1. Let $N$ be the set of all matrices in $\text{GL}_n(K)$ with exactly one non-zero entry in every row and every column. Show that $N$ is a closed subgroup of $\text{GL}_n(K)$, that its identity component $N^o = D_n$ is the subgroup of diagonal matrices, that $N$ has $n!$ connected components and that $N$ is the normaliser of $D_n$.

2. Give examples of non-closed subgroups of $\text{GL}_2(\mathbb{C})$ and compute their closures.

3. Describe the Hopf algebra structures on the coordinate rings of $\mathbb{G}_a$ and $\text{GL}_n$.

4. Prove that a $T_0$ topological group is already $T_2$. Show that an infinite linear algebraic group is always $T_0$ but never $T_2$. Explain the discrepancy!

5. Show that the product of irreducible affine $K$-varieties is again irreducible. This fails for non-algebraically closed fields $K$: exhibit zero divisors in $\mathbb{C} \otimes_{\mathbb{R}} \mathbb{C}$.