

Lecture 2

CSE 331

Aug 31, 2022

Enroll on Piazza

The screenshot shows the Piazza interface for CSE 331. The top navigation bar includes 'piozza', 'CSE 331 - Q & A', 'Resources', 'Statistics', and 'Manage Class'. A 'Buy a License' button and a 'Switch to contribution mode' link are also visible. The user's name 'Atri Rudra' is in the top right.

The main content area is titled 'Class at a Glance' and is updated 0 seconds ago. It features a 'Go to Live Q&A' link. The summary includes:

- no unread posts
- no unanswered questions
- no unanswered followups

License status: pending instructor license (13 days left)

20	total posts
173	total contributions
6	instructors' responses
1	students' responses
n/a	avg. response time

Student Enrollment: 145 enrolled out of 160 (estimated) [Edit](#)

Download us in the app store:

Share Your Class

Professors appreciate Piazza best when they see how it is being used. Allow colleagues to view your class through a demo link - a restricted, read only version of your class where all students' names are anonymized and all student information hidden.

`https://piazza.com/demo_login?mid=86gh0xa02ve4zk&auth=f0ddc1e`

Opening this link in the same browser will log you out as atri@buffalo.edu

The left sidebar shows a 'New Post' button and a search bar. Below it, a 'Show Actions' section lists several pinned posts with their dates and brief descriptions, such as 'VM setup office hours' (8/30/22) and 'CSE 220 Unix session' (8/29/22).

<https://piazza.com/buffalo/fall2022/cse331/>

Read the syllabus CAREFULLY!

🏠 » CSE331: Algorithms and Complexity (22) » Syllabus Quiz

Syllabus Quiz

Options

[View handin history](#)

[View writeup](#)

[Download handout](#)

🕒 Due: December 13th 2022, 11:59 pm

📅 Last day to handin: December 13th 2022, 11:59 pm

No graded material will be handed back until you pass the syllabus quiz!

Academic Integrity

Question 1: Sharing my answers to this syllabus quiz with other 331 students

- Is OK if I do it to help out a friend
- It does not matter since there is no grade attached with it
- Is an academic integrity violation and should not be done
- Is an academic integrity violation but I can take the chance

Question 2: Penalty for academic violation in CSE 331 is an automatic

- warning and a chance to make-up
- A zero in the assignment AND a letter grade reduction (for first violation across all CSE courses) and an F in the course (for 2nd violation across all CSE courses)
- A zero in the course-online assignment and nothing else

Autolab FAQ

Autolab

Details on Autolab, which will be used for all homework submissions in CSE 331.

The main link

We will be using the UB CSE extension to [Autolab](#) for submission and (auto)grading of CSE 331 homeworks. You can access Autolab via <https://autograder.cse.buffalo.edu/>.

Signing up

Follow these steps to setup an account on Autolab (unless you already have one in which case you'll use your existing account):

1. Go to [this page](#) and click on the [Sign in with MyUB link](#). A new account will automatically be created for you.
2. I believe Autolab should now be using your preferred name instead of your official UB first and last name. **If this is not the case, please let us know ASAP.**
3. We will have leader boards for all the programming assignments. For anonymity, all students are identified by their chosen nicknames. So please make sure you pick an appropriate one (you can change your nickname at any point in time).
4. After you have done the above steps, you wait.

What happens next

Here are the steps that we need to take on our end:

Homework 0 is out

note #18 stop following 24 views Actions

HW 0 is out

Here is the direct link to the HW 0 page:
<http://www-student.cse.buffalo.edu/~atri/cse331/fall22/tws/hw0/index.html>

Couple of things to note:

- Autolab will not start accepting HW 0 submissions until 11:45pm tonight
- You should also be able to get to the HW0 page from the "Homeworks" dropdown menu from the top navbar.
 - Heads up you might need to (force) reload the 331 webpage and/or clear recent history in case the HW 0 link does not appear directly in the navbar.

homework0

Edit good note 0

Updated 2 hours ago by Atri Rudra

Recitation notes for this week

note @19 stop following 22 views Actions

Recitation 1 notes

You can access the recitation notes for this week from the schedule page:

<http://www-student.cse.buffalo.edu/~atri/cse331/fall22/schedule.html>

Since this is the first week, I'm making an explicit post on recitation notes. In future, I will not post about the notes but you should expect them to be linked from the schedule page by 11:45pm on Tuesdays. In some rare cases, it might be delayed until Wed morning (but feel free to post on piazza to check in case they are not up by the usual Tuesday time).

recitation

Edit good note 0

Updated 1 hour ago by Atri Rudra

Allowed Sources

Allowed sources

You can **ONLY** use the following sources for reference once you start working on the homework problems:

1. the Kleinberg-Tardos textbook,

Other textbooks are not allowed

While you can use other textbooks (e.g. those listed in the [syllabus](#)) to better understand the lecture material, you cannot use them once you start working on the homeworks.

2. any material linked from this webpage or the CSE 331 piazza page (including any discussion in the Q&A section),

One-click rule

When using webpages that are allowed as sources, you cannot click on link on that source. (Otherwise within a constant number of clicks one can reach any webpage one wants.)

3. specific mathematical result from a previous course,
4. anything discussed in the lectures, recitations and/or office hours and
5. any notes that you might have taken during class or recitation.

