Qinder — The Quantum-Powered Dating Service of Tomorrow

Finding a significant other was difficult enough pre-pandemic, even with the prevalence of campus parties, dating apps, social mixers, and more. However, during the COVID era, meeting new people and fostering organic connection is nearly impossible. Apps like Tinder and Bumble find pairings quickly, but rely heavily on in-person interaction to determine attraction and fit, which is currently infeasible. Platforms like DataMatch and Aphrodite necessitate significant computational time to generate optimal pairings, but harness questionnaires to ensure ideal matchings. However, by harnessing the power of quantum annealing, we created a dating platform that matches you with your entangled pair as quickly as light travels.

Ad for Tinder, a popular dating app

Essentially, the software will have an input of 2N individuals, with a ratio between 0 and 1 for the compatibility of each possible pair. This data is collected by dating platform surveys, and matches shared hobbies, interests, love languages, life outlooks, and more.

We will configure the problem as such:

Given a group of 2N people, find nonoverlapping N pairings that maximize the sum of the *compatibility* of all the pairs subject to the constraint that each pair is *valid*.

Let C(i, j) give the *compatibility* of person i and person j, where C(i, j) = C(j, i)

Let V(i, j) = 1 if person i and person j form a *valid* pair, and 0 otherwise

The classical solution progresses as follows:

The number of possible sets of pairings is given by (2N)! / (N! * 2^N). This can be seen by considering arranging the 2N people in a line and pairing individual 2i — 1 with

individual 2i. One must then divide by N! as the relative orders of the pairs does not matter, and divide again by 2^N since the relative order within each pair does not matter. Finally, to evaluate the total compatibility of a set of pairs and verify that each pair is valid is O(N), so the overall complexity of a fully optimal solution is O(N * (2N)! / (N! * N²)) > O(N!). Suboptimal solutions could potentially be reached in polynomial time using greedy algorithms or gradient descent, but we seek to provide a globally optimal solution.

We now configure the problem for quantum annealing:

Let S be the set of valid pairs S = {(x1, y1), (x2, y2), … (xm, ym)} where m = |S|

The optimal solution z = z1z2…zm can be represented as an m digit binary string where the ith digit is 1 if and only if (xi, yi) is one of the chosen pairings.

Thus, our problem is equivalent to maximizing ΣC(xi, yi)*zi subject to Σzi = N and zi*zj = 0 if xi = xj or yi = yj or xi = yj or xj = yi.

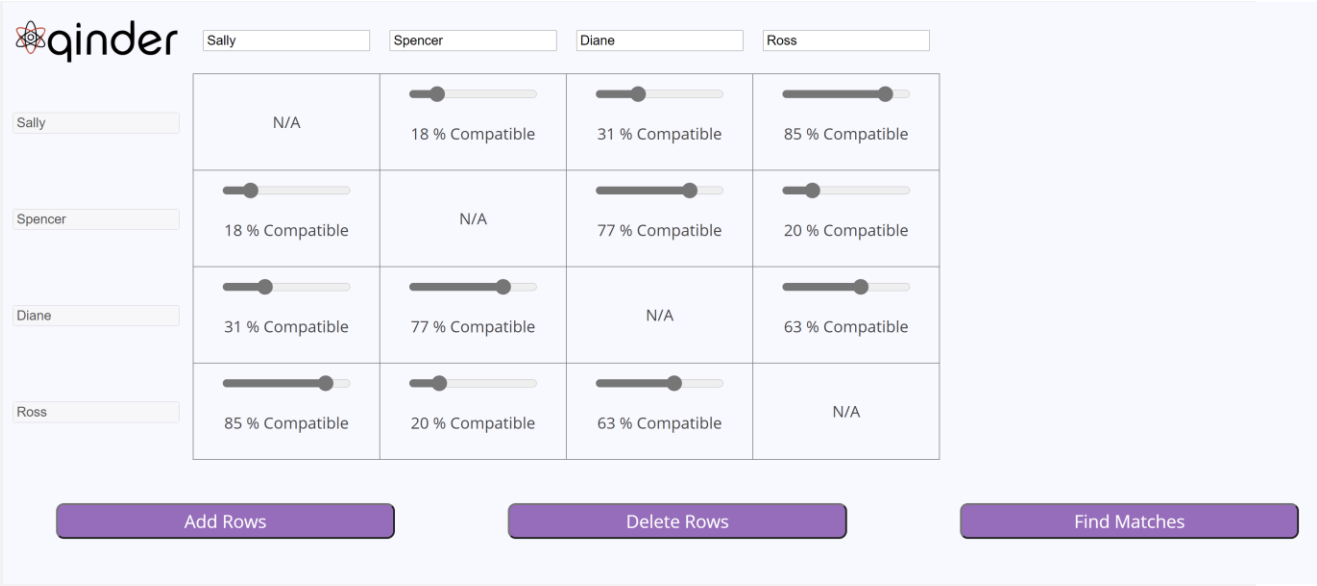
The above constraints can be encoded into the cost function as follows

