1. Let $q : \Delta^2 \to X$ be the quotient map obtained by the preserving the ordering identification of the edges $[v_0, v_1]$ and $[v_1, v_2]$ in the simplex $\Delta^2 = [v_0, v_1, v_2]$.
   (a) Compute the homology groups $H_*(X)$;
   (b) Compute the relative homology groups $H_*(X, A)$ where $A = q([v_0, v_2])$.

2. Compute the fundamental group and the homology groups of the Klein bottle.

3. Let $X$ be the mapping cone of a map $p : S^1 \to S^1$ of degree $p$.
   (a) Compute the groups $H_n(X)$;
   (b) Compute the groups $H_n(\tilde{X})$ where $\tilde{X}$ is the universal cover of $X$.

4. Compute the fundamental group of the quotient space of an annulus obtained by identifying antipodal points on the outer circle and identifying points on the inner circle which are $2/3\pi$-apart.

5. Find all covering spaces of $\mathbb{RP}^2 \vee \mathbb{RP}^2$.

6. Compute the Euler characteristic $\chi(T^n)$ of the $n$-dimensional torus and the group $H_n(T^n)$.

7. Compute the homology groups of $K \times S^1$ where $K$ is the Klein bottle.

8. Does there exist a covering space of the surface $M_3$ of genus 3 with
   (a) the deck transformation group $\mathbb{Z} \times \mathbb{Z}$?
   (a) the deck transformation group $\mathbb{Z} \times \mathbb{Z} \times \mathbb{Z}$?
   (c) [Extra Credit] the fundamental group $\mathbb{Z} \times \mathbb{Z}$?