Everything else is not allowed

Note that the above list covers all the allowed sources and **everything else is not allowed**. In particular, **YOU ARE NOT SUPPOSED TO SEARCH FOR SOLUTIONS ON THE**

... even for programming Q

For discussions and posts on [piazza](#).

Basic programming references

C++ Sources

- [cppreference.com](#) (and all pages within the website).

Java Sources

- [Oracle Java Documentation](#) (and all pages within the website).

Python Sources

- [Python 3.5.2 documentation](#) (and all pages within the website).

Asymptotic Analysis

- [Big-O cheat sheet](#).

Wikipedia Pages

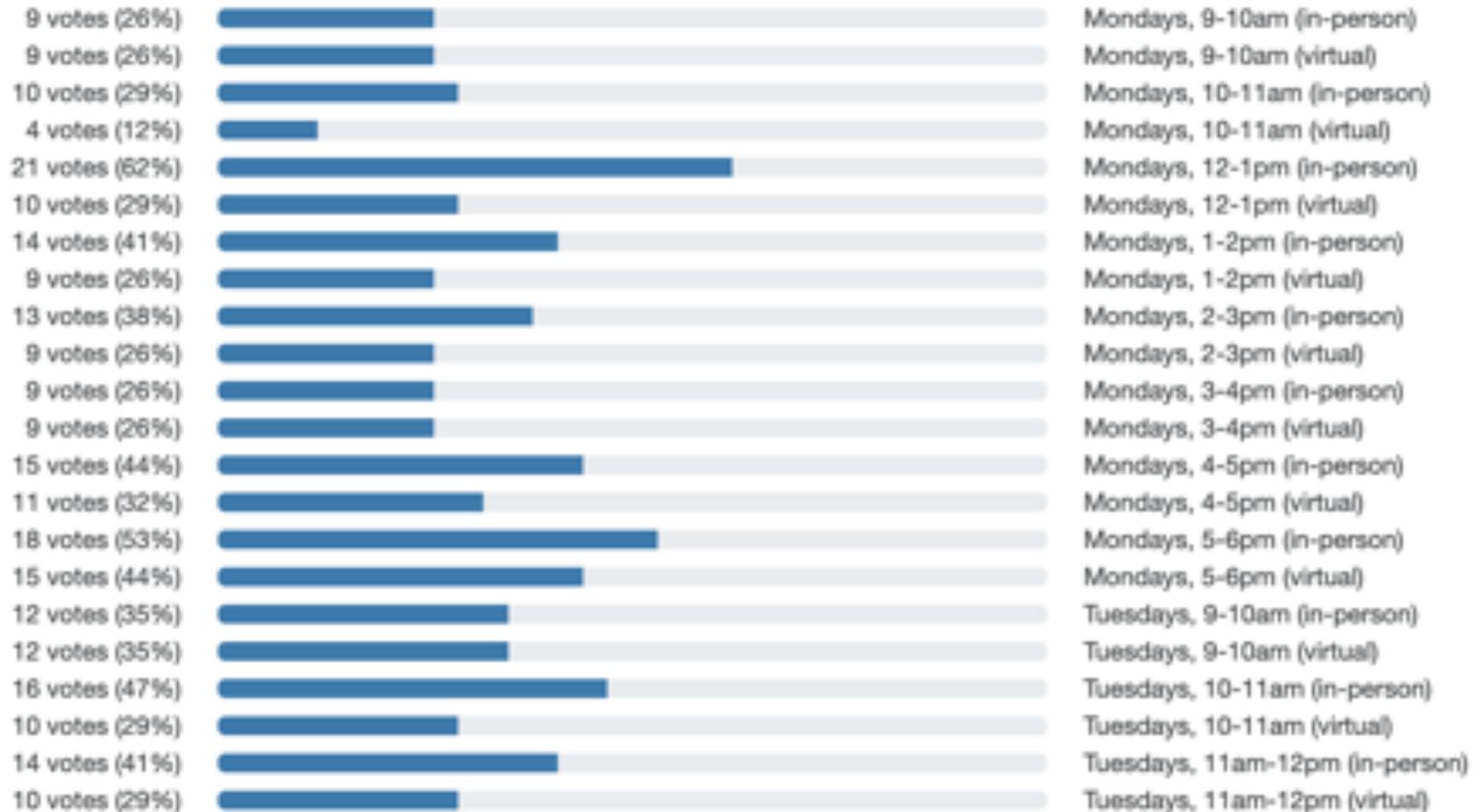
Below are some approved Wikipedia pages (in addition to those that are already linked to in other pages in the [CSE 331 Fall 2018 web page](#)).

- [Gale Shapley algorithm](#).
- [DFS](#).
- [Dijkstra's Algorithm](#).
- [Prim's algorithm](#).

TA Office hours finalized tomorrow

TA office hours closes in 3 day(s)

A total of 34 vote(s) in 75 hours



Night Office hour as well

Late night office hour closes in 3 day(s)

A total of 37 vote(s) in 75 hours



Special OH for VM setup

VM setup office hours closes in 1 day(s)

A total of 2 vote(s) in 1 hours



Time finalized tonight!

