This homework is due electronically on Gradescope at 11:59PM EDT, October 14, 2024. To receive full credit all your answers should be carefully justified.

Please make note of the following:

A. LATEX: All solutions are required to be typeset in LATEX.

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 in Ed post #945.

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.

1. **[12 pts] Rajiv's Random Recipe Ransack**

   A group of 6 TAs decide to take a trip to Honeygrow for a midnight snack, and each of them get 4 distinct ingredients. To their horror, Rajiv pops out from behind the counter, demanding a payment of 8 of their 24 total distinguishable ingredients to make his own stir-fry. Otherwise, he'll curse them and they'll fail all their midterms!

   Rajiv loves all the ingredients on the Honeygrow menu, so he randomly chooses 8 out of the 24 ingredients to take. Each ingredient is equally likely to be taken. What's the probability that Rajiv will take at least one ingredient from each TA?

2. **[10 pts] Chukka's Menu Mix-Up**

   After being a loyal McDonald's customer for so long, Chukka has been offered a special tour of the back kitchen! Upon entering the kitchen, he sees the following menu items in a pile on the kitchen table: a McSpicy's, b Prosperity Burgers, and c Shaker Fries. As a part of his special tour, the McDonald's manager lets Chukka pick two items uniformly at random from the pile. Note that after Chukka picks the first item, the chef makes one more of that item to replenish the pile, before Chukka picks again. What is the probability that Chukka will end up with two different types of menu items? You may assume that $a + b + c \geq 2$.

3. **[14 pts] Mc-Croc-ald's**

   Since the opening of the new McDonald's, Andrew has been trying to max out his points by buying a Happy Meal every day and has thus acquired quite the selection of Croc toy key chains. He decided he will give 9 Crocs to his favorite 4 TAs at random. Each Croc is equally likely to be given to any of the TAs and will definitely be given to a TA.

   However, Andrew wants to make sure none of the 4 TAs leave empty handed. Therefore, if any of the 4 TAs do not get Crocs, Andrew will redistribute the 9 Crocs. What is the probability Andrew will only give out the Crocs once?

4. **[10 pts] Why Did the Chicken Bowl Cross the Road?**

   Mallika, Grace, and Sophia are working a busy shift at Chipotle when they accidentally lose between 0 and 8 (inclusive) distinct burrito bowl orders containing either chicken al pastor or garlic guajillo steak. Grace remembers that for two bowls chosen uniformly at random, there is a 1/2 chance that they both are chicken. How many bowls did they lose, and how many of each type?

5. **[8 pts] A Gluttonous Graph**

   The gluttonous Kevin loves the new McDonalds on campus! However, one day, before eating his fries and nuggets, he decides to play around with them a bit and lays out his chicken nuggets (which he has at least 2 of) and fries such that each fry he has connects two chicken nuggets. He

then notices that no matter how he decides to place his fries and chicken nuggets, there always are two nuggets that have the same number of fries connected to it. Help Kevin prove that this will always true so he can devour his scrumptious snack slovenly!

6. **[12 pts] Late Night McDonalds Run**

   A group of diagnosed insomniac 160 TAs get into a kerfuffle on a midnight grading snack break (at McDonalds, of course). The 9 TAs break into two groups: 5 TAs who crave a burger (Team Big Mac), and 4 TAs who would much prefer chicken nuggets (Team McNuggets). In an effort to better balance the groups and broker world peace, Team Big Mac and Team Nuggets each swap one of their members to the other team. This results in Team Big Mac having 4 members craving burgers and 1 craving chicken nuggets, and Team McNuggets with 3 members craving chicken nuggets and 1 craving a burger.

   However, after each TA orders their desired meal, Ronald McDonald arrives (he's here to celebrate Fast Food Day 1 month early) and uniformly at random gives a meal intended for a member of Team McNuggets to Team Big Mac. He then randomly checks one of Team Big Mac's meals, which he finds to be chicken nuggets. What is the probability that the meal transferred to Team Big Mac by Ronald McDonald was composed of chicken nuggets?