

ACORN SOFT

Algebraic Manipulation

for the BBC Microcomputer Models A and B

Loading instructions

There are four programs on this cassette:

POLYNOM

RATIONAL

TRIGONOM

FOURIER

To load the programs, enter for example,

CHAIN "POLYNOM"

Each program will take about one minute to load.

Introduction

The four programs in the Algebraic Manipulation Pack will perform a wide variety of mathematical manipulations, such as expanding and simplifying different types of algebraic and trigonometric expressions, and symbolically differentiating or integrating them.

General purpose symbolic mathematical packages are available only for large computers and generally require several times the amount of memory available on any micro. The Acornsoft Algebraic Manipulation Package uses original mathematical techniques to enable each program to perform a limited number of types of algebraic manipulation on a micro. The method is basically to make several key substitutions into the expression supplied by the user: the values returned are then used to construct a simplified equivalent expression.

POLYNOM

The Polynomial program will expand polynomials in X, Y and Z, and will integrate or differentiate with respect to X.

Enter the expression for expansion using X, Y and Z, and any constants or parentheses required. Then to the prompt:

E/D/I/N/Q?

enter a single letter to designate Expand, Derivative, Integral, New expression, or Quit: alternatively, press RETURN for a menu.

Examples

(Note: User input is underlined to distinguish it from computer output.)

A = $(x+1)^4$

E/D/I/N/Q? E

A = $X^4 + 4X^3 + 6X^2 + 4X + 1$

E/D/I/N/Q? D

Algebraic Manipulation Package
POLYNOM
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Type the expression in X, Y and Z.

$$A = (X+1)^4$$

E/D/I/N/Q ? E

$$A = X^4 + 4X^3 + 6X^2 + 4X + 1$$

E/D/I/N/Q ? D

$$dA/dX = 4X^3 + 12X^2 + 12X + 4$$

E/D/I/N/Q ? _

$$dA/dX = 4X^3 + 12X^2 + 12X + 4$$

E/D/I/N/Q? N

$$A = \frac{X*(Y^3-Z)/2 - (X+Y)*(X-2*Y)*(Y-4*X) + (X-Y)^6}{}$$

E/D/I/N/Q? E

$$A = 4X^3 - 5X^2Y - 7XY^2 + 1.5XY - 0.5XZ + 6X + 2Y^3 - 6Y$$

E/D/I/N/Q? I

$$IA \, dX = X^4 - (5/3)X^3Y - (7/2)X^2Y^2 + 0.75X^2Y - 0.25X^2Z + 3X^2 + 2Y^3 - 6XY$$

E/D/I/N/Q? N

$$A = \frac{(X+1)^6 + (X+Y+1)^4 + (X+Y+Z+1)^2}{}$$

E/D/I/N/Q? E

$$A = X^6 + 6X^5 + 16X^4 + 4X^3Y + 24X^3 + 6X^2Y^2 + 12X^2Y + 22X^2 + 4XY^3 + 12XY^2 + 14XY + 2XZ + 12X + Y^4 + 4Y^3 + 7Y^2 + 2YZ + 6Y + Z^2 + 2Z + 3$$

E/D/I/N/Q? D

$$dA/dX = 6X^5 + 30X^4 + 64X^3 + 12X^2Y + 72X^2 + 12XY^2 + 24XY^2 + 44X + 4Y^3 + 12Y^2 + 14Y + 2Z + 12$$

Accuracy

The expression must be such that the degree of any term containing X is 6 or less, that of any term containing Y is 4 or less, any containing Z is 2 or less. If the exact expansion contains terms of greater degree than these such terms will be lost, and inaccuracy will be introduced into the coefficients of the other terms.

RATIONAL

The Rational program expands an expression in X into the form $p(X)/q(X)$ where $p(X)$ and $q(X)$ are polynomials of degree four or less in X.

Enter the expression in terms of X. The program will print the expanded expression, then prompt to rerun (with a new expression) or quit.

Examples

$$A = \frac{1+(1-X)/(1+X)+(2-X)/(2+X)}{X^2+3X+2}$$

This simplifies to

$$\frac{-X^2+3X+6}{X^2+3X+2}$$

Press space bar to start again.

$$A = \frac{((X+1)*(X-2)*(X+3)) / ((X-1)*(X+2)*(X-3))}{X^3 + 2X^2 - 5X - 6}$$

This simplifies to

$$\frac{X^3 + 2X^2 - 5X - 6}{X^3 - 2X^2 - 5X + 6}$$

Accuracy

The expression must be such that, when expressed in the form $p(X)/q(X)$, $p(X)$ and $q(X)$ are polynomials of degree four or less. If this is not the case, inaccuracy may occur, and the resultant expression may be more complex than the original expression.

