Memento of Useful Tips and Tricks for HP50g

Merciadri[1] *Luca*

Abstract

This document presents a short list of math. important commands on HP50g. There is not much documentation about HP50g on Internet, so it completes the user's manual (see [HP06]).

1 Commands

1. **define(**$f(a, b, \cdots, y) = f(a, b, \cdots, y)$**)**: defines f (function of more than one variable).
2. **deriv(**$\mathrm{P}(x, y, z)$**,**$[x, y, z]$**)**: gives $\nabla(\mathrm{P}(x))$.
3. **desolve(**$g(f(x))$**,**$f(x)$**)**: solves any differential equation, if possible, if $f(x)$ is the unknown.
4. **egvl(**M**)**: gives the eigenvalues of M.
5. **egv(**M**)**: gives the eigenvectors and eigenvalues of M.
6. $f(x, y)$: gives $f(x, y)$.
7. **factormod(**$P(x)$**)**: gives the factorization of a given $P(x)$ polynomial.
8. **idn(**n**)**: gives I_n.
9. **image(**M**)**: gives im M.
10. **ilap**: inverse Laplace transform: $L^{-1}[F(s)] = f(t)$.
11. **invmod(**x**)**: performs the inverse of x modulo the current modulus.
12. **isol(**$f(t) = 0$**,'**t**')**: finds solutions of $f(t)$, by isolating t.
13. **ker(**M**)**: gives ker M.
14. **lagrange(**$[[x_1, x_2, x_3, \cdots], [y_1, y_2, y_3, \cdots]]$**)**: gives a Lagrange polynomial interpolation.
15. **lap**: Laplace transform: $L[f(t)] = F(s)$.
16. **lapl(**$\mathrm{P}(x, y, z)$**,**$[x, y, z]$**)**: gives $\nabla^2(\mathrm{P}(x)) = \nabla \bullet \nabla(\mathrm{P}(x))$.
17. **ldec(**$g(x)$**,**f_h**)**: gives the general solution of a linear ODE (with constant coeff.).
18. **lim(**$f(x)$**,** $a(+0)$**)**: $\lim_{x \to a^{(+)}} f(x)$.
19. **linsolve(**$[\mathrm{P}_1(x, y),\ \mathrm{P}_2(x, y)]$**,**$[x, y]$**)**: solves $\mathrm{P}_1(x, y)$ and $\mathrm{P}_2(x, y)$, according to x and y.
20. **lu(**M**)**: gives a Crout LU decomposition of M, using partial pivoting.
21. **mad(**M**)**: gives, in RPN mode: det M, M^{-1}, matrix coefficients of $p(x)$ so $(x \cdot I - A) \cdot p(x) = M(x) \cdot I$, and the characteristic polyn. of M.
22. **modsto(**x**)**: changes the current modulus to x.
23. **partfrac(**$f(x)$**)**: gives the decomposition of the rational $f(x)$ fraction into partial fractions.
24. **pcar(**M**)**: gives the characteristics polynomial of M, assuming M is a square matrix.
25. **signtab(**$f(x)$**)**: gives infor. on the sign of $f(x)$ through its domain.
26. **simult()**: allows > 1 functions to be plotted simultaneously.
27. **solve(**$\mathrm{P}(u) = c$**,** u**)**: isolates variable, finds solution(s).
28. **solvex(**$\mathrm{P}(x) = c$**)**: finds solution(s).
29. **subst(**$f(x)$**,** $g(x)$**)**: verifies if g is a solution of the O.D.E. $f(x)$.
30. **subst(**$f(x)$**,**a**)**: gives $f(a)$.
31. **tabval(**$f(x)$**,{**a b**}**): gives range of $f(x)$ between a and b.
32. **tabvar(**$f(x)$**)**: complete analysis of $f(x)$.
33. **taylr(**$f(x)$**,**x**,**a**)**: gives a Taylor series expansion of $f(x)$, for the order a.
34. **tran(**M**)**: gives the transposate of the M matrix.
35. **trn(**M**)**: gives the transconjugate ("adjoint") of the M matrix.
36. **vandermonde(**$n\ o\ \cdots\ p$**)**: generates V.

2 Plotting Functions

1. **Bar**: for plotting simple bar charts.
2. **Conic**: for plotting conic equations (circles, ellipses, hyperbolas, parabolas).
3. **Diff Eq**: for plotting the numerical solution of a linear differential equation.
4. **Fast3D**: for plotting curved surfaces in space.
5. **Function**: for equations of the form $y = f(x)$ in plane Cartesian coordinates.
6. **Gridmap**: for plotting real and imaginary part traces of a complex function.
7. **Histogram**: for plotting frequency histograms (statistical applications).
8. **Parametric**: for plotting equations of the form $x = x(t)$, $y = y(t)$ in the plane.
9. **Polar**: for equations of the from $r = f(\theta)$ in polar coordinates in the plane.
10. **Pr-Surface**: for parametric surfaces given by $x = x(u, v)$, $y = y(u, v)$, $z = z(u, v)$.
11. **Ps-Contour**: for plotting contour plots of surfaces.
12. **Scatter**: for plotting scatter plots of discrete data sets (statistical applications).
13. **Slopefield**: for plotting traces of the slopes of a function $f(x, y) = 0$.
14. **Truth**: for plotting inequalities in the plane.
15. **Wireframe**: for plotting curved surfaces in space showing wireframe grids.
16. **Y-Slice**: for plotting a slicing view of a function $f(x, y)$.

