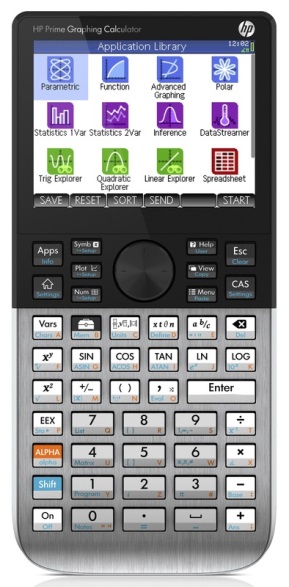
**Astro lab 4**

**a simple user’s guide for astro lab 4 on hp prime**

****

**1. Presentation**

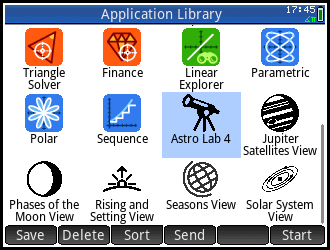
**Astro Lab 1** was made for *TI-89 Titanium*, **Astro Lab 2** for *TI Nsprire CX*, **Astro Lab 3** for *Mathematica* and now, **Astro Lab 4** is for ***HP Prime* *Calculator***.

You can still download **Astro Lab 3** (***Astronomical Algorithms*** post) for *Mathematica* on Wolfram’s community forum .

All functions were coded with the help of the book of *Jean Meeus* : Astronomical Algorithms.

**2. Initialization**

First of all, you have to copy the ***files*** in your HP Prime. After, go to the Apps menu and you will see;

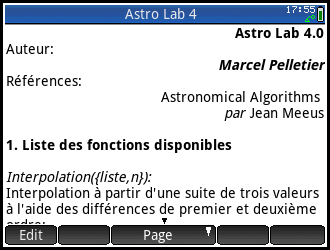
***Screen Capture 1***

Select and start the apps **Astro Lab 4**.

When you do this, the program initialize the list **L1** with the location of my house at Montréal, in the province of Québec, in Canada.

After that, you are at the info page.

***Screen Capture 2***



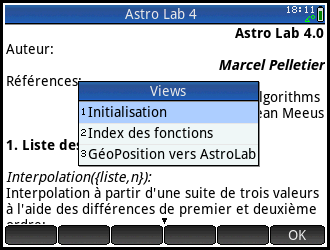
You will notice that the help section is in french, but the functions names are in english. You can translate the text if you prefer.

**Astro Lab 4** has three types of functions;

1. ***apps functions;***
2. ***time functions;***
3. ***celestial mechanics functions.***

To access the functions that control **Astro Lab 4**, you have to press the ***View*** key at any time. If you do, you will see a small menu along with three commands;

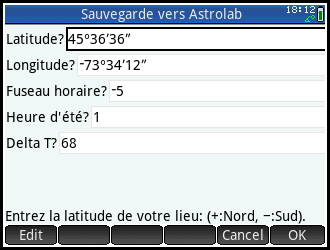
***Screen Capture 3***



1. **Initialisation**
2. **Index des fonctions**
3. **GéoPosition vers AstroLab**

In this menu, the second command brings you to the info screen of **Astro Lab 4**. The first and third are differents. The third can **save** your location in a special variable called « *lieu* » in the apps files. So when you start again the apps, this will be your new location.

***Screen Capture 4***

If you change this values and if you select OK, then this location will be saved in **Astro Lab 4**.

If you just want to change momentarally the location of your observation site, select in the ***View*** menu the first option call **Initialisation**.

Otherwise, the new location is not saved in the apps files but only in the memory of the Prime. After that, if you want to return to your initial location, simply start **Astro Lab 4** again in the ***Apps***menu.

In this input, the « Fuseau horaire » field is the timezone of your location, the « Heure d’été » field is the daylight saving time and the « Delta T » field is the difference in seconds between the Dynamical Time (DT) and the Universal Time (UT). So we have

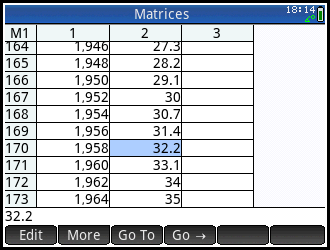
where is the Terrestrial Time. If you want to calculate a planet position in the time scale , simply set at ***Initialisation***.

