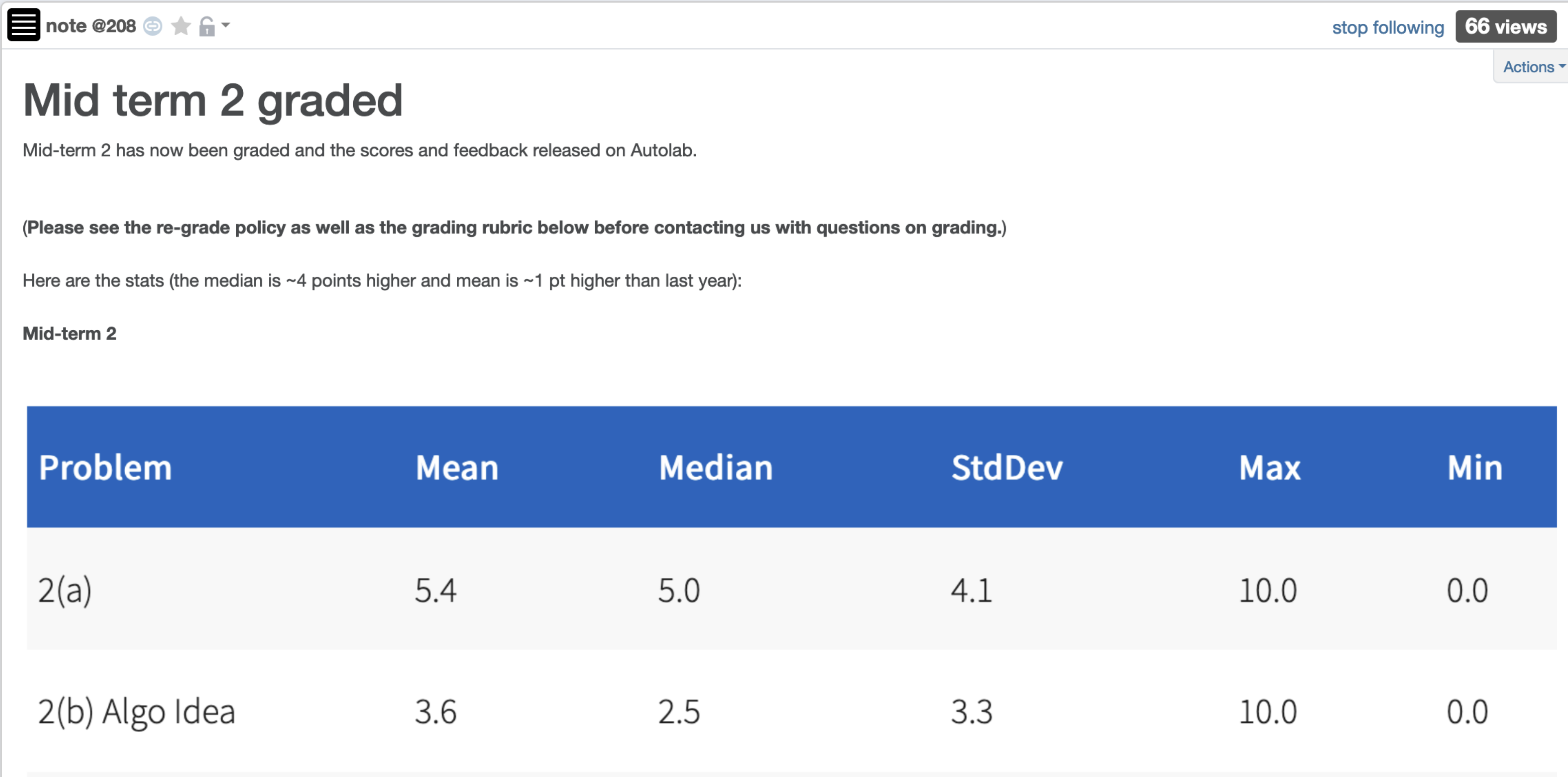
Lecture 21

CSE 331

Oct 21, 2024

Mid-term 2 graded



Mid term 2 graded

Mid-term 2 has now been graded and the scores and feedback released on Autolab.

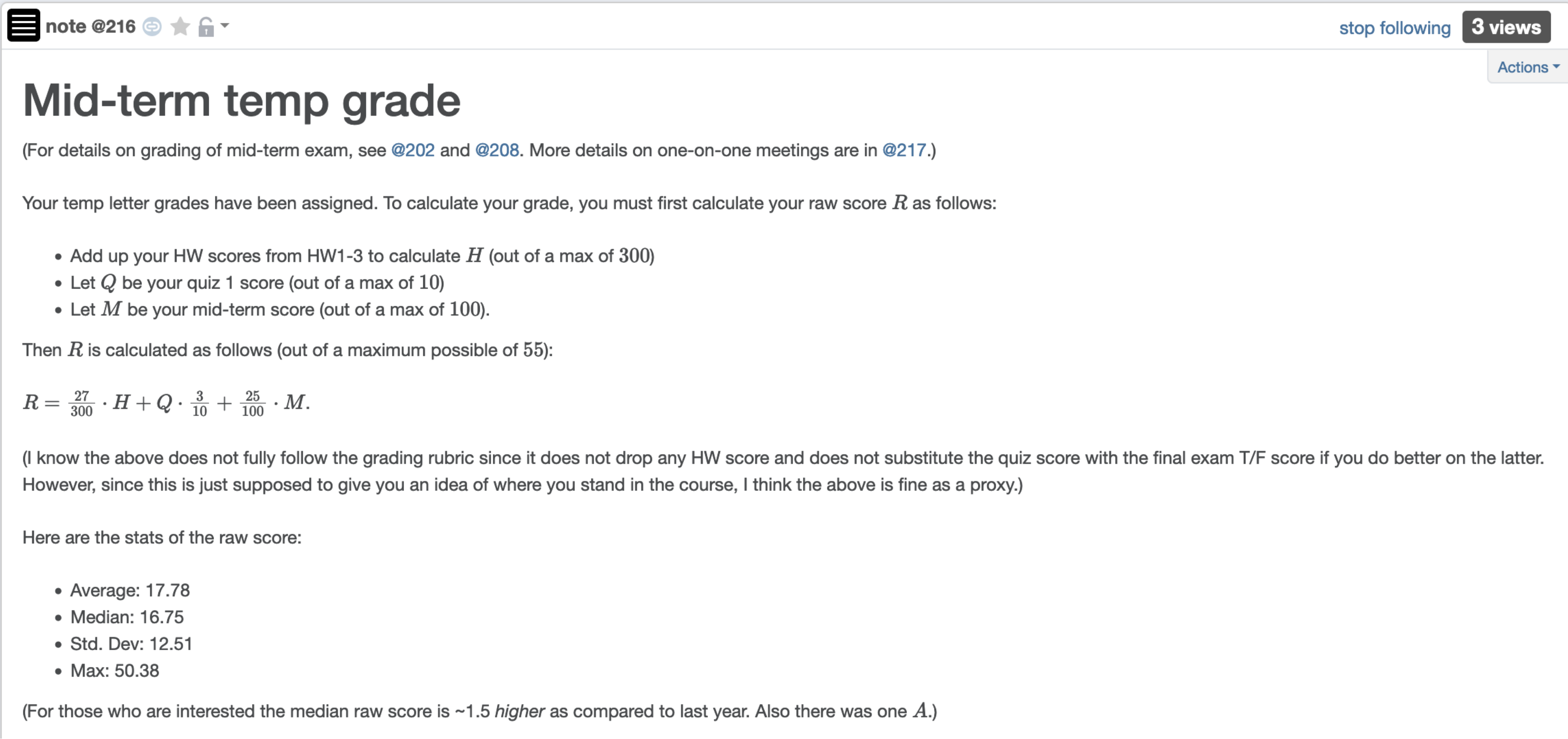
(Please see the re-grade policy as well as the grading rubric below before contacting us with questions on grading.)

