



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

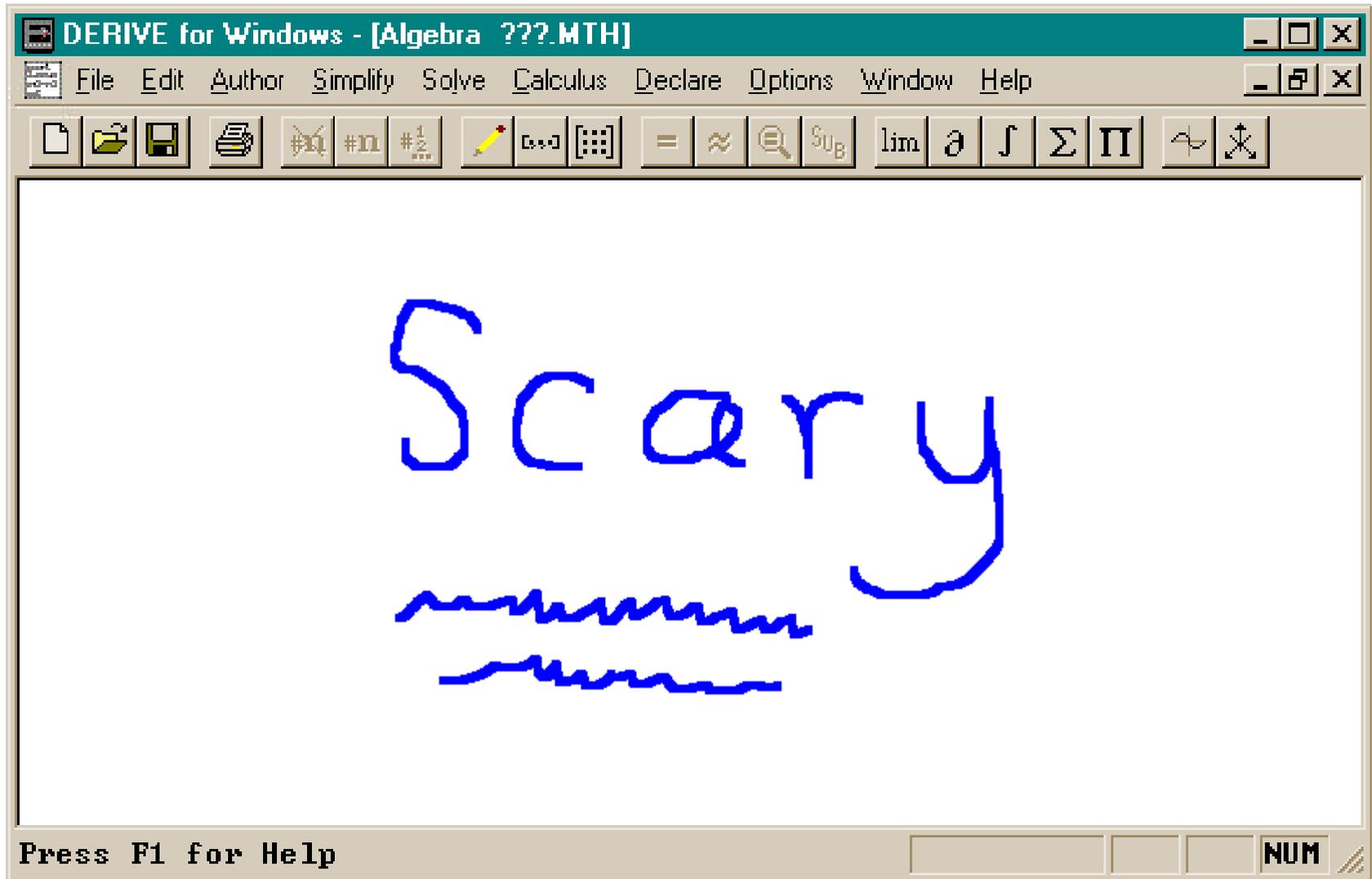
- Keep a familiar face but add powerful new features
- Enhance the interface to take full advantage of the Windows environment
- Appeal to new users as well as old fans
- Expand programming possibilities
- Continue to improve the fundamentals: mathematical ability

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

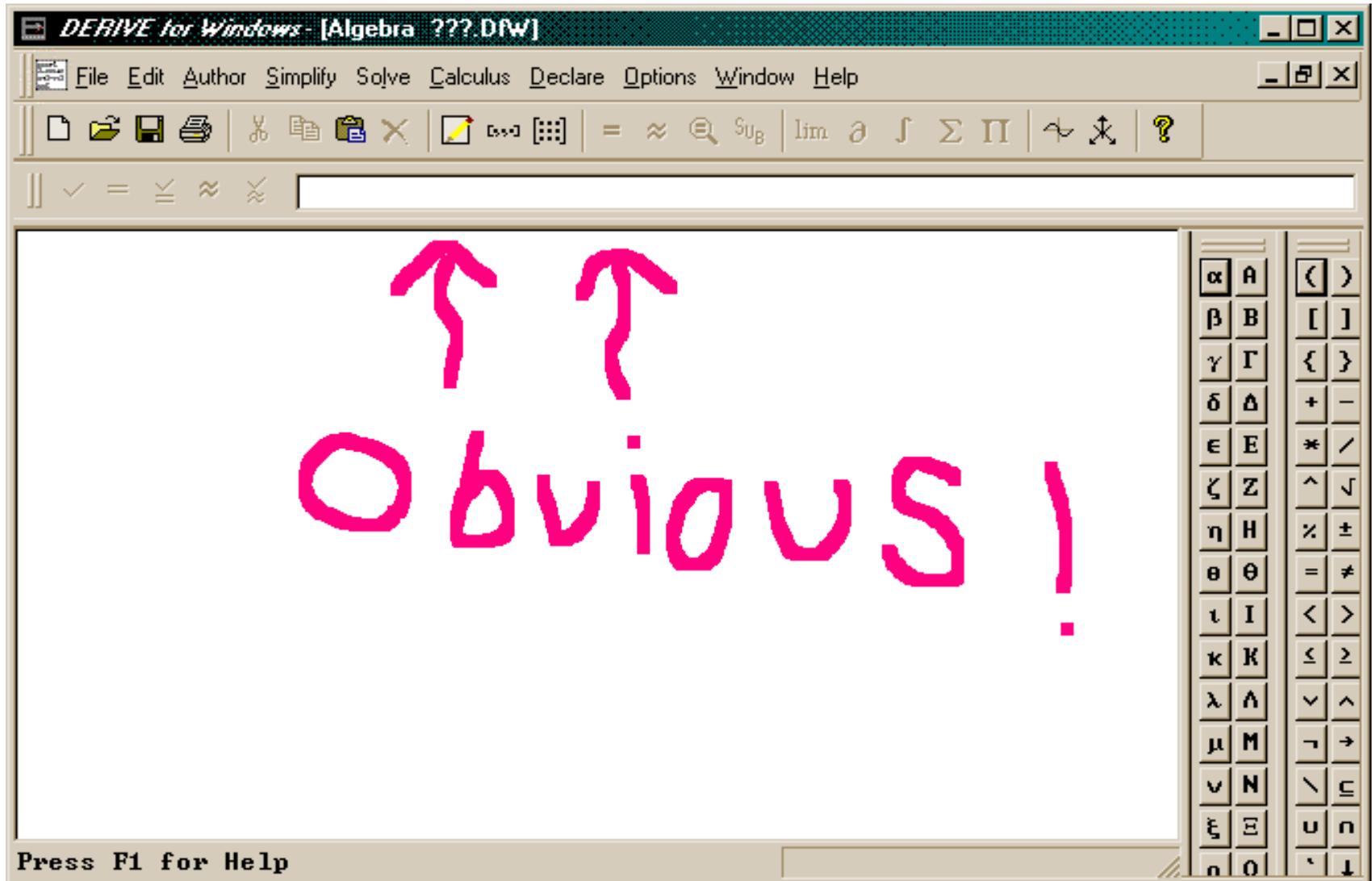
This is my first day. Where do I write? How do I start???

