The derivative package

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The `derivative` package provides a set of commands which makes writing ordinary and partial derivatives of arbitrary order in a straight forward manner. Additionally, this package provides a set of commands to define variants of the aforementioned derivatives. A set of optional arguments along with lots of package options allow for easy and great flexibility over the derivative's format, such as where the function is positioned, point of evaluation, and switching between fraction styles. Moreover, the mixed order of the partial derivative and variants hereof is automatically computed. This package is written in the `expl3` language and requires therefore the LaTeX3 package bundles `l3kernel` and `l3package`. Additionally, the `mleftright` package is optional and provides the improved automatically scaling `\mleft` and `\mright`.

Contents

1 Introduction

This package started as a personal package a few years ago that I used in various projects. Firstly, it was written in TeX and LaTeX, which gave rise to various errors as the complexity of the package grew larger and ended up as a spaghetti code. Therefore, the code was rewritten into the LaTeX3 language and may now be easily maintained. Originally this package was written because there did not exist any great package for derivatives. It was first much later that I discovered the `diffcoeff` package, which does a good job. However, at this time, I had already written much of the code with no documentation. So I decided to write one and make it into a package for the public.

As a note on terminology, I use the wording *infinitesimal* abbreviated as `inf` for the operator symbols d, ∂, δ etc. that used in derivatives like $\frac{\mathrm{d}y}{\mathrm{d}x}, \frac{\partial y}{\partial x}, \frac{\delta y}{\delta x}$ and in differentials like $\mathrm{d}x, \partial_x, \delta x$. In the description of macros and options, I often write *cs-⟨placeholder⟩* to denote a comma-separated list of *⟨placeholder⟩*. For example, [⟨*cs-numbers*⟩] is used in the option section for math space keys to denote comma-separated list of numbers. It should also be noted that whenever an argument reads ⟨*keyvalue list*⟩, it means that it is a comma-separated list of keyvalue pairs.

The github respository can be found at www.github.com/sjelatex/derivative.

2 Derivative

`\pdv` `*[`⟨*keyval list*⟩`]{`⟨*function*⟩`}/!{`⟨*variables*⟩`}_{`⟨*point₁*⟩`}^{`⟨*point₂*⟩`}`

The partial derivative `\pdv` is defined with a set of mandatory and optional arguments that either typeset specific parts or changing the style of the derivative. In this package, the partial derivative is defined with an italic partial differential ∂ as

```
\DeclareDerivative{\pdv}{\partial}[style-var=multiple, sep-inf-ord=1,
delims-eval=(), delims-eval-/=()]
```

`*`   The first argument of `\pdv` is an optional star that determines where the function is typeset; either in the numerator of the fraction or next to the fraction. Using the option `switch-*=false`, the function is typeset in the numerator when the star is absent, and next to the fraction when the star is present as shown below

$$\texttt{\textbackslash pdv\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^2 f}{\partial x\,\partial y}$$

$$\texttt{\textbackslash pdv*\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^2}{\partial x\,\partial y}f$$

The effect of the star's presence can be switched around using `switch-*=true` i.e. the equations in the above example are exchanged.

`[`⟨*keyval list*⟩`]`   The second argument is optional and is written inside square brackets. This argument
―――――   is used to set the options of the derivative using a `key=value` semantic. For example
Updated: v1.0   the order of differentiation can be set via the `order` option

$$\texttt{\textbackslash pdv[order=\{2,3\}]\{f\}\{x,y,z\}} \quad \Longrightarrow \quad \frac{\partial^6 f}{\partial x^2\,\partial y^3\,\partial z}$$

$$\texttt{\textbackslash pdv[order=\{\textbackslash beta,a,n+2a\}]\{f\}\{x,y,z\}} \quad \Longrightarrow \quad \frac{\partial^{3a+\beta+n} f}{\partial x^\beta\,\partial y^a\,\partial z^{n+2a}}$$

$$\texttt{\textbackslash pdv[order=\{2,n\textasciicircum 2,n\textasciicircum 2-1\}]\{f\}\{x,y,z\}} \quad \Longrightarrow \quad \frac{\partial^{2n^2+1} f}{\partial x^2\,\partial y^{n^2}\,\partial z^{n^2-1}}$$

$$\texttt{\textbackslash pdv[order=\{3/2-n/3,n/2,1/3\}]\{f\}\{x,y,z\}} \quad \Longrightarrow \quad \frac{\partial^{n/6+11/6} f}{\partial x^{3/2-n/3}\,\partial y^{n/2}\,\partial z^{1/3}}$$

The list of options that can be applied to derivatives can be found in section 4.3.

`{`⟨*function*⟩`}`   This is the first mandatory argument that typeset the function that is to be differentiated

$$\texttt{\textbackslash pdv\{f(x,y,z)\}\{x,y,z\}} \quad \Longrightarrow \quad \frac{\partial^3 f(x,y,z)}{\partial x\,\partial y\,\partial z}$$

$$\texttt{\textbackslash pdv\{e\textasciicircum x\textbackslash sin(y)\textbackslash ln(z)\}\{x,y,z\}} \quad \Longrightarrow \quad \frac{\partial^3 e^x \sin(y)\ln(z)}{\partial x\,\partial y\,\partial z}$$

The function is simply typeset in the numerator or to the right of the derivative.

/ The fourth argument is an optional slash written *between the function and the variable* arguments and means alternative style. When the exclamation mark argument is absent, the slash determines which fraction style the derivative is typeset with, as described in section 4.3. Using the package's default, the derivative is typeset with `\frac` when the slash is absent, and `\slashfrac`[1] when the slash is present, as shown below

$$\pdv{f}{x,y} \quad \implies \quad \frac{\partial^2 f}{\partial x\,\partial y}$$

$$\pdv{f}/{x,y} \quad \implies \quad \partial^2 f\big/\partial x\,\partial y$$

When the exclamation mark argument is present, the slash argument switches between compact styles instead of fraction styles (see below).

As for the star argument, the effect of the slash's presence can be switched around using `switch-/=true` i.e. the equations in the above example are exchanged.

! The fifth argument is an optional exclamation mark written *between the function and the variable* arguments and switches the derivative into compact style, as described in section 4.3. Using the option `switch-!=false` and the package's default fractions, the derivative is typeset with `\frac` when the slash is absent, and `\slashfrac` when the slash is present, as shown below

$$\pdv{f}!{x,y} \quad \implies \quad \partial x\,\partial y f$$

$$\pdv{f}/!{x,y} \quad \implies \quad \partial_{x,y} f$$

As for the star argument, the effect of the exclamations mark's presence can be switched around using `switch-!=true` i.e. the equations in the above example are exchanged.

Note. The order of `/` and `!` is important i.e. `\pdv{f}!/{x,y}` gives $\partial/f x, y$ and not the indented output $\partial_{x,y} f$.

{⟨*variables*⟩} This is the second and final mandatory argument, which purpose is to typeset the variable in which the function is differentiated with respect to. The variables are given in a comma-separated list e.g. `{x, y, z}`

$$\pdv{f}{x} \quad \implies \quad \frac{\partial f}{\partial x}$$

$$\pdv{f}{x,y} \quad \implies \quad \frac{\partial^2 f}{\partial x\,\partial y}$$

_{⟨*point₁*⟩}^{⟨*point₂*⟩} This is the last optional argument that specifies the point(s) of evaluation or variables held constant. It is an *e-type* argument in the xparse language and is given by `e{_^}`. This means that the subscript `_` and superscript `^` accepts an argument given in braces. Moreover, the order of `_` and `^` is independent as shown below

---

[1]which is a macro defined by the package, see section 7.1 for more information.

$$\texttt{\textbackslash pdv\{f\}\{x,y\}\_\{(x\_1,y\_1)\}} \implies \left(\frac{\partial^2 f}{\partial x\,\partial y}\right)_{(x_1,y_1)}$$

$$\texttt{\textbackslash pdv\{f\}\{x,y\}\textasciicircum\{(x\_2,y\_2)\}} \implies \left(\frac{\partial^2 f}{\partial x\,\partial y}\right)^{(x_2,y_2)}$$

$$\texttt{\textbackslash pdv\{f\}\{x,y\}\_\{(x\_1,y\_1)\}\textasciicircum\{(x\_2,y\_2)\}} \implies \left(\frac{\partial^2 f}{\partial x\,\partial y}\right)^{(x_2,y_2)}_{(x_1,y_1)}$$

$$\texttt{\textbackslash pdv\{f\}\{x,y\}\textasciicircum\{(x\_2,y\_2)\}\_\{(x\_1,y\_1)\}} \implies \left(\frac{\partial^2 f}{\partial x\,\partial y}\right)^{(x_2,y_2)}_{(x_1,y_1)}$$

The subscript argument is commonly used as the point of evaluation or variables held constant. If needed, the superscript argument may be used for the second point of evaluation.

2.1 Other derivatives

This package offers five other derivatives: Ordinary derivative \odv, material derivative \mdv, functional derivative \fdv, the average rate of change \adv and the Jacobian \jdv. A unique feature of this package, is that you can define your own derivatives as described in section 5.1.

\odv   *[⟨*keyval list*⟩]{⟨*function*⟩}/{⟨*variables*⟩}_{⟨*point₁*⟩}^{⟨*point₂*⟩}

Updated: v1.1

In this package, the ordinary derivative is defined with an upright lowercase d if the package option upright=true is used else it will use an italic lowercase d

```
\DeclareDerivative{\odv}{\mathrm{d}}
\DeclareDerivative{\odv}{\mathnormal{d}}
```
upright=true
italic=true

because it is used by many nowadays books

$$\frac{\mathrm{d}f}{\mathrm{d}x} = \lim_{h\to 0}\left(\frac{f(x+h)-f(x)}{h}\right)$$

However it can always be changed with the style-inf key.