When you ***Start*** **Astro Lab 4**, the content of the matrix **M1** is loaded with the app var *deltaT.*

***In this matrix, the first column is a year and the second column is the value of « Delta T » for that year.***

If you select the Matrix **M1** in the ***Matrix view*** and if you scroll down to , you will see that for this year, .

***Screen Capture 5***



**2. Working with Astrolab 4**

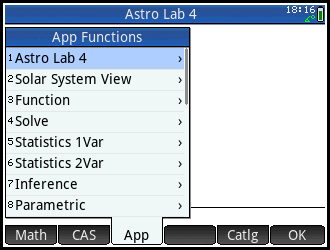
Most of the functions of **Astro Lab 4** uses lists for input and output. The functions make a copy of the input list in the list **L2**. At the end, a copy of the output is in **L3** or **L4**. If the function has a number for input or output, this number is not copy in a list. The function can reuse the output of a previous function or a user can redo a function with the list **L2** at the input.

I make this because this is a practical way to view the result. Next exemple shows that.

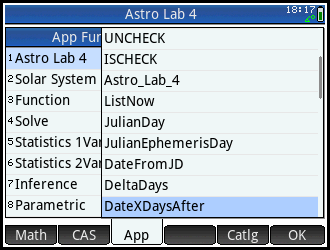
***Suppose someone want to know the date 1000 days after September 8 of 2016.***

You have to select the function that can do this. First, press the ***Home*** Key and after press the ***Toolbox*** menu key.

***Screen Capture 6***

Select App menu and **Astro Lab 4**.

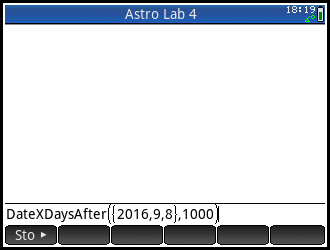
Go to ***DateXDaysAfter*** command and tap OK.

***Screen Capture7***

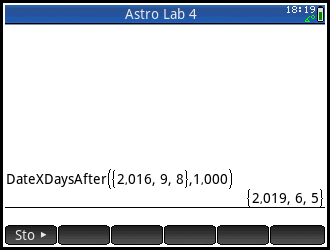
Now you have to enter

***All the date are in the following format :***

***Screen Capture 8***

After, press the ***Enter*** key.

***Screen Capture 9***

So this is .

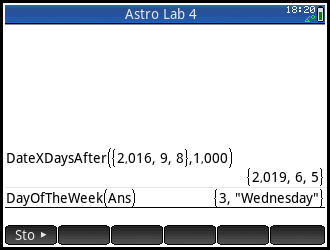
But which day in the week is it?

Select in the ***toolbox*** menu the **Astro Lab 4** menu and go to the

***DayOfTheWeek*** command.

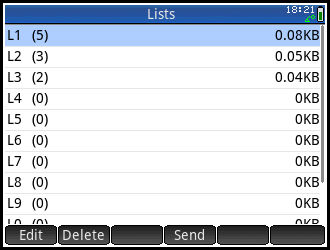
Now type and ***Enter*** key.

***Screen Capture 10***

It’s a Wednesday.

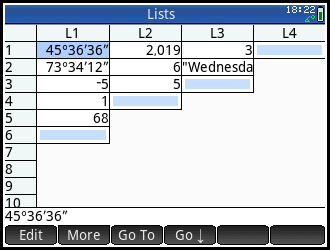
If you want to view your input or output, go to the ***List*** menu.

***Screen Capture 11***



Now press the ***Enter*** key.

You will see the contain of the lists in your ***HP Prime***.

***Screen Capture 12***

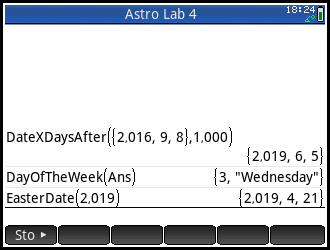
In this view, you can navigate and view the results of your calculations.

Do not change the list **L1** because it will change the location. If you change it, you have to initialize again and it will be alright.

