HP Calculator Programming

Richard J. Nelson

Introduction

Do you use an HP calculator that has a programming capability, and do you actually use it?

Of the 24 models, see Table 1 below, 23 are on the HP website 13, or 54.2%, are programmable. If the Home and Office machines are omitted, the numbers are: 17 models, and 13 or 76.5%, are programmable. What does this mean?

A program is a sequence of instructions (functions and/or data) that are keyed (or loaded) into the calculator's memory that will solve a particular problem or provide specific information. A program capability also includes special instructions that provide prompting for inputs and labeling for outputs. Another aspect of a program capability is the ability to perform decision logic so the particular parts of a program may be changed depending on the results of previous instructions. This capability provides "intelligence" to the program.

The program capability of the 10 current models ranges from very simple such as the HP-12C to very complex (and very powerful) such as the HP 50g. Older HP calculators such as the HP-71B or HP-75C used a computer like programming language called BASIC. The HP-12C and HP-15C programming language is an RPN FOCAL⁽¹⁾ like language, and the HP 50g uses an RPL programming language. The algebraic calculators use what may be called an Aplet programming language.

#	Financial Calculators	Scientific & Graphing	Home & Office
1	HP 10bII	HP 10s	HP Calcpad 100
2	HP 10bII+	HP-15C Limited Edition	HP CalcPad 200
3	HP 20b	HP 33s	OfficeCalc 100
4	HP 30b	HP 35s	OfficeCalc 200
5	HP-12C	HP 39gs	OfficeCalc 300
6	HP-12C 30 th Anniversary	HP 39gII	PrintCalc 100
7	HP-17bII+	HP 40gs	QuickCalc
8		HP 48gII	
9		HP 50g	
10		SmartCalc HP 300s	
	5 of 7 = 71% programmable	8 of 10 = 80% programmable	None programmable

Table 1 – Current HP Calculator Products (24)

Note: Programmable calculators are in blue.

Programmable Calculators

Very simple programmable calculators are often described as keystroke programmable. The idea is that if you wanted to make a calculation such as calculating the volume of a sphere using RPN;

$$V = \frac{4\pi r^3}{3}$$

you would key the radius, r, press ENTER twice, x twice (cubes the radius), π , x, 4, x, 3, \div . If the diameter is 2 inches the radius is 1 inch, and the volume is 4.188 cubic inches.

Now let's increase the diameter by 1/2 inch so the radius is 1.25 inches. The volume now is very nearly double or 8.181 cubic inches.

If you are an orange grower making a statistical size analysis of your oranges, and if you had dozens of problems to solve, you would soon get tired of pressing so many keys for each orange measured. The process of keying the same keystrokes and storing them in program memory is called "writing" a program. Even a simple program can be a big time saver if many problems of the same type are being solved. If it took you twice the time to put the keystrokes into memory as it did to make a single calculation you would save time starting with the third calculation. The calculations from then on would be solved nearly instantaneously.

There are two ways a program may be entered into a calculator. (1) By keying it into the calculator as just described, or (2) By down loading the program from an external source as the HP 50g does by using its USB or IrDA port. If the user is experienced with the model he or she uses the keying of short programs is very fast. Longer, more complex programs, however, are best down loaded. The *HP Solve* ongoing HP 48 One Minute Marvels column, started in issue 14, is an example of very useful and especially efficient programs that may be keyed into the RPL programmed HP 48/49/50 in one minute or less.

Running a program requires starting the program by pressing a key. Depending on the model a single keystroke or perhaps one with a shifted key is required. Running programs on HP calculators is easy and straight forward. When you have multiple programs in memory the convenience of running a particular program will depend on the programming feature set of the machine. Running multiple programs on the HP-12C, for example, is much more difficult than running hundreds of programs on an HP 50g. The latter has many more programming features.

Using vs. Writing Programs

You don't have to write programs in order to take advantage of using programs. One characteristic of calculator programmers is that they tend to collect programs because they want to take advantage of other programmer's expertise. Every programmable calculator user should learn to be able to key in a short program. This skill is very powerful, and it will allow you to greatly extend the capability of your calculator. Calculators are not only work-horse tools; they may also be a source of boredom relief and actual fun. See the examples of four games for the HP-12C in the article "The HP-12C, 30 Years and Counting" in *HP Solve* issue 25, page 9, I25,P9, Appendix C. The ability to write a game program is beyond the average HP-12C user, especially because the programming environment is so simple, but the ability of any HP-12C user to play the games should not limited because a small effort to learn how to load a program isn't made.