\mdv   *[⟨*keyval list*⟩]{⟨*function*⟩}/{⟨*variables*⟩}_{⟨*point₁*⟩}^{⟨*point₂*⟩}

Updated: v1.1

The material derivative is used in some branches of physics e.g. thermodynamic, fluid dynamic etc. It comes with an upright uppercase D when the package option upright=true else it will use an italic uppercase D. In this package, the material derivative is defined as

```
\DeclareDerivative{\mdv}{\mathrm{D}}
\DeclareDerivative{\mdv}{\mathnormal{D}}
```
upright=true
italic=true

In physics, the material derivative is defined by

$$\frac{\mathrm{D}\varphi(\mathbf{r},t)}{\mathrm{D}t} := \frac{\partial \varphi(\mathbf{r},t)}{\partial t} + \dot{\mathbf{r}} \cdot \nabla\varphi(\mathbf{r},t)$$

`\fdv`   *[⟨*keyval list*⟩]{⟨*function*⟩}/{⟨*variables*⟩}_{⟨*point₁*⟩}^{⟨*point₂*⟩}

The functional derivative is used in the calculus of variation and uses a lowercase delta. With the package's default settings, it will use an italic delta. In this package, the functional derivative is defined as

```
\DeclareDerivative{\fdv}{\delta}
```

In physics, it is for example used in the Lagrange equation or in the derivation of the Hartree-Fock equation

$$\frac{\delta I}{\delta q_\alpha} = \frac{\partial L}{\partial q_\alpha} - \frac{\mathrm{d}}{\mathrm{d}t}\frac{\partial L}{\partial \dot{q}_\alpha} = 0, \qquad \frac{\delta \mathcal{L}}{\delta \psi_n^*} = \hat{F}|\psi_n\rangle - \epsilon_n|\psi_n\rangle = 0,$$

respectively.

`\adv`   *[⟨*keyval list*⟩]{⟨*function*⟩}/{⟨*variables*⟩}_{⟨*point₁*⟩}^{⟨*point₂*⟩}

The average rate of change is defined to use an upright uppercase delta with the packages default settings. In this package, the average rate of change is defined as

```
\DeclareDerivative{\adv}{\Delta}
```

The average rate of change is used to determine the slope of a straight line

$$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

`\jdv`   *[⟨*keyval list*⟩]{⟨*function*⟩}/{⟨*variables*⟩}_{⟨*point₁*⟩}^{⟨*point₂*⟩}

The Jacobian is defined to use an italic partial differential with the package's default settings. Also a pair of parentheses is automatically inserted around the function and variable. In this package, the Jacobian is defined as

```
\DeclareDerivative{\jdv}{\partial}[fun=true, var=1]
```

which gives

$$\frac{\partial(f, g, h)}{\partial(x, y, z)}$$

3 Differentials

\odif   *[⟨*keyval list*⟩]{⟨*variables*⟩}

The differential \odif is defined with a set of mandatory and optional arguments that either typeset specific parts or changing the style of the differential. It is defined with an upright lowercase d when `upright=true` else it will be defined with an italic lowercase d

```
\DeclareDifferential{\odif}{\mathrm{d}}
\DeclareDifferential{\odif}{\mathnormal{d}}
```
upright=true
italic=true

*   The first argument of \odif is an optional star that determines the notation style of the differential. Using the option `switch-*=false`, the variables and orders are typeset in a subscript and superscript respectively when the star is present. When the star is absent, then the macros associated infinitesimal is placed in front of each variable as shown below

$$\odif\{x,y,z\} \implies \mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z$$

$$\odif*\{x,y,z\} \implies \mathrm{d}_{x,y,z}$$

The effect of the star's presence can be switched around using `switch-*=true` i.e. the equations in the above example are exchanged, as described in section 4.3.

[⟨*keyval list*⟩]   The second argument is optional and is written inside square brackets. This argument is used to set the options of the differential using a `key=value` semantic.

$$\odif[\text{order}=\{n,3\}]\{x,y,z\} \implies \mathrm{d}^n x\,\mathrm{d}^3 y\,\mathrm{d}z$$

$$\odif[\text{sep-var-inf}=0]\{x,y,z\} \implies \mathrm{d}x\mathrm{d}y\mathrm{d}z$$

$$\odif*[\text{sep-var-var}=0]\{x,y,z\} \implies \mathrm{d}_{xyz}$$

The list of options that can be applied to differential can be is found in section 4.4

{⟨*variables*⟩}   This is the mandatory argument, which purpose is to typeset the variables, as shown below

$$\odif\{x\} \implies \mathrm{d}x$$

$$\odif\{s\_1,s\_2\ldots,s\_n\} \implies \mathrm{d}s_1\,\mathrm{d}s_2\ldots\mathrm{d}s_n$$

3.1 Other differentials

This package offers four other differentials: partial differential \pdif, uppercase D \mdif, delta \fdif and Delta \adif. A unique feature of this package, is that you can define your own differential as described in section 5.2.

\pdif   *[⟨*keyval list*⟩]{⟨*variables*⟩}

The partial differential \pdif is typically used as a shorthand notation for the partial derivative. In this package it is defined as

```latex
\DeclareDifferential{\pdif}{\partial}[style-notation=single,
style-notation-*=mixed]
```

The non-star and star version gives (left side)

$$\partial_x^i \, \partial_y^j \, \partial_z^k := \frac{\partial^{i+j+k}}{\partial x^i \, \partial y^j \, \partial z^k}$$

$$\partial^i x \, \partial^j y \, \partial^k z := \frac{\partial^{i+j+k}}{\partial x^i \, \partial y^j \, \partial z^k}$$

respectively.

\mdif   *[⟨*keyval list*⟩]{⟨*variables*⟩}

Another commonly used shorthand notation for various derivatives is the differential with an uppercase D. In this package it is defined with a upright D when `upright=true` else it is defined with an italic uppercase D

```latex
\DeclareDifferential{\mdif}{\mathrm{D}}[style-notation=single,
style-notation-*=mixed]
\DeclareDifferential{\mdif}{\mathnormal{D}}[style-notation=single,
style-notation-*=mixed
```
`upright=true`

`italic=true`

The non-star and star version gives

$$\mathrm{D}_x^i \, \mathrm{D}_y^j \, \mathrm{D}_z^k$$

$$\mathrm{D}^i x \, \mathrm{D}^j y \, \mathrm{D}^k z$$

respectively.

\fdif   *[⟨*keyval list*⟩]{⟨*variables*⟩}

When working with functional derivatives another differential is frequently encountered. This differential uses a delta symbol and is defined as

```latex
\DeclareDifferential{\fdif}{\delta}
```

For example an expression like

$$\delta J = \int_a^b \frac{\partial L}{\partial f} \, \delta f(x) + \frac{\partial L}{\partial f'} \frac{\mathrm{d}}{\mathrm{d}x} \, \delta f(x) \, \mathrm{d}x$$

is frequently encountered.

\adif   *[⟨*keyval list*⟩]{⟨*variables*⟩}

To wrap it up, a differential for differences is defined as

```latex
\DeclareDifferential{\adif}{\Delta}
```

For example, the difference between two energy levels may be written as

$$\Delta E = E_2 - E_1$$

4 Options

This package accepts its options using the well-known *key=value* syntax. The keys are divided into categories, for which each key have its associated category as a prefix.

\derivset   {⟨*command*⟩}[⟨*keyval list*⟩]

Updated: v1.0   The \derivset is meant to set the default values for derivatives and differentials options in the preamble. It can be used in the document but this is what the new [⟨*keyval list*⟩] arguments are for in the derivative and differential commands.

{⟨*command*⟩}   A mandatory argument that determines which command the *key=value* pairs are assigned to, where the allowed ⟨*commands*⟩ are the derivatives and differentials defined by the package and you, see sections 5.1 and 5.2 for more information. The special value all is also allowed, which gives access to the options that applies to *all* derivatives and differentials.

[⟨*keyval list*⟩]   This optional argument accepts its input as a comma-separated list of *key=value* pairs. Leaving out [⟨*keyval list*⟩] sets the options to the package's default settings for the chosen {⟨*command*⟩}. E.g. \derivset{\odv} sets the options for the ordinary derivative to the packages default settings.

4.1 Categories

This section seeks to give a detailed description of each category.

- The style-⟨...⟩ keys sets either the font style or the fraction style of ⟨...⟩. The font styles \mathnormal/\symnormal and \mathrm/\symup are commonly used in literature. The fraction style can be either \frac, \dfrac, \tfrac, \sfrac[R], \slashfrac[1] or any command with two mandatory arguments.

- The delims-⟨...⟩ keys sets the delimiters used around the ⟨...⟩. The Rule of Two applies here: 'Always two there are, no more, no less. A left and a right delimiter'. The allowed delimiters are those that can be scaled with \left, \big etc.

- The scale-⟨...⟩ keys sets the size of the ⟨...⟩'s delimiters. The values big, Big, bigg, and Bigg are self-explanatory and internally a left and right version are used e.g. \bigl and \bigr. The value none inserts the delimiters (except periods) unscaled. While the value auto scales the delimiters automatically using \left and \right.

- The sep-⟨...⟩-⟨...⟩ keys inserts their value between ⟨...⟩ and ⟨...⟩. If the value is a comma-separated list of up to three numbers (e.g. {x,y,z}) it will be converted into the syntax \muskip x mu plus y mu minus z mu and inserted. All other values are used as they were given.

- The switch-⟨...⟩ keys serves to change an argument's behaviour by swapping the effect of an optional character's presence.

- The `sort-⟨…⟩` keys deals with the sorting algorithm behind the mixed order, where you can choose the sorting method that suits you best.

- The miscellaneous keys does not fit into any of the above categories and no longer have the prefix `misc`

Note. A value with superscripted R means it requires a package. Additionally, some keys have two versions; with and without `-/` at the end. These keys are related to the slash argument. If `switch-/=false` then the keys with and without `-/` are used when the slash argument is present and absent, respectively. Setting `switch-/=true` then these keys are used in the opposite cases of the slash argument's presence.

4.2 Package options

The package options can be used with

$$\usepackage[⟨\textit{keyval list}⟩]{derivative}$$

italic

New: v1.1

`true, false`   `false`

Sets the font-style of the infinitesimals d and D used in `\odv`, `\mdv`, `\odif` and `\mdif` to italic using `\mathnormal`. The options `italic` and `upright` are mutually exclusive.

upright

New: v1.1

`true, false`   `true`

Sets the font-style of the infinitesimals d and D used in `\odv`, `\mdv`, `\odif` and `\mdif` to upright using `\mathrm`. The options `italic` and `upright` are mutually exclusive.

