TEXAS INSTRUMENTS

Soft Warehouse INC
Honolulu, Hawaii

DERIVE® for Windows Version 5
Rumor Becomes Reality

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with a little help from our friends

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A major overhaul, not a new paint job

- Keep a familiar face but add powerful new features

- Enhance the interface to take full advantage of the Windows environment

- Appeal to new users as well as old fans

- Expand programming possibilities

- Continue to improve the fundamentals: mathematical ability

Our many users asked for improvements, such as:

- A better authoring method

- Improved syntax error reporting

- The ability to wrap long expressions

- Larger screen fonts for teaching
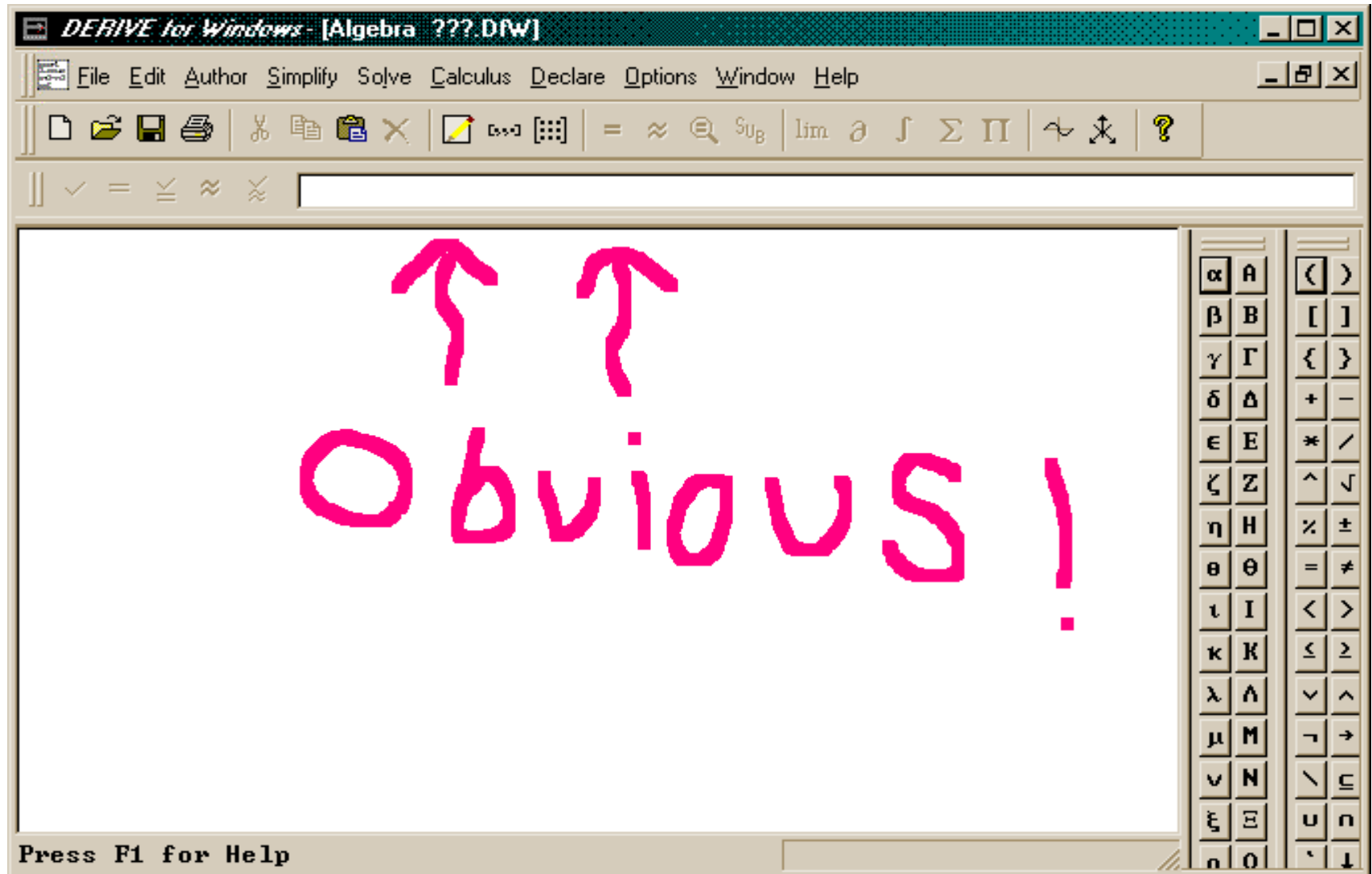
- A restorable plot window state

This is my first day. W here do I
write? H ow do I start???
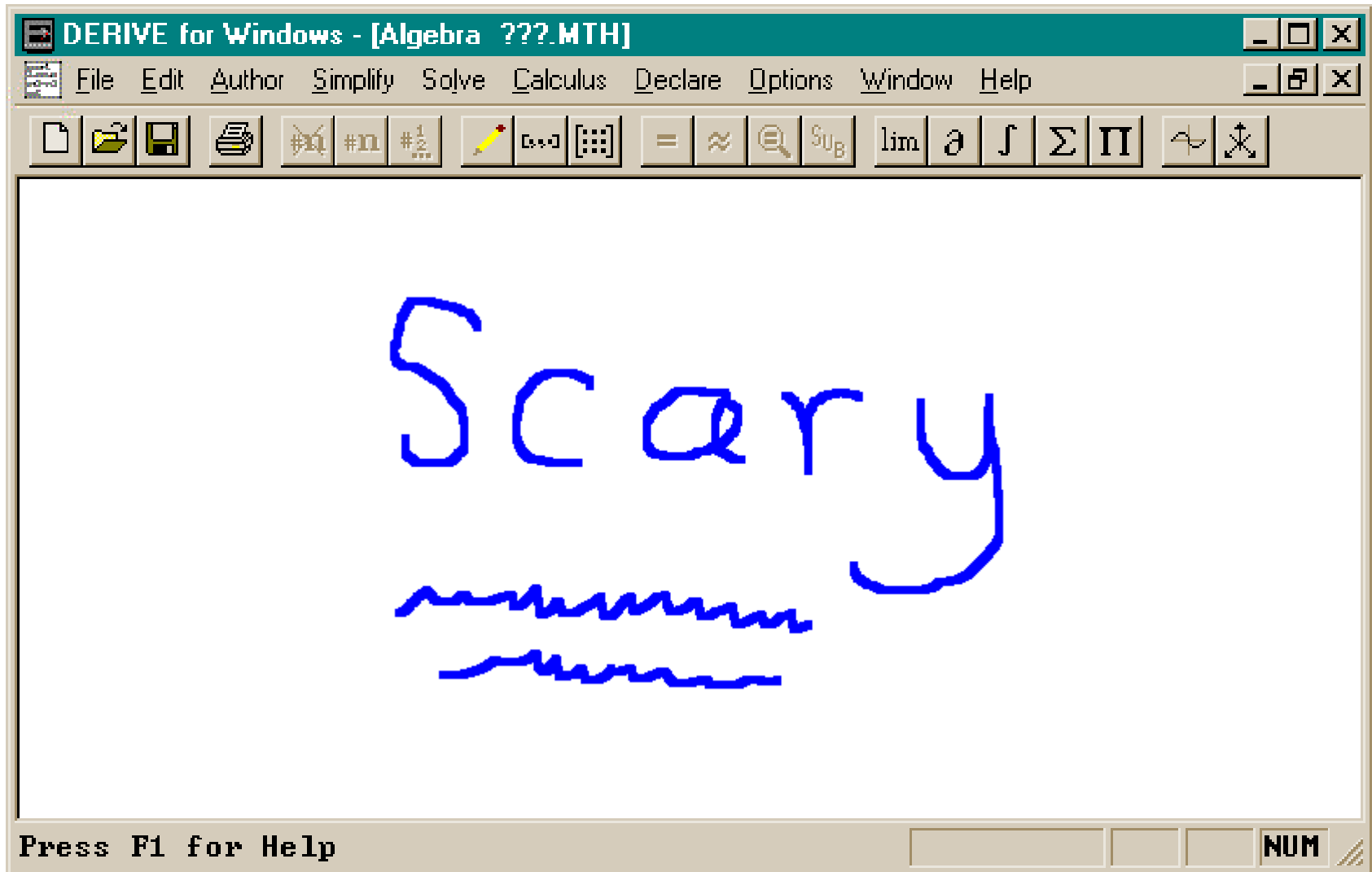
VER 4

DERIVE for Windows - [Algebra ???.MTH]

File   Edit   Author   Simplify   Solve   Calculus   Declare   Options   Window   Help

Scary

Press F1 for Help

NUM

Hey, an author bar!