How to Unix session

note @12

stop following 96 views

Actions

CSE 220 Unix session

As I mentioned in class today, CSE 220 will be hosting a how to use the Unix system session. I have confirmation on the time and date:

- Tuesday, Sep 6, 7:15pm

The above is assuming the room reservation goes through for which we're awaiting confirmation. Once I get that I'll post the location here as well.

The session will be in **Cooke 121**.

office_hours

Edit good note 0

Updated 1 day ago by Atri Rudra

Questions/Comments?



Why should I care about CSE 331?



The proof is in the performance



EMPTYHEADED



10x faster

A large, thick green arrow pointing from the EmptyHeaded logo towards the Oracle logo.

Better algorithm with little hacking will beat a worse algorithm with tons of hacking

If detecting communities is not for
you

Google™

Microsoft®



From someone who got a Google job

“You can let your algorithms class know that the phone interviews are essentially like **a difficult algorithms test.**”

Lots of data structures, specifying the algorithm, analyzing the run time and space requirements... And all on the phone and **you're supposed to talk through your thought process.**”

Coding jobs will be done by AI



stacksort

In a recent xkcd's alt text, Randall Munroe suggested stacksort, a sort that searches StackOverflow for sorting functions and runs them until it returns the correct answer. So, I made it. If you like running arbitrary code in your browser, try it out.

Like (or hate) it? Comment on HackerNews

stackoverflow_sort(
Try a list of numbers, a string, a
list of words or json.

[8,6,7,5,3,0,9]);

Sort

var output =
Output from the function.

;

output console

Coding jobs will be done by AI

MIT News

ON CAMPUS AND AROUND THE WORLD

Browse

or

Search



FULL SCREEN

Researchers have developed a flexible way of combining deep learning and symbolic reasoning to teach computers to write short computer programs. Here, Armando Solar-Lezama (left), a professor at CSAIL, speaks with graduate student Maxwell Nye.

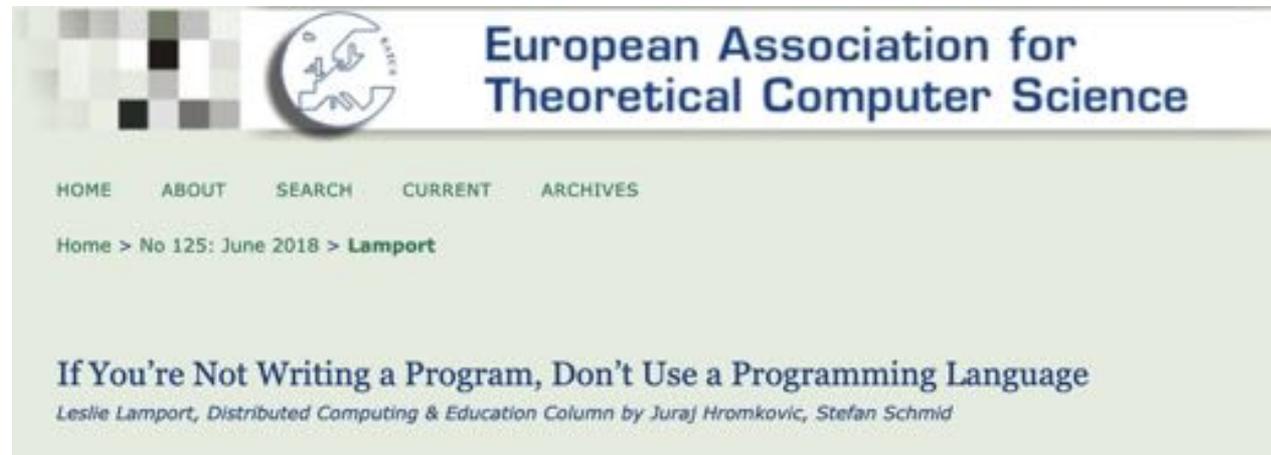
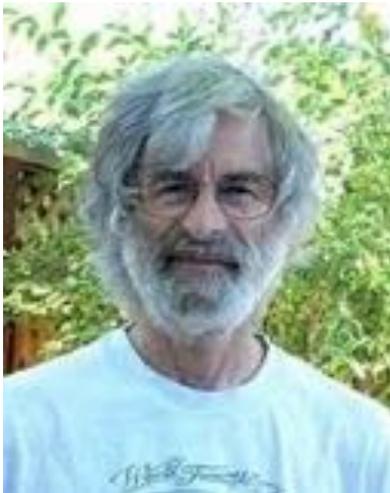
Photo: Kim Martineau

Toward artificial intelligence that learns to write code

Researchers combine deep learning and symbolic reasoning for a more flexible way

So am I doomed?

There will still be room for high level *algorithmic* thinking!

A screenshot of the European Association for Theoretical Computer Science website. The header features a logo on the left, a navigation menu with links for HOME, ABOUT, SEARCH, CURRENT, and ARCHIVES, and the title "European Association for Theoretical Computer Science" on the right. Below the navigation menu, there is a breadcrumb trail: "Home > No 125: June 2018 > Lamport". The main content area displays the title "If You're Not Writing a Program, Don't Use a Programming Language" and the author information "Leslie Lamport, Distributed Computing & Education Column by Juraj Hromkovic, Stefan Schmid".

