Time

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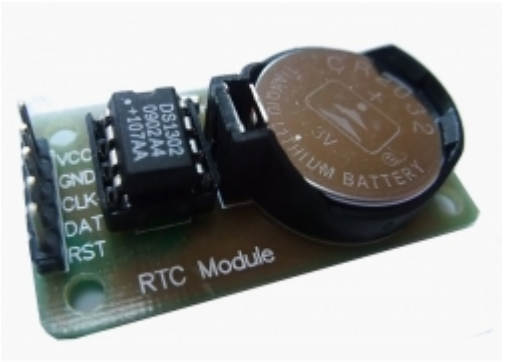
Waikato Linux Users Group
28 August 2017
Ian Stewart

Time of Year (TOY) Clock

Real Time Clock – Maintained with battery during power off.

- RTC Counts Seconds, Minutes, Hours, Date of the Month, Month, Day of the Week, and Year with Leap-Year valid up to 2100
- Integrated Circuit. E.g. DS1338, DS1302, DS1307, DS3234, etc.
- Low current draw.
- Oscillator using external 32.768kHz crystal.
- PC's typical battery 2032



RTC for Raspberry Pi
http://www.hobbytronics.co.uk/real-time-clock-ds1338
DS1338 Datasheet
https://datasheets.maximintegrated.com/en/ds/DS1338-DS1338Z.pdf

Unix Epoch Time

- Unix time / POSIX time / Epoch time is a system for describing instants in time.
- The number of seconds that have elapsed since 00:00:00 Coordinated Universal Time (UTC), Thursday, 1 January 1970.
- Minus the number of leap seconds that have taken place since then.

- Unix time about to hit 1 billion in Denmark (+2 UTC)

Unix time
https://en.wikipedia.org/wiki/Unix_time

Bash commands for Unix Time

- $ date
  Mon Aug 28 14:38:09 NZST 2017

- $ date +%s
  1503887892

- $ date; date +%s
  Mon Aug 28 14:47:17 NZST 2017
  150388843

- $ date --date="@0" --utc
  Thu Jan 1 00:00:00 UTC 1970

Unix Time milestones

- $ date --date="@0"
  Thu Jan 1 12:00:00 NZST 1970

No Daylight savings in NZ in 1970?

- $ date --date="@1000000000" --utc
  Sun Sep 9 01:46:40 UTC 2001
- $ date --date="@-1000000000"
  Mon Apr 25 09:43:20 NZMT 1938
- $ date --date="@1500000000"
  Fri Jul 14 14:40:00 NZST 2017
- $ expr $((2**31))
  2147483648
- $ date --date="@2147483648"
  Tue Jan 19 16:14:08 NZDT 2038

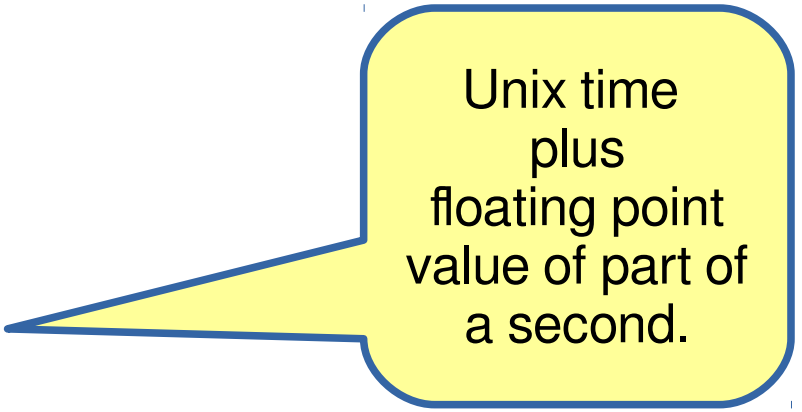
32 Bit time comes to an end in NZ

CPU Clock – Higher Resolution

- The CPU clock used by the Linux OS for internals.
- $ time wget www.guardian.co.uk --quiet

  real 0m1.996s
  user 0m0.036s
  sys 0m0.024s

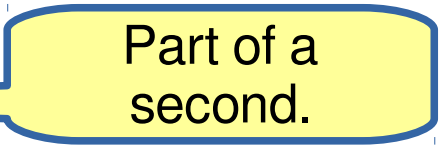
- $ python
  >>> import time
  >>> time.time()
  1503891249.5765698



CPU Clock – Higher Resolution

```
1 import time
2 start = time.time()
3 for i in range(1000000):
4     x = i ** 2
5 end = time.time()
6 difference = end - start
7 print(difference)
```

- $ python3 time_delay.py
  0.752239227294921 9
-
- Increase looping from 1 million to 10 million
- $ python3 time_delay.py
- 7.5426077842712 4

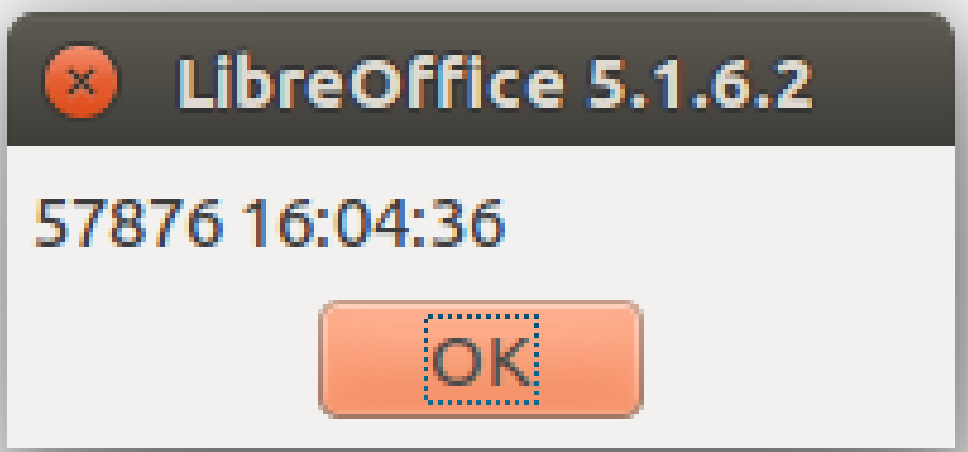


Seconds since midnight.

