



Welcome
to
CSE 331

Let's do some introductions



http://www.zazzle.com/warning_teaching_assistant_bag-149882665435161818

TAs first



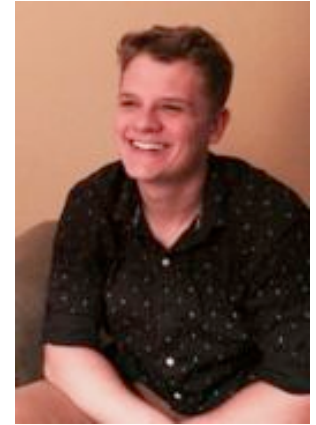
Meg



Adhish



Emily



Jordan



Elliott



Tri



Ashish

About Me

Atri Rudra

atri “at” buffalo

Office: 319 Davis

Office hours: Mon, 3:00-3:50pm; Wed 2:00-2:50pm

OH starts today

Contact us all at

cse-331-staff@buffalo.edu

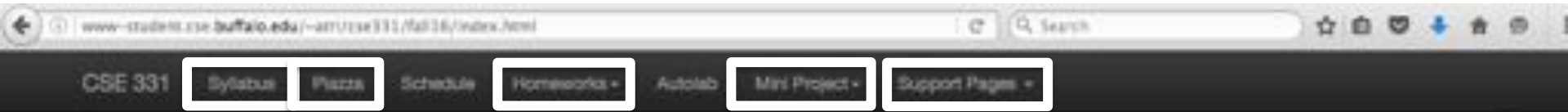
Handouts for today

Syllabus (online)

Homework Policy document (online)

Homework 0 (online)

One Stop Shop for the Course



CSE 331

Fall 2016

CSE 331 events

Today August 2016

Sun	Mon	Tue	Wed	Thu	Fri	Sat
31	Aug 1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20

<http://www-student.cse.buffalo.edu/~atri/cse331/fall16/index.html>

Homework 0 (Optional)

CSE 331 Syllabus Piazza Schedule **Homeworks -** Autolab Mini Project - Support Pages -

Homework 0

Due by **12:30pm, Friday, September 2, 2016**

Make sure you follow all the [homework policies](#).

All submissions should be done via [Autolab](#)

Submitting HW 0 is optional. However, we do encourage you to submit to get familiar with [Autolab](#) and to get some feedback. It will also allow us to iron out some kinks in [Autolab](#).

HW 0

[Allowed Sources](#)

[Homework Policies](#)

Due: this Friday

⚠ [Autolab is not fully functional yet.](#)

We are doing some final tweaks on [Autolab](#) so it is not open for submission yet. You should be able to start submitting your homeworks on [Autolab](#) starting sometime on Wed, August 31, 2016. Even then it might not have all the functionality. We hope to have the main features in place by the time HW 1 is rolled out.

What is a proof?

Two things to remember

DO NOT CHEAT!

WORK HARD!

You might not be good at algos

YET



Academic Dishonesty

All your submissions must be your own work

Penalty:

Minimum: An **F** grade

Possible: **F** “due to academic dishonesty” on your transcript

YOUR responsibility to know what is cheating, plagiarism etc.

If not sure, come talk to me

Excuses like “I have a job,” “This was OK earlier/in my country,” “This course is hard,” etc. **WON’ T WORK**

I DO NOT HAVE ANY PATIENCE WITH ANY CHEATING :
YOU WILL GET AN F IN THE COURSE FOR YOUR FIRST MISTAKE

Read the syllabus CAREFULLY!

CSE 331

Introduction to Algorithm Analysis and Design

Fall 2016

University at Buffalo

Department of Computer Science & Engineering

CSE 331 — Introduction to Algorithm Analysis and Design

I' ll need confirmation in writing. No graded material will be handed back till I get this signed form from you!

I, _____ (PRINT name), acknowledge that I have read and understood the syllabus (and the homework policy document) for this course, CSE 331 *Introduction to Algorithm Analysis and Design*.

I also acknowledge that I understand the definition of academic integrity as outlined in the syllabus, and that I will minimally receive a grade of F in the course if I am found to have breached academic integrity, *even if it occurs for the first time*. In particular, I understand that I cannot claim that I did not understand the rules if I am found to have breached academic integrity.

Signature: _____

Date: _____

Where to find the form

CSE 331 Syllabus Piazza Schedule Homeworks + Autolab Mini Project + Support Pages +

CSE 331 Syllabus

Fall 2016

Mondays, Wednesdays and Fridays, 1:00-1:50pm, [KNOX](#) 110.

Please note

It is **your responsibility** to make sure you read and understand the contents of this syllabus. If you have any questions, please contact the instructor.

Acknowledgment

Once you have read the syllabus carefully, please sign [this form](#) and return it to Atri. As an incentive for you to fill in this form, you will not receive any feedback on your assignments till you fill in the form.

Academic Integrity

Grading break-down

Grading Policy

Here is the split of grades:

Course Component	% of grade
Mini project	6%
Homeworks	31%
Quizzes	3%
Exams	60%

Autolab

AUTØLAB

You need to sign in or sign up before continuing.

Autolab Homepage

 Remember me

[Sign up](#)

[Forgot your password?](#)

[Didn't receive confirmation instructions?](#)

[Sign in with your CMU account](#)

[Autolab Project](#) - [Contact](#) - [GitHub](#) - [Facebook](#) - [Logout](#)

More details
forthcoming

Thanks for
your patience!

