# Conventions and Notations

## Categories

We follow the von Neumann–Bernays–Gödel set theory and distinguish between *sets* and *classes*. All categories are assumed to be *locally small* in the sense that the objects form a class and for each pair of objects the morphisms between them form a set. When a category is abelian or exact, we assume in addition that for each pair of objects the extensions (in the sense of Yoneda) form a set.

We denote by Set the category of *sets* and by Ab the category of *abelian groups*. The *cardinality* of a set $X$ is denoted by card $X$.

Morphisms are composed from right to left. For the composite $X \xrightarrow{\alpha} Y \xrightarrow{\beta} Z$ we write $\beta\alpha$.

Functors $\mathcal{C} \to \mathcal{D}$ are by convention covariant. Replacing one of the categories by its opposite category identifies contravariant functors $\mathcal{C} \to \mathcal{D}$ with covariant functors $\mathcal{C}^{\mathrm{op}} \to \mathcal{D}$ or $\mathcal{C} \to \mathcal{D}^{\mathrm{op}}$.

## Rings and Modules

All rings are associative and have a unit.

For a ring $\Lambda$ we consider the category $\operatorname{Mod}\Lambda$ of *right* $\Lambda$*-modules* but drop the adjective 'right'. Left $\Lambda$-modules are identified with modules over the *opposite ring* $\Lambda^{\mathrm{op}}$. The full subcategory of finitely presented $\Lambda$-modules is denoted by $\operatorname{mod}\Lambda$, and $\operatorname{proj}\Lambda$ denotes the full subcategory of finitely generated projective $\Lambda$-modules.

When $\Lambda$ and $\Gamma$ are $k$-algebras over a commutative ring $k$, then $\Gamma$-$\Lambda$-*bimodules* ${}_{\Gamma}M_{\Lambda}$ are identified with modules over the algebra $\Gamma^{\mathrm{op}} \otimes_k \Lambda$.

## Numbers

We denote by $\mathbb{Z}$ the set of integers and write

$$\mathbb{N} = \{0, 1, 2, 3, \dots\}$$

for the set of non-negative integers.