Program-Link – Connecting Computers and Casio Calculators

Overview

The FA-122 Program-Link program enables transfer of data and programs between a Casio graphics calculator and a Windows or MacOS computer. Valuable examples include:

1. Data and Program transmission from the calculator to a computer
   - Capturing a screen image as a bitmap, which can then be used in a word processor to produce handouts and transparencies.
   - Backing up the complete state of the calculator's memory, which can later be restored (see below).
   - Backing up data or programs created on the calculator.
   - Backing up data loaded into the calculator from a data gathering device.
2. Data and Program transmission from a computer to the calculator
   - Downloading data or programs to the calculator (see extended discussion below).
   - Restoring backed up information, such as the whole state of a calculator's memory. This can be valuable for initializing a classroom set of calculators so that they all have the same programs and data.

Downloading is probably the most important use of Program-Link; this is orders of magnitude easier than entering programs or data through the calculator keypad. Easy enough that sharing among teachers and campuses becomes a reality. Calculator programs (providing new functions) and data sets (for analysis) are available:

1. On the Internet
2. On diskettes from Casio, available through the Milby Math Department
3. From you – Program-Link provides a graphical interface for writing calculator programs and converting data (even from spreadsheets) to calculator format.

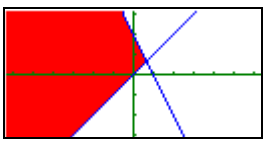
Connecting

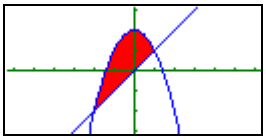
1. Execute the Program-Link program. This can be obtained from the Milby Math Department; follow the printed directions for installing from diskette.
2. Connect the cable to the computer's COM port and the calculator's data port. Be sure to push the connector all the way into the calculator, ***push hard!***
3. Make sure the calculator has been turned off, then turn it back on so that it will notice the connection.

You should now be ready to transfer data. (The connection process is similar for connecting two calculators.)

Transferring

Screen Capture





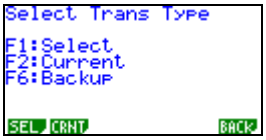
1. Make sure you are properly connected and are running Program-Link (see **Connecting**, above).
2. Check the calculator's mode for image transfer – on the calculator,
   - Press **Menu**
   - Pick **Link** [C] from the menu
   - Pick **Image Set Mode** [F6]
   - Pick **Monochrome** [F2] or **Color** [F3] (You probably want Color, even for producing handouts – grayscale looks better than pure black and white).
   - Press **Menu** again to get back to a familiar screen.

2. In the calculator, make sure you are displaying the screen you want to capture.
3. In Program-Link, click on the **Screen Capture** icon (like a screen with a camera) or pick **Screen Capture** from the **Link** menu.
4. On the calculator, press the F ←→ D key (Fractional to Decimal) to begin sending the current calculator screen.

Calculator screen bitmaps can brought into Word documents using **Insert Picture** and positioned using **Insert Frame**.

Uploading: Sending from Calculator to Computer

1. Make sure you have the desired data or program on the calculator.
2. Make sure you are properly connected and are running Program-Link (see **Connecting**, above).
1. In Program-Link, click on the **Receive** icon (blue arrow coming from a calculator) or pick **Receive** from the **Link** menu. The computer is now ready to receive.
2. On the calculator, send the data:
   - Press **Menu**
   - Pick **Link** [C] from the menu
   - Pick **Transmit** [F1]
   - Pick **Select** [F1] to choose the data to send.
     Other choices are to send whatever you last chose (F2: Current)
     or to send the complete calculator data (F6: Backup)
   - Use the arrow keys to highlight the program(s) or data set(s) you want to send.
   - Press **SEL** [F1] to tag each item being sent. A triangle will mark each selected item.
   - Press **TRAN** [F6] to finally send the data to the computer. (Be sure the computer is ready; see steps 1-3.)



Downloading: Receiving on the Calculator from the Computer

1. Make sure you have the desired data or program on the computer.
2. Make sure you are properly connected and are running Program-Link (see **Connecting**, above).
1. On the calculator, prepare to receive:
   - Press **Menu**
   - Pick **Link** [C] from the menu
   - Pick F2: **Receive**
2. On the computer, send one list or catalog from Program-Link.
3. Note that you will be overwriting any data or programs which have the same name as the files you are downloading.

