

Some Useful Maple Commands

diff: Compute symbolic derivatives

```
> ex1 := exp( sin(4*x) ) + ln( x^2 + sqrt(x) ) ;
```

$$ex1 := e^{\sin(4x)} + \ln(x^2 + \sqrt{x})$$

```
> diff( ex1, x ) ;
```

$$4 \cos(4x) e^{\sin(4x)} + \frac{2x + \frac{1}{2\sqrt{x}}}{x^2 + \sqrt{x}}$$

```
> diff( ex1, x$2 ) ;
```

$$-16 \sin(4x) e^{\sin(4x)} + 16 \cos(4x)^2 e^{\sin(4x)} + \frac{2 - \frac{1}{4x^{(3/2)}}}{x^2 + \sqrt{x}} - \frac{\left(2x + \frac{1}{2\sqrt{x}}\right)^2}{(x^2 + \sqrt{x})^2}$$

```
> diff( diff( cos(x/y) , x ) , y );
```

$$\frac{\cos\left(\frac{x}{y}\right)x}{y^3} + \frac{\sin\left(\frac{x}{y}\right)}{y^2}$$

int: Compute symbolic integrals (anti-derivatives and definite integrals)

```
> ex2 := 1 / sqrt( x^2 - a^2 );
```

$$ex2 := \frac{1}{\sqrt{x^2 - a^2}}$$

```
> int( ex2, x );
```

$$\ln(x + \sqrt{x^2 - a^2})$$

A definite integral

```
> int( ex2, x=1..2 );
```

$$\ln(2 + \sqrt{-(a-2)(a+2)}) - \ln(1 + \sqrt{-(a-1)(a+1)})$$

Don't expect miracles!!

```
> int( ex1, x );
```

$$\int e^{\sin(4x)} + \ln(x^2 + \sqrt{x}) dx$$

Multi-dimensional integrals are often straightforward:

```
> ex3 := (x^3 + y^3) / (x^2 - y^2);
```

$$ex3 := \frac{x^3 + y^3}{x^2 - y^2}$$

```
> int(int(ex3, x), y);
```

$$\frac{1}{6}x^2y + \frac{1}{3}(y-x)^3 \ln(y-x) - \frac{1}{9}y^3 - \frac{1}{6}y^2x + \frac{11}{18}x^3 + xy^2 \ln(y-x) - \ln(y-x)yx^2$$

series and taylor: Compute power series expansions

```
> series(exp(x), x=0);
```

$$1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \frac{1}{120}x^5 + O(x^6)$$

```
> series(exp(x), x=0, 11);
```

$$1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \frac{1}{120}x^5 + \frac{1}{720}x^6 + \frac{1}{5040}x^7 + \frac{1}{40320}x^8 + \frac{1}{362880}x^9 + \frac{1}{3628800}x^{10} + O(x^{11})$$

```
|> taylor(exp(x), x=0);
```

$$1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \frac{1}{120}x^5 + \mathbf{O}(x^6)$$

```
|> Order := 8;
```

Order := 8

```
|> taylor(exp(x), x=0);
```

$$1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \frac{1}{120}x^5 + \frac{1}{720}x^6 + \frac{1}{5040}x^7 + \mathbf{O}(x^8)$$

```
|> Order := 6:
```

```
|> taylor((1 + x)^(-1), x=0, 7);
```

$$1 - x + x^2 - x^3 + x^4 - x^5 + x^6 + \mathbf{O}(x^7)$$

```
|> convert(%, 'polynom');
```

$$1 - x + x^2 - x^3 + x^4 - x^5 + x^6$$

```
|> coeffs(%, 'x');
```

1, -1, 1, -1, 1, -1, 1

solve: Solve equations, including linear systems

```
> eq1 := x + y + z = 6;   eq2 := 2*x + y + z =  
2;   eq3 := x + y + 3*z = 3;  
      eq1 := x + y + z = 6  
      eq2 := 2 x + y + z = 2  
      eq3 := x + y + 3 z = 3
```

```
> solve( {eq1, eq2, eq3} );  
      {x = -4, y =  $\frac{23}{2}$ , z =  $\frac{-3}{2}$ }
```

```
> solve( {eq1, eq2, eq3} , {x, y, z} );  
      {x = -4, y =  $\frac{23}{2}$ , z =  $\frac{-3}{2}$ }
```

```
|> eq[1] := c[1] + c[2] + c[3] = 6:  
|> eq[2] := 2*c[1] + c[2] + c[3] = 2:  
|> eq[3] := c[1] + c[2] + 3*c[3] = 3:  
|> eq[1]; eq[2]; eq[3];
```

$$c_1 + c_2 + c_3 = 6$$

$$2c_1 + c_2 + c_3 = 2$$

$$c_1 + c_2 + 3c_3 = 3$$

```
|> solve( {eq[1], eq[2], eq[3]},  
|>         { c[1], c[2], c[3]} );
```

$$\{c_1 = -4, c_2 = \frac{23}{2}, c_3 = \frac{-3}{2}\}$$

```
|> solve( {eq[1], eq[2], eq[3]} );
```

$$\{c_1 = -4, c_2 = \frac{23}{2}, c_3 = \frac{-3}{2}\}$$

Common Mistakes and Helpful Hints

(0) Not terminating statement with ';' or ':' (but note that Maple V.5 now warns of "premature end of input")

```
> a := int(x^2, x=0..1)
>