*Today, programming is generally equated with coding. It's hard to convince students who want to write code that they should learn to think mathematically, above the code level, about what they're doing. Perhaps the following observation will give them pause. **It's quite likely that during their lifetime, machine learning will completely change the nature of programming. The programming languages they are now using will seem as quaint as Cobol, and the coding skills they are learning will be of little use. But mathematics will remain the queen of science, and the ability to think mathematically will always be useful.***

Proof Idea vs. Proof Details

Questions 1 and 2

For Q1 and Q2, think of the algorithm and proof ideas as things that go inside a header (`.h`) file. They are the high level overview of how you are approaching the problem; you don't have to be very technical here. For example, listing out all the steps in your algorithm, what proof technique are you using, what property of the algorithm are you induction on, etc.

Algorithm and proof details are the implementation inside the source (`.cc`) file. They are simply the detailed technical algorithm/ proof of the idea that was outlined.

More on the idea vs details divide

Always start off with the ideas. Just smashing random keys on the keyboards won't get you anywhere with writing code and certainly would not help with proofs. In the real world, a user of your library doesn't care about the details; just wants to know how to use it. Similarly, in your proof and algorithm ideas, briefly explain what you're doing, how it works and why it should work. For example, if you're using contradiction in the proof details; just state that you use contradiction on a specific property (but do specify which property).

In the algorithm and proof details, be as detailed as you can be and try to avoid loopholes (more explained below).

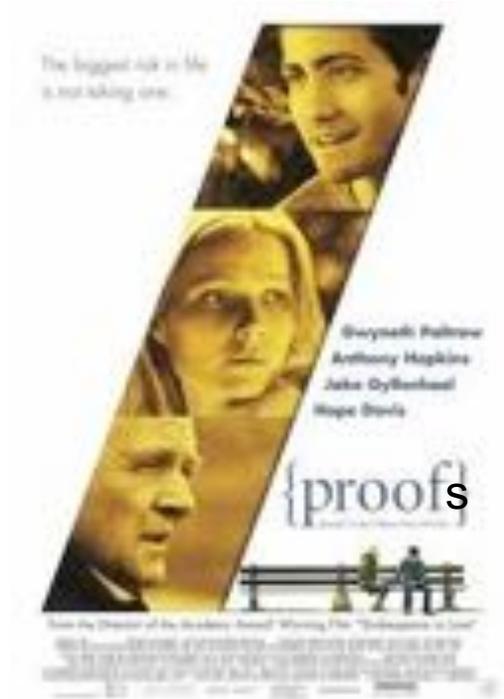
Questions/Comments?



Bit more about the course



We'll do loads of



<http://www.impawards.com/2005/proof.html>

Writing down your thought process formally and precisely!

An incorrect “proof”



A more subtle incorrect “proof”

Brad Pitt had a beard



waleg.com

Every goat has a beard



animaldiversity.org

Hence, Brad Pitt is a goat.

Why should we do proofs?

We will focus a lot on proofs in CSE 331. In this document I will motivate why doing proofs is good even though you might not do proofs for a living. — While doing this, we will also go through examples of how to write algorithm ideas and details as well as proof ideas and details (which you will need to write in your homework solutions).

Some reasons to do proofs

In this section, I will lay out some reasons why I think it is beneficial for you guys to do proofs. The first two are probably more along the lines of “if you do proofs for a living” situation. The rest of the reasons should be valid for all of you. I will try and make the reasons as concrete as possible: in the next section, we will consider algorithms for the specific problem of generating all permutations (recall that we *previously* had punted on designing an algorithm for this problem).

Sometimes you might not have a choice

One of the easiest way to verify an algorithm idea you have is to code up the algorithm and then test it on some (say random) inputs. However, sometimes this might not be a choice. E.g. if you work on [Quantum Computing](#), then you do not have a quantum computer to run your quantum code on! So currently pretty much the only choice you have is to prove that your algorithm is indeed correct. For example, one of the crowning achievements of quantum computing is [Shor's algorithm](#) to compute the factors of large numbers efficiently on a quantum computer (that recall does not exist yet). (You might also want to read [Scott Aaronson's high level description of Shor's algorithm](#)). The reason why [factoring large numbers](#) is important is that if one can solve this problem efficiently then one can break the [RSA cryptosystem](#). RSA is used everywhere (e.g. when you use your credit card online, RSA is used to make the transaction secure), so this is a big deal.

A common complaint

Your examples in class look nothing like HW questions.

True because....



zazzle.com

False because...

HWs and exams will test your **understanding** of the material

To get an A in the class

Have to get at least 90.000000000000000000000000000000%

Rest graded on the curve

A cautionary tale...

