



# ***DERIVE***® for Windows Version 5 Rumor Becomes Reality

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# A major overhaul, not a new paint job

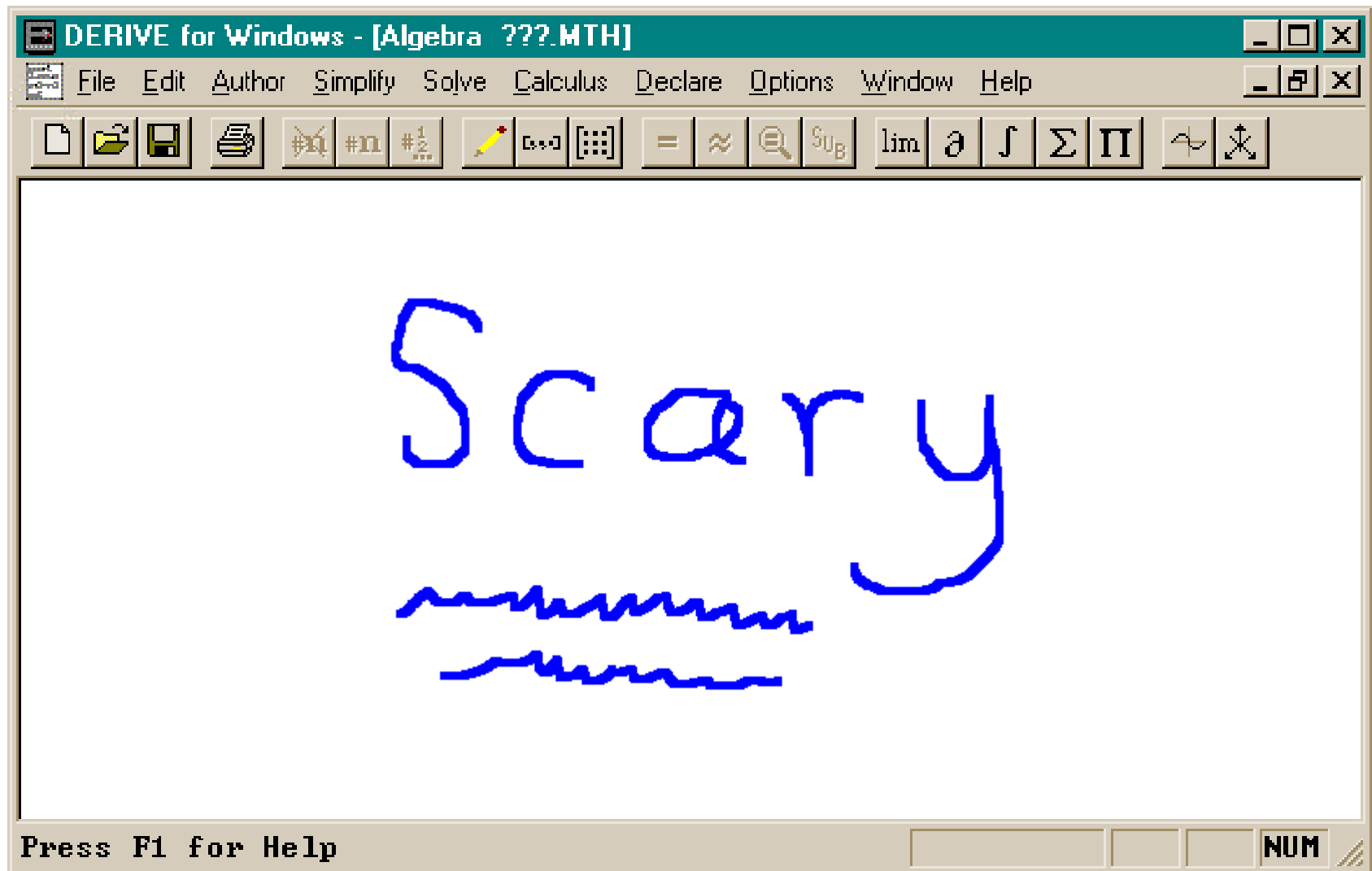
- Keep a familiar face but add powerful new features
- Enhance the interface to take full advantage of the Windows environment
- Appeal to new users as well as old fans
- Expand programming possibilities
- Continue to improve the fundamentals: mathematical ability

# 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

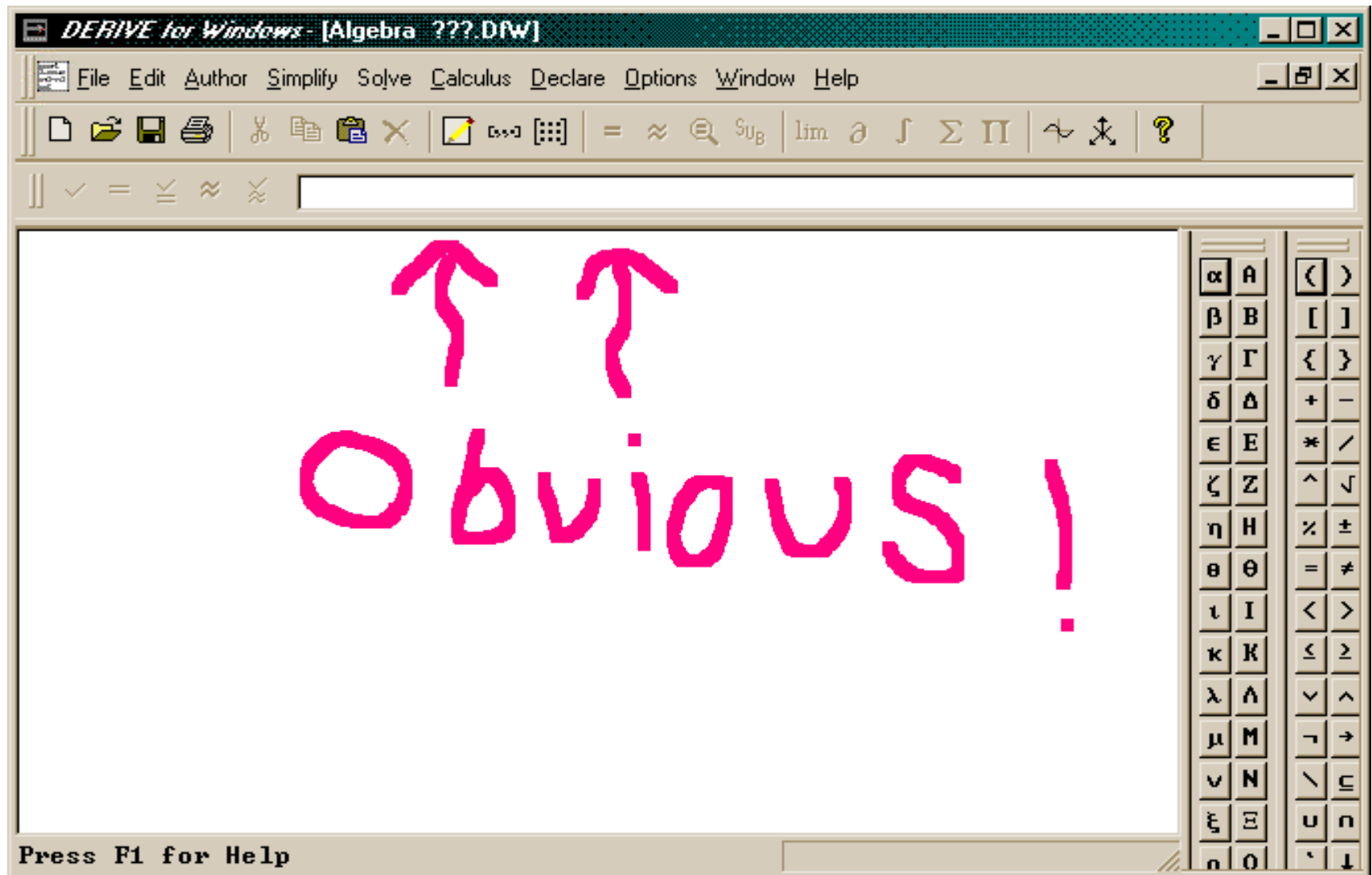
This is my first day. Where do I write? How do I start???

VERSION 4



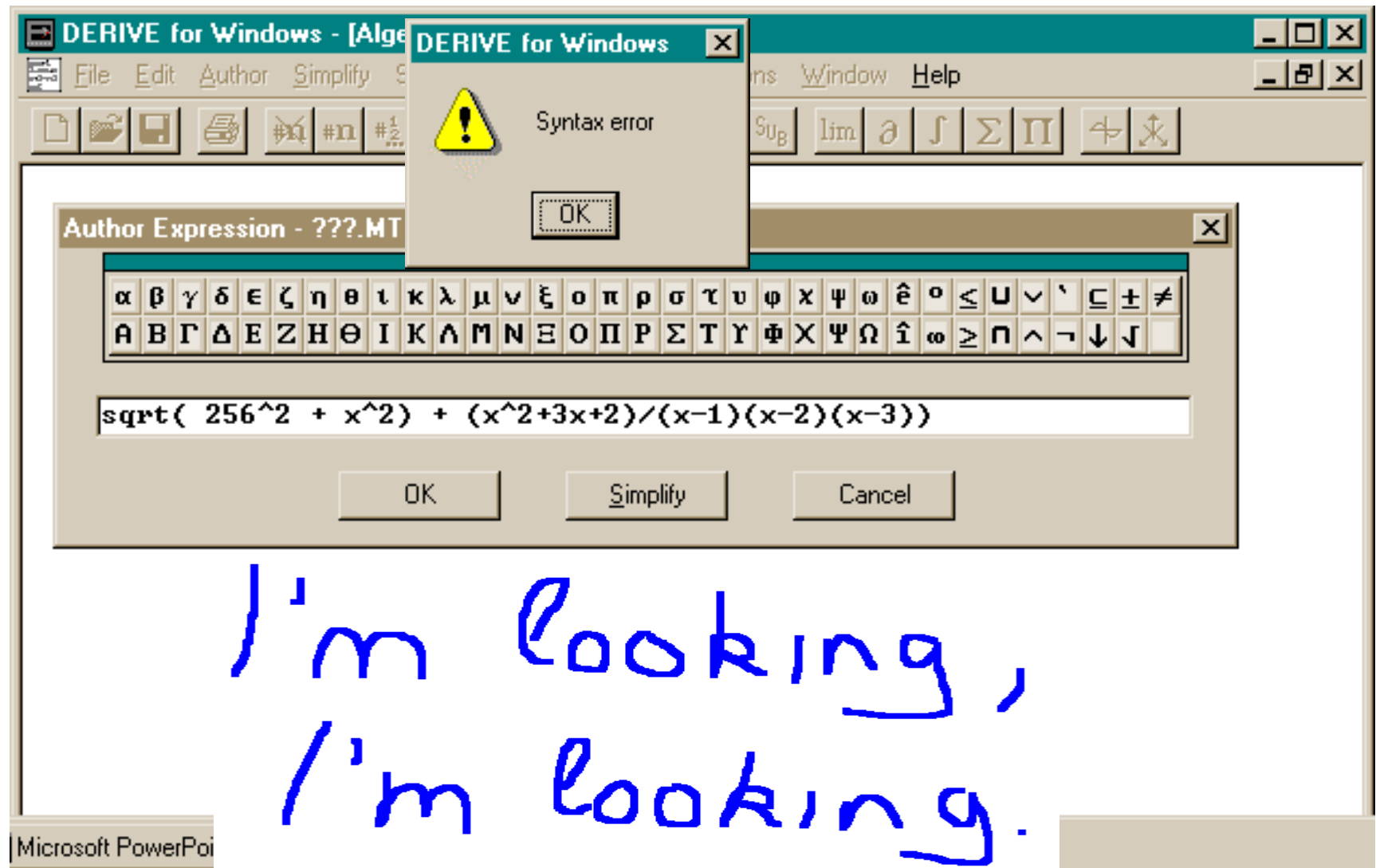
Hey, an author bar!