VER5

DERIVE for Windows - [Algebra ???.DfW]

File Edit Author Simplify Solve Calculus Declare Options Window Help

Obvious!

Press F1 for Help

W here is the error????

Cursor shows error position

Big numbers, big expressions;
that's great, but where on earth
(or in the aether) do they all end???

VER 4

DERIVE for Windows - [Algebra ???.MTH]

File Edit Author Simplify Solve Calculus Declare Options Window Help

#1: "Did you know: Derive can calculate large integers"

#2: 100! = 93326215443944152681699238856266700490715968264381621468592...

#3: "Derive can also calculate partial fractions for you."

$$
#4: \quad \frac{x^2 + 3 \cdot x + 3}{(x^2 + x + 1)^3 \cdot (x - 1)^2} = \frac{2 \cdot x}{3 \cdot (x^2 + x + 1)^3} + \frac{x}{(x^2 + x + 1)^2} +
$$

? ? ?

User=Simp(User)   0.0s   NUM

It's a wrap!!!

VER 5

#1:   100! =

9332621544394415268169923885626670049071596826438162146859296~
3895217599993229915608941463976156518286253697920827223758251~
18521091686400000000000000000000000000

$$#2: \quad \frac{x^2 + 3 \cdot x + 3}{(x^2 + x + 1)^2 \cdot (x - 1)^2} = \frac{2 \cdot x}{3 \cdot (x^2 + x + 1)^2} + \frac{x}{x^2 + x + 1} +$$

$$\frac{11}{9 \cdot (x^2 + x + 1)} + \frac{7}{9 \cdot (x - 1)^2} - \frac{1}{x - 1}$$

Press F1 for Help   User

Can you read this at the back??

VER 4

} Note the middle term

DERIVE for Windows - [Algebra ???.MTH]

File　Edit　Author　Simplify　Solve　Calculus　Declare　Options　Window　Help

#4:　$(3 - 2 \cdot y^2) \cdot (x^2 - y^2)^5$

#5:　$(x + (a + 1)^{10})^2 - (a + 1)^{20}$

#6:　$x^2 + 2 \cdot x \cdot (a + 1)^{10}$

#7:　$\dfrac{a^3}{(a - b) \cdot (a - c)} + \dfrac{b^3}{(b - c) \cdot (b - a)} + \dfrac{c^3}{(c - a) \cdot (c - b)}$

#8:　$a + b + c$

#9:　$\dfrac{(x^6 + a^6) \cdot (x + 1)}{(x^6 + a^6) \cdot (x^2 - a^2) + a^2 \cdot x^2 \cdot (x^4 - a^4)} + \dfrac{a^2 \cdot x^2 \cdot (x + 1)}{x^6 - a^6 - a^2 \cdot x^2 \cdot (x^2 - \cdots}$

#10:　$\dfrac{x + 1}{x^2 - a^2}$

#11:　$\dfrac{(a \cdot n + b \cdot m)^2 + (a \cdot m - b \cdot n)^2}{(a \cdot p + b \cdot q)^2 + (a \cdot q - b \cdot p)^2}$

#12:　$\dfrac{m^2 + n^2}{2 \quad 2}$

Superfluous variables are eliminated　　　0.0s　　　NUM

Large screen font

VERS 5

DERIVE for Windows - [Algebra ???.DfW]

File Edit Author Simplify Solve Calculus Declare Options Window Help

#7:
$$\frac{a^3}{(a-b)\cdot(a-c)} + \frac{b^3}{(b-c)\cdot(b-a)} + \frac{c^3}{(c-a)\cdot(c-b)}$$

#8:

#9:

Now that's a term I can SEE!

Press F1

atic

"Plotting x ^2 + y ^2 < 64 we get a circle..."

VER 4

(It was here yesterday)
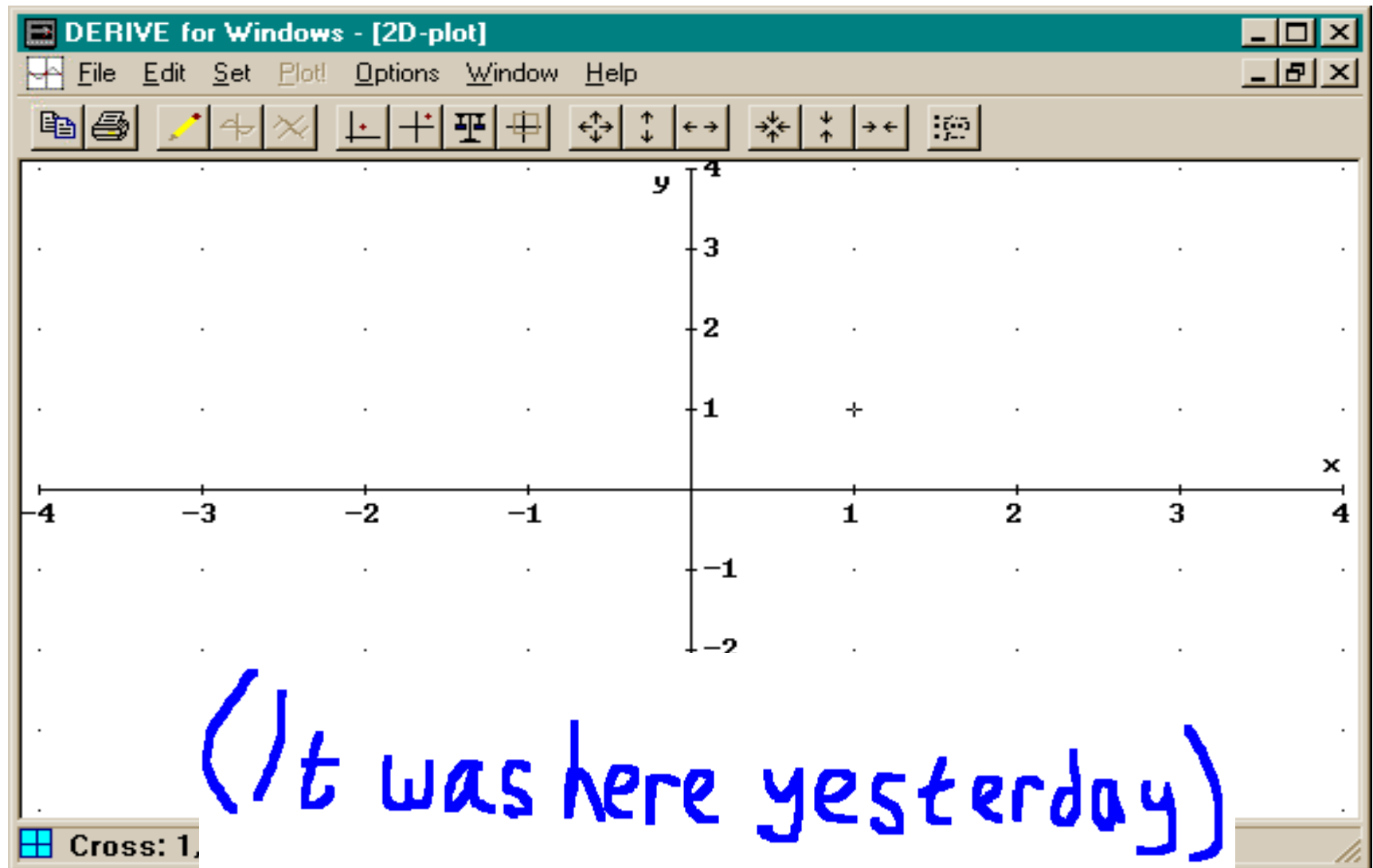
Plot scales remembered