Pre-requisites

Required (officially)

CSE 250, CSE 191 and MTH 142

At least a C-

Required (for practical purposes)

Comfort with proofs

Willingness to work hard!

Disabilities

Information included in the syllabus

In short, let me know and consult with Office of Disability Services

Preferred Name

If you prefer using name diff from UB records

Let me know and we'll make a note of it.

TA Office hours

YOU decide!

Look for survey on piazza (should be up in a day or two)

Recitations

Will start next week

Exams

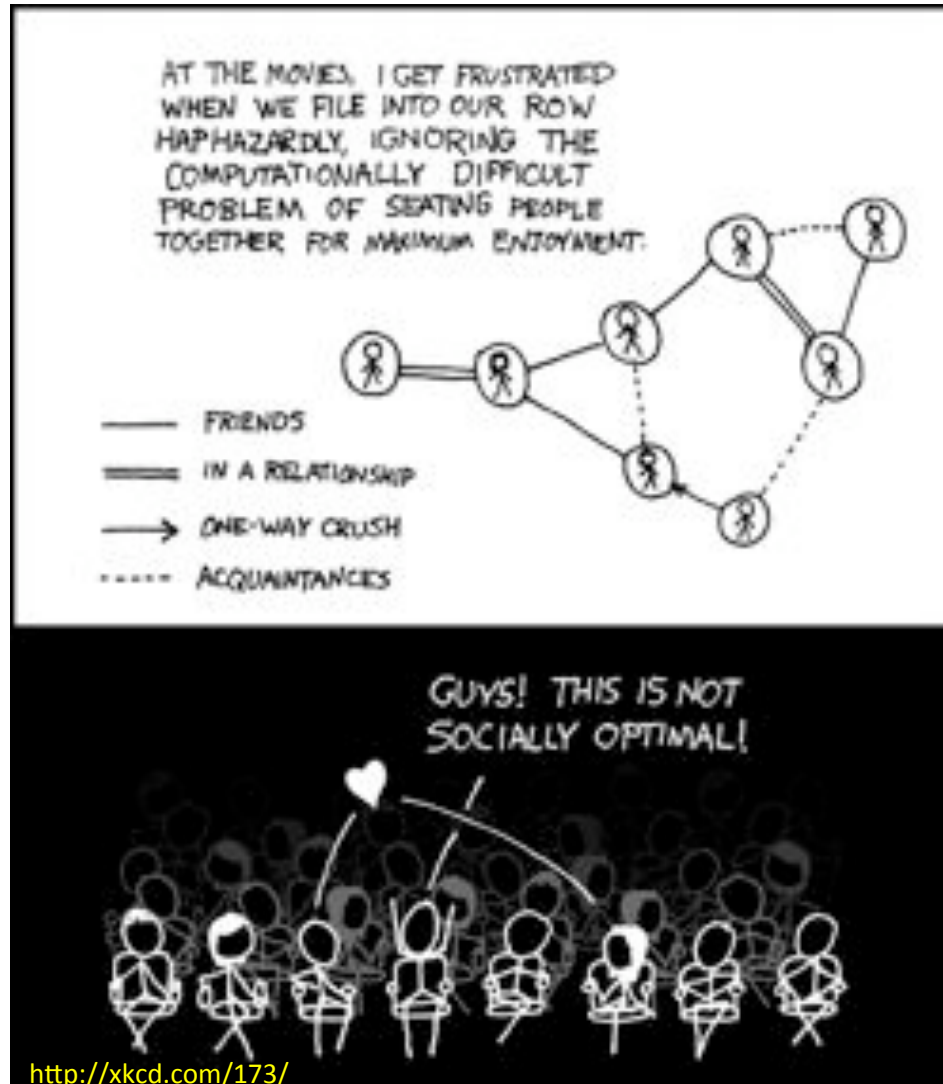
Mid term (two parts)

Mon, **Oct 17** and Wed, **Oct 19**, 2015. Usual place and time.

Final exam

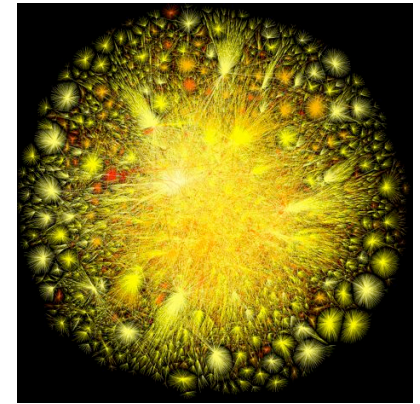
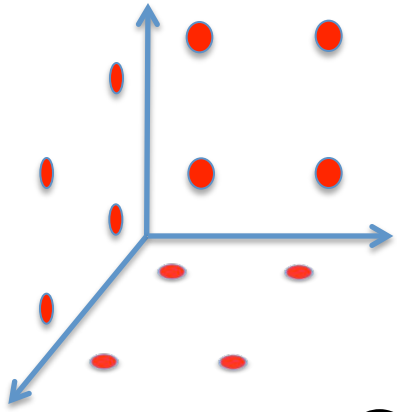
Fri, **Dec 16**, 2015. KNOX 110, **noon-2:30pm**

This course: how to solve problems!



Why should I care ?

