This homework is due electronically on Gradescope at 11:59PM EDT, November 29, 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**: Please make sure to strictly follow our collaboration policy as clarified on Piazza.

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] Gingerbread Friends, Gingerbread Enemies

As a thank you to the CIS 1600 Head TAs, Claire has been baking gingerbread man cookies for them, and has baked a total of $n \geq 4$ gingerbread men. Suddenly, the gingerbread men come to life! To respect the gingerbread men, Claire has to now ask each gingerbread man which other gingerbread men they would be willing to be placed on the same plate with. She also asks the gingerbread men if they would be willing to be placed on the same plate with themselves. Claire realizes she can now model the responses as a relation $R$, where $(g_1, g_2) \in R$ if gingerbread man $g_1$ is willing to be placed on the same plate with gingerbread man $g_2$.

After all this, Claire is surprised since she realizes that $R$ is an equivalence relation with $n - 2$ equivalence classes and that no equivalence class contains exactly 3 elements. Given all this information, please help Claire find how many elements there are in the set $R$.

2. [10 pts] Piazza Post #1399

As the semester approaches its end, Ishaan has been reminiscing about all of his memories as a CIS 1600 TA. He recounts all of the fond memories he’s made, the people and friends that he has met, and all of the fun times he had while on staff. The CIS 1600 staff wants to thank him for all of the hard work he’s put in throughout the years (those Piazza posts definitely did not write themselves). Megan’s final gift to Ishaan is, of course, a math problem she posts on Piazza, knowing he will see and respond in a matter of minutes: Megan creates the set $A$, which denotes the set of people Ishaan has befriended and supported on staff. Megan then asks him to consider the relation $R$, which is an antisymmetric equivalence relation on $A$. Megan then asks, ”

“What is |$R$|? If you get this right, I’ll bake cookies for everyone, including the students!”

Unfortunately, for the first time ever, Ishaan gets locked out of Piazza and can’t post his answer. Help him (and yourself) get cookies by answering the problem!

3. [10 pts] TA Pair Share

The Head TAs have been looking for new ways to increase bonding and collaboration between the CIS 1600 Staff. They decide to assign each experienced TA to be a mentor to a TA who is new to staff that they vibe with. There are $n$ different experienced TAs, and $k$ distinct new TAs. The head TAs realize that each of the $n$ experienced TAs vibe with exactly $m$ distinct new TAs, and each of the $k$ distinct new TAs vibe with exactly $m$ distinct experienced TAs. Prove or disprove that this implies that $n = k$. You may assume that $0 < m \leq n, k$. 