```
\def\zl{{\ensuremath{\color{blue} z_l}}}
```

also can be put into “preamble”

$$0 = \frac{\partial}{\partial {\color{blue} z_l}}\left(\|h(z_{l-1})\cdot w_l - {\color{blue} z_l}\| + \lambda\|h({\color{blue} z_l})\cdot w_{l+1} - z_{l+1}\|\right)$$

```
\usepackage{expl3,xparse}

\ExplSyntaxOn
\NewDocumentCommand{\midarrow}{m}
{
    \tl_set:Nn \l_tmpa_tl { (#1) }
    \regex_replace_all:nnN { \, } { \c{rightarrow} } \l_tmpa_tl
    \regex_replace_all:nnN { \; } { \)\; \c{hspace}\cB\{ 1cm \cE\} \( } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$(a \rightarrow A); \hspace{1cm} (b \rightarrow B); \hspace{1cm} (c \rightarrow C)$$

1 reTwoToThree

```
\ExplSyntaxOn
\NewDocumentCommand{\reTwoToThree}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { 2 } { 3 } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$c^2 = a^2 + b^2$$

$$c^3 = a^3 + b^3$$

$$\begin{aligned} c^3 =& a^3 + b^3 \\ =& b^3 + a^3 \end{aligned}$$

2 RenewDocumentCommand

```
\ExplSyntaxOn
\NewDocumentCommand{\reTwoToThree}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { 2 } { 3 } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$c^2 = a^2 + b^2$$

3 recolor

```
\usepackage{expl3,xparse}
\usepackage{xcolor}

\ExplSyntaxOn
\NewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { 2 } { \c{ensuremath}{\c{color}{red}{2}} } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$c^2 = a^2 + b^2$$

```
\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { 2 } { \c{color}{blue}{2} } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$c^2 = a^2 + b^2$$

```
\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { [\d] } { \c{color}{red}{\0} } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$c^{23} = a^{24} + b^{25}$$

```
\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { ([\d])([\d]) } { \c{color}{red}{\1}\c{color}{blue}{\2} } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$c^{23} = a^{24} + b^{25}$$

