diff or Diff - differentiation or partial differentiation

diff(f, x1, ..., xj)	$\frac{d^j}{dx_j \ldots dx_1} f$
diff(f, [x1$n])	$\frac{d^n}{dx_1^n} f$
diff(f, x1$n, [x2$n, x3], ..., xj, [xk$m])	$\frac{d^r}{dx_k^m \, dx_j \ldots dx_3 \, dx_2^n \, dx_1^n} f$

f	-	algebraic expression or an equation
x1, x2, ..., xj	-	names representing differentiation variables
n		algebraic expression entering constructions like x$n, representing nth order derivative, assumed to be integer order differentiation

Find $\frac{d\,(x \sin(cosx))}{dx}$

```
> diff(x*sin(cos(x)),x);
```

$$\sin(\cos(x)) - x\cos(\cos(x))\sin(x)$$

Find higher order derivatives.

Find $\frac{d^3 sinx}{dx^3}$

```
> diff(sin(x),x$3);
```

$$-\cos(x)$$

Compute partial derivatives.

Ex:Find $\frac{\partial^2\,(x^2+x\,y^2)}{\partial y\,\partial x}$.

```
> diff(x^2+x*y^2,x,y);
```

$$2y$$

The Diff command is inert, it returns unevaluated.

```
> Diff(tan(x),x);
```

$$\frac{d}{dx}\tan(x)$$

The command map (f,list) applies the function f to each elements of the list.

Ex: To find third derivative of sin x, tanx and $\cot^{-1}x$.

Sol: > map(diff,[sin(x),tan(x), arccot(x)], x$3);

$$\left[-\cos(x), 2\left(1+\tan(x)^2\right)^2+4\tan(x)^2\left(1+\tan(x)^2\right), -\frac{8x^2}{\left(1+x^2\right)^3}+\frac{2}{\left(1+x^2\right)^2}\right]$$

implicitdiff

- differentiation of a function defined by an equation

`implicitdiff(f, y, x)`

`f  algebraic expressions or equations`

y (variable) name or function of dependent variable

x name (of derivative variable)

EX: find $\frac{dy}{dx}$ and from $x^2+y^2=1$

Sol: implicitdiff(x^2+y^2=1,y,x)

Ex: Find $\frac{d^2y}{dx^2}$ if $x^2+y^3=1$. Answer:

$> f := x\text{^}2 + y\text{^}3 = 1;$

$> implicitdiff(f, y, x, x);$

$$-\frac{2}{9}\frac{3y^3+4x^2}{y^5}$$

int - definite and indefinite integration

int(expression,x, options) $\int expression\, dx$

int(expression,x=a..b, options) $\int_a^b expression\, dx$

Double integration

int(expression, [x, y], options) $\iint expression\, dx\, dy$

int(expression, [x = a..b, y = c..d,], options) $\int_c^d\int_a^b expression\, dx\, dy$

`expression` - algebraic expression; integrand

`x, y` - names; variables of integration

`a, b, c, d` - endpoints of interval on which integral is taken

`options` (optional) various options to control the type of integration performed.

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> $Int(f, x)$

$$\int f \, dx$$

```
> v := Int(f(x), x = a..b);
```

$$v := \int_a^b f(x) \, dx$$

Double integral

> $Int(f, x, y)$

$$\iint f \, dx \, dy$$

Triple integral

> $Int(f, x, y, z)$

$$\iiint f \, dx \, dy \, dz$$

Examples

```
> int( x/(x^3-1), x );
```

$$\frac{1}{3}\ln(x-1)-\frac{1}{6}\ln\left(x^2+x+1\right)+\frac{1}{3}\sqrt{3}\arctan\left(\frac{1}{3}(2x+1)\sqrt{3}\right)$$

```
> int( exp(-x^2)*ln(x), x=0..infinity );
```

$$-\frac{1}{4}\sqrt{\pi}\,\gamma-\frac{1}{2}\sqrt{\pi}\ln(2)$$

A double integral

```
> int(x*y^2, [x, y] );
```

$$\frac{1}{6}x^2y^3$$

```
> int(x*y^2, [x = 0..y, y = -2..2]);
```

$$\frac{32}{5}$$

Find:

1) $\int_0^1 e^{x^3}\,dx$ > $f := int(\exp(x\hat{}3), x = 0..1);$

$$f := \int_0^1 e^{x^3}\,dx$$

> $evalf(\%)$

$$1.341904418$$

> $int(\exp(x\hat{}3), x = 0..1, numeric)$

$$1.341904418$$

2) $f := \int_a^b \frac{1}{x}\,dx$

> $f := int\left(\frac{1}{x}, x = a..b\right);$

Warning, unable to determine if 0 is between a and b; try to use assumptions or use the AllSolutions option

$$f := \int_a^b \frac{1}{x}\,dx$$

> $f := int\left(\frac{1}{x}, x = a..b, allsolutions\right)$

$$f :=$$

$$\begin{cases} \begin{cases} undefined & \mathrm{And}(0 < b, a < 0) \\ \left(\begin{cases} \infty & a = 0 \\ -\ln(a) & otherwise \end{cases}\right) + \left(\begin{cases} -\infty & b = 0 \\ \ln(b) & otherwise \end{cases}\right) & otherwise \end{cases} & a < \\ 0 & b = \\ -\left(\begin{cases} undefined & \mathrm{And}(0 < a, b < 0) \\ \left(\begin{cases} \infty & b = 0 \\ -\ln(b) & otherwise \end{cases}\right) + \left(\begin{cases} -\infty & a = 0 \\ \ln(a) & otherwise \end{cases}\right) & otherwise \end{cases}\right) & b < \end{cases}$$

3) $\displaystyle\int_a^b \frac{1}{e^x}\,dx$

> $f := int\left(\frac{1}{\exp(x)}, x = a..b, allsolutions\right)$

$$f := \begin{cases} \left(e^b - e^a\right) e^{-b-a} & a < b \\ 0 & b = a \\ \left(e^b - e^a\right) e^{-b-a} & b < a \end{cases}$$

4)Find integral of sinx , tanx and lnx to each elements.

> $map(int, [\sin(x), \tan(x), \ln(x)], x)$

5) $\displaystyle\int_0^1 e^{-x^2}\ln(x)\,dx$

6) **Find the third integral of cos2x , cot3x and $\sin^{-1}$ 2x to each elements.**

7) $\displaystyle\int x\,e^{a\,x}\sin(b\,x)\,dx$