Polynomial Arithmetic Utility
Version 6.0 RC1

$$x^2 + 7x - 3$$

$$4a^3 + 7a^2 + a$$

$$nm^2 - m$$

$$3x - 2$$

$$5$$

by Anthony Cagliano

copyright © 2012 – ClrHome Productions

Thank you for choosing the **Polynomial Arithmetic Utility**, designed, programmed, and administrated by Anthony Cagliano, internet alias 'ACagliano', and optimized by Kevin Rhodes. This utility makes adding, subtracting, multiplying, and dividing polynomials easy. The drawback is that it does not show work. That aside, it is a very compact, precise program, that will work on most simple polynomial arithmetic problems.

First off, this program is designed only for use on the Z80 line of Texas Instruments graphing calculators. As such, it will only work on the following models:

- TI-83+
- TI-83+ SE
- TI-84+
- TI-84+ SE
- TI-84+ emulator on the TI-Nspire

The program has not been tested on any other calculator model, but it is possible that it may work on the TI-83. However, its usage in this manner is neither supported nor recommended. Want to report a bug or request a feature. Use the Contact Form at http://ac.clrhome.org.

Warning

This program is *Release Candidate*, a more-stable-than-beta program release. Release candidates are testing releases, and thus inherit a degree of beta instability. Please note that this program has been intensively tested on the designer's calculator and seems to function without issue. If no issues are reported within two weeks of issue of this release candidate, then the 'release candidate' designation will be removed.

Installation

To install this program on your calculator, you will need either TI Connect for Windows, TI Connect X for Macintosh, or TiLP for Linux (TiLP will also work on Windows and on Macintosh computers running an operating system older than 10.7). TI Connect may be downloaded from http://education.ti.com. TiLP can be downloaded from http://lpg.ticalc.org/prj_tilp/. You will also need the TI Connectivity Cable. One should have come with your calculator. If you do not have one, any USB A to Mini B cable will work. If you do not have this, you can type in the program yourself, via the [PRGM] ▯ *New* ▯ *Create New* menu. The source code is included in this package.

To use TI Connect or TI Connect X, you will need to start up the program, then select *TI Device Explorer*. If your calculator is connected to your computer, you should see a list of variables on your calculator. Select the program (POLYDIV.8Xp is the file name), and drag it onto the screen where you see the variables on your calculator. The program will be transferred. Once it says done, or stops loading, check your calculator. You should see a program called "POLYDIV".

To use TiLP on Linux, you will need to install it first. Type the following command into your terminal:

```
sudo apt-get install tilp2
```

You will be asked to confirm. Type in "Y" for yes and let the computer do its magic. Once it is done, you will need to patch the program, because it does not support the later calculator models or cables. To do this, type the following commands into your terminal:

```
wget
http://launchpadlibrarian.net/79510370/new-devices-and-fixed
-sysfs-warning.patch

sudo patch /lib/udev/rules.d/45-libticables.rules <
new-devices-and-fixed-sysfs-warning.patch
```

Once the patch has been installed, you can then run the program, from the command line, by specifying the calculator type and the type of connection. Use the following:

```
sudo tilp  --calc=calc type --cable=DirectLink

where calc type is ti83+ or ti84+, depending on your calculator
model
```

TiLP will load, and if will recognize your calculator. Using a similar method to that used by TI Connect, you can click on the POLYDIV.8Xp file and drag it onto the list of variables on your calculator. The transfer will then complete and you are done.

Usage

As of Version 4.3, this program supports polynomial multiplication, division, addition, and subtraction. As of Version 6.0, this program supports direct input of the polynomials. You no longer need to input the number of terms in the polynomial, followed by each coefficient, one-by-one. You may simply enter the

polynomial, exactly as you see it. The program parses your input and builds the lists. You may also enter '-1' rather than a valid polynomial to recall the last Operand 1 used. You may enter '-2' to recall the last Operand 2 and '-3' to recall the result of the last operation (leave out the single-quotes).