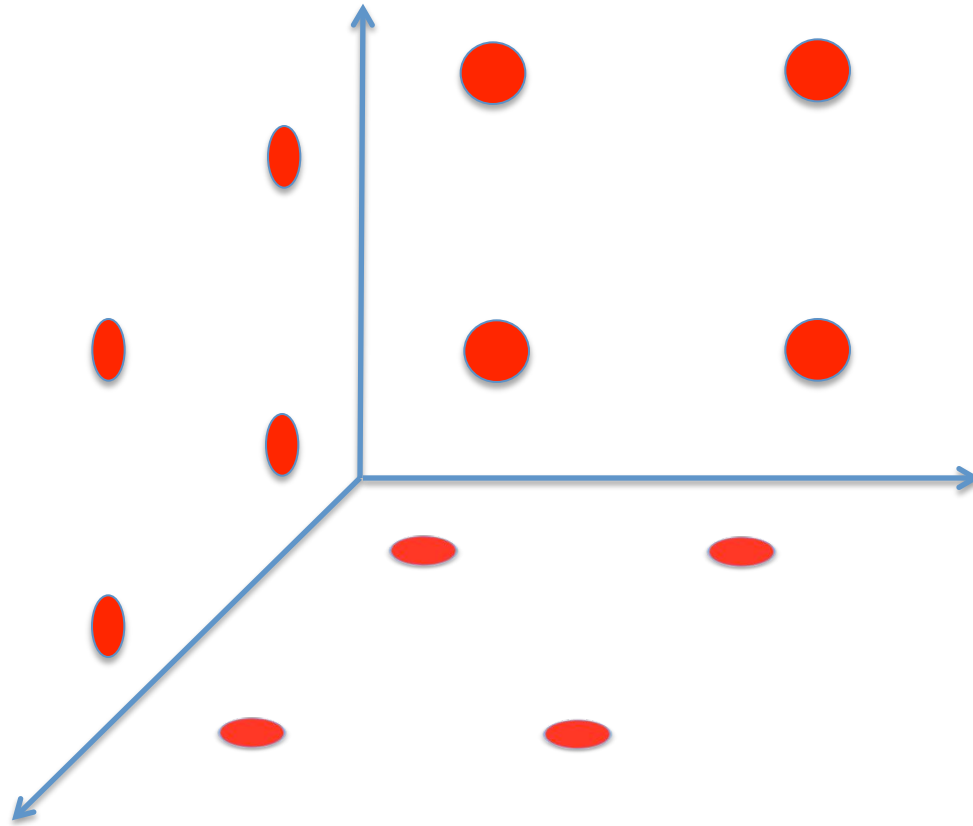




Combining Shadows to Understanding the network

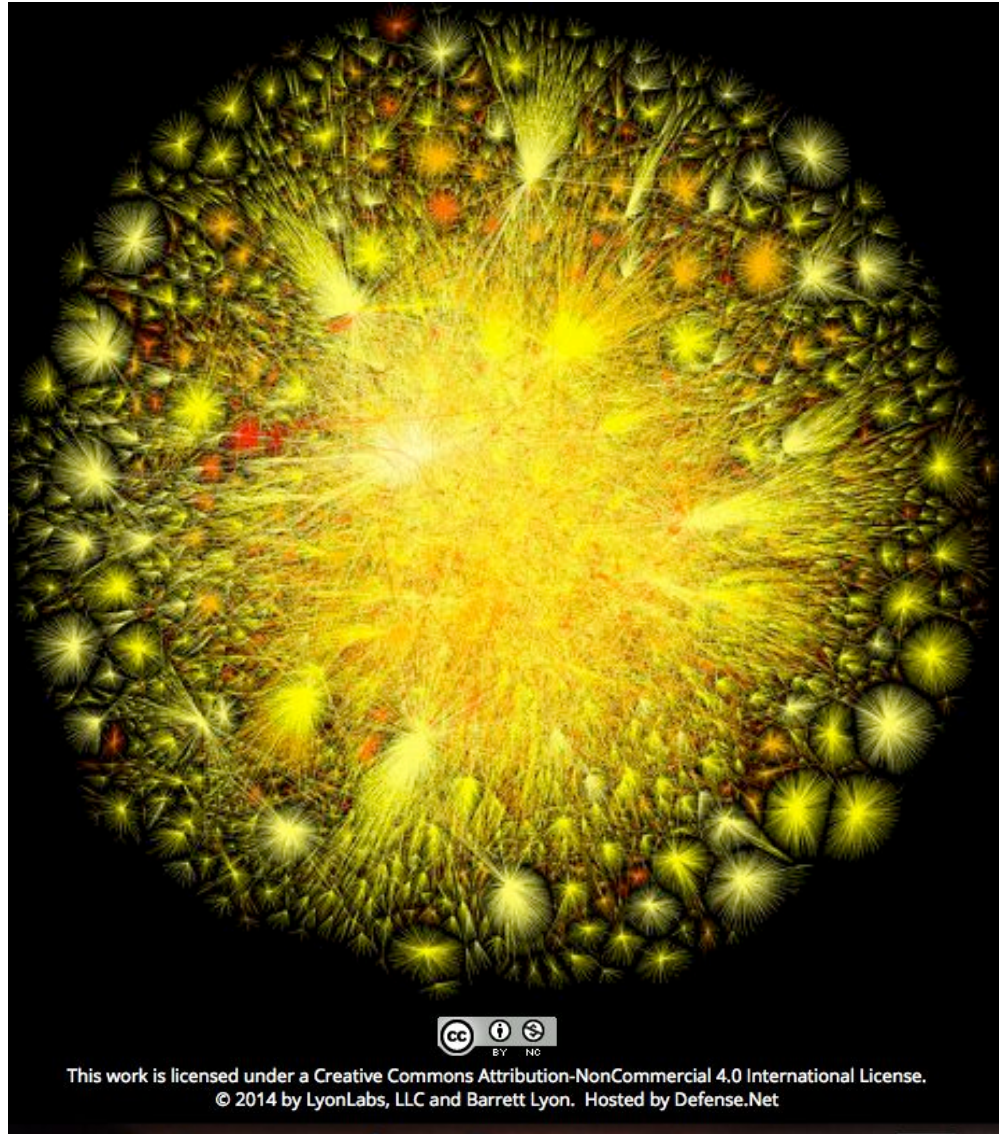


The key technical problem

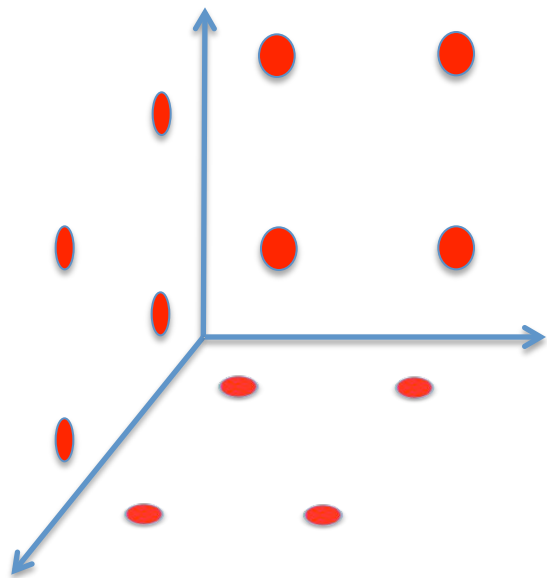


Given the three projections, what is the largest size of the original set of points?

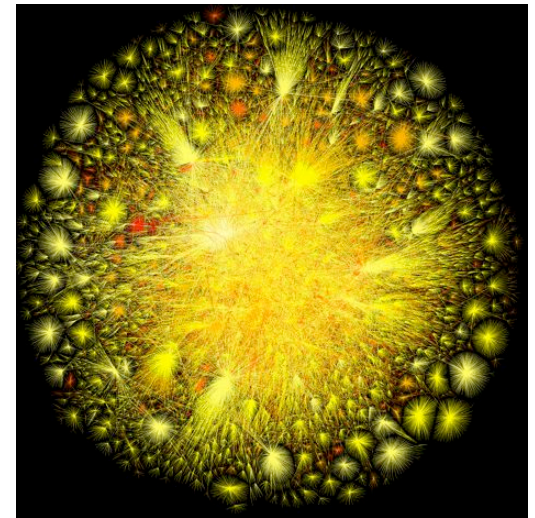
Detecting Communities