✓
✓
✓
✓



Hey, an author bar!

NEW



Where is the error???

✓
✓
✓
✓
✓

The screenshot shows the DERIVE for Windows interface. A dialog box titled "DERIVE for Windows" with a yellow warning icon and the text "Syntax error" is overlaid on the main window. The main window's title bar reads "DERIVE for Windows - [Alge...". The menu bar includes "File", "Edit", "Author", "Simplify", "ns", "Window", and "Help". The toolbar contains icons for file operations and mathematical symbols like \int , \sum , and π . Below the toolbar is a panel titled "Author Expression - ??? .MT" containing a grid of mathematical symbols. The main text area displays the expression: $\sqrt{256^2 + x^2} + (x^2 + 3x + 2) / (x - 1)(x - 2)(x - 3)$. At the bottom of the dialog are "OK", "Simplify", and "Cancel" buttons. Handwritten blue text at the bottom of the slide reads "I'm looking, I'm looking." The Microsoft PowerPoint logo is visible in the bottom left corner.

Cursor shows error position

VER 5

DERIVE for Windows - [Algebra ??? DW]

File Edit Author Simplify Solve Calculus Declare Options Window Help

sqrt(256²+a²)+(x²+3x+2)/(x-1)(x-2)(x-3)

There's the error

Error message

Syntax error after cursor: Unexpected delimiter User

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

✓
 ✓
 ✓
 ✓

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

User=Simp(User) 0.0s NUM

Can you read this at the back??

VIEW

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

VERSION 5

The screenshot shows the DERIVE software window with the title bar "DERIVE for Windows - [Algebra ????.DW]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help". The toolbar contains icons for a pencil and a hand. Below the toolbar is a status bar with symbols for checkmark, equals, less than or equal to, approximately, and not equal to. The main workspace displays three algebraic expressions:

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

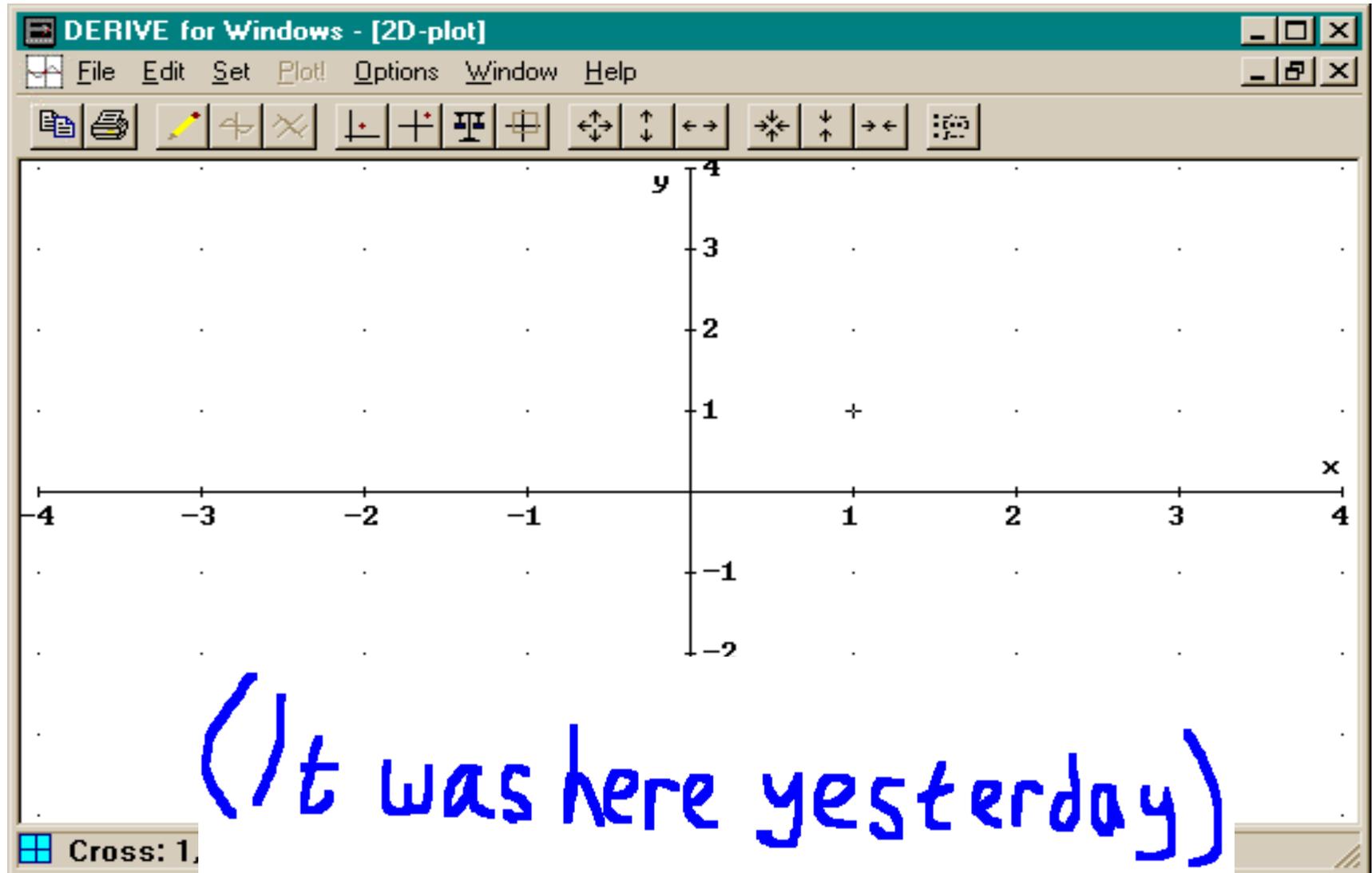
#8:

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

Two red arrows point from the handwritten text in #9 to the denominators of the second and third terms in #7. The status bar at the bottom left says "Press F1" and the bottom right shows "atic" and a small icon.

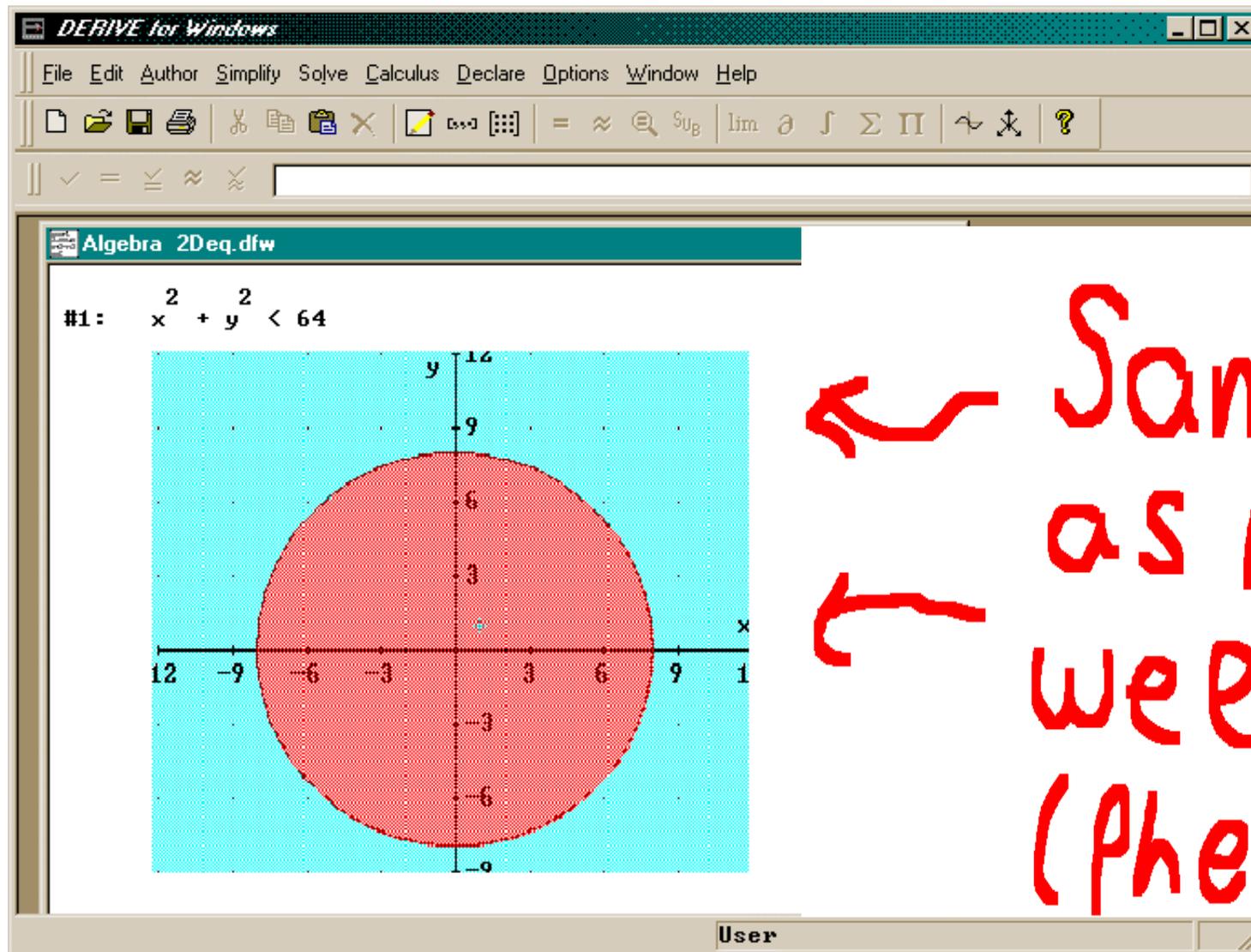
"Plotting $x^2 + y^2 < 64$ we get a circle..."

✓
✓
✓
✓



Plot scales remembered

V
M
R
S



← Same
← as last
week
(phew!)