```
\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { x } { {\c{color}{red}{\0}} } \l_tmpa_tl
        \regex_replace_all:nnN { y } { {\c{color}{cyan}{\0}} } \l_tmpa_tl
        \regex_replace_all:nnN { \c{epsilon} } { {\c{color}{orange}{\0}} } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$
\begin{aligned}
0 \leq \epsilon = \frac{\overline{PF}}{d\left(P,L\right)} = \frac{\overline{PF}}{\overline{PP'}} &= \frac{\left\|(x,y)-(0,y_{F})\right\|}{\left\|(x,y)-(x,y_{L})\right\|} = \frac{\left\|(x,y-y_{F})\right\|}{\left\|(0,y-y_{L})\right\|} = \frac{\sqrt{x^2+\left(y-y_{F}\right)^2}}{\sqrt{\left(y-y_{L}\right)^2}} \\
\epsilon^2 &= \frac{x^2+\left(y-y_{F}\right)^2}{\left(y-y_{L}\right)^2} = \frac{x^2+y^2-2y_{F}y+y_{F}^2}{y^2-2y_{L}y+y_{L}^2} \\
0 &= x^2+\left(1-\epsilon^2\right)y^2-2\left(y_{F}-\epsilon^2 y_{L}\right)y+\left(y_{F}^2-\epsilon^2 y_{L}^2\right) \\
&\overset{\epsilon\neq 1}{=} x^2+\left(1-\epsilon^2\right)\left[y^2-\frac{2\left(y_{F}-\epsilon^2 y_{L}\right)}{1-\epsilon^2}y+\frac{y_{F}^2-\epsilon^2 y_{L}^2}{1-\epsilon^2}\right] \\
&= x^2+\left(1-\epsilon^2\right) \\
&\quad \left[y^2-\frac{2\left(y_{F}-\epsilon^2 y_{L}\right)}{1-\epsilon^2}y+\left(\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2-\left(\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2+\frac{y_{F}^2-\epsilon^2 y_{L}^2}{1-\epsilon^2}\right] \\
&= x^2+\left(1-\epsilon^2\right)\left[\left(y-\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2+\frac{\left(y_{F}^2-\epsilon^2 y_{L}^2\right)\left(1-\epsilon^2\right)-\left(y_{F}-\epsilon^2 y_{L}\right)^2}{\left(1-\epsilon^2\right)^2}\right] \\
&= x^2+\left(1-\epsilon^2\right)\left(y-\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2+\frac{\left(y_{F}^2-\epsilon^2 y_{L}^2\right)\left(1-\epsilon^2\right)-\left(y_{F}-\epsilon^2 y_{L}\right)^2}{1-\epsilon^2}
\end{aligned}
$$

```
\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { y_{{\c{scriptscriptstyle} F}} }
                                                    {
                                                        {
                                                               \c{color}{red}
                                                                       {
                                                                       { \0 }
                                                                       }
                                                               }
                                                    }
                                                    \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$
\begin{aligned}
0 \leq \epsilon = \frac{\overline{PF}}{d\left(P,L\right)} = \frac{\overline{PF}}{\overline{PP'}} &= \frac{\left\|(x,y)-(0,y_{F})\right\|}{\left\|(x,y)-(x,y_{L})\right\|} = \frac{\left\|(x,y-y_{F})\right\|}{\left\|(0,y-y_{L})\right\|} = \frac{\sqrt{x^2+\left(y-y_{F}\right)^2}}{\sqrt{\left(y-y_{L}\right)^2}} \\
\epsilon^2 &= \frac{x^2+\left(y-y_{F}\right)^2}{\left(y-y_{L}\right)^2} = \frac{x^2+y^2-2y_{F}y+{y_{F}}^2}{y^2-2y_{L}y+y_{L}^2} \\
0 &= x^2+\left(1-\epsilon^2\right)y^2-2\left(y_{F}-\epsilon^2 y_{L}\right)y+\left({y_{F}}^2-\epsilon^2 y_{L}^2\right) \\
&\overset{\epsilon\neq 1}{=} x^2+\left(1-\epsilon^2\right)\left[y^2-\frac{2\left(y_{F}-\epsilon^2 y_{L}\right)}{1-\epsilon^2}y+\frac{{y_{F}}^2-\epsilon^2 y_{L}^2}{1-\epsilon^2}\right] \\
&= x^2+\left(1-\epsilon^2\right) \\
&\quad \left[y^2-\frac{2\left(y_{F}-\epsilon^2 y_{L}\right)}{1-\epsilon^2}y+\left(\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2-\left(\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2+\frac{{y_{F}}^2-\epsilon^2 y_{L}^2}{1-\epsilon^2}\right] \\
&= x^2+\left(1-\epsilon^2\right)\left[\left(y-\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2+\frac{\left({y_{F}}^2-\epsilon^2 y_{L}^2\right)\left(1-\epsilon^2\right)-\left(y_{F}-\epsilon^2 y_{L}\right)^2}{\left(1-\epsilon^2\right)^2}\right] \\
&= x^2+\left(1-\epsilon^2\right)\left(y-\frac{y_{F}-\epsilon^2 y_{L}}{1-\epsilon^2}\right)^2+\frac{\left({y_{F}}^2-\epsilon^2 y_{L}^2\right)\left(1-\epsilon^2\right)-\left(y_{F}-\epsilon^2 y_{L}\right)^2}{1-\epsilon^2}
\end{aligned}
$$

```
\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { \c{sqrt}(.) }
                                                    {
                                                         {
                                                                 \c{color}{red}
                                                                         {
                                                                         { \c{sqrt} \1 }
                                                                         }
                                                              }
                                                    }
                                                    \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$0 \leq \epsilon = \frac{\overline{PF}}{d\left(P, L\right)} = \frac{\overline{PF}}{\overline{PP'}} = \frac{\left\|(x,y)-(0,y_F)\right\|}{\left\|(x,y)-(x,y_L)\right\|} = \frac{\left\|(x,y-y_F)\right\|}{\left\|(0,y-y_L)\right\|} = \frac{\sqrt{x^2+\left(y-y_F\right)^2}}{\sqrt{\left(y-y_L\right)^2}}$$