4.3 Derivative options

The options in this subsection are available for derivatives defined by the package and you with the commands in section 5.1.

Style

style-inf

Updated: v1.0, v1.3

⟨*math-font-style*⟩⟨*infinitesimal*⟩   `d`

Sets the derivative's infinitesimal including font style. It is a meta key, meaning it sets the value of both `style-inf-num` and `style-inf-den` in one go.

$$\odv[style-inf=\symbf{d}]{f}{x} \quad \implies \quad \frac{\mathbf{d}f}{\mathbf{d}x}$$

style-inf-num

New: v1.3

⟨*math-font-style*⟩⟨*infinitesimal*⟩   `d`

Sets the infinitesimal including font style used in the derivative's numerator. This option is also used in the compact versions i.e. when the exclamation mark argument is used.

$$\odv[style-inf-num=\symbf{d}]{f}{x} \quad \implies \quad \frac{\mathbf{d}f}{\mathrm{d}x}$$

style-inf-den

New: v1.3

⟨*math-font-style*⟩⟨*infinitesimal*⟩ d

Sets the derivative's infinitesimal including font style. This change was necessary to allow multiple font styles, e.g. `style-inf=\mathbf{\mathrm{d}}`. The default infinitesimal is a plain 'd' with no associated font style.

$$\texttt{\textbackslash odv[style-inf-den=\textbackslash symbf\{d\}]\{f\}\{x\}} \quad \Longrightarrow \quad \frac{\mathrm{d}f}{\mathbf{d}x}$$

style-frac ⟨*fraction*⟩ \frac

The derivative uses the fraction set by this key whenever `switch-/=false` and the slash argument is absent. The key's default value is the usual fraction `\frac`.

$$\texttt{\textbackslash odv[style-frac=\textbackslash tfrac]\{f\}\{x\}} \quad \Longrightarrow \quad \tfrac{\mathrm{d}f}{\mathrm{d}x}$$

style-frac-/ ⟨*fraction*⟩ \slashfrac

The derivative uses the fraction set by this key whenever `switch-/=false` and the slash argument is present. The key's default value is a text-styled fraction `\slashfrac`[1] i.e. on the form $\partial^2 f / \partial x \, \partial y$.

$$\texttt{\textbackslash odv[style-frac-/=\textbackslash sfrac]\{f\}/\{x\}} \quad \Longrightarrow \quad {}^{\mathrm{d}f}\!/_{\mathrm{d}x}$$

| style-var | single, multiple | single |

New: v1.0

This option determines how the derivative treats its variables and some features. The variable argument is treated as a single variable when `single` is used. Moreover the mixed order is set equal to the first order given in `order=⟨order⟩` which by default is `1`. The variable argument is treated as a comma separated list of variables with `multiple` similarly to a partial derivative. Moreover the mixed order is automatically calculated from the list of orders given in `order=⟨order⟩`.

$$\texttt{\textbackslash pdv[style-var=single]\{f\}\{x, y, z\}} \quad \Longrightarrow \quad \frac{\partial f}{\partial x, y, z}$$

$$\texttt{\textbackslash pdv[style-var=multiple]\{f\}\{x, y, z\}} \quad \Longrightarrow \quad \frac{\partial^3 f}{\partial x \, \partial y \, \partial z}$$

| style-var-/ | single, multiple | single |

New: v1.3

This option behaves identical to `style-var`, however it is used when the slash argument is present and the exclamation mark is absent assuming `switch-/=false` and `switch-!=false`.

| style-var-! | single, multiple, mixed | single |

New: v1.3

This options sets the shorthand notation of the derivative i.e. when the exclamation mark is present. When `single` is used, a single differential is created with the variables and orders in a subscript and superscript, respectively. The value `multiple` creates a differential for each variable. While the value `mixed` creates differentials their variable and order in a subscript and superscript, respectively.

$$\texttt{\textbackslash pdv[style-var-!=single]\{f\}!\{x, y, z\}} \quad \Longrightarrow \quad \partial_{x,y,z} f$$

$$\texttt{\textbackslash pdv[style-var-!=multiple]\{f\}!\{x, y, z\}} \quad \Longrightarrow \quad \partial x \, \partial y \, \partial z f$$

$$\texttt{\textbackslash pdv[style-var-!=mixed]\{f\}!\{x, y, z\}} \quad \Longrightarrow \quad \partial_x \, \partial_y \, \partial_z f$$

| style-var-/! | single, multiple, mixed | single |

New: v1.3

This option behaves identical to `style-var-!`, however it is used when both the exclamation mark and slash arguments are present assuming `switch-/=false` and `switch-!=false`.

Scaling

| scale-eval | auto, none, big, Big, bigg, Bigg | auto |

This key sets the size of the delimiters used for the point of evaluation. This scaling is used whenever `switch-/=false` and the slash argument is absent. The key's default value is set to scale the delimiters automatically.

$$\texttt{\textbackslash pdv[scale-eval=auto]\{f\}\{x, y\}\_\{(x\_0, y\_0)\}} \quad \Longrightarrow \quad \left(\frac{\partial^2 f}{\partial x \, \partial y} \right)_{(x_0, y_0)}$$

scale-eval-/	auto, none, big, Big, bigg, Bigg	auto

This key sets the size of the delimiters used for the point of evaluation. This scaling is used whenever `switch-/=false` and the slash argument is present. The key's default value is set to scale the delimiters automatically.

$$\text{\textbackslash pdv[scale-eval-/=none]\{f\}/\{x, y\}\_\{(x\_0, y\_0)\}} \quad \implies \quad \left(\partial^2 f\big/\partial x\,\partial y\right)_{(x_0,y_0)}$$

scale-fun	auto, none, big, Big, bigg, Bigg	auto

This key sets the size of the delimiters used around the function. The scaling is used whenever `fun=true` is used. The key's default value is set to scale the delimiters automatically.

$$\text{\textbackslash pdv[scale-fun=big, fun]\{f\}\{x, y\}} \quad \implies \quad \frac{\partial^2 (f)}{\partial x\,\partial y}$$

scale-var	auto, none, big, Big, bigg, Bigg	auto

This key sets the size of the delimiters used around the variable. The scaling is used whenever `var=true` is used. The key's default value is set to scale the delimiters automatically.

$$\text{\textbackslash pdv[scale-var=Big, var]\{f\}\{x, y\}} \quad \implies \quad \frac{\partial^2 f}{\partial\left(x\right)\partial\left(y\right)}$$

scale-frac	auto, none, big, Big, bigg, Bigg	auto

This key sets the size of the delimiters used for around the fraction. This scaling is used whenever `switch-/=false`, the slash argument is absent and `frac=true` is used. The key's default value is set to scale the delimiters automatically.

$$\text{\textbackslash pdv[scale-frac=bigg, frac]\{f\}\{x, y\}} \quad \implies \quad \left(\frac{\partial^2 f}{\partial x\,\partial y}\right)$$

scale-frac-/	auto, none, big, Big, bigg, Bigg	auto

This key sets the size of the delimiters used for around the fraction. This scaling is used whenever `switch-/=false`, the slash argument is present and `frac=true` is used. The key's default value is set to scale the delimiters automatically.

$$\text{\textbackslash pdv[scale-frac-/=Bigg, frac]\{f\}/\{x, y\}} \quad \implies \quad \Bigg(\partial^2 f\big/\partial x\,\partial y\Bigg)$$

Delimiters

delims-eval	⟨*left delimiter*⟩⟨*right delimiter*⟩	. \rvert

This key sets the left and right delimiters used to indicate the point of evaluation. These delimiters are inserted whenever `switch-/=false` and the slash argument is absent. The key's default left and right delimiters are a left and a right parenthesis, respectively.

$$\text{\textbackslash pdv[delims-eval=.|]\{f\}\{x, y\}\_\{(x\_0, y\_0)\}} \quad \implies \quad \frac{\partial^2 f}{\partial x\,\partial y}\bigg|_{(x_0,y_0)}$$

delims-eval-/   ⟨*left delimiter*⟩⟨*right delimiter*⟩   . \rvert

This key sets the left and right delimiters used to indicate the point of evaluation. These delimiters are inserted whenever `switch-/=false` and the slash argument is present. The key's default left and right delimiters are a left and a right parenthesis, respectively.

$$\pdv[delims-eval-/=[]]\{f\}/\{x, y\}_\{(x\_0, y\_0)\} \implies \left[\partial^2 f\big/\partial x\,\partial y\right]_{(x_0,y_0)}$$

delims-fun   ⟨*left delimiter*⟩⟨*right delimiter*⟩   ( )

This key sets the left and right delimiters used around the function and these are inserted whenever `fun=true` is used. The key's default left and right delimiters are a left and a right parenthesis, respectively.

$$\pdv[delims-fun=\langle\rangle, fun]\{f\}\{x, y\} \implies \frac{\partial^2 \langle f\rangle}{\partial x\,\partial y}$$

delims-var   ⟨*left delimiter*⟩⟨*right delimiter*⟩   ( )

This key sets the left and right delimiters used around the variable and these are inserted whenever `var=true` is used. The key's default left and right delimiters are a left and a right parenthesis, respectively.

$$\pdv[delims-var=\{\}, var]\{f\}\{x, y\} \implies \frac{\partial^2 f}{\partial\{x\}\,\partial\{y\}}$$

delims-frac   ⟨*left delimiter*⟩⟨*right delimiter*⟩   ( )

This key sets the left and right delimiters used around the fraction in the derivative e.g. $\left(\frac{\partial}{\partial x}\right)y$. These delimiters are inserted whenever `switch-/=false`, the slash argument is absent and `frac=true` is used. The key's default left and right delimiters are a left and a right parenthesis, respectively.