3 Built-in Shortcuts

1. **R-shift HOLD Enter**: changes between exact and approximate mode.
2. **Down**: opens appropriate editor for item on level one of the stack or history.
3. **Right**: swaps items on level one (*RPN*).
4. **Up**: accesses stack or history. Similar to HIST button.
5. **Left**: starts picture view to look at last graph or picture.
6. **R-shift Down**: displays full names of items in soft menu.
7. **R-shift Right**: X-modem server mode.
8. **R-shift HOLD Right**: Kermit server mode.
9. **L-shift HOLD TOOL**: toggles real/complex mode.
10. **R-shift Function keys**: recalls object.
11. **L-shift Function keys**: stores object (*RPN*).
12. **L-shift HOLD PREV**: jumps to the last menu you were in. (So if you go from the PRG menu into the MTH menu, this will jump back to the PRG menu.)
13. **L-shift HOLD UPDIR**: goes back to home, no matter how far down in a directory you are.

[1] Luca.Merciadri@student.ulg.ac.be

4 Common Problems

If you encounter problems with this calculator, many solutions could help you. Here they are:

1. To restart the calculator if there is a bug, press [ON], [F1], [F3] and wait a few seconds;
2. A more powerful solution is to press [ON], [F1] and [F6]. Then, you can press [F1] (yes) if you want the calculator to try to recover the data in `\HOME`; if you simply want it to erase `HOME` directory (and the port 0), press [F6] (no);
3. If you think a library has a problem, you can press [ON], [F3] and [←];
4. If there is a real problem, remove the batteries. Replace them immediately if you do not want to lose any information.

5 Communication with the Computer

5.1 On the Calculator

To allow the calculator to receive data, you have to press Right Shift (the red shift button) and the right arrow.

5.2 Using Microsoft Windows ©

If you are using Microsoft Windows ©, you can use the software called "HP48g, 49g, 50g series Calculator Connectivity Kit," edited by HP.

5.3 Using Linux

Evidently, if you are using Linux, it is a little bit more fair-haired, as habitually. If you use Ubuntu or another Debian-like distro, you can simply type

```
apt-get install ckermit
```

in a shell, with super-user's rights. For other distro's, you can use the following bash script, which will install `kermit`, or make it yourself.

```
#!/bin/bash
if [ $UID != 0 ]; then
echo "you need to be root to install ckermit"
exit
fi

if [ -x /usr/bin/wget ]; then
echo "ckermit download"; else
echo "wget is not installed on your computer"
exit
fi

wget ftp://kermit.columbia.edu/kermit/archives/cku201.tar.gz
mkdir /usr/local/src/kermit
mv cku201.tar.gz /usr/local/src/kermit
cd /usr/local/src/kermit
tar xvfz cku201.tar.gz
make linux
make install
echo "ckermit has been installed on your computer"
```

With a not Debian-like distro, you continue using

```
chmod +x ckermit_install.sh && ./ckermit_install.sh
```

Whatever the distro, you launch kermit using

```
kermit -l /dev/ttyS0
```

where "S0" is replaced by "S($x-1$)", x being the COM port where your calculator is located on your computer, and without braces.

In kermit, begin by typing the following text.

```
set carrier-watch off
robust
```

You can now send and receive files with your calculator. To send a file, type `send`, followed by the name of the file. To be in server mode, just type `server`: kermit will wait a file to be sent by the calculator, if any.

6 System Menu and Power

As you know, this calculator works on batteries. Anyway, you can use rechargeable batteries. Furthermore, you can power the calculator using the USB cable. Just plug it into the calculator and connect the USB cable to your computer. It should work. To test this, you can press [ON], and [F6], simultaneously. Then, press [8]. It should display something like "USB POWER WORK."

As you have noticed, the system menu has many functions, which are intuitive.

7 Installing Libraries

Libraries must be distingished from simple programs. They may be necessary for some of your programs. They always end with a `.lib`. The simplest way to *install* a library is to put it on a storage folder in your calculator (using tools described above). They then need to be copied (or moved, as you want), using the filer, in the FLASH, so in port `2:FLASH`. After this, just make a soft-reset, pressing simultaneously [ON] and [C]. Your librairies are now available through the LIB menu.