VER5



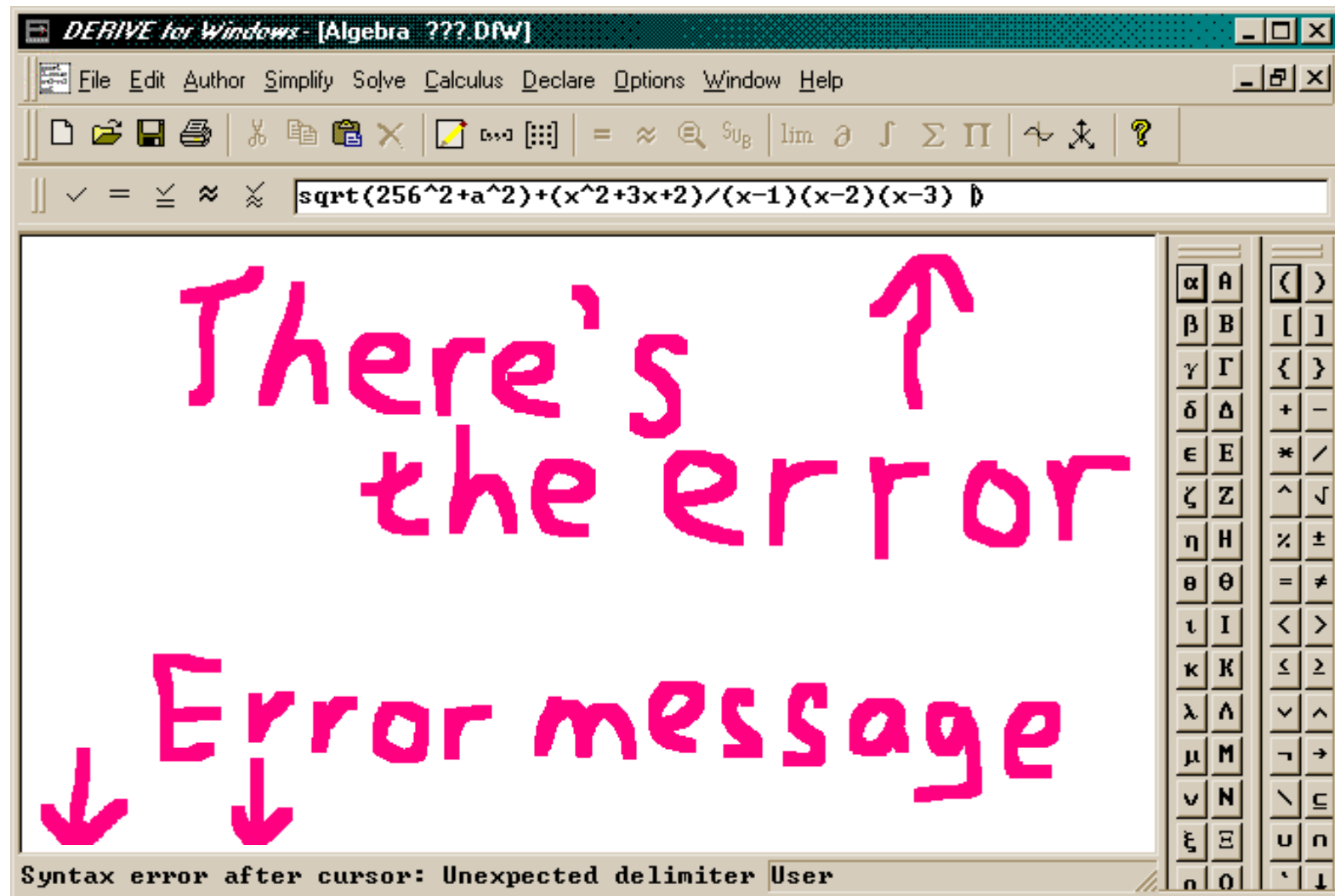
Where is the error???

VIEW 4



Cursor shows error position

VER 5



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! = 9332621544394415268169923885626670049071596826438162146859**

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

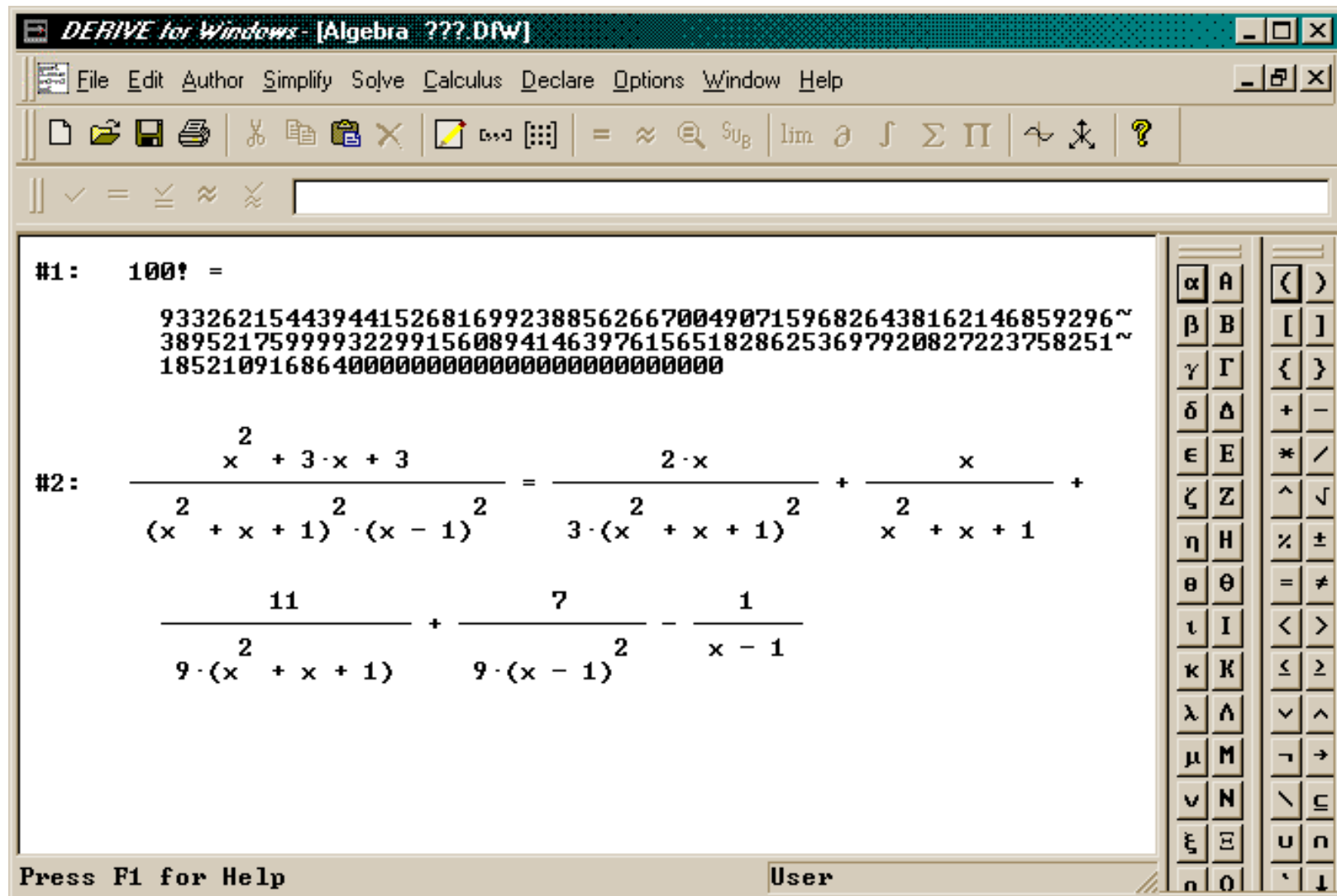
#4: 
$$\frac{x^2 + 3x + 3}{(x^2 + x + 1)^3 - (x - 1)^2} = \frac{2 - x}{3 \cdot (x^2 + x + 1)^3} + \frac{x}{(x^2 + x + 1)^2} +$$

Three large blue question marks are drawn below the partial fraction decomposition.

User=Simp(User) 0.0s NUM



# VER5



Can you read this at the back??