TRIGONOM

The Trigonometry program expands trigonometric expressions in X and Y into a linear sum of simple trigonometric functions, and will integrate and differentiate with respect to X.

Enter the expression in terms of SIN, COS, TAN, COT, SEC or CSC (cosecant) of X or a multiple of X, and SIN or COS of Y. PI may be used, and radian measure is assumed. To the prompt:

E/D/I/N/Q?

reply as for the polynomial program. Alternatively, press RETURN for a menu.

Examples

$$A = \frac{2*\text{TANX}*\text{TANX} - \text{COTX}*\text{CSCX} + 3*\text{COS}(2*X)/4 + \text{SINX}*\text{COSY}}{E}$$

E/D/I/N/Q? E

$$A = -\text{COTX}.\text{CSCX} + 2\text{SEC}^2\text{X} - 1.25 + \text{SINX}.\text{COSY} - 1.5\text{SIN}^2\text{X}$$

E/D/I/N/Q? I

$$\text{IA dX} = \text{CSCX} + 2\text{TANX} - 1.25\text{X} - \text{COSX}.\text{COSY} - 0.75(\text{X} - \text{SINX}.\text{COSX})$$

E/D/I/N/Q? N

$$A = \frac{\text{SECX}}{I}$$

E/D/I/N/Q? I

$$\text{IA dX} = \text{LN TAN}(X/2 + \text{PI}/4)$$

E/D/I/N/Q? D

$$dA/dX = \text{TANX}.\text{SECX}$$

E/D/I/N/Q? N

$$A = \frac{((\text{SIN}(X + 3*\text{PI}/2))/\text{COS}(X + \text{PI})) + ((\text{COS}(X - 3*\text{PI}/2))/\text{SIN}(X + \text{PI}/2))}{E}$$

E/D/I/N/Q? E

$$A = -\text{TANX} + 1$$

E/D/I/N/Q? D

$$dA/dX = -\text{SEC}^2 X$$

E/D/I/N/Q? I

$$IA \, dX = \text{LN COSX} + X$$

Accuracy

The program uses the following functions to generate the expansion:

1, TANX, SECX, COTX, CSCX, $\text{SEC}^2 X$ (= SECX.SECX), COTX, TANX, SECX, CSCX, SINY, COSY, COSX.SINY, COSX.COSY, SINX, SINX.SINY, SINX.COSY, SINX.COSX, $\text{SIN}^2 X$.

If the expression cannot be exactly represented by a linear combination of these functions, the expansion given by the program will be inaccurate, and will frequently be much more complex than the original expression.

FOURIER

The Fourier program transforms products and powers of sines and cosines into linear combinations of sines and cosines of integer multiples of X, and will integrate or differentiate with respect to X. The expression is entered in terms of X, as in the polynomial program, using SIN and COS of (N*X).

The constant PI may be used, and radian measure is assumed. To the prompt:

E/D/I/N/Q?

reply as for the polynomial program. Alternatively, press RETURN for a menu.

Example

$$A = \frac{\text{SIN}(2*X)*\text{SIN}(5*X) - 4*\text{SINX}* \text{COS}(3*X)}$$

E/D/I/N/Q? E

$$A = 2\text{SIN}(2X) + 0.5\text{COS}(3X) - 2\text{SIN}(4X) - 0.5\text{COS}(7X)$$

E/D/I/N/Q? D

$$dA/dX = 4\text{COS}(2X) - 1.5\text{SIN}(3X) - 8\text{COS}(4X) - 3.5\text{SIN}(7X)$$

E/D/I/N/Q? N

$$A = (\text{COSX} + \text{SINX})^8$$

E/D/I/N/Q? E

$$A = 4.375 + 7\text{SIN}(2X) - 3.5\text{COS}(4X) - \text{SIN}(6X) + 0.12500002\text{COS}(8X)$$

E/D/I/N/Q? D

$$dA/dX = 14\text{COS}(2X) + 14\text{SIN}(4X) - 6\text{COS}(6X) - \text{SIN}(8X)$$

E/D/I/N/Q? I

$$IA \, dX = 4.375X - (3.5/1)\text{COS}(2X) - 0.875\text{SIN}(4X) + (0.5/3)\text{COS}(6X) + 1.56250025E - 2\text{SIN}(8X)$$

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