f(z) = -ΣC(xi, yi)*zi — αΣzi + βΣΣzi * zj * g(i, j), where g(i, j) = 1 if (xi = xj or yi = yj or xi = yj or xj = yi) and 0 otherwise.

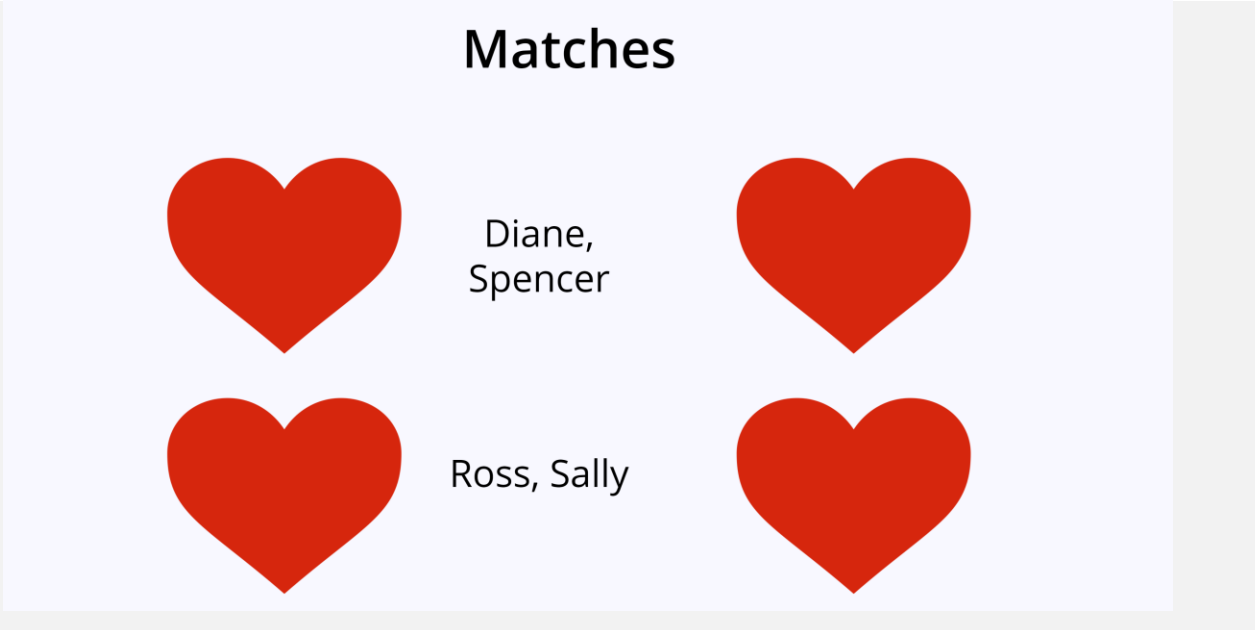
This will converge to the optimal solution for properly chosen α, β. If fewer than N pairings are created, α must be increased, and if pairings are generated such that one or more people are in multiple pairings, β must be increased. If the two aforementioned conditions are satisfied, the solution is the optimal one.

Since f(z) is a quadratic function of the binary variables zi, each zi can be mapped to a qubit. The function f(z) is then encoded in QUBO format.

We program this algorithm with DWave, and embed it in a sleek web-app for public usage.



Data-entering page



Matches page

As a note, to keep our service from conforming to heteronormativity, we include the option to set the compatibility between any two individuals, and not just males:females. For instance, if Ross were gay, we would set his compatibility with Sally and Diane to 0.

This app was created by Sreya Vangara, Jeremy McCulloch, and Lilian Luong for iQuHack 2021.