CIS 1600 Assigned: October 28, 2024

Homework 10T

Due: 11:59PM EDT, October 30, 2024

This homework is due electronically on Gradescope at 11:59PM EDT, October 30, 2024. To receive full credit all your answers should be carefully justified.

Please make note of the following:

A. LaTeX: Please typeset all your answers in LaTeX based on the template we provide for you. Failure to do so will result in a 0 for the homework.

B. Standard Deductions:

- 5 points will be deducted from your homework if you do not select pages when submitting to Gradescope.

C. Solutions: Please make sure to keep your solutions clear and precise. While no points will be deducted for overly verbose solutions, clarity and brevity are important skills that can be developed through CIS 1600.

D. Collaboration: Please make sure to strictly follow our collaboration policy as clarified on Ed.

E. Citations: All solutions must be written in your own words. If you would like to use part of a solution from a problem presented in lecture, recitation, or past homework solutions you may do so with attribution; i.e., provided you add a comment in which you make clear you copied it from these sources.

F. Outside Resources: Any usage of resources outside of the course materials on the course website or Canvas is strictly prohibited. Violations may seriously affect your grade in the course.

G. Late Policy: We will allow you to drop two homework assignments assigned on a Tuesday and two homework assignments due on a Thursday (i.e. two 'T' homeworks and two 'H' homeworks). Because of this, we will not accept late homework under any circumstances. If you will be missing school for an extended period of time due to severe illness, please notify the professor.

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1. [10 pts] Odd Degrees, Even Coverage

Dilini is on a mission to encourage her classmates to register to vote. She decides to place voter registration flyers in the hallways linking classrooms together throughout the school. Any classroom is reachable by any other classroom via a series of hallways, and she wants to place exactly one flyer in each hallway so every student sees the information no matter where they walk between classes. There's at most one hallway between any two classrooms. However, she wants to make sure that she doesn't miss any hallway or accidentally put up extra flyers.

To accomplish this, she needs to create a route through the school so that she walks down each hallway exactly once to put one flyer in each hallway, potentially revisiting some classrooms if needed. However, she wants to make sure to end at a different classroom than she started.

Prove that it's possible for her to create such a route if and only if there are exactly two classrooms such that there are odd number of hallways leading into each of them.

2. [10 pts] DON'T FORGET TO VOTE GO VOTE

CIVIC DUTY! The CIS 1600 staff loves civic duties and voting! They want to print flyers with the message "`DONTFORGETTOVOTEGOVOTE`" to hand out on Locust, and it's Sid's job to type them up! Unfortunately, Sid is so bad at typing, every time he tries to type a letter, he chooses an uppercase letter uniformly at random. Given this, what is the fewest number of letters Sid would need to type for the expected number of occurrences of "`DONTFORGETTOVOTEGOVOTE`" in his string to be at least 1?

3. [10 pts] Richard's Riveting Re-election

The year is 1600, election year for CIS1600-land. President Richard is vying for reelection for his 20th term, and luckily, his henchman Victor is counting votes! To determine r, the number of votes Richard gets, Victor does the following process:

He first generates a random odd digit from 1 to 9, inclusive, and writes this down as r. Then, he repeatedly generates random digits uniformly, from 0 to 9, not necessarily odd, and appends it to the end of r. He repeats this until r is either 6 digits long, or r is even. For example, one way this could go is

$$3 \to 35 \to 353 \to 3534$$

At this point, he would stop, and Victor would record $r = 3534$ votes for Richard. However, Victor needs to make sure that Richard is very likely to win. Help Victor determine the expected number of digits in r.