V
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5

DERIVE for Windows

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Algebra 2Deq.dfw

#1: $x^2 + y^2 < 64$

Same
← as last
← week
(phew!)
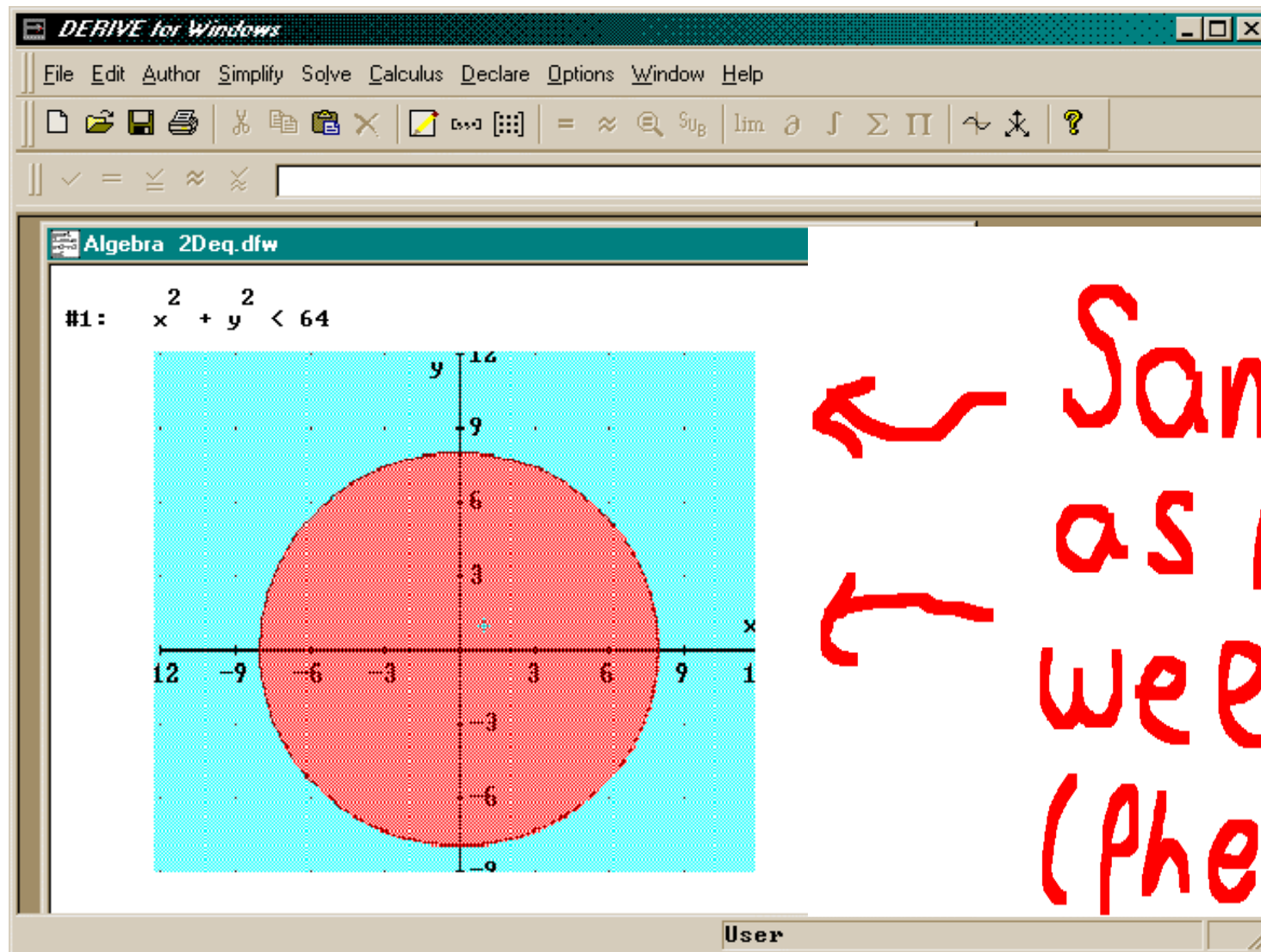
User

Algebra Window Enhancements

- Include graphic plot images, text, and embedded objects in session worksheets

- Add formatting capabilities

- Observe elapsed time and percentage of memory used during long computations

- View and modify user-defined functions, variables, and domain declarations

Plot Window Enhancements

- Rotate and zoom multiple, shaded 3D surface plots in real-time

- Create 3D surface plots in spherical and cylindrical coordinates

- Frame 3D plots in a labeled enclosing box

- Position annotations in 2D and 3D plot windows with a mouse click

