```
      |\^/|       Maple 9 (IBM INTEL LINUX)
._|\|   |/|_. Copyright (c) Maplesoft, a division of Waterloo Maple Inc. 2003
 \  MAPLE  /  All rights reserved. Maple is a trademark of
 <____ ____>  Waterloo Maple Inc.
      |        Type ? for help.
> interface(screenwidth=120);
> root[3](23);root(23,3);
                                                           (1/3)
                                                         23

                                                           (1/3)
                                                         23


> evalf(Pi,1000);
3.1415926535897932384626433832795028841971693993751058209749445923078164062862089986280348253421170679821480865132823\
   06647093844609550582231725359408128481117450284102701938521105559644622948954930381964428810975665933446128475693\
   48233786783165271201909145648566923460348610454326648213393607260249141273724587006606315588174881520920962829254\
   09171536436789259360011330530548820466521384146951941519305486026852868871973819326117931051185489\
   07446237996274956735188575272489122793818301194912983367336244065664308602139494639522473719070217986094370277055\
   39217176293176752384674818467669405132000568127145263546598037875169047312647878696091736371787214684409017243301465494\
   95853710507922796895289235420199561121290219608640344181598136297747713099605187072113499999998372978049951059731\
   73281609631858950244594553469083026425223082533446850352619311881710100031378387528865875332083814206171776691473\
   03598253490428755468731159562863882353787593751957781857780532171226806613001927876611195909216420199


> Digits:=1000;sqrt(2.0);Digits:=10;sqrt(3.0);
                                             Digits := 1000

1.41421356237309504880168872420969807856967187537694807317667973799073247846210703885038753432764157273501384623091\
   29702492483605585037372126441214970999358314132226659275055927557999505011527820605714701095599716059702745345968\
   62014728517418640889198609552329230484308714321450839762603627995251407989687253396546331808829640620615258352\
   50547457502877599617298355575220337531857011354374603404894884716038689997069900481503054402779031645442478230684\
   93693186215805784631115966687130130156185689872372352885092648612494977154218334204285686060146824720771435854874\
   15565706967765372022646854470158588016207584749242562726002085584466521459388983944370926591860131388246648615708\
   30100594858704003186480342194897278290641045072636881313739855256117322040245091227026941127573627280495073810\
   89675040183698683684507257993647290607629969413804765548237289971803268024744206292691248590521810044598425150591\
   1202494413417285314781058036033710773091828693147101711116839165817268894197587165821521282295184884


                                             Digits := 10

                                             1.732050808

> P:=expand(simplify((2*x+1)^2*(x^5-1)/(x-1)));
                             6      5      4      3      2
                   P := 4 x  + 8 x  + 9 x  + 9 x  + 9 x  + 5 x + 1

> factor(X^12-1);
              2            2        2      4    2
   (X - 1) (1 + X + X ) (1 + X) (1 - X + X ) (1 + X ) (X  - X  + 1)

> #phi12 est le facteur qui n'apparait pas dans:
> factor(X^6-1);factor(X^4-1);
              2                  2
   (X - 1) (1 + X + X ) (1 + X) (1 - X + X )

                              2
          (X - 1) (1 + X) (1 + X )

> factor(P,complex);factor(P,real);factor(P);
4. (x + 0.8090169944 + 0.5877852523 I) (x + 0.8090169944 - 0.5877852523 I)
                                                                    2
   (x - 0.3090169944 + 0.9510565163 I) (x - 0.3090169944 - 0.9510565163 I)

               2                2                                       2