Conquering Shadows to Conquering the Internet



Algorithmically compute
the missing set



The proof is in the performance

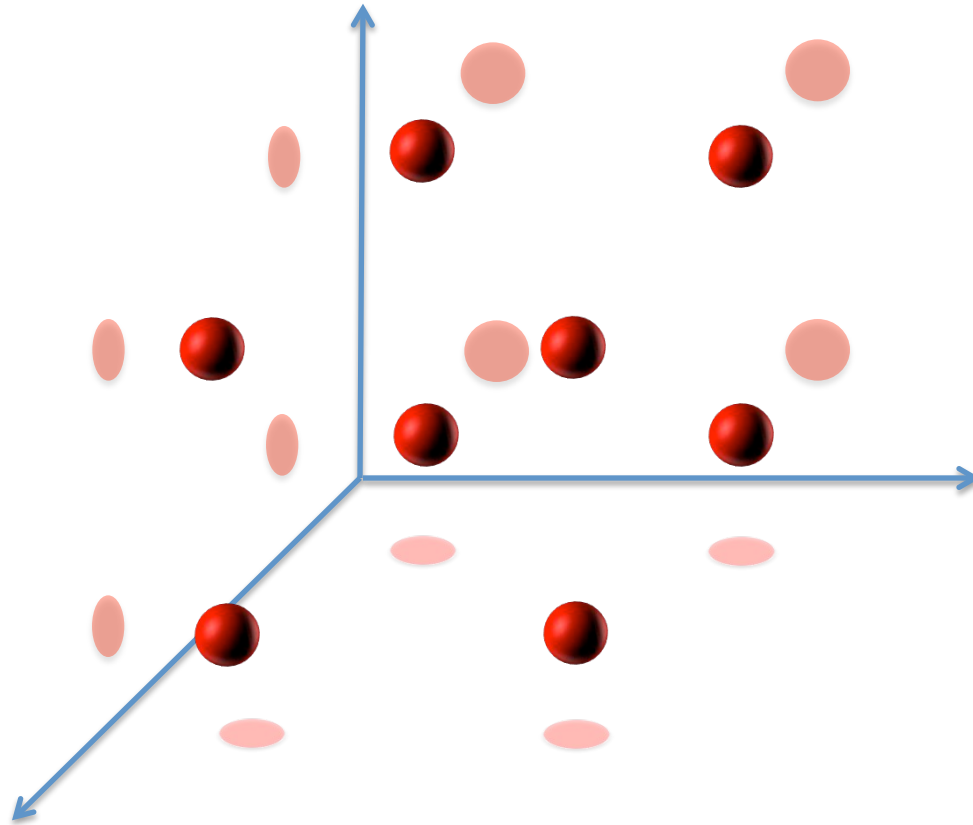


10x faster



Better algorithm with little hacking will beat 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

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.**”

Why care about algorithms?

