Platforms & Tools

D2L (DEN):
- Syllabus ✓
- Lecture Notes ✓
- Lecture Videos ✓
- HW Assignments ✓
- HW Submissions ✓
- Any other reference material ✓
- Exams ✓

Piazza: Discussion Board ✓

Roles & Responsibilities

- Instructor — lectures
- TAs — HW issues, Exam grading issues
- Graders — grade HW
- Course Producers
- CS Dept. Advisors — Reg. issues
- DEN Support — Any tech DEN platform issues

Textbooks

- Algorithms Design by Jon Kleinberg & Eva Tardos

- Supplemental Textbook: Introduction to Algorithms, 3rd edition, by Cormen et al.

Your Responsibilities

- Attending lecture
- Study material from Klemberg textbook
- Do HW problems ← ?
- Do as many other problems from textbook as possible

Your Grades

Mock Exam	4%	Anytime **BEFORE** Exam 1
Exam 1	44%	July 22 During class
Exam 2	52%	Aug 10 "
	100%	

Grading Scale

90 - 100	A	60 - 64.99	C^+
86 - 89.99	A^-	55 - 59.99	C
80 - 85.99	B^+	50 - 54.99	C^-
70 - 79.99	B	45 - 49.99	D
65 - 69.99	B^-	Below 45.99	F

- Scale will be adjusted if median falls below 75.

- At least the top 20% of the class will receive an A.

- At least the next 10% of the class (between top 20% and top 30%) will receive an A^-.

Prerequisites

- Discrete Math - Mathematical Induction
- Sorting methods
- Basic data structures: Arrays, stacks, queues, linked lists
- Basics of graphs: Trees, cycles, DAG, adjacency list/matrix, etc.
- Graph search algorithms: BFS, DFS

High level Syllabus

- Introduction ← today
- Review of some prereq's + asymptotic notations
- Major algorithmic techniques
  - Greedy
  - Divide & Conquer
  - Dynamic Programming → Exam 1
- Network Flow ← Reductio
- Computational Complexity Theory
- Approximation Algorithms
- Linear Programming ← Reductio

Corrections

1- ~~An algorithm is a set of instructions in machine language.~~

Kharazmi 780-850

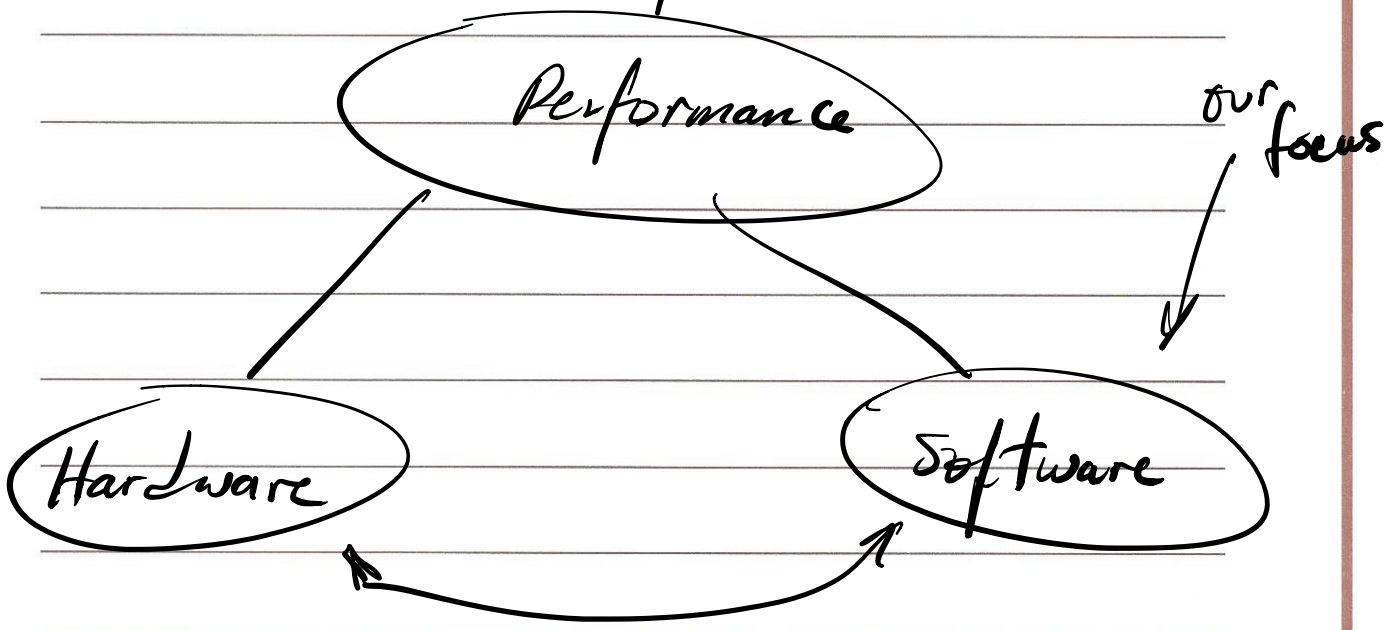
↓

Algorithm

2- ... ~~Algorithmic science advanced on Wall Street ...~~

3- ... ~~I invite 6 million algorithms for a listen ...~~

- Correctness
- Performance



- parallel processing
  - DMP
  - SMP
  - hybrids
- Memory hierarchy
- GPU

When studying a problem, we go through the following steps:

1- Come up with a concise problem statement

2- Present a solution

3- Prove correctness

4- Perform complexity analysis

Stable Matching

Stable Matching Example

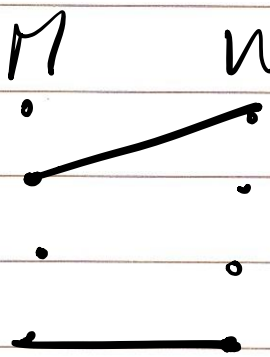
Problem: We are interested in matching n men with n women so that they could stay happily married ever after.