When I was an undergrad

 Took algorithms as a sophomore

Understood all the lectures

Did not study outside of lectures

 (We had no homeworks)

Did decent on the mid-term

Nearly flunked the finals

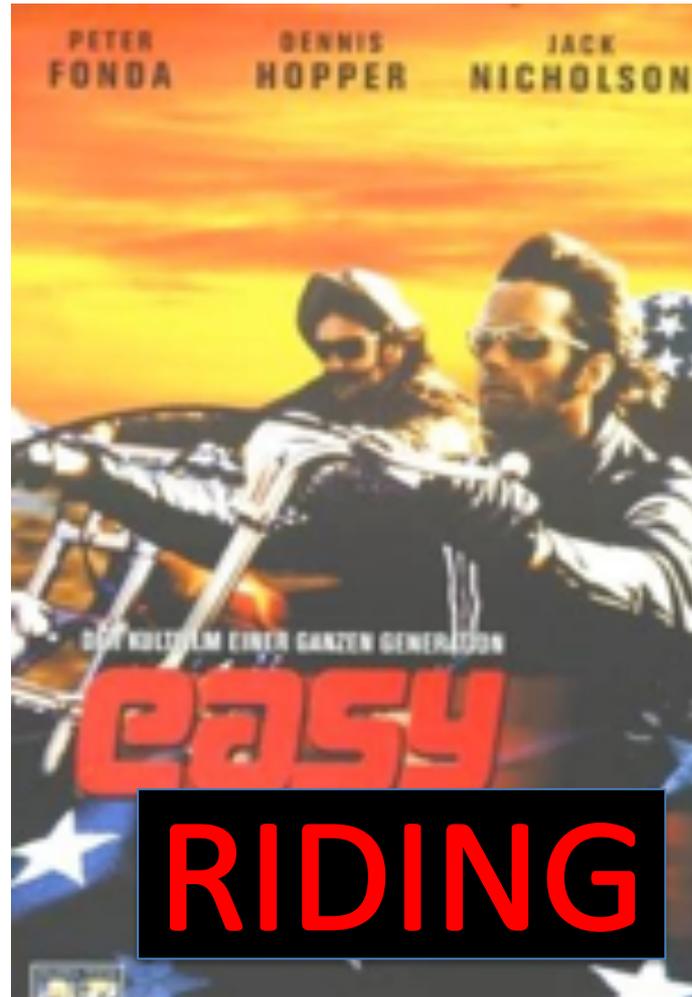
Got a **C**



Questions/Comments?



How we will make 331



What we'll strive to do

Help you with your questions and/or doubts

If need be, email us for time outside of regular office hours

We're not mind readers



If you need it, ask for help



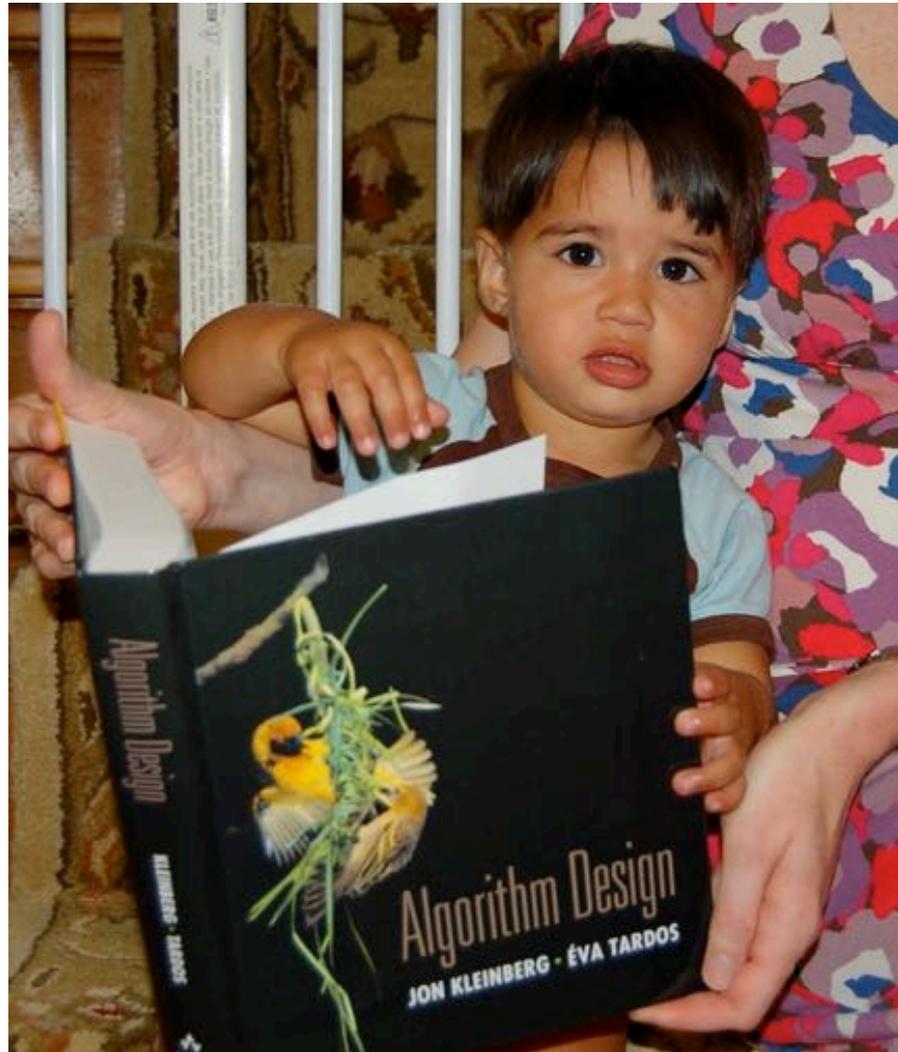
More chances to recover

Lowest two Q1, Q2 and Q3 HW scores will be dropped

If you do better on the final exam than the mid-term exam

then only final exam score will count

Follow the Textbook



CSE 331 Support Page

This page contains certain webpages that students taking CSE 331 might find useful.

