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CSC 440 - Assignment 1 Analysis

Invariant Documentation

Initialization - The input file gives us 'n' number of *knights* and *ladies*, who each have a list of preferences which is n long. The knights & ladies are placed into their respective lists and dictionaries. Finally engagements dictionary is initialized, even though it is empty. Initialization is only correct if the input file has no errors.

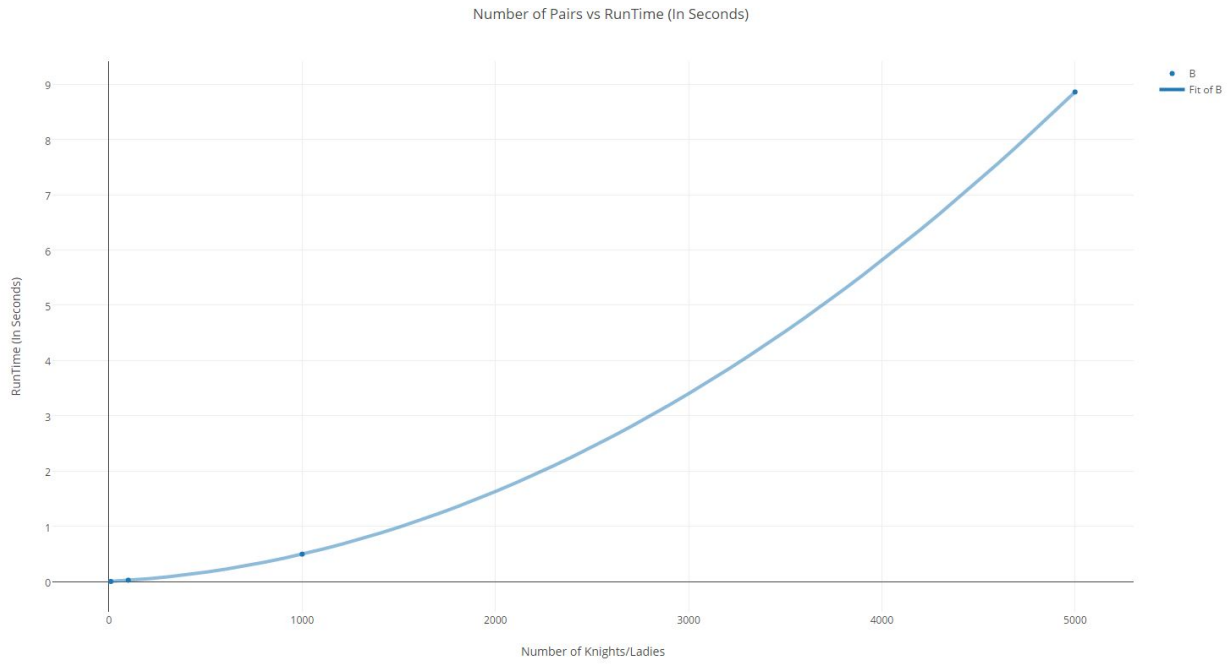
Maintenance - At any point in we go back to the top of the while loop, which is only true while we have an element in *freeKnights* we have several true statements.

1. There currently is no unstable relationships between a knight and a lady who is currently engaged.
2. There is an equal number of ladies engaged as knights.
3. Anyone knight has not (and will never) propose to anyone lady more than once.
4. Any lady who has been proposed to prefers her current engagement over any other possibility that has been presented to her.

Termination - The list *freeKnights* is empty of entries and engagements has both a legitimate key (lady) and value (knight) associated with it. This shall occur after at most n^2 - n + 1 proposals. Also all of the engagements have been displayed for the user.

Benchmarking and Analysis

We were provided with 5 data files, with a different value for n number of knights/ladies. The sizes are 10,100,1000,5000 and 10000 knights. Our computers were unable to reliably handle the 10k input, so our data only covers up to 5000 knights. We ran 5 time runs on each of the given inputs, then plotted the average times below, while also showing a quadratic curve of best fit.



Here is a table with the exact values rounded to the nearest thousandth of a second for each set of trials

n	Average time (in seconds)
10	.003
100	.026
1000	.497
5000	8.859

The plot shows that our data has a very close quadratic curve of best fit. This matches the $O(n^2)$ asymptotic complexity of Gale-Shapley, showing that the algorithm indeed has a quadratic time complexity.