Lecture 2

CSE 331

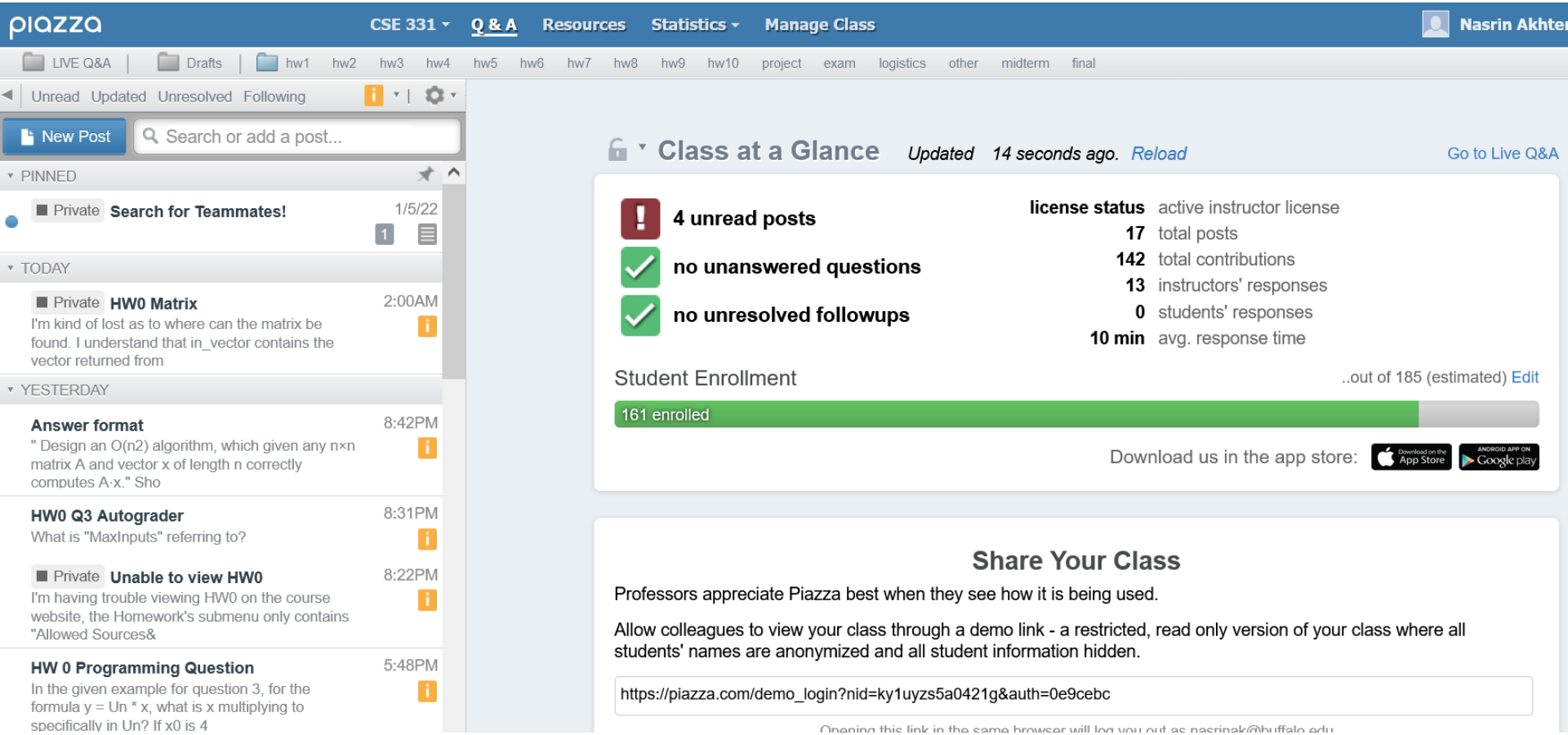
Please have a face mask on

Masking requirement

UB requires all students, employees and visitors – regardless of their vaccination status – to wear face coverings while inside campus buildings.

https://www.buffalo.edu/coronavirus/health-and-safety/health-safety-guidelines.html

Enroll on Piazza



https://piazza.com/buffalo/spring2022/cse331/home

Read the syllabus CAREFULLY!

