Exercise Sheet 9: Advanced LaTeX

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Exercise 9.1. Typeset the following paragraph.

> **Lemma 8.2 (Yoneda)** *Let* $\mathbf{C}$ *be locally small. For any object* $C \in \mathbf{C}$ *and functor* $F \in \mathbf{Sets}^{\mathbf{C}^{op}}$ *there is an isomorphism*
>
> $$\mathrm{Hom}(yC, F) \cong FC$$
>
> *which, moreover, is natural in both* F *and* C*.*
>
> *Here:*
>
> *(1) the Hom is* $\mathrm{Hom}_{\mathbf{Sets}^{\mathbf{C}^{op}}}$*,*
>
> *(2) naturality in* F *means that, given any* $\vartheta : F \to G$*, the following diagram commutes:*
>
> $$\begin{array}{ccc} \mathrm{Hom}(yC, F) & \xrightarrow{\cong} & FC \\ {\scriptstyle \mathrm{Hom}(yC,\vartheta)}\downarrow & & \downarrow{\scriptstyle \vartheta_C} \\ \mathrm{Hom}(yC, G) & \xrightarrow{\cong} & GC \end{array}$$
>
> *(3) naturality in* C *means that, given any* $h : C \to D$*, the following diagram commutes:*
>
> $$\begin{array}{ccc} \mathrm{Hom}(yC, F) & \xrightarrow{\cong} & FC \\ {\scriptstyle \mathrm{Hom}(yh,F)}\uparrow & & \uparrow{\scriptstyle Fh} \\ \mathrm{Hom}(yD, F) & \xrightarrow{\cong} & FD \end{array}$$
>
> (Awodey, Steve. 2006. Category Theory. Oxford University Press. p. 162)

Hint: You can use tikz[1] with the `tikz-cd` library to typeset the *commutative diagrams*, but several other packages are also available.

Exercise 9.2. Write a paper proving the *binomial theorem*:

> Let $n \in \mathbb{N}$. Then
>
> $$(x + y)^n = \sum_{k=0}^{n} \binom{n}{k} x^k y^{n-k}.$$

You may use any sources that you need, provided that you properly cite them. Make sure your paper includes an introduction, a conclusion, and all necessary preliminaries. Try to make your paper as easy to read as possible.

[1] https://github.com/pgf-tikz/pgf