

Lecture 3

CSE 331

Sep 2, 2016

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: _____

Join piazza!

The screenshot displays the Piazza Q&A interface for a CSE 331 course. The top navigation bar includes the Piazza logo, course name 'CSE 331', and tabs for 'Q&A', 'Resources', 'Statistics', and 'Manage Class'. A user profile for 'Ari Rubin' is visible in the top right.

The left sidebar shows a list of posts:

- HW1: HW0 Q1 (Sorting Program...** (8/1/18) - Some things to note about Q1. Avoid using Internet Explorer to submit files. It's not supported by AutoLab. You may
- HW1: Clarification on language bel...** (8/1/18) - Wanted to clarify one doubt that some of you have had. Starting with HW 1, you will be able to submit to any of C++&B
- HW1: You should be added to Aut...** (8/30/18) - In case you already created an Autolab account (as per @16), you should be added to the CSE 331 course, if you had a
- Search for Teammates!** (8/15/18) - 7 Open Teammate Searches

The main content area features a 'Class at a Glance' summary, updated 4 seconds ago:

- no unread posts** (44 total posts)
- no unanswered questions** (296 total contributions)
- no unresolved followups** (29 instructors' responses, 3 students' responses, 15 min avg. response time)

Below this is a 'Student Enrollment' section showing 100 enrolled students out of 205 (estimated).

The main post is by an instructor:

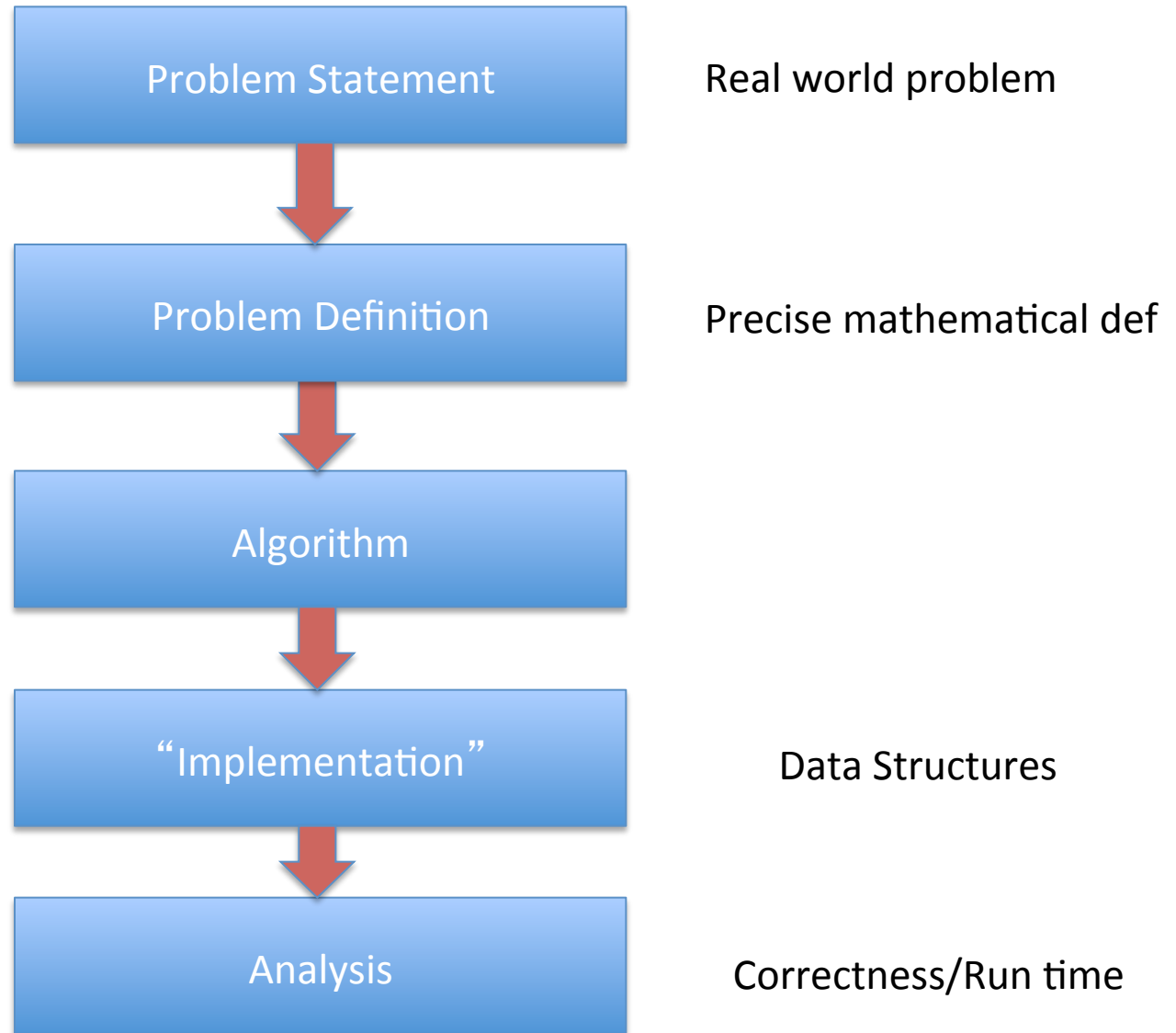
Dear Professors:

Last Fall, we launched a new service called Piazza Careers. And through this service, we have connected students with other students studying similar subjects, with recent alumni now in industry, and with potential employers. Many of them have successfully secured internships and jobs through our service!

Just as Piazza was born out of my deeply personal struggle to get help when I was stuck as a shy student (one of few women in my Computer Science class), Piazza Careers is born out of the challenges I faced grappling with what to do with my life - how and where to pursue my passions. We at Piazza have been at the first problem now for over 4 years and are just starting to embark on the second.

We have a vision for Piazza Careers, and like with Piazza Q&A we can't get there without your feedback. We are eager to make a real impact on students' lives, helping enhance their experience in their classes as well as their careers. It will require a lot of iteration and hard work. We'll inevitably make a few mistakes along the way and we ask for your

Main Steps in Algorithm Design



National Resident Matching

The screenshot shows the homepage of the National Resident Matching Program (NRMP). The browser address bar displays "www.nrmp.org" and the search bar contains "nrmp". The main navigation menu includes "ABOUT", "NEWS & ANNOUNCEMENTS", "THE MATCH A TO Z", "CONTACT US", and "NRMP". A search bar labeled "KEYWORD" is present. Below the navigation, there are links for "RESIDENCY", "FELLOWSHIP", "HOW IT WORKS", "POLICIES", and "MATCH DATA".

The main content area features a large banner with a photograph of a young girl in a blue medical cap and stethoscope, sitting on the floor and holding a teddy bear. To the right of the photo, the text reads "ON CY:" and "2015". Below the photo, it says "Hotel Monaco, New Orleans, LA". To the right of the banner, there is a section titled "Collectively discuss" with a bulleted list:

- strengthening transition to residency
- strategies for unmatched applicants
- resident readiness for training

At the bottom of the banner, it says "medical school faculty • residency program directors • hospital executives".

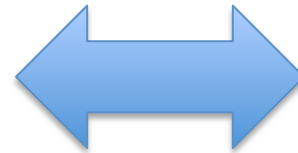
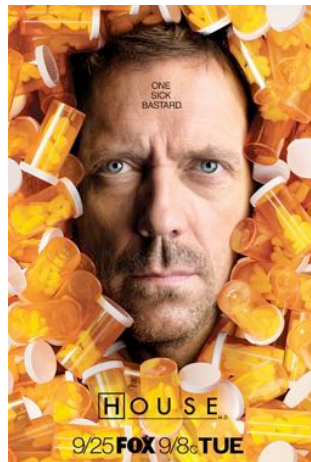
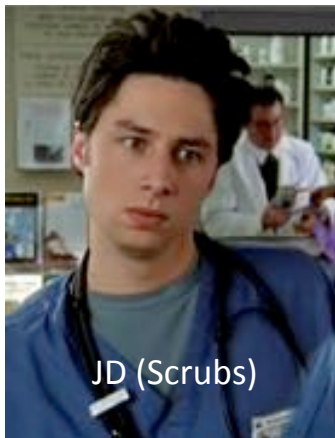
On the right side of the page, there is a vertical navigation menu with three main buttons: "START HERE", "RESIDENCY OVERVIEW", and "FELLOWSHIP OVERVIEW". To the right of these buttons are three smaller buttons: "REGISTER /LOGIN FOR A MATCH" (orange), "REGISTER /LOGIN HELP" (blue), and "EMAIL THIS PAGE" (blue with an envelope icon).