The material is roughly divided into two parts: one on (primarily mathematical) background material and one of common mistakes that students generally make.

Disclaimer

Please note that this material is intended as a support material. It is not meant as a replacement for actually having taken background courses like CSE 118, 191 or 250 nor is this meant to be exhaustive. I'll try my best to make these as comprehensive as possible but that might take some time.

Background material

CSE 331 will need a fair bit of math: most of which you must have seen earlier. However, if you have not used those material for a bit then you might be a bit rusty. The pages linked below are some notes that I wrote up that might help you refresh the material that you might

Common Mistakes

Here we collect some common mistakes that students make in CSE 331 material (and sometimes more than once). The hope is to list these common pitfalls so that you can avoid them!

Other Resources

Below we collect other 331 related material that do not neatly fall into the two left category:

- [Visualizing Algorithms.](#)

<http://www-student.cse.buffalo.edu/~atri/cse331/support/index.html>

The cautionary tale has a silver lining...



C in undergrad algorithms



Ph.D. in algorithms/complexity

The only way to do well is to work hard



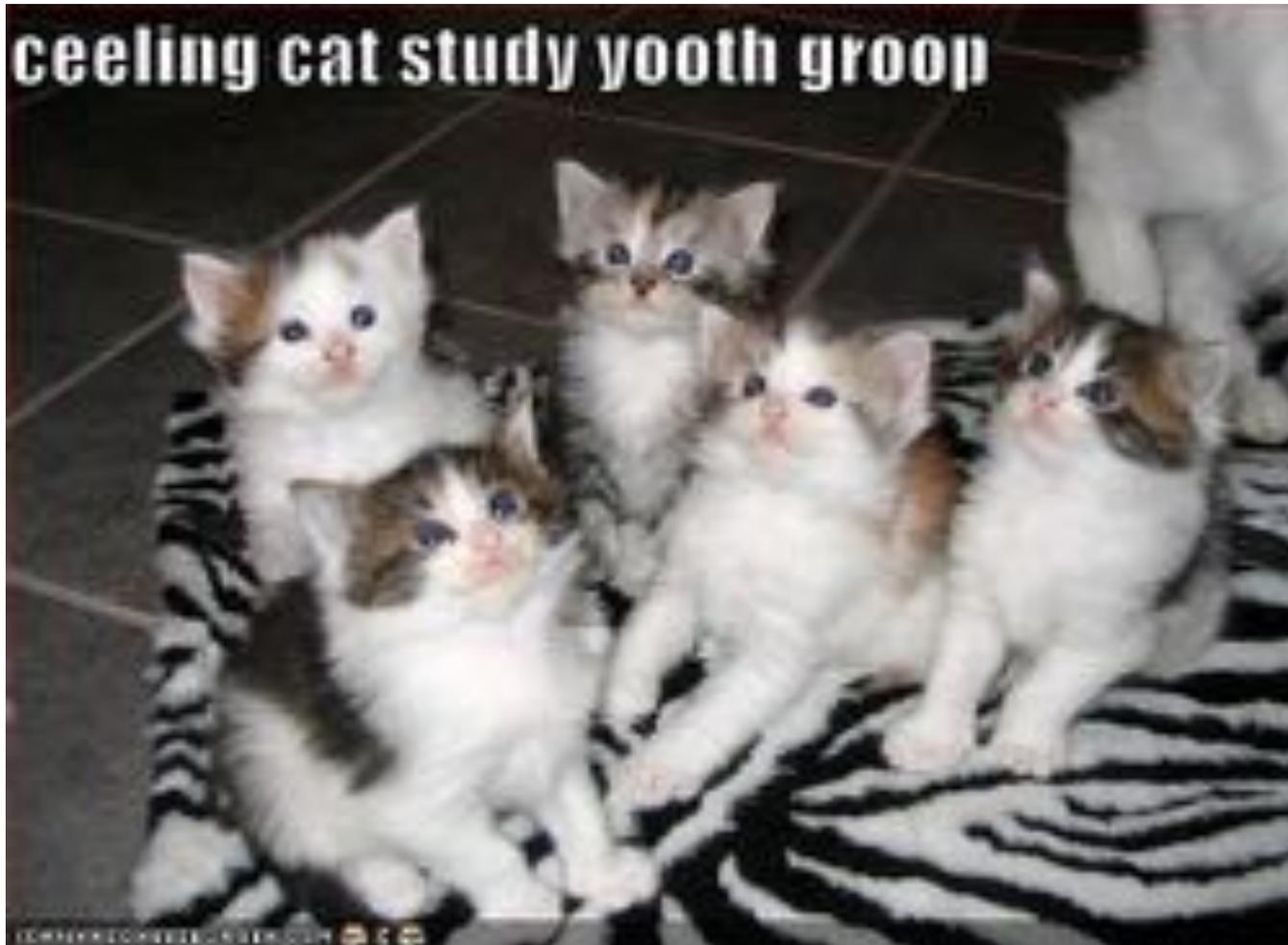
Questions/Comments?



Let the fun begin!



Remember: Stick with your group



Common solution: Let's build an app for that!

