This homework is due electronically on Gradescope at 11:59PM EDT, October 4, 2023. 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: You may not collaborate with anyone via any means.

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. [10 pts] Om Nom Nom!
Answer the following questions. You may express your answer as a percentage, decimal or
fraction. **For this question only, you do not need to show your work. Only your final
answer will be graded.**

For questions (a), (b), (c), find the probabilities of the events described based on the following
experiment: The menu at Claire’s Cookies contains \( n \) cookies labeled 1, 2, \ldots, \( n \). Nathan ”the
biggest munch” Chen is visiting Claire’s Cookies for lunch, and picks a cookie to eat uniformly
at random. Not yet satisfied, he returns for dinner and again picks a cookie to eat uniformly
at random. Note that Nathan can eat the same cookie for lunch and dinner should he wish.
Question (d) is based on a similar experiment (read the problem statement below for details).

For questions (e), (f), (g), find the probabilities of the events described based on the experiment
of rolling two standard fair six-sided dice.

(a) The first cookie chosen is number 1 and the second cookie chosen is number \( n \).

(b) The numbers of the two cookies are consecutive integers with the first cookie’s number being
one less than the second cookie’s number.

(c) The second cookie chosen has a higher number than the first cookie chosen.

(d) Nathan realizes that he actually does not want to eat the same cookie for lunch and dinner.
Now, recalculate (a), (b), and (c), assuming this time that Nathan can never eat the same
cookie for lunch and dinner.

(e) The maximum of the two numbers rolled is less than or equal to 3.

(f) The maximum of two numbers rolled is exactly equal to 3.

(g) Recalculate parts (e), (f) for \( x \) instead of 3, where 1 \( \leq x \leq 6 \). Give a solution in terms of \( x \),
instead of a piece wise solution.

2. [10 pts] Limited Edition Girl Scout Cookies
Sara has \( n \geq 1 \) Xin-Mints laid out on her table. Before she can enjoy her cookies though,
disaster strikes! Being the klutz that she is, she accidentally spills her glass of milk all over the
table in such a way that \( m \geq 0 \) milk rivers form between pairs of cookies. Note that these milk
rivers are bidirectional, each milk river runs between exactly two cookies, and there is at most
one milk river between two cookies. Prove that \( n \leq n^2 - 2m \).

3. [10 pts] C is for Cookie. \( \Omega \) is for...
Cookie Monster is trying to learn about probability. Help him solve the following problem and
he’ll reward you with a cookie of your choice!
Suppose you select a card uniformly at random from a standard deck, and then without putting it back, you select a second card uniformly at random from the remaining cards. What is the probability that both cards have rank no higher than 10, and at least one of the cards is red? Note that an ace is considered the highest rank.