At the bottom of the page, there is a paragraph of text:

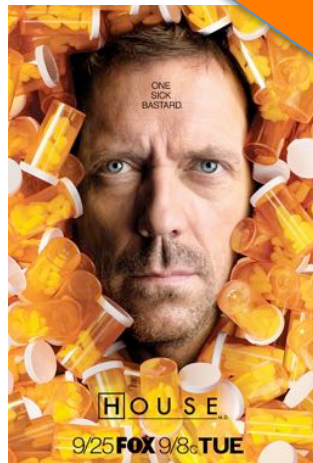
The Match provides unparalleled medical matching services in the United States. It's 100% objective, 100% accurate, and 100% committed to a fair and transparent process. With its internationally recognized algorithm, comprehensive data reports, and advanced technology, The Match is helping applicants achieve their dreams.

Getting it right since 1952.

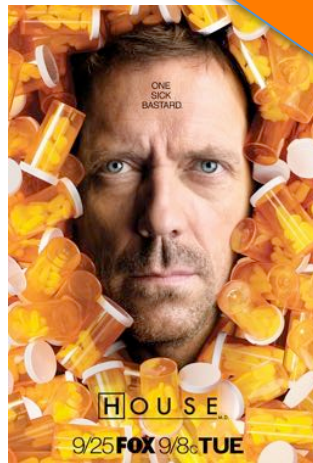
(Screen) Docs are coming to BUF



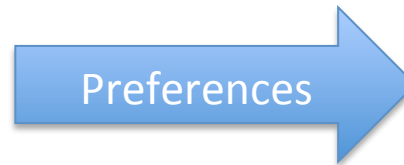
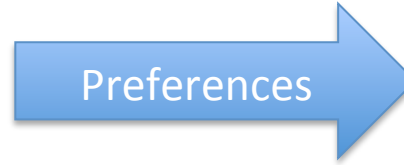
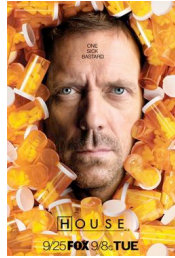
What can go wrong?



The situation is unstable!



What happens in real life



NRMP plays matchmaker



Stable Matching Problem



David Gale



Lloyd Shapley

Questions/Comments?