Web Images Videos Maps News Shopping Gmail more ▾

atrinudra@gmail.com | My Profile | News | Web History | My Account | Help | Sign out

Google maps seattle wa Search Maps Show search options

Get Directions My Maps Print Send Link

Driving directions to Buffalo, NY

I-90 E 3,387 mi 1 day 18 hours

This route has tolls.

Seattle, WA

1. Head southwest on Madison St toward 4th Ave 0.1 mi
2. Take the 1st right onto 4th Ave 0.2 mi
3. Take the 1st right onto Spring St 0.1 mi
4. Turn right onto the I-5 S ramp to Portland 0.3 mi
5. Follow signs for I-90 E/Bellevue/Spokane and merge onto I-90 E 87.7 mi
6. Take exit 510 for US-212 E toward Battlefield/Broadway/Little Bighorn 0.3 mi
7. Turn left at US-212 E 108 mi
8. Turn right at US-212 E/Park Ave 34.1 mi
9. Turn right at US-212 E/US-85 S 2.4 mi
10. Turn left at S Dakota 34 E 17.3 mi
11. Turn left to merge onto S Dakota 34 E/I-90 E/US-14 E 54.7 mi
12. Take exit 106A to merge onto I-19 N 11.7 mi

seattle wa

© 2010 Google - Map data © 2010 Google, Imagery © 2010 Google, Labels © 2010 Google

Driving directions

Why care about algorithms?

amazon.com

Hi, AJR. We have recommendations for you. (0/2/21)

Today's Deals | Gifts & Wish Lists | Gift Cards

FREE Two-Day Shipping for College

Amazon Video On Demand

Automotive

Baby

Beauty

Books

Camera & Photo

Cell Phones & Service

Clothing

Computer & Accessories

Electronics

Grocery & Gourmet Food

Health & Personal Care

Home & Garden

Home Improvement

Industrial & Scientific

Jewelry

Kindle Store

Kitchen & Dining

Magazines

Movies & TV

MP3 Downloads

Music

Musical Instruments

Office Products

Patio, Lawn & Garden

Bestsellers

Hot New Releases

Movers & Shakers

Most Gifted




Most Wanted For

Any Category

Bestsellers




The most popular items on Amazon.com (Updated hourly)

Electronics Bestsellers

1. 26 days in the top 100

Kindle Wireless Reading Device, Wi-Fi, 6" Display, Graphite - Latest Generation by Amazon
2. 26 days in the top 100

Kindle 3G Wireless Reading Device, Free 3G + Wi-Fi, 6" Display, Graphite, 3G Works Globally - Latest Generation by Amazon
3. 26 days in the top 100

Kindle 3G Wireless Reading Device, Free 3G + Wi-Fi, 6" Display, White, 3G Works Globally - Latest Generation by Amazon

See all bestsellers in Electronics

Toys & Games Bestsellers

1. 713 days in the top 100

2. 2 days in the top 100

3. 113 days in the top 100


Computing Bestsellers on the fly

Why care about algorithms?

Welcome - Already a member? | [Sign In](#) | [My Itineraries](#) | [My Account](#) | [Customer Support](#) | [Feedback](#)

Home Vacation Packages Hotels Cars **Flights** ^{NO FEES} Cruises Activities DEALS & OFFERS Maps Business Travel

Start search over

Change your search

Departure airport:

Destination airport:

Departing: (mm/dd/yy)

Returning: (mm/dd/yy)

Airline: [More info](#)

Class:

Nonstop flights only
 Refundable flights only

Change Travelers

1 Adult
[Change travelers](#)

⚡ - Indicates flight is operated by another airline. Move your mouse over the icon for details.

Buffalo, NY (BUF) to Atlanta, GA (ATL)

These results cover a metro area with [several airports](#). Review your choices carefully.

	Mix & Match Airlines	US Airways	AirTran Airways	Delta	UNITED	Continental
Nonstop	from \$274 \$295 total see below	—	from \$274 \$295 total	from \$283 \$305 total	—	—
1 stop	from \$254 \$293 total see below	from \$254 \$293 total	from \$341 \$373 total	—	from \$283 \$326 total	from \$283 \$326 total

[Show more airlines »](#)

Prices are per person for roundtrip travel, they are e-ticket prices and include **all flight taxes and fees**. Prices do not include **baggage fees or other fees** charged directly by the airline.