Syllabus Quiz

Admin Options

CA Options

Options

View handin history

View writeup

Download handout

Due: **May 16th 2022, 2:12 pm**

Last day to handin: **May 16th 2022, 4:12 pm**

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

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

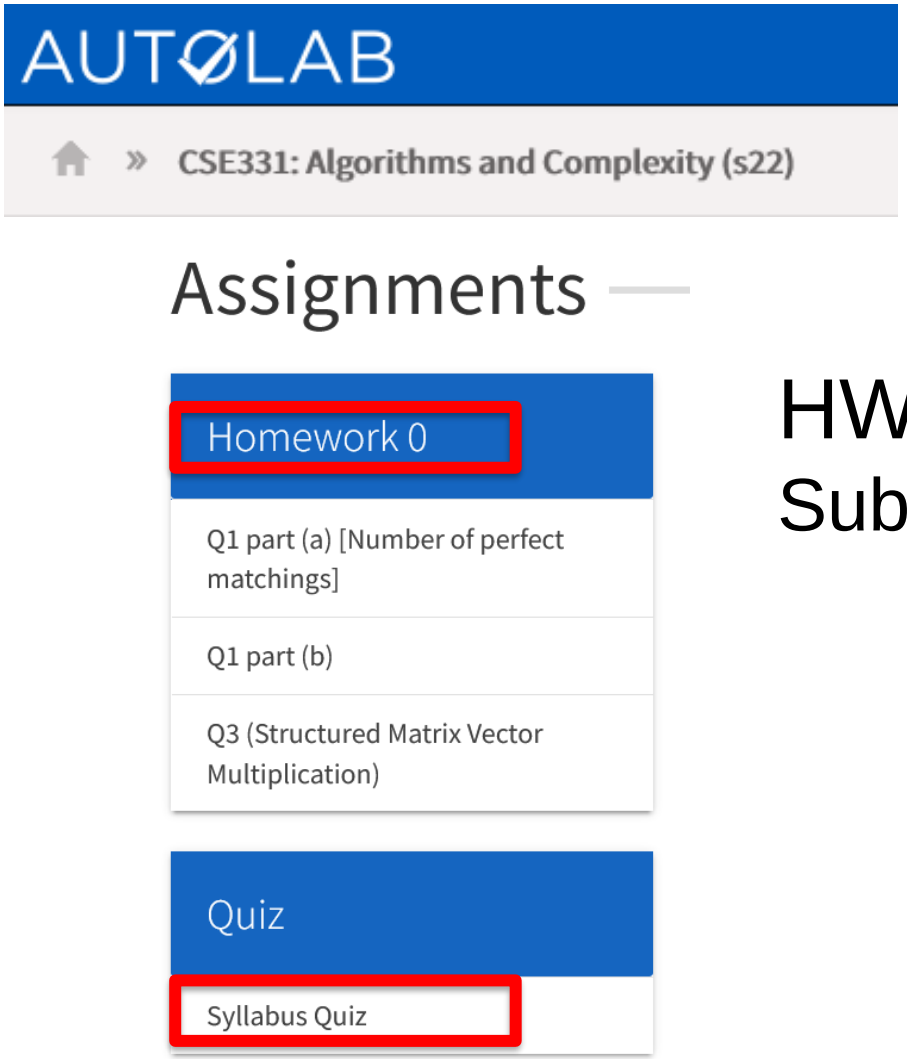
Follow these steps to setup an account on Autolab (unless you already have one in which case you'll use your existing account):

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:

HW 0 is Out



HW0 is out!

Submit Q1 and Q3 (not Q2).

HW 0 is Out

Q1 part (a) [Number of perfect matchings]

Options

View handin history

View writeup

Download handout

Please make sure you are submitting for PART (A) and NOT part (b) for Q1

Due: **February 7th 2022, 9:00 am**

Last day to handin: **February 7th 2022, 9:00 am**

Sources *:

! PDF only please

Collaborator

HW 0 is Out

Q1 part (b)

Options

View handin history

View writeup

Download handout

Please make sure you are submitting for PART (B) and NOT part (a) of Q1

Due: **February 7th 2022, 9:00 am**

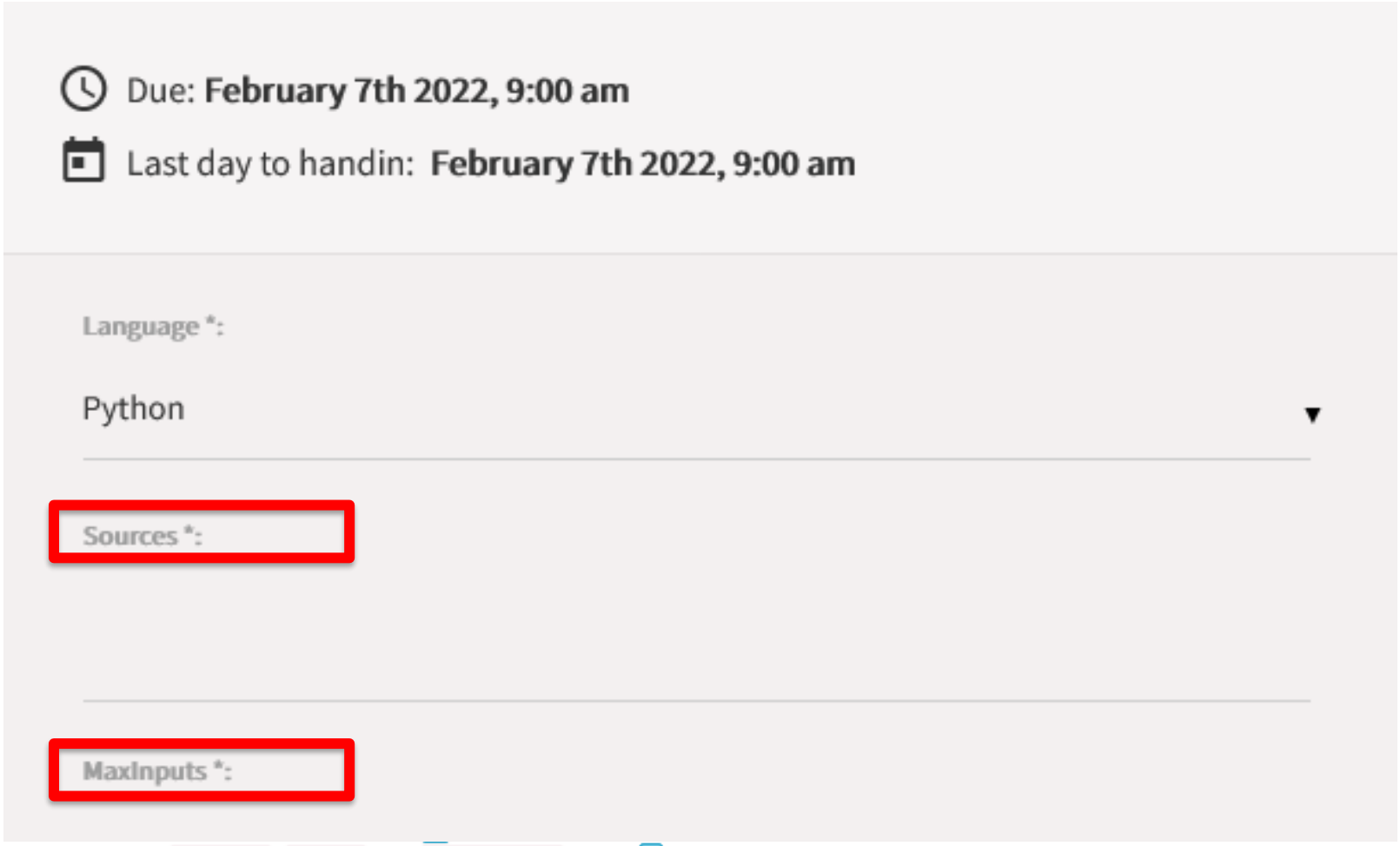
Last day to handin: **February 7th 2022, 9:00 am**

Sources *:

Collaborators *:

! PDF only please

HW 0 is Out



- What do the textfields `MaxInputs`, `Sources`, and `Collaborators` mean?

