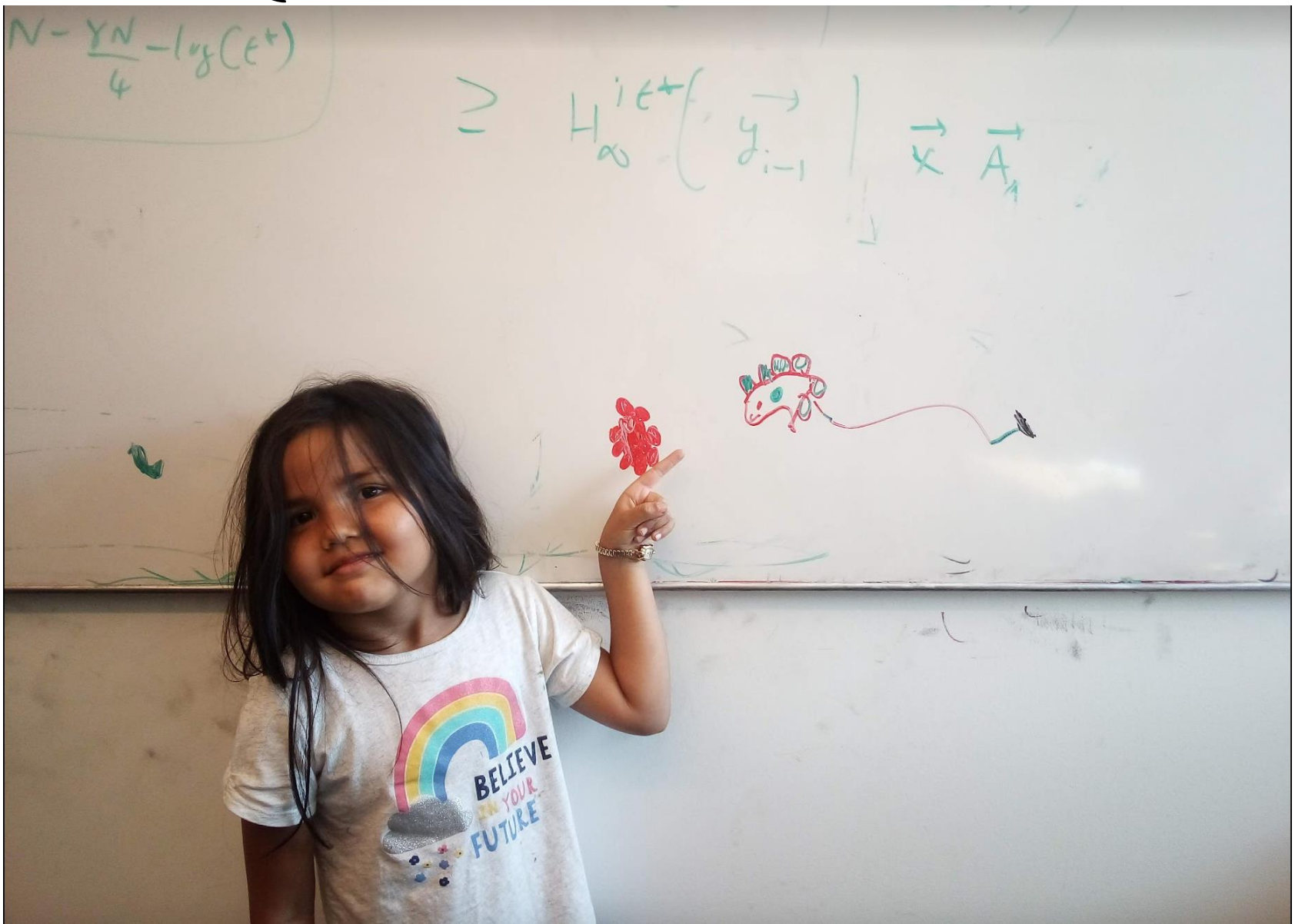




Output: Length of shortest paths from s to all nodes in V

Dijkstra's shortest path algorithm

Questions/Comments?