Transfering Data Between Calculators

This is essentially the same process as uploading or downloading. It doesn't involve **Program-Link**, but I had some extra space here so I though I'd mention it.

1. After a cable has been plugged securely into both calculators, turn each one off and back on again so that they notice they're connected.
2. Treat one calculator as the Sending Calculator and follow the instructions for Uploading above.
3. Treat the other calculator as the Receiving Calculator and follow the instructions for Downloading above.

Suggested activity: have each student prepare a series of numbers and save it in list storage L1 or L2. Then have them exchange data and try to guess the rule for the other students series. Make sure that students who created a list in L1 exchange with students who created a list in L2; incoming data always overwrites the local storage with the same name.

Trouble-Shooting

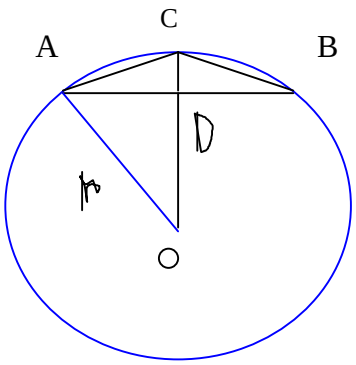
- You try to send or receive and nothing happens – double-check that you are properly connected and running Program-Link (see **Connecting**).
- You go to **Link** menu and find you're thrown into a lower-level menu such as the **Transmit** or **Receive** menu – just hit the **Exit** button, under the gray **Menu** button, to go back up one level.

Introduction - The perimeter of a regular polygon inscribed in a circle can be used to get approximations of Π.

The focus of this exercise is to write a program to show as the number of sides of the polygon increase the better the approximation is for Π.

Problem: *Given the length of a side of a regular polygon of n sides, it is possible to fine the length of a side of a polygon of the same radius with 2n sided*

First Polygon - A Square



$(DO)^2 + (AD)^2 = (OA)^2$

$s = AB \quad ; \frac{1}{2} s = AD$

$r = OA$

$(DO)^2 + (1/2\ s)^2 = r^2$

$\underline{DO = Sqrt (r^2 - (1/2\ s)^2)}$

$AD = DO \ ; \quad 2(AD)^2 = r^2 \ ; \quad AD = r / (Sqrt(2)) \ ; \ \underline{s = 2r / (Sqrt(2))}$

Next Polygon

$CD = r - DO \ ; \ AD = \frac{1}{2} s$

$(AC)^2 = (\frac{1}{2} s)^2 + (r - \underline{Sqrt (r^2 - (1/2\ s)^2)})^2$

$(AC)^2 = 2 r^2 - r (Sqrt (4 r^2 - s^2)$

$\underline{AC = Sqrt (2 r^2 - r (Sqrt (4 r^2 - s^2)))}$

The Program:

Let r = ½ , s = 0.70710681, N = 4

0.5→R~
0.70710681→S~
4 → N >
While N < 1025
N x S → A >
Sqrt (2 x R x R – (R x Sqrt (4 x R x R - S x S))) →S~
2 x N → N >

WhileEnd

How to write the program

Select the *PRGM icon* in the Main Menu.
The Program List is displayed

Program List

Exe Edit New Del Del-A >

F1 F2 F3 F4 F5 F6

Select F3 (New)

Enter Program Name

```
Program Name
[PIAPPROX  ]



 Run    Base          Key       Sybl
```

F1 F2 F5 F6

Press EXE

```
==========PIAPPROX ======================



 Top   Btm   Src   Menu       Sybl
```

Enter Radius and assign the value to variable R

```
==========PIAPPROX ======================
0.5 → R~
```

```
Top    Btm    Src    Menu        Sybl
```

Enter Length of side of Square and assign the value to variable S

```
==========PIAPPROX ======================
0.5 → R~
0.707106781 → S~

Top    Btm    Src    Menu        Sybl
```

Enter Number of sides of Square and assign the value to variable N

```
==========PIAPPROX ======================
0.5 → R~
0.707106781 → S~
4 → N

Top    Btm    Src    Menu        Sybl
```

Create Loop to multiply number of sides by 2 (more sides) and calculate the perimeter of the new polygon

```
==========PIAPPROX ======================
0.5 → R~
0.707106781 → S~
4 → N >
```

```
While  N < 1025
```