  `MaxInputs` is only relevant to the third (programming) question, where you can specify the number of testcases you want the Grader to test your code on (for partial credit). This is especially useful if your code times out if you run it on all 10 inputs. `Sources` and `Collaborators` applies to all assignments and their use is outlined on the Homework Policy page.

https://cse.buffalo.edu/~nasrinak/cse331/spr22/autolab.html

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

CSE 331 | Syllabus | Piazza | Schedule | Homeworks | Autolab | Mini Project | Support Pages | Youtube channel

- All 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

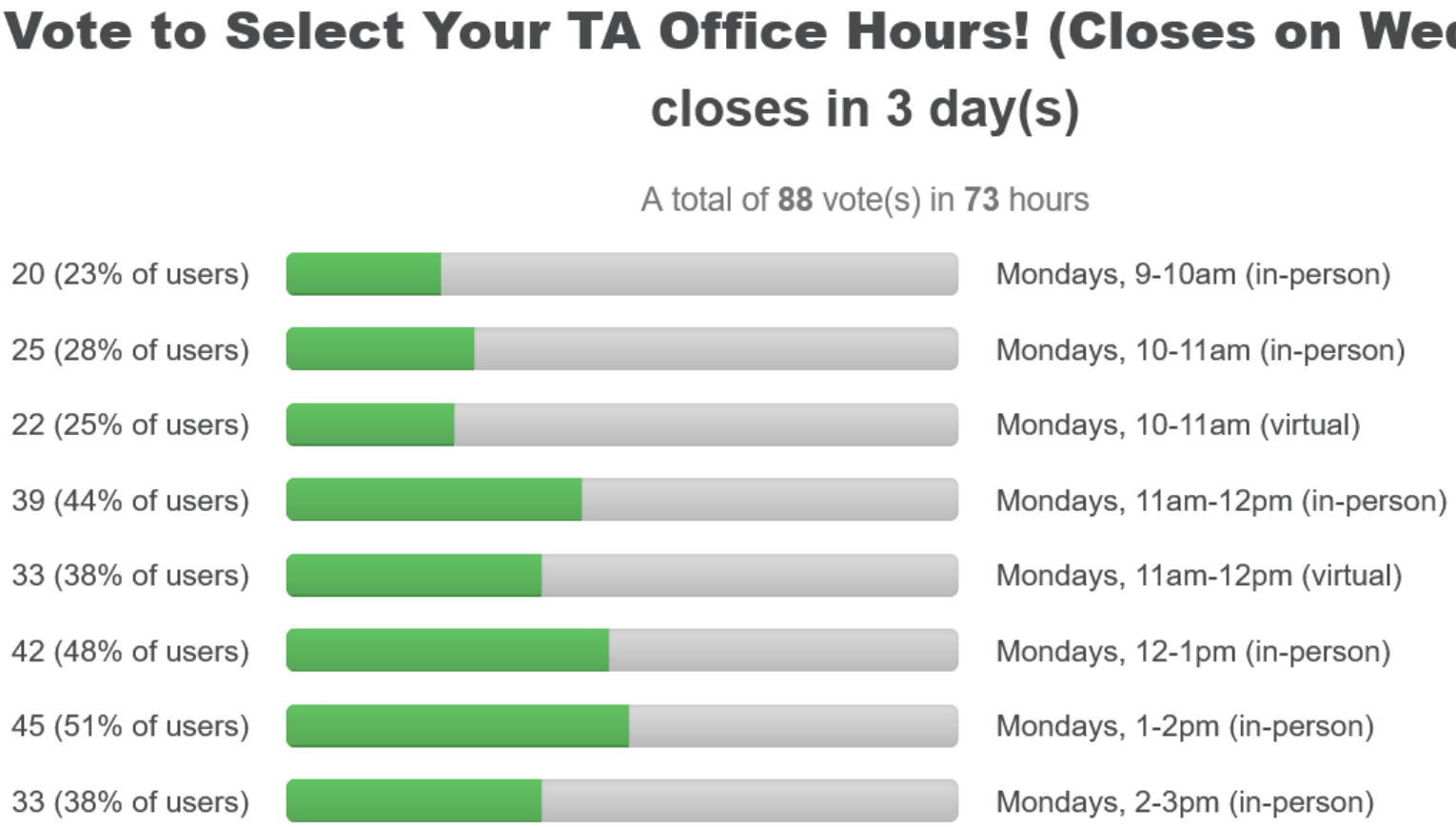
- Big-O cheat sheet.

Wikipedia Pages

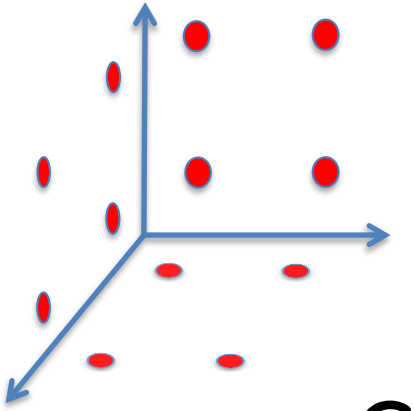
Below are some approved Wikipedia pages (in addition to those that are already linked to in other pages in the CSE 331 Fall 2018 web page.