In the early days of calculators, especially the first two decades, the high end programmable scientific calculator was the most powerful tool a technical user could buy. There was a tremendous effort by HP and the HP user community to write and share programs. What most current users may not appreciate is the fact that these tens of thousands of programs will frequently run on today's models with little changes for the new/changed functions.

An example is the financial HP 20b or 30b that is repurposed into a high end RPN scientific calculator⁽²⁾. One of the sources for program ideas, as well as new functions to be added to the machine, is the PPC $ROM^{(3)}$.

There are many sources aside from a specific internet search for HP Calculator programs, RPN, RPL, or Aplet. Here are a few.

- Google "HP Calculator Aplets" for 230,000 results. Downloading Aplets to an HP 39/40gs is described in a pdf file by G. T. Springer at: <u>http://glencoe.mcgraw-hill.com/sites/dl/free/0078887046/628217/Aplets_to_the_HP_3940gs.pdf</u>
- 2. RPL programs may be found at: <u>http://www.hpcalc.org/</u>
- 3. RPL and RPN programs may be found at: <u>http://www.hpmuseum.org/</u>
- 4. RPN and RPL programs may be found on a DVD available at: <u>http://www.pahhc.org/ppccdrom.htm</u>. This DVD has all the User Community Newsletters (where many programs were published), the PPC ROM User's Manual, 29 years of HPCC Datafile, the Australian Newsletters, and HHC Conference Proceedings.
- 5. HP's Calculator website: http://h30248.www3.hp.com/calcclub/

Observations and Conclusions

More than three quarters of HP's Financial, Scientific, and Graphic calculators are programmable. This means that HP is providing the greatest value to their users with a programmable "language" of a type that may be described as RPN FOCAL like, RPL, or Aplet. The best programming features will include easy editing, input prompting, labeling of results, and conditional branching that provides the "intelligence" needed for advanced programming. Most HP calculators have a single keystroke capability for running programs and considerable time may be saved if multiple calculations of the same type are required. It is very useful for any programmable calculator user to learn how to enter programs into their machine because you don't have to be a programmer to save time.

Programs may be user keyed or loaded through an I/O port. Many programs written years or decades ago will run on current models. A table of current models is provided with the programmable machines indicated. Internet resources are provided as a resource for the reader to find a program to suit their current needs.

HP Calculator Programming - Notes

- (1) FOCAL is a folklore name given to the programming language RPN HP-41C/CV/CX machines. See HP Solve Issue 23 page 34, 123,P34. Most of the RPN programmable calculators from the HP-65 to the HP-41 used a similar programming "language" that may be described as FOCAL like.
- (2) See *HP Solve* issue 24, page 22, I24,P22, for the article by Jake Schwartz on Repurposing the HP 20b/30b Calculator platform. An update on this HP user Community project is included in this issue.
- (3) The PPC ROM was an early 80's HP User Community project that developed highly efficient programs that provide the core calculations to be applied to many very high level programming tasks. The programs were specific to the FOCAL language of the HP-41C/CV/CX machines, They were so well documented with so many applications examples, that the 500 page, telephone sized book, the <u>PPC ROM User's Manual</u>, apply to today's RPN machines. Hundreds of the smartest international minds contributed to these programs. See issue **HP Solve** 16 for an overview of the HP-41C.CV/CX in the article titled, "The HP-41System 30 Years old." The PPC ROM project was essentially the first "Community Software Development for Embedded Devices". See:

http://www.embeddedcomponents.com/blogs/2007/04/community-software-development-for-embedded-devices/

An HHC 2011 Conference presentation at HP San Diego, <u>The PPC ROM 30 Years Later</u>, provided a PPC ROM review with historical information previously unpublished. A video of the presentation, prepared by Eric Rechlin, may be found at: <u>http://www.youtube.com/watch?v=L-3SI5jRHv8</u>