Step 1: Come up with a concise problem statement.

We have a set of n men, $M = \{m_1, \ldots m_n\}$

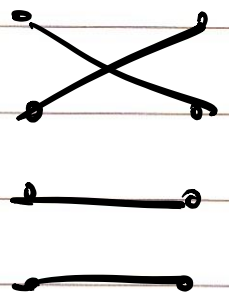
We have a set of n women, $W = \{w_1, \ldots w_n\}$

Def. A *Matching* S is a set of ordered pairs.



A matching

Def. A *perfect matching* S' is a matching with the property that each member of M and each member of W appear in exactly one pair in S'.



A perfect Matching

Add notion of preferences

Each man $m \in M$ ranks all women

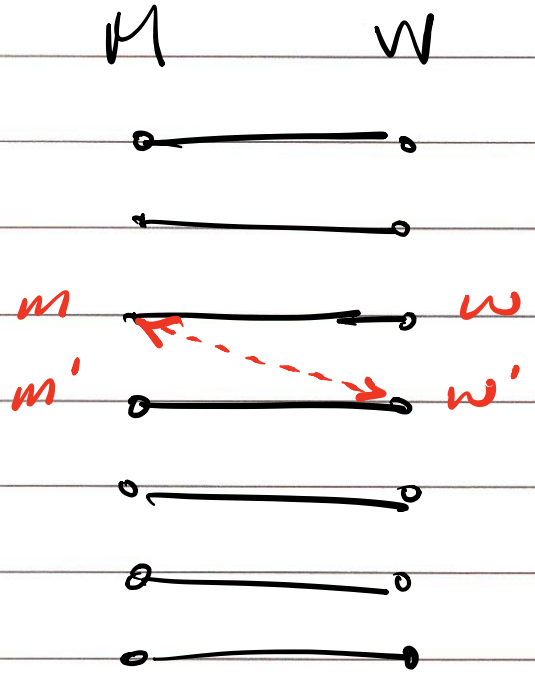
- m prefers w to w' if m ranks w higher than w'.

- Ordered ranking of m is his preference list

$P_{m_i} = \{w_{i_1}, w_{i_2}, \ldots w_{i_n}\}$

Same for women, i.e. each woman $w \in W$ ranks all men...

S



Such a pair (m, w') is called an instability WRT S

Def. Matching S is stable if

1. It is perfect

2. There are no instabilities WRT S

Step 1: **Input:** Preference lists for a set of n men & n women. ✓

Output: Set of n marriages w/ no instabilities ✓

Step 2: Gale-Shapley Alg.

Step 3 Proof of Correctness

(1) From the woman's perspective, she starts single, and once she gets engaged and she can only get into better engagements

(2) From the man's perspective, he starts single, gets engaged, and may get dropped repeatedly only to settle for a lower ranking woman.

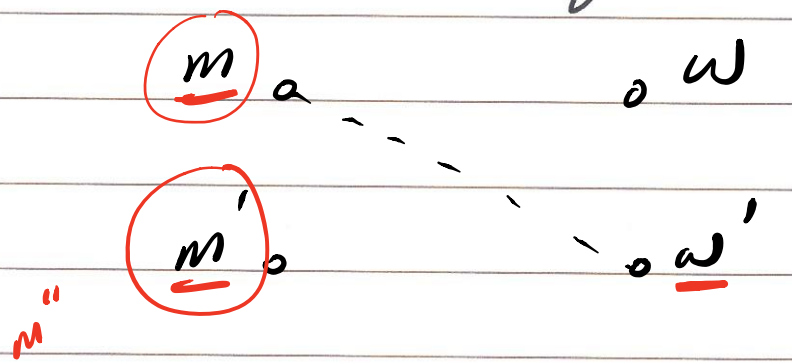
(3) Solution will terminate in at most n^2 iterations.

(4) Solution is a perfect matching

(5) Solution is a stable matching

Proof by Contradiction

Assume an instability exists in our solution involving two pairs $(m, w), (m', w')$



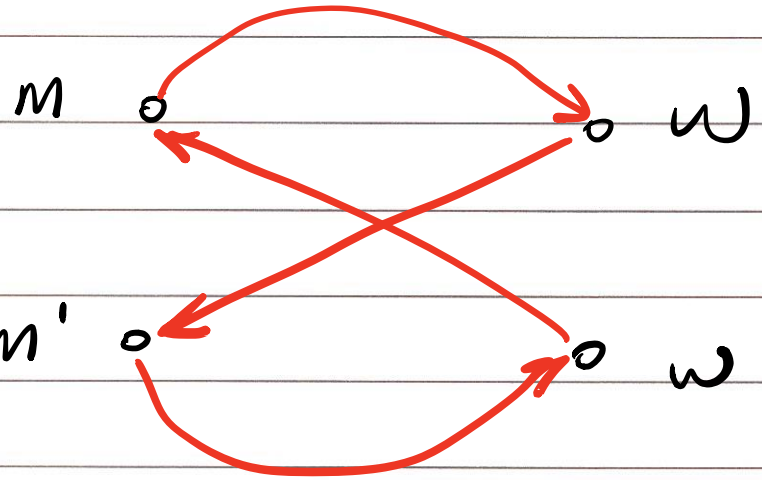
Say (m, w') is an instability

Q: Did m propose to w' at some point in the execution?

If no, then w must be higher than w' on his list → Contradiction!

If yes, he must have been rejected in favor of m'' and due to (1) either $m'' = m'$ or m' is better than m''

⇒ Contradiction!



Men proposing: (m, w), (m', w')

Women " : (m, w'), (m', w)