No Expedia booking fees on flights PLUS you still earn airline miles! [See details](#)

1 Choose a departing flight or [view complete roundtrips](#)

Sort by: Price Duration Departure time Arrival time

Roundtrip: from \$254.00 + \$39.80 taxes & fees = \$293.80

6:25 am Depart Buffalo (BUF)
Arrive Atlanta (ATL) **10:39 am**

Sun 21-Nov
Duration: 4hr 14min

US Airways 1656 / 29
Connect in Charlotte (CLT)

[Preview seat availability](#) [Select this departure](#)

Don't spend too much on this flight. Book as a package and save up to \$450*. [Shop Now](#)

Roundtrip: from \$254.00 + \$39.80 taxes & fees = \$293.80

7:05 pm Depart Buffalo (BUF)
Arrive Atlanta (ATL) **11:27 pm**


Sun 21-Nov
Duration: 4hr 22min

US Airways 959 / 1897
Connect in Charlotte (CLT)

Booking cheapest air tickets

Why care about algorithms?

Web Images Videos Maps News Shopping Gmail more ▼



About 176,000,000 results (0.19 seconds) [Advanced search](#)

Everything
More

Any time
Past 2 months
More search tools

[How Does Google Work? Learn How Google Works: Search Engine + AdWords](#) ☆
OMG infographic shows the search process, from indexing right on through to search result ranking & delivery.
[ppcblog.com/how-google-works/](#) - Cached

[Google Technology](#) ☆
How exactly **does Google** manage to find the right results for every query as quickly as ... Building upon the breakthrough **work** of B. F. Skinner, ...
[www.google.com/technology/pigeonrank.html](#) - Cached - Similar

[How Google Works](#) ☆
How **Google Works**. As a company, **Google** focuses on three key areas: Search, ... (See also How the **Google Ad Auction Works** or learn more about **Google ads**.) ...
[www.google.com/howgoogleworks/](#) - Cached
+ Show more results from [www.google.com](#)

[How Does Google Work? | SEO Book.com](#) ☆
Jun 30, 2010 ... This image might need updated in the years to come, but it **does** a great job laying out how **Google works** when you type a query into their ...
[www.seobook.com/how-does-google-work](#) - Cached

[How does Google work - PageRank explained | Switch I.T.](#) ☆
How **does Google work** - PageRank explained. Ben Richardson - March 2005. Many people are under the impression that if they create a web site with a catchy ...
[www.switchit.com/news/improve-pagerank.asp](#) - Cached - Similar

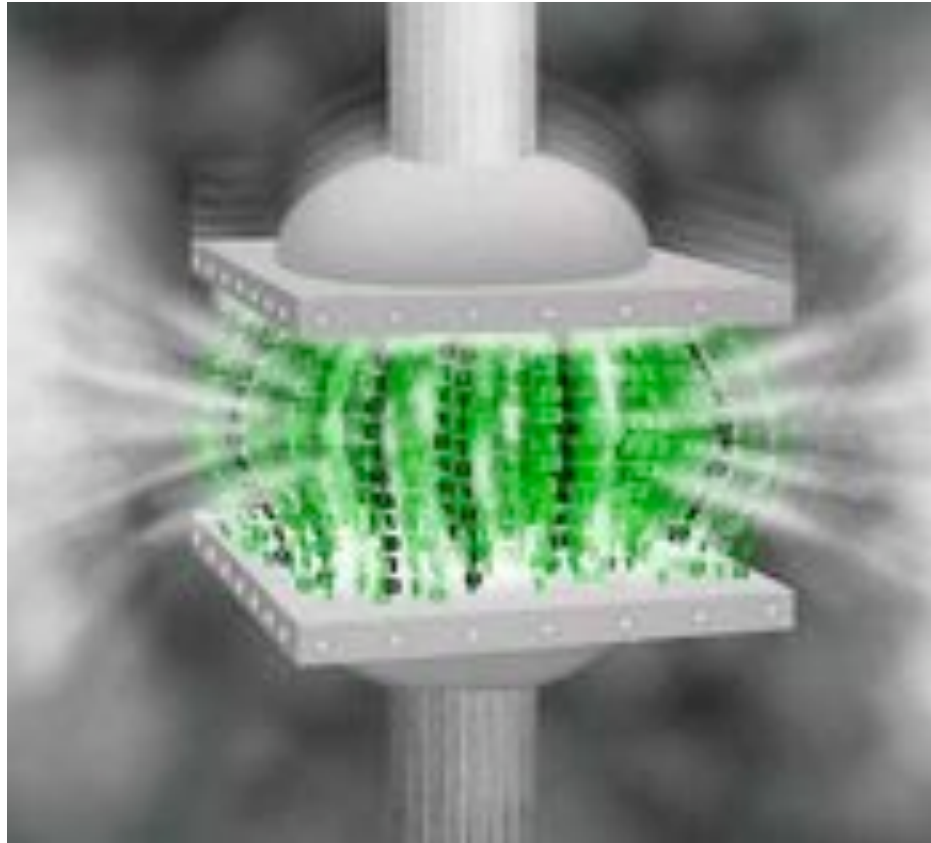
[How Google Works - Google Guide](#) ☆
Feb 2, 2007 ... For more information on how **Google works**, take a look at the following ...
How does Google collect and rank results?, [www.google.com/](#) ...
[www.googleguide.com](#) - Part II: Understanding Results - Cached - Similar

[How Does Google Work](#) ☆
Google is the undisputed king of the search engines. This leads to the question of **how does Google work?**
[www.marketingitan.com/how_does_google_work](#) - Cached - Similar

[Google: How does it work? by Jon Burgess of RedFusion Media](#) ☆

Google searches

Why care about algorithms?