- Save screen images in various graphics file formats

Framed 3D plot
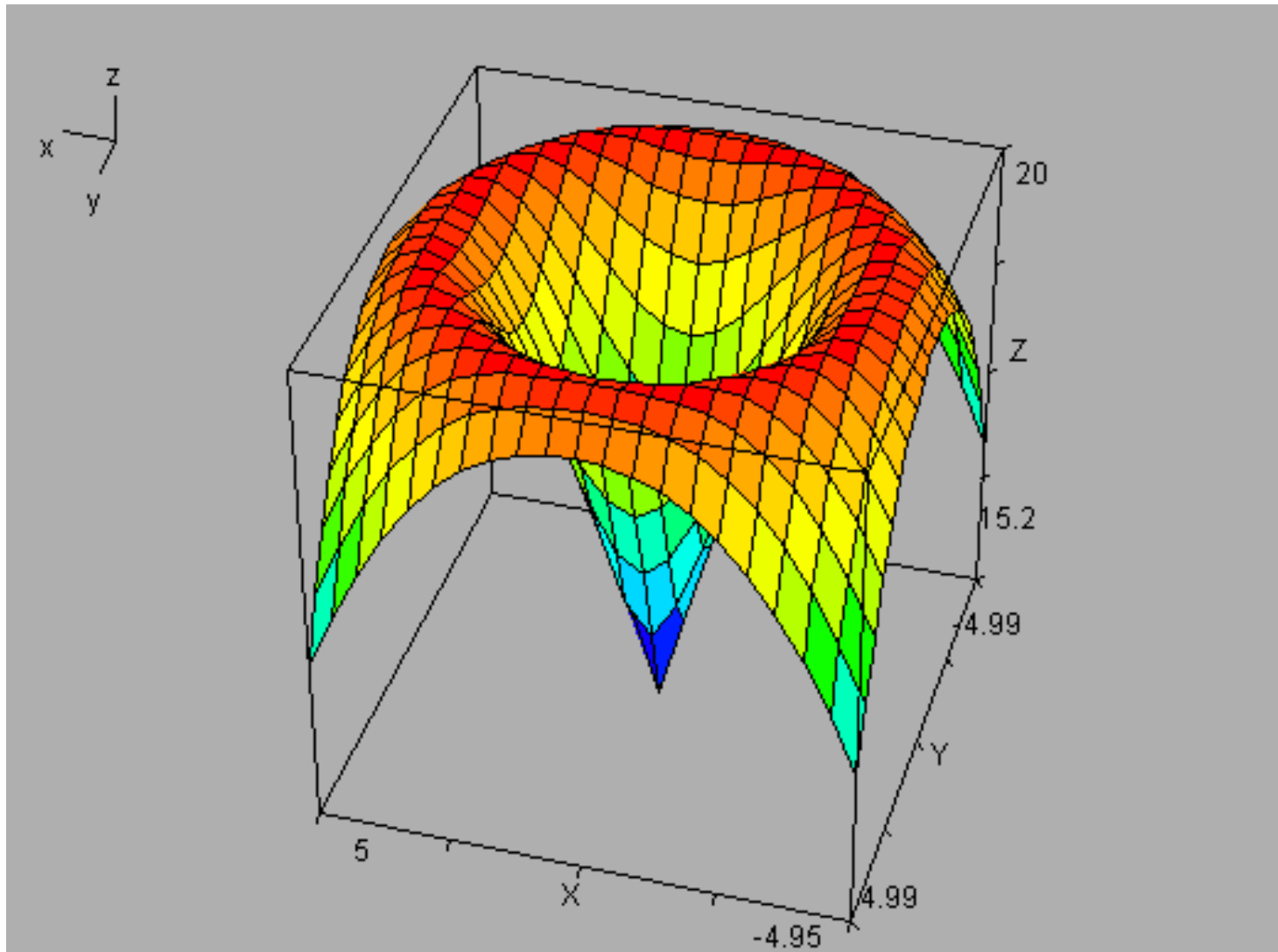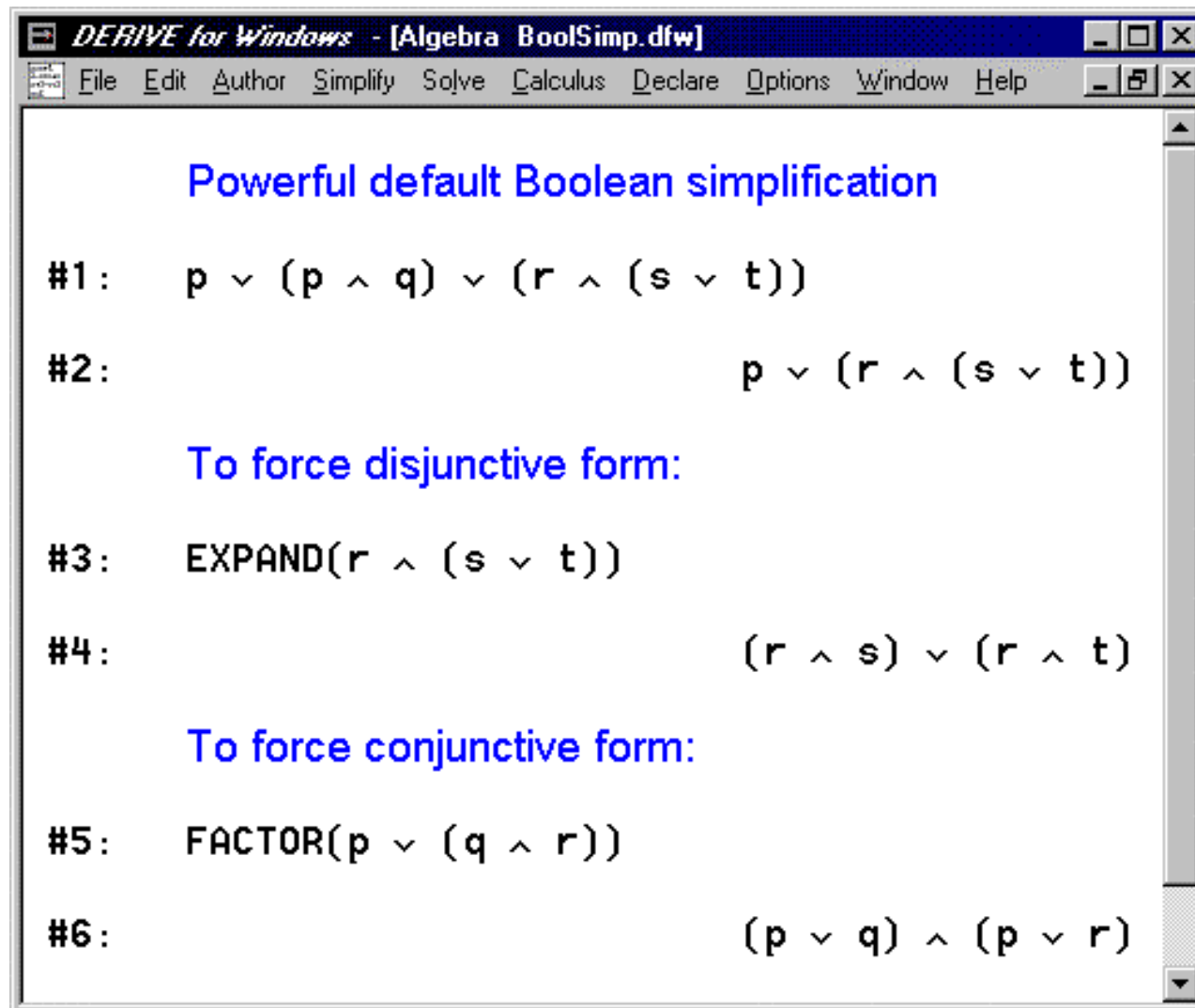
Mathematical Enhancements

- Boolean algebra additions

- New equation solving possibilities

- Stronger arithmetic

- Calculus gets better and better

- Improved handles on mathematical objects

- More convenient output formats

Boolean algebra

DERIVE for Windows - [Algebra BoolSimp.dfw]

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Powerful default Boolean simplification

#1: $p \lor (p \land q) \lor (r \land (s \lor t))$

#2: $\qquad\qquad\qquad\qquad p \lor (r \land (s \lor t))$

To force disjunctive form:

#3: $\text{EXPAND}(r \land (s \lor t))$

#4: $\qquad\qquad\qquad\qquad (r \land s) \lor (r \land t)$

To force conjunctive form:

#5: $\text{FACTOR}(p \lor (q \land r))$

#6: $\qquad\qquad\qquad\qquad (p \lor q) \land (p \lor r)$

Nonlinear equation solving
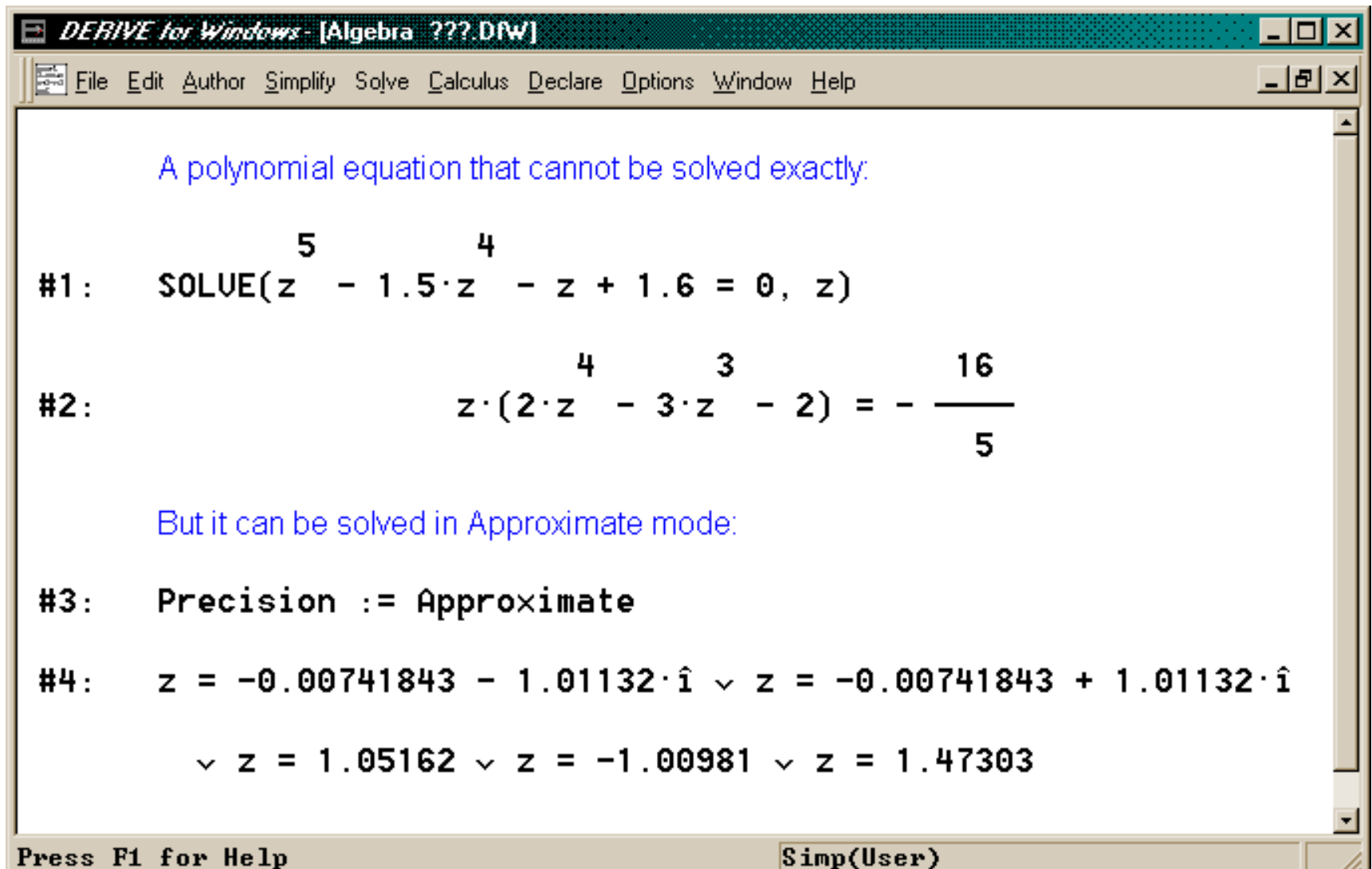
Solve simultaneous *nonlinear* algebraic equations:

The intersection of two circles of radius r:

#1: $\text{SOLVE}(x^2 + y^2 = r^2 \wedge (x - r)^2 + y^2 = r^2, [x, y])$

#2: $\left[x = \dfrac{r}{2} \wedge y = \dfrac{\sqrt{3} \cdot r}{2}\right] \vee \left[x = \dfrac{r}{2} \wedge y = -\dfrac{\sqrt{3} \cdot r}{2}\right]$

Approximate equation solving

File Edit Author Simplify Solve Calculus Declare Options Window Help

A polynomial equation that cannot be solved exactly:

#1: $\text{SOLVE}(z^5 - 1.5 \cdot z^4 - z + 1.6 = 0, z)$

#2: $z \cdot (2 \cdot z^4 - 3 \cdot z^3 - 2) = -\dfrac{16}{5}$

But it can be solved in Approximate mode:

#3:   Precision := Approximate

#4: $z = -0.00741843 - 1.01132 \cdot \hat{\imath} \lor z = -0.00741843 + 1.01132 \cdot \hat{\imath}$

$\lor z = 1.05162 \lor z = -1.00981 \lor z = 1.47303$

Press F1 for Help   Simp(User)

Algebraic numbers
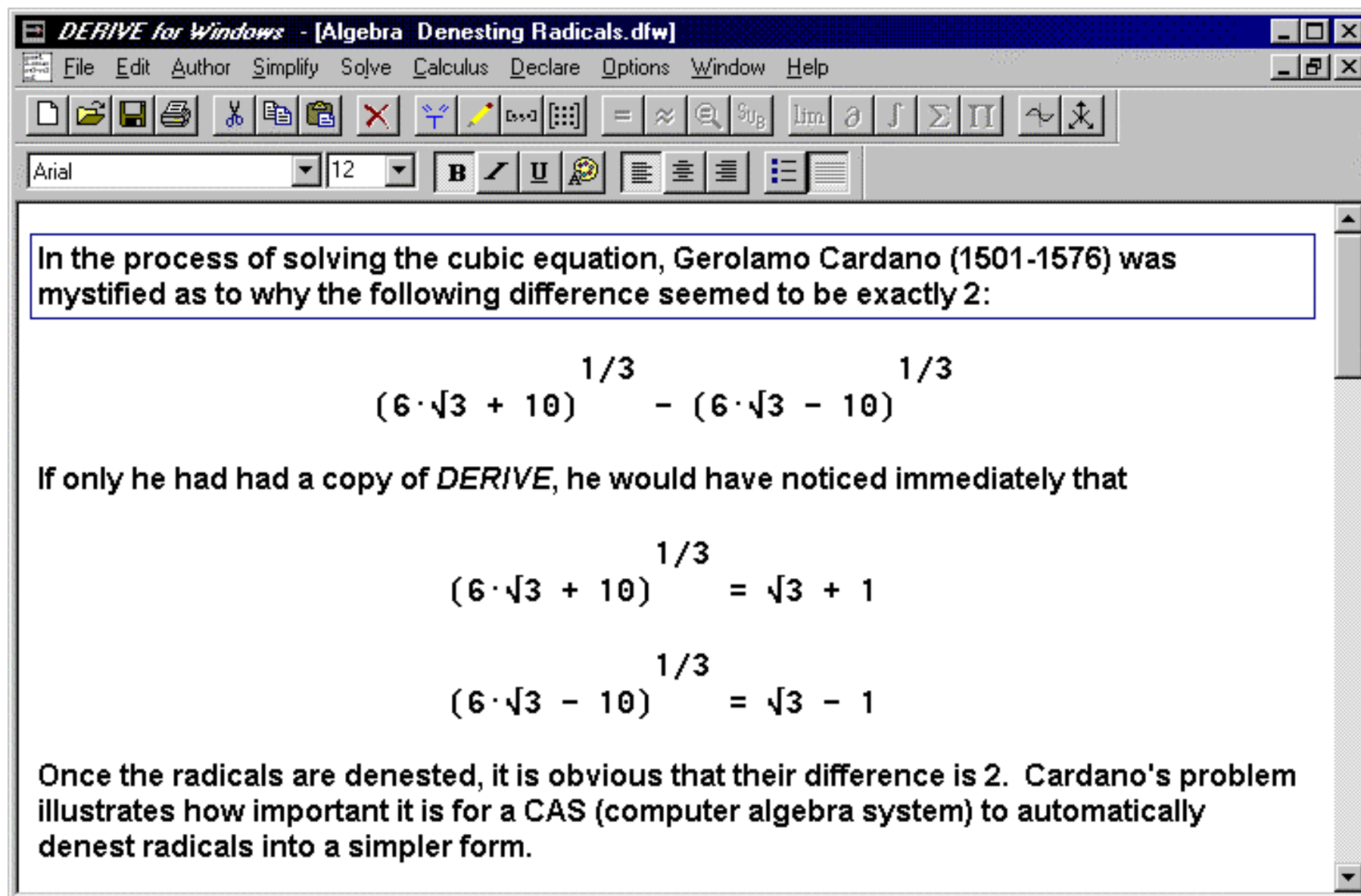
More powerful denesting:

$$\#1: \quad \left[\frac{14 \cdot \sqrt{93}}{243} + \frac{5}{9} \right]^{1/3}$$

$$\#2: \quad \frac{\sqrt{93}}{18} + \frac{1}{2}$$

Denesting example

Arial   12   **B** *I* U

In the process of solving the cubic equation, Gerolamo Cardano (1501-1576) was mystified as to why the following difference seemed to be exactly 2:
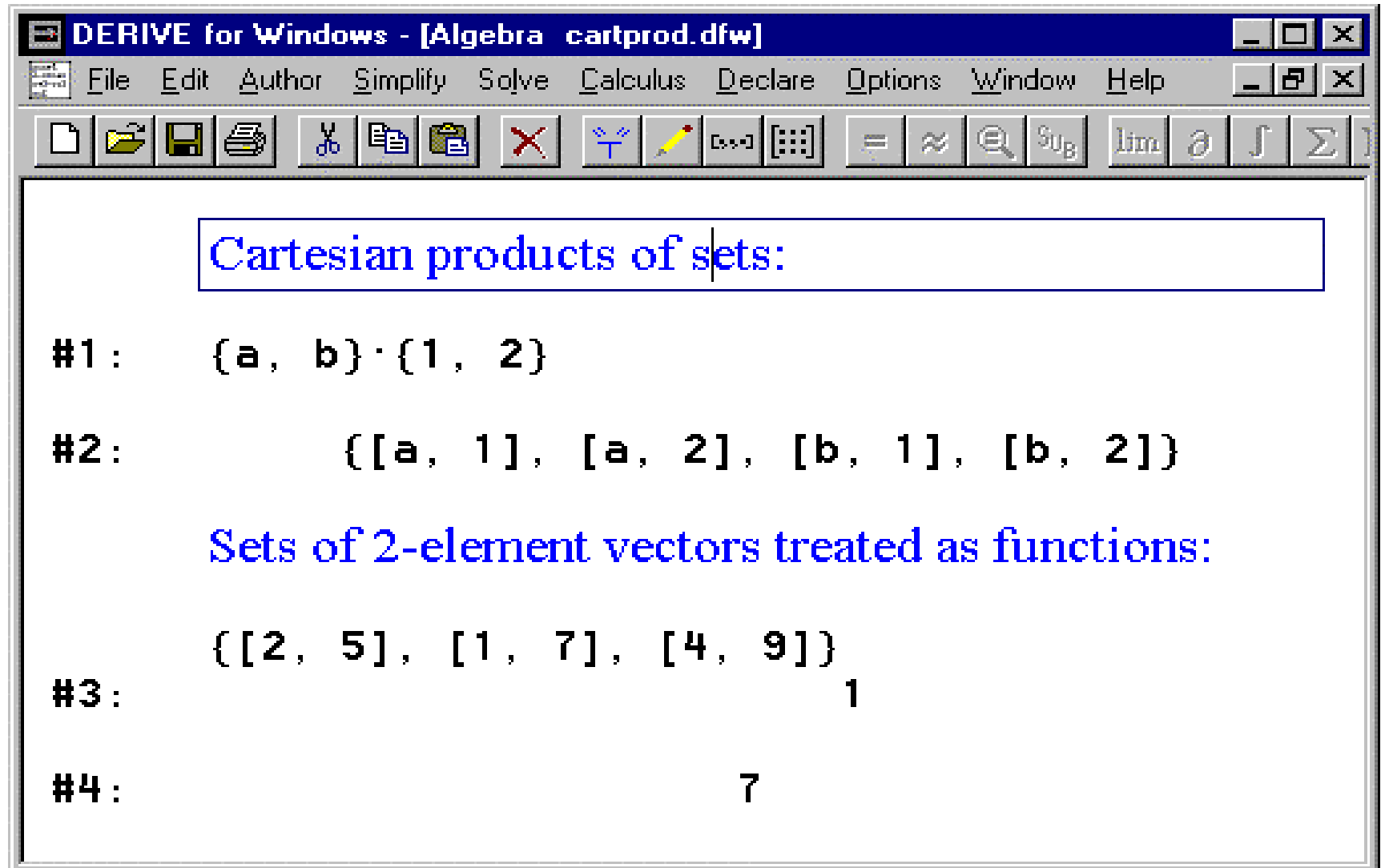
$$(6 \cdot \sqrt{3} + 10)^{1/3} - (6 \cdot \sqrt{3} - 10)^{1/3}$$

If only he had had a copy of *DERIVE*, he would have noticed immediately that

$$(6 \cdot \sqrt{3} + 10)^{1/3} = \sqrt{3} + 1$$

$$(6 \cdot \sqrt{3} - 10)^{1/3} = \sqrt{3} - 1$$

Once the radicals are denested, it is obvious that their difference is 2. Cardano's problem illustrates how important it is for a CAS (computer algebra system) to automatically denest radicals into a simpler form.

Sets and vectors

DERIVE for Windows - [Algebra cartprod.dfw]

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Cartesian products of sets:

#1:   {a, b}·{1, 2}

#2:   {[a, 1], [a, 2], [b, 1], [b, 2]}

Sets of 2-element vectors treated as functions:

{[2, 5], [1, 7], [4, 9]}
#3:   1

#4:   7

Answers in convenient forms
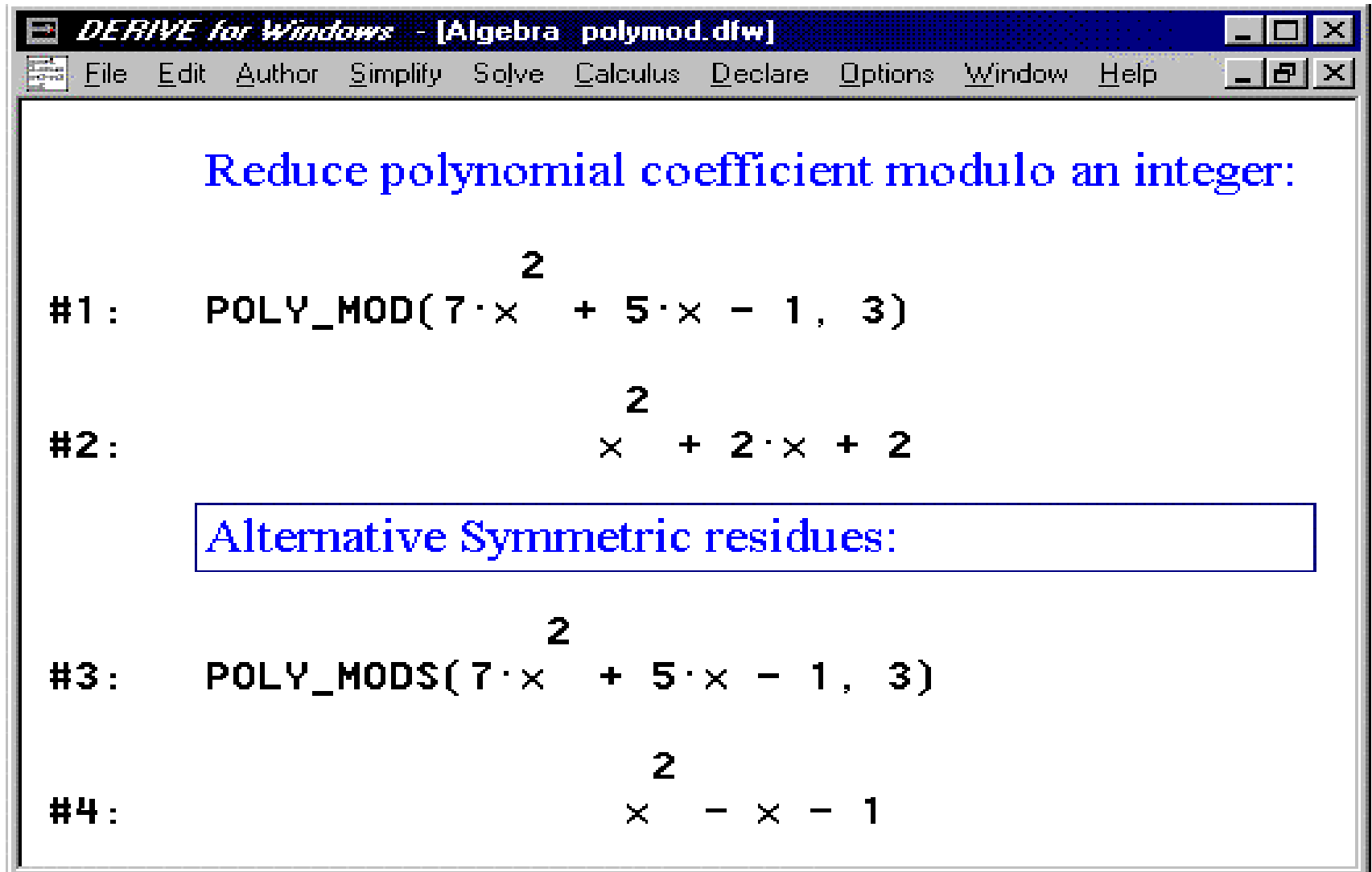
Advanced polynomial functions