Matching Employers & Applicants

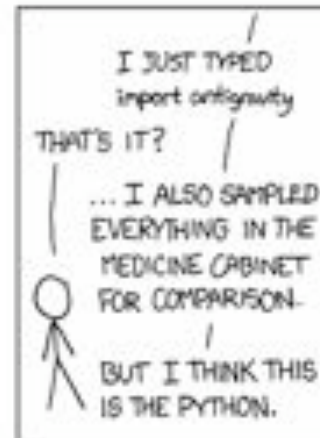
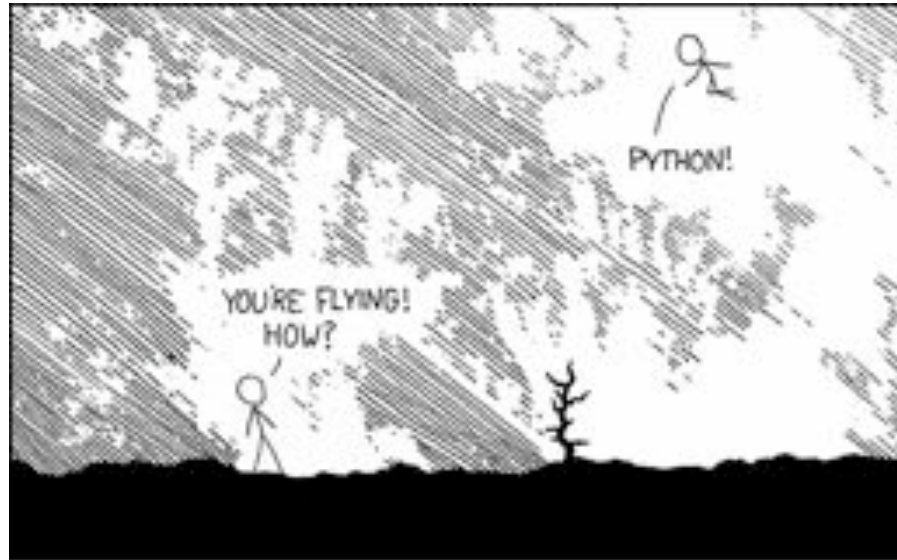
Input: Set of employers (E)
Set of applicants (A)
Preferences

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

Simplicity is good



Questions to think about

1) How do we specify preferences?

Preference lists

2) Ratio of applicant vs employers

1:1

3) Formally what is an assignment?

(perfect) matching

4) Can an employer get assigned > 1 applicant?

NO

5) Can an applicant have > 1 job?

NO

6) How many employer/applicants in an applicants/employers preferences?

All of them

7) Can an employer have 0 assigned applicants?

NO

8) Can an applicant have 0 jobs?

NO

Questions/Comments?



Non-feminist reformulation

n men

Each with a preference list

n women

Match/marry them in a “stable” way

On matchings

Mal



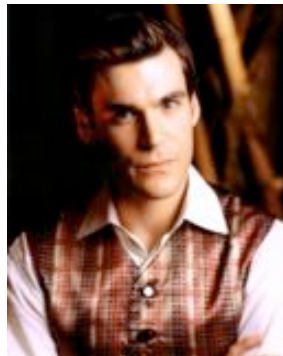
Inara

Wash



Zoe

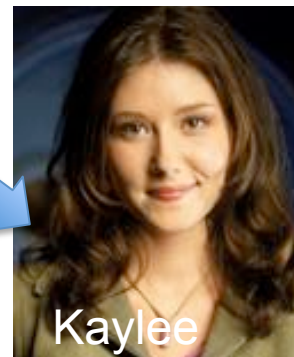
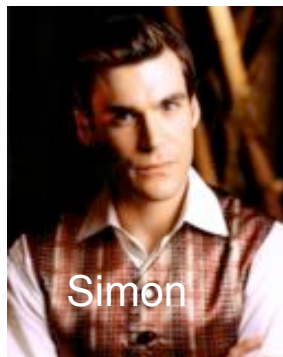
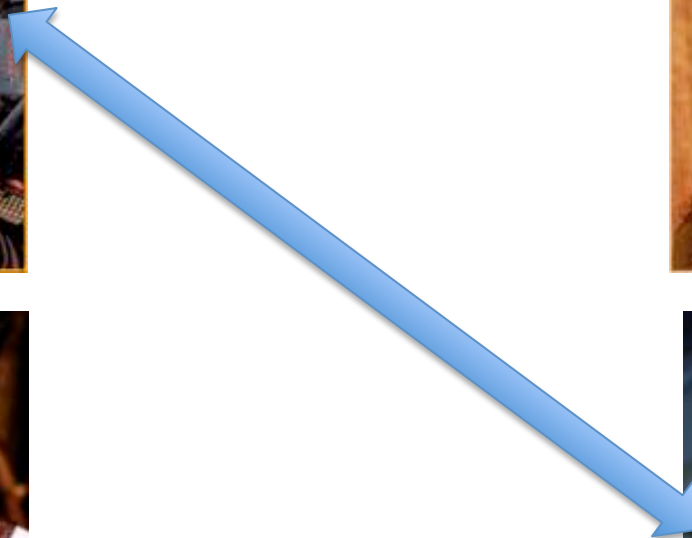
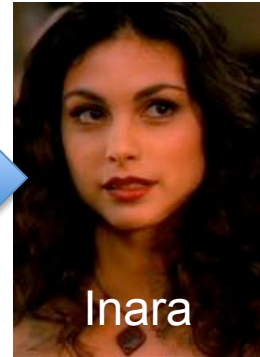
Simon



