Exercise 1.
Prove the following q-gram lemma:
Let $P$ and $S$ be strings of length $w$ with at most $k$ mismatches. Then $P$ and $S$ share at least $w + 1 - (k + 1)q$ common $q$-grams.

Exercise 2.
SWIFT algorithm:

- Sketch the Function $U(n, q, \epsilon)$ for increasing values of $n$. Let $q = 7$, $\epsilon = 0.1$ and $n_0 = 30$. Draw it for the interval $n = n_0 \ldots n_0 + 35$.

- The Lemma 2.2 in the SWIFT script contains a formula to compute $w$ (for a $w \times e$ parallelogram) Show that every local alignment with $\tau q$-hits and $e$ errors lies in a $w \times e$ parallelogram.

Exercise 3.
Suffix filters:
Determine all strong matches for the given weights and edit distances:

$$
\begin{align*}
    i & : 0 1 2 3 4 5 \\
    t_i & : 2 1 1 2 1 1 \\
    dist(A_i, B_i) & : 1 1 0 2 0 1
\end{align*}
$$

Exercise 4.
Factor filters:
Prove Theorem 3 (optimal factorization) from the script.