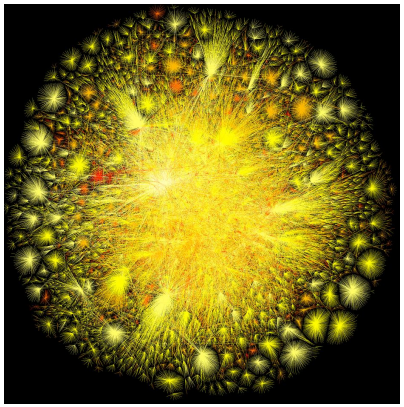
- Gale Shapley algorithm.
- DFS.
- Dijkstra's Algorithm.
- Prim's algorithm

TA Office hours finalized tomorrow



Why should I care about CSE 331?





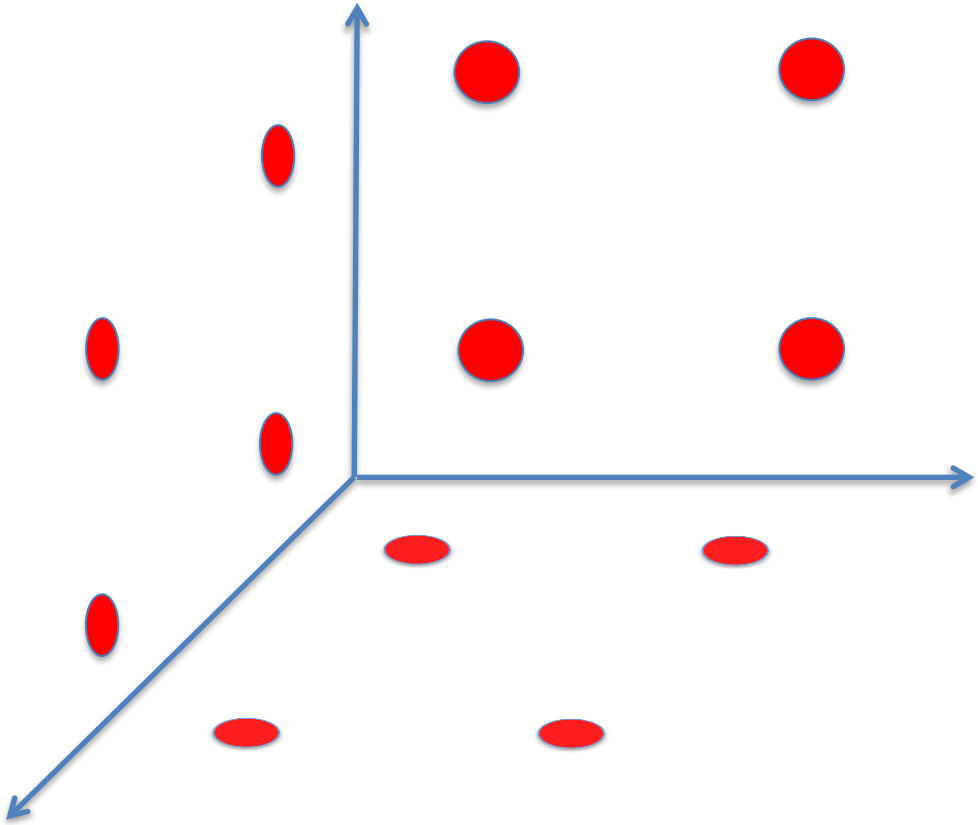
Combining Shadows to Understanding the network