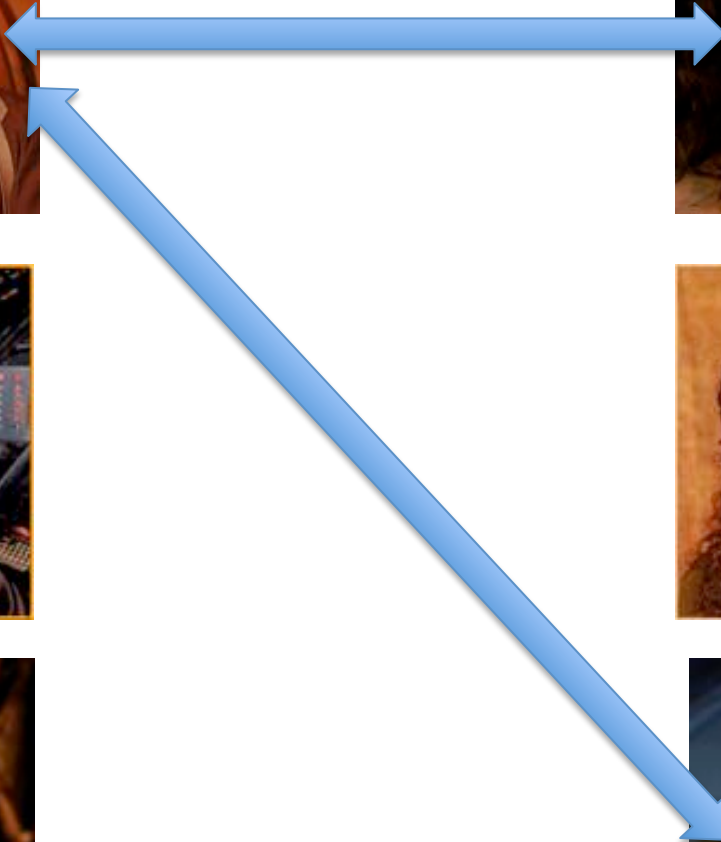
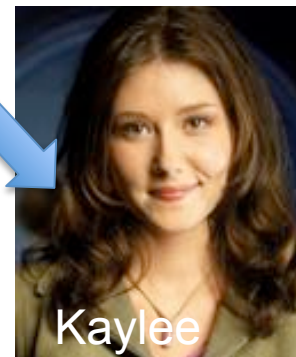
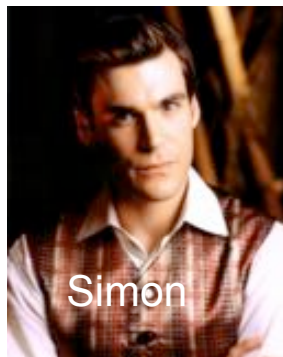
Kaylee