$$\pdv[delims-frac=||, frac]\{f\}\{x, y\} \implies \left|\frac{\partial^2 f}{\partial x\,\partial y}\right|$$

delims-frac-/   ⟨*left delimiter*⟩⟨*right delimiter*⟩   ( )

This key sets the left and right delimiters used around the fraction in the derivative e.g. $(\partial/\partial x\,)y$. These delimiters are inserted whenever `switch-/=false`, the slash argument is present and `frac=true` is used. The key's default left and right delimiters are a left and a right parenthesis, respectively.

$$\pdv[delims-frac-/=\|\|, frac]\{f\}/\{x, y\} \implies \left\|\partial^2 f\big/\partial x\,\partial y\right\|$$

Math spacing and separators

The options in this subsection inserts extra horizontal math space. The below equation illustrates where the space is inserted for each option

$$\frac{\partial}{\partial x}\langle\texttt{frac-fun}\rangle f \qquad \frac{\partial\langle\texttt{inf-fun}\rangle f}{\partial\langle\texttt{inf-var}\rangle x} \qquad \frac{\partial^2 f}{\partial x\langle\texttt{var-inf}\rangle\partial y}$$

$$\frac{\partial\langle\texttt{inf-ord}\rangle 2\, f}{\partial x\langle\texttt{var-ord}\rangle 2} \qquad \frac{\partial^3\langle\texttt{ord-fun}\rangle f}{\partial x^2\langle\texttt{ord-inf}\rangle\partial y} \qquad \left(\frac{\partial f}{\partial x}\right)^{\langle\texttt{eval-sp}\rangle x_2}_{\langle\texttt{eval-sb}\rangle x_1}$$

where it have been split into six to give a better overview. Here $\langle...\rangle$ means the value given to the option $\texttt{sep-}\langle...\rangle$. Some of the math spaces shown above are only used when $\texttt{style-var=multiple}$. Additionally, when the option $\texttt{style-var=single}$ is used then the following math space is used in the denominator

$$\frac{\partial(f, g)}{\partial(x\langle\texttt{var-var}\rangle y)}$$

where the Jacobian have been used as an example.

sep-inf-ord ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}   0

Sets the math space that is inserted in the infinitesimal's power left to the (mixed) order. It is only inserted when the (mixed) order *is different* from 1. The key's default value is 0 mu.

$$\texttt{\textbackslash pdv[sep-inf-ord=\textbackslash here]\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^{\langle\texttt{here}\rangle 2} f}{\partial x\, \partial y}$$

$$\texttt{\textbackslash pdv[sep-inf-ord=\textbackslash here, order=2]\{f\}!\{x,y\}} \quad \Longrightarrow \quad \partial^{\langle\texttt{here}\rangle 2} x\, \partial y f$$

sep-inf-fun ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}   0

This key sets the math space that is inserted between the infinitesimal and the function when the mixed order *is equal* to 1. The space is only inserted when a non-blank function is printed *in the numerator*. The key's default value is 0 mu.

$$\texttt{\textbackslash pdv[sep-inf-fun=\textbackslash here]\{f\}\{x\}} \quad \Longrightarrow \quad \frac{\partial_{\langle\texttt{here}\rangle} f}{\partial x}$$

sep-ord-fun ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}   0

This key sets the math space that is inserted between the infinitesimal's order and the function when the mixed order *is different* from 1. The space is only inserted when a non-blank function is printed *in the numerator*. The key's default value is 0 mu.

$$\texttt{\textbackslash pdv[sep-ord-fun=\textbackslash here]\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^2 {}_{\langle\texttt{here}\rangle} f}{\partial x\, \partial y}$$

sep-frac-fun ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}   0

New: v1.0

This key sets the math space that is inserted between the fractional part of the derivative and the function. The space is only inserted when a non-blank function is printed *next to the derivative*. The key's default value is 0 mu.

$$\texttt{\textbackslash pdv*[sep-frac-fun=\textbackslash here]\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^2}{\partial x\, \partial y}{}_{\langle\texttt{here}\rangle} f$$

sep-inf-var ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}   0

This key sets the math space that is inserted between the infinitesimal and the following variable. The space is only inserted when a *non-blank* variable is given. The key's default value is 0 mu.

$$\texttt{\textbackslash pdv[sep-inf-var=\textbackslash here]\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^2 f}{\partial_{\langle\texttt{here}\rangle} x\, \partial_{\langle\texttt{here}\rangle} y}$$

$$\texttt{\textbackslash pdv[sep-inf-var=\textbackslash here]\{f\}!\{x,y\}} \quad \Longrightarrow \quad \partial_{\langle\texttt{here}\rangle} x\, \partial_{\langle\texttt{here}\rangle} y f$$

sep-var-ord ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}   0

This key sets the math space that is inserted in a variable's power left to the order. The space is only inserted when the order *is different* from 1. The key's default value is 0 mu.

$$\verb|\pdv[sep-var-ord=\here, order=n]{f}{x,y}| \quad \implies \quad \frac{\partial^{n+1} f}{\partial x^{\langle\text{here}\rangle n}\, \partial y}$$

sep-var-inf $\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}   `\mathop{}\!`

They key sets the math space that is inserted between a variable and the following infinitesimal. It is only inserted when more than one *non-blank* variables are given. Additionally, in fraction mode, it is also required that the variable's order *is equal* to 1. The key's default value is `\mathop{}\!`.

$$\verb|\pdv[sep-var-inf=\here, order=n]{f}{x,y,z}| \quad \implies \quad \frac{\partial^{n+2} f}{\partial x^{n}\, \partial y_{\langle\text{here}\rangle}\partial z}$$

$$\verb|\pdv[sep-var-inf=\here, order=n]{f}!{x,y,z}| \quad \implies \quad \partial^{n} x_{\langle\text{here}\rangle}\partial y_{\langle\text{here}\rangle}\partial z f$$

sep-ord-inf $\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}   `\mathop{}\!`

They key sets the math space that is inserted between a order and the following infinitesimal. It is only inserted when more than one *non-blank* variables are given and when the variable's order *is different* from 1. The key's default value is `\mathop{}\!`.

$$\verb|\pdv[sep-ord-inf=\here, order=n]{f}{x,y,z}| \quad \implies \quad \frac{\partial^{n+2} f}{\partial x^{n}{}_{\langle\text{here}\rangle}\partial y\, \partial z}$$

sep-ord-ord $\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}   ,

New: v1.3

They key sets the math space that is inserted between two orders. The space is only inserted when more than one *non-blank* variables are given, and the option `style-var=`and its variants is `single`. The key's default value is a comma.

$$\verb|\pdv[sep-ord-ord=\here, order={n,2}]{f}/!{x,y}| \quad \implies \quad \partial_{x,y}^{n_{\langle\text{here}\rangle}2} f$$

sep-ord-var $\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}   0

New: v1.3

They key sets the math space that is inserted between an order and the following variable. The space is only inserted in shorthand mode when the variable style set to `multiple`. The key's default value is 0 `mu`.

$$\verb|\odv[sep-ord-var=\here, order=n]{f}!{x,y}| \quad \implies \quad \mathrm{d}^{n}{}_{\langle\text{here}\rangle}x\, \mathrm{d}y f$$

sep-var-var $\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}   ,

New: v1.0

They key sets the math space that is inserted between two variables. The space is only inserted when more than one *non-blank* variables are given, and the option `style-var=`and its variants is `single`. The key's default value is a comma.

$$\verb|\pdv[sep-var-var=\here, style-var=single]{f}{x,y}| \quad \implies \quad \frac{\partial f}{\partial x_{\langle\text{here}\rangle}y}$$

$$\verb|\pdv[sep-var-var=\here]{f}/!{x,y}| \quad \implies \quad \partial_{x_{\langle\text{here}\rangle}y} f$$

sep-eval-sb	⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}	0

This key sets the math space that is inserted in the evaluation subscript left to the point of evaluation. The space is only inserted when a *non-blank* subscript is given. The key's default value is 0 `mu`.

$$\text{\textbackslash pdv[sep-eval-sb=\textbackslash here]\{f\}\{x,y\}\_\{(x\_1,y\_1)\}} \quad \Longrightarrow \quad \left(\frac{\partial^2 f}{\partial x \, \partial y} \right)_{\langle\texttt{here}\rangle(x_1,y_1)}$$

sep-eval-sp	⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩}	0

This key sets the math space that is inserted in the evaluation superscript left to the point of evaluation. The space is only inserted when a *non-blank* superscript is given. The key's default value is 0 `mu`.

$$\text{\textbackslash pdv[sep-eval-sp=\textbackslash here]\{f\}\{x,y\}\^\{(x\_2,y\_2)\}} \quad \Longrightarrow \quad \left(\frac{\partial^2 f}{\partial x \, \partial y} \right)^{\langle\texttt{here}\rangle(x_2,y_2)}$$

Switches

switch-*	true, false	false

The effect of the star argument's presence can be switched with the value `true`. That is, the function is typeset next to the fraction when the star is absent and in the numerator when the star is present. As an example, compare below where the option is turned on (`true`) and off (`false`)

$$\text{\textbackslash pdv[switch-*=false]\{y\}\{x\}} \quad \Longrightarrow \quad \frac{\partial y}{\partial x}$$

$$\text{\textbackslash pdv[switch-*=true]\{y\}\{x\}} \quad \Longrightarrow \quad \frac{\partial}{\partial x} y$$

respectively. The key's default value is false.

switch-/	true, false	false

The effect of the slash argument's presence can be switched with the value `true`. That is, the derivative is typeset with the fraction set by `style-frac-/` when the slash is absent and with the fraction set by `style-frac` when the slash is present. As an example, compare below where the option is turned on (`true`) and off (`false`)

$$\text{\textbackslash pdv[switch-/=false]\{y\}\{x\}} \quad \Longrightarrow \quad \frac{\partial y}{\partial x}$$

$$\text{\textbackslash pdv[switch-/=true]\{y\}\{x\}} \quad \Longrightarrow \quad \partial y / \partial x$$

respectively. The key's default value is false.

switch-!	true, false	false

New: v1.3   The effect of the exclamation mark argument's presence can be switched with the value `true`. That is, the derivative is in shorthand mode the exclamation mark is absent and in fraction mode when the exclamation is present. As an example, compare below where the option is turned on (`true`) and off (`false`)

$$\verb|\pdv[switch-!=false]{f}!{x, y}| \implies \partial x\, \partial y\, f$$

$$\verb|\pdv[switch-!=true]{f}!{x, y}| \implies \frac{\partial^2 f}{\partial x\, \partial y}$$

respectively. The key's default value is false.

switch-sort	`true, false`	`true`

New: v1.2

The sorting algorithm of the mixed order is turned on when given the value `true` i.e. the methods given in `sort-method={…}` are applied. Likewise, the sorting algorithm is turned off when given the value `false` i.e. the terms in the mixed order are ordered by first appearance in `order={…}`. As an example, compare below where the option is turned on (`true`) and off (`false`)

$$\verb|\pdv[switch-sort=false, order={a+b,2kn-d,2-2b}]{f}{x,y,z}| \implies \frac{\partial^{a-b+2kn-d+2} f}{\partial x^{a+b}\, \partial y^{2kn-d}\, \partial z^{2-2b}}$$

$$\verb|\pdv[switch-sort=true, order={a+b,2kn-d,2-2b}]{f}{x,y,z}| \implies \frac{\partial^{2kn+a-b-d+2} f}{\partial x^{a+b}\, \partial y^{2kn-d}\, \partial z^{2-2b}}$$

respectively. The key's default value is true.

