1. Which real world problem have you chosen to work on? Why is it an important problem?
Our team will address student loneliness at the National University of Singapore (NUS). Loneliness may be understood as a condition where individuals experience qualitative and quantitative mental defects in social relationships (Zahedi et al., 2022); stemming from lacking deep human connections (Chong, 2023). University students are more prone to loneliness given difficulties in adjusting to new environments, forming new social connections, and being distanced from familiar relationships (Zahedi et al., 2022). However, there are negative implications for students' physical and mental states and academic performance (Zahedi et al., 2022). Studies have linked loneliness to mental health consequences like hopelessness and depression (Zahedi et al., 2022), and negative physiological impacts like immune system changes (Chong, 2023).

NUS students are also no strangers to loneliness, evident in the many posts on the official NUS Subreddit where students openly discuss their loneliness and difficulties in forming sustained social connections (r/nus, n.d.). An October 2023 post by NUS Subreddit user *biscuitsandtea2020* asked: "How many of y'all feel lonely?" It garnered 245 upvotes and over 60 comments where users shared sentiments of loneliness whilst studying in NUS (u/biscuitsandtea, 2023).

Recognising the many serious and negative implications of loneliness on mental and physical well-being, it becomes imperative to address loneliness in the NUS community. We propose an app to foster new social connections by matching small groups of individuals to share a meal. By creating more opportunities for tangible interactions within the NUS community, we support students in forming more and deeper human connections. We will first pilot the app with the smaller NUS College community, with plans to expand its usage to the broader NUS community in future.

2. What will your app do and how will it help solve or mitigate the problem?
To address the issue of loneliness, our application aims to match NUS students based on certain user-indicated characteristics and preferences into small group sizes of 3-5 to facilitate optimal bonding and interactive conversation (Fay et al., 2000). While our current idea aims for the groups to meet for a meal, our application's basic idea can be further scaled to alternative activities of users' choice, such as going to a board game cafe.

Users will be able to indicate a variety of factors that will be considered in our matching algorithms. We plan to first consider 3 factors: 1) Dietary restrictions (e.g. vegetarian, halal, allergies) to determine the meal type and location; 2) Price range for the meal; 3) Interests and hobbies (large categories, e.g. arts and cultural activities, sports, literature) to match users based on common or related interests.

We also aim to focus more on the user interface and user experience (UI/UX) to encourage usage of the application. A quality UI/UX will ensure a larger and more consistent user base, which should lead to a greater probability that users can meet suitable meal partners and potentially remain friends beyond the initial meeting. Even if the group does not remain close or even in contact after the meal event, by introducing new people to each other within the NUS community, we can reduce loneliness and foster a stronger sense of community and belonging by simply recognising more faces on campus (Reilly, 2023).

3. Genetic Algorithm: Functions and Applications to Our Project
Given that our app aims to match people into groups with multiple people, **genetic algorithms (GA)** are suitable. GAs are search heuristics for optimisation problems inspired by the process of natural selection (Mitchell, 1998). A flowchart of a GA is provided in the Appendix. Genetic algorithms comprises the following stages: (Zheng et al., 2017)

Table 1: Mapping of GA stages to Group Matching project

Stage	**Role in Genetic Algorithm**	**Application to our Project**
Initialisation	Generate an initial population of potential solutions through a random method (217).	Generate an initial population of potential groups through a random method. Each group represents a potential meet-up group and consists of 4 or 6 individuals with attributes of interest (e.g. introversion/extroversion).
Fitness Function	Create a fitness function that assigns a fitness score to each individual. This fitness score evaluates individuals' quality as a solution to a problem (217).	The fitness function will evaluate the group's quality as a meet-up group. The evaluation parameters will be defined during our user-testing research.
Selection	Select individuals for crossover based on fitness values through selection operations, such as roulette wheel selection, whereby individuals with a higher fitness score have a higher probability of being selected (218).	Select 2 groups for crossover based on fitness values (defined through fitness function) through selection operation. Preference is given to higher fitness groups.
Crossover	Combine the characteristics of two parent individuals to create two new individuals to be added to the population (218).	Apply crossover to combine characteristics from two parent groups and create new group. Crossover operation is designed to maintain or enhance compatibility in the new groups. E.g. for uniform crossover, randomly select 2 or 3 individuals from two different groups of 4 or 6. Combine them to form a new group.
Reproduction	Form the next generation through crossover and mutation; new individuals inherit characteristics from their parent individuals (219-220).	Form the next generation of groups through crossover. The new groups will inherit characteristics from their parent groups.
Termination Condition	Force the algorithm to stop the process based on some pre-determined condition (217). In our context, this can be a convergence criterion, whereby the algorithm will terminate if fitness values have not improved over multiple generations,	

Resources for further research

We intend to use research papers on genetic matching applied to the context of group formation, as well as general resources on GAs. Understanding these resources requires some knowledge of maths and statistics; for example, Zheng's paper discusses minimising the sum of squared differences. We can overcome this with our group members' knowledge of econometrics.

4. User Considerations

We expect users to use this app when they are trying to find new friends in NUS. The target demographic is NUS students, especially Year Ones who might be more prone to loneliness. An issue users might run into is that they might not find suitable matches or it will take a while to match them. This is because the

app requires a large pool of users before it can provide suitable matches. Thus, we must estimate the minimum number of users needed before initiating matching. Another issue is that users who have been matched with a group might unexpectedly become unavailable but have no way of informing their group beforehand. Hence, our app can have a function for users to back out at least 24 hours before the meal, leaving enough time to find replacement matches.

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Appendix

Figure 1: Flowchart of Genetic Algorithm