The screenshot shows the Street Bump website interface. At the top, there is a dark green header with the Street Bump logo on the left, an 'About' link in the center, and a 'Sign In' link on the right. The main content area is divided into two columns. The left column features a section titled 'Where's Street Bump being used?' with a subtitle '549 trips, 37,016 bumps, 0 potholes filled, and 0 roadway problems identified'. Below this is a map of Truro, NS, with a red callout box overlaid on it. The callout box is a red star shape with a blue outline and contains the text 'Potential issues?'. The map shows a street grid with a red location pin and a 'Street Bump' logo. The right column features a section titled 'What's Street Bump?' with a green background. It contains a paragraph of text: 'Street Bump is a crowd-sourcing project that helps residents improve their neighborhood streets. Volunteers use the Street Bump mobile app to collect road condition data while they drive. The data provides governments with real-time information to fix problems and plan long term investments.' Below the text is a video player showing a 3D map of a street grid with a car icon. At the bottom of the video player are controls for play, volume, and a 'Learn More' button. Below the video player is an 'App Store' logo and a 'Learn More' button. At the bottom of the page, there is a link: 'Want to use Street Bump to improve your community? [Contact Us](#)'.

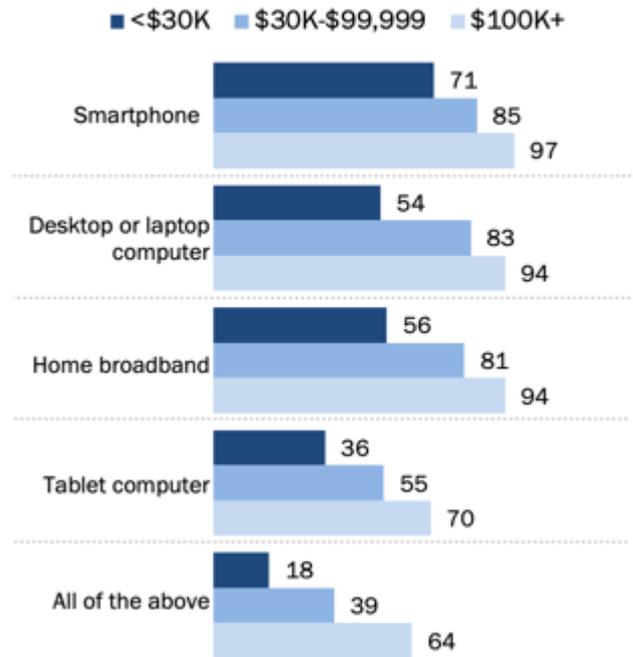
The smartphone blind-spot

Many of us in CSE assume that “everyone” has smartphones

More generally, we assume “everyone” has access to the Internet

Lower-income Americans have lower levels of technology adoption

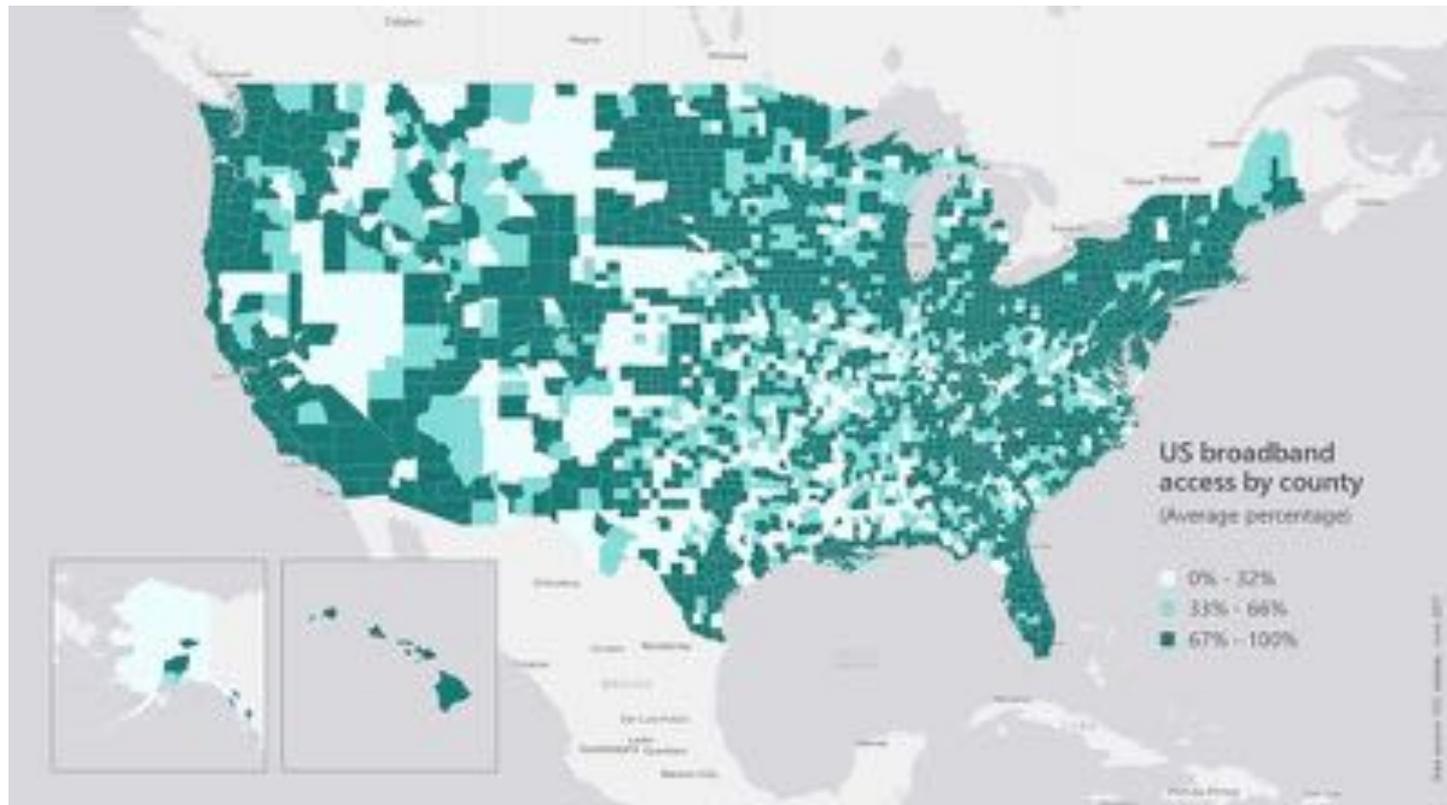
% of U.S. adults who say they have the following ...