   4. (x + 0.5000000000)  (x  + 1.618033989 x + 1.000000000) (x  - 0.6180339888 x + 1.000000000)

           4    3    2                 2
   (x  + x  + x  + x + 1) (2 x + 1)

> factor(X^12-1,{sqrt(3),I});
bytes used=4000068, alloc=3341724, time=0.16
       1/2           1/2                1/2            1/2              1/2                1/2
(2 X + 3   - I) (2 X - 3   - I) (2 X + 3   + I) (2 X - 3   + I) (2 X - 1 + 3   I) (2 X - 1 - 3   I)

          1/2             1/2
   (2 X + 1 + 3   I) (2 X + 1 - 3   I) (X + I) (X - I) (X - 1) (1 + X)/256

> expand(cos(5*a));
                      5           3
          16 cos(a)  - 20 cos(a)  + 5 cos(a)

> int(cos(5*x)/(2+sin(x)),x=0..Pi/2);
bytes used=8000356, alloc=4717728, time=0.28
                      -209 ln(2) + 209 ln(3) - 254/3

>
> P:=int(cos(5*x)/(2+sin(x)),x);
                    4            3            2
          P := 4 sin(x)  - 32/3 sin(x)  + 26 sin(x)  - 104 sin(x) + 209 ln(2 + sin(x))

> simplify(diff(P,x)-cos(5*x)/(2+sin(x)));

                                  0

> int(sin(x)/(x^n),x=0..infinity);
bytes used=12006772, alloc=5700588, time=0.43
bytes used=16007644, alloc=6617924, time=0.60
          1/2  (-n)
        Pi    2     GAMMA(1 - n/2)
        --------------------------
              GAMMA(1/2 + n/2)
```

```
> ###########################################
> # a retenir: comment liberer une variable:
> a:='a';
                                             a := a

> assume(a>0); int(exp(-a*x^2),x=0..infinity);
                                              1/2
                                            Pi
                                          -------
                                             1/2
                                          2 a~
> taylor(tan(x),x=0,10);
                     3        5    17   7    62   9       10
          x + 1/3 x  + 2/15 x  + --- x  + ---- x  + O(x  )
                                 315      2835

> series(tan(x),x=0,10);
                     3        5    17   7    62   9       10
          x + 1/3 x  + 2/15 x  + --- x  + ---- x  + O(x  )
                                 315      2835

> f:= series(ln(1+sin(x))/(sin(sin(x)-x)),x=0,9);
                    -2       -1   13   13       431   2   1363   3       4
          f := - 6 x   + 3 x   - -- - -- x - ---- x  - ---- x  + O(x )
                                 10   20     1400      8400

> F:=convert(f,polynom);
                                                     2         3
                    6          13   13 x   431 x    1363 x
          F := - ---- + 3/x - -- - ---- - ------ - ------
                    2         10    20     1400     8400
                   x

# NB: polynom donne tout de m{\^e}me une fraction!
> with(CodeGeneration);
          [C, Fortran, IntermediateCode, Java, LanguageDefinition, Matlab, Names, Translate, VisualBasic]

> Matlab(F,output=string);
"cg = -6 / x ^ 2 + 3 / x - 0.13e2 / 0.10e2 + 0.13e2 / 0.20e2 * x - 0.431e3 / 0.1400e4 * x ^ 2 + 0.1363e4 / 0.8400
     * x ^ 3;
     "

> ##############################################################
> #A retenir: comment creer une fonction a partir d'un symbole:
> g:=a->eval(F,x=a);g(1);
                                              |
                          g := a -> F         |
                                              | x = a
                                 -31883
                                 ------
                                  8400

###########################
> with(linalg);
[BlockDiagonal, GramSchmidt, JordanBlock, LUdecomp, QRdecomp, Wronskian, addcol, addrow, adj, adjoint, angle, aug

   backsub, band, basis, bezout, blockmatrix, charmat, charpoly, cholesky, col, coldim, colspace, colspan, compa

   concat, cond, copyinto, crossprod, curl, definite, delcols, delrows, det, diag, diverge, dotprod, eigenvals,

