# CSE 421 Section 6

## Midterm Review

# Announcements & Reminders

- **HW4** regrade requests are open, answer keys on Ed
- **HW5** was due yesterday, 10/30
  - Late submissions open until tomorrow, 11/1 @ 11:59pm
- There is no homework this week.
- Your **midterm exam** is on **Monday, 11/4 @ 6:00–7:30pm, Gates G04**
  - Let us know by **tomorrow, Friday 11/1** if you cannot make it
  - If you are sick, let us know as soon as you know
  - A **practice midterm** is available on Ed

# Midterm format

- Several multiple choice/short answer problems
- 3 long-form problems
  - Similar in style to homework
- 90 minutes
- You will be given a standard reference sheet, view it on Ed
- You may bring one sheet of double sided 8.5x11” paper containing your own handwritten notes.
  - Must write name, student number, and UW NetID
  - Must turn in with exam

# Today’s plan

1. (35 min) 6 stations around the room with practice problems
    - Station 1: Short answer
    - Station 2: Stable matching reduction*
    - Station 3: Graph algorithms
    - Station 4: Greedy algorithms*
    - Station 5: Divide and conquer*
    - Station 6: Dynamic programming
2. (10 min) Go over some of these problems

**the problem at this station was an extra problem on a previous section handout*

# Problems

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

# Problem 1 – Short answer

If $p$ ranks $r$ first and $r$ ranks $p$ first, then $(p, r)$ must be in every stable matching.

# Problem 1 – Short answer

Running DFS on a directed acyclic graph may produce:

- ❑ Tree edges
- ❑ Back edges
- ❑ Forward edges
- ❑ Cross edges

# Problem 1 – Short answer

The recurrence $T(n) = 2T(n/3) + \Theta(n^2)$ simplifies to…?

# Problem 1 – Short answer

Suppose $G$ has positive, distinct edge costs. If $T$ is an MST of $G$, then it is still an MST after replacing each edge cost $c_e$ with $c_e^2$.

# Problem 1 – Short answer

Let $G = (V, E)$ be a weighted, undirected graph. Consider any cut $S \subseteq V$, and let $e$ be an edge of minimum weight across the cut $S$. Then every MST contains $e$.

# Problem 2 – Stable matching reduction

There are $R$ riders, $H$ horses with $2H < R < 3H$. Riders and horses have preferences for each other. Also, riders prefer the first 2 rounds. Horses prefer to ride every round.

Set up 3 rounds of rides, so that every rider will ride a horse exactly once, every horse does exactly 2 or 3 rides, and there are no unstable matches.

# Problem 3 – Graph modeling

Given $(a_1, b_1), \ldots, (a_n, b_n)$, the person living in unit $a_i$ is moving to $b_i$. Some people may be new arrivals ($a_i =$ null) or moving out ($b_i =$ null). Give an algorithm that returns a valid moving order (every unit is vacated before someone moves in), or "not possible" and a minimal list of pairs that explains why.

# Problem 4 – Greedy algorithms

Given a set $\mathcal{X}$ of integer intervals $[a, b] \subseteq \mathbb{Z}$, find the smallest set $\mathcal{Y} \subseteq \mathcal{X}$ such that every point in any interval of $\mathcal{X}$ belongs to some interval of $\mathcal{Y}$ (i.e. $\mathcal{Y}$ covers $\mathcal{X}$).

# Problem 5 – Divide and conquer

$A[1..n]$ is a mountain if there is a peak $i$ such that

$$A[1] < \cdots < A[i-1] < A[i] \text{ and } A[i] > A[i+1] > \cdots > A[n].$$

The peak may be at 1 or $n$. Given a mountain, find the peak in $O(\log n)$ time.

# Problem 6 – Dynamic programming

Compute the maximum reward going from $(1,1)$ to $(m,n)$ on a grid, where you gain $R[i,j]$ whenever passing through $(i,j)$. Starting/ending count as passing through. $R[i,j]$ may be negative (penalty) or $-\infty$ (impassible).