Some Useful Maple Commands

`diff`: Compute symbolic derivatives

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

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

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

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

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

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

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

```
> 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( subs(a=0,ex2), x=1..2 );
```

$$-\frac{1}{3}\sqrt{-3}$$

Don't expect miracles!!

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

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

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);
```

$$\frac{1}{6}x^2\,y - \frac{1}{6}y^3\ln(x^2+y^2) + \frac{1}{9}y^3 + \frac{1}{3}x^3\arctan\left(\frac{y}{x}\right) - \frac{1}{3}y^3\arctan\left(\frac{x}{y}\right)$$
$$-\frac{1}{6}x\,y^2 - \frac{1}{3}x^3\ln\left(\frac{x}{y}\right) + \frac{1}{6}x^3\ln\left(\frac{x^2}{y^2}+1\right)$$

`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} );
```

$$\{z=\frac{-3}{2}, y=\frac{23}{2}, x=-4\}$$

```
> 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]} );
```

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

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

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

Common Mistakes and Helpful Hints

(0) Not terminating statement with ';' or ':' *(but note that Maple V.5 and later versions now warn 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";
```

$$string1 := \text{"This is a Maple string"}$$

```
> 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);
```

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

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

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

(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, '∞') **then**
    if type($\Re(x)$, '∞') **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(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)
      end if
elif type(x, ‘*‘) and
select(type, [op(x)], ’specfunc’(’anything’, ’csgn’)) ≠ [ ] 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, π) then
    t := map(proc(x)
            if type(x / π, 'rational') then x / π end if
        end proc, {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))
        end if
    else sin(x) := 'sin'(x)
    end if
elif type(x, `*`) and member(π, [op(x)], 'n') and ℑ(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
```