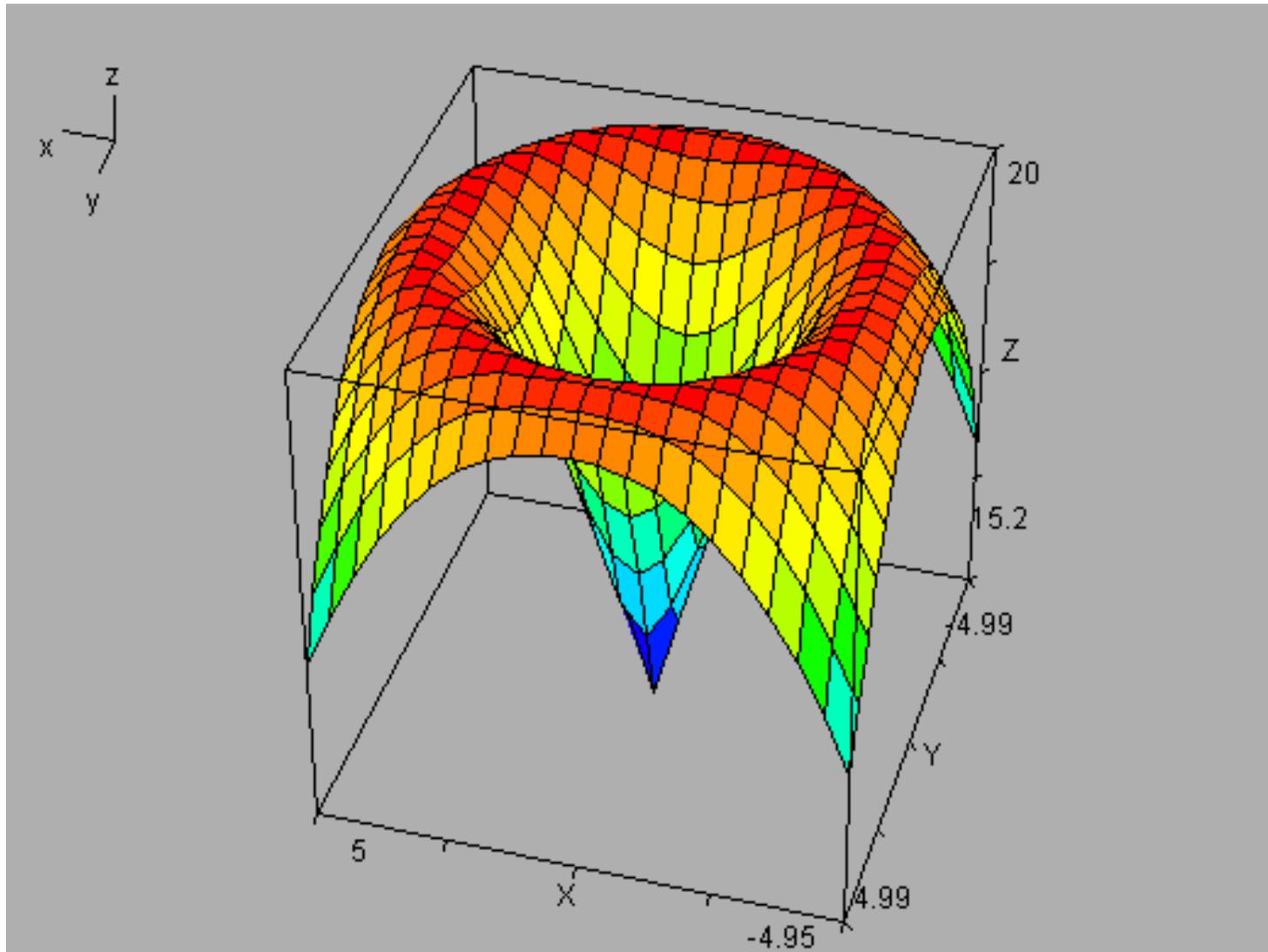
Algebra Window Enhancements

- 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

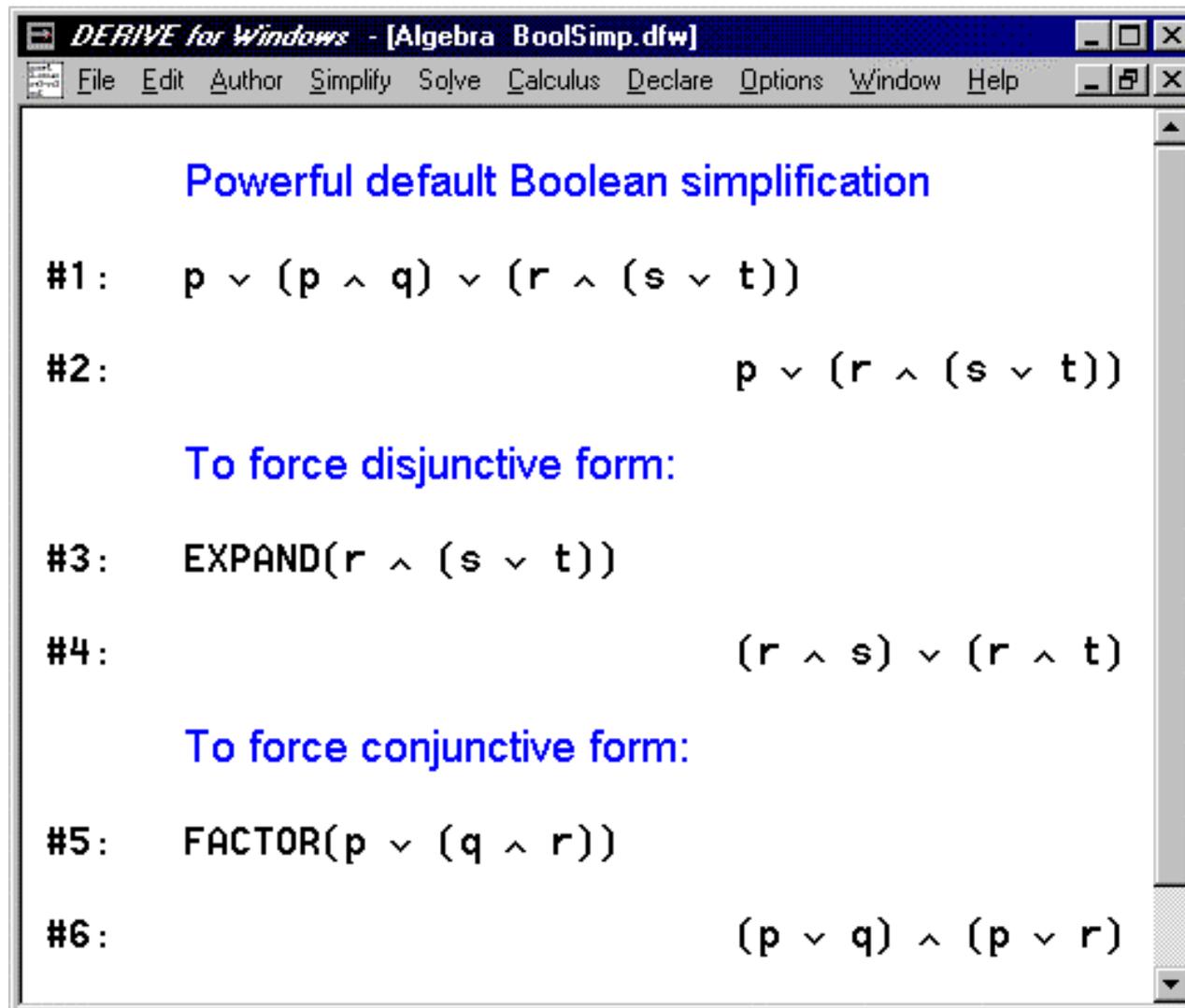


V
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Mathematical Enhancements

- 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



The screenshot shows a window titled "DERIVE for Windows - [Algebra BoolSimp.dfw]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help". The main text area contains the following content:

Powerful default Boolean simplification

#1: $p \vee (p \wedge q) \vee (r \wedge (s \vee t))$

#2: $p \vee (r \wedge (s \vee t))$

To force disjunctive form:

#3: `EXPAND($r \wedge (s \vee t)$)`

#4: $(r \wedge s) \vee (r \wedge t)$

To force conjunctive form:

#5: `FACTOR($p \vee (q \wedge r)$)`

#6: $(p \vee q) \wedge (p \vee r)$

Nonlinear equation solving

DERIVE for Windows - [Algebra slv2crcls.dfw]

File Edit Author Simplify Solve Calculus Declare Options Window Help

Times New Roman 18 **B** / **U** 

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

The screenshot shows the DERIVE for Windows software interface. The title bar reads "DERIVE for Windows - [Algebra ???.DW]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help".

A blue text prompt says: "A polynomial equation that cannot be solved exactly:"

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

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

A blue text prompt says: "But it can be solved in Approximate mode:"

#3: `Precision := Approximate`

#4:
$$z = -0.00741843 - 1.01132 \cdot i \vee z = -0.00741843 + 1.01132 \cdot i$$

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

At the bottom left, it says "Press F1 for Help". At the bottom right, the status bar shows "Simp(User)".

Algebraic numbers

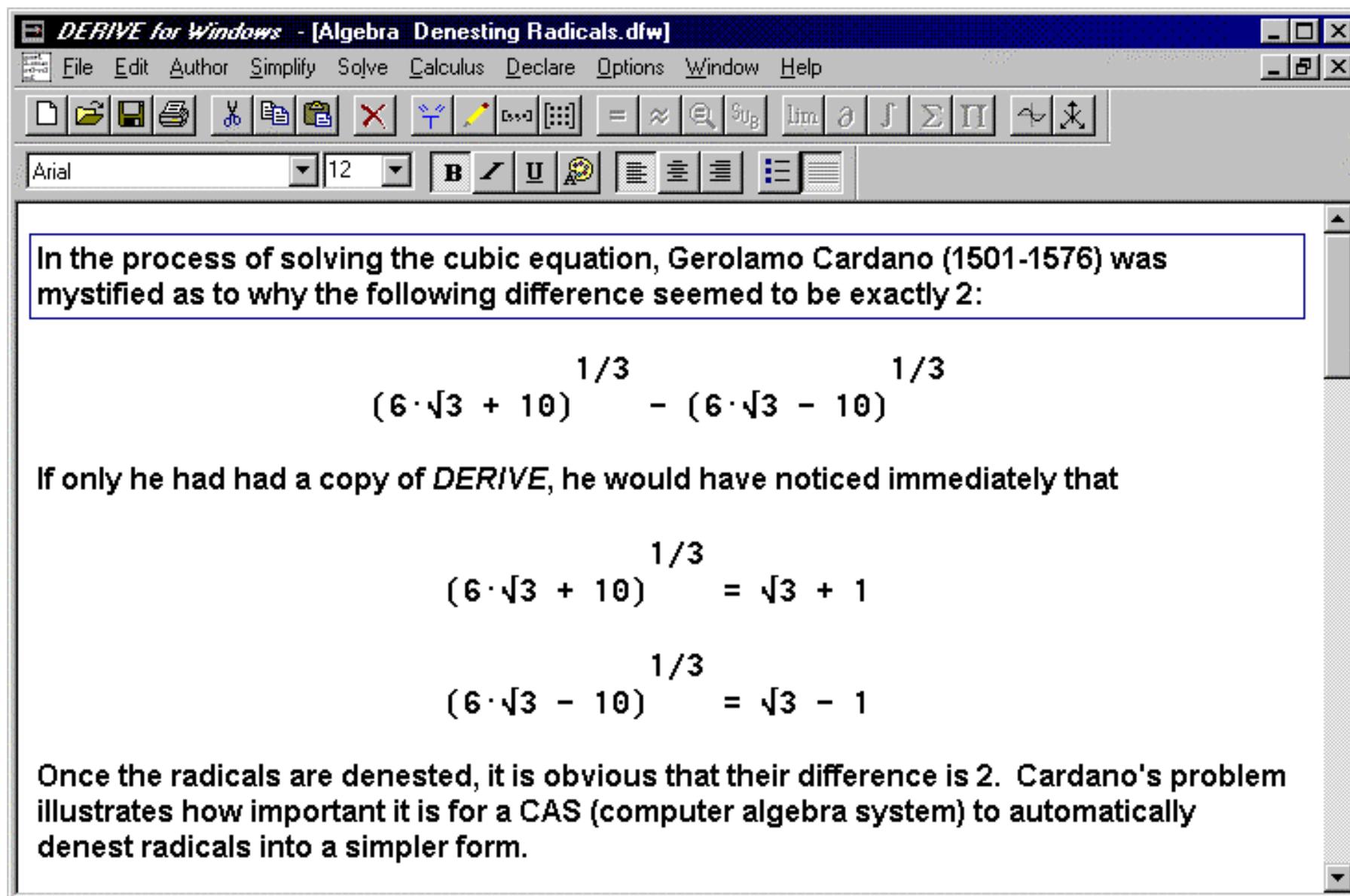
DERIVE for Windows - [Algebra inequal.dfw]

File Edit Author Simplify Solve Calculus Declare Options Window Help

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

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

Denesting example



DERIVE for Windows - [Algebra Denesting Radicals.dfw]