Sort

The keys given in this subsection will be briefly described here and a in-depth description will be given in section 6.

sort-method	`abs, lexical, number, sign, symbol`	`sign, symbol, abs`

Updated: v1.2

This key sets the sorting method behind the mixed order using build-in algorithms. The symbolic terms in the mixed order are sorted by their sign, symbolic length, numerical value and absolute value by the `sign`, `symbol`, `number` and `abs` algorithms, respectively. The value `lexical` sorts the terms by lexicographical order i.e. alphabetically. The key takes its input as a comma-separated list of values, accepting up to three values e.g.

$$\texttt{\textbackslash pdv[sort-method=abs, order=\{c+kn,-b+2a\}]\{f\}\{x,y\}} \implies \frac{\partial^{2a+c+kn-b} f}{\partial x^{c+kn} \, \partial y^{-b+2a}}$$

$$\texttt{\textbackslash pdv[sort-method=lexical, order=\{c+kn,-b+2a\}]\{f\}\{x,y\}} \implies \frac{\partial^{2a-b+c+kn} f}{\partial x^{c+kn} \, \partial y^{-b+2a}}$$

$$\texttt{\textbackslash pdv[sort-method=number, order=\{c+kn,-b+2a\}]\{f\}\{x,y\}} \implies \frac{\partial^{2a+c+kn-b} f}{\partial x^{c+kn} \, \partial y^{-b+2a}}$$

$$\texttt{\textbackslash pdv[sort-method=symbol, order=\{c+kn,-b+2a\}]\{f\}\{x,y\}} \implies \frac{\partial^{kn+c-b+2a} f}{\partial x^{c+kn} \, \partial y^{-b+2a}}$$

$$\texttt{\textbackslash pdv[sort-method=sign, order=\{c+kn,-b+2a\}]\{f\}\{x,y\}} \implies \frac{\partial^{c+kn+2a-b} f}{\partial x^{c+kn} \, \partial y^{-b+2a}}$$

$$\texttt{\textbackslash pdv[sort-method=\{sign,symbol\}, order=\{c+kn,-b+2a\}]\{f\}\{x,y\}} \implies \frac{\partial^{kn+c+2a-b} f}{\partial x^{c+kn} \, \partial y^{-b+2a}}$$

$$\texttt{\textbackslash pdv[sort-method=\{sign,symbol,abs\}, order=\{c+kn,-b+2a\}]\{f\}\{x,y\}} \implies \frac{\partial^{kn+2a+c-b} f}{\partial x^{c+kn} \, \partial y^{-b+2a}}$$

are all valid inputs. Note how the terms are ordered differently with different methods. This key is further described in section 6.1. The key's default value uses the three algorithms `sign`, `symbol`, `abs`.

sort-numerical	`auto`, `first`, `last`, `symbolic`	`auto`

Updated: v1.0

This key determines where the numerical term[2] is placed in the mixed order. The numerical term will *always* be placed as the first with `first` and as the last term with `last` in the mixed order. While `auto` will automatically determine where to place the numerical term depending on the sign of the first symbolic term. This is shown below

$$\texttt{\textbackslash pdv[sort-numerical=first, order=\{n,2\}]\{f\}\{x,y\}} \implies \frac{\partial^{2+n} f}{\partial x^{n} \, \partial y^{2}}$$

$$\texttt{\textbackslash pdv[sort-numerical=last, order=\{-n,2\}]\{f\}\{x,y\}} \implies \frac{\partial^{-n+2} f}{\partial x^{-n} \, \partial y^{2}}$$

where the value `auto` would have placed the numerical term opposite in both equations. The value `symbolic` treats the numerical term as a symbolic term with symbolic length equal zero and is thus sorted alongside with all other terms

$$\texttt{\textbackslash pdv[sort-numerical=symbolic, order=\{2+n,-a\}]\{f\}\{x,y\}} \implies \frac{\partial^{n+2-a} f}{\partial x^{2+n} \, \partial y^{-a}}$$

The key is further described in section 6.2, and its default value is auto.

sort-abs-reverse	`true`, `false`	`false`

The sorting algorithm `abs` sorts the terms by their absolute value in a descending manner. If the value `true` is used, then the terms will be sorted in an ascending manner instead. See section 6.3 for more information.

---

[2]The numerical term is the sum of all the orders that does not contain any symbols but solely consist of numbers.

$$\texttt{\textbackslash pdv[sort-abs-reverse=false, sort-method=abs, order=2a-3b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{-3b+2a} f}{\partial x^{2a-3b}}$$

$$\texttt{\textbackslash pdv[sort-abs-reverse=true, sort-method=abs, order=2a-3b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{2a-3b} f}{\partial x^{2a-3b}}$$

sort-lexical-reverse	true, false	false

The sorting algorithm `lexical` sorts the terms in lexicographical order according to their character code i.e. alphabetically. If the value `true` is used, then the terms will be sorted in reverse lexicographical order instead. See section 6.3 for more information.

$$\texttt{\textbackslash pdv[sort-lexical-reverse=false, sort-method=lexical, order=a+b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{a+b} f}{\partial x^{a+b}}$$

$$\texttt{\textbackslash pdv[, sort-lexical-reverse=true, sort-method=lexical, order=a+b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{b+a} f}{\partial x^{a+b}}$$

sort-number-reverse	true, false	false

The sorting algorithm `number` sorts the terms by their numerical value in a descending manner. If the value `true` is used, then the terms will be sorted in an ascending manner instead. See section 6.3 for more information.

$$\texttt{\textbackslash pdv[sort-number-reverse=false, sort-method=number, order=2a-3b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{2a-3b} f}{\partial x^{2a-3b}}$$

$$\texttt{\textbackslash pdv[sort-number-reverse=true, sort-method=number, order=2a-3b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{-3b+2a} f}{\partial x^{2a-3b}}$$

sort-sign-reverse	true, false	false

The sorting algorithm `sign` sorts the terms by their numerical sign where the positive terms are placed before the negative terms. The value `true` will reverse this ordering such that the negative terms are placed before the positive terms. See section 6.3 for more information.

$$\texttt{\textbackslash pdv[sort-sign-reverse=false, sort-method=sign, order=a-b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{a-b} f}{\partial x^{a-b}}$$

$$\texttt{\textbackslash pdv[sort-sign-reverse=true, sort-method=sign, order=a-b]\{f\}\{x\}} \quad \implies \quad \frac{\partial^{-b+a} f}{\partial x^{a-b}}$$

sort-symbol-reverse	true, false	false

The sorting algorithm `symbol` sorts the terms by their symbolic length in a descending manner. If the value `true` is used, then the terms will sorted in an ascending manner instead. See section 6.3 for more information.

$$\texttt{\textbackslash pdv[sort-symbol-reverse=false, sort-method=symbol, order=ab+c]\{f\}\{x\}} \implies \frac{\partial^{ab+c} f}{\partial x^{ab+c}}$$

$$\texttt{\textbackslash pdv[sort-symbol-reverse=true, sort-method=symbol, order=ab+c]\{f\}\{x\}} \implies \frac{\partial^{c+ab} f}{\partial x^{ab+c}}$$

Miscellaneous

`fun`	`true, false`	`false`

Adds or remove delimiters around the function.

$$\texttt{\textbackslash pdv[fun=false]\{f\}\{x,y,z\}} \implies \frac{\partial^3 f}{\partial x\, \partial y\, \partial z}$$

$$\texttt{\textbackslash pdv[fun=true]\{f\}\{x,y,z\}} \implies \frac{\partial^3 (f)}{\partial x\, \partial y\, \partial z}$$

$$\texttt{\textbackslash pdv[fun]\{f\}\{x,y,z\}} \implies \frac{\partial^3 (f)}{\partial x\, \partial y\, \partial z}$$

Without setting the option to a value is equivalent to setting it to `true` as seen above.

`frac`	`true, false`	`false`

Adds or remove delimiters around the fractional part of the derivative.

$$\texttt{\textbackslash pdv[frac=false]\{f\}\{x,y,z\}} \implies \frac{\partial^3 f}{\partial x\, \partial y\, \partial z}$$

$$\texttt{\textbackslash pdv[frac=true]\{f\}\{x,y,z\}} \implies \left(\frac{\partial^3 f}{\partial x\, \partial y\, \partial z} \right)$$

$$\texttt{\textbackslash pdv*[frac=true]\{f\}\{x,y,z\}} \implies \left(\frac{\partial^3}{\partial x\, \partial y\, \partial z} \right) f$$

$$\texttt{\textbackslash pdv[frac]\{f\}\{x,y,z\}} \implies \left(\frac{\partial^3 f}{\partial x\, \partial y\, \partial z} \right)$$

Without setting the option to a value is equivalent to setting it to `true` as seen above.

