1. The Yoneda Lemma
(Supervised by Sara Mehidi – Block 2 only)

Category theory has brought forth a new approach to understanding mathematical objects. In short, the Yoneda perspective says that the essence of mathematical objects is entirely determined by how they are related to other objects. Just as Cayley's theorem states that every group is a subgroup of a symmetric group, the Yoneda lemma is sometimes seen as a generalization of Cayley's theorem and states that every (locally small) category $\mathcal{C}$ embeds into a category of functors defined on $\mathcal{C}$. In simple words, this means that everything we need to know about an object X in $\mathcal{C}$ is encoded in its image by this embedding, namely, $\text{Hom}(-, X)$. Moreover, using the lemma, we are able to prove Cayley's theorem with very little effort, but also many more complex results in various fields of mathematics.

Once a familiarity with the language of categories, functors, and representability is acquired, the goal of this project is to understand the Yoneda lemma through examples, as well as explore some of its applications.

References:

- Riehl, E. *Category Theory in Context.* Dover Publications, 2017.
  https://math.jhu.edu/~eriehl/context.pdf (Chapter 2).

Algebraic geometry