Some Useful Maple Commands

`diff:` Compute symbolic derivatives

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

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

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

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

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

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

```
> 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 );
```

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

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);
```

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

`series` and `taylor`: Compute power series expansions

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

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

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

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

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

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

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

$$Order := 8$$

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

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

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

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

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

```
> 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];
```

$$c_1 + c_2 + c_3 = 6$$

$$2\,c_1 + c_2 + c_3 = 2$$

$$c_1 + c_2 + 3\,c_3 = 3$$

```
> 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

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

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

```
> eval(mysum);
```

$$\mathbf{proc}(x, y)\ x + y\ \mathbf{end}$$

```
> op(mysum);
```

$$\mathbf{proc}(x, y)\ x + y\ \mathbf{end}$$

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

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

```
> eval(nops);
```

$$\mathbf{proc}()\ \mathbf{option}\ \mathit{builtin};\ 143\ \mathbf{end}$$

```
> eval(sin);
proc(x::algebraic)
local n, t;
option 'Copyright (c) 1992 by the University of Waterloo. All rig\
hts reserved.' ;
    if nargs ≠ 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( π )' )
    then
        t := op( 1, x );
        if t < 1 / 2 then 'sin'( x )
        elif t < 1 then sin( ( 1 – t )*π )
        elif t < 2 then –sin( ( 2 – t )*π )
        else sin( ( t – 2*iquo( trunc( t ), 2 ) )*π )
        fi
```

```
elif type(x, '+') and traperror(sign(x)) = -1 then -sin(-x)
elif type(x, '+') and has(x, π) then
    t := map(
        proc(x) if type(x / π, 'rational') then x / π fi end,
        {op(x)});
    if nops(t) = 1 then
        t := op(t);
        if t < 0 then sin(x - 2*π*trunc(1 / 2*t) + 2*π)
        elif t < 1 / 2 then sin(x) := 'sin'(x)
        elif t < 1 then cos(x - 1 / 2*π)
        elif t < 2 then -sin(x - π)
        else sin(x - 2*π*trunc(1 / 2*t))
        fi
    else sin(x) := 'sin'(x)
    fi
elif type(x, '*') and member(π, [op(x)], 'n') and ℑ(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 := 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(t^2 + 1)
        elif n = 'arccsc' then 1 / t
        elif n = 'arcsec' then sqrt(1 - 1 / t^2)
        elif n = 'arccot' then 1 / sqrt(t^2 + 1)
        else sin(x) := 'sin'(x)
        fi
    elif type(x, 'function') and op(0, x) = '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)
    fi
end
```