***Another exemple with date function***

***When is Easter going to be in 2019?***

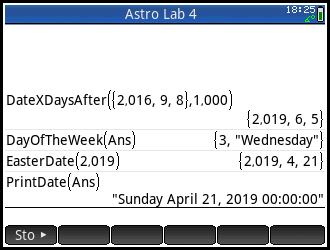
***Screen Capture 13***



If you want you can « pretty print » this date.

Simply choose the ***PrintDate*** command.

***Screen Capture 14***

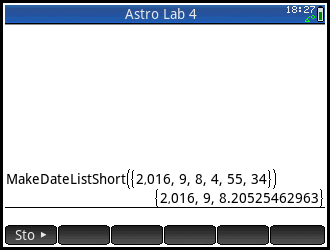


***Some astronomy***

All astronomy functions work with the short list date . You can make this list with the ***MakeDateListShort*** command. For exemple, let’s assume you want the short list date associated with september 8, 2016 at 04h55m34s. You’ll have to enter

Once you have entered the command above, you will see the correct list for your input in the function.

***Screen Capture 15***



The function ***ListNow*** will do the samething but with the time and date of your **HP Prime**.

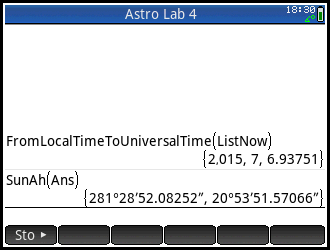
***Imagine someone wishes to calculate the position of the sun for the present moment.***

The time in the calculator is the local time, so we have to convert to Universal Time and after that we can calculate the sun’s position.

*The exemple below is the result of my location for the date and time*

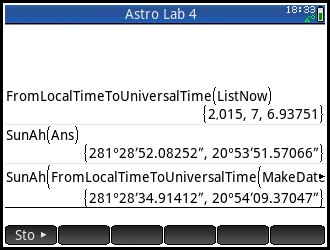
First I converted the local time to Universal Time and after I used the ***SunAh*** function to calculate the Azimuth (from North) and the Altitude of the sun.

***Screen Capture 16***



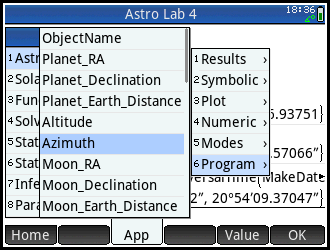
You can do this in just one input command line like this :

The result will be the same.

***Screen Capture 17***

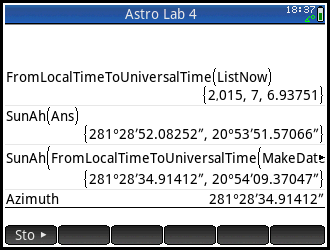
If you want, you can review the result differently. In fact, many results are copied in the globals variables associated with the application. If you press the **Vars** key and tap the **App** menu and **Astro Lab 4** and **Program**, you will see this :

***Screen Capture 18***

Here you can choose a global variable to see the last result.

If you tap **Azimuth** and press **Enter** key, you will see :

***Screen Capture 19***



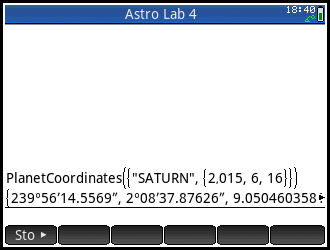
***Exemple***

***Astro Lab 4 will calculate the apparent right ascension and declination of planet Saturn on June 16, 2015 at 00h DT (or TT).***

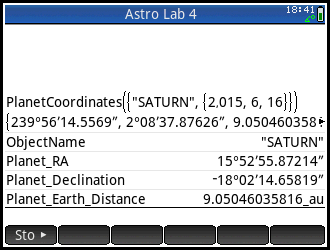
1. Do ***Initialization*** with *Delta T = 0;* (Because we have here DT or TT)
2. Select the command ;
3. You have to input : ;
4. Press ***enter;***

This is your output screen :

***Screen Capture 20***

Now you have to select in the ***Var menu*** the variables associated with the function. If you select ***Planet\_RA*** and ***Planet\_Declination*** you will see the right ascension and the declination of planet Saturn at this time .