`var`	`none, all,` ⟨*cs-numbers*⟩	`none`

Adds or remove delimiters around the variable. The value `all` adds delimiters around all variables and `none` removed all delimiters. However, if only some variables needs delimiters then ⟨*cs-numbers*⟩ can be used e.g. `var={1,3}` adds delimiters around the first and third variable

$$\texttt{\textbackslash pdv[var=none]\{f\}\{x,y,z,t\}} \implies \frac{\partial^4 f}{\partial x\,\partial y\,\partial z\,\partial t}$$

$$\texttt{\textbackslash pdv[var=\{1,3\}]\{f\}\{x,y,z,t\}} \implies \frac{\partial^4 f}{\partial(x)\,\partial y\,\partial(z)\,\partial t}$$

$$\texttt{\textbackslash pdv[var=all]\{f\}\{x,y,z,t\}} \implies \frac{\partial^4 f}{\partial(x)\,\partial(y)\,\partial(z)\,\partial(t)}$$

$$\texttt{\textbackslash pdv[var]\{f\}\{x,y,z,t\}} \implies \frac{\partial^4 f}{\partial(x)\,\partial(y)\,\partial(z)\,\partial(t)}$$

Without setting the option to a value is equivalent to setting it to `all` as seen above.

| order | {⟨cs-orders⟩} | 1 |

ord   Sets the order of differentiation for each variable as a comma separated list of values.

New: v1.0

$$\texttt{\textbackslash pdv[order=\{2,3\}]\{f\}\{x,y,z\}} \implies \frac{\partial^6 f}{\partial x^2\,\partial y^3\,\partial z}$$

$$\texttt{\textbackslash pdv[order=\{\textbackslash beta,a,n+2a\}]\{f\}\{x,y,z\}} \implies \frac{\partial^{3a+\beta+n} f}{\partial x^\beta\,\partial y^a\,\partial z^{n+2a}}$$

$$\texttt{\textbackslash pdv[order=\{2,n\^{}2,n\^{}2-1\}]\{f\}\{x,y,z\}} \implies \frac{\partial^{2n^2+1} f}{\partial x^2\,\partial y^{n^2}\,\partial z^{n^2-1}}$$

$$\texttt{\textbackslash pdv[order=\{3/2-n/3,n/2,1/3\}]\{f\}\{x,y,z\}} \implies \frac{\partial^{n/6+11/6} f}{\partial x^{3/2-n/3}\,\partial y^{n/2}\,\partial z^{1/3}}$$

mixed-order	
mixord	
New: v1.0	

mixed-order
mixord
New: v1.0

$\{\langle mixed\ order\rangle\}$ <div style="float:right">1</div>

The mixed order is automatically calculated from the orders of differentiation set by `order={`$\langle orders\rangle$`}`. In cases where it fails or another form is preferred, the calculated mixed order can be overwritten with this option.

$$\pdv[\text{order=\{n+3k, n-k\}, mixed-order=\{2(n+k)\}]\{f\}\{x,y\}} \quad \implies \quad \frac{\partial^{2(n+k)} f}{\partial x^{n+3k}\, \partial y^{n-k}}$$

4.4 Differential options

The options in this subsection are available for differentials defined by the package and you with the commands in section 5.2. All options in this section were introduced in `v1.0`.

Style

style-inf
Updated: v1.0

$\langle math\text{-}font\text{-}style\rangle\langle infinitesimal\rangle$ <div style="float:right">d</div>

Sets the differential's infinitesimal including font style. This change was necessary to allow multiple font styles, e.g. `style-inf=\mathbf{\mathrm{d}}`. The default infinitesimal is a plain 'd' with no associated font style.

style-var
Updated: v1.3

`single, multiple, mixed` <div style="float:right">`multiple`</div>

Sets the differential's notation when the star argument is absent (given `switch-*=false`). The key's default value is `multiple`. The value `single` creates a single differential with the variables and orders in a subscript and superscript, respectively. The value `multiple` creates a differentials for each variable. The value `mixed` creates multiple differentials with the variables and orders in a subscript and superscript, respectively.

$$\text{\odif[style-var=multiple, order=\{n,1,2\}]\{x,y,z,t\}} \quad \implies \quad \mathrm{d}^n x\, \mathrm{d}y\, \mathrm{d}^2 z\, \mathrm{d}t$$

$$\text{\odif[style-var=single, order=\{n,1,2\}]\{x,y,z,t\}} \quad \implies \quad \mathrm{d}^{n,1,2}_{x,y,z,t}$$

$$\text{\odif[style-var=mixed, order=\{n,1,2\}]\{x,y,z,t\}} \quad \implies \quad \mathrm{d}^n_x\, \mathrm{d}_y\, \mathrm{d}^2_z\, \mathrm{d}_t$$

style-var-*
Updated: v1.3

`single, multiple, mixed` <div style="float:right">`single`</div>

Sets the differential's notation when the star argument is present (given `switch-*=false`). The key's default value is `single`.

Scaling

scale-var

`auto, none, big, Big, bigg, Bigg` <div style="float:right">`auto`</div>

Sets the size of the delimiters used around the variable when the star argument is absent (given `switch-*=false`). The scaling is used whenever `var=true` is used. The key's default value is set to scale the delimiters automatically.

scale-var-*

`auto, none, big, Big, bigg, Bigg` <div style="float:right">`auto`</div>

Sets the size of the delimiters used around the variable when the star argument is present (given `switch-*=false`). The scaling is used whenever `var=true` is used. The key's default value is set to scale the delimiters automatically.

Delimiters

`delims-var` — ⟨*left delimiter*⟩⟨*right delimiter*⟩ ( )

Sets the left and right delimiters used around the variable when the star argument is absent (given `switch-*=false`). The delimiters are inserted when `var=true` is used. The key's default delimiters are a left and right parenthesis, respectively.

`delims-var-*` — ⟨*left delimiter*⟩⟨*right delimiter*⟩ ( )

Sets the left and right delimiters used around the variable when the star argument is present (given `switch-*=false`). The delimiters are inserted when `var=true` is used. The key's default delimiters are a left and right parenthesis, respectively.

Math spacing and separators

The options in this subsection inserts extra horizontal math space. Below, illustrates where the space is inserted for each option

$$\partial_{\langle\texttt{inf-var}\rangle}x_{\langle\texttt{var-inf}\rangle}\partial y \qquad\qquad {}_{\langle\texttt{begin}\rangle}\partial x_{\langle\texttt{end}\rangle}$$
$$\partial^{\langle\texttt{inf-ord}\rangle 2}{}_{\langle\texttt{ord-var}\rangle}x \qquad\qquad \partial^{2\langle\texttt{ord-ord}\rangle 2}_{x\langle\texttt{var-var}\rangle y}$$

where it have been split into four to give a better overview.

`sep-begin` — ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩} `\mathop{}\!`

Sets the math space that is inserted to the left of the first differential. The key's default value is `\mathop{}\!`.

`sep-inf-ord` — ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩} 0

This key sets the math space that is inserted in the infinitesimal's power left to the order. It is only inserted when the mixed order *is different* from 1. The key's default value is 0 `mu`.

`sep-inf-var` — ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩} 0

This key sets the math space that is inserted between the infinitesimal and the following variable. The space is only inserted when the order *is equal* to 1 and a non-blank variable is given. The key's default value is 0 `mu`.

`sep-ord-var` — ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩} 0

This key sets the math space that is inserted between the infinitesimal's power and the following variable. The space is only inserted when the order *is different* from 1 and a non-blank variable is given. The key's default value is 0 `mu`.

`sep-var-inf` — ⟨*cs-number*⟩, {⟨*mspace*⟩}, {⟨*delimiter*⟩} `\mathop{}\!`

They key sets the math space that is inserted between a variable and the following infinitesimal. It is only inserted when more than one non-blank variables are given. The key's default value is `\mathop{}\!`.

sep-var-var	$\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}	,

Sets the math space that is inserted between two variables. The space is only inserted when `style-var=single` and more than one non-blank variables are given. The key's default value is a comma.

sep-ord-ord	$\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}	,

Sets the math space that is inserted between two orders. The space is only inserted when `style-var=single` and more than one non-blank orders are given. The key's default value is a comma.

sep-end	$\langle$*cs-number*$\rangle$, {$\langle$*mspace*$\rangle$}, {$\langle$*delimiter*$\rangle$}	0

Sets the math space that is inserted to the right of the last differential. The key's default value is 0.

Switches

switch-*	true, false	false

The effect of the star argument's presence can be switched with the value `true`. As an example, compare below where the option is turned on (`true`) and off (`false`),

$$\verb|\odif[switch-*=false]{x,y,z,t}| \implies \mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z\,\mathrm{d}t$$

$$\verb|\odif[switch-*=true]{x,y,z,t}| \implies \mathrm{d}_{x,y,z,t}$$

The key's default value is false.

Miscellaneous

var	none, all, $\langle$*cs-numbers*$\rangle$	none

Adds or remove delimiters around the variable. The value `all` adds delimiters around all variables and `none` removed all delimiters. However, if only some variables needs delimiters then $\langle$*cs-numbers*$\rangle$ can be used e.g. `var={1,3}` adds delimiters around the first and third variable

$$\verb|\odif[var=none]{x,y,z,t}| \implies \mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z\,\mathrm{d}t$$

$$\verb|\odif[var={1,3}]{x,y,z,t}| \implies \mathrm{d}(x)\,\mathrm{d}y\,\mathrm{d}(z)\,\mathrm{d}t$$

$$\verb|\odif[var=all]{x,y,z,t}| \implies \mathrm{d}(x)\,\mathrm{d}(y)\,\mathrm{d}(z)\,\mathrm{d}(t)$$

$$\verb|\odif[var]{x,y,z,t}| \implies \mathrm{d}(x)\,\mathrm{d}(y)\,\mathrm{d}(z)\,\mathrm{d}(t)$$

Without setting the option to a value is equivalent to setting it to `all` as seen above.

order	{$\langle$*cs-orders*$\rangle$}	1
ord	Sets the differentiation order of each variable.	