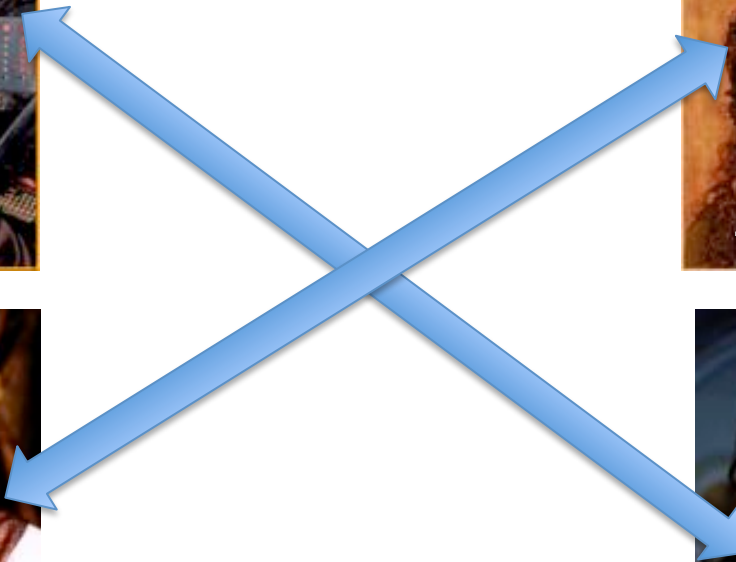
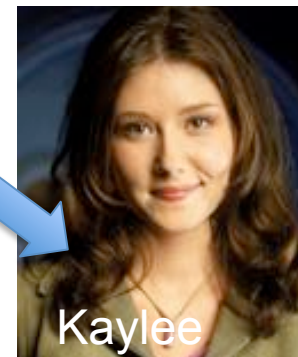
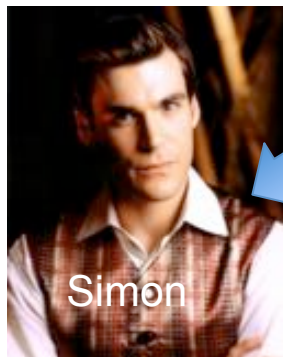
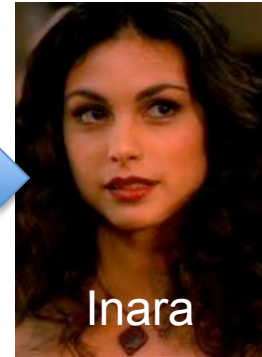
A valid matching



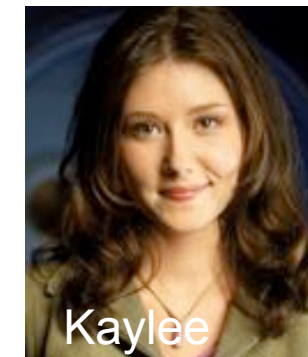
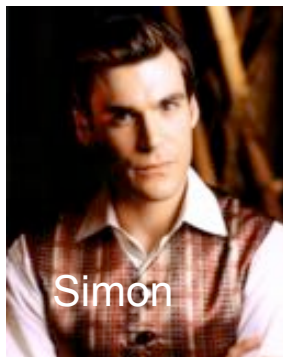
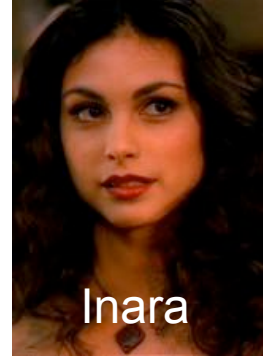
Not a matching



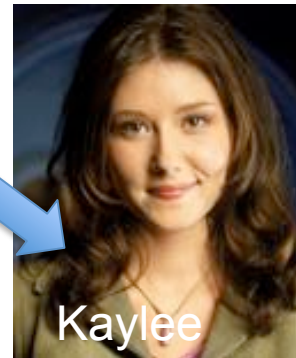
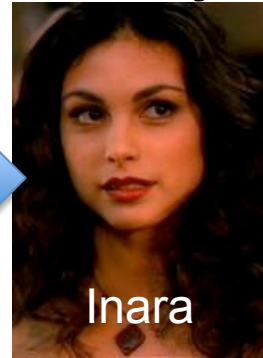
Perfect Matching



Preferences



Instability



Questions/Comments?



Discuss: Naïve algorithm!



The naïve algorithm

Go through all possible perfect matchings S

If S is a stable matching

then Stop



Else move to the next perfect matching

Gale-Shapley Algorithm



David Gale



Lloyd Shapley

$O(n^3)$ algorithm

Moral of the story...