***Screen Capture 21***

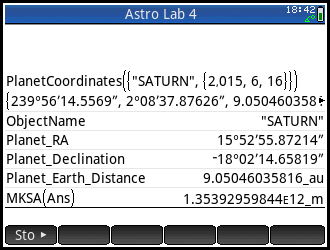
The value in the variable

***Planet\_Earth\_Distance***

is tagged with a unit (AU). You can transform it in meter with the

command in the ***Units menu***!

***Screen Capture 22***



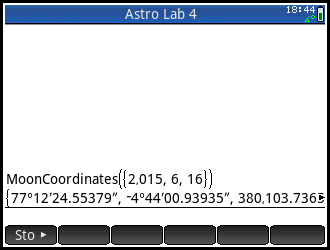
***Exemple***

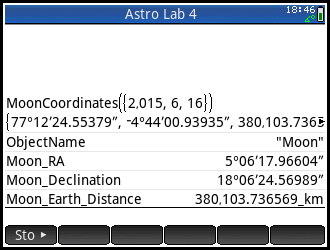
***Astro Lab 4 will calculate the apparent right ascension and declination of the moon on June 16, 2015 at 00h UT.***

1. Do ***Initialization*** with *Delta T = 68;* (Because we have here UT!)
2. Select the command ;
3. You have to input : ;
4. Press ***enter;***

This is your output screen :

***Screen Capture 23***



***Screen Capture 24***

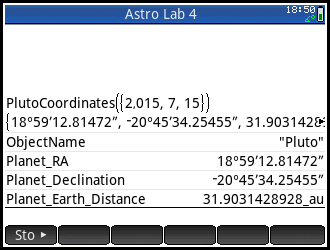
***Exemple***

***Astro Lab 4 will calculate the apparent right ascension and declination of pluto on July 15, 2015 at 00h UT.***

1. Do ***Initialization*** with *Delta T = 68;* (Because we have here UT!)
2. Select the command ;
3. You have to input : ;
4. Press ***enter;***

This is your output screen :

***Screen Capture 25***



***For the historical « rendez-vous » of the probe New Horizons and Pluto.***

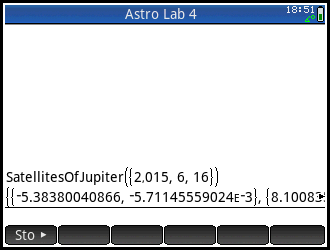
***Exemple***

***Astro Lab 4 will calculate the apparent earth view of the satellites of Jupiter on  
 June 16, 2015 at 00h UT.***

1. Do ***Initialization*** with *Delta T = 68;* (Because we have here UT!)
2. Select the command ;
3. You have to input : ;
4. Press ***enter;***

This is your output screen :

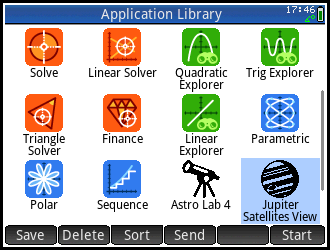
***Screen Capture 26***

The return list show the coordinates of the four satellites of Jupiter. If you select in the ***apps*** ***menu***

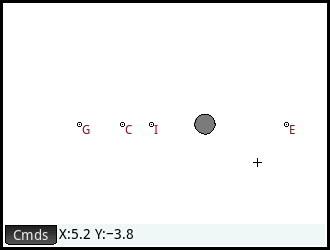
***Jupiter Satellites View***

you will see the graphic of this configuration ***view from Earth***.

***Screen Capture 27***



***Screen Capture 28***

In this view, Jupiter and is four satellites are visible. The letter is the first letter of the name of the satellite. We have

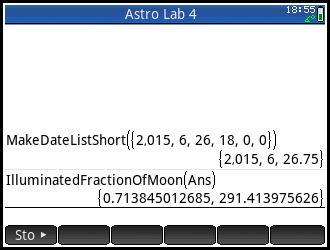
To see a ***telescope view*** of this configuration, you just have to turn your calculator upside down! You can ***move this view*** with your finger to see more at left or at right.