Here are the stats (the median is ~4 points higher and mean is ~1 pt higher than last year):

Mid-term 2

Problem	Mean	Median	StdDev	Max	Min
2(a)	5.4	5.0	4.1	10.0	0.0
2(b) Algo Idea	3.6	2.5	3.3	10.0	0.0

Temp mid-term grade assigned



Mid-term temp grade

(For details on grading of mid-term exam, see @202 and @208. More details on one-on-one meetings are in @217.)

Your temp letter grades have been assigned. To calculate your grade, you must first calculate your raw score R as follows:

- Add up your HW scores from HW1-3 to calculate H (out of a max of 300)
- Let Q be your quiz 1 score (out of a max of 10)
- Let M be your mid-term score (out of a max of 100).

Then R is calculated as follows (out of a maximum possible of 55):

$$R = \frac{27}{300} \cdot H + Q \cdot \frac{3}{10} + \frac{25}{100} \cdot M.$$

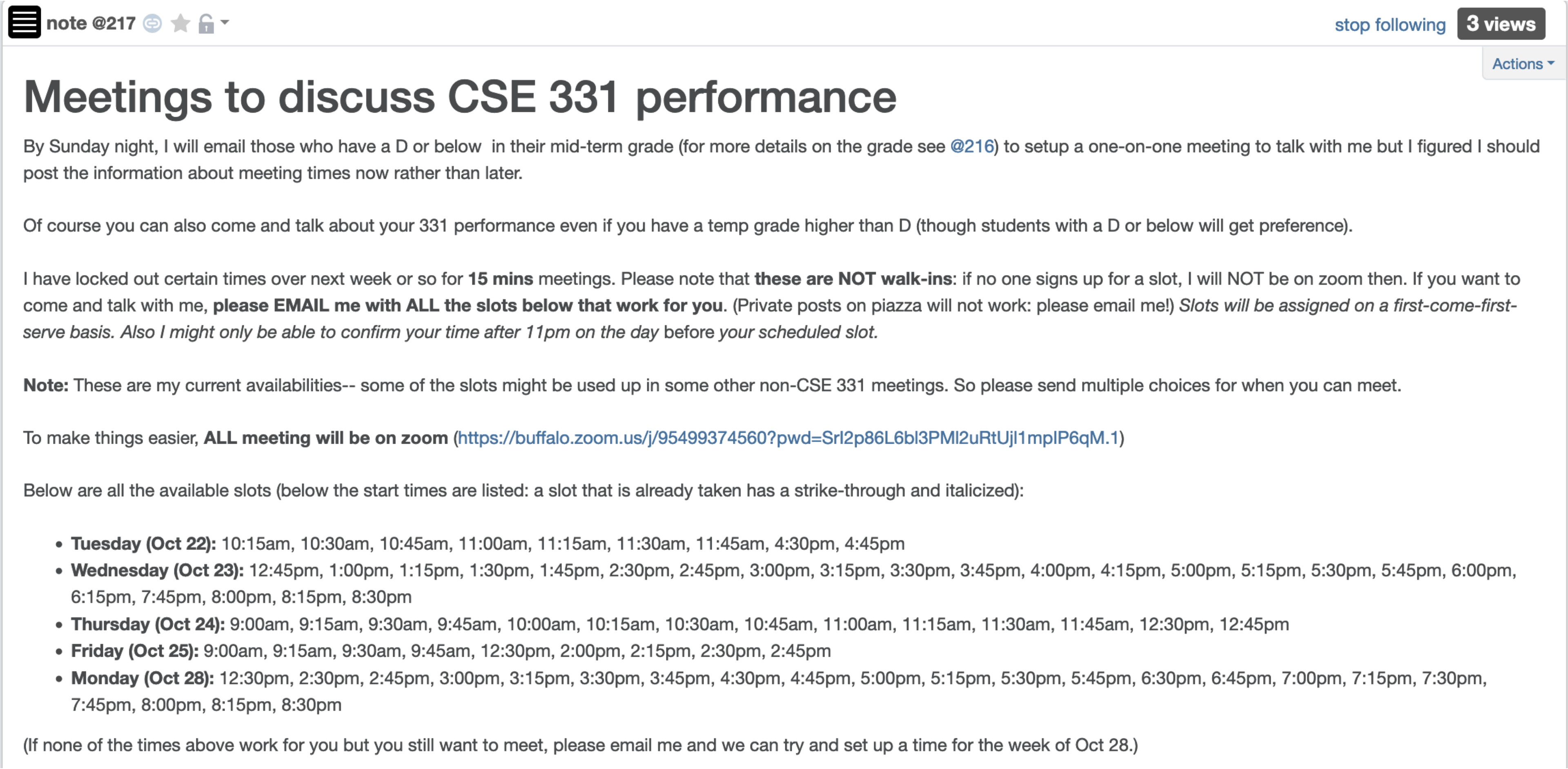
(I know the above does not fully follow the grading rubric since it does not drop any HW score and does not substitute the quiz score with the final exam T/F score if you do better on the latter. However, since this is just supposed to give you an idea of where you stand in the course, I think the above is fine as a proxy.)