relationalAI

rAI

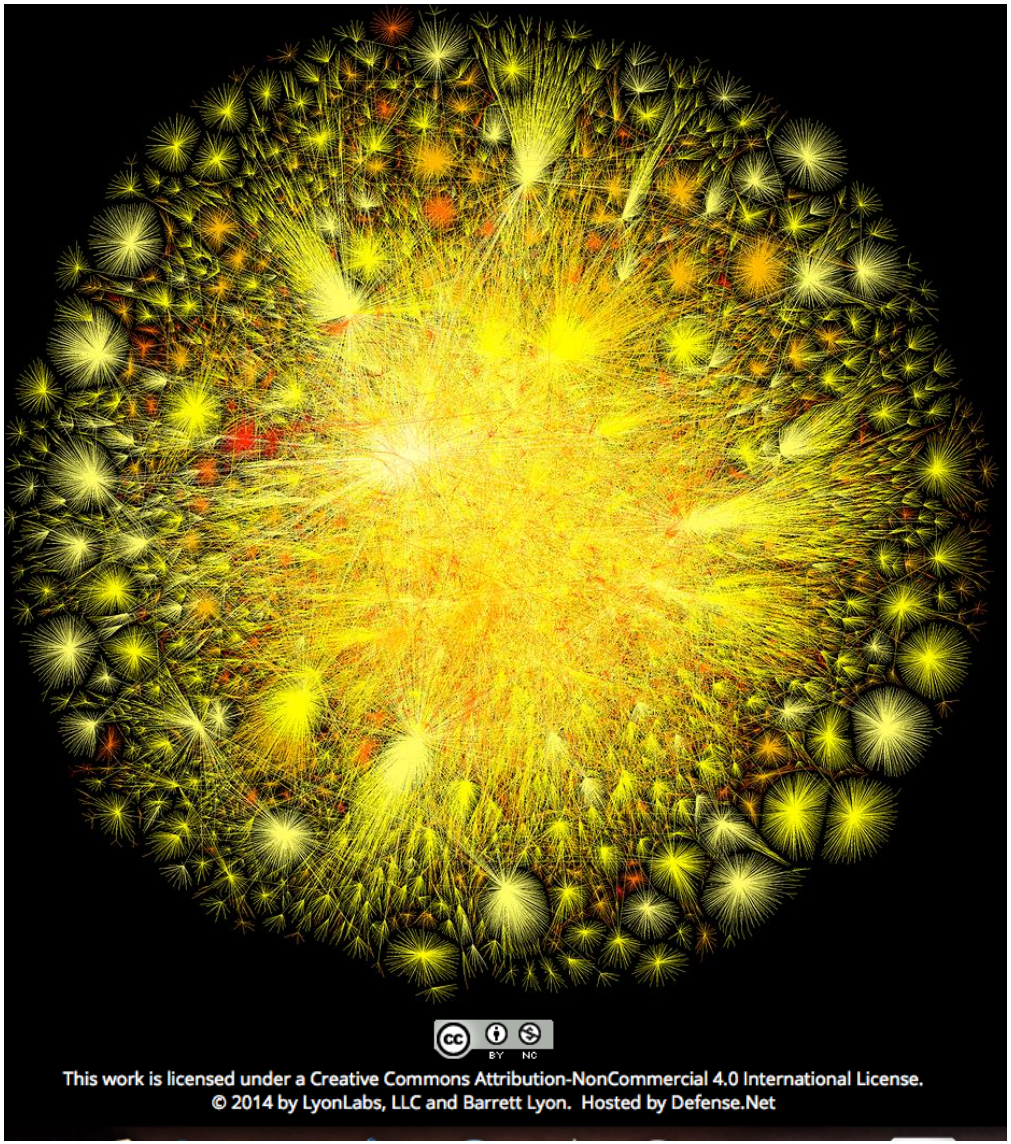
Stanford University

The key technical problem

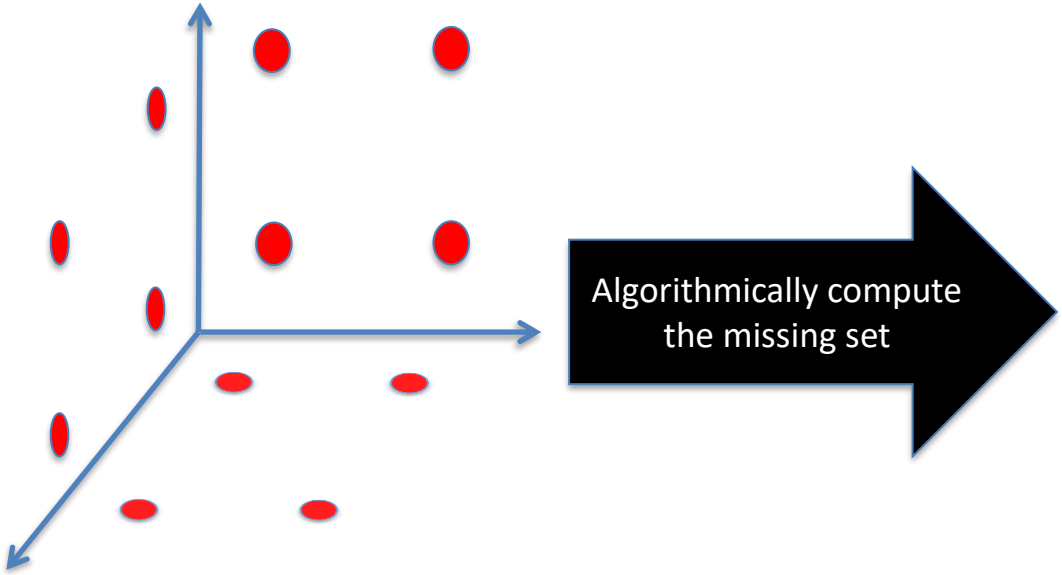


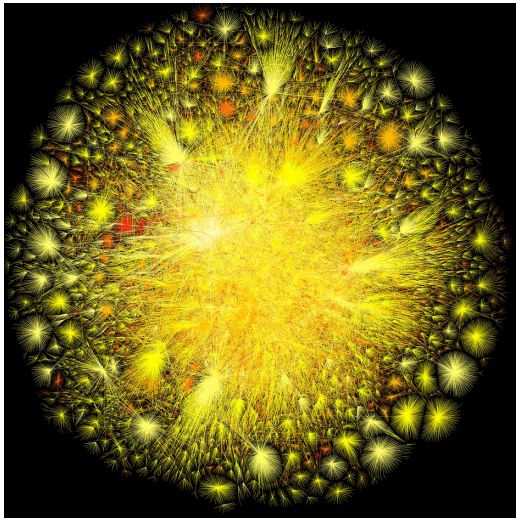
Given the three projections, what is the largest size of the original set of points?

