Lecture 4

CSE 331

Sep 4, 2024

Please do keep on asking Qs!

The only bad question is the one that is not asked!

Not just technical Qs but also on how the class is run

We're not mind readers

If you need it, ask for help

Syllabus Quiz (and sections)

note @42

stop following 1 view

Actions

Your Autolab section will be updated every Sunday

The way we enforce our policy that you will not receive graded HWs until you get >=18 on the syllabus quiz is by putting those who pass the syllabus quiz in section `Y` and the rest are in section `N`. We then only release grades for those in section `Y`. (You can find your section by clicking on the dropdown menu with your name on the top right of the CSE 331 page on Autolab and then by clicking `Course Profile`)

I have updated your sections. If you passed the syllabus quiz before 11am on Sunday (Sep 1) then your section should have been updated to a `Y`.

I plan to update the sections every Sunday (so if you pass the syllabus quiz after 11am Sep 1 you will have to wait until Sep 8).

logistics autolab

Edit good note 0

Updated 25 seconds ago by Atri Rudra

Separate Proof idea/proof details

</> Note

Notice how the solution below is divided into proof idea and proof details part. **THIS IS IMPORTANT: IF YOU DO NOT PRESENT A PROOF IDEA, YOU WILL NOT GET ANY CREDIT EVEN IF YOUR PROOF DETAILS ARE CORRECT**.

Proof Idea

As the hint suggests there are two ways of solving this problem. (I'm presenting both the solutions but of course you only need to present one.)

We begin with the approach of reducing the given problem to a problem you have seen earlier. Build the following complete binary tree: every internal node in the tree represents a "parent" RapidGrower while its two children are the two RapidGrowers it divides itself into. After s seconds this tree will have height s and the number of RapidGrowers in the container after s seconds is the number of leaf nodes these complete binary tree has, which we know is 2^s. Hence, the claim is correct.

The proof by induction might be somewhat simpler for this problem if you are not comfortable with reduction. In this case let $R(s)$ be the number of RapidGrowers after s seconds. Then we use induction to prove that $R(s) = 2^s$ while using the fact that $2 \cdot 2^s = 2^{s+1}$.

Proof Details

We first present the reduction based proof. Consider the complete binary tree with height s and call it $T(s)$. Further, note that one can construct $T(s+1)$ from $T(s)$ by attaching two children nodes to all the leaves in $T(s)$. Notice that the newly added children are the leaves of $T(s+1)$. Now assign the root of $T(0)$ as the original RapidGrower in the container. Further, for any internal node in $T(s)$ ($s \geq 0$), assign its two children to the two RapidGrowers it divides itself into. Then note that there is a one to one correspondence between the RapidGrowers after s seconds and the leaves of $T(s)$. Then we use the well-known fact (cite your 191/250 book here with the exact place where one can find this fact): $T(s)$ has 2^s leaves, which means that the number of RapidGrowers in the container after s seconds is 2^s, which means that the claim is correct.

Office hours finalized

note @34 stop following 66 views

Actions

331 OH and locations

The CSE 331 office hours are finalized! The exact times, location and identity of the CSE 331 staff member can be found in one of these two locations (please see the possible exceptions for Tue, Sep 3 below):

- The Google calendar in the 331 landing page
- The CSE 331 staff information in the 331 syllabus page

The **locations of the OH** are as follows:

All office hours (of TAs as well as Atri) will be in **Salvador Lounge**, **EXCEPT** for these specific times:

- **MONDAYS**
  - 1:00-2:00pm: Clemens 17
  - 2:00-3:00pm: Clemens 06
  - 3:00-5:00pm: Clemens 220
- **TUESDAYS**
  - 2:00-6:00pm: Davis 113Y
- **FRIDAYS**
  - 12:00-2:00pm: Baldy 111
  - 2:00-6:00pm: Baldy 109

1st True/False poll

poll @40 stop following 1 view

Actions

The first true/false question

The plan is to do a weekly True/false question on piazza. This week I'm about a day late but going forward, the way it is going to work is that every Monday (or so) I will post a statement in a poll and ask you guys to vote True or False. (Please just vote and do not post your justification: yet.) Then after two days, I will give the correct answer (and we will see how well crowd-sourcing works in this context) and then ask for you guys to construct the correct justification. Note that this is to give you guys more practice for the true/false questions on the exams (there will be pretty much no true/false questions on the homeworks). So try and work on these on your own so that you gain some practice.

Anyhow, here is the **question for this week**. Is the following statement **True** or **False**?

