

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 ) ;
```

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

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

```
[ > 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( x^2 , x = 0 .. 2 );
```

$$\frac{8}{3}$$

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) ;
```

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

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) ;
```

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

```
[ > Order := 8 ;
```

Order := 8

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

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

```
[ > Order := 6:
```

```
[ > taylor((1 + x)^(-1), x=0, 7);  
      1 - x + x^2 - x^3 + x^4 - x^5 + x^6 + 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 := 2x + y + z = 2  
      eq3 := x + y + 3z = 3
```

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

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

```
[ > 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]} );
```

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

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

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

Common Mistakes and Helpful Hints

(0) Not terminating statement with ';' or ':'

```
[ > 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"
```

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

(3) Unique syntax for programming constructs

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

(4) Use 'eval' or 'op' command to display definitions

```
[ > mysum := proc(x,y) x + y end:
```

```
[ > eval(mysum);  
      proc(x, y) x + y end proc
```

```
[ > op(mysum);  
      proc(x, y) x + y end proc
```


(5) Use 'interface(verboseproc=2)' to display system proc. defns.

```
[ > interface(verboseproc=2) ;
```

```
[ > eval(nops) ;  
      proc() option builtin; 203 end proc
```

```
[ > eval(sin) ;  
proc(x::algebraic)  
local n, t, pull_out, keep_in;  
option 'Copyright (c) 1992 by the University of Waterloo. All rights reserved.' ;  
      if nargs  $\neq$  1 then  
          error "expecting 1 argument, got %1", nargs  
      elif type(x, 'complex(float)') then evalf('sin'(x))  
      elif type(x, ' $\infty$ ') then  
          if type( $\Re(x)$ , ' $\infty$ ') then x*undefined  
          elif type(x, 'imaginary') then x  
          else  $\infty + \infty*I$   
          end if  
      elif type(x, 'undefined') then x*undefined  
      elif  
      type(x, 'SymbolicInfinity') and traperror(is(x, real)) = true
```

```

then undefined
elif type(x, 'imaginary') or type(x, '*') and
member(true, map(type, { op(x) }, 'imaginary')) then
    I*sinh(-I*x)
elif type(x, 'complex(numeric)') then
    if csgn(x) < 0 then -sin(-x) else 'sin'(x) end if
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))* $\pi$ )
    end if
elif type(x, '*') and
select(type, [op(x)], 'specfunc'('anything', 'csgn'))  $\neq$  [ ] then
    pull_out, keep_in := selectremove(type, x,
        'specfunc'('anything', 'csgn'));
    pull_out*sin(keep_in)
elif type(x, 'specfunc'('anything', 'csgn')) then x*sin(1)
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 /  $\pi$  end if
  end proc, { 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))
  end if
else sin(x) := 'sin'(x)
end if
elif type(x, '*') and member( $\pi$ , [op(x)], 'n') and  $\Im(x) = 0$ 
then
  t := subsop(n = 1, x);
  n := frac(t);
  if n = 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)

```

```

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

```