Detecting Communities



Conquering Shadows to Conquering the Internet





The proof is in the performance

EMPTYHEADED




10x faster

ORACLE

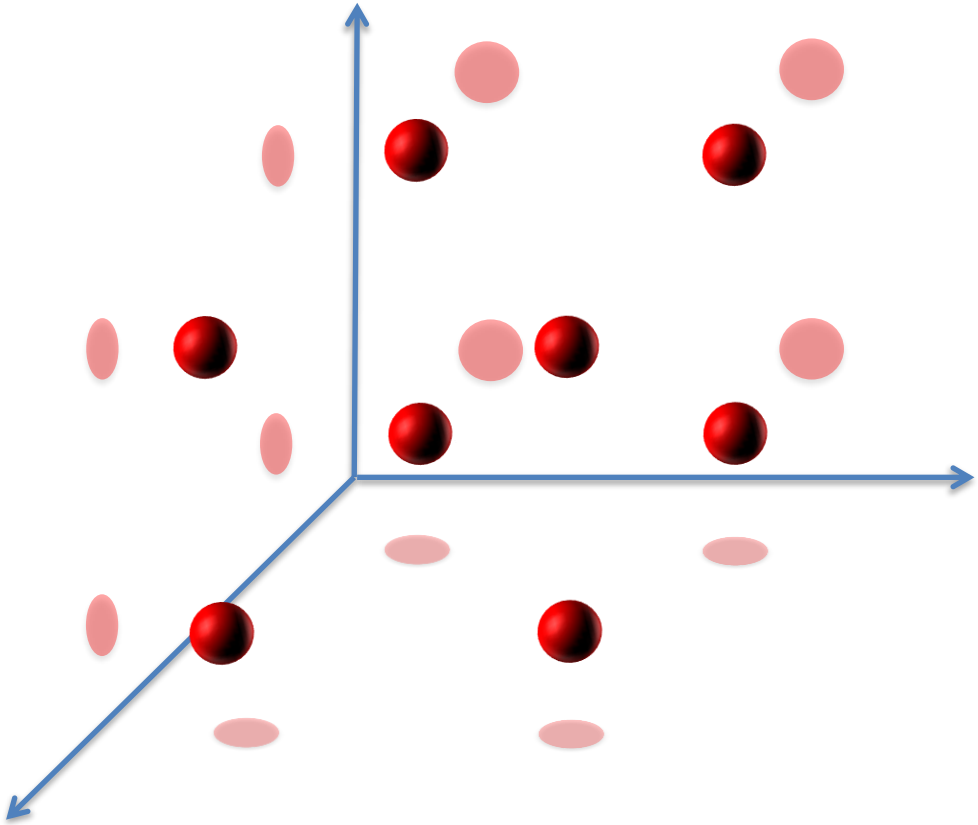
Dato GraphLab

LogicBlox

SNAP

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

The key technical problem



Highly trivial: $4^3 = 64$

Still trivial: $4^2 = 16$

Correct answer: $4^{1.5} = 8$

If detecting communities is not for you

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

stack**sort**

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.

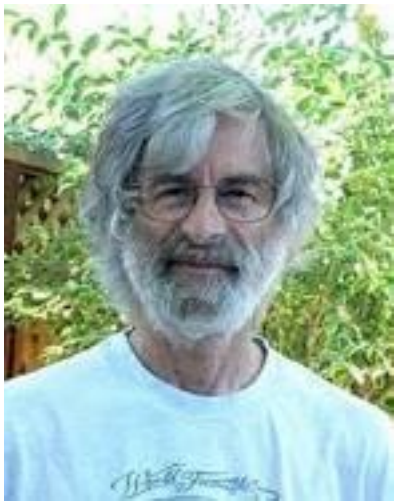
Photo: Kim Martineau

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!



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.***

Questions/Comments?

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.

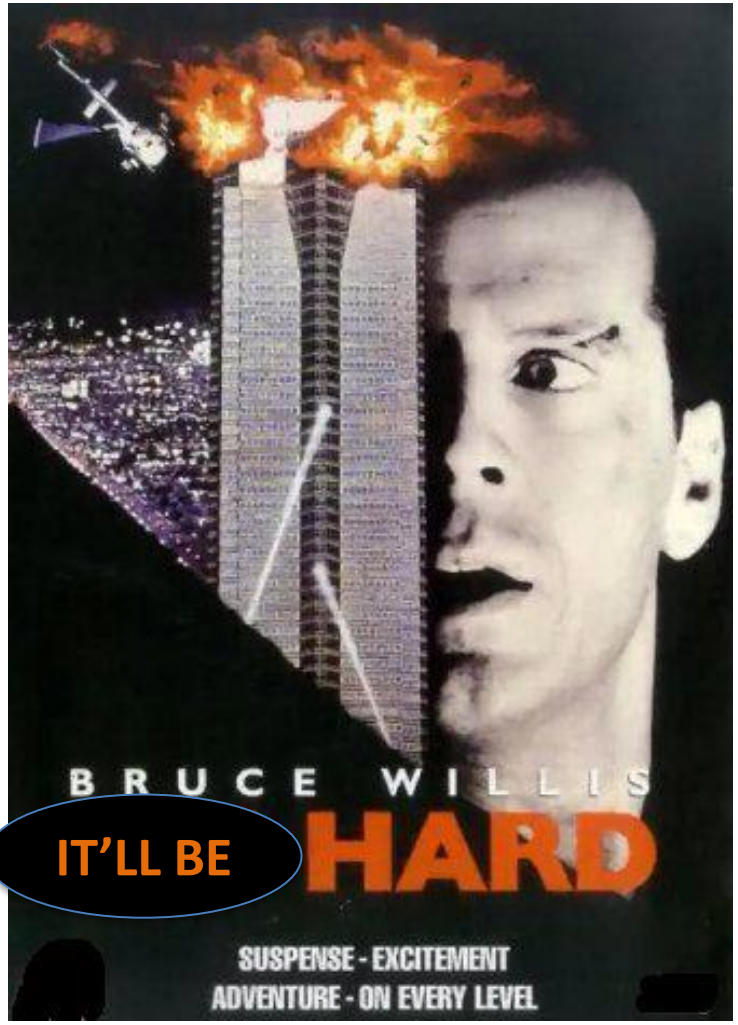
More on the idea vs details divide

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).

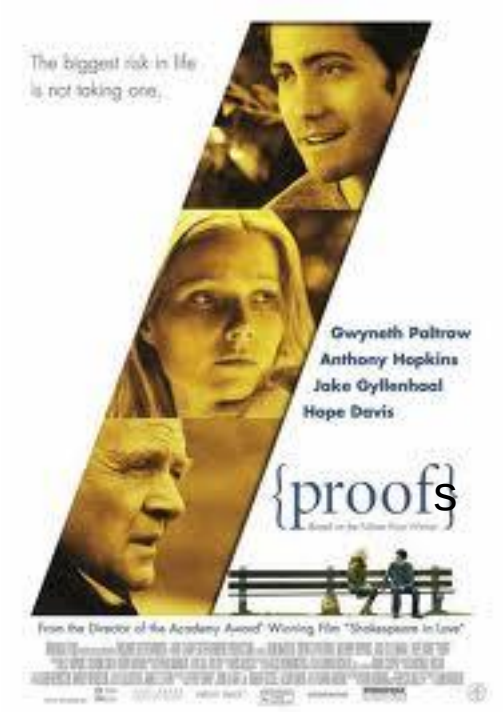
In the algorithm and proof details, be as detailed as you can be and try to avoid loopholes (more explained below).