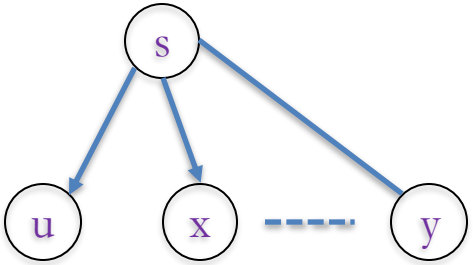


Finish reduction on the board…

Towards Dijkstra's algo: part ek

Determine $d(t)$ one by one

$$d(s) = 0$$

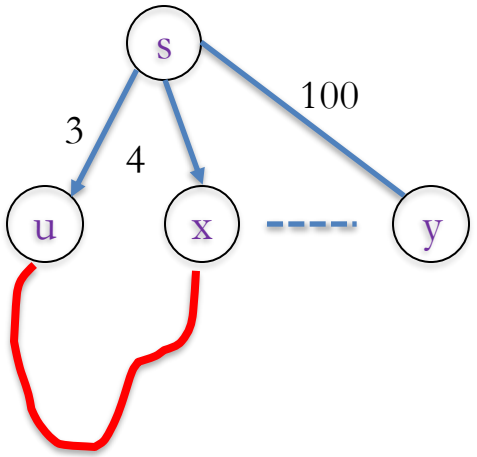


Towards Dijkstra's algo: part do

Determine d(t) one by one

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

$$d(u) = \ell_{(s,u)}$$



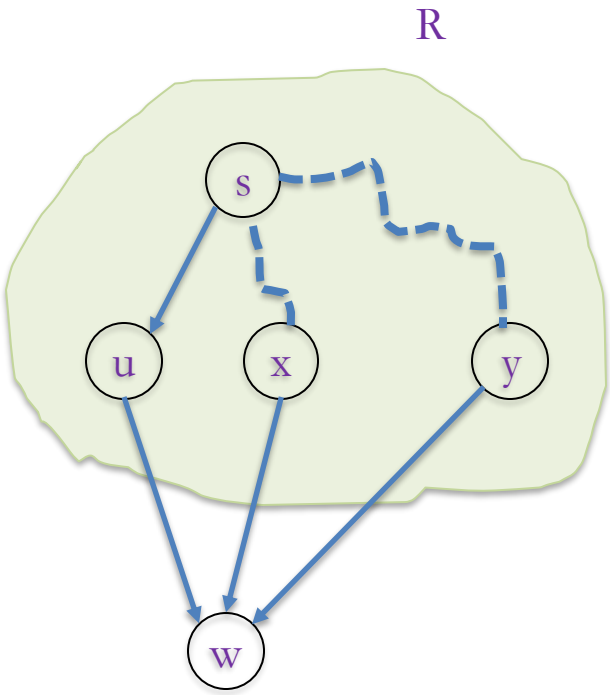
Length of ~ is ≥ 0

Not making any claim on other vertices

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

