

The polynomial.sty package*

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The package `polynomial.sty` offers an easy way to write (univariate) polynomials and rational functions. It defines two commands, one for polynomials `\polynomial{coeffs}` and one for rational functions `\polynomialfrac{Numerator}{Denominator}`. The first of them, `\polynomial`, prints a polynomial with the coefficients in the comma separated list of the argument. The second, `\polynomialfrac`, prints a fraction of two polynomials. There is also an optional argument to the commands that changes the properties of the polynomials. The default values can be changed by the command `\polynomialstyle`. In the following the commands are described by a set of explained examples.

The coefficients of the polynomials are given as a comma separated lists. If a coefficient is a zero it is not printed, and if it is 1 only the monomial is printed. By default there is a plus in between two terms, but if the first character of the coefficient is minus it is changed to minus.

Examples:

<code>\polynomial{1,2,3,4,5}</code>	$1 + 2x + 3x^2 + 4x^3 + 5x^4$
<code>\polynomial{3,35,0,0,45}</code>	$3 + 35x + 45x^4$
<code>\polynomial{c_0,-c_1,c_2,-c_3,c_4}</code>	$c_0 - c_1x + c_2x^2 - c_3x^3 + c_4x^4$
<code>\polynomial{0,0,0,1,-1,1,0,1,0,0,1,0,0}</code>	$x^3 - x^4 + x^5 + x^7 + x^{10}$
<code>\polynomial{-3,A\sin(\alpha t), e^{j\phi},</code> <code>\left(\sum_{k=0}^{\infty} a^k\right)</code>	$-3 + A \sin(\alpha t)x + e^{j\phi}x^2 + \left(\sum_{k=0}^{\infty} a^k\right)x^3$
<code>\polynomialfrac{a,b,c,-d,e}{f,g,h,i}</code>	$\frac{a + bx + cx^2 - dx^3 + ex^4}{f + gx + hx^2 + ix^3}$

There is a set of variables that can be used in an optional argument, using the keyval-style. By default the the exponents increases from left to right. There are two Boolean variables, `falling` and `reciprocal`, that change this. Both are used as `falling=true` or `falling=false`. The default is `true` for both variables, meaning, e.g., that `falling` is the same as the first variant. The difference between the commands is that the first uses decreasing exponents from left to right instead of increasing, while the second uses increasing exponents from right to left (hence giving the reciprocal polynomial). If both are true the polynomial will be written with decreasing exponents from right to left.

Examples:

<code>\polynomial[falling]{a,b,c,-d,e}</code>	$a + bx^{-1} + cx^{-2} - dx^{-3} + ex^{-4}$
<code>\polynomial[reciprocal]{a,b,c,-d,e}</code>	$ax^4 + bx^3 + cx^2 - dx + e$
<code>\polynomial[reciprocal,falling]{a,b,c,-d,e}</code>	$ax^{-4} + bx^{-3} + cx^{-2} - dx^{-1} + e$
<code>\polynomialfrac[falling]{a,b,c,-d,e}{f,g,h,i}</code>	$\frac{a + bx^{-1} + cx^{-2} - dx^{-3} + ex^{-4}}{f + gx^{-1} + hx^{-2} + ix^{-3}}$
<code>\polynomialfrac[reciprocal]{a,b,c,-d,e}{f,g,h,i}</code>	$\frac{ax^4 + bx^3 + cx^2 - dx + e}{fx^3 + gx^2 + hx + i}$

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It is also possible to change the polynomial variable through the optional argument `var=<nbr>`. The starting value of the exponents can be changed through `start=<nbr>`. There is also a variable `step=<nbr>` that changes the incrementation steps of the exponents.

Examples:

<code>\polynomial[var=t]{a,b,c,-d,e}</code>	$a + bt + ct^2 - dt^3 + et^4$
<code>\polynomial[var=\Phi,start=2]{a,b,c,-d,e}</code>	$a\Phi^2 + b\Phi^3 + c\Phi^4 - d\Phi^5 + e\Phi^6$
<code>\polynomial[var=z,falling]{a,b,c,-d,e}</code>	$a + bz^{-1} + cz^{-2} - dz^{-3} + ez^{-4}$
<code>\polynomialfrac[var=\varphi,reciprocal,start=-3]{a,b,c,-d,e}{f,g,h,i}</code>	$\frac{a\varphi + b + c\varphi^{-1} - d\varphi^{-2} + e\varphi^{-3}}{f + g\varphi^{-1} + h\varphi^{-2} + i\varphi^{-3}}$
<code>\polynomial[step=3,var=\pi]{a,b,c,-d,e}</code>	$a + b\pi^3 + c\pi^6 - d\pi^9 + e\pi^{12}$
<code>\polynomial[step=2,reciprocal,falling,start=3]{a,b,c,-d,e}</code>	$ax^{-5} + bx^{-3} + cx^{-1} - dx + ex^3$
<code>\polynomial[step=-3,start=2]{a,b,c,-d,e}</code>	$ax^2 + bx^{-1} + cx^{-4} - dx^{-7} + ex^{-10}$

Sometimes, it is desirable to use other addition and subtraction symbols than the default. This is done by the variables `add` and `sub`. If the first coefficient is negative this will also have the subtraction sign specified in `sub`. In some cases the additive inverse is denoted by a normal minus, while the subtraction (if defined) something else, e.g., \ominus . For this purpose there is a third variable `firstsub`.

Examples:

<code>\polynomial[add=\oplus,sub=\ominus]{a,-b,c,-d,e}</code>	$a \ominus bx \oplus cx^2 \ominus dx^3 \oplus ex^4$
<code>\polynomial[add=\oplus,sub=\ominus]{-a,b,-c,d,-e}</code>	$\ominus a \oplus bx \ominus cx^2 \oplus dx^3 \ominus ex^4$
<code>\polynomial[add=\oplus,sub=\ominus,firstsub=-]{-a,b,-c,d,-e}</code>	$-a \oplus bx \ominus cx^2 \oplus dx^3 \ominus ex^4$

All of the above variables can be set either for individual commands, as shown, or for the rest of the document with the command `\polynomialstyle`. In this case there is also an option that resets all values to the starting values, called `default`.

Examples:

<code>\polynomial{a,b,c,-d,e}</code>	$a + bx + cx^2 - dx^3 + ex^4$
<code>\polynomialstyle{var=z,falling}</code>	
<code>\polynomial{a,b,c,-d,e}</code>	$a + bz^{-1} + cz^{-2} - dz^{-3} + ez^{-4}$
<code>\polynomial[reciprocal]{a,b,c,-d,e}</code>	$az^{-4} + bz^{-3} + cz^{-2} - dz^{-1} + e$
<code>\polynomial[start=3,falling=false]{a,b,c,-d,e}</code>	$az^3 + bz^4 + cz^5 - dz^6 + ez^7$
<code>\polynomialfrac{a,b,c,-d,e}{f,g,h,i}</code>	$\frac{a + bz^{-1} + cz^{-2} - dz^{-3} + ez^{-4}}{f + gz^{-1} + hz^{-2} + iz^{-3}}$
<code>\polynomialstyle{add=\oplus,sub=\ominus}</code>	
<code>\polynomial{a,b,c,-d,e}</code>	$a \oplus bz^{-1} \oplus cz^{-2} \ominus dz^{-3} \oplus ez^{-4}$
<code>\polynomialstyle{default}</code>	
<code>\polynomial{a,b,c,-d,e}</code>	$a + bx + cx^2 - dx^3 + ex^4$