My interest in coding has developed since I was eight. That was the first time the virus ‘Whboy’ infected my father’s computer. Shocked by how complicated the virus could be, its composition became a childhood myth and eventually motivated me to pursue further studies in computer science and figure more about algorithms and logics.

I have kept on exploring the world of algorithms. From the fundamental sorting algorithms to its optimisations, from the purest recursion function to dynamic programming, from the Binary search tree to the Red-Black tree, all those algorithms and data structures amazed me with their high consistency and efficiency in dealing with complicated puzzles. In many competitive programming competitions such as the national Olympics of informatics and Code Jam, those algorithms become my useful instruments in solving the questions in the fastest approach.

Among them, sorting algorithms are the most common. Quicksort is an example of them. As its name suggests, it is claimed to have the shortest average running time for sorting. However, since the worst case of QuickSort has a running time of O(N^2), it is unimaginable for me to link it with “quick”. Hence, to achieve the average case of O(NlogN), I start to explore how we may optimise the Quicksort. The key to do so is to ensure a fair partition, namely choosing suitable pivots. At the first version of Quicksort, a pivot is selected from a fixed position - the first or the last place of the array. However, when facing sorted array, this way of choosing pivots inevitably results in a worst-case partition. Thus, to avoid this, a shuffle of the array may effectively reduce the possibility of getting the worst case when facing ordered arrays. A more advanced way of randomisation is to use Median-of-3 partition: by selecting the first, last and another random element and using their median as pivot may increase the probability of having a best-case partition.

However, I still find flaws in this method as the worst-case still occurs in arrays with equal elements. After researching, I have finally encountered the best approach in ‘Data Structures and Algorithm Analysis in C’. Insertion sort performs better than QuickSort does when sorting arrays of shorter length due to its higher efficiency. Additionally, by grouping all elements the same as the selected pivot, it can avoid worst-case partition in sub-steps. With the combination of insertion and QuickSort and the grouping of equal elements, the running time to sort arrays with repeated elements greatly reduces. This approach of sorting is also known as Qsort. Eventually, I have finally reached the ‘quick’ and the spirit to keep improving one approach attracts me deeply.

Logic, on the other hand, is another aspect that draws my attention. Induction is a fundamental proof method in Mathematic. With induction, to prove the validity of a statement requires only a valid base case and a correct inductive step. This concept challenges the traditional way of proof, and it makes me wonder similar uses in coding. Like mathematic formulas, a line of code is also a statement which should be able to get validated. After reading relative books and searching online, I find out an important concept of logic in computer science - Hoare’s Logic. Just like a base case in induction, the precondition of the Hoare’s triple indicates the initial state before running the code. The inductive step, in this case, becomes the postcondition after running the code and each line of code is the process to change from pre to postconditions. Like invariant quantity in maths, there is also invariant in the logic triple to prove the validity of code.

This parallelism between Math and coding helps me better understand the new concept and it brings me further is other areas of Computer Science.

With the knowledge of logic and algorithms, I have applied them in real-life application beyond my curricular time. I have taken part in Robotics competition and use the algorithms such as Greedy to find the shortest path inside the unexplored map. With that, the running time for a robot to navigate has greatly reduced. Through this experience, I have understood how useful and powerful algorithms and logics are even during daily life.

The knowledge I have builds up a solid foundation for my future study. I believe that the opportunity to study at such an outstanding university would guide me further.