Once you have provided the polynomials, you will be presented with a menu, enabling you to select what to do with the two polynomials. **Please note, that for subtraction and division, Operand 1 will be treated as the minuend and dividend and Operand 2 will be treated as the subtrahend and divisor, respectively**. Selecting an option launches the appropriate algorithm, and after a short pause, during which the answer is computed, the result of the operation is shown on the screen. As of Version 6.0, the result is displayed as a polynomial, not as a list. For those of you who wish to use the results, the TI List File "ANS" will hold the answer. For division only, the remainder is in TI List File "TEMP2".

The Algorithms

This program utilizes very simple algorithms. These are very common-sense oriented to use on pen and paper, but as for making them work on a computational device...well, let's just say it wasn't fun.

For division, the algorithm involves looking at the dividend n terms at a time, where n is the number of terms in the divisor. Then, it divides the first term of the dividend into the first term in the divisor. The result becomes the first term of the quotient. Multiply that by the divisor and subtract the result from the dividend. Then we load in the next term of the dividend and repeat the process until we reach the last term.

For multiplication, we use the same rules you would follow for standard multiplication. We multiply the first term of the second operand by the entire first operand. Then we multiply the next term out and add it to the results of the first, and keep going in this fashion until we hit the end. This must be done in reverse order, starting with the last term and moving to the first. This algorithm is fairly trivial to implement, one you get over hurdles with ensuring your added lists are the same size.

For addition and subtraction, we must simply ensure that our lists are the same size, then we can add the lists or subtract them. No algorithm is really involved. Granted, most users won't need these operations, but they are included to save some time.

Version History

Version 1.0 (2006)

- First official release.
- Used synthetic division algorithm that was slow, supported only integers, and was limited in size of polynomials.

Version 2.0 (2012)
- Distribution upgrade.
- Used renewed algorithm that is faster, can handle theoretically infinitely large polynomials, but supports only integers.
- UI vastly improved.

Version 2.1 (2012)
- Distribution bug-fix.
- Output UI revised to fix a bug where results that overflowed the screen would be cut off. It now pauses and allows you to scroll through the entire result.

Version 3.1 (2012)
- Distribution upgrade.
- Program now supports integer coefficients in the dividend, divisor, and quotient.

Version 3.2 (2012)
- Distribution bug-fix.
- Input UI revised to fix a confusing bug, causing the "Exponent n" prompt to appear amongst the text under it. As of Version 3.2, this line clears the text under it on the entire line.

Version 4.3 (2012)
- Distribution upgrade.
- Support for multiplying, adding, and subtracting polynomials now added.

Version 5.3 (2012)
- Distribution upgrade.
- All algorithms upgraded with assistance from Kevin Rhodes. They are now faster and more concise.
- Save and recall feature added, allowing you to use the last operands you entered, rather than retype them.
- Version string added to splash screen.

Version 6.0 RC1 (2012)
- Distribution upgrade
- Polynomial input and result display changed so that users may input the actual polynomial rather than a list of coefficients and that the result is displayed as a polynomial rather than a list of coefficients.

Legal Notices

This program is copyright © 2012 – ClrHome Productions. The package was designed, programmed, and distributed by Anthony Cagliano, internet alias 'ACagliano". This section provides legal stipulations with regard to the fair use of this program, warranty information, and rights of users to modify and redistribute the package.

I hereby issue to all end users an unlimited license to redistribute this software package, with the following attached preconditions: (1) That the coding is not modified in any way without my permission, and (2) that the entire package is sent, so that any recipients will have the documentation as well. I attach stipulation 1 so that I can provide full product support for all circulating copies. Having modified versions floating around that I do not know about complicates supporting the product.

As I do with all releases, I issue an unlimited lifetime warranty, applicable to the software of the program, and to the software of your calculator. This program is written in TI-Basic, a weak programming language with virtually no capacity to have undesired effects upon your calculator. That being said, in the unlikely event that this program does cause damage, support is available for as long as you use the software. Contact me at http://ac.clrhome.org.