```

$$a := \frac{1}{3}$$

(1) Using '=' rather than ':=' for assignment

```
> a = 2;

```

$$\frac{1}{3} = 2$$

```
> a;

```

$$\frac{1}{3}$$

```
> a := 2;

```

$$a := 2$$

```
> a;

```

$$2$$

(2) Using quotes (') rather than double quotes (") to delimit strings

```
> string1 := "This is a Maple string";  
string1 := "This is a Maple string"
```

```
> string1 := "This is a Maple string";  
string1 := "This is a Maple string"
```

```
> string2 := 'This is not a Maple string';  
missing operator or `;`
```

(3) Unique syntax for programming constructs

```
> for i from 1 to 2 do  
>   print(i);  
> od;  
  
1  
2
```



```

> eval(sin);
proc(x::algebraic)
local n, t;
option 'Copyright (c) 1992 by the University of Waterloo. All rights reserved.';
    if nargs  $\neq$  1 then
        ERROR('expecting 1 argument, got '.nargs)
    elif type(x, 'complex(float)') then evalf('sin'(x))
    elif type(x, '*') and member(I, {op(x)}) then
        I*sinh(-I*x)
    elif type(x, 'complex(numeric)') then
        if csgn(x) < 0 then -sin(-x) else 'sin'(x) fi
    elif type(x, '*') and type(op(1, x), 'complex(numeric)')
        and csgn(op(1, x)) < 0 then -sin(-x)
    elif type(x, '*') and type(x, 'rational '&*' identical( $\pi$ '))
then
        t := op(1, x);
        if t < 1 / 2 then 'sin'(x)
        elif t < 1 then sin((1 - t)* $\pi$ )
        elif t < 2 then -sin((2 - t)* $\pi$ )
        else sin((t - 2*iquo(trunc(t), 2))* $\pi$ )
        fi

```

```

elif type(x, '+' ) and traperror(sign(x)) = -1 then -sin(-x)
elif type(x, '+' ) and has(x,  $\pi$ ) then
    t := map(
        proc(x) if type(x /  $\pi$ , 'rational' ) then x /  $\pi$  fi end,
        { op(x) });
    if nops(t) = 1 then
        t := op(t);
        if t < 0 then sin(x - 2* $\pi$ *trunc( 1 / 2*t) + 2* $\pi$ )
        elif t < 1 / 2 then sin(x) := 'sin'(x)
        elif t < 1 then cos(x - 1 / 2* $\pi$ )
        elif t < 2 then -sin(x -  $\pi$ )
        else sin(x - 2* $\pi$ *trunc( 1 / 2*t))
        fi
    else sin(x) := 'sin'(x)
    fi
elif type(x, '*') and member( $\pi$ , [op(x)], 'n' ) and  $\Im(x) = 0$ 
then
    t := subsop(n = 1, x);
    if frac(t) = 0 then 0
    elif frac(1 / 2*t - 1 / 4) = 0 then 1
    elif frac(1 / 2*t + 1 / 4) = 0 then -1
    elif frac(t - 1 / 2) = 0 then (-1)^(t - 1 / 2)
    else sin(x) := 'sin'(x)

```

```

fi
elif type( $x$ , 'function' ) and nops( $x$ ) = 1 then
     $n := \text{op}(0, x)$ ;
     $t := \text{op}(1, x)$ ;
    if  $n = \text{'arcsin'}$  then  $t$ 
    elif  $n = \text{'arccos'}$  then  $\text{sqrt}(1 - t^2)$ 
    elif  $n = \text{'arctan'}$  then  $t / \text{sqrt}(t^2 + 1)$ 
    elif  $n = \text{'arccsc'}$  then  $1 / t$ 
    elif  $n = \text{'arcsec'}$  then  $\text{sqrt}(1 - 1 / t^2)$ 
    elif  $n = \text{'arccot'}$  then  $1 / \text{sqrt}(t^2 + 1)$ 
    else  $\sin(x) := \text{'sin'}$ ( $x$ )
fi
elif type( $x$ , 'function' ) and  $\text{op}(0, x) = \text{'JacobiAM'}$  then
    JacobiSN( $\text{op}(x)$ )
elif type( $x$ , 'arctan(algebraic, algebraic)') then
     $\text{op}(1, x) / \text{sqrt}(\text{op}(1, x)^2 + \text{op}(2, x)^2)$ 
else  $\sin(x) := \text{'sin'}$ ( $x$ )
fi
end

```