4.5 All derivatives and differentials

The options in this subsection are applied to all derivatives and differential because some options should be consisting regardless of the derivative and differential. The options are accessed using `\derivset{all}[`⟨*key=value*⟩`]`.

scale-auto   `leftright, mleftmright`[R]   `leftright, mleftmright`[R]

Updated: v1.1   Sets the dynamic scaling methods of delimiters. The value `leftright` sets the method to use `\left` and `\right`. The value `mleftmright` requires the mleftright package and sets the method to use `\mleft` and `\mright` instead. The default value is `leftright` unless mleftright have been loaded then it is `mleftmright`.

5 Defining variants

This section goes into detail with how to define derivative and differential variants based on the package's internal commands, as mentioned earlier. The derivative package provides a LaTeX 2ε way of defining the derivatives.

5.1 Derivative variant

`\NewDerivative`
`\RenewDerivative`
`\ProvideDerivative`
`\DeclareDerivative`

⟨*control-sequence*⟩{⟨*infinitesimal*⟩}[⟨*key=value*⟩]

This family of commands are used to define a derivative variant with the macro name ⟨*control-sequence*⟩. Moreover, the new derivative will use {⟨*infinitesimal*⟩} as its infinitesimal and inherit the package's default settings given in section 4.3, but they may be overwritten with [⟨*key=value*⟩]. The difference between them is as follows:

- `\NewDerivative` is similar to `\NewDocumentCommand` of the xparse package and will issue an error if ⟨*control-sequence*⟩ has already been defined.

- `\RenewDerivative` is similar to `\RenewDocumentCommand` of the xparse package and will issue an error if ⟨*control-sequence*⟩ has not previously been defined.

- `\ProvideDerivative` is similar to `\ProvideDocumentCommand` of the xparse package and will define ⟨*control-sequence*⟩ if it does not have an existing definition. It will not issue any errors.

- `\DeclareDerivative` is similar to `\DeclareDocumentCommand` of the xparse package and will always define the ⟨*control-sequence*⟩ with the new definition regardless of whether it already exists.

Examples of their use can be found in section 2.

⟨*control-sequence*⟩ The first argument is the macro name of the derivative that is to be defined.

{⟨*infinitesimal*⟩} The second argument makes the derivative ⟨*control-sequence*⟩ use {⟨*infinitesimal*⟩} as its infinitesimal. It is equivalent to setting `style-inf=`{⟨*infinitesimal*⟩}.

[⟨*key=value*⟩] The optional argument accepts its input as a comma-separated list of *key=value* pairs, which overrides the package's default options for the keys given. The derivative ⟨*control-sequence*⟩ will use the package's default settings if the argument is left out.

5.2 Differential variant

`\NewDifferential`
`\RenewDifferential`
`\ProvideDifferential`
`\DeclareDifferential`

⟨*control-sequence*⟩{⟨*infinitesimal*⟩}[⟨*key=value*⟩]

This family of commands are used to define a differential variant with the macro name ⟨*control-sequence*⟩. Moreover, the new derivative will use {⟨*infinitesimal*⟩} as its infinitesimal and inherit the package's default options given in section 4.4, but they may be overwritten with [⟨*key=value*⟩]. The difference between them is as follows:

- `\NewDifferential` is similar to `\NewDocumentCommand` of the xparse package and will issue an error if ⟨*control-sequence*⟩ has already been defined.

- \RenewDifferential is similar to \RenewDocumentCommand of the xparse package and will issue an error if ⟨control-sequence⟩ has not previously been defined.

- \ProvideDifferential is similar to \ProvideDocumentCommand of the xparse package and will define ⟨control-sequence⟩ if it does not have an existing definition. It will not issue any errors.

- \DeclareDifferential is similar to \DeclareDocumentCommand of the xparse package and will always define the ⟨control-sequence⟩ with the new definition regardless of whether it already exists.

Examples of their use can be found in section 3.

⟨control-sequence⟩   The first argument is the macro name of the differential that is to be defined.

{⟨infinitesimal⟩}   While the second argument makes the differential ⟨control-sequence⟩ use {⟨infinitesimal⟩} as its infinitesimal. It is equivalent to setting style-inf={⟨infinitesimal⟩}.

[⟨key=value⟩]   The optional argument accepts its input as a comma-separated list of *key=value* pairs, which overrides the package's default options for the keys given. The derivative ⟨control-sequence⟩ will use the package's default settings if the argument is left out.

6 The mixed order

6.1 Sorting algorithms

A unique feature of this package is that the sorting method behind the mixed order may be changed using built-in algorithms and there are currently four available: `abs`, `number`, `sign` and `symbol`. The algorithms have been chosen such that it the terms in the mixed order may be arranged in many ways with as few algorithms as possible to suit your liking. A sorting method may consist of up to three algorithms which are applied in layers.

- The sorting algorithm `sign` separates the positive and negative terms, and puts the positive terms before the negative terms in the mixed order. The option `sort-sign-reverse=true` reverses ordering such that the negative terms appear before the positive terms.

- The sorting algorithm `symbol` sorts the terms in a descending manner according to their length. The option `sort-symbol-reverse=true` sorts the terms in a ascending manner instead.

- The sorting by `abs` sorts the terms in a descending manner. The option `sort-abs-reverse=true` sorts the terms in an ascending manner instead.

- The sorting by `number` sorts the terms in a descending manner. The option `sort-number-reverse=true` sort the terms in an ascending manner instead.

- The sorting by `lexical` sorts the terms in a lexicographical order that is alphabetically. The option `sort-lexical-reverse=true` sort the terms in reverse lexicographical ordering.

When using the option `sort-method={...}`, the number of algorithms determines the number of layers e.g. `sort-method={sign,symbol}` is a sorting method with two layers, where the algorithms `sign` and `symbol` are applied in layer 1 and layer 2, respectively. E.i the `sign` algorithm splits the terms into two groups, one with positive terms and one with negative terms. Then the `symbol` algorithm will sorts the terms within each groups according to the terms symbolic length. The mixed order is then formed by combining these two sorted groups.

6.1.1 Examples

The examples below are uses partial derivatives with `order={3a-3hh-2b, 4c+4gg+2ff, -5d-5ee}` and a close up view of the mixed order. Square brackets are used to indicate grouping of terms and the text below a group refers to the algorithm applied. Here the words positive and negative, long and short, and big and low refers to the `sign`, `symbol`, and `abs` algorithms, respectively. A row of square brackets represents a layer.

The packages default sorting method is `sort-method={sign,symbol,abs}` which is used below. The `sign` algorithm separate the positive and negative terms in the first

layer. While in the second layer, the terms are separated by symbol length etc.

$$\frac{\partial^{4gg+2ff+4c+3a-5ee-3hh-5d-2b} f}{\partial x^{3a-3hh-2b} \, \partial y^{4c+4gg+2ff} \, \partial z^{-5d-5ee}}$$

$$\underbrace{\underbrace{\underbrace{4gg}_{\text{big}} + \underbrace{2ff}_{\text{low}}}_{\text{long}} + \underbrace{\underbrace{4c}_{\text{big}} + \underbrace{3a}_{\text{low}}}_{\text{short}}}_{\text{positve}} - \underbrace{\underbrace{\underbrace{5ee}_{\text{big}} - \underbrace{3hh}_{\text{low}}}_{\text{long}} - \underbrace{\underbrace{5d}_{\text{big}} - \underbrace{2b}_{\text{low}}}_{\text{short}}}_{\text{negative}}$$

as expected. Interchanging `sign` and `symbol` from the previous example i.e `sort-method={symbol,sign,abs}`, then the `symbol` and `sign` algorithms are now applied in the first and second layer, respectively. The result is shown below

$$\frac{\partial^{4gg+2ff-5ee-3hh+4c+3a-5d-2b} f}{\partial x^{3a-3hh-2b} \, \partial y^{4c+4gg+2ff} \, \partial z^{-5d-5ee}}$$

$$\underbrace{\underbrace{\underbrace{4gg}_{\text{big}} + \underbrace{2ff}_{\text{low}}}_{\text{positive}} - \underbrace{\underbrace{5ee}_{\text{big}} - \underbrace{3hh}_{\text{low}}}_{\text{negative}}}_{\text{long}} + \underbrace{\underbrace{\underbrace{4c}_{\text{big}} + \underbrace{3a}_{\text{low}}}_{\text{positive}} - \underbrace{\underbrace{5d}_{\text{big}} - \underbrace{2b}_{\text{low}}}_{\text{negative}}}_{\text{short}}$$

where a clear difference is seen between the above two examples.

The above two examples used 3-layer sorting methods but as mentioned earlier, the sorting method can also be constructed with one and two algorithms i.e. 1-layer and 2-layer sorting methods. A sorting method with two layers could be constructed as `sort-method={sign,symbol}` and the terms are ordered by sign and then symbolic length. In this case, there is not a third layer

$$\frac{\partial^{4gg+2ff+3a+4c-3hh-5ee-2b-5d} f}{\partial x^{3a-3hh-2b} \, \partial y^{4c+4gg+2ff} \, \partial z^{-5d-5ee}}$$

$$\underbrace{\underbrace{4gg + 2ff}_{\text{long}} + \underbrace{3a + 4c}_{\text{short}}}_{\text{positive}} - \underbrace{\underbrace{3hh - 5ee}_{\text{long}} - \underbrace{2b - 5d}_{\text{short}}}_{\text{negative}}$$

The last example shows a 1-layer sorting method given as `sort-method=symbol` which gives the result

$$\frac{\partial^{-3hh+4gg+2ff-5ee+3a-2b+4c-5d} f}{\partial x^{3a-3hh-2b} \, \partial y^{4c+4gg+2ff} \, \partial z^{-5d-5ee}}$$

$$\underbrace{-3hh + 4gg + 2ff - 5ee}_{\text{long}} + \underbrace{3a - 2b + 4c - 5d}_{\text{short}}$$

as expected.