VER 4

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

#8:  $a + b + c$

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

#10:  $\frac{x + 1}{x^2 - a^2}$

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

#12:  $\frac{m^2 + n^2}{2^2}$

Superfluous variables are eliminated 0.0s NUM

Note the middle term

# Large screen font

VER 5

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

File Edit Author Simplify Solve Calculus Declare Options Window Help

✓ = ≤ ≈ ≉

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

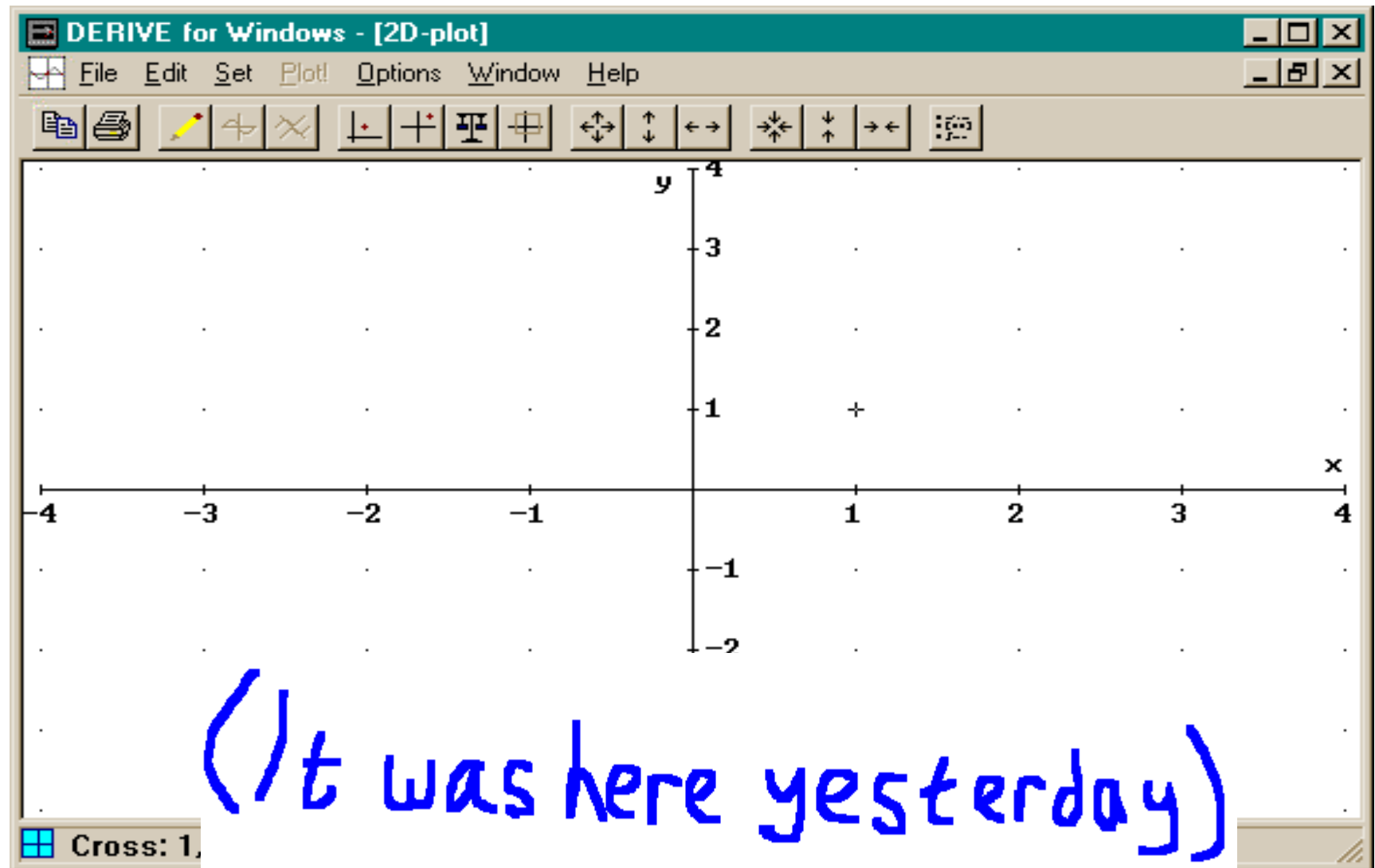
#8:

#9: Now that's a term I can SEE!

Press F1 atic

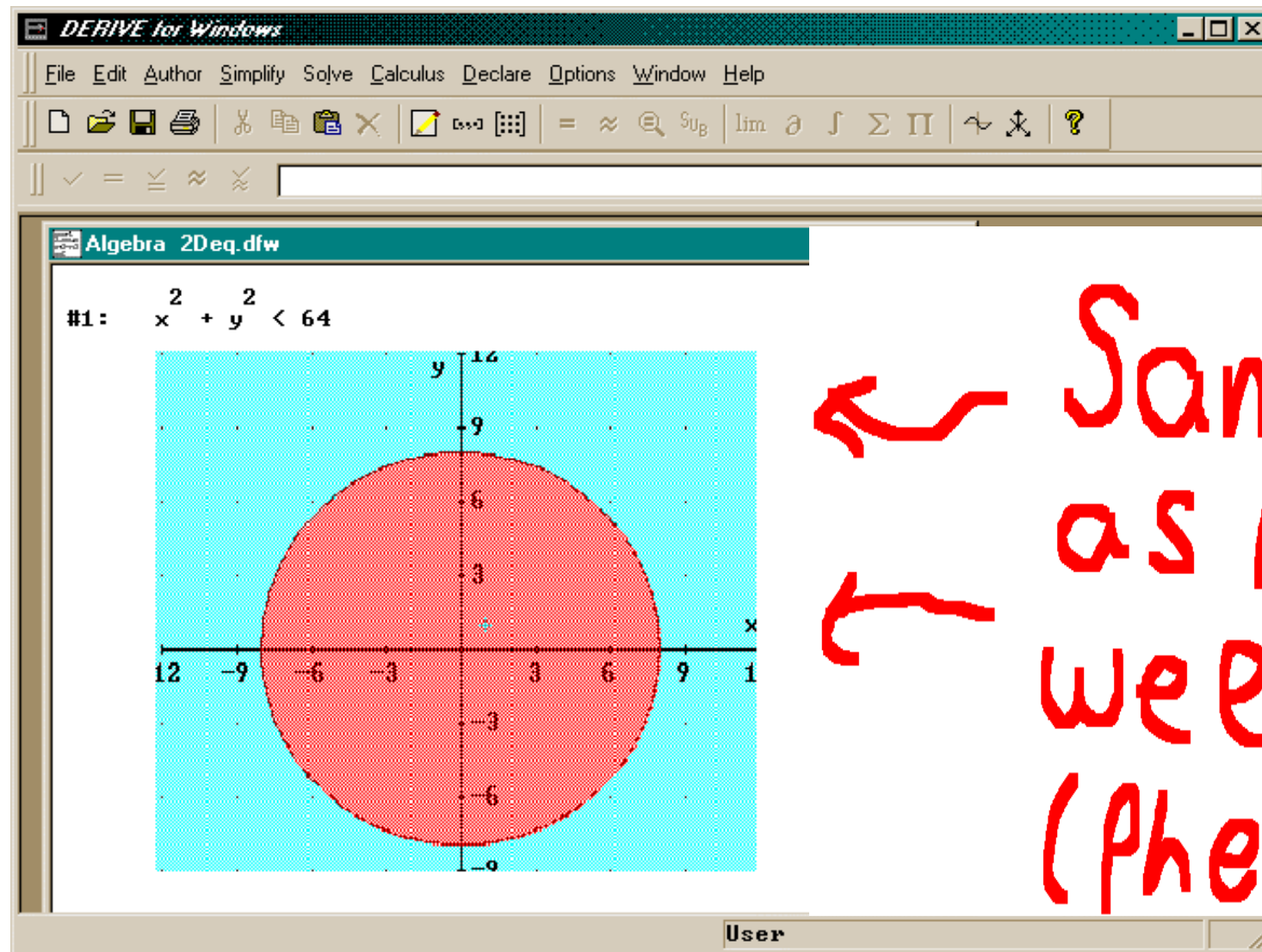
"Plotting  $x^2 + y^2 < 64$  we get a circle..."