- Seconds since midnight. E.g. LibreOffice Basic “timer”

```
REM  *****  BASIC  *****

Sub Main
' Use of Timer
dim seconds_since_midnight as long
seconds_since_midnight = timer
time_now = time
msgbox (seconds_since_midnight & " " & time_now)
End Sub
```



Leap Seconds

- Because of irregularities in the Earth's rate of rotation, a one-second adjustment that is occasionally applied to Coordinated Universal Time (UTC) in order to keep its time of day close to the mean solar time, or UT1.
- Implemented in 1972
- If required applied 30 June or 31 December.
- Since 1972: 27 leap seconds applied.

Leap Seconds
https://en.wikipedia.org/wiki/Leap_second

Python **ephem**eris module

- Ephem module. http://rhodesmill.org/pyephem/index.html
- From: Ephemeris (Related to Astronomy Astrology)
  A table or data file giving the calculated positions of a celestial object at regular intervals throughout a period.
- Python ephem time with an epoch of 31 Dec 1899 12:00:00.
- Floating point value of days and part of a day.

```
1 import ephem
2
3 d = ephem.Date('2017/08/28 11:59:59.9999')
4
5 print('Behind the date {} is the number {}.'.format(d, float(d)))
```

```
$ python3 ephem_demo.py
Behind the date 2017/8/28 12:00:00 is the number 42973.9999999884.
```

```
1 import ephem
2
3 d = ephem.Date('2017/08/28 12:00:00.0')
4
5 print('Behind the date {} is the number {}.'.format(d, float(d)))
```

```
$ python3 ephem_demo.py
Behind the date 2017/8/28 12:00:00 is the number 42974.0.
```

Python **ephem**eris module

- Python ephem time with an epoch of 31 Dec 1899 12:00:00.

```
1 import ephem
2
3 d = ephem.Date('1899/12/31 12:00:00.0')
4
5 print('Behind the date {} is the number {}.'.format(d, float(d)))
```

```
$ python3 ephem_demo.py
Behind the date 1899/12/31 12:00:00 is the number 0.0.
```

```
1 import ephem
2 d = ephem.Date('1899/12/30 00:00:00.0')
3 print('Behind the date {} is the number {}.'.format(d, float(d)))
```

```
$ python3 ephem_demo.py
Behind the date 1899/12/30 00:00:00 is the number -1.5.
```

```
1 import ephem
2 d = ephem.Date('1900/1/1 00:00:00.0')
3 print('Behind the date {} is the number {}.'.format(d, float(d)))
```

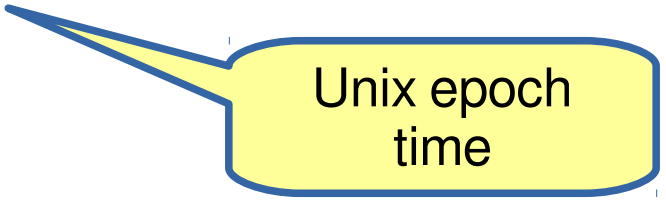
```
$ python3 ephem_demo.py
Behind the date 1900/1/1 00:00:00 is the number 0.5.
```

Converting Ephem time to Unix time

- Takes a PyEphem date and return a Python datetime giving your local time.

```
1 import ephem
2 d = ephem.Date('1970/1/1 00:00:00')
3 lt = ephem.localtime(d)
4 print('Behind the date {} is the number {}.'.format(d, float(d)))
5 print('The local time is {}'.format(lt))
6 print(type(lt))
7 print(int(lt.timestamp()))
```

```
$ python3 ephem_demo.py
Behind the date 1970/1/1 00:00:00 is the number 25567.5.
The local time is 1970-01-01 12:00:00.000003
<class 'datetime.datetime'>
0
```



Converting Ephem time to Unix time

- Takes a PyEphem date and return a Python datetime giving your local time.

```
1 import ephem
2 d = ephem.Date('2017/7/14 2:40:00.000001')
3 lt = ephem.localtime(d)
4 print('Behind the date {} is the number {}.'.format(d, float(d)))
5 print('The local time is {}'.format(lt))
6 print(type(lt))
7 print(int(lt.timestamp()))
```

Add 0.000001 to fudge the rounding error

```
$ $ python3 ephem_demo.py
Behind the date 2017/7/14 02:40:00 is the number
42928.611111111124.
The local time is 2017-07-14 14:40:00.000004
<class 'datetime.datetime'>
1500000000
```

Converting Unix time to Ephem time

```python
import ephem
import datetime
d = datetime.datetime(2017, 7, 14, 14, 40, 0)
print(d)
print(d.timestamp())
date_ephem = ephem.Date(d)
print(date_ephem)
print(float(date_ephem))
```

```
$ python3 ephem_demo.py
2017-07-14 14:40:00
1500000000.0
2017/7/14 14:40:00
42929.11111111112
```

Unix time

Ephem time

Demo – Ephem / Unix time – Sun Info

```
$ python3 sun_info.py -s

The date is Monday, 28 August 2017.