DERIVE for Windows - [Algebra polymod.dfw]

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Reduce polynomial coefficient modulo an integer:

#1: $\text{POLY\_MOD}(7 \cdot x^2 + 5 \cdot x - 1, 3)$

#2: $x^2 + 2 \cdot x + 2$

Alternative Symmetric residues:

#3: $\text{POLY\_MODS}(7 \cdot x^2 + 5 \cdot x - 1, 3)$

#4: $x^2 - x - 1$

Stronger calculus
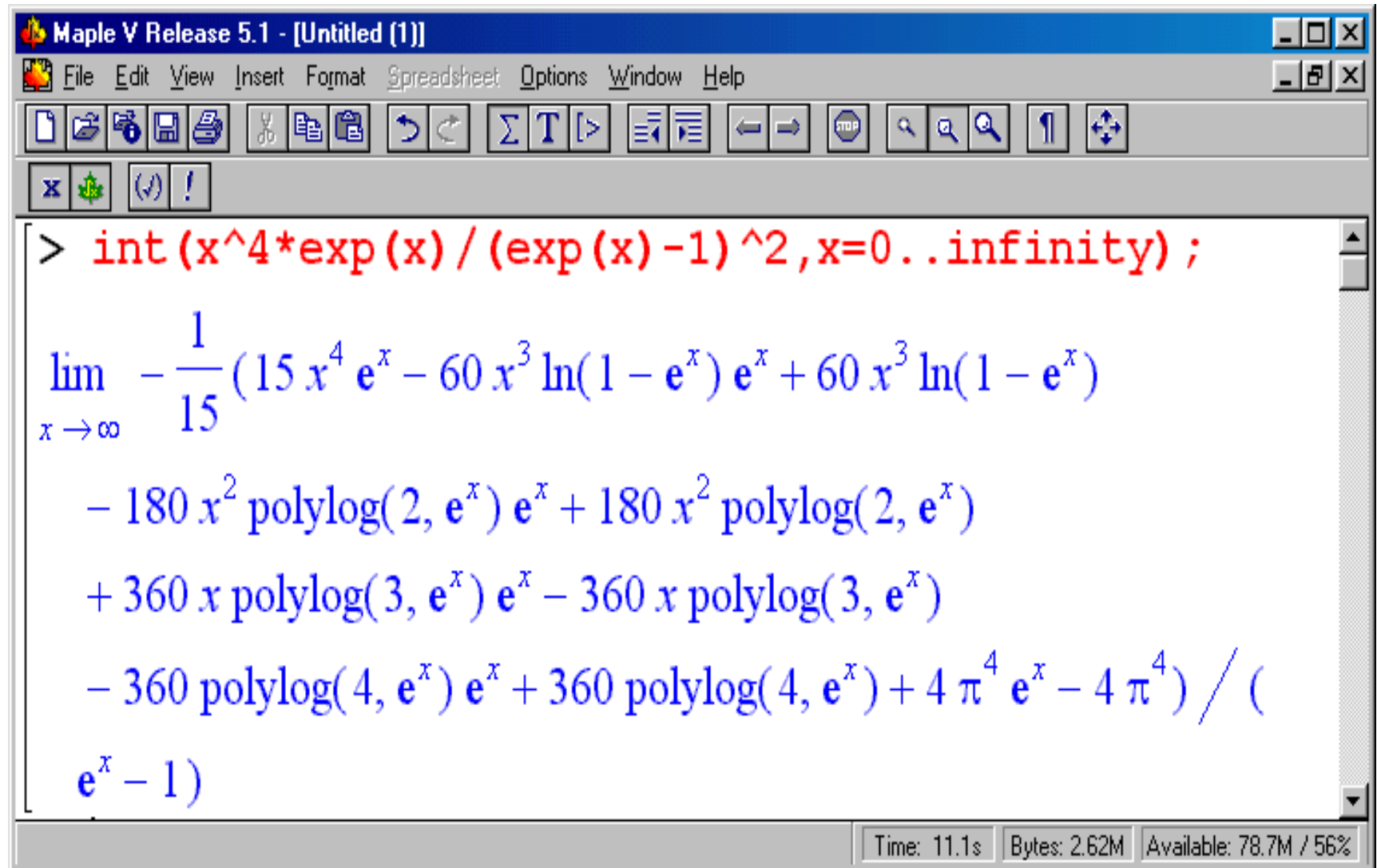
A difficult definite integral:

#1:
$$\int_0^\infty \frac{x^4 \cdot \hat{e}^x}{(\hat{e}^x - 1)^2} \, dx$$

#2:
$$\frac{4 \cdot \pi^4}{15}$$

Comparison with Maple

Another calculus example
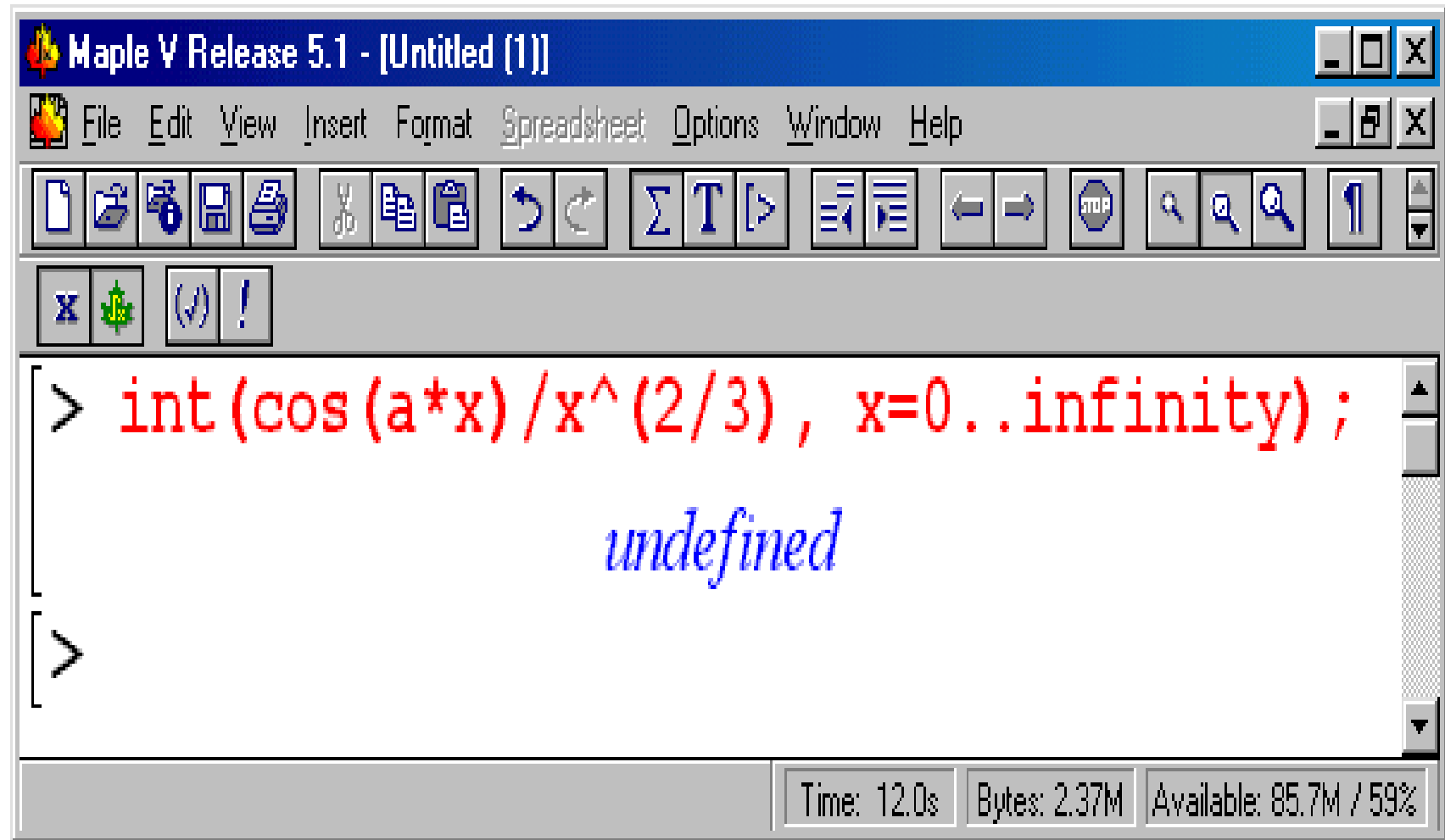
Another difficult definite integral:

#1:
$$\int_{0}^{\infty} \frac{\cos(a \cdot x)}{x^{2/3}} \, dx$$

#2:
$$\frac{3 \cdot \sqrt{3} \cdot \left(\dfrac{1}{3}\right)!}{2 \cdot |a|^{1/3}}$$

Again, the corresponding Maple result


```
> int(cos(a*x)/x^(2/3), x=0..infinity);

                        undefined

>
```

Programming Enhancements

- More program control constructs
- Initialize local variables and increment operators
- More readable user-defined functions

An old definition in the new language


```
        POLY_DEGREE_AUX(u, x, n) :=
           If u = 0
#1:           n
              POLY_DEGREE_AUX(DIF(u, x), x, n + 1)
              POLY_DEGREE_AUX(DIF(u, x), x, n + 1)


#2:    POLY_DEGREE(u, x) := POLY_DEGREE_AUX(u, x, -1)


        New_poly_degree(u, x, n) :=
           Prog
              n := -1
              Loop
#3:              If u = 0
                    RETURN n
                 u := DIF(u, x)
                 n := n + 1
```

} Old
} Style

‖ New
‖ Style

User

Initialize local variables and increment operators

The old SOLVE_MOD - messy isn't it?
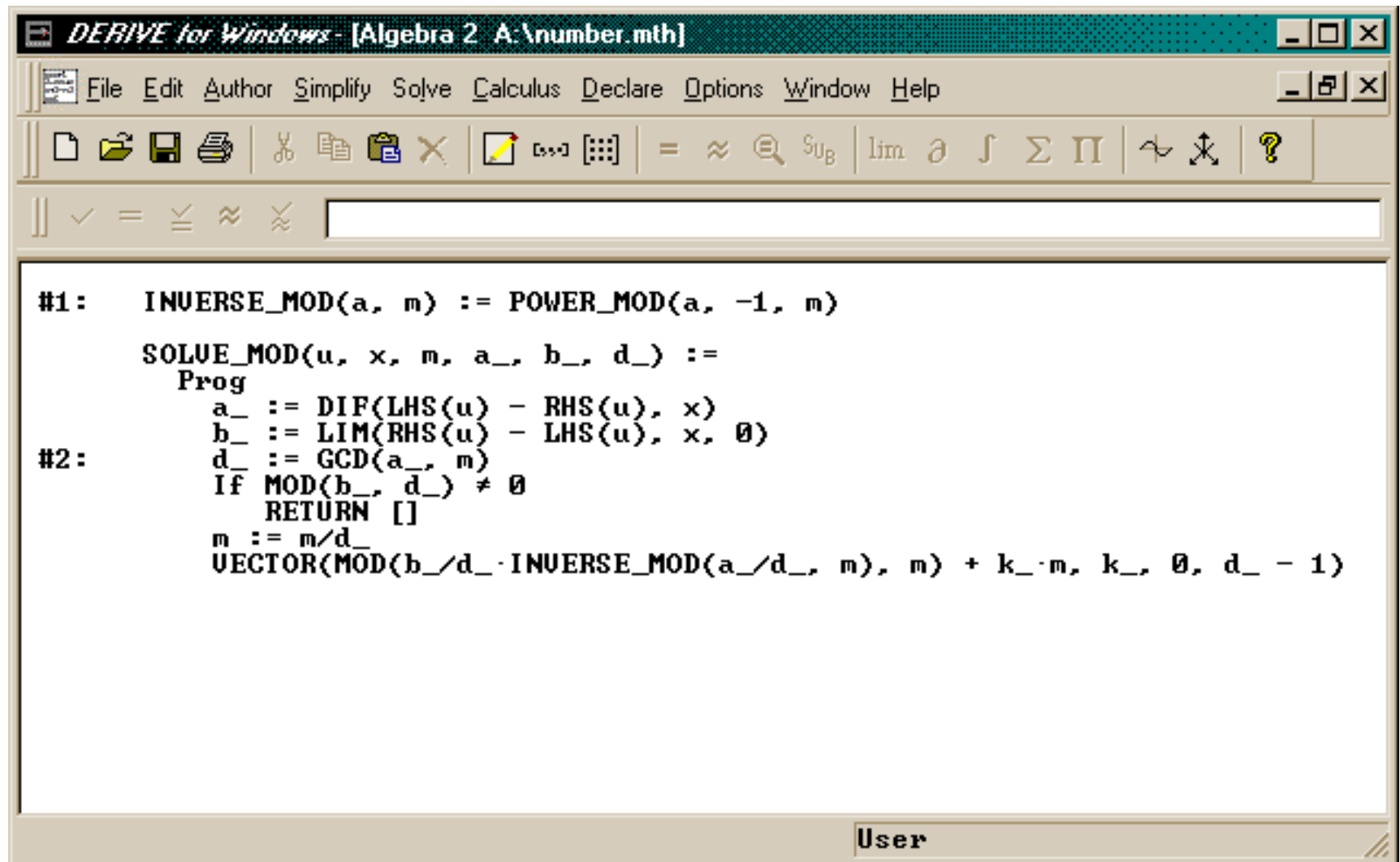
The new & improved SOLVE_MOD - so much nicer!

```
DERIVE for Windows - [Algebra 2  A:\number.mth]

File  Edit  Author  Simplify  Solve  Calculus  Declare  Options  Window  Help


#1:     INVERSE_MOD(a, m) := POWER_MOD(a, -1, m)

        SOLVE_MOD(u, x, m, a_, b_, d_) :=
           Prog
              a_ := DIF(LHS(u) - RHS(u), x)
              b_ := LIM(RHS(u) - LHS(u), x, 0)
#2:           d_ := GCD(a_, m)
              If MOD(b_, d_) ≠ 0
                 RETURN []
              m := m/d_
              VECTOR(MOD(b_/d_·INVERSE_MOD(a_/d_, m), m) + k_·m, k_, 0, d_ - 1)




                                                            User
```

Summary

Version 5 is our largest advance ever in:

- The algebra-window interface

- The 3D plot-window capabilities & interface

- Mathematical capabilities

- Programmability

System Requirements

- Microsoft Windows 95/98/NT

- 256 colors or more

- 16 MB RAM

Target Release Dates

- Currently being Alpha-tested

- Beta by October 1999

- Release by January 2000
  (Can anyone say **DERIVE** 2000?)

Last but not Least

- Thank you for your patience while we get Version 5 right.

- We appreciate your support and loyalty over the years.

- Your creative ideas and suggestions will continue to be the driving impetus for improving **DERIVE**®.