Doing Math with Maxima

1 Symbolic Mathematical Programming Language

The following examples show how grouping affect results.

```
-->     6-5*(4-3^2*(2-X));
```

(%o50) $6-5\cdot(4-9\cdot(2-X))$

Simplify

```
-->     ratsimp(%);
```

(%o51) $76-45\cdot X$

Solve equation

```
-->     f(X):=76-45*X;
```

(%o56) $\mathrm{f}(X):=76-45\cdot X$

```
-->     f(4);
```

(%o57) -104

Second expression with a different grouping.

```
-->     6-5*[4-3^2*2-X];
```

(%o1) $[6-5\cdot(-X-14)]$

Simplify

```
-->     ratsimp(%);
```

(%o2) $[5\cdot X+76]$

Solve equation

```
-->     f(X):=5*X+76;
```

(%o3) $\mathrm{f}(X):=5\cdot X+76$

```
-->     f(4);
```

(%o4) 96

Third expression with different grouping

```
--> 6-5*4-3^2*2-X;
```

(%o5) $-X-32$

```
--> f(X):=-X-32;
```

(%o6) $\mathrm{f}(X) := -X-32$

```
--> f(4);
```

(%o7) -36

Expanding exponents

```
--> expand((-2*W*X^2*Y^4)^3);
```

(%o49) $-8\cdot W^3\cdot X^6\cdot Y^{12}$

Factorization

```
--> expand((X +Y)^2);
```

(%o48) $Y^2+2\cdot X\cdot Y+X^2$

2 Solving Equations

```
--> solve(X+3=4/(X+5),X);
```

(%o46) $[X=-\sqrt{5}-4, X=\sqrt{5}-4]$

```
--> solve(X^2+8*X+11, X);
```

(%o47) $[X=-\sqrt{5}-4, X=\sqrt{5}-4]$

```
--> solve(-5/(2*X +3)=6/(7*X -1), X);
```

(%o44) $[X=-\frac{13}{47}]$

3 Solving Quadratic Equation

```
-->    solve(5*X^2 - 3*X = 4, X);
```

(%o43) $[X = -\frac{\sqrt{89}-3}{10}, X = \frac{\sqrt{89}+3}{10}]$

4 Gauss-Jordan Reduction Method

```
-->    linsolve([2*X+3*Y = 18, 3*X-4*Y = -7], [X,Y]);
```

(%o42) $[X = 3, Y = 4]$

5 The equation of a straight line

```
-->    y = 5 - 1/4*x;
```

(%o35) $y = 5 - \frac{x}{4}$

```
-->    plot2d([5-x/4], [x,-10,10],
        [plot_format, gnuplot],
        [gnuplot_postamble, "set zeroaxis;"])$
```

This is how you solve for a specific variable.

```
-->    solve(P=5-1/8*Q, Q);
```

(%o8) $[Q = 40 - 8 \cdot P]$

6 Special products and factoring

```
-->    factor(X^4-16);
```

(%o13) $(X-2) \cdot (X+2) \cdot \left(X^2+4\right)$

7 Example 1:

We are given the total cost function (TC) and the demand function (Q).

```
-->     TC = 0.5*Q^2;
```

(%o20) $TC = 0.5 \cdot Q^2$

```
-->     Q = 40 - 2*P;
```

(%o21) $Q = 40 - 2 \cdot P$

```
-->     solve(Q = 40 - 2*P, [P]);
```

(%o22) $[P = -\frac{Q-40}{2}]$

```
-->     expand(%);
```

(%o23) $[P = 20 - \frac{Q}{2}]$

Then we compute the total revenue (TR)

```
-->     TR=(20-Q/2)*Q;
```

(%o24) $TR = \left(20 - \frac{Q}{2}\right) \cdot Q$

```
-->     expand(%);
```

(%o25) $TR = 20 \cdot Q - \frac{Q^2}{2}$

Then compute the profit as TR-TC

```
-->     profit = (20*Q-Q^2/2)-(0.5*Q^2);
```

(%o26) $profit = 20 \cdot Q - 1.0 \cdot Q^2$

Plot the function

```
-->     plot2d([20*Q-1.0*Q^2], [Q,0,20],
         [plot_format, gnuplot],
         [gnuplot_postamble, "set zeroaxis;"])$
```

Compute the first and second derivatives.

```
-->     diff(20*Q-1.0*Q^2,Q);
```

(%o29) $20 - 2.0 \cdot Q$

```
-->     solve(20-2.0*Q,Q);
```

rat: replaced -2.0 by -2/1 = -2.0

(%o31) $[Q = 10]$

```
-->     P=20-10/2;
```

(%o32) $P = 15$

```
-->     diff(20*Q-1.0*Q^2,Q,2);
```

(%o30) -2.0