File Edit Author Simplify Solve Calculus Declare Options Window Help

Arial 12 B / 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]

File Edit Author Simplify Solve Calculus Declare Options Window Help

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

The screenshot shows the DERIVE for Windows software interface. 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 window contains the following text:

The familiar SOLVE command returns a Boolean expression

#1: $\text{SOLVE}([x + y = 3, 3 \cdot x^2 - 2 \cdot x + y = 9], [x, y])$

#2: $[x = -1 \wedge y = 4, x = 2 \wedge y = 1]$

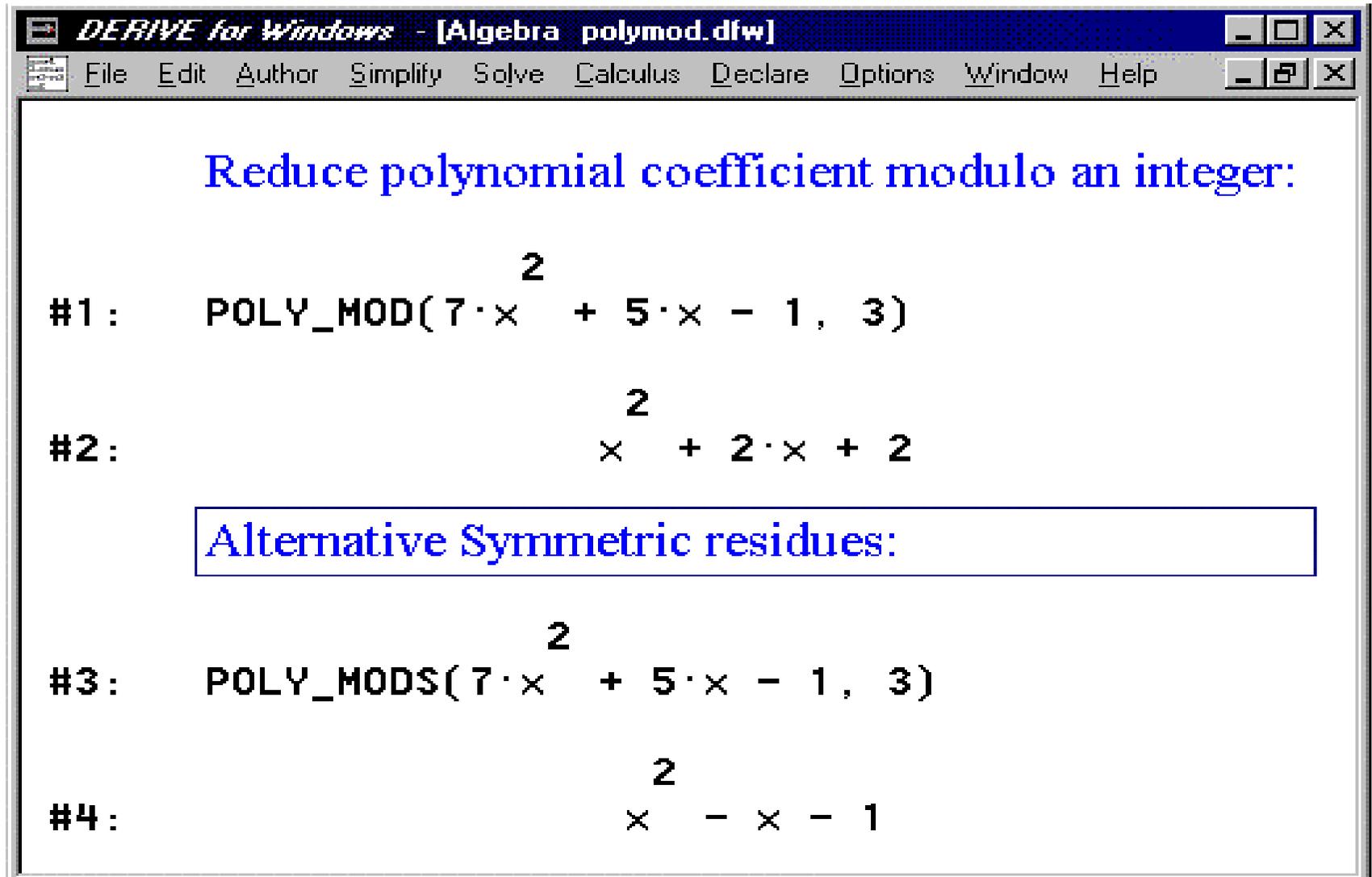
The new SOLUTIONS command returns a matrix

#3: $\text{SOLUTIONS}([x + y = 3, 3 \cdot x^2 - 2 \cdot x + y = 9], [x, y])$

#4: $\begin{bmatrix} -1 & 4 \\ 2 & 1 \end{bmatrix}$

At the bottom of the window, it says "Press F1 for Help" on the left and "User" on the right.

Advanced polynomial functions



The screenshot shows the DERIVE for Windows software interface. 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 window 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 window contains the following text and mathematical expressions:

A difficult definite integral:

#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

Maple V Release 5.1 - [Untitled (1)]