<http://www.di.ens.fr/~cherniav/teaching.html>

Data compression

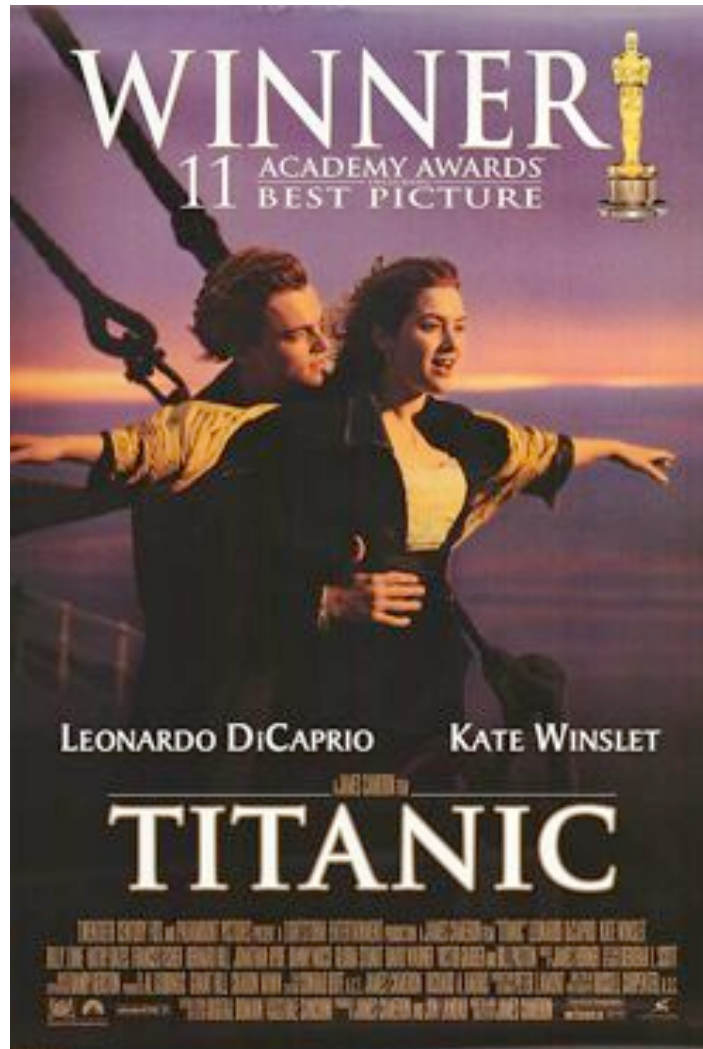
Why care about algorithms?



<http://www.switched.com/2010/02/11/fix-dvd-scratches-using-a-banana-and-toothpaste/> courtesy: thebiggs

Error correction

(And I could) go on...



<http://www.movieposter.com/poster/MPW-33672/Titanic.html>

Find out for yourself

Mini project: Video on social impact of algorithm. Groups of size = 3

CSE 331 Syllabus Piazza Schedule Homeworks - Autolab Mini Project - Support Pages -

CSE 331 Mini Project

Fall 2016

Details and motivations for the mini project.

Motivation

CSE 331 is primarily concerned with the technical aspects of algorithms: how to design them and then how to analyze their correctness and runtime. However, algorithms are pervasive in our world and is common place in many aspects of society. The main aim of the mini-project is to have you explore in some depth social implications of algorithms.

Just to give two examples for such implications:

- Algorithms are pervasive in financial transactions and these algorithms have consequences beyond just trading:



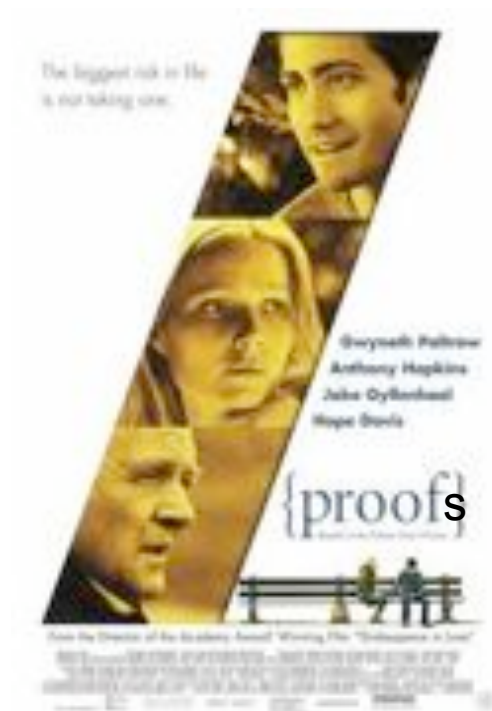
Questions/Comments?



Now about the course



We'll do loads of



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

Writing down your thought process formally and precisely!

The language of proofs

Brad Pitt had a beard



waleg.com

Every goat has a beard



animaldiversity.org

Hence, Brad Pitt is a goat.

Why do proofs?

