**Assignment 1**

**Stable Marriable Problem using Gale-Shapley Algorithm**

**Team members: NAME - EMAIL - UID**

* Aditya Mallakula – mallakula.2@wright.edu – U01093160
* Chris Davis Jaldi – jaldi.2@wright.edu – U01099335
* Vanaja Uppala – uppala.19@wright.edu – U01080568

**Gale Shapley Algorithm Pseudocode:**

1. Initialization:
   * We begin by creating a list called “*free\_men”*, which includes all men who are not currently engaged to a woman.
   * We also define a variable “*proposals\_count”* to keep track of the number of proposals made during the algorithm.
2. Core loop:
   * The algorithm continues until there are unmarried men available.
   * For each available man, the algorithm chooses the next woman on his preference list to propose to.
   * When a man proposes to a woman, the “*proposal\_count”* increases.
   * Proposal handling:
     + If the chosen woman is not already engaged, the man will become engaged to her.
     + If the woman is already engaged to another man, the algorithm determines whether she prefers the new man (the proposer) to her current partner.
       - If she prefers the new man, she breaks off her current engagement and becomes engaged to the new man.
       - If she prefers her current partner, the new man remains free and is added back to the list of “*free\_men”* to propose again later.
3. Output:
   * The loop continues until all men are engaged or there are no more women to propose to.
   * When the loop is completed, the result is a stable matching of women and their partners, as well as the total number of proposals made by the algorithm.

**Complexity Analysis:**

* **Time Complexity:**
  + The Gale-Shapley algorithm uses a loop in which every free man proposes to women on his preference list until all men are engaged.
  + Each man can make at most *n* proposals (where *n* is the number of women), resulting in a worst-case scenario of *O(n2)* for *n* men and *n* women.
  + In each iteration, engagements are updated based on whether a woman prefers the current proposal to her previous engagement.
  + Reading the input file to parse preferences for men and women involves iterating through each person's list, which takes *O(n2)*.
  + Writing the output involves iterating through the final matching results, which takes *O(n)*.
  + The Gale-Shapley algorithm is the primary contributor to the time complexity, with a total time complexity of *O(n2)*.
* **Space Complexity:**
  + The preference lists for men and women are stored in dictionaries, resulting in a space complexity of *O(n)* for both men and women's preferences, for a total of *O(n)*.
  + Additional data structures, such as the list of free men and the dictionary of engagements (matching), require *O(n)* space.
  + The overall space complexity is *O(n)*.