Given n numbers $a_1, \ldots, a_n$ such that for every $i \in [n]$ (we will use $[n]$ to denote the set of integers $\{1, \ldots, n\}$) we have $a_i \in \{0, 1\}$. That is, we are given n numbers each of which is a bit. Then we can sort these n numbers in $O(n)$ time.

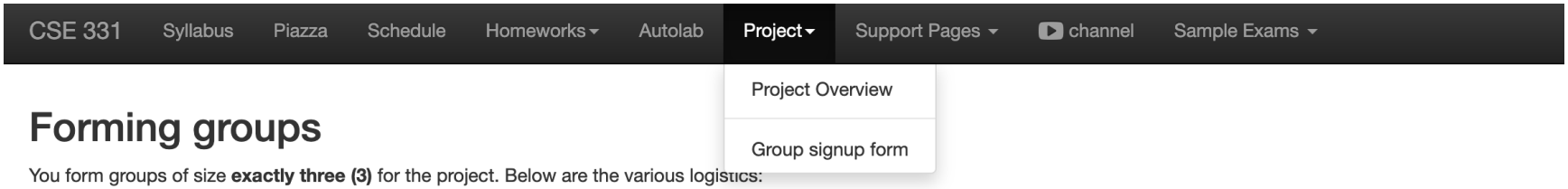
- ○ True
- ○ False

Please select one option

Submit

Register your project groups

Deadline: Friday, Sep 20, 11:59pm



Forming groups

You form groups of size **exactly three (3)** for the project. Below are the various logistics:

- You have two choices in forming your group:
  1. You can form your group on your own: i.e. you can submit the list of EXACTLY three (3) group members in your group.

> **</> Note**
>
> Note that if you pick th… …nnot submit as a group of size two. If …
>
> Also, if you form a gro…

If you miss this deadline then you will get a ZERO on the ENTIRE project

  2. You can submit *just your name*, and you will be assigned a random group *among all students who take this second option.* However, **note that if you pick this option, you could end up in a group of size** 2. There will be at most two groups of size 2.

> **</> Potential risk**
>
> Note that if you pick the option of being assigned a random group, you take on the risk that a assigned group might not "pull their weight." We unfortunately cannot help with such aspects of group dynamics. (Of course if a group member is being abusive, please do let Atri know.) Please note that a group member who does not do much work will get penalized on the individual component of the project grade.

- **Submitting your group composition**
  Use this Google form to submit your group composition (the form will allow you to pick one of the two options above).

- You need to fill in the form for group composition by **11:59pm on Friday, September 20**.

Piazza Response policy

Piazza Response policy

Please note the following rules regarding response time to student questions on Piazza:

1. Any question posted between Friday 5pm and Monday 9am might not get an answer from CSE 331 staff before Monday 9am.
2. On weekdays, we will aim to respond to student question within four hours unless the question is posted between 7pm and 9am, in which case we might only be able to respond after 9am.

Please note that the above does *not* means that we will never answer questions posted in the evening/night times as mentioned above-- it's just that we might not always be able to respond within four hours. Based on previous years, I do expect there to be reasonable response time in the evening times as well-- it's just that OUR response times might be more variable.

Solutions to HW 0 out

note @45 stop following 1 view

Actions

HW 0 solution out

Here is the solution to HW 0:

http://www-student.cse.buffalo.edu/~atri/cse331/fall24/hws/hw0/soln.html

You can also access it from the `Homeworks` drop down menu.

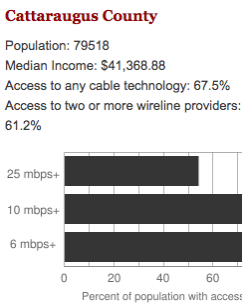
(Please note that as it says in the solutions, from HW 1, solutions will be released as a link to a PDF.)

Please see the schedule page for the recitation notes for this week.

homework0

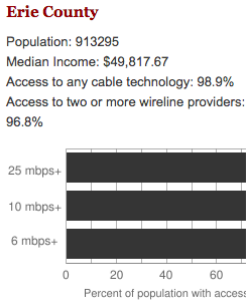
Edit good note 0 Updated 1 minute ago by Atri Rudra

Make broadband more available



BOTH
technical and
societal issues

Say you are tasked
to come up with
the infrastructure



Questions/Comments?

Make broadband more available

Input requirements

Where are the customers located?

What are the bandwidth requirements?

How is the input represented?

What objective are we optimizing?

How should the connections be configured?