6.2 The numerical term

With the symbolic part of the mixed order treated, it is time to look at the numerical term[2] which have a symbolic of zero. For this reason it is treated differently than the symbolic terms. The numerical term can be placed either at the beginning or at the end of the mixed order with the values `first` and `last`, respectively. The package can also determine where to place the numerical term with the value `auto`. Compare below

$$\texttt{sort-numerical=auto:} \quad \frac{\partial^{\beta+2} f}{\partial x^\beta\, \partial y^2} \quad \frac{\partial^{\beta-2} f}{\partial x^\beta\, \partial y^{-2}} \quad \frac{\partial^{2-\beta} f}{\partial x^{-\beta}\, \partial y^2} \quad \frac{\partial^{-2-\beta} f}{\partial x^{-\beta}\, \partial y^{-2}}$$

$$\texttt{sort-numerical=first:} \quad \frac{\partial^{2+\beta} f}{\partial x^\beta\, \partial y^2} \quad \frac{\partial^{-2+\beta} f}{\partial x^\beta\, \partial y^{-2}} \quad \frac{\partial^{2-\beta} f}{\partial x^{-\beta}\, \partial y^2} \quad \frac{\partial^{-2-\beta} f}{\partial x^{-\beta}\, \partial y^{-2}}$$

$$\texttt{sort-numerical=last:} \quad \frac{\partial^{\beta+2} f}{\partial x^\beta\, \partial y^2} \quad \frac{\partial^{\beta-2} f}{\partial x^\beta\, \partial y^{-2}} \quad \frac{\partial^{-\beta+2} f}{\partial x^{-\beta}\, \partial y^2} \quad \frac{\partial^{-\beta-2} f}{\partial x^{-\beta}\, \partial y^{-2}}$$

$$\texttt{sort-numerical=symbolic:} \quad \frac{\partial^{\beta+2} f}{\partial x^\beta\, \partial y^2} \quad \frac{\partial^{\beta-2} f}{\partial x^\beta\, \partial y^{-2}} \quad \frac{\partial^{2-\beta} f}{\partial x^{-\beta}\, \partial y^2} \quad \frac{\partial^{-\beta-2} f}{\partial x^{-\beta}\, \partial y^{-2}}$$

Note that `sort-numerical=symbolic` behaviour is determined by the chosen algorithms in `sort-method={…}`. Here, the algorithm is the package default.

6.3 Reversing the sort algorithm

The reverse keys serves to reverse the ordering of the sorting algorithms. This allows for even greater flexibility over the sorting method. So if the default ordering of an algorithm is not wished it may be reversed with the corresponding reverse key. The reverse keys in action are shown below (`sort-method=`⟨*1 algorithm only*⟩ is also used to better show off the reverse functionality)

$$\texttt{sort-abs-reverse=false:} \quad \frac{\partial^{-3b+2a} f}{\partial x^{2a}\, \partial y^{-3b}} \qquad \texttt{sort-abs-reverse=true:} \quad \frac{\partial^{2a-3b} f}{\partial x^{2a}\, \partial y^{-3b}}$$

$$\texttt{sort-number-reverse=false:} \quad \frac{\partial^{2a-3b} f}{\partial x^{2a}\, \partial y^{-3b}} \qquad \texttt{sort-number-reverse=true:} \quad \frac{\partial^{-3b+2a} f}{\partial x^{2a}\, \partial y^{-3b}}$$

$$\texttt{sort-sign-reverse=false:} \quad \frac{\partial^{a-b} f}{\partial x^{a}\, \partial y^{-b}} \qquad \texttt{sort-sign-reverse=true:} \quad \frac{\partial^{-b+a} f}{\partial x^{a}\, \partial y^{-b}}$$

$$\texttt{sort-symbol-reverse=false:} \quad \frac{\partial^{ab+c} f}{\partial x^{ab}\, \partial y^{c}} \qquad \texttt{sort-symbol-reverse=true:} \quad \frac{\partial^{c+ab} f}{\partial x^{ab}\, \partial y^{c}}$$

$$\texttt{sort-lexical-reverse=false:} \quad \frac{\partial^{a+b+c} f}{\partial x^{a}\, \partial y^{c}\, \partial z^{b}} \qquad \texttt{sort-lexical-reverse=true:} \quad \frac{\partial^{c+b+a} f}{\partial x^{a}\, \partial y^{c}\, \partial z^{b}}$$

6.4 Mixed order override

In cases where the mixed order fails to be calculated or another form is preferred, then the mixed order override can be used

$$\texttt{\textbackslash pdv[order=\{n+3k, n-k\}]\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^{2n+2k} f}{\partial x^{n+3k}\, \partial y^{n-k}}$$

$$\texttt{\textbackslash pdv[order=\{n+3k, n-k\}, mixed-order=\{2(n+k)\}]\{f\}\{x,y\}} \quad \Longrightarrow \quad \frac{\partial^{2(n+k)} f}{\partial x^{n+3k}\, \partial y^{n-k}}$$

7 Miscellaneous

7.1 Slashfrac

`\slashfrac` $[\langle scale \rangle]\{\langle numerator \rangle\}\{\langle denominator \rangle\}$

A text-styled fraction i.e. a/b, is commonly used in text-mode. While `\slashfrac{a}{b}` is certainly longer to write than `a/b`, which only requires three keystrokes, but for the implementation of text-styled derivatives a macro for it is needed.

$[\langle scale \rangle]$ The optional argument is the scaling parameter for the slash and takes the inputs as shown below. Leaving out $[\langle scale \rangle]$ sets the scaling parameter to `auto`

$$\texttt{\textbackslash slashfrac[auto]\{y\_f\}\{x\}} \quad \Longrightarrow \quad y_f/x$$

$$\texttt{\textbackslash slashfrac[none]\{y\_f\}\{x\}} \quad \Longrightarrow \quad y_f/x$$

$$\texttt{\textbackslash slashfrac[big]\{y\_f\}\{x\}} \quad \Longrightarrow \quad y_f/x$$

$$\texttt{\textbackslash slashfrac[Big]\{y\_f\}\{x\}} \quad \Longrightarrow \quad y_f\big/x$$

$$\texttt{\textbackslash slashfrac[bigg]\{y\_f\}\{x\}} \quad \Longrightarrow \quad y_f\bigg/x$$

$$\texttt{\textbackslash slashfrac[Bigg]\{y\_f\}\{x\}} \quad \Longrightarrow \quad y_f\Bigg/x$$

This argument is subject to change, see consideration 8.2(ii) for more information.

$\{\langle numerator \rangle\}$ Typesets the fraction's numerator.

$\{\langle denominator \rangle\}$ Typesets the fraction's denominator.

8 To do

Entries marked with ✓ will be implemented in a future release specified in the entry.
Entries marked with ✗ will not be implemented.

8.1 Future implementation

The list describes what *will be added* to the package in a later release.

(i) Implement the option to turn off the sorting of the terms in the mixed order. This could be made as a `draft` / `final` option.
    ✓✗**Conclusion:** *There could be an draft/final option for the package. But what is should turn off/on is harder to say.*

8.2 Future considerations

The list describes what *might be changed or added* to the package in a later release.

(i) It can become rather cumbersome to read a derivative with a very long function. To ease this up, I am considering to add a switch that exchange the variable and the function arguments. But this might be against the LaTeX way of using arguments, which is the reason it have not been done and I would like feedback on it.

(ii) I am considering making the optional argument of `\slashfrac` into a `[⟨key=value⟩]` argument with something like `scale={⟨scaling⟩}`.
    ✓**Conclusion:** *I want an key-value implementation like this in the future, but it will not be added in the next release.*

Index

Numbers in bold refer to the page where the entry is defined.

Index of Options

Index of Commands

Change history

v0.9
2019-07-21
Beta

- First release of the package. The package is currently in a beta version.

v0.95
2019-09-18
Beta

- *Please ignore this version, since it contained the wrong* .sty *and* .pdf *files* :(.

- Removed the single token restriction of the infinitesimal since it made no sense.

- Fixed the documentation errors and typos.

- Minor fixes to the code.

v0.95b
2019-09-21
Beta

- Contains the correct .sty and .pdf files :).

- One minor code fix.

v0.96
2019-12-22
Beta

- Fixed the double superscript issue for higher order derivative when the variable contained a superscript.

v0.97
2020-02-03
Beta

- Fixed the argument specifier of `\__deriv_scale_big:nnnn` when it was used (it was used with `:nnnm`).

v0.98
2020-07-20
Beta

- Fixed a bug concerning the subscript argument due to recent changes to the `xparse` package dated 2020-05-14 (the fix works with earlier versions of `xparse` as well).

v1.0
2021-05-25

- Added new options for derivatives

- Added new values for existing options

- Added new commands to write differentials

- Changed usage of `style-inf`

- Changed the order argument to an option argument

- Changed default values for some options

- Changed math space keys to accept more general inputs

- Changed `\derivset` to define default options

- Merged the codes for ordinary and partial derivatives

- Removed the mixed order argument

- Removed the options `misc-add-delims` and `misc-remove-delims`

- Replaced the commands in section 5 with new ones. Old ones no longer works.

- Code clean-up and optimization

- Fixed code errors

- Fixed documentation errors

- Enhanced support for preventing options effecting nested derivatives/differentials

v1.01
2021-05-28

- Changed the option `sep-end` default value because it caused issues

- Fixed code errors due to changes introduced in version 1.0 to the option `style-inf`

- Fixed documentation errors

v1.1
2021-06-03

- Added package options to be used in `\usepackage[`⟨*options*⟩`]{derivative}`

- No longer secretly depends on unicode-math when using X_ETEX or LuaTEX

- The package no longer uses `\symup` which have been replaced with `\mathrm` for simplicity

- If mleftright is loaded then the default value of `scale-auto` is `mleftmright`

v1.2
2022-07-09

- Code clean-up and optimisation that significantly speeds up usage of the package

- Added new sorting algorithm `sort-method=lexical` that sorts terms alphabetically

- Added the option `sort-lexical-reverse`

- Added the option `switch-sort` that turns on/off the sorting algorithm of the mixed order

- Fixed bug concerning `scale-`⟨...⟩`=none` when the corresponding delimiter option contained a period.

- Fixed documentation errors