$$\begin{aligned}
\epsilon^2 =& \frac{x^2+\left(y-y_F\right)^2}{\left(y-y_L\right)^2} = \frac{x^2+y^2-2y_Fy+y_F^2}{y^2-2y_Ly+y_L^2} \\
0 =& x^2+\left(1-\epsilon^2\right)y^2-2\left(y_F-\epsilon^2y_L\right)y+\left(y_F^2-\epsilon^2y_L^2\right) \\
\overset{\epsilon\neq 1}{=}& x^2+\left(1-\epsilon^2\right)\left[y^2-\frac{2\left(y_F-\epsilon^2y_L\right)}{1-\epsilon^2}y+\frac{y_F^2-\epsilon^2y_L^2}{1-\epsilon^2}\right] \\
=& x^2+\left(1-\epsilon^2\right) \\
& \left[y^2-\frac{2\left(y_F-\epsilon^2y_L\right)}{1-\epsilon^2}y+\left(\frac{y_F-\epsilon^2y_L}{1-\epsilon^2}\right)^2-\left(\frac{y_F-\epsilon^2y_L}{1-\epsilon^2}\right)^2+\frac{y_F^2-\epsilon^2y_L^2}{1-\epsilon^2}\right] \\
=& x^2+\left(1-\epsilon^2\right)\left[\left(y-\frac{y_F-\epsilon^2y_L}{1-\epsilon^2}\right)^2+\frac{\left(y_F^2-\epsilon^2y_L^2\right)\left(1-\epsilon^2\right)-\left(y_F-\epsilon^2y_L\right)^2}{\left(1-\epsilon^2\right)^2}\right] \\
=& x^2+\left(1-\epsilon^2\right)\left(y-\frac{y_F-\epsilon^2y_L}{1-\epsilon^2}\right)^2+\frac{\left(y_F^2-\epsilon^2y_L^2\right)\left(1-\epsilon^2\right)-\left(y_F-\epsilon^2y_L\right)^2}{1-\epsilon^2}
\end{aligned}$$

```
\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { \c{omega} } { {\c{color}{red}{\0}} } \l_tmpa_tl
        \regex_replace_all:nnN { V } { {\c{color}{cyan}{\0}} } \l_tmpa_tl
        \regex_replace_all:nnN { v } { {\c{color}{orange}{\0}} } \l_tmpa_tl
        \regex_replace_all:nnN { = } { {\c{color}{green}{\0}} } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$
\begin{aligned}
\boldsymbol{\omega} &= [\boldsymbol{\omega}]^{V}\, V^{*} = [\boldsymbol{\omega}]^{\tilde{V}}\, \tilde{V}^{*} \\
&= \omega_{i}^{\boldsymbol{v}} {V^{*}}^{i}{}_{k} = \omega_{j}^{\tilde{\boldsymbol{v}}} {\tilde{V}^{*}}{}^{j}{}_{k}
\end{aligned}
$$

$$
\omega_{j}^{\tilde{\boldsymbol{v}}} {\tilde{V}^{*}}{}^{j}{}_{k} = \omega_{i}^{\boldsymbol{v}} {V^{*}}^{i}{}_{k}
$$

$$
\omega_{j}^{\tilde{\boldsymbol{v}}} = \omega_{i}^{\boldsymbol{v}} {V^{*}}^{i}{}_{k} \left({\tilde{V}^{*}}{}^{j}{}_{k}\right)^{-1} = \omega_{i}^{\boldsymbol{v}} {V^{*}}^{i}{}_{k} \left(\tilde{V}^{*-1}\right)^{k}{}_{j} = \omega_{i}^{\boldsymbol{v}} Q^{i}{}_{j}
$$

$$
\boldsymbol{\omega}\left(\tilde{\boldsymbol{v}}_{j}\right) = \omega_{j}^{\tilde{\boldsymbol{v}}} = \omega_{i}^{\boldsymbol{v}} Q^{i}{}_{j} = \boldsymbol{\omega}\left(\boldsymbol{v}_{i}\right) Q^{i}{}_{j} = \boldsymbol{\omega}\left(\tilde{\boldsymbol{v}}_{k} B^{k}{}_{i}\right) Q^{i}{}_{j} = \boldsymbol{\omega}\left(\tilde{\boldsymbol{v}}_{k}\right) B^{k}{}_{i} Q^{i}{}_{j}
$$

$$
\boldsymbol{\omega}\left(\tilde{\boldsymbol{v}}_{j}\right) = \boldsymbol{\omega}\left(\tilde{\boldsymbol{v}}_{k}\right) B^{k}{}_{i} Q^{i}{}_{j}
$$

$$
B^{k}{}_{i} Q^{i}{}_{j} = \delta^{k}{}_{j} \Rightarrow Q^{i}{}_{j} = F^{i}{}_{j}
$$

$$
\omega_{j}^{\tilde{\boldsymbol{v}}} = \omega_{i}^{\boldsymbol{v}} Q^{i}{}_{j} = \omega_{i}^{\boldsymbol{v}} F^{i}{}_{j}
$$

$$
\omega_{j}^{\tilde{\boldsymbol{v}}} = \omega_{i}^{\boldsymbol{v}} F^{i}{}_{j} \Rightarrow \begin{bmatrix} \vdots \\ \omega_{i}^{\tilde{\boldsymbol{v}}} \\ \vdots \end{bmatrix}^{\intercal} = \begin{bmatrix} \vdots \\ \omega_{i}^{\boldsymbol{v}} \\ \vdots \end{bmatrix}^{\intercal} F
$$

$$
\omega_{k}^{\tilde{\boldsymbol{v}}} B^{k}{}_{j} = \omega_{i}^{\boldsymbol{v}} F^{i}{}_{k} B^{k}{}_{j} = \omega_{i}^{\boldsymbol{v}} \delta^{i}{}_{j} = \omega_{j}^{\boldsymbol{v}}
$$

$$
\omega_{j}^{\boldsymbol{v}} = \omega_{k}^{\tilde{\boldsymbol{v}}} B^{k}{}_{j} \Rightarrow \begin{bmatrix} \vdots \\ \omega_{i}^{\boldsymbol{v}} \\ \vdots \end{bmatrix}^{\intercal} = \begin{bmatrix} \vdots \\ \omega_{i}^{\tilde{\boldsymbol{v}}} \\ \vdots \end{bmatrix}^{\intercal} B
$$

4 combine \def or \newcommand and ExpL3 \regex_...