Output requirements

Problem Definition

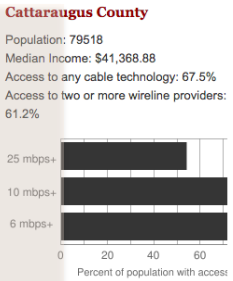
Where should we lay down the physical stuff?

What algorithm should be use to do this?

Algorithm Design

Implement the scheme

How should we do testing and maintenance?



Is Internet a right?

Environmental factors

Security/Privacy

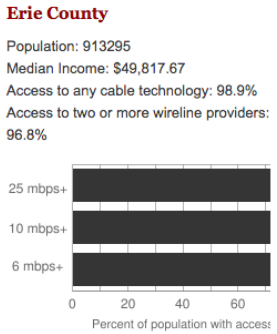
Where is funding coming from?

Income inequality in population

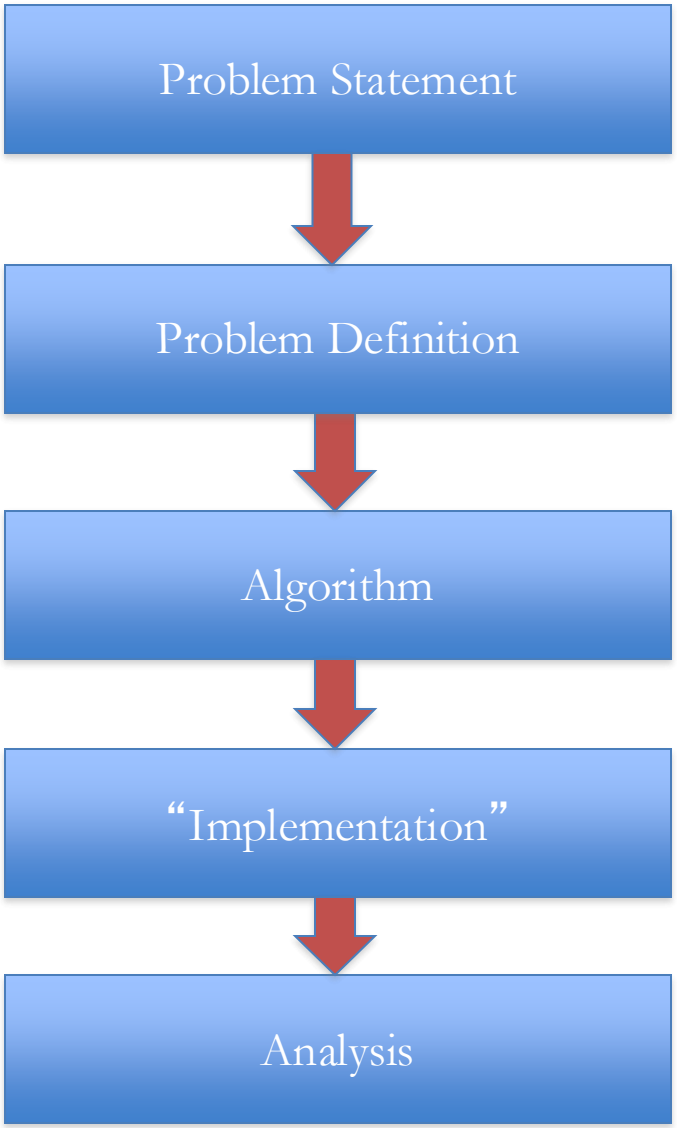
Get regulatory approval
Hire people

Get access to physical space

Outreach



Main Steps in Algorithm Design



Real world problem

Precise mathematical def

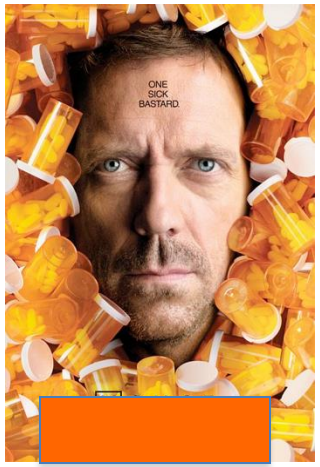
Data Structures

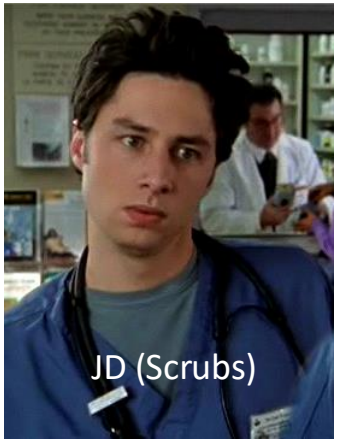
Correctness/Run time

Questions/Comments?

