**Mathematical activities**

In my younger years when I had no access to any computer game but to keep playing Spider Solitaire, one of my book shelves was always filled with sudoku books, with now yellowed papers and almost fainted handwriting in pencil. Those are the major entertainments for my primary school life. During that time, my greatest pleasure with my mother, a math teacher, was to learn abacus from her and beat her in 24 Game.

Looking back now, I can see how much I have gained from these little math games and how much they roused in me my passion for mathematics in general: in Spider Solitaire and sudoku, I learned the magic of logic and inference; in abacus, I mastered the basic mental arithmetic; in 24 game, I improved my sensibility for numbers and culculation.

But besides these games, I enjoy Klotski number game most. It is a Chinese traditional game that has a n\*n matrix with one space left blank. The position of numbers is disorganized and the player needs to recover it.

I quickly learned and mastered the game. Within three days, my record improved from over one minute to 26 seconds. When I was indulged in the game to reach a higher record, I found one puzzle extremely hard to solve, where only two numbers were displaced and I only needed to switch the positions of 14 and 15, I tried for almost half an hour without any progress. I began searching online for method to solve this problem. I initially play this game by ordering the numbers line by line till the last two, and I was amazed by the method of depression of order when I saw it online: first complete the outmost orders to make it become a 3\*3 matrix, then continue to make it become 2\*2. I tried this method on that unsolved puzzle, but still, the outcome was frustrating. I came across a case of 3\*3 matrix where there is no solution, and it was proved by showing the number of inversions in the sequence was odd, and the Klotski was thus unsolvable. *What if mine has no solution neither? But how can I prove that with n=4?*

By investigating in the concept of inversion, I finally found that it the case of n=4, there are two possibilities: if the empty space is in an even line, then it is solvable if the number of inversions is even, and if the empty space is in an odd line, then it is solvable if the number of inversions is odd.

The concept of Inversion in a sequence: the parity of the number of inversions determines whether a Klotski puzzle is solvable.

My addiction to this game may contribute to the easy-to-follow rules and millions of permutations of the game, but the most important reason is that I enjoy so much the process of challenging myself and pushing myself to the limit, and by employing some mathematical methods, I can always surpass myself and transcend the problems.

**Non-mathematical activities**

As a core member of U-CODE movement in our school, I always hold the believe that programing is the language connecting the future and the present. In the words of Steve Jobs, “Everyone should learn to program a computer, because it teaches you how to think.”

The education of coding and CS, however, is not popularized in many areas and region of China, even no guidance and opportunity for students to be exposed with.

U-CODE movement is such a service to help with the promotion of girls’ coding. We all members aim to empower girls with coding skills to explore boundless potential in STEM. We are dedicated to promoting the availability of pragmatic CS education, nurturing the ability of independent thinking, and collaborating to design for peace, innovation and a sustainable future together.

However, all of us learned coding from scratch. In order to make sure that we were able to teach other girls, along with self-study and peer teaching, we made approaches to different organizations for sponsorship in order to get a professional teacher. After a month’s striving, a company in Shanghai responded us and sent us an Indian teacher to teach us two hours a week. With the availability of outside help, as well as our own efforts, we finished all the introduction courses within one semester.

We did all of this to provide the opportunity of learning coding to those girls from local schools. Immersed in bilingual teaching, those girls are guided to explore and learn coding and computer science; to break the stereotype and limitation of gender, and stimulate the boundless potential.

It turned out to be much more difficult to transfer what I had acquired to other girls and make them understand it. Those ways of conveying ideas that sound so easy and natural when we are learning coding seem to be so hard for us even to repeat now. Our teacher was patient enough to help us. And when we all managed to teach others with an interesting analogy or an easy-to-understand real-life example, it seems that to teach does not need one to be a master in some field. It is just a process through which I impart my knowledge into other people, or give inspiration to those at the same level.

**If you have done any math outside of school (e.g., college courses, online courses, math circles, other summer programs, independent study), please tell us about it and briefly describe the material covered.**

Advanced training: your motivation, learn what…

Enhance my understanding and ability of application of mathematical knowledge.

Online (college) course: course name, university, platform, description

Mathematics projects: list all and describe them…

I did some self-study through edX. In the past year, I finished the course of Fat Chance: Probability from the Ground Up provided by Harvard University. It covered counting, probability and many statistical applications. Then I self-studied MIT’s paradox and infinity which showed me the mind-boggling world of infinity as well as theorems like Cantor's Theorem, the Banach-Tarski Theorem, and Gödel's Theorem.

Besides online courses, I self-studied all the Chinese high school math within one semester. Afterwards, I went for advanced training to enhance my own understanding. I have been to such advanced trainings for three years for in-depth study, including properties and applications of exponential, logarithmic & power function, solid and analytical geometry, trigonometry, the properties and operations of vectors, sequence and series, inequalities, conic sections, the concept and application of derivative, the operations of complex numbers, as well as permutations and combinations.

Last year, I also went for Exeter Summer Program and studied relativity & Quantum Mathematics to explore the interdisciplinary of mathematics and quantum mechanics.

By applying mathematics in real life scenarios, I did some math projects. Last semester I did a math project on the investigation of the efficiency of different studying approaches by applying my learning in statistics and probabilities. I did an experiment in a primary school and collected three sets of data with different levels of practice intensity of math problems, and then analyzed the data by employing statistical approaches like hypothesis testing to determine the significance of her results and came to a convincing conclusion.

I am currently doing a project concerning mathematics in air pollution. I collected data for the air quality in Changshu Region for a year, and I’m building a mathematical model and analyze the variation of different pollutants, considering the effect of time and season on the spread of these pollutants.