```
\def\01{\colorbox{yellow!50}{$\left(y_{{\scriptscriptstyle F}}^{2}-\epsilon^{2}y_{{\scriptscript

\ExplSyntaxOn
\RenewDocumentCommand{\recolor}{m}
{
    \tl_set:Nn \l_tmpa_tl { #1 }
    \regex_replace_all:nnN { x } { {\c{color}{red}{\0}} } \l_tmpa_tl
        \regex_replace_all:nnN { y } { {\c{color}{cyan}{\0}} } \l_tmpa_tl
        \regex_replace_all:nnN { \c{epsilon} } { {\c{color}{orange}{\0}} } \l_tmpa_tl
    \tl_use:N \l_tmpa_tl
}
\ExplSyntaxOff
```

$$0 \leq \epsilon = \frac{\overline{PF}}{d(P,L)} = \frac{\overline{PF}}{\overline{PP'}} = \frac{\|(x,y)-(0,y_F)\|}{\|(x,y)-(x,y_L)\|} = \frac{\|(x,y-y_F)\|}{\|(0,y-y_L)\|} = \frac{\sqrt{x^2+(y-y_F)^2}}{\sqrt{(y-y_L)^2}}$$

$$\begin{aligned}
\epsilon^2 =& \frac{x^2+(y-y_F)^2}{(y-y_L)^2} = \frac{x^2+y^2-2y_F y+y_F^2}{y^2-2y_L y+y_L^2} \\
0 =& x^2+\left(1-\epsilon^2\right)y^2-2\left(y_F-\epsilon^2 y_L\right)y+\left(y_F^2-\epsilon^2 y_L^2\right) \\
\overset{\epsilon\neq 1}{=}& x^2+\left(1-\epsilon^2\right)\left[y^2-\frac{2\left(y_F-\epsilon^2 y_L\right)}{1-\epsilon^2}y+\frac{y_F^2-\epsilon^2 y_L^2}{1-\epsilon^2}\right] \\
=& x^2+\left(1-\epsilon^2\right) \\
& \left[y^2-\frac{2\left(y_F-\epsilon^2 y_L\right)}{1-\epsilon^2}y+\left(\frac{y_F-\epsilon^2 y_L}{1-\epsilon^2}\right)^2-\left(\frac{y_F-\epsilon^2 y_L}{1-\epsilon^2}\right)^2+\frac{y_F^2-\epsilon^2 y_L^2}{1-\epsilon^2}\right] \\
=& x^2+\left(1-\epsilon^2\right)\left[\left(y-\frac{y_F-\epsilon^2 y_L}{1-\epsilon^2}\right)^2+\frac{\left(y_F^2-\epsilon^2 y_L^2\right)\left(1-\epsilon^2\right)-\left(y_F-\epsilon^2 y_L\right)^2}{\left(1-\epsilon^2\right)^2}\right] \\
=& x^2+\left(1-\epsilon^2\right)\left(y-\frac{y_F-\epsilon^2 y_L}{1-\epsilon^2}\right)^2+\frac{\left(y_F^2-\epsilon^2 y_L^2\right)\left(1-\epsilon^2\right)-\left(y_F-\epsilon^2 y_L\right)^2}{1-\epsilon^2}
\end{aligned}$$