R. Herzog, G. Müller
Universität Heidelberg

Worksheet 4 (Solution)

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All required data for this worksheet is supplied in week-04.zip.

All solution files can be found in week-04-sol.zip.

Problem 4.1. (Math Formatting)

The supplied `problem-4-1-stub.tex` builds without errors. Modify the file so that it builds without errors and renders like the supplied `problem-4-1-sol.pdf`, with the exception of your names and matriculation number, which should be replaced by your actual data.

Solution.

The following modifications are required:

(a) In the beginning of the document, the first system needs to be changed from the chosen equation with an aligned block to a subequation environment around align, i. e., to

```
\begin{subequations}
        \label{eq:system}
        \begin{align}
                2x + y &= 5, \label{eq:sum}\\
                x - y &= 1. \label{eq:diff}
        \end{align}
\end{subequations}
```

(b) The first modification makes it possible to reference the subequations individually in the next math environment's tag via

```
\begin{equation}
        \label{eq:x}
        \tag{\ref{eq:sum}+\ref{eq:diff}}
        3x = 6.
\end{equation}
```

(c) In the next text line, we can then exchange the prose and reference for the cleaner direct referencing via

```
From \eqref{eq:x}, we get $x = 2$, and substituting into \eqref{eq:diff} (or \eqref{eq:sum}) then gives
↪  $y = 1$.
```

(d) The matrix equation in the second section simply needs capitalization in the dots used, which one can find out via `texdoc nicematrix` or simply by looking ahead in the same equation, where the vertical dots in the vectors render correctly, i. e.,

```
\begin{bNiceMatrix}
        a_{11} & \Cdots & a_{1m} \\
        \Vdots & \Ddots & \Vdots \\
        a_{n1} & \Cdots & a_{nm}
\end{bNiceMatrix}
```

(e) All augmented matrices then need the correct vertical delimiter and spacing, which can thankfully be done by changing the single definition in line 12 of the document, which should be

```
\DeclarePairedDelimiterX{\augment}[2]{\lbrack}{\rbrack}{#1 \;\delimsize\vert\; \mathopen{} #2}
```

(f) The large numbered equation block needs to be replaced with an unnumbered one and the aligned environment simply needs to be replaced with cases, no other formatting required, giving

```
\begin{equation*}
        \abs{L(A, b)} =
        \begin{cases}
                0                 & \text{if } \rank(A) \neq \rank(\augment{A}{b}), \\
                \abs{L(A, 0)} = 1 & \text{if } \rank(A) = \rank(\augment{A}{b}) = m, \\
                \abs{L(A, 0)} > 1 & \text{if } \rank(A) = \rank(\augment{A}{b}) < m.
        \end{cases}
\end{equation*}
```

(g) Finally, the last line needs small matrices. For `pmatrix`, the lecture told us that this is achieved via `psmallmatrix` and the nicematrix equivalent is adding the `small` option, which can be found via `texdoc nicematrix`, so we end up with

```
For the system in \eqref{eq:system}, we have $n = m = 2$ and $\rank\begin{psmallmatrix} 2 & 1 \\ 1 & -1
↪  \end{psmallmatrix} =\rank\begin{pNiceArray}{cc|c}[small] 2 & 1 & 5 \\ 1 & -1 & 1 \end{pNiceArray} =
↪  m$, so it is uniquely solvable, in agreement with the explanation in \zcref{sec:example}.
```