   eigenvalues, eigenvectors, eigenvects, entermatrix, equal, exponential, extend, ffgausselim, fibonacci, forwa

   frobenius, gausselim, gaussjord, geneqns, genmatrix, grad, hadamard, hermite, hessian, hilbert, htranspose,

   ihermite, indexfunc, innerprod, intbasis, inverse, ismith, issimilar, iszero, jacobian, jordan, kernel, lapla

   leastsqrs, linsolve, matadd, matrix, minor, minpoly, mulcol, mulrow, multiply, norm, normalize, nullspace, or

   permanent, pivot, potential, randmatrix, randvector, rank, ratform, row, rowdim, rowspace, rowspan, rref, sca

   singularvals, smith, stackmatrix, submatrix, subvector, sumbasis, swapcol, swaprow, sylvester, toeplitz, trac

   transpose, vandermonde, vecpotent, vectdim, vector, wronskian]

> with(LinearAlgebra);
[&x, Add, Adjoint, BackwardSubstitute, BandMatrix, Basis, BezoutMatrix, BidiagonalForm, BilinearForm,

   CharacteristicMatrix, CharacteristicPolynomial, Column, ColumnDimension, ColumnOperation, ColumnSpace,

   CompanionMatrix, ConditionNumber, ConstantMatrix, ConstantVector, Copy, CreatePermutation, CrossProduct,

   DeleteColumn, DeleteRow, Determinant, Diagonal, DiagonalMatrix, Dimension, Dimensions, DotProduct,

   EigenConditionNumbers, Eigenvalues, Eigenvectors, Equal, ForwardSubstitute, FrobeniusForm, GaussianEliminatio

   GenerateEquations, GenerateMatrix, GetResultDataType, GetResultShape, GivensRotationMatrix, GramSchmidt,

   HankelMatrix, HermiteForm, HermitianTranspose, HessenbergForm, HilbertMatrix, HouseholderMatrix, IdentityMatr

   IntersectionBasis, IsDefinite, IsOrthogonal, IsSimilar, IsUnitary, JordanBlockMatrix, JordanForm, LA_Main,

   LUDecomposition, LeastSquares, LinearSolve, Map, Map2, MatrixAdd, MatrixExponential, MatrixFunction, MatrixIn

   MatrixMatrixMultiply, MatrixNorm, MatrixPower, MatrixScalarMultiply, MatrixVectorMultiply, MinimalPolynomial,

   Modular, Multiply, NoUserValue, Norm, Normalize, NullSpace, OuterProductMatrix, Permanent, Pivot, PopovForm,

   QRDecomposition, RandomMatrix, RandomVector, Rank, RationalCanonicalForm, ReducedRowEchelonForm, Row, RowDime

   RowOperation, RowSpace, ScalarMatrix, ScalarMultiply, ScalarVector, SchurForm, SingularValues, SmithForm, Sub
```

```
      SubVector, SumBasis, SylvesterMatrix, ToeplitzMatrix, Trace, Transpose, TridiagonalForm, UnitVector,

      VandermondeMatrix, VectorAdd, VectorAngle, VectorMatrixMultiply, VectorNorm, VectorScalarMultiply, ZeroMatrix,

      ZeroVector, Zip]

>  A:=Matrix([[1,2],[3,4]]);
                                           [1    2]
                                      A := [      ]
                                           [3    4]

>  B:=A+1;
                                           [2    2]
                                      B := [      ]
                                           [3    5]

>  Determinant(A); A.B;
                                            -2

                                       [ 8    12]
                                       [        ]
                                       [18    26]

>  a:='a';
                                         a := a

>  A:=Matrix(4,4,symbol=a);B:=Matrix(4,4,symbol=b);
                             [a[1, 1]    a[1, 2]    a[1, 3]    a[1, 4]]
                             [                                        ]
                             [a[2, 1]    a[2, 2]    a[2, 3]    a[2, 4]]
                        A := [                                        ]
                             [a[3, 1]    a[3, 2]    a[3, 3]    a[3, 4]]
                             [                                        ]
                             [a[4, 1]    a[4, 2]    a[4, 3]    a[4, 4]]

                             [b[1, 1]    b[1, 2]    b[1, 3]    b[1, 4]]
                             [                                        ]