✓  
E  
R  
4



# Plot scales remembered

VER 5



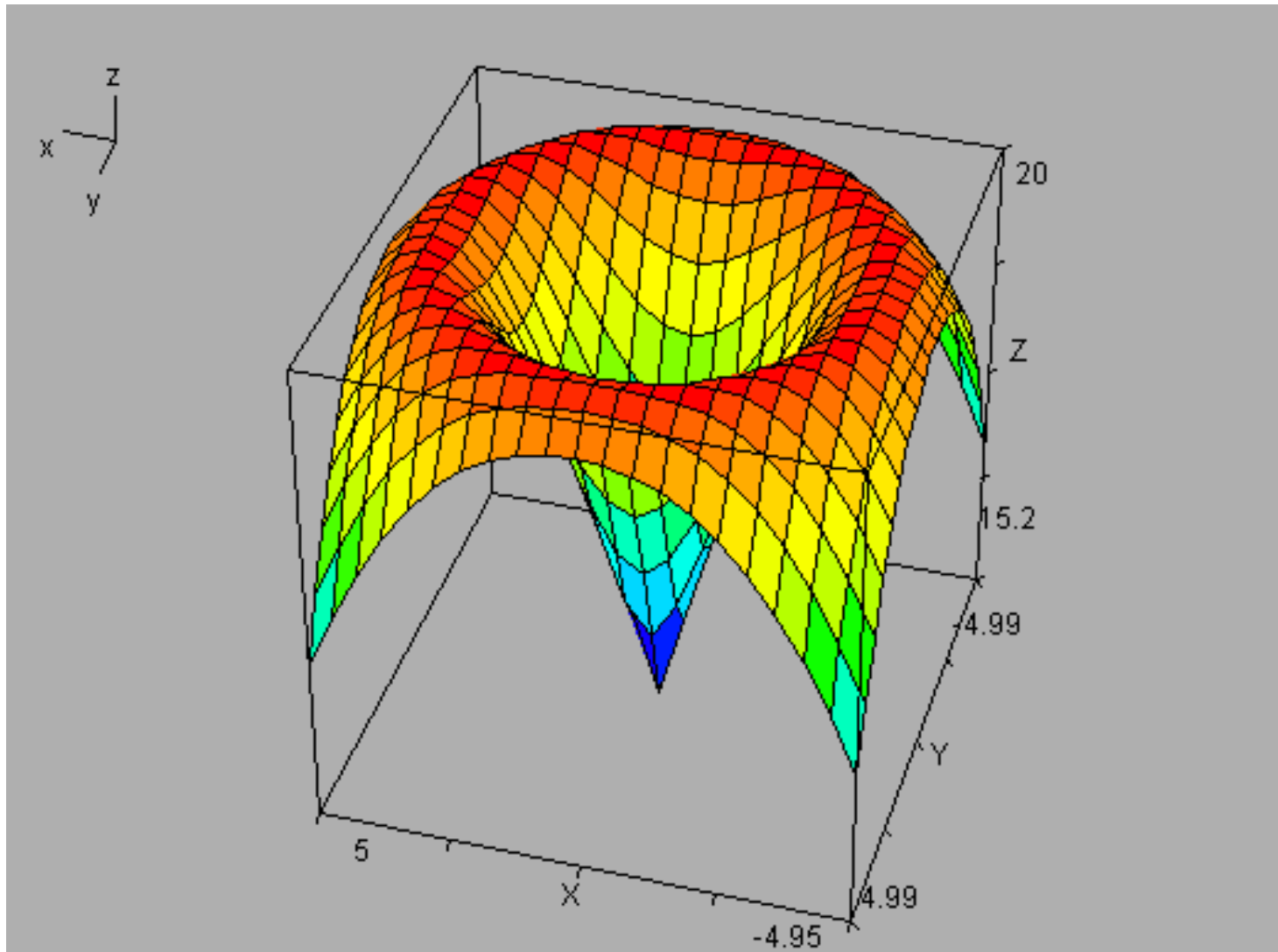
# Algebra Window Enhancements

- 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



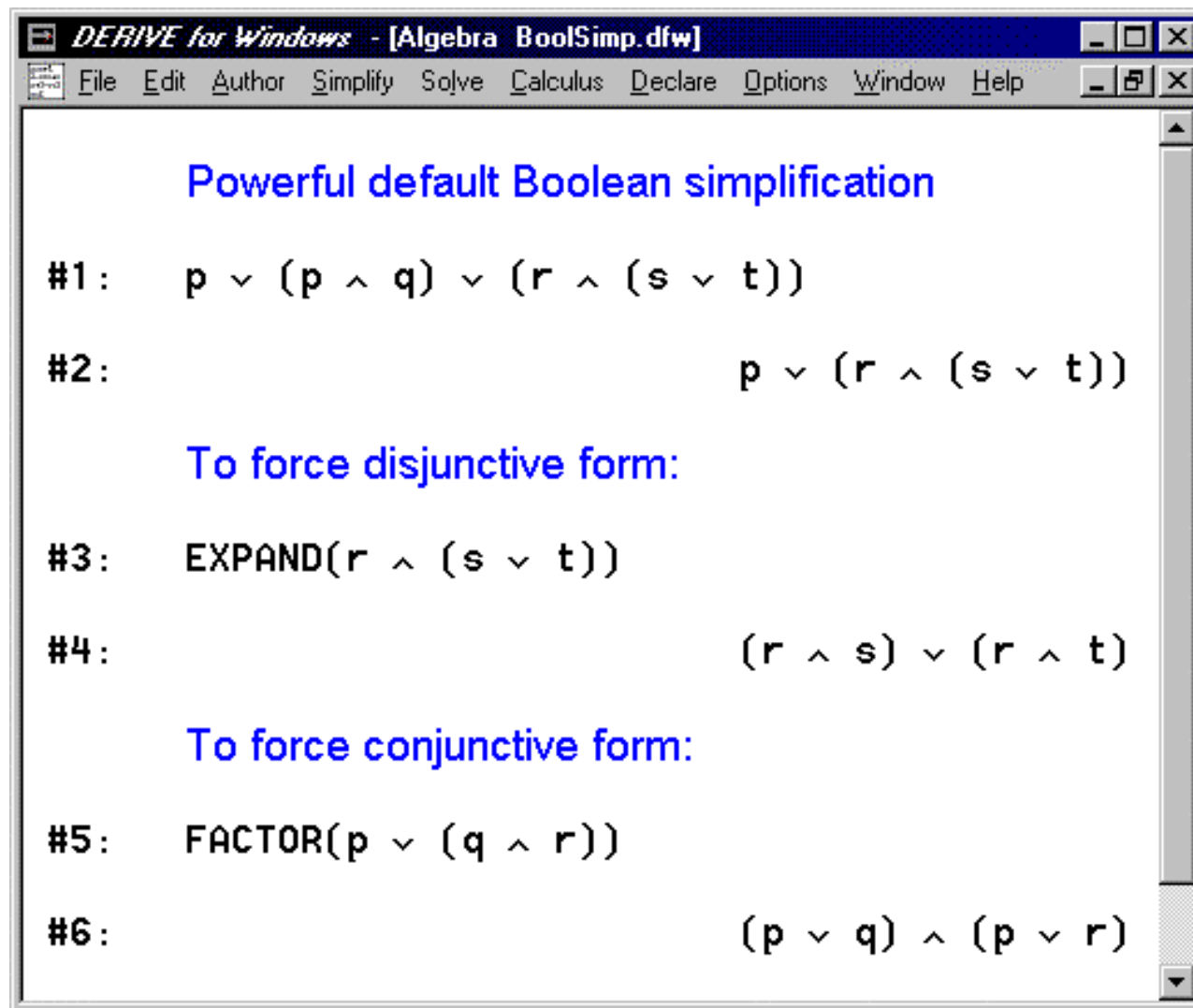
V  
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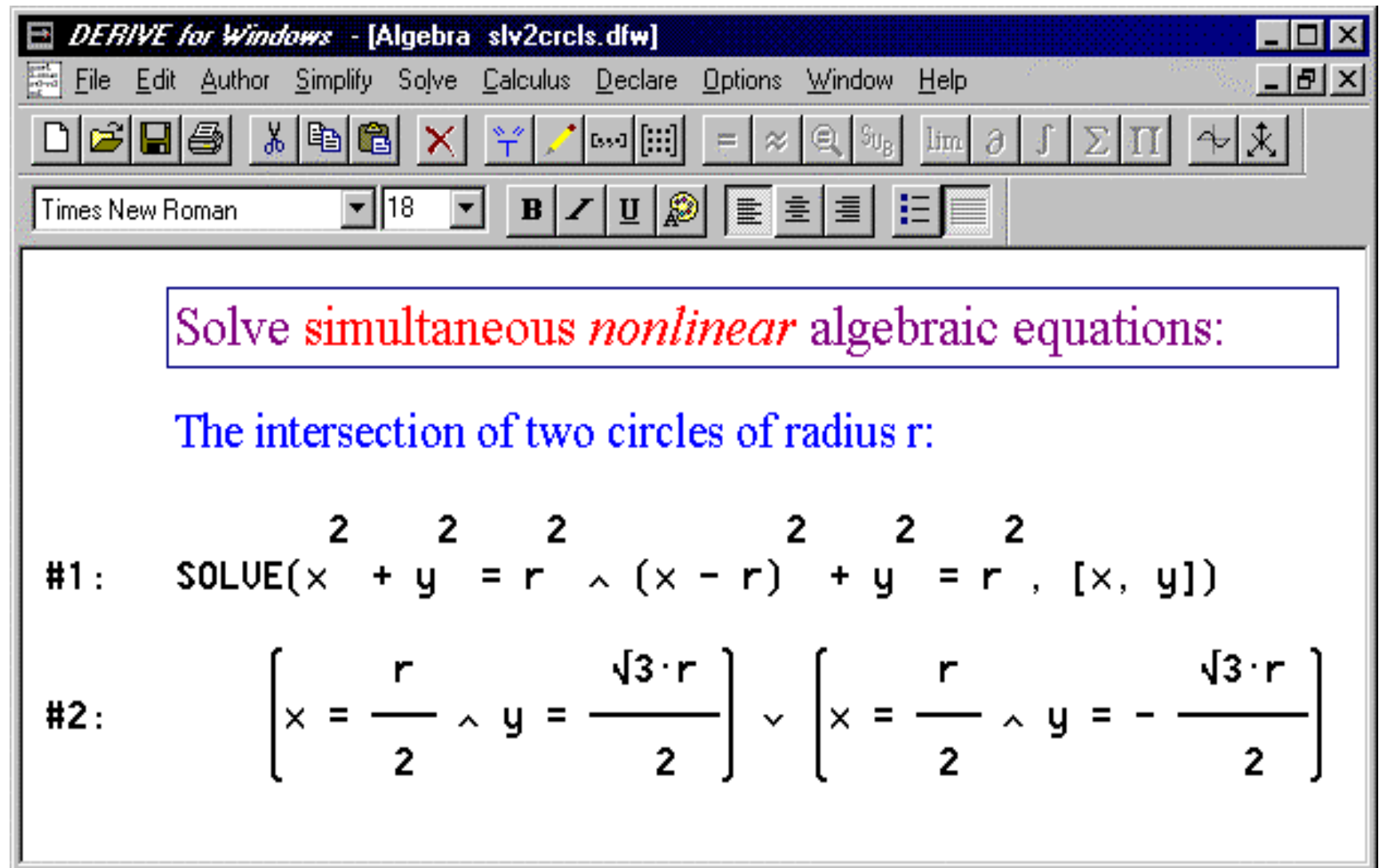
# Mathematical Enhancements

- 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



# Nonlinear equation solving



The screenshot shows the DERIVE for Windows software interface. The title bar reads "DERIVE for Windows - [Algebra slv2crcls.dfw]". The menu bar includes File, Edit, Author, Simplify, Solve, Calculus, Declare, Options, Window, and Help. The toolbar contains various mathematical symbols and functions. The font is Times New Roman, size 18. The main window displays the following text:

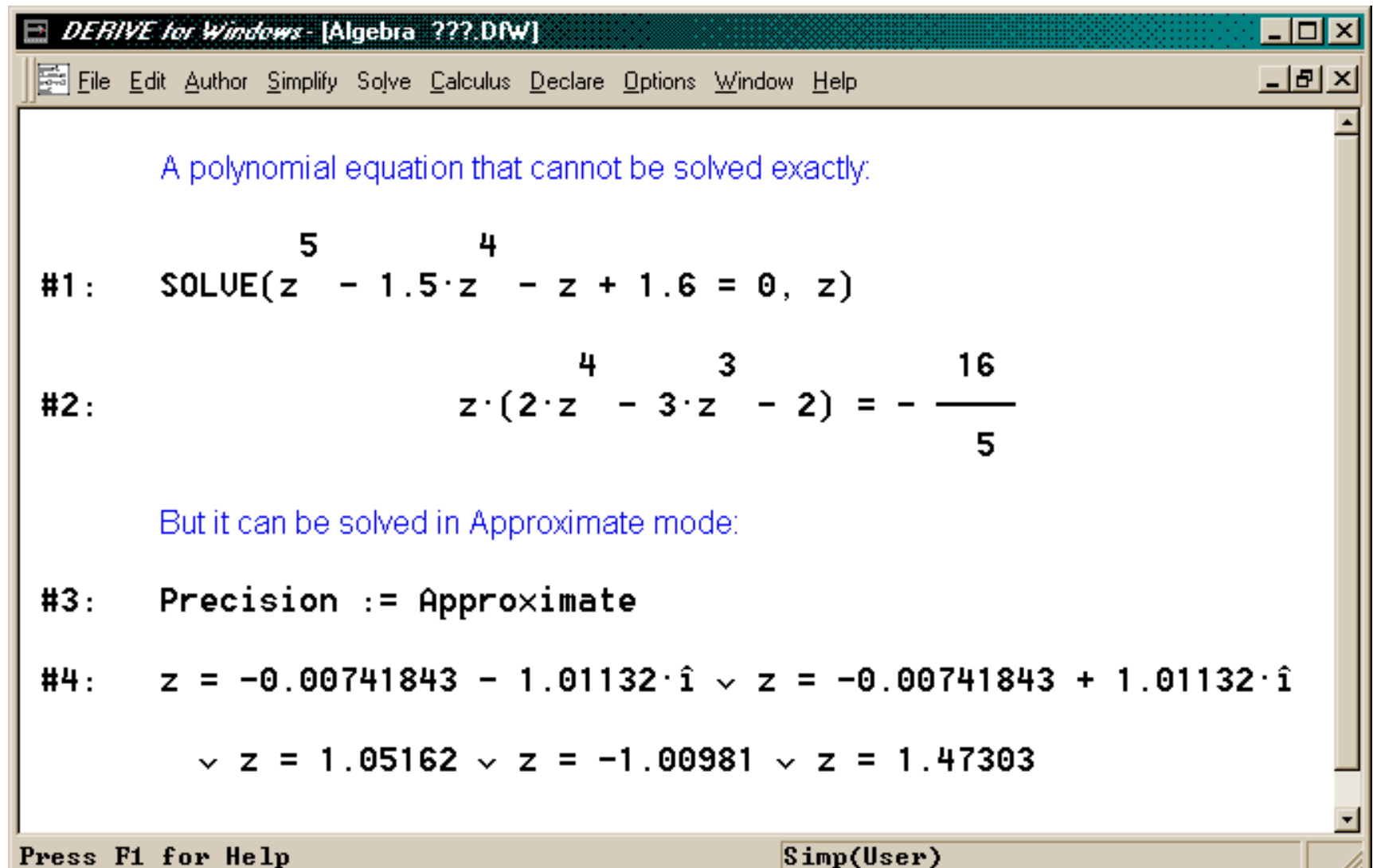
Solve simultaneous *nonlinear* algebraic equations:

The intersection of two circles of radius r:

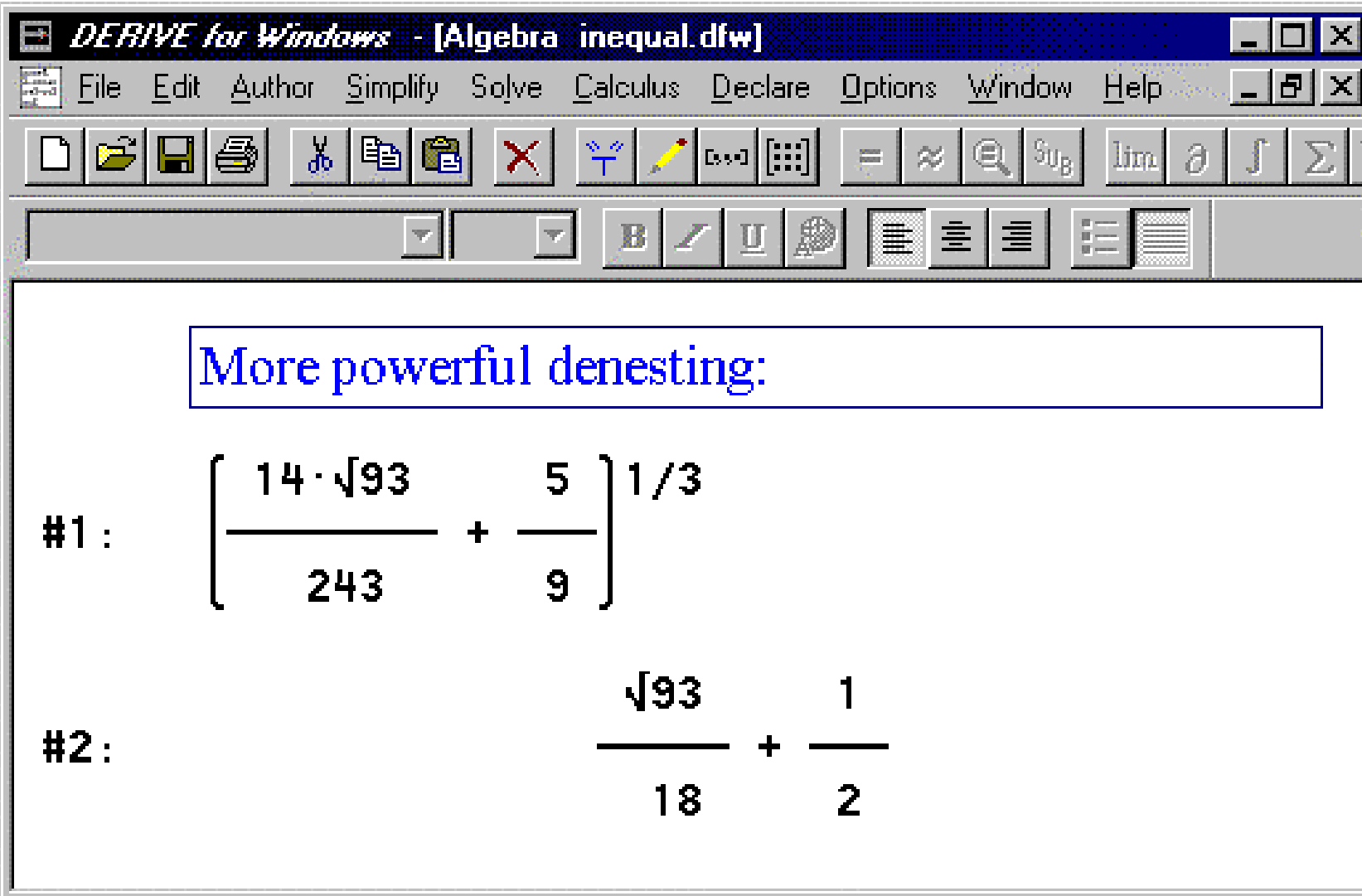
#1: 
$$\text{SOLVE}(x^2 + y^2 = r^2 \wedge (x - r)^2 + y^2 = r^2, [x, y])$$

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

# Approximate equation solving



# Algebraic numbers



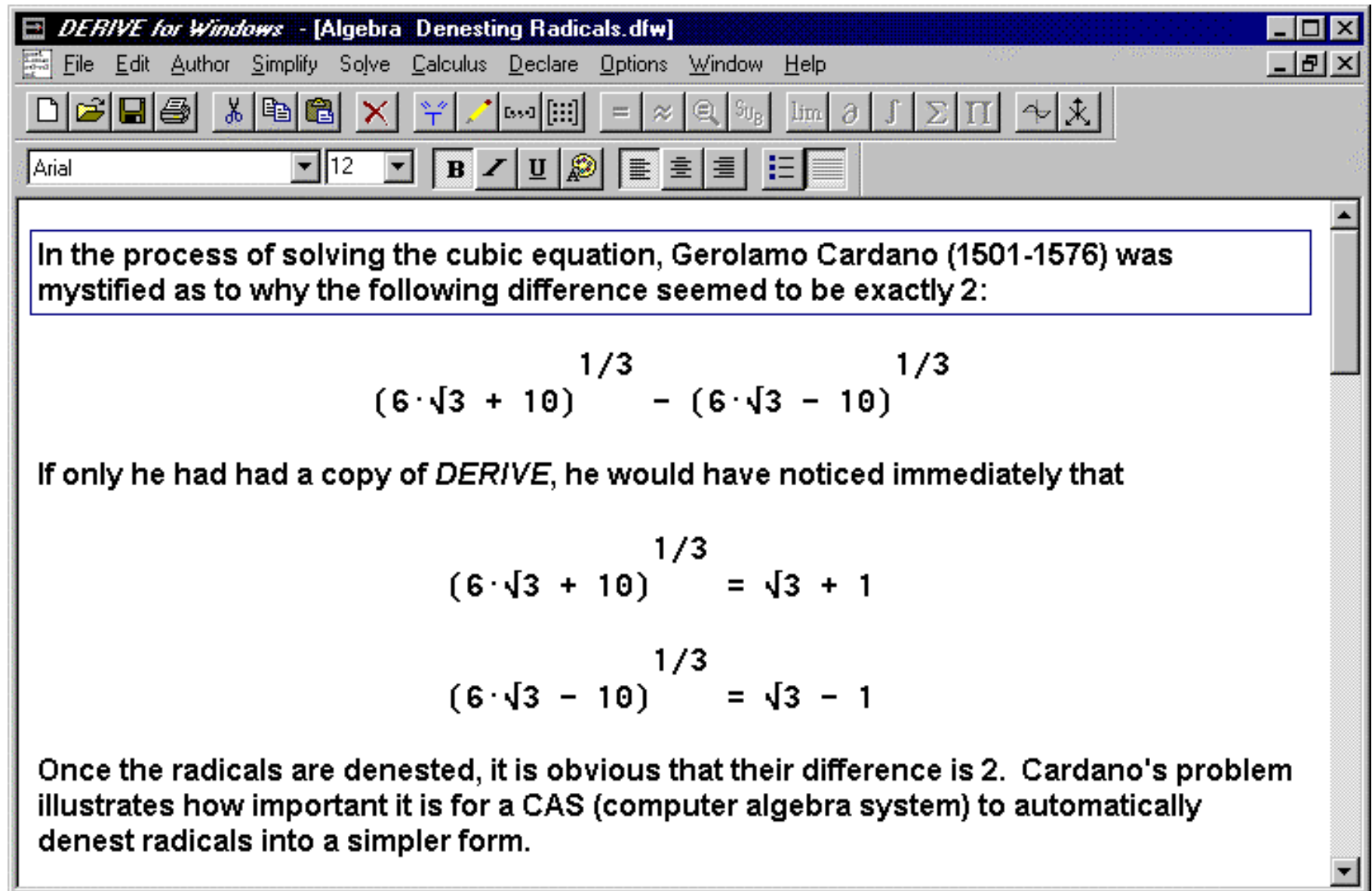
The screenshot shows the DERIVE for Windows software interface. The title bar reads "DERIVE for Windows - [Algebra inequal.dfw]". The menu bar includes File, Edit, Author, Simplify, Solve, Calculus, Declare, Options, Window, and Help. The toolbar contains various icons for file operations, editing, and mathematical functions. The main workspace displays two mathematical expressions, #1 and #2, which are algebraic numbers.

More powerful denesting:

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

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

# Denesting example



The screenshot shows the DERIVE for Windows software interface. The title bar reads "DERIVE for Windows - [Algebra Denesting Radicals.dfw]". The menu bar includes File, Edit, Author, Simplify, Solve, Calculus, Declare, Options, Window, and Help. The toolbar contains various mathematical symbols and functions. The text area contains the following content:

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]

File Edit Author Simplify Solve Calculus Declare Options Window Help

Cartesian products of sets:

#1:  $\{a, b\} \cdot \{1, 2\}$

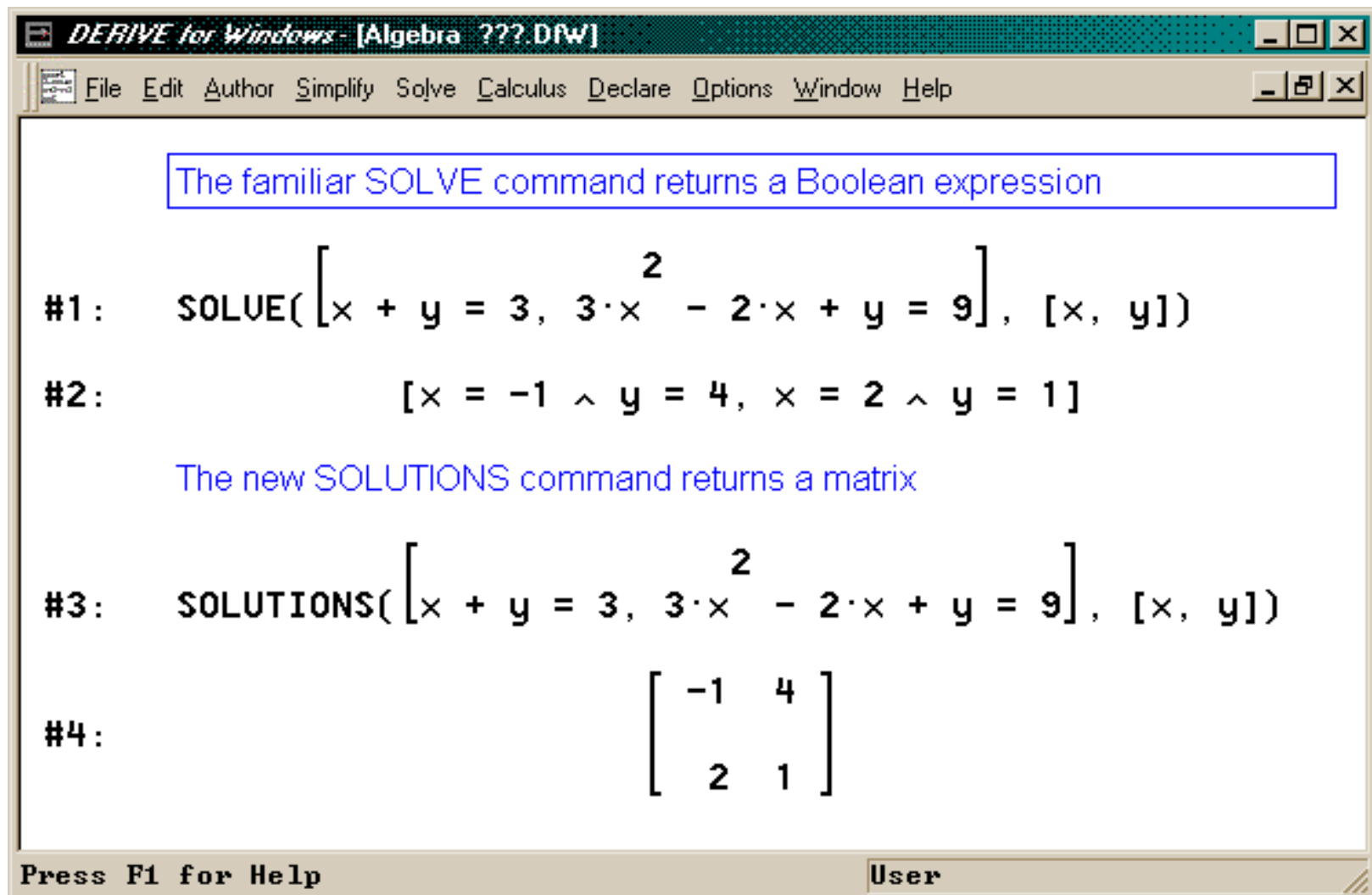
#2:  $\{[a, 1], [a, 2], [b, 1], [b, 2]\}$

Sets of 2-element vectors treated as functions:

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

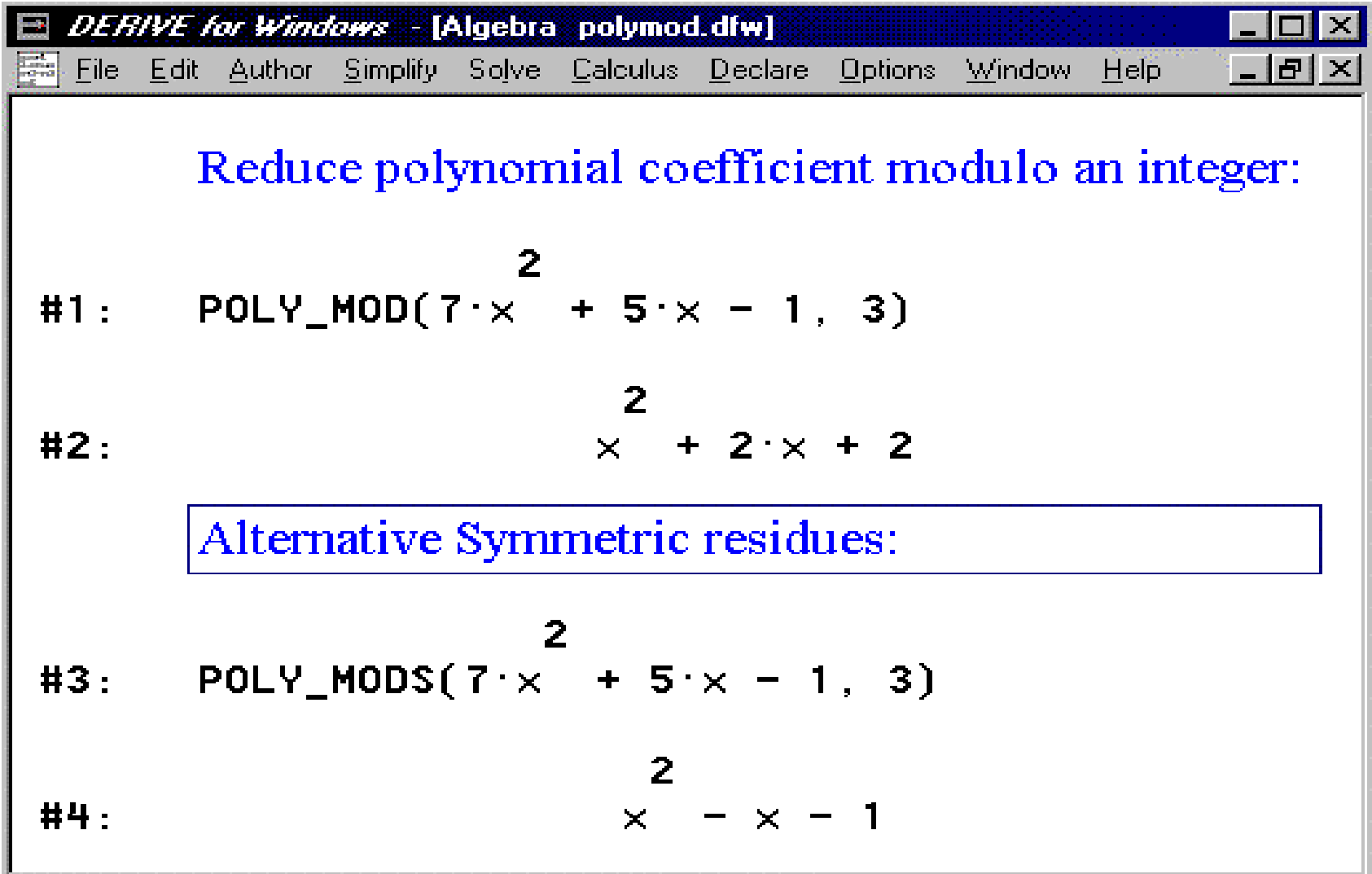
#4:  $7$

# Answers in convenient forms





# Advanced polynomial functions



The screenshot shows the DERIVE for Windows application window. The title bar reads "DERIVE for Windows - [Algebra polymod.dfw]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help". The main workspace contains the following text:

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:  $x^2 - x - 1$

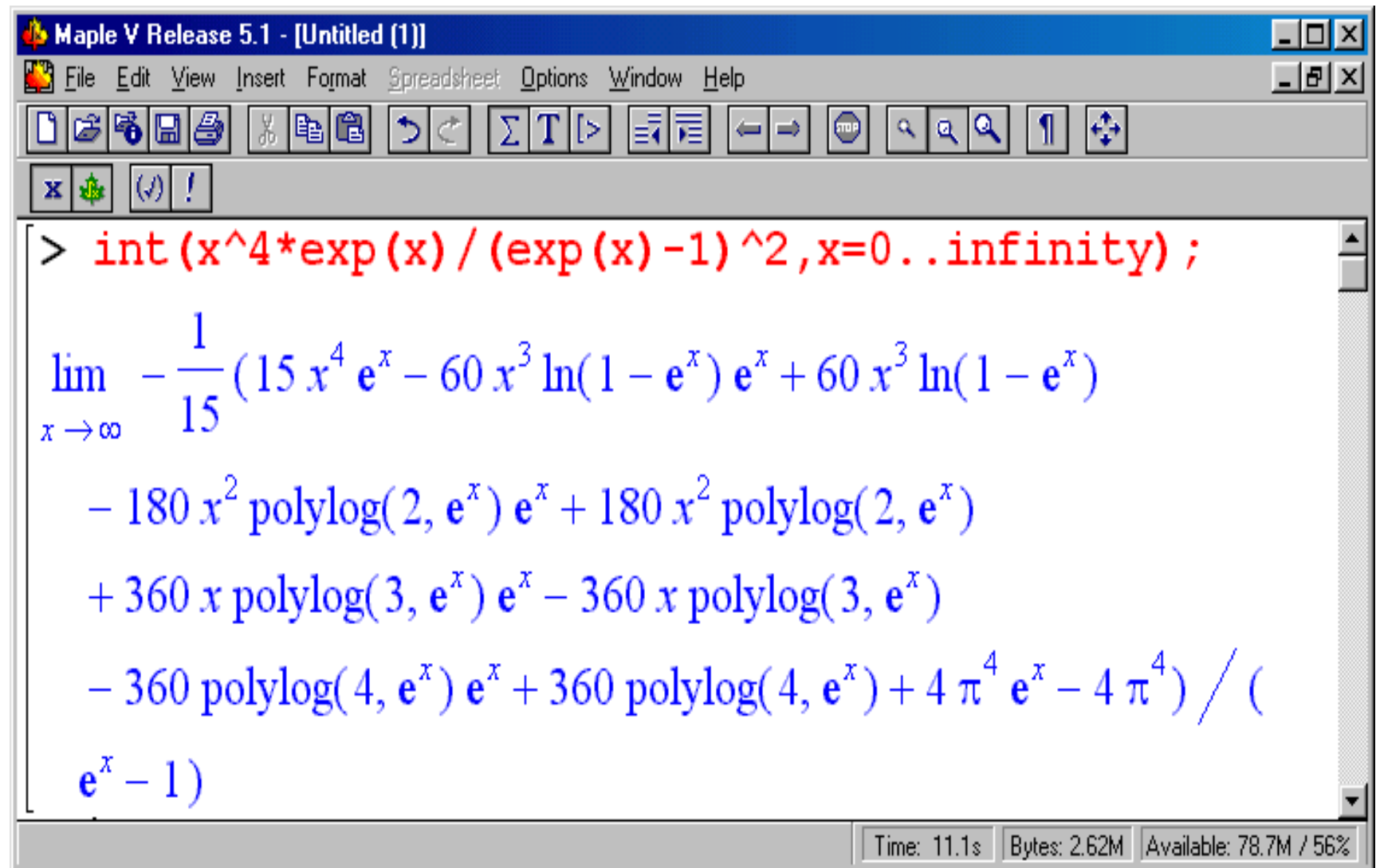
# Stronger calculus

The screenshot shows the DERIVE for Windows software window. The title bar reads "DERIVE for Windows - [Algebra ???.DFW]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help". The main workspace contains the text "A difficult definite integral:" in blue. Below this, two problems are listed:

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

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

# Comparison with Maple



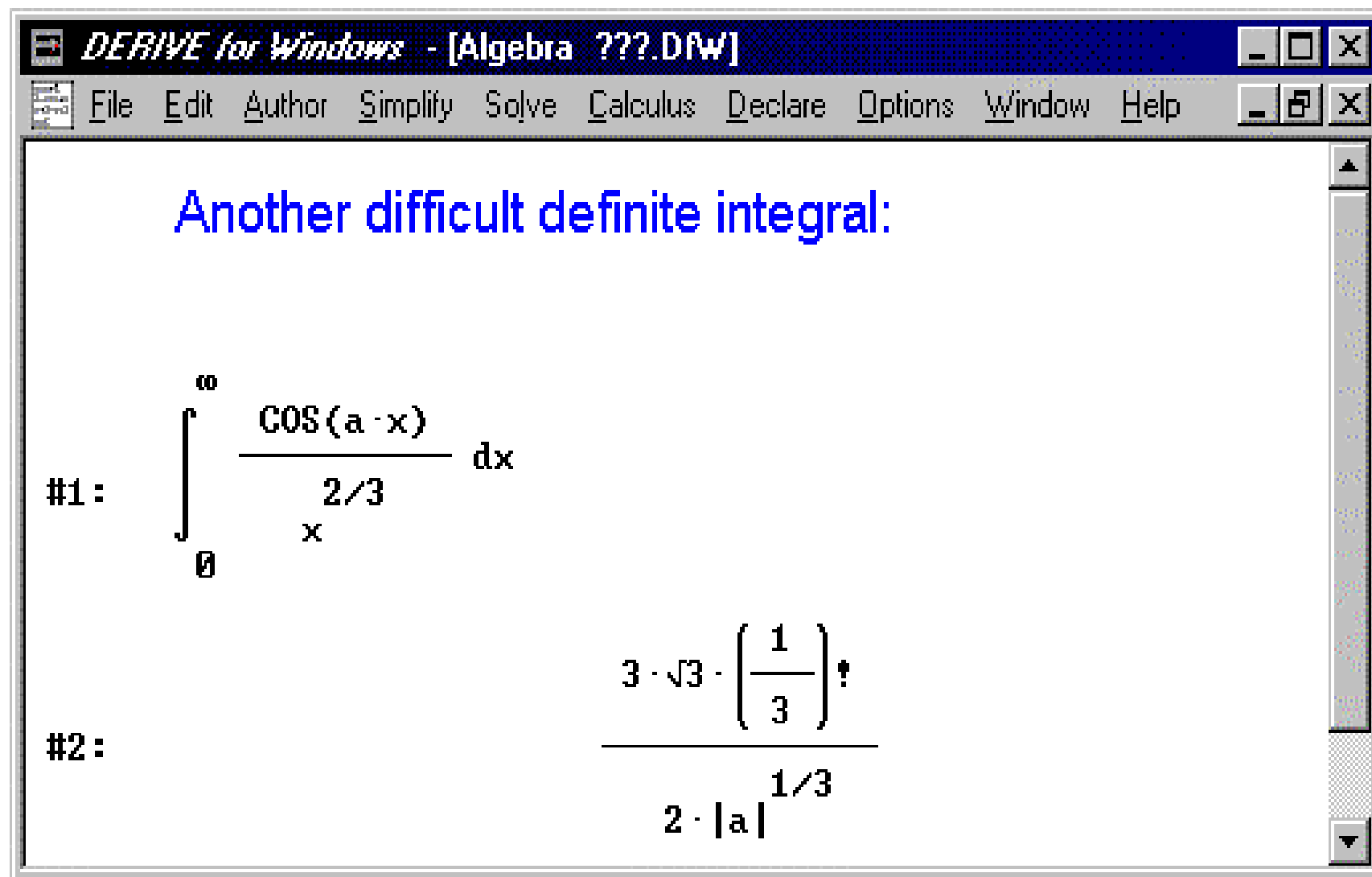
The screenshot shows the Maple V Release 5.1 interface. The title bar reads "Maple V Release 5.1 - [Untitled (1)]". The menu bar includes File, Edit, View, Insert, Format, Spreadsheet, Options, Window, and Help. The toolbar contains various icons for file operations, editing, and navigation. The main workspace displays a command in red text and its result in blue text.

```
> int (x^4*exp (x) / (exp (x) -1) ^2 ,x=0..infinity) ;
```

$$\lim_{x \rightarrow \infty} -\frac{1}{15} (15 x^4 e^x - 60 x^3 \ln(1 - e^x) e^x + 60 x^3 \ln(1 - e^x) - 180 x^2 \operatorname{polylog}(2, e^x) e^x + 180 x^2 \operatorname{polylog}(2, e^x) + 360 x \operatorname{polylog}(3, e^x) e^x - 360 x \operatorname{polylog}(3, e^x) - 360 \operatorname{polylog}(4, e^x) e^x + 360 \operatorname{polylog}(4, e^x) + 4 \pi^4 e^x - 4 \pi^4) / (e^x - 1)$$

The status bar at the bottom indicates: Time: 11.1s, Bytes: 2.62M, Available: 78.7M / 56%.

# Another calculus example

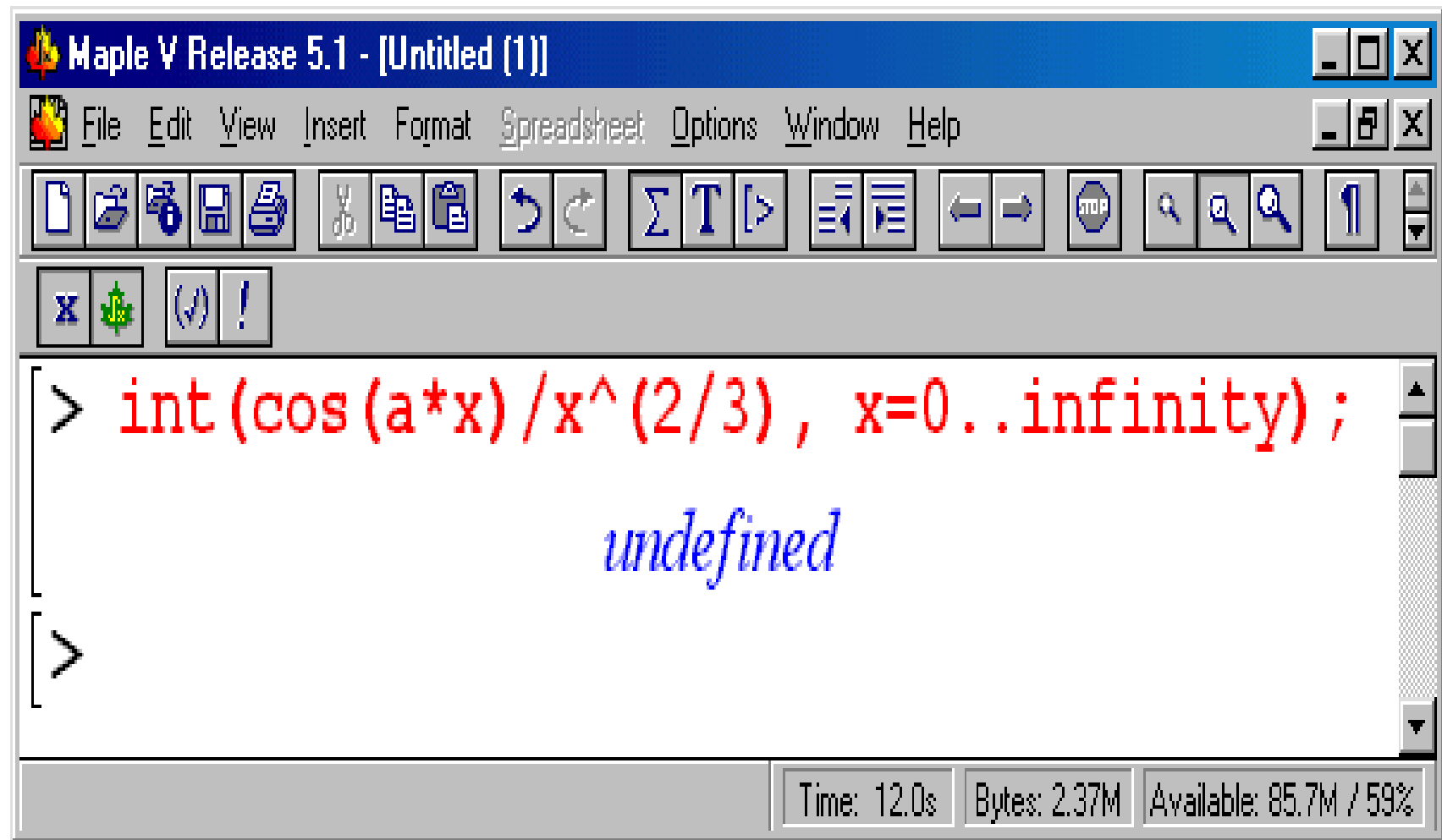


The screenshot shows the DERIVE for Windows application window. The title bar reads "DERIVE for Windows - [Algebra ???.DFW]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help". The main workspace contains the text "Another difficult definite integral:" in blue. Below this, two mathematical expressions are displayed:

#1: 
$$\int_0^{\infty} \frac{\cos(a \cdot x)}{x^{2/3}} dx$$

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

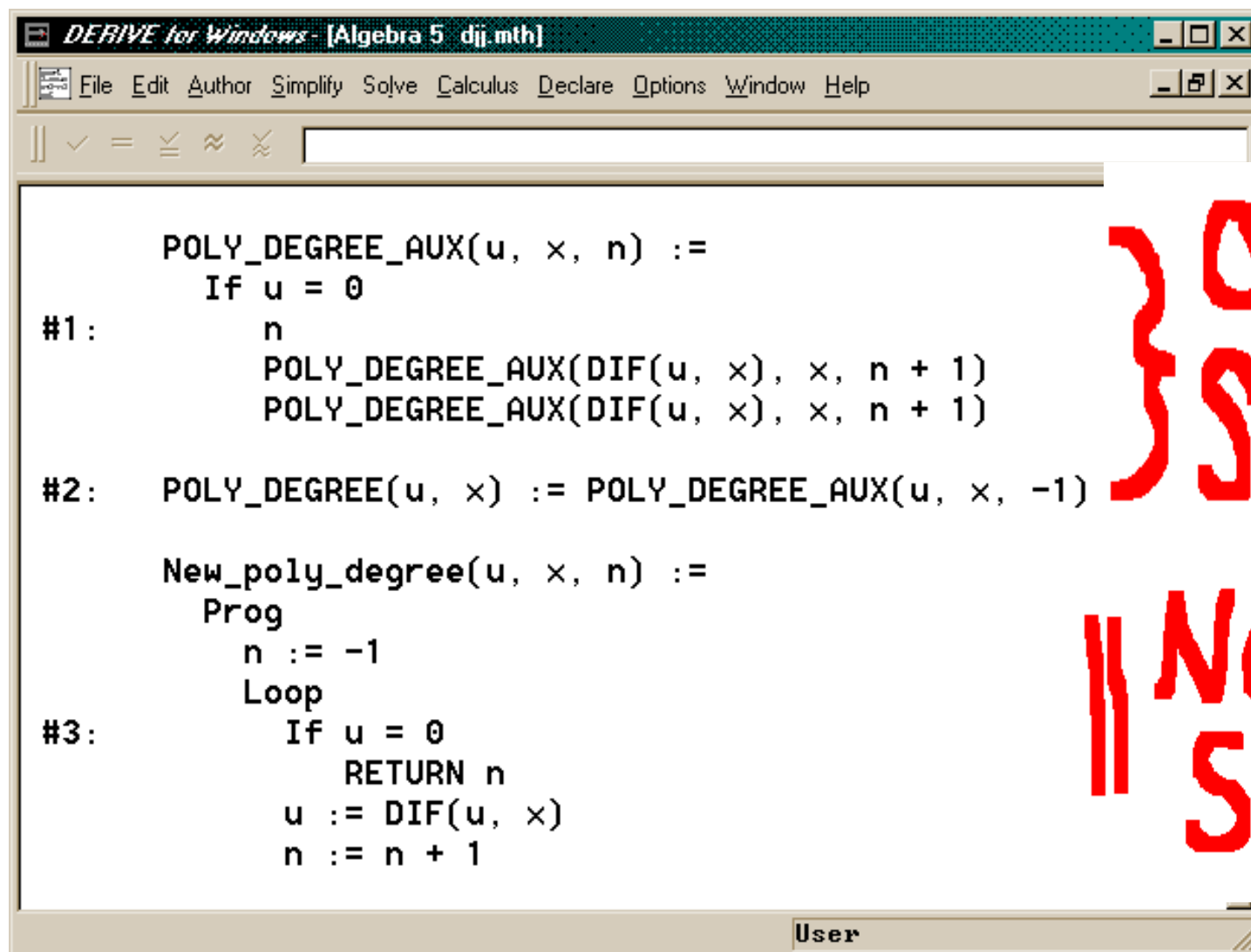
Again, the corresponding Maple result



# Programming Enhancements

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

# An old definition in the new language



The screenshot shows the DERIVE for Windows software interface. The title bar reads "DERIVE for Windows - [Algebra 5 djj.mth]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help". Below the menu bar is a toolbar with icons for opening, saving, and other functions. The main text area contains the following code:

```
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
```

The status bar at the bottom right shows "User".

} Old  
Style

|| New  
Style

# Initialize local variables and increment operators

```
DERIVE for Windows - [Algebra 5: d1j.mth]
File Edit Author Simplify Solve Calculus Declare Options Window Help

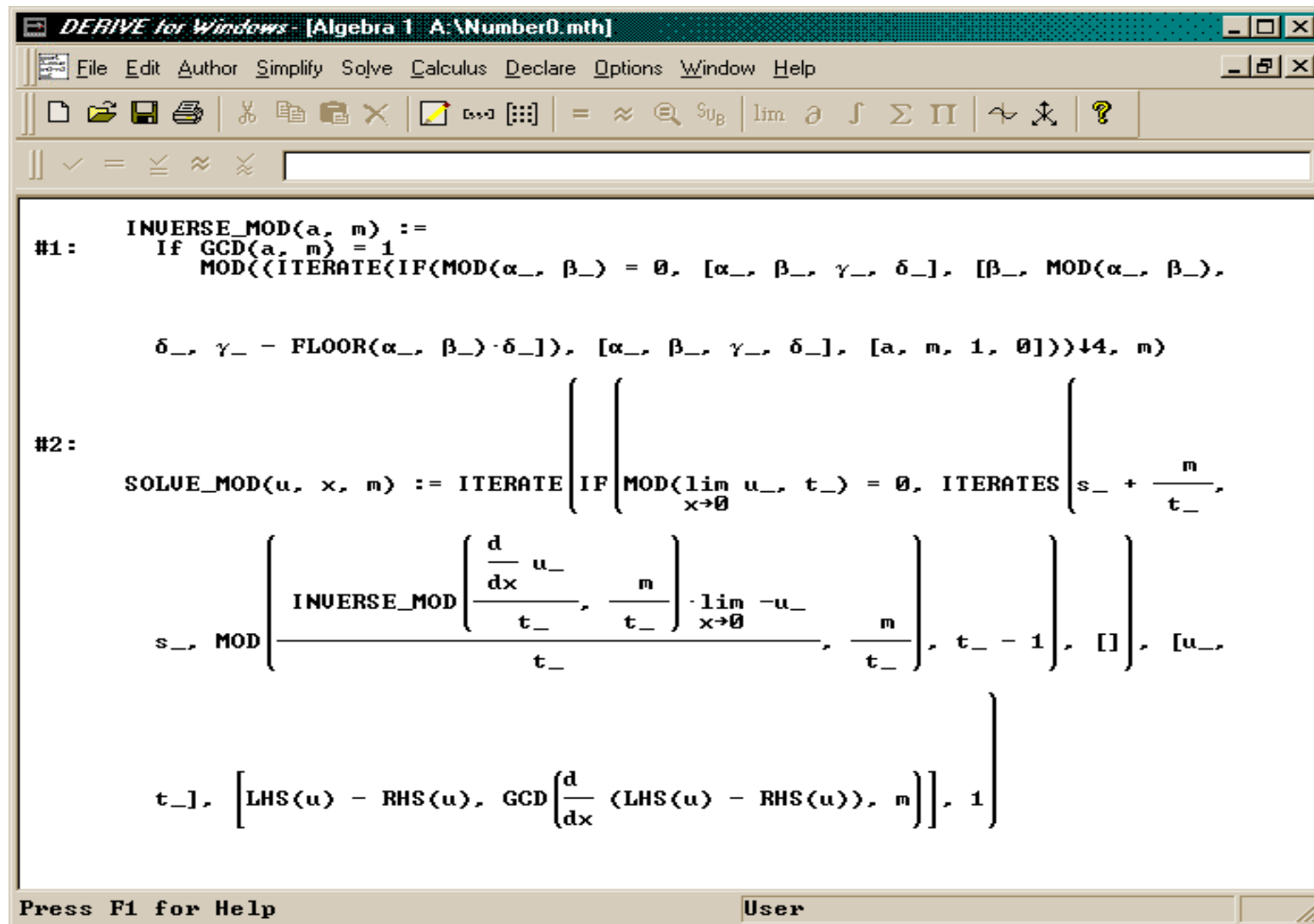
New_poly_degree(u, x, n) :=
  Prog
    n := -1
    Loop
      #1: If u = 0
          RETURN n
          u := DIF(u, x)
          n := n + 1
      Better_poly_degree(u, x, n := -1) :=
        Loop
          If u = 0
            #2: RETURN n
            u := DIF(u, x)
            n :=+ 1
```

Initialize local variable

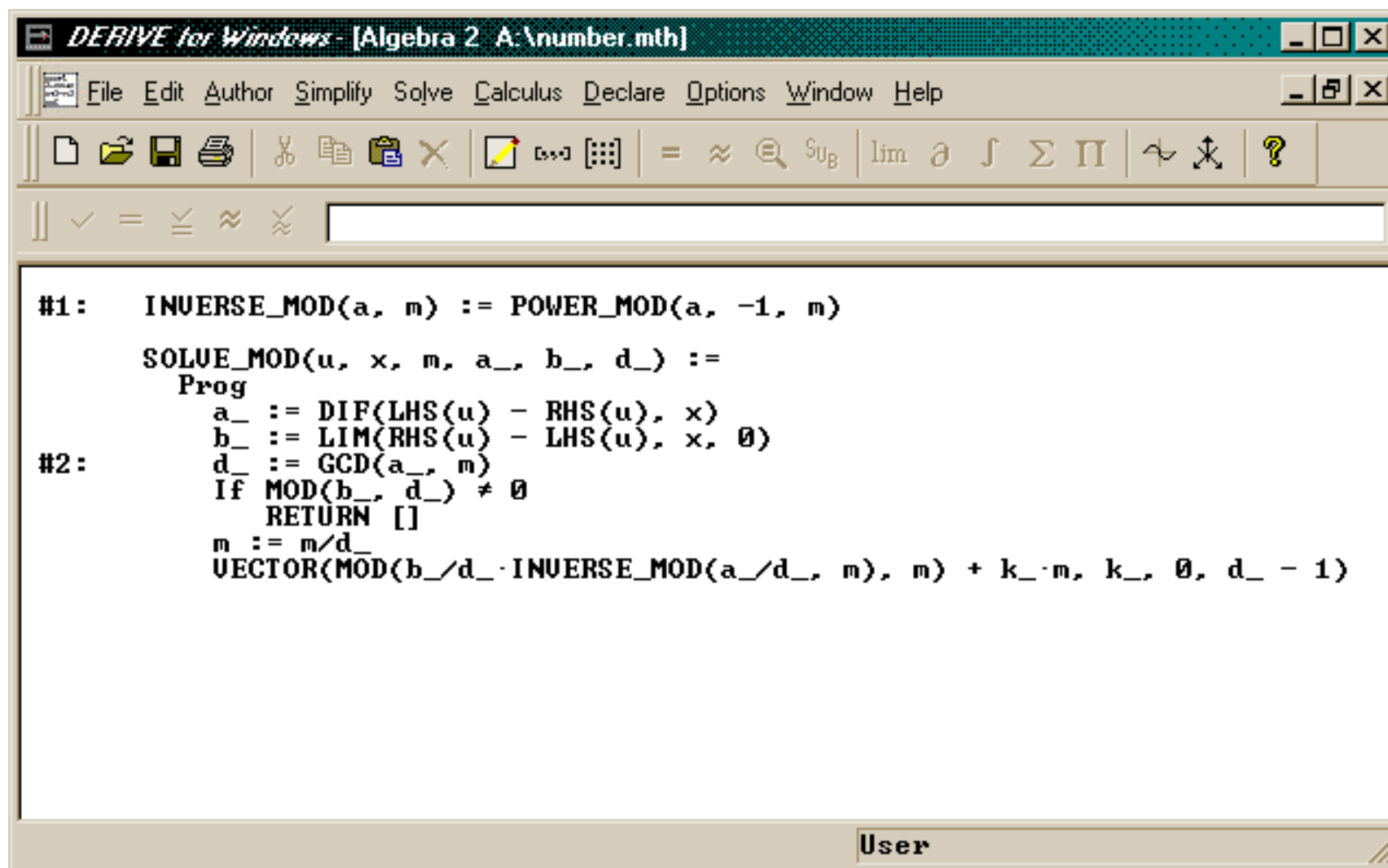
Increment n



# The old SOLVE\_MOD - messy isn't it?



# The new & improved SOLVE\_MOD - so much nicer!



The screenshot shows the DERIVE for Windows software interface. The title bar reads "DERIVE for Windows - [Algebra 2 A:\number.mth]". The menu bar includes File, Edit, Author, Simplify, Solve, Calculus, Declare, Options, Window, and Help. The toolbar contains various icons for file operations, editing, and mathematical functions. Below the toolbar is a row of mathematical symbols:  $\checkmark$ ,  $=$ ,  $\leq$ ,  $\approx$ ,  $\neq$ , and a text input field. The main workspace contains the following code:

```
#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_)  $\neq$  0
        RETURN []
      m := m/d_
      VECTOR(MOD(b_/d_·INVERSE_MOD(a_/d_, m), m) + k_·m, k_, 0, d_ - 1)
```

The status bar at the bottom right shows the name "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***®.