Questions/Comments?

Bit more about the course



We'll do loads of



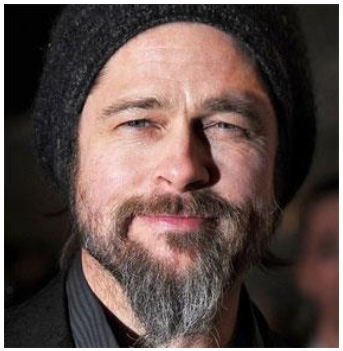
http://www.impawards.com/2005/proof.html

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.

CSE 331 Support Pages

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 computes 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.

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

A common complaint

Your examples in class look nothing like HW questions.

It’s because …

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

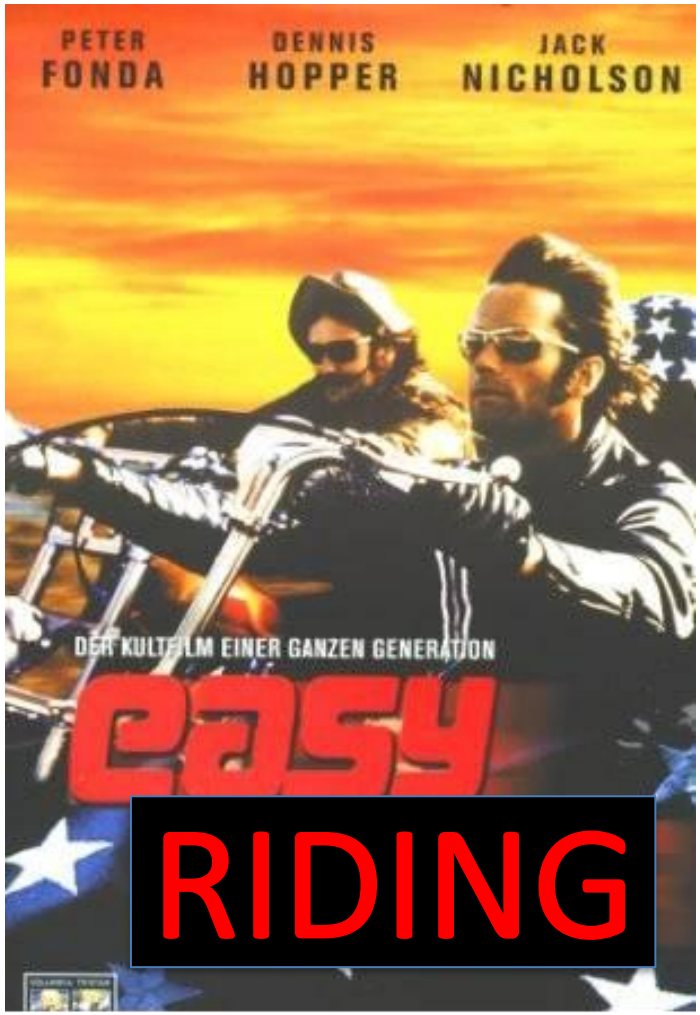
To get an A in the class

Have to get at least 90%

Rest graded on the curve

Questions/Comments?

How we will make 331



What we'll strive to do

Help you with your questions and/or doubts

Utilize all the resources: Piazza, office hours, recitations, email to course staff, …

