Writing derivatives

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Abstract

This document describes the package esdiff that makes writing derivatives very easy. It allows to write derivatives, partial derivatives, multiple derivatives. Some typographic options are available. The macro about crossed derivatives was given on `comp.text.tex` by Peter Schmitt.

1 Derivatives

`\diff`

Derivatives are obtained with the command diff.
To get $\frac{\mathrm{d}f}{\mathrm{d}x}$, just write `$\diff{f}{x}$`.
The ordre of the derivative can be set in square brackets. So `$\diff[n]{f}{x}$` gives $\frac{\mathrm{d}^n f}{\mathrm{d}x^n}$.

`\diff*`

It's easy to precise the point where the derivative is calculated:
`$\diff*{f}{x}{x_0}$` gives $\left(\frac{\mathrm{d}f}{\mathrm{d}x}\right)_{x_0}$.
Of course, those two options can be used together: `$\diff*[2]{g}{y}{0}$` gives as expected $\left(\frac{\mathrm{d}^2 g}{\mathrm{d}y^2}\right)_0$.

2 Partial derivatives

`\diffp`

Partial derivatives are obtained with the macro diffp, using the same syntaxe as with diff: a star version to put a subscript, and square brackets to set the order of the derivative according to only one variable.
To get $\frac{\partial f}{\partial x}$, just write `$\diffp{f}{x}$`.
We obtain $\frac{\partial^2 f}{\partial x^2}$ wrtiting `$\diffp[2]{f}{x}$`.

`\diffp*`

The notation $\left(\frac{\partial p}{\partial V}\right)_T$ is the result of `$\diffp*{p}{V}{T}$`.

The notation of crossed derivatives is automatic. To get $\frac{\partial^3 f}{\partial x \partial y^2}$, write `$\diffp{f}{{x}{y^2}}$`. This method can be used to write a partial derivative, without square beackets. So `$\diffp{f}{{x^2}}$` gives $\frac{\partial^2 f}{\partial x^2}$.

We can mix options: `$\diffp*{f}{{x^2}{y^3}}{z}$` gives $\left(\dfrac{\partial^5 f}{\partial x^2 \partial y^3}\right)_z$.

3 Options

Several options are available:

- by default, derivatives are written in displaystyle on text mode. The display option set this default. With the text option, derivatives are written in textstyle on text mode;
- by default, the d of the derivative is written in roman. Available options are roman and italic;
- we can set the space between the d and the symbol of the function or of the variable. By default, this space is null. Available options are thin, med and big. It may be fine to add a space when the d is in italic;
- We can set the space between the ∂ and the symbol of the function or of the variable. By default, this space is null. Available options are thinp, medp and bigp;
- the space between ∂x and ∂y in crossed derivatives may be too narrow. It is null by default. Available options are thinc, medc and bigc;

4 The code

The package presents itself.

```
⟨*package⟩
\NeedsTeXFormat{LaTeX2e}
\ProvidesPackage{esdiff}
```

We set default values for the options.

```
\newcommand{\taille}[1]{\displaystyle{#1}}
\newcommand{\difint}{\mkern 0mu}
\newcommand{\derpint}{\mkern 0mu}
\newcommand{\croisint}{\mkern 0mu}
```

The d is roman by default..

```
\newcommand{\dop}{\mathrm{d}}
```

Options:

```
\DeclareOption{display}{\renewcommand{\taille}[1]{\displaystyle{#1}}}
\DeclareOption{text}{\renewcommand{\taille}[1]{\textstyle{#1}}}
\DeclareOption{roman}{\renewcommand{\dop}{\ensuremath{\mathrm{d}}}}
\DeclareOption{italic}{\renewcommand{\dop}{\ensuremath{d}}}
\DeclareOption{thin}{\renewcommand{\difint}{\ensuremath{\,}}}
\DeclareOption{med}{\renewcommand{\difint}{\ensuremath{\;}}}
\DeclareOption{big}{\renewcommand{\difint}{\ensuremath{\:}}}
\DeclareOption{thinp}{\renewcommand{\derpint}{\ensuremath{\,}}}
\DeclareOption{medp}{\renewcommand{\derpint}{\ensuremath{\;}}}
\DeclareOption{bigp}{\renewcommand{\derpint}{\ensuremath{\:}}}
\DeclareOption{thinc}{\renewcommand{\croisint}{\ensuremath{\,}}}
\DeclareOption{medc}{\renewcommand{\croisint}{\ensuremath{\;}}}
```

```
\DeclareOption{bigc}{\renewcommand{\croisint}{\ensuremath{\:}}}
\ProcessOptions\relax
```

4.1 Derivative

Test of star version.

```
\def\diff{\@ifstar{\diffstar}{\diffnostar}}
```

Star version. The subscript is given.

```
\def\diffstar{\@ifnextchar[{\@diffstar}{\@@diffstar}}
```