File Edit View Insert Format Spreadsheet Options Window Help

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

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

Time: 11.1s Bytes: 2.62M Available: 78.7M / 56%

Another calculus example

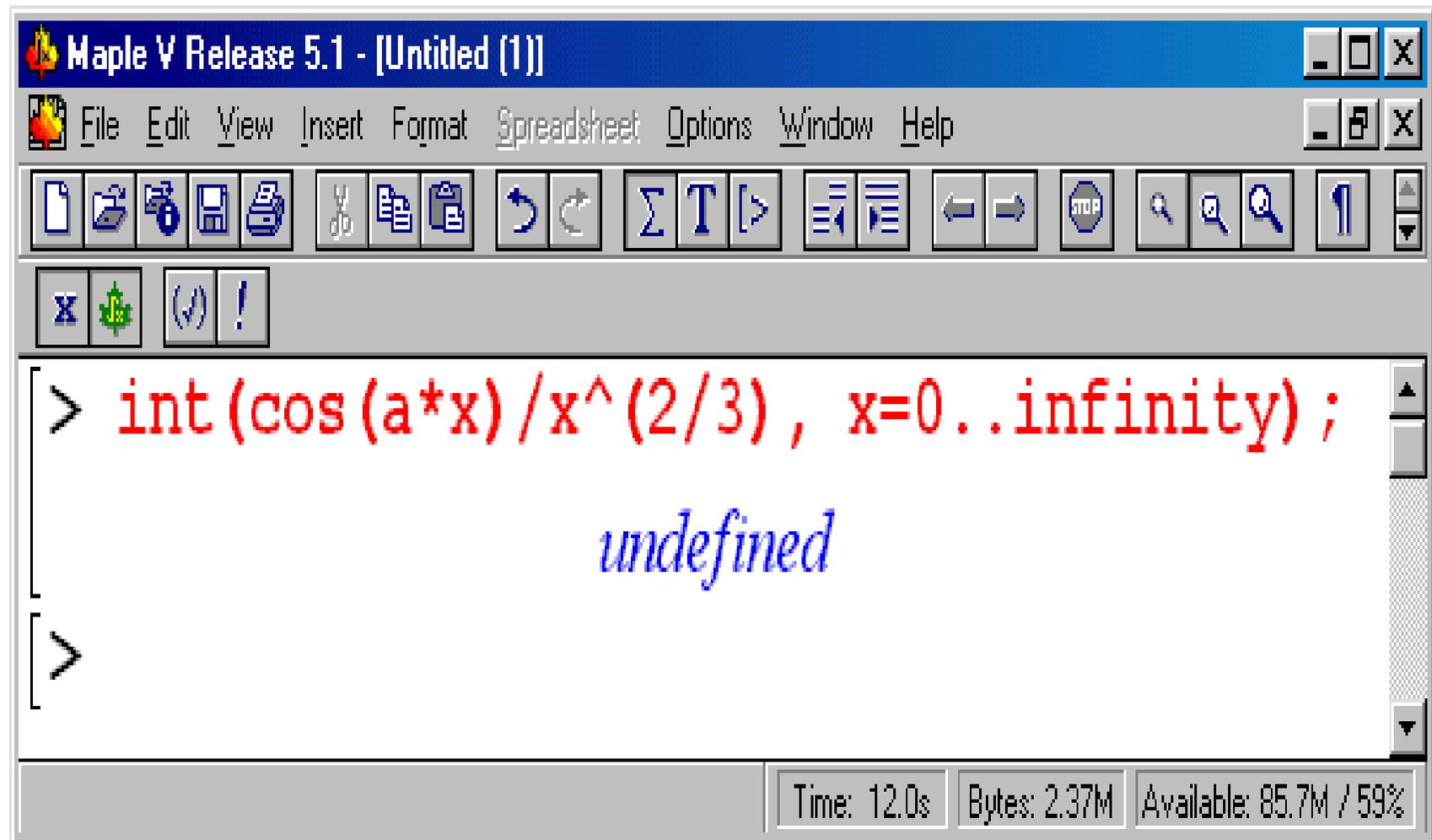
The screenshot shows a window titled "DERIVE for Windows - [Algebra ???.DFW]". The menu bar includes "File", "Edit", "Author", "Simplify", "Solve", "Calculus", "Declare", "Options", "Window", and "Help". The main display area contains the following text:

Another difficult definite integral:

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

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

Again, the corresponding Maple result



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

Time: 12.0s Bytes: 2.37M Available: 85.7M / 59%

Programming Enhancements

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

An old definition in the new language

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

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

User
```

} Old Style

|| New Style

Initialize local variables and increment operators

```
DERIVE for Windows - [Algebra 5: dij.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