Here are the stats of the raw score:

- Average: 17.78
- Median: 16.75
- Std. Dev: 12.51
- Max: 50.38

(For those who are interested the median raw score is ~1.5 *higher* as compared to last year. Also there was one A.)

Details on 1-on-1 meetings



Meetings to discuss CSE 331 performance

By Sunday night, I will email those who have a D or below in their mid-term grade (for more details on the grade see @216) to setup a one-on-one meeting to talk with me but I figured I should post the information about meeting times now rather than later.

Of course you can also come and talk about your 331 performance even if you have a temp grade higher than D (though students with a D or below will get preference).

I have locked out certain times over next week or so for **15 mins** meetings. Please note that **these are NOT walk-ins**: if no one signs up for a slot, I will NOT be on zoom then. If you want to come and talk with me, **please EMAIL me with ALL the slots below that work for you**. (Private posts on piazza will not work: please email me!) *Slots will be assigned on a first-come-first-serve basis. Also I might only be able to confirm your time after 11pm on the day* before *your scheduled slot.*

Note: These are my current availabilities-- some of the slots might be used up in some other non-CSE 331 meetings. So please send multiple choices for when you can meet.

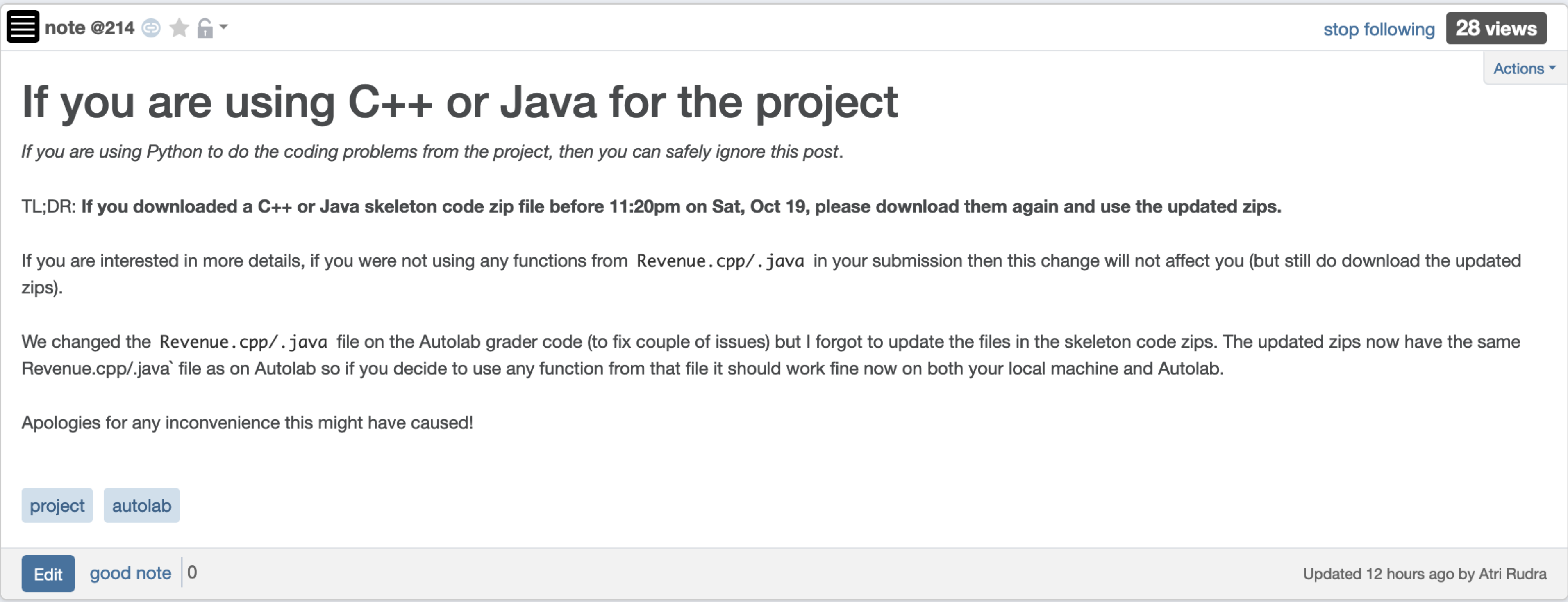
To make things easier, **ALL meeting will be on zoom** (https://buffalo.zoom.us/j/95499374560?pwd=Srl2p86L6bl3PMl2uRtUjl1mplP6qM.1)

Below are all the available slots (below the start times are listed: a slot that is already taken has a strike-through and italicized):

- **Tuesday (Oct 22):** 10:15am, 10:30am, 10:45am, 11:00am, 11:15am, 11:30am, 11:45am, 4:30pm, 4:45pm
- **Wednesday (Oct 23):** 12:45pm, 1:00pm, 1:15pm, 1:30pm, 1:45pm, 2:30pm, 2:45pm, 3:00pm, 3:15pm, 3:30pm, 3:45pm, 4:00pm, 4:15pm, 5:00pm, 5:15pm, 5:30pm, 5:45pm, 6:00pm, 6:15pm, 7:45pm, 8:00pm, 8:15pm, 8:30pm
- **Thursday (Oct 24):** 9:00am, 9:15am, 9:30am, 9:45am, 10:00am, 10:15am, 10:30am, 10:45am, 11:00am, 11:15am, 11:30am, 11:45am, 12:30pm, 12:45pm
- **Friday (Oct 25):** 9:00am, 9:15am, 9:30am, 9:45am, 12:30pm, 2:00pm, 2:15pm, 2:30pm, 2:45pm
- **Monday (Oct 28):** 12:30pm, 2:30pm, 2:45pm, 3:00pm, 3:15pm, 3:30pm, 3:45pm, 4:30pm, 4:45pm, 5:00pm, 5:15pm, 5:30pm, 5:45pm, 6:30pm, 6:45pm, 7:00pm, 7:15pm, 7:30pm, 7:45pm, 8:00pm, 8:15pm, 8:30pm

(If none of the times above work for you but you still want to meet, please email me and we can try and set up a time for the week of Oct 28.)

