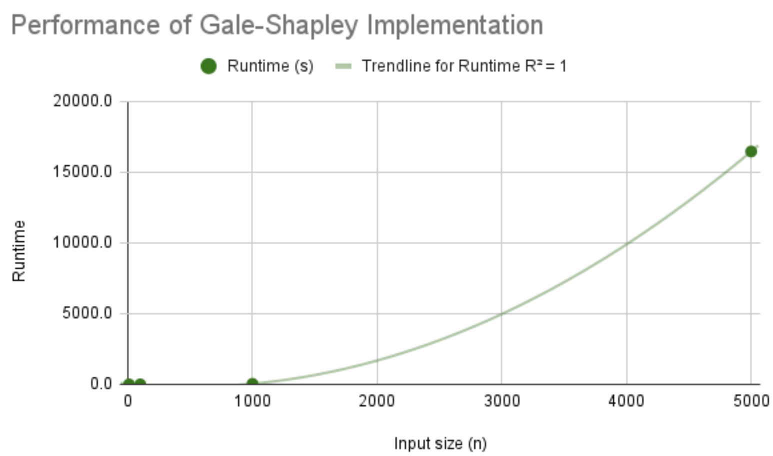
Matching Benchmarks

The times recorded using the provided benchmark inputs are as follows:

Input size (n)	Running time (s)
10	0.03
100	0.09
1000	38.48
5000	16400 (estimate)



This graph was generated using Google Sheets. I was not able to let the program complete with $n = 5000$, so I extrapolated the value based on the geometric increase rate between the previous two times.

Sheets reports an R^2 value of 1, or "perfect fit", which is to be expected with such a small dataset. However, it does suggest that my algorithm at least loosely falls within the bounds of $O(n^2)$ complexity. It is most certainly of some polynomial complexity.

I think that the overhead I added with objects, classes, etc. contributed to the lengthy runtime of the program. If I were to revise the code, I would make it work directly with the strings loaded from the input file, thereby speeding up the program up and providing an accurate reading for $n = 5000$.

Pandemic!

1. What is the maximum number of initially infected students such that, regardless of how they are placed in the classroom, at least one initially healthy student always remains healthy?

   4 students. If 5 students are placed along the diagonal of the classroom, the entire class becomes infected. If one of these students is made healthy, this fate is avoided.

2. What is the minimum number of initially infected students such that there is some arrangement of that many initially infected students that will result in every student eventually becoming infected?

   5 students. As mentioned previously, if these infected students happen to reside along the diagonal, the entire class becomes infected.

3. Can you arrange this minimum number of infected students in such a way that the infection never spreads to any healthy student?

   Yes. If, instead, these five students are all placed in a single line (horizontal or vertical), then no other student will become infected.

4. How would your answers change if there were n^2 students in an $n \cdot n$ grid?

   My answer to 1. would become $n-1$ and my answer to 2. would become n.

5. Does it matter if n is even or odd?

   No.

6. What geometric property about the set of infected students never changes as the days pass and the infection spreads?

   The number of infected students cannot grow at a rate faster than doubling each day. This is because each new infection requires at least two infected neighbors.