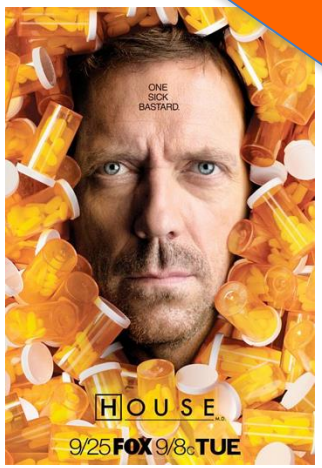
National Resident Matching

(Screen) Docs are coming to BUF

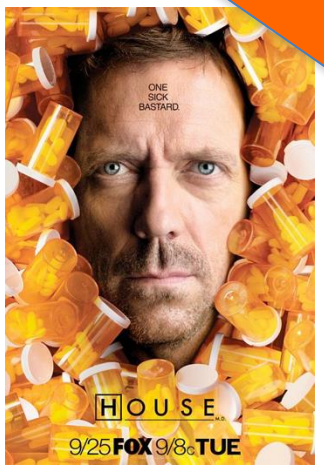




What can go wrong?



The situation is unstable!



What happens in real life

Preferences

NRMP
National Resident Matching Program

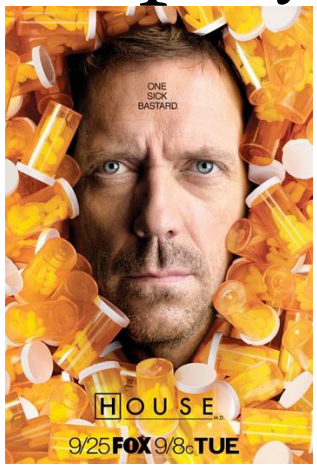
Information

NRMP
National Resident Matching Program

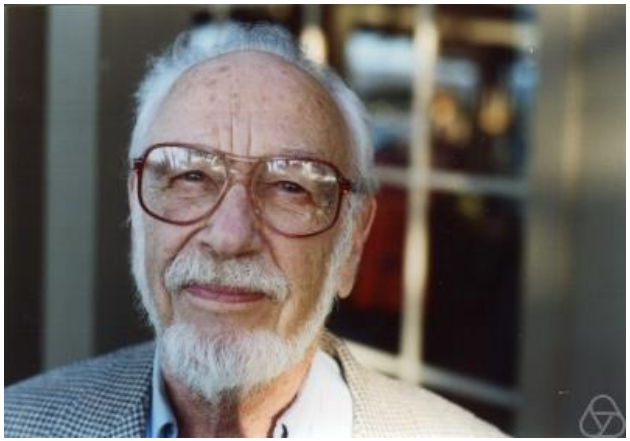
Preferences

NRMP
National Resident Matching Program

NRMP plays matchmaker



Stable Matching Problem



David Gale

Lloyd Shapley*

Questions/Comments?

Incorrect Proof Details: Q1(b) on HW0

Argument does not use ANYTHING about the problem statement!

Follows from part (a)

perfect matchings with n men and n women

This assumes number of perfect matchings only depends on n

Base case: P(1) = 1! = 1

Inductive hypothesis: Assume that P(n-1) = (n-1)!

Inductive step: Note that P(n) = n*P(n-1) = n*(n-1)! = n!

What are the issues with the above "proof"?

Incorrect Proof Details: Q1(b) on HW0

Needs justification

Claim 1: Number of perfect matchings is = number of permutations of 1…n

Claim 2: Number of permutations of 1…n is n!

Needs justification

Claims 1 + 2 prove the result

Follow from 191 (?)

What are the issues with the above proof?

Proof by contradiction for Q1(a)

Assume for contradiction there is an example where number of perfect matchings depends on the identities of the men and women.

Let n =1 and consider two cases
(1) M = {BP} and W = {JA}
(2) M = {BBT} and W = {AJ}

You can only assume things about the example directly implied by it being a counter-example

In both cases the number of perfect matchings is 1 = 1!

Hence contradiction.

There is NO contradiction

What are the issues with the above proof?

Questions/Comments?

Matching Employers & Applicants

Input: Set of employers (E)
Set of applicants (A)
Preferences

Output: An assignment of applicants to employers that is "stable"

For every x in A and y in E such that x is **not** assigned to y, either

(i) y prefers *every* accepted applicant to x; or

(ii) x prefers her employer to y