Under the supervision of Professor Vasily Dolgushev, I conducted the research that introduced a more streamlined version of the groupoid GTSh of GT-shadows and contributed to the SageMath package for working with GT-shadows. The groupoid GTSh is a 'computable' approximation to the gentle version of the Grothendieck–Teichmüller group $\widehat{\mathsf{GT}}_{gen}$. The set of objects of GTSh is the poset $\mathrm{NFI}^{\mathrm{B}_3}(\mathrm{F}_2)$ of B_3-invariant finite index normal subgroups of the free group F_2 on two generators. This object is worth studying because it is very 'likely' that in most cases, the element of GTSh lifts to the absolute Galois group. And it is already known that for dihedral posets, every element of GTSh lifts to the absolute Galois group.

Mentored by Professor Maxence Mayrand, I participated in a research internship that constructed new GKP code from the Abelian varieties on the cyclotomic field $K = \mathbb{Q}(\zeta_n)$. The construction $(K \otimes_{\mathbb{Q}} \mathbb{R})/\mathcal{O}_K$ is an abelian variety of CM-type. We defined a skew-symmetric form E and extended it to a hermitian inner product H on $(K \otimes_{\mathbb{Q}} \mathbb{R})/\mathcal{O}_K$. Under certain restrictions, this defines a GKP code. There is a homomorphism from $\mathrm{Aut}(X, L)$ to $\{$unitary operators on $H^0(X, L \otimes L)\}$, the gates. It is already known that this construction produces Clifford gates. I computed the decomposition of these Clifford gates as the Hadamard gate, S-gate and CNOT-gate. An interesting phenomenon is that the expression of the gate produced by the case $n = 5$ contains CNOT-gate.

Under the supervision of Professor Lisa Berger, Ajmain Yamin and Connor Stewart, I participated in an online collaborative research to obtain equations for K_9 dessin, that is the bipartification dessin of the complete regular map from K_9 graph. We proved that the Riemann surface of the K_9 dessin is a degree 9 cover of the Bolza surface $y^2 = x(x^4 - 1)$ with covering group $(\mathbb{Z}/3\mathbb{Z})^2$. We used the fact that any unramified abelian cover of a Riemann surface S is obtained from pulling back S along an unramified abelian cover of the Jacobian $\mathrm{Jac}(S)$ of S. So, we computed the equation for the Abel-Jacobi map of the Bolza surface S_B and constructed a degree 9 cover of the Jacobian $\mathrm{Jac}(S_B)$ and obtained the equation.

These research experiences let me explore a wide range of mathematics and significantly improve my self-learning, writing, programming and speaking skills. It is these research experiences that boost my determination to seek admission to a graduate program and do mathematical research.