The ordre is given in square brakets, and there is a subscript.

```
\def\@diffstar[#1]#2#3#4{\mathchoice{\left(\frac{\dop^{#1}\difint#2}%
{\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}%
{\taille{\left(\frac{\dop^{#1}\difint#2}%
{\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}}%
{\scriptstyle{\left(\frac{\dop^{#1}\difint#2}%
{\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}}%
{\scriptstyle{\left(\frac{\dop^{#1}\difint#2}%
{\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}}}
```

There is only a subscript.

```
\def\@@diffstar#1#2#3{\mathchoice{\left(\frac{\dop\difint#1}%
{\dop\difint#2}\right)_{\mkern-7mu#3}}%
{\taille{\left(\frac{\dop\difint#1}{\dop\difint#2}%
\right)_{\mkern-7mu#3}}}{\scriptstyle{\left(%
\frac{\dop\difint#1}{\dop\difint#2}\right)%
_{\mkern-7mu#3}}}%
{\scriptstyle{\left(\frac{\dop\difint#1}{\dop\difint#2}\right)%
_{\mkern-7mu#3}}}}
```

No star version (no subscript).

```
\def\diffnostar{\@ifnextchar[{\@diffnostar}{\@@diffnostar}}
```

The ordre is given in square brackets.

```
\def\@diffnostar[#1]#2#3{\mathchoice{\frac{\dop^{#1}\difint#2}%
{\dop\difint#3^{#1}}}%
{\taille{\frac{\dop^{#1}\difint#2}{\dop\difint#3^{#1}}}}%
{\scriptstyle{\frac{\dop^{#1}\difint#2}{\dop\difint#3^{#1}}}}%
{\scriptstyle{\frac{\dop^{#1}\difint#2}{\dop\difint#3^{#1}}}}}
```

Basic notation.

```
\def\@@diffnostar#1#2{\mathchoice%
{\frac{\dop\difint#1}{\dop\difint#2}}%
{\taille{\frac{\dop\difint#1}{\dop\difint#2}}}%
{\scriptstyle{\frac{\dop\difint#1}{\dop\difint#2}}}%
{\scriptstyle{\frac{\dop\difint#1}{\dop\difint#2}}}}
```

4.2 Partial derivatives

Test of the star version.

```
\def\diffp{\@ifstar{\diffpstar}{\diffpnostar}}
```

Star version: a subscript is given.

```
\def\diffpstar{\@ifnextchar[{\@diffpstar}{\@@diffpstar}}
```

Ordre of derivative is given, and there is a subscript.

```
\def\@diffpstar[#1]#2#3#4{\mathchoice{\left(\frac{\partial^{#1}%
\derpint#2}{\partial\derpint#3^{#1}}\right)_{\mkern-7mu#4}}%
{\taille{\left(\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}%
\right)_{\mkern-7mu#4}}}%
{\scriptstyle{\left(\frac{\partial^{#1}\derpint#2}%
{\partial\derpint#3^{#1}}%
\right)_{\mkern-7mu#4}}}%
{\scriptstyle{\left(\frac{\partial^{#1}\derpint#2}%
{\partial\derpint#3^{#1}}%
\right)_{\mkern-7mu#4}}}}
```

There is only a subscript.

```
\def\@@diffpstar#1#2#3{\mathchoice{\left({\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}\right)_{\mkern-7mu#3}}%
            {\taille{\left({\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}\right)_{\mkern-7mu#3}}}%
            {\scriptstyle{\left({\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}\right)_{\mkern-7mu#3}}}%
            {\scriptstyle{\left({\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}\right)_{\mkern-7mu#3}}}}
```

No star version (no subscript is given).

```
\def\diffpnostar{\@ifnextchar[{\@diffpnostar}{\@@diffpnostar}}
```

The ordre of derivative is given.

```
\def\@diffpnostar[#1]#2#3{\mathchoice{\frac{\partial^{#1}\derpint#2}%
{\partial\derpint#3^{#1}}}%
{\taille{\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}}}%
{\scriptstyle{\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}}}%
{\scriptstyle{\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}}}}
```

Basic notation.

```
\def\@@diffpnostar#1#2{\mathchoice{\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}%
```

```
            {\taille{\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}}%
            {\scriptstyle{\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}}%
            {\scriptstyle{\begingroup
            \toks0={}\count0=0
            \degree #2\degree
            \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
            {\the\toks0}%
            \endgroup}}}
```

Macros used for crossed derivatives.

```
\def\degree #1{\ifx #1\degree \expandafter\stopd
                      \else \expandafter\addd \fi #1^1$#1\addd}
\def\stopd #1\addd{}
\def\addd #1^#2#3$#4\addd{\advance\count0 #2
                          \toks0=\expandafter{\the\toks0%
                           {\partial\derpint #4}%
                          \croisint}\degree}
⟨/package⟩
```