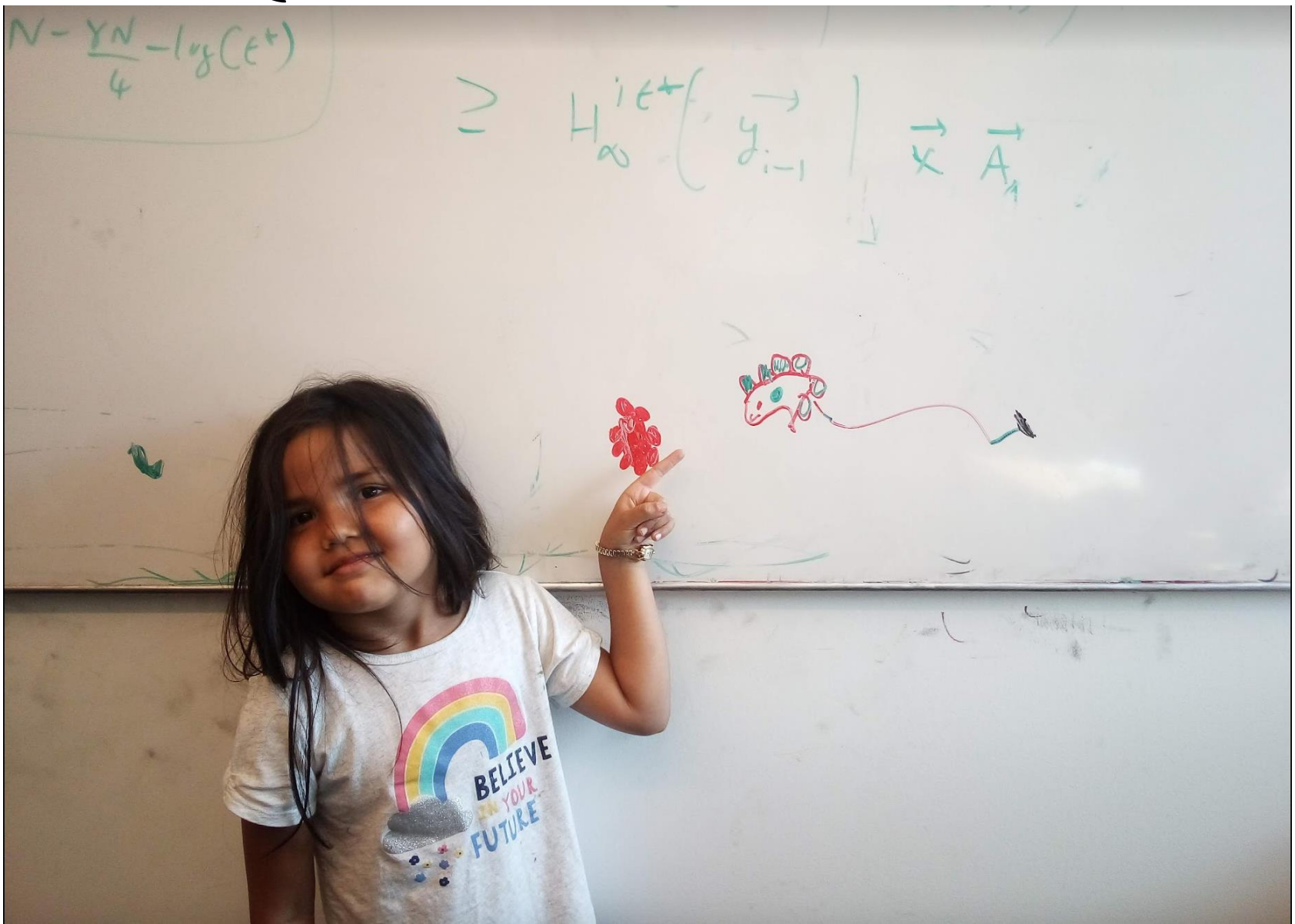
$$d(w) \leq d(u) + \ell_{(u,w)}$$

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

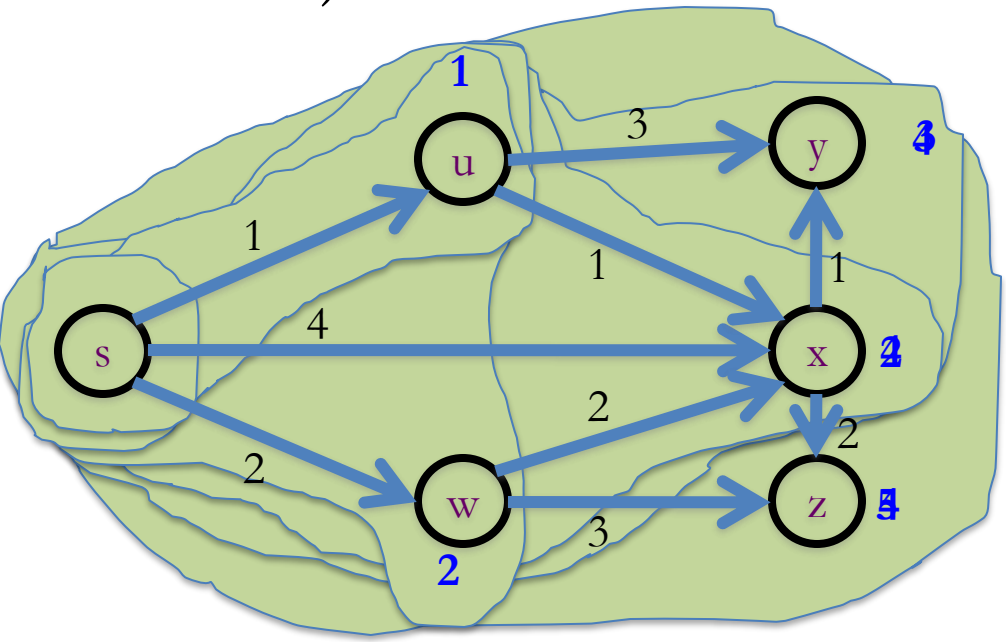
$$d(w) \leq d(y) + \ell_{(y,w)}$$

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

Questions/Comments?



Dijkstra's shortest path algorithm



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

d(s) = 0 d(u) = 1

d(w) = 2 d(x) = 2

d(y) = 3 d(z) = 4

Input: Directed G=(V,E), $\ell_e \geq 0$, 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