Calculate the perimeter of the current polygon and calculate the length of one side of the new polygon

```
==========PIAPPROX ======================
0.5 → R~
0.707106781 → S~
4 → N >
While  N < 1025
N x S → A >
Sqrt ( 2 x R x R -  ( R x Sqrt ( 4 x R x R – S x S) ) ) → S~
```

Calculate the number of sides of the new polygon

```
==========PIAPPROX ======================
0.5 → R~
0.707106781 → S~
4 → N >
While  N < 1025
N x S → A >
Sqrt ( 2 x R x R -  ( R x Sqrt ( 4 x R x R – S x S) ) ) → S~
2 x N → N>
```

Press Shift Quit

Select PGRM icon from the Main Menu ----- Program List ---- Select program PIAPROX and press F1 (Exe).

The following data should appear --- Note to get the next value press Exe

4.000000000
2.828427124
8.000000000
3.061467458
16.00000000
3.121445151
32.00000000
3.136548489
64.00000000
3.140331156
128.0000000
3.141277250
256.0000000
3.141513800
512.0000000
3.141572939
1024.000000
3.141587724

Casio Activity: The Power of Compounding

You decide to start a savings program with a $1,000 investment the beginning of each year. Furthermore, you expect to earn 10% annually in a well diversified mutual fund invested in growth stocks. Program your calculator to calculate the cumulative value of your investment at the end of each year. Continue this for ten years and record your results below. Ignore taxes since you will be investing in a tax-advantaged account such as an IRA, a 403B, or a 401K.

Year	Investment	Cumulative Value
1	$1,000	_____
2	1,000	_____
3	1,000	_____
4	1,000	_____
5	1,000	_____
6	1,000	_____
7	1,000	_____
8	1,000	_____
9	1,000	_____
10	1,000	_____

Designate "A" as the storage location for the annual investment. Designate "B" as the storage location for 1 plus the rate of return. Let "C" be the cumulative value of the investment. For each year "A" will be added to the beginning-of-the-year value for "C" and the sum would be multiplied by "B" to determine the end-of-the-year value for "C." Steps to solve the problem are as follows:

Initialize values for A, B, and C from RUN menu:
1000 ==> ALPHA A EXE
1.1==>ALPHA B EXE
0==>ALPHA C EXE

Enter program from PRGM menu:

F3 COM EXE
(ALPHA C + ALPHA A) X ALPHA B ===> ALPHA C EXE
EXIT EXIT

Now run the program:
Highlight COM which is the name of the prgram you entered.
Touch EXE to calculate $1,100 for the value of the investment at the end of Year 1.
Touch EXE to calculate $2,300 for the value of the investment at the end of Year 2.

Continue touching EXE to calculate the value for the remaining years, 3 through 10.

After these impressive results, you decide to further investigate your wealth accumulation potential by using more aggressive saving and taking full advantage of your company's matching contribution of $750 each year. You plan to contribute $2,000 the beginning of the first year and will continue investing more each year according to the schedule below. You assume an 8% annual return. Write a program which will prompt you for the beginning contribution each year and then will calculate the cumulative value of your investment. Complete the table below.

Year	Investment	Cumulative Value
1	$2,000	_____
2	2,500	_____
3	3,000	_____
4	3,500	_____
5	4,000	_____
6	5,000	_____
7	5,000	_____
8	5,000	_____
9	5,000	_____
10	5,000	_____

With this activity you will program in a "?" to prompt you for the amount of the investment each year. Steps for the Casio are shown below.

Initialize values from RUN menu:
0 ==> ALPHA A EXE
1.08 ==> ALPHA B EXE
0 ==> ALPHA C EXE

Enter program from PRGM menu:
F3 COMP EXE
SHIFT PRGM F4 ==> ALPHA A F6 F5
(ALPHA C + ALPHA A + 750) X ALPHA B ==> ALPHA C EXE
EXIT EXIT

Screen shows: ?==>A:(C + A + 750) X B ==> C

Now run the program:
Highlight COMP the name of the second program.
Enter EXE 2000 EXE to calculate $2,970 for the value at the end of Year 1.
Enter EXE 2500 EXE to calculate $6,717 for the value at the end of Year 2.

Continue this pattern to calculate the value for the remaining years, 3 through 10.