Makes you think logically about problems and solutions

From a friend who works on Google Maps:

Proving that the algorithm I am implementing is correct helps me identify corner cases

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](https://www.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

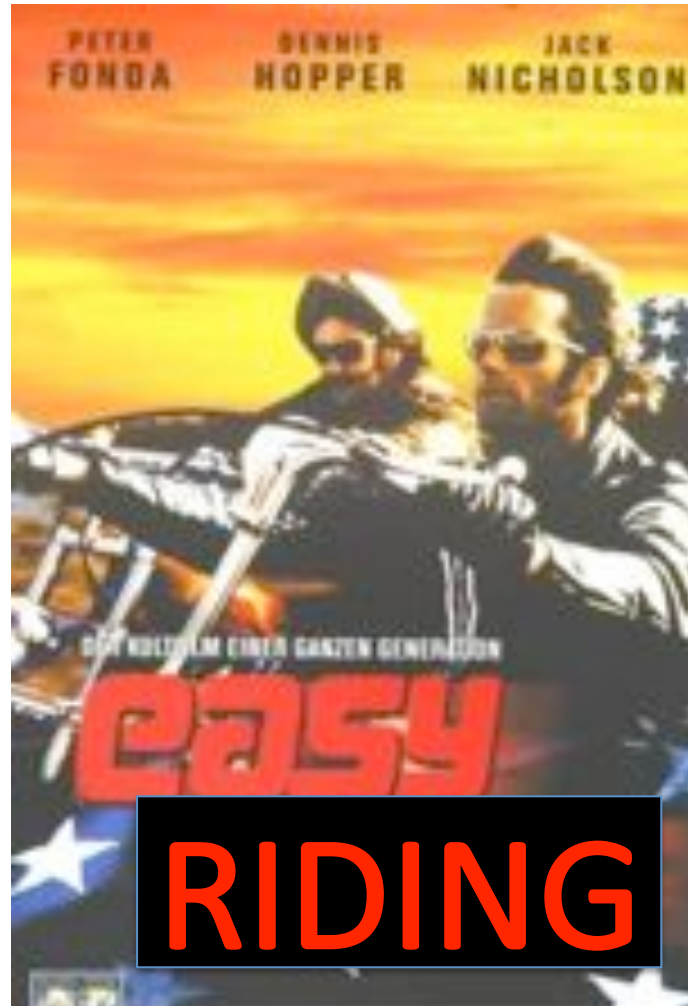
Got a **C**



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



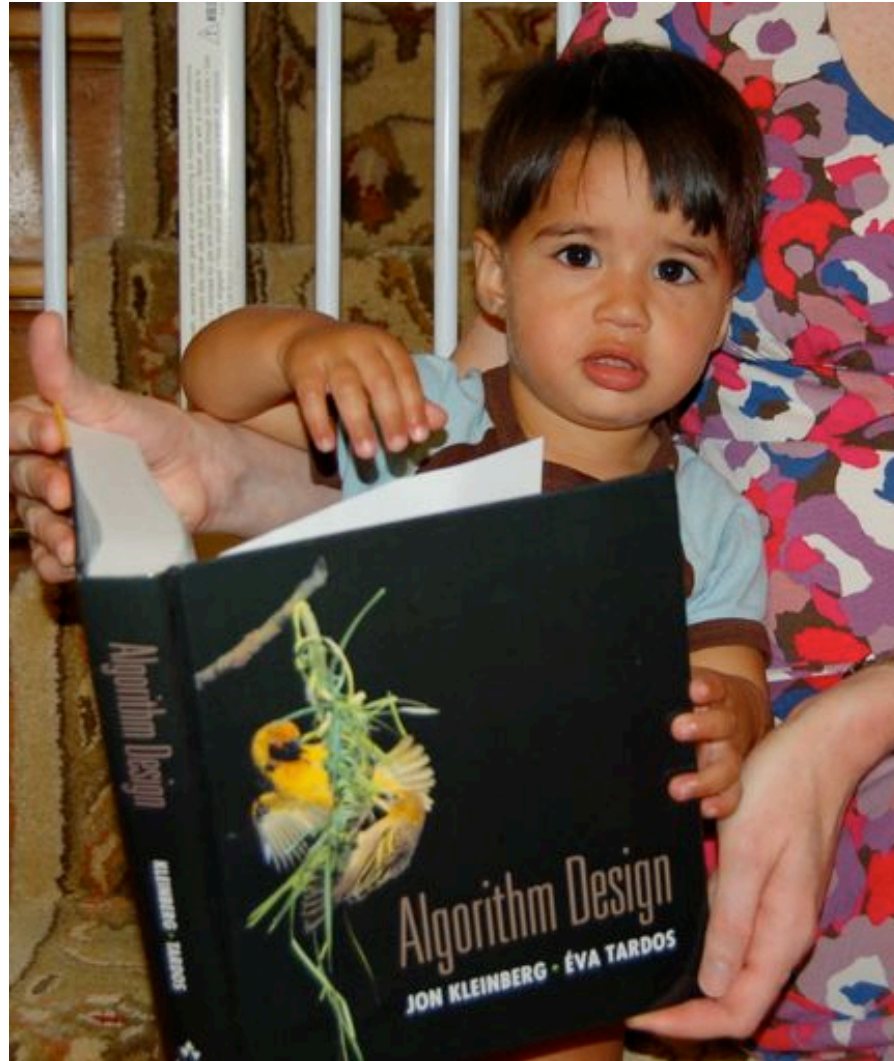
More chances to recover

Lowest three 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 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 have seen in CSE 116, 191 or 250. Also some of the

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](#).

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