***Exemple***

***Astro Lab 4 will calculate the illuminated fraction of the Moon’s disk on  
 June 26, 2015 at 18h UT.***

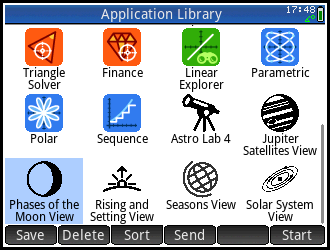
***This is the input :***

This is your output screen :

***Screen Capture 29***

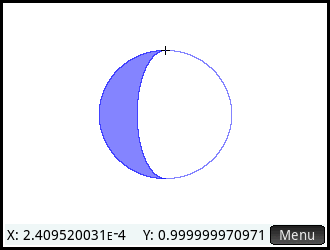
Now, you have to select the application ***Phases of the Moon View*** in the ***Apps menu*** to see this view.

***Screen Capture 30***



After that, your output will be…

***Screen Capture 31***



In this view, the illuminated limb is white.

***Exemple***

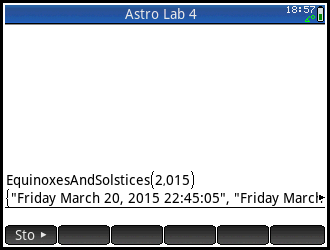
***Astro Lab 4 will calculate the times of the equinoxes and solstices for 2015.***

***This is the input :***

1. After that, choose « **Seasons View** » in the ***App’s menu.***

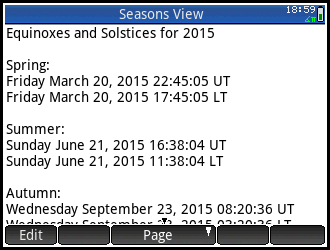
This is your output screen after the first step :

***Screen Capture 32***



The second output will be :

***Screen Capture 33***

In this view, you can navigate with your finger or with the ***page button***!

The times is show in ***Universal Time*** and in ***Local Time***. For the Local Time in this view, the ***daylight saving time*** is **zero**.

***Exemple***

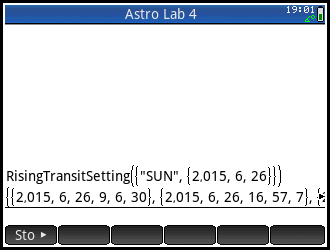
***Astro Lab 4 will calculate the times of the sunrise and sunset on June 26, 2015.***

***This is the input :***

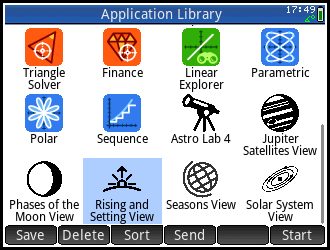
1. After that, choose « **Rising and Setting View** » in the ***App’s menu.***

This is your output screen after the first step :

***Screen Capture 34***

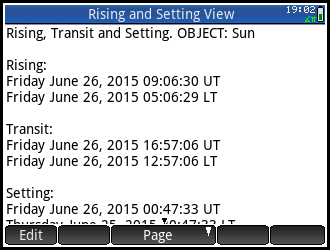
The output list content the time of a rising time, a transit time and a setting time in ***Universal time*** for this day.

***Screen Capture 35***



***Before this step, make sure that your TimeZone setting and DayLight saving time setting in Astro Lab 4 match the rising and setting‘s date!***

***Screen Capture 36***



Here, you have the same ***Universal Time*** and the ***Local Time***.

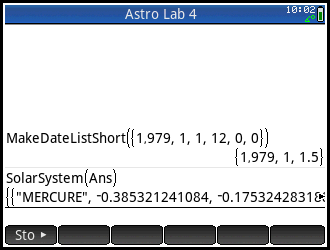
***Exemple***

***In 1979, the orbit of Pluto crossed the orbit of Neptune. Astro Lab 4 will calculate the coordinates of the planets on January 1, 1979 at 12h00m00s UT and after that, the apps « Solar System View » will show this configuration, to view this event.***

***This is the input :***

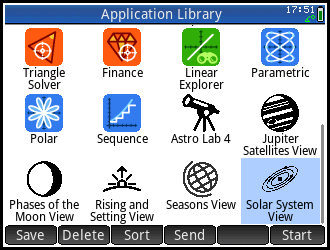
1. After that, choose « **Solar System View** » in the ***App’s menu.***

This is your output screen after the second step :