Note: Respondents who did not give an answer are not shown.
Source: Survey conducted Jan. 8-Feb. 7, 2019.

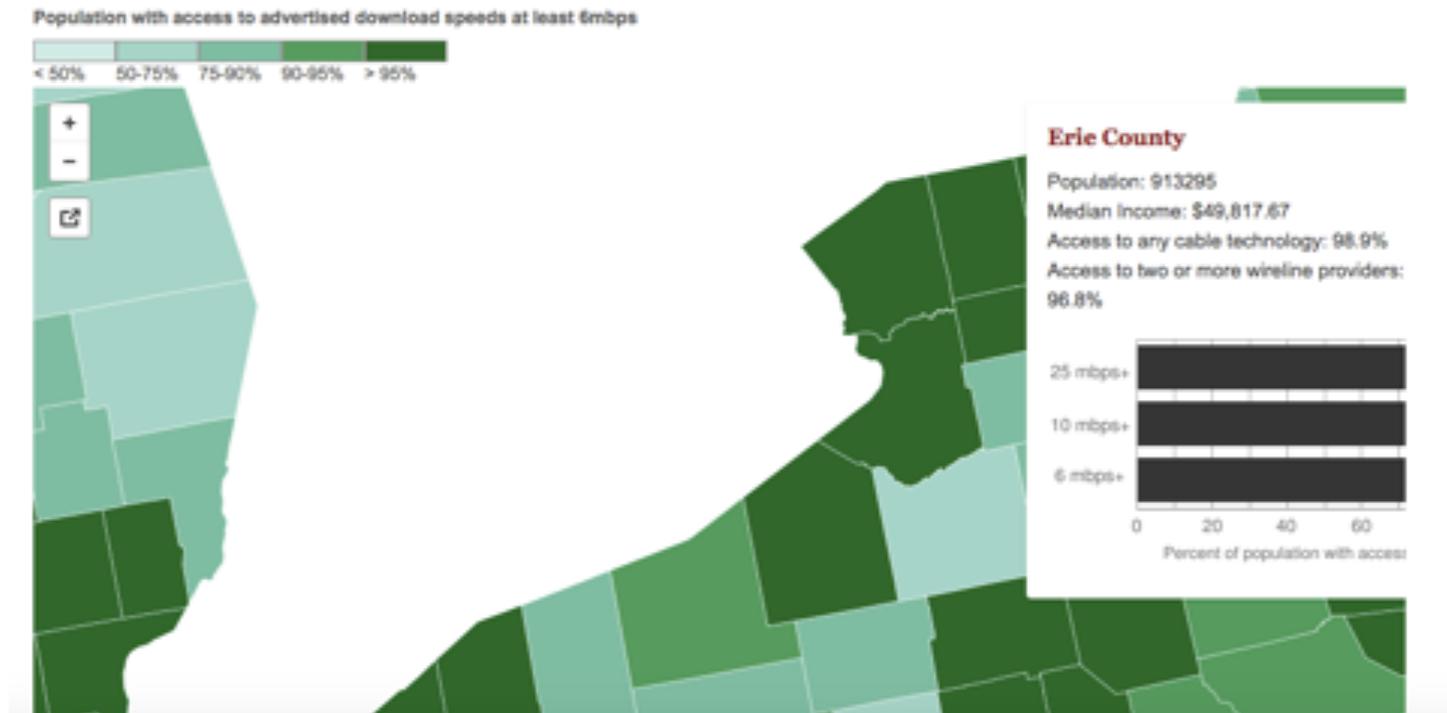
PEW RESEARCH CENTER

Broadband access



<https://assets.bwbx.io/images/users/iqjWHBFdfxIU/iZSjibxE1KJs/v1/800x-1.jpg>

Erie county is reasonably good



<http://www.governing.com/gov-data/broadband-speeds-availability.html>

One county over

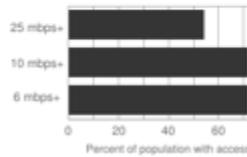


<http://www.governing.com/gov-data/broadband-speeds-availability.html>

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%



Say you are tasked to come up with the infrastructure

BOTH technical and societal issues

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%