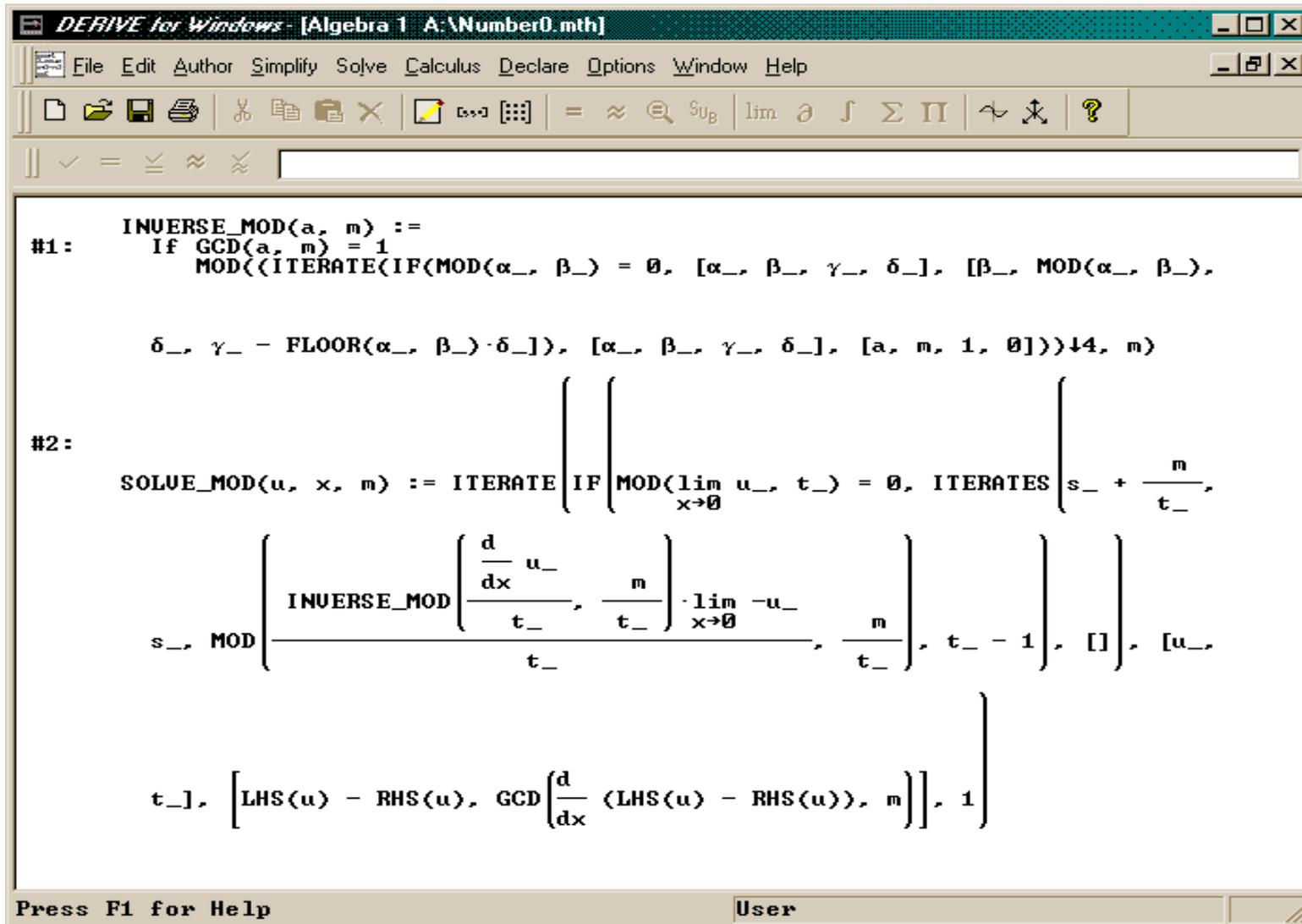
Better_poly_degree(u, x, n := -1) :=
  Loop
  #2:   If u = 0
        RETURN n
        u := DIF(u, x)
        n :=+ 1
```

Initialize local variable

Increment n

User

The old SOLVE_MOD - messy isn't it?

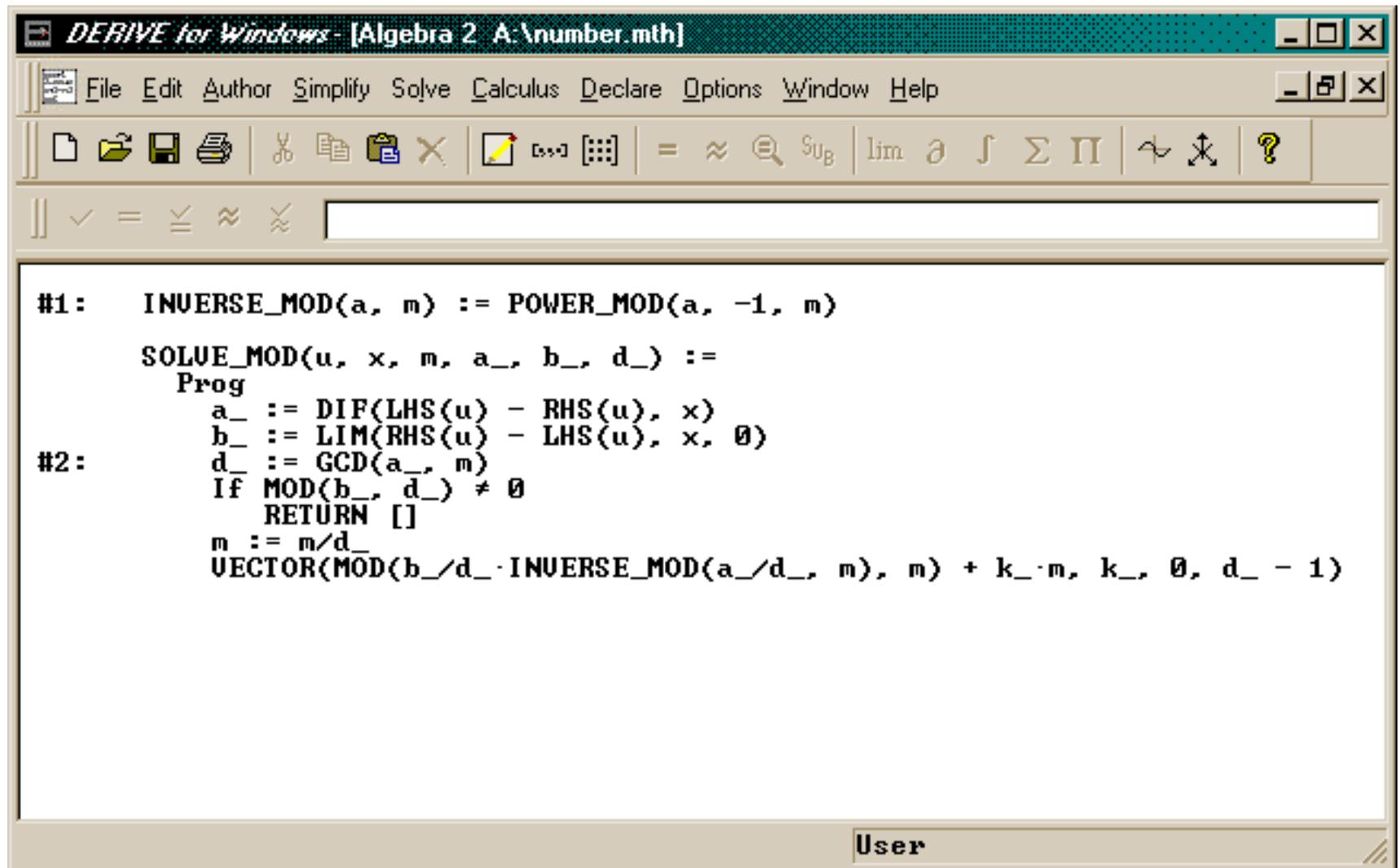


```

#1:  INVERSE_MOD(a, m) :=
      If GCD(a, m) = 1
      MOD((ITERATE(IF(MOD(alpha_, beta_) = 0, [alpha_, beta_, gamma_, delta_], [beta_, MOD(alpha_, beta_),
      delta_, gamma_ - FLOOR(alpha_, beta_) * delta_], [alpha_, beta_, gamma_, delta_], [a, m, 1, 0])) + 4, m)

#2:  SOLVE_MOD(u, x, m) := ITERATE(IF(MOD(lim_{x to 0} u_, t_) = 0, ITERATES(s_ + m/t_,
      s_, MOD(INVERSE_MOD(d/dx u_ / t_, m) * lim_{x to 0} -u_ / t_, m), t_ - 1, []), [u_,
      t_], [LHS(u) - RHS(u), GCD(d/dx (LHS(u) - RHS(u)), m)]), 1)
  
```

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, mathematical symbols, and a help icon. Below the toolbar is a status bar with symbols for comparison operators. The main workspace contains the following code:

```
#1:  INUERSE_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_·INUERSE_MOD(a_/d_, m), m) + k_·m, k_, 0, d_ - 1)
```

The status bar at the bottom right of the window displays 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***®.