8 Installing Programs

When downloading a program, be sure that you do not need a special library to make it work. If you have installed the library/librairies it depends on, put your program in the APPS directory (in `/HOME`) in the calculator's storage. You can access it using `VAR` menu if you are in Algebraic mode. If you use RPN, it will only show the stack's state after the call to your program. A general way to launch your program is to go through your files folder, and press [EVAL] when the cursor is on the program you want to launch.

9 Modifying KEYTIME

The `KEYTIME` variable represents the the number of ticks (assuming 1 second is equivalent to 8192 ticks) that a repeated press of the same key will be ignored for, with a range of 0 through 4096. Thus, if you think the calculator is "too slow" with your input, just modify `KEYTIME` var, following (e.g. in RPN mode) this procedure:

1. Type your new `KEYTIME` value;
2. Press [ENTER];
3. Type `KEYTIME`;
4. Press [STO].

You can also type, directly `<<500->KEYTIME>>`. To make this value remaining after a reset, you can create a variable (containing this) called `STARTUP` in the `HOME` directory; `STARTUP` is run each time the calculator is reset.

To check the value of `KEYTIME`, you can simply press [CAT], scroll down to see `KEYTIME` , and press `OK` when it is selected.

10 Strange Facts

10.1 Rational Proper Fractions

Consider the rational fraction

$$x \mapsto \frac{1}{x(x+1)}.$$

It is proper, and one can easily notice that

$$\frac{1}{x(x+1)} = \frac{1}{x} - \frac{1}{x+1}.$$

It is easy to find, but HP50g cannot find this, using `PARTFRAC` function.

10.2 Antiderivatives

Consider the function

$$x \mapsto \frac{1}{e^x - 1}.$$

We shall want to compute

$$\int \frac{1}{e^x - 1}\,\mathrm{d}x.$$

However, the HP50g cannot do this. Let's use IBP, this function being continuous on $]0;+\infty[$. We then have $f = \frac{1}{e^x-1}$, $Df = -(e^x-1)^{-2}e^x$; $Dg = 1$, $g \simeq x$. Thus,

$$\int \frac{\mathrm{d}x}{e^x-1} = \frac{x}{e^x-1} + \int \frac{x\cdot e^x}{(e^x-1)^2}\,\mathrm{d}x \Big| \quad \begin{array}{c} u = e^x - 1 \\ \Leftrightarrow \mathrm{d}u = e^x \\ \text{and } x = \ln(u+1) \end{array}$$

$$= \frac{x}{e^x-1} + \int \frac{\ln(u+1)}{u^2}\,\mathrm{d}u.$$

Let $f = \ln(u+1)$, $Df = \frac{1}{u+1}$; $Dg = \frac{1}{u^2}$, $g \simeq -\frac{1}{u}$. It yields that

$$\begin{aligned}\int \frac{\ln(u+1)\,\mathrm{d}u}{u^2} &= -\frac{\ln(u+1)}{u} + \int \frac{1}{u(u+1)}\,\mathrm{d}u \\ &= -\frac{\ln(u+1)}{u} + \int \left(\frac{1}{u} - \frac{1}{u+1}\right)\mathrm{d}u \\ &\simeq -\frac{\ln(u+1)}{u} + \ln|u| - \ln|u+1|\,.\end{aligned}$$

The antiderivative is thus

$$\begin{aligned}\int \frac{\mathrm{d}x}{e^x-1} &= \frac{x}{e^x-1} + \int \frac{\ln(u+1)}{u^2}\,\mathrm{d}u \\ &\simeq \frac{x}{e^x-1} - \frac{\ln(u+1)}{u} + \ln|u| - \ln|u+1| \\ &= \frac{x}{e^x-1} - \frac{\ln(e^x-1+1)}{e^x-1} + \ln|e^x-1| - \ln|e^x-1+1| \\ &= \frac{x}{e^x-1} - \frac{\ln(e^x)}{e^x-1} + \ln|e^x-1| - \ln|e^x| \\ &= \ln\frac{e^x-1}{e^x}.\end{aligned}$$

References

[cal09a] Business support forums - slow type with HP 50g calculator, 2009. http://forums11.itrc.hp.com/service/forums/bizsupport/questionanswer.do?admit=109447626+1244141423458+28353475&threadId=1162038.

[cal09b] Where is Hp 50g's KEYTIME command?, 2009. http://www.physicsforums.com/showthread.php?t=157969.

[dar09] Transfert sous Linux, 2009. http://www.hp-network.com/docs/transfert_linux/linux.php.

[geo09] Hewlett Packard Calculator Tips & Tricks, 2009. http://www.geocalc.com.au/tips.

[HP06] HP. *HP50g Graphing Calculator User's Guide*, 2006. http://smendes.com/hp50g.pdf.