Start early when a homework is released

We’re not mind readers

If you need it, ask for help

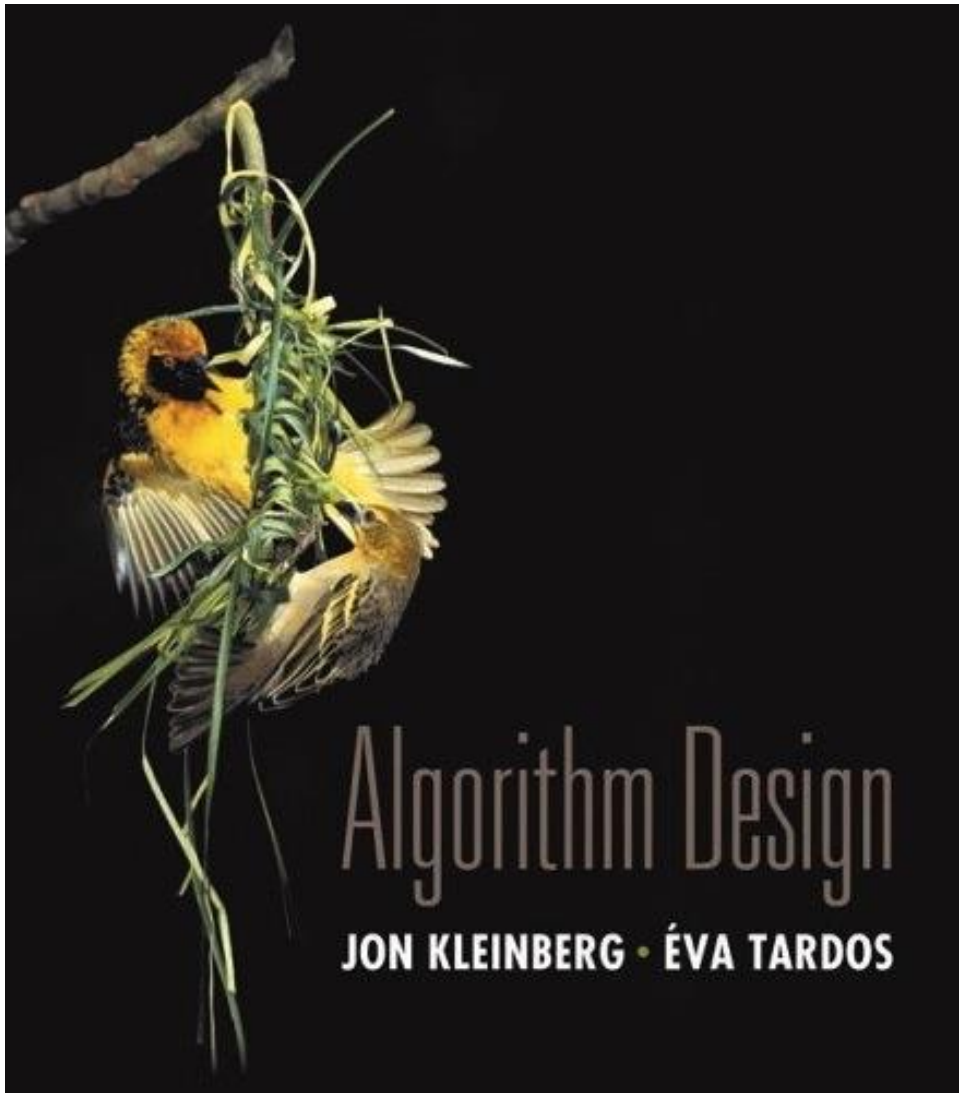
More chances to recover

Lowest two 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 Pages

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 116, 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!

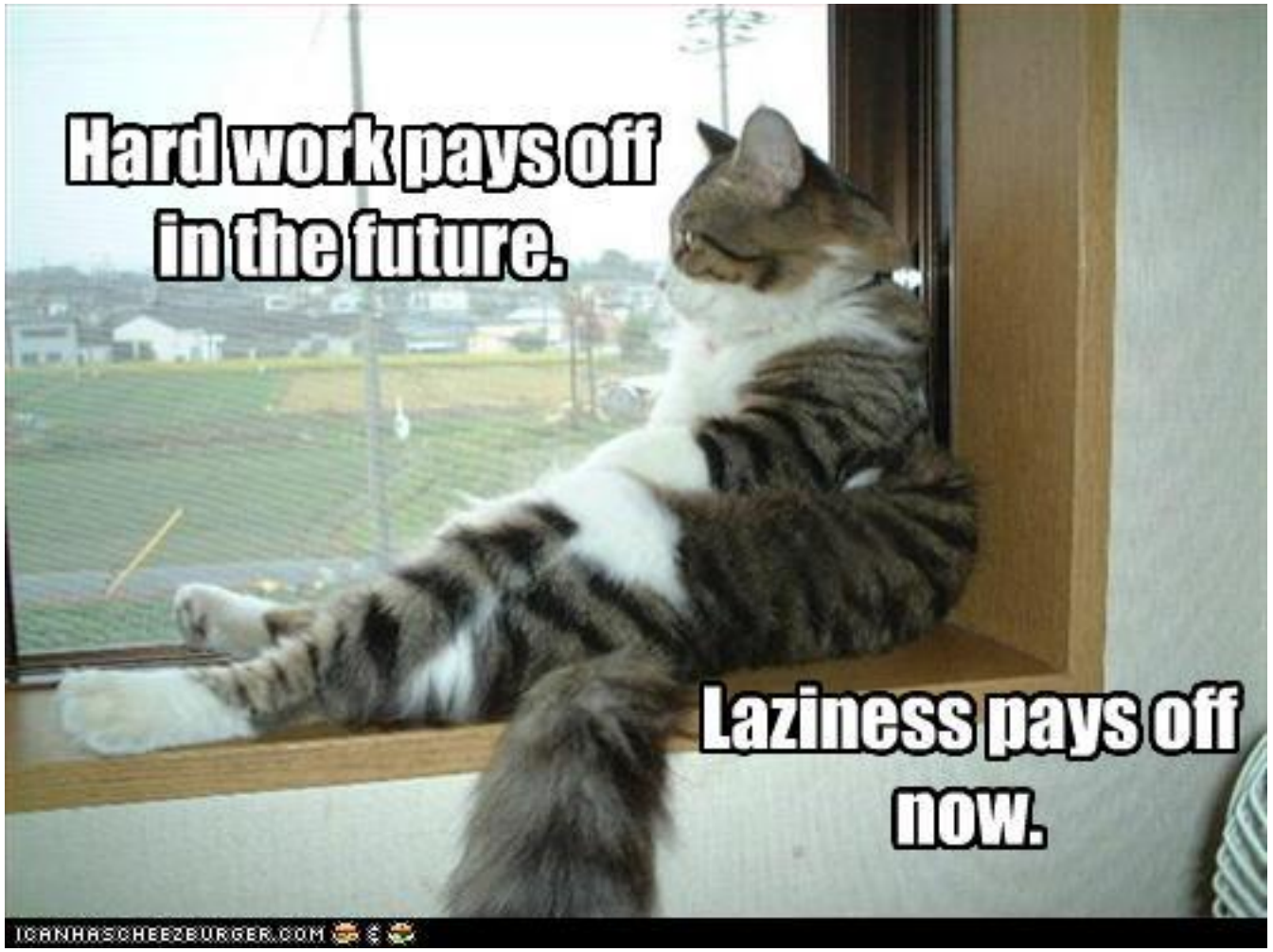
Other Resources

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

- Visualizing Algorithms.

https://cse.buffalo.edu/~nasrinak/cse331/support/index.html

The only way to do well is to work hard



Questions/Comments?