***Screen Capture 37***

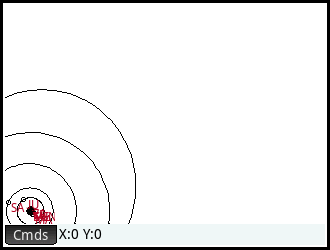
After that, go to the ***apps menu*** and choose « **Solar System View** »

***Screen Capture 38***



The first screen is not always the good one because you have to move the cursor at the . Below, the cursor *is at* the

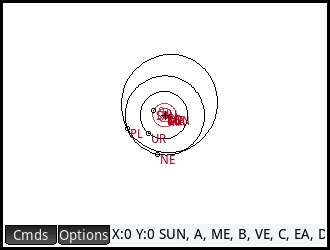
***Screen Capture 39***



***Now, don’t touch the screen of the Prime with your fingers!***

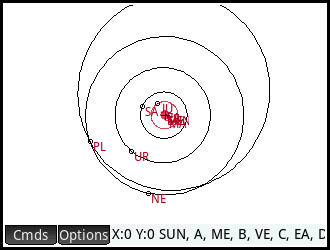
***If necessary, ZoomOut*** or ***ZoomIn*** with the ***minus key*** or the ***plus Key*** and move the cursor with the ***central black button*** of the ***Prime*** until you reach !

***Screen Capture 40***

Now if you ***Zoom*** with the ***plus key*** or the ***minus key*,** your screen will be centered on the .

***Astro Lab 4*** show the configuration of the planets at ***this moment***.

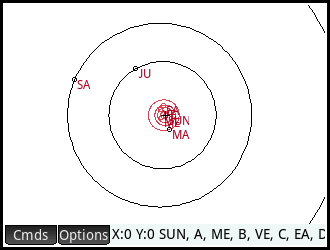
***Screen Capture 41***



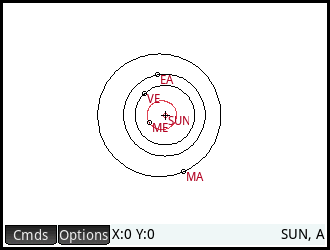
Yes, the Pluto’s orbit crossed the orbit of Neptune in .

If you ***zoom*** in with the ***plus key***, you will see the inner planets!

***Screen Capture 42***



***Screen Capture 43***



***Exemple***

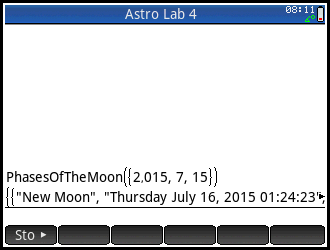
***Astro Lab 4 will calculate the times of the phases of the Moon at Mid-July, 2015.***

***This is the input :***

1. After that, choose « **Phases of the Moon View** » in the ***App’s menu***;

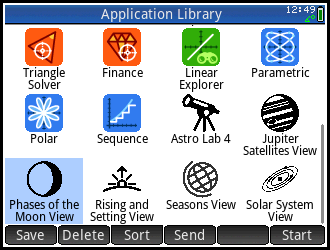
This is your output screen after the first step :

***Screen Capture 44***

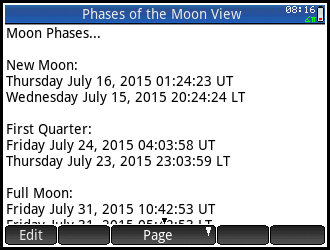


After that, go to the ***Apps menu*** and choose « **Phases of the Moon View** ». This ***view*** have two purposes, one graphical and one for text output.

***Screen Capture 45***



***Screen Capture 46***

******

***Note*** :

In this ***view***, the **Daylight Saving Time** of your setting don’t appear in the **Local Time**.

**3. last word.**

**Astro Lab 4** can do much more than this, but I think you have to try it yourself. It’s a simple and practical tool to use. What I don’t like in a program is it’s restraining element. For that reason, I prefer functionnal programming. But I think someone, with this basic set of functions, can do a program with fancy input or output.

I am 52 years old and my summer activity is astronomy and programming. I have a degree in Physics and I have taught mathematics for 30 years.

***Imagination and HP Prime calculator  
 will allow you to boldly go where no man has gone before…***