                             [b[2, 1]    b[2, 2]    b[2, 3]    b[2, 4]]
                        B := [                                        ]
                             [b[3, 1]    b[3, 2]    b[3, 3]    b[3, 4]]
                             [                                        ]
                             [b[4, 1]    b[4, 2]    b[4, 3]    b[4, 4]]

>  d:=Determinant(A.B): factor(d);
(b[4, 1] b[3, 2] b[1, 4] b[2, 3] - b[3, 1] b[4, 2] b[1, 4] b[2, 3] - b[1, 1] b[2, 2] b[4, 3] b[3, 4]

    + b[1, 1] b[3, 2] b[4, 3] b[2, 4] + b[3, 1] b[4, 2] b[1, 3] b[2, 4] - b[1, 1] b[3, 2] b[2, 3] b[4, 4]

    + b[1, 1] b[4, 2] b[2, 3] b[3, 4] - b[2, 1] b[1, 2] b[3, 3] b[4, 4] + b[1, 1] b[2, 2] b[3, 3] b[4, 4]

    + b[2, 1] b[4, 2] b[3, 3] b[1, 4] - b[2, 1] b[4, 2] b[1, 3] b[3, 4] - b[1, 1] b[4, 2] b[3, 3] b[2, 4]

    + b[2, 1] b[1, 2] b[4, 3] b[3, 4] - b[3, 1] b[2, 2] b[1, 3] b[4, 4] + b[3, 1] b[2, 2] b[4, 3] b[1, 4]

    + b[3, 1] b[1, 2] b[2, 3] b[4, 4] - b[3, 1] b[1, 2] b[4, 3] b[2, 4] + b[4, 1] b[1, 2] b[3, 3] b[2, 4]

    - b[4, 1] b[1, 2] b[2, 3] b[3, 4] - b[4, 1] b[3, 2] b[1, 3] b[2, 4] + b[2, 1] b[3, 2] b[1, 3] b[4, 4]

    - b[2, 1] b[3, 2] b[4, 3] b[1, 4] - b[4, 1] b[2, 2] b[3, 3] b[1, 4] + b[4, 1] b[2, 2] b[1, 3] b[3, 4]) (

   -a[2, 4] a[1, 1] a[3, 3] a[4, 2] - a[1, 4] a[2, 1] a[3, 2] a[4, 3] + a[4, 4] a[1, 1] a[3, 3] a[2, 2]

    - a[1, 4] a[3, 1] a[2, 3] a[4, 2] - a[3, 4] a[1, 1] a[4, 3] a[2, 2] + a[1, 4] a[2, 1] a[3, 3] a[4, 2]

    + a[3, 4] a[4, 1] a[1, 3] a[2, 2] + a[2, 4] a[4, 1] a[3, 3] a[1, 2] - a[2, 4] a[4, 1] a[1, 3] a[3, 2]

    - a[4, 4] a[3, 1] a[1, 3] a[2, 2] - a[4, 4] a[2, 1] a[3, 3] a[1, 2] + a[4, 4] a[2, 1] a[1, 3] a[3, 2]

    + a[1, 4] a[4, 1] a[2, 3] a[3, 2] - a[2, 4] a[3, 1] a[4, 3] a[1, 2] - a[3, 4] a[2, 1] a[1, 3] a[4, 2]

    + a[3, 4] a[1, 1] a[2, 3] a[4, 2] + a[2, 4] a[1, 1] a[3, 2] a[4, 3] - a[4, 4] a[1, 1] a[2, 3] a[3, 2]

    + a[1, 4] a[3, 1] a[4, 3] a[2, 2] + a[2, 4] a[3, 1] a[1, 3] a[4, 2] - a[3, 4] a[4, 1] a[2, 3] a[1, 2]

    + a[3, 4] a[2, 1] a[4, 3] a[1, 2] - a[1, 4] a[4, 1] a[3, 3] a[2, 2] + a[4, 4] a[3, 1] a[2, 3] a[1, 2])

>
>  f:=(i,j)->a[i-1]^(j-1);
                                                    (j - 1)
                              f := (i, j) -> a[i - 1]

>  A:=Matrix(6,6,f); d:=Determinant(A):factor(d);
                          [         2        3        4        5]
                          [1    a[0]     a[0]     a[0]     a[0] ]
                          [                                     ]
                          [         2        3        4        5]
                          [1    a[1]     a[1]     a[1]     a[1] ]
                          [                                     ]
                          [         2        3        4        5]
                          [1    a[2]     a[2]     a[2]     a[2] ]
                     A := [                                     ]
                          [         2        3        4        5]
                          [1    a[3]     a[3]     a[3]     a[3] ]
                          [                                     ]
                          [         2        3        4        5]
                          [1    a[4]     a[4]     a[4]     a[4] ]
                          [                                     ]
                          [         2        3        4        5]
                          [1    a[5]     a[5]     a[5]     a[5] ]
```

```
bytes used=20092628, alloc=6617924, time=0.74
(a[2] - a[4]) (a[1] - a[4]) (a[1] - a[2]) (a[4] - a[5]) (-a[5] + a[2]) (-a[5] + a[1]) (-a[4] + a[0]) (a[0] - a[2]

   (a[0] - a[1]) (a[0] - a[5]) (a[3] - a[4]) (a[3] - a[2]) (a[3] - a[1]) (a[3] - a[5]) (a[3] - a[0])

#################################
> quit
bytes used=21295404, alloc=6617924, time=0.77
```