CS 180 Discussion 1A

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Outline

- Homework
  - Gradescope
- In-class Questions:
  - Stable Marriage Problem
  - Interview Questions

Homework

- We will use gradescope to grade the homework assignments.
  - Website: www.gradescope.com
  - Entry code to enroll: MPG54N
  - Sign up with the format of <First Name><Last Name>, UID <xxx-xxx-xxx>, and your email address.

Homework

- Make sure you start each problem on a NEW page.
- Raw photo is not accepted.
- You are suggested to edit using Latex, or word. This is NOT a requirement. If you choose to write it, make sure your handwriting is clear.
- All email or paper submissions will NOT be accepted.
- Late submissions are not accepted.
- HW will be assigned most weeks on Wednesday, and due a week later, the following Thursday morning at 8 am.

Stable Marriage Problem

The Stable Marriage Problem states that given N men and N women, where each person has ranked all members of the opposite sex in order of preference, marry the men and women together such that there are no two people of opposite sex who would both rather have each other than their current partners. If there are no such people, all the marriages are “stable”.

Consider the following example.

Let there be two men m1 and m2 and two women w1 and w2.
Let m1‘s list of preferences be {w1, w2}
Let m2‘s list of preferences be {w1, w2}
Let w1‘s list of preferences be {m1, m2}
Let w2‘s list of preferences be {m1, m2}

The matching { {m1, w2}, {w1, m2} } is not stable because m1 and w1 would prefer each other over their assigned partners. The matching {m1, w1} and {m2, w2} is stable because there are no two people of opposite sex that would prefer each other over their assigned partners.

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```
Initialize all men and women to free
while there exist a free man m who still has a woman w to propose to
{
    w = m's highest ranked such woman to whom he has not yet proposed
     Remove m from w’s preference list
    if w is free
       (m, w) become engaged
    else some pair (m', w) already exists
       if w prefers m to m'
          (m, w) become engaged
           m' becomes free
       else
          (m', w) remain engaged
}
```

Time Complexity: O(n^2). At each time, we will remove a woman from a man’s preference list. There are n mans and there are n women in the man’s preference list.

Stable Marriage Problem

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```
Is the resulting marriage a “stable marriage”?
Proof: To show that it is a stable marriage, let’s assume we have a
dissatisfied pair, X-b, where in the marriage they are paired as X-a and
Y-b (current).
Since X prefers b over his current partner a, then he must have proposed
to b before a. Woman b either rejected or accepted him, but dropped him
for another better man than X. Thus, b must prefer Y to X, contradicting
our assumption that b is dissatisfied, so it is a stable marriage.
```

Interview questions

- Useful resources:
  - Leetcode
    - Easy, medium, and hard ones
  - GeeksforGeeks

Two sum [leetcode 1]

Given an array of integers, return **indices** of the two numbers such that they add up to a specific target.
You may assume that each input would have ***exactly*** one solution, and you may not use the *same* element twice.

Example:

```
Given nums = [2, 7, 11, 15], target = 9,
Because nums[0] + nums[1] = 2 + 7 = 9,
return [0, 1].
```

Two sum [leetcode 1]

Example:

```
Given nums = [2, 7, 11, 15], target = 9,
Because nums[0] + nums[1] = 2 + 7 = 9,
return [0, 1].

Solution 1:
For each num in nums, treat it as the first adding number, and try
to find the other num.

Time Complexity: O(N^2)
```

Two sum [leetcode 1]

HASH:
Number: 2, Position: 0
Number: 7, Position: 1
Number: 11, Position: 2
Number: 15, Position 3

Example:

```
Given nums = [2, 7, 11, 15], target = 9,
Because nums[0] + nums[1] = 2 + 7 = 9,
return [0, 1].

Solution 2:
Scan the num in nums once, but remember the ones and positions we
have already seen using HASH.
Only try to find the second number in the HASH (numbers we have
already seen).
HASH takes constant time.


Time Complexity: O(N)
```