C++/Java project zips



If you are using C++ or Java for the project

If you are using Python to do the coding problems from the project, then you can safely ignore this post.

TL;DR: **If you downloaded a C++ or Java skeleton code zip file before 11:20pm on Sat, Oct 19, please download them again and use the updated zips.**

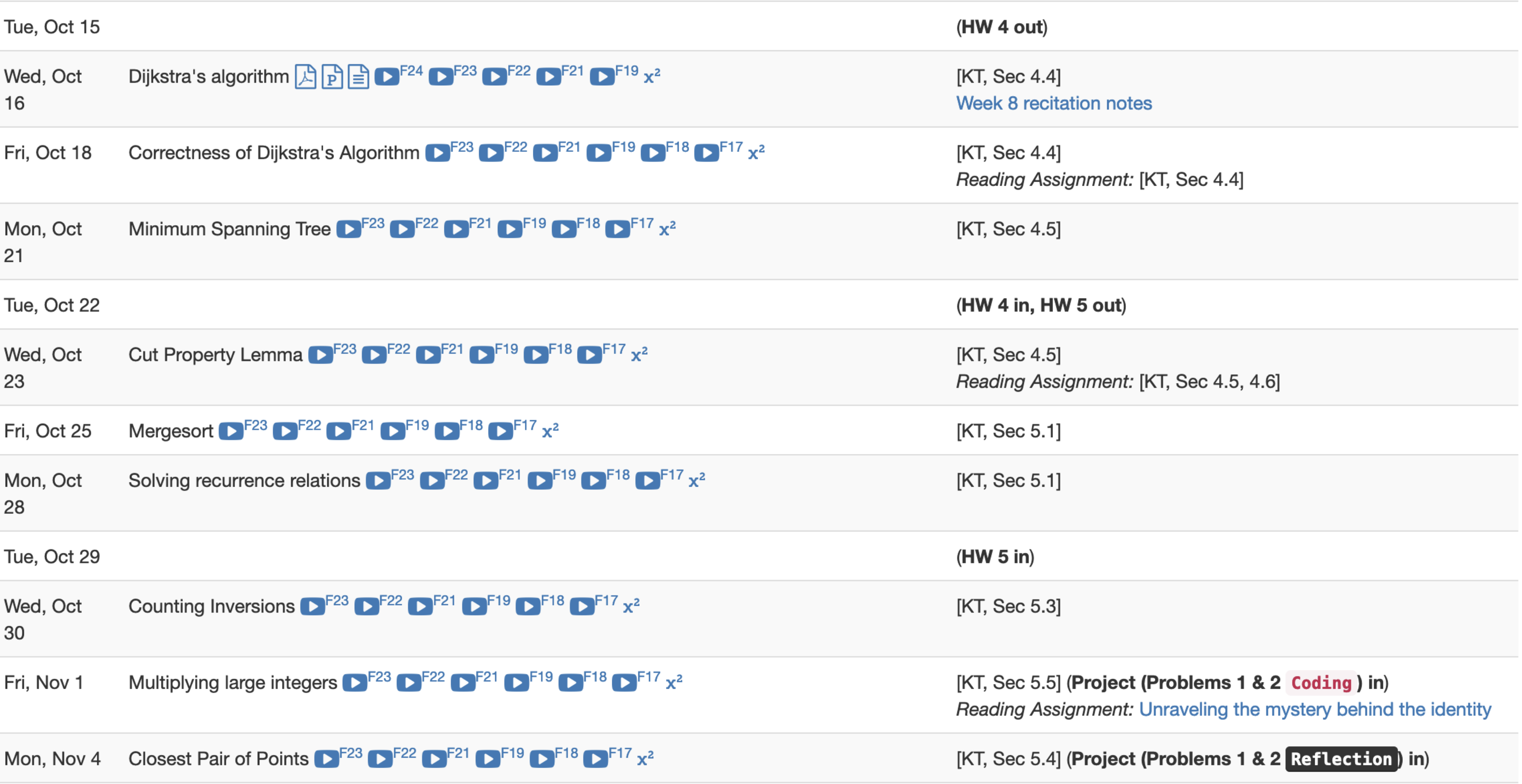
If you are interested in more details, if you were not using any functions from `Revenue.cpp/.java` in your submission then this change will not affect you (but still do download the updated zips).

We changed the `Revenue.cpp/.java` file on the Autolab grader code (to fix couple of issues) but I forgot to update the files in the skeleton code zips. The updated zips now have the same Revenue.cpp/.java` file as on Autolab so if you decide to use any function from that file it should work fine now on both your local machine and Autolab.

Apologies for any inconvenience this might have caused!

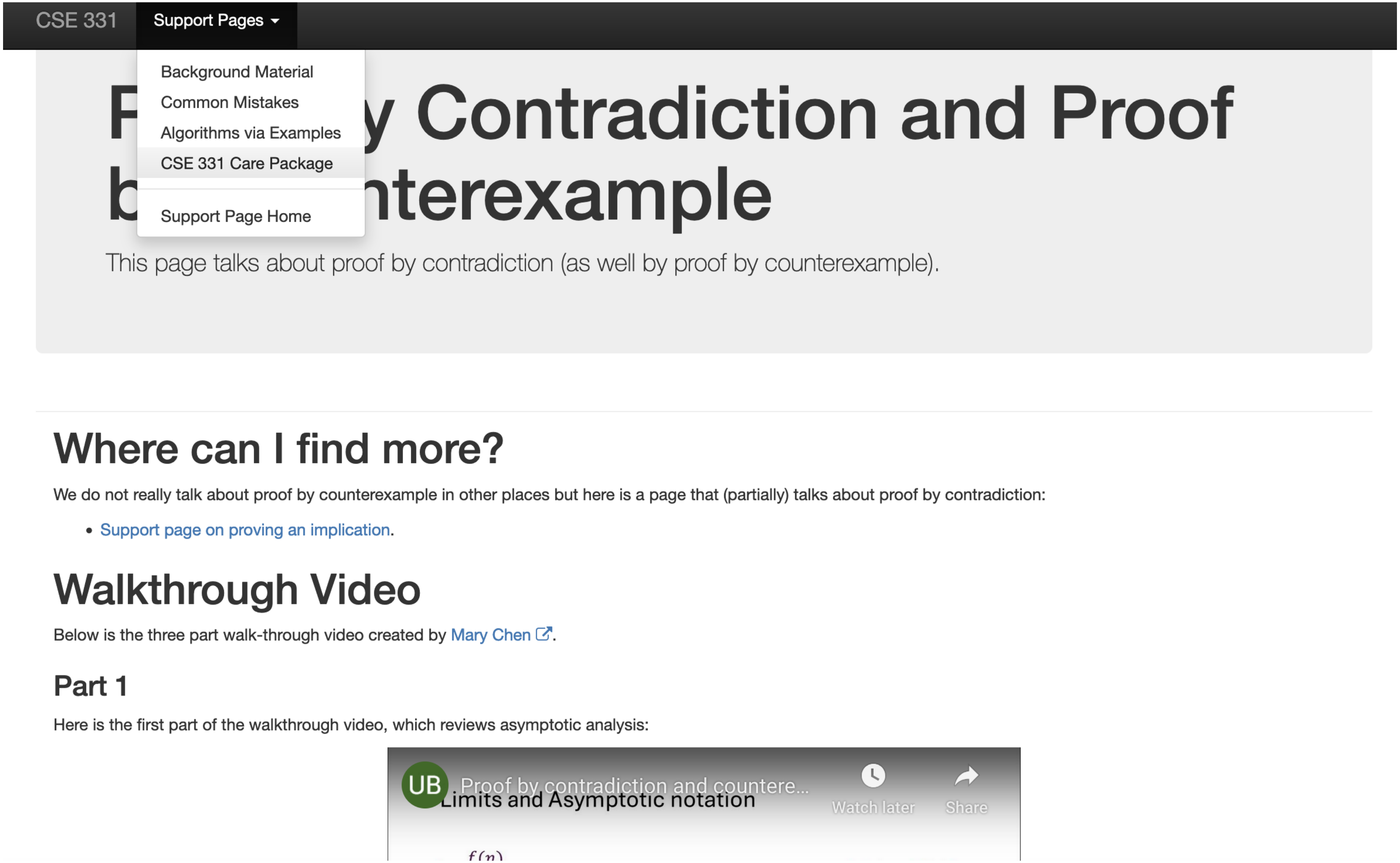
Updated 12 hours ago by Atri Rudra

Project deadlines coming up



Tue, Oct 15		**(HW 4 out)**
Wed, Oct 16	Dijkstra's algorithm 📄 P 📄 ▶F24 ▶F23 ▶F22 ▶F21 ▶F19 x^2	[KT, Sec 4.4] Week 8 recitation notes
Fri, Oct 18	Correctness of Dijkstra's Algorithm ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 4.4] *Reading Assignment:* [KT, Sec 4.4]
Mon, Oct 21	Minimum Spanning Tree ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 4.5]
Tue, Oct 22		**(HW 4 in, HW 5 out)**
Wed, Oct 23	Cut Property Lemma ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 4.5] *Reading Assignment:* [KT, Sec 4.5, 4.6]
Fri, Oct 25	Mergesort ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 5.1]
Mon, Oct 28	Solving recurrence relations ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 5.1]
Tue, Oct 29		**(HW 5 in)**
Wed, Oct 30	Counting Inversions ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 5.3]
Fri, Nov 1	Multiplying large integers ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 5.5] **(Project (Problems 1 & 2 `Coding`) in)** *Reading Assignment:* Unraveling the mystery behind the identity
Mon, Nov 4	Closest Pair of Points ▶F23 ▶F22 ▶F21 ▶F19 ▶F18 ▶F17 x^2	[KT, Sec 5.4] **(Project (Problems 1 & 2 `Reflection`) in)**

New walkthrough videos up



F y Contradiction and Proof b nterexample

This page talks about proof by contradiction (as well by proof by counterexample).

Where can I find more?

We do not really talk about proof by counterexample in other places but here is a page that (partially) talks about proof by contradiction:

- Support page on proving an implication.

Walkthrough Video

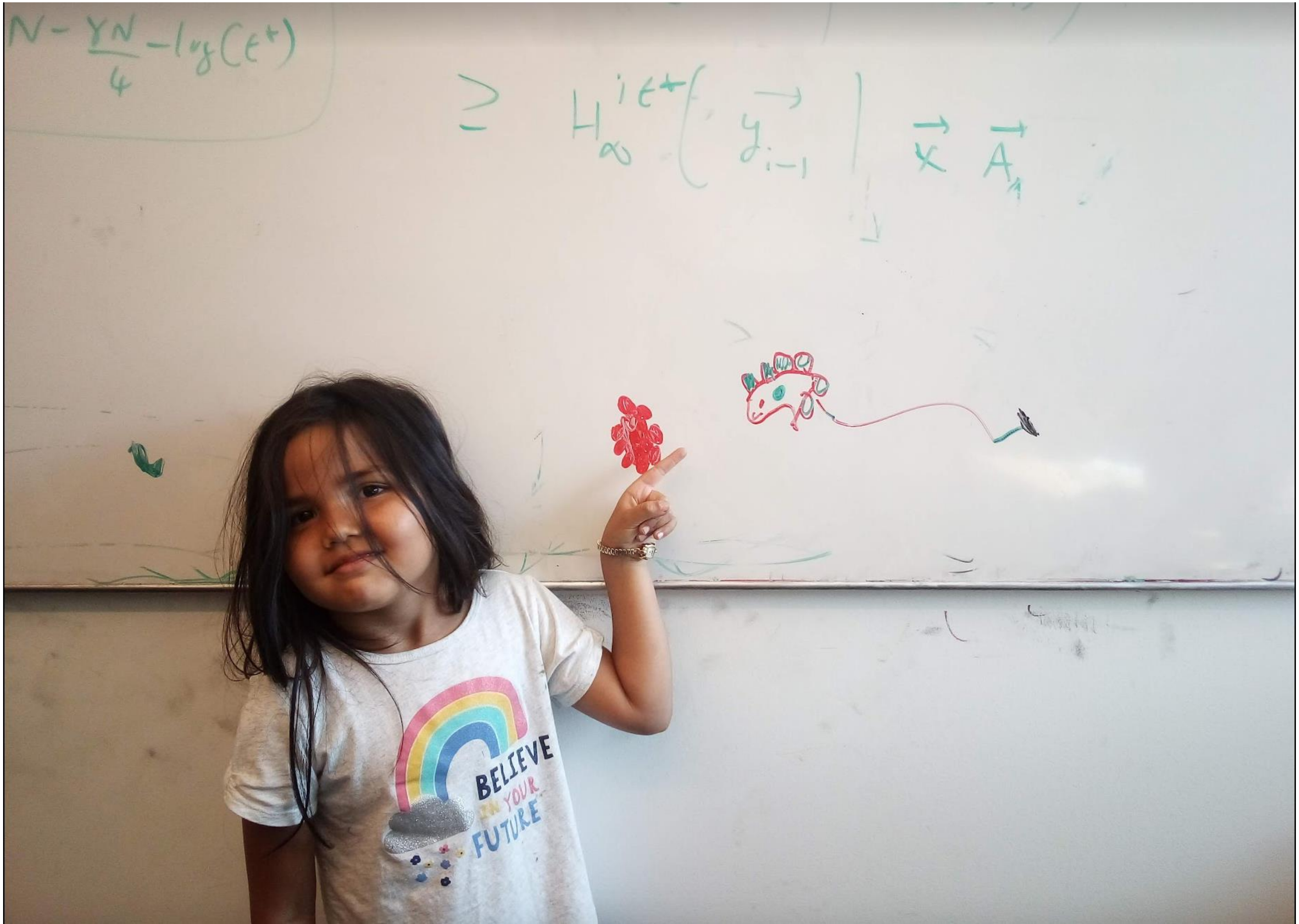
Below is the three part walk-through video created by Mary Chen.

Part 1

Here is the first part of the walkthrough video, which reviews asymptotic analysis:

UB
Proof by contradiction and countere...
Limits and Asymptotic notation
Watch later
Share
$f(n)$

Questions/Comments?



Dijkstra's shortest path algorithm

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

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 $R$
    $d(w) = d'(w)$
```

At most n iterations

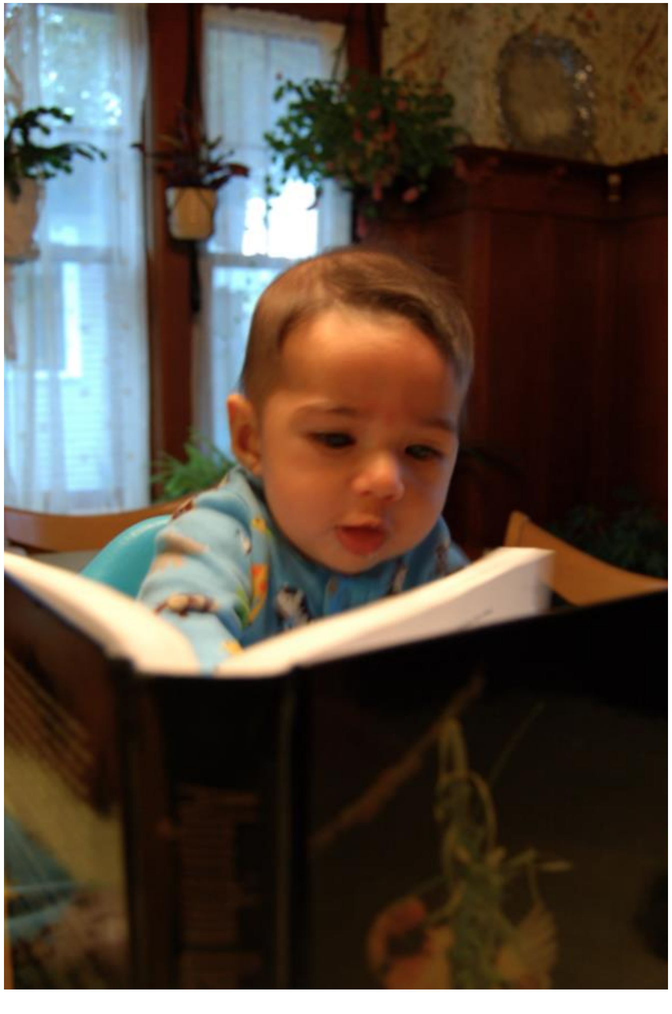
$\Sigma_{x \in V} O(In_x+1)$
$=O(m+n)$ time

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

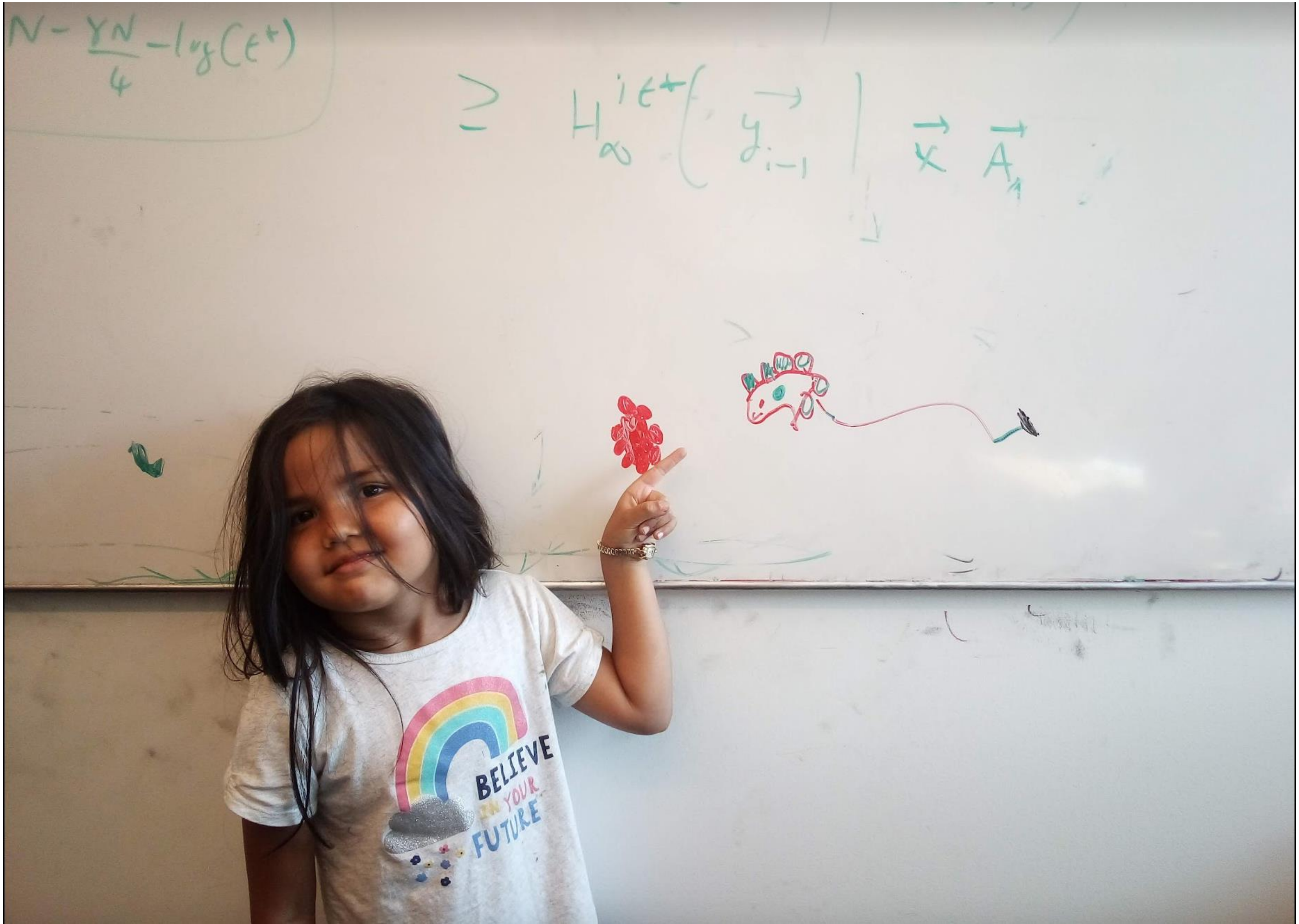
$O((m+n) \log n)$ time implementation with priority Q

Reading Assignment

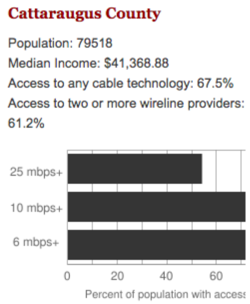
Sec 4.4 of [KT]



Questions/Comments?



Make broadband more available



Cattaraugus County

Population: 79518

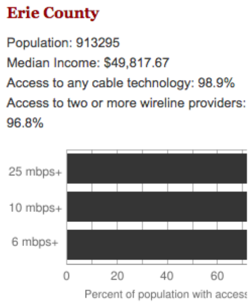
Median Income: $41,368.88

Access to any cable technology: 67.5%

Access to two or more wireline providers: 61.2%

BOTH
technical and
societal issues

Say you are tasked
to come up with
the infrastructure



Erie County

Population: 913295

Median Income: $49,817.67

Access to any cable technology: 98.9%

Access to two or more wireline providers: 96.8%

Building a fiber network

Lay down fibers to connect n locations

All n locations should be connected

Laying down a fiber costs money

What is the cheapest way to lay down the fibers?

Today’s agenda

Minimum Spanning Tree (MST) Problem

Greedy algorithm(s) for MST problem

On to the board…

Minimum Spanning Tree Problem

Input: Undirected, connected $G = (V,E)$, edge costs c_e

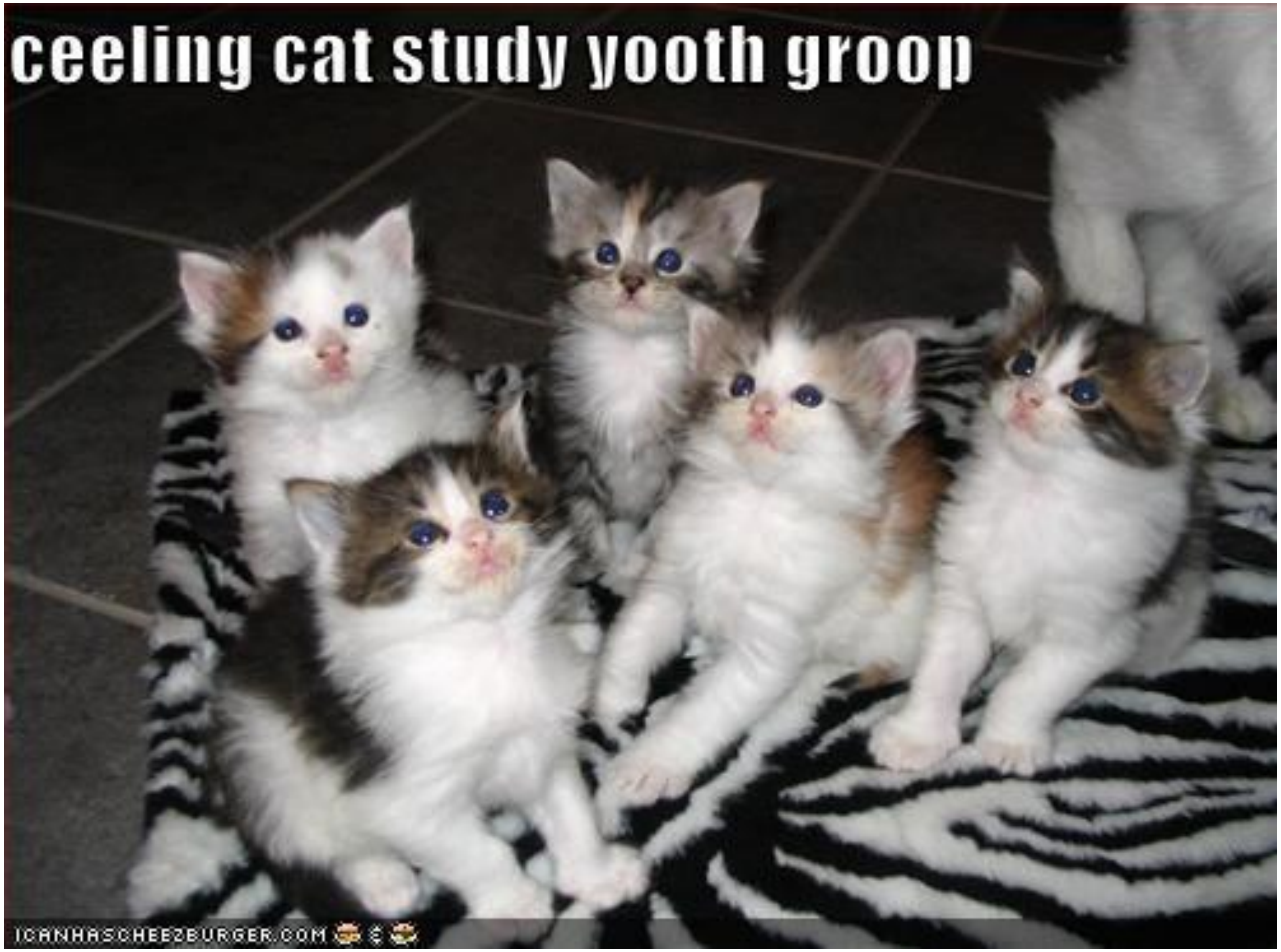
Output: Subset $E' \subseteq E$, s.t. $T = (V,E')$ is connected
$C(T)$ is minimized

If all $c_e > 0$, then T is indeed a tree

Rest of today's agenda

Greedy algorithm(s) for MST problem

Discuss: Greedy algorithm!



Kruskal’s Algorithm

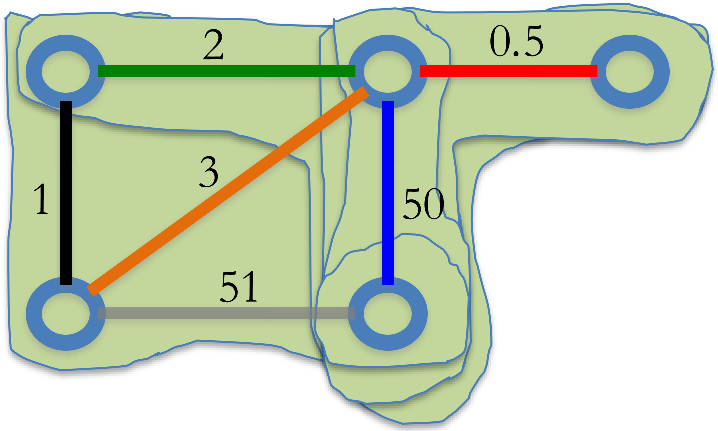
Joseph B. Kruskal

Input: $G=(V,E)$, $c_e > 0$ for every e in E

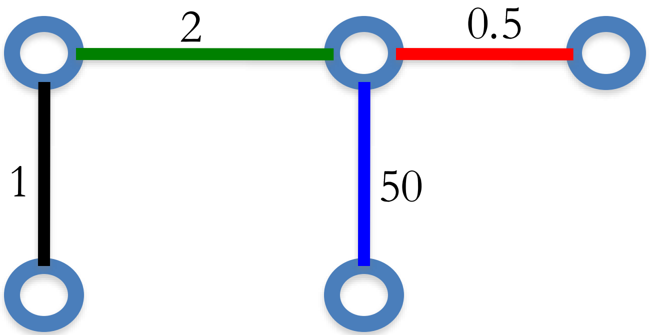
```
$T = \emptyset$
Sort edges in increasing order of their cost
Consider edges in sorted order
    If an edge can be added to $T$ without adding a cycle then add it to $T$
```

Prim's algorithm

Similar to Dijkstra' s algorithm



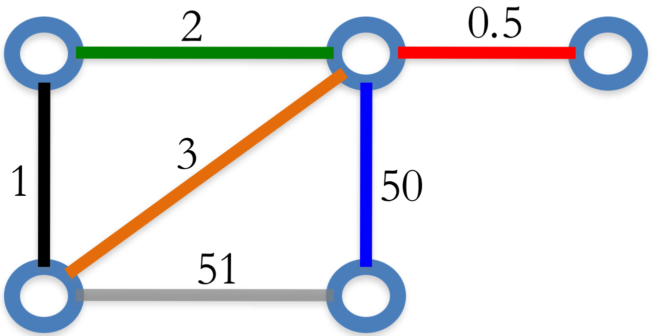
Robert Prim



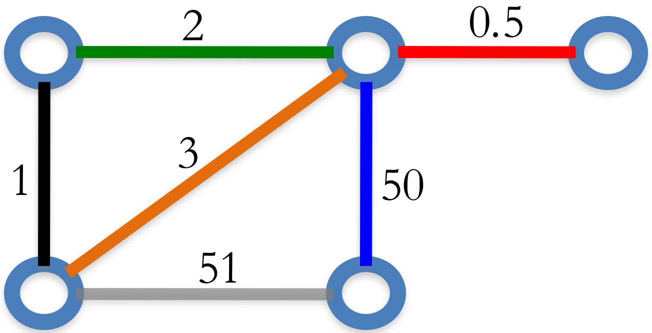
Input: $G=(V,E)$, $c_e > 0$ for every e in E

```
$S = \{s\}$, $T = \emptyset$

While $S$ is not the same as $V$

    Among edges $e= (u,w)$ with $u$ in $S$ and $w$ not in $S$, pick one with minimum cost

    Add $w$ to $S$, $e$ to $T$
```

Reverse-Delete Algorithm



Input: $G=(V,E)$, $c_e > 0$ for every e in E

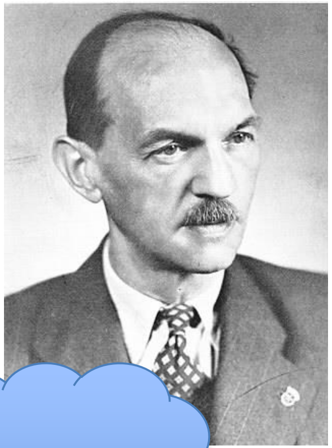


```
T = E

Sort edges in decreasing order of their cost

Consider edges in sorted order

     If an edge can be removed T without disconnecting T then remove it
```

(Old) History of MST algorithms

1920: Otakar Borůvka

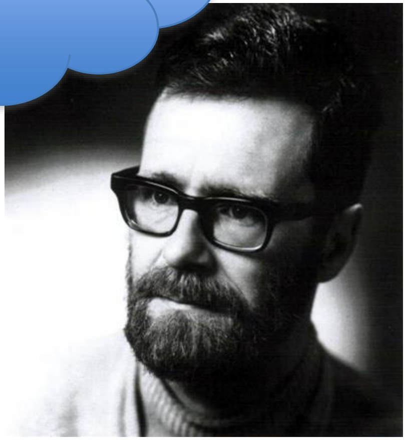
1930: Vojtěch Jarník



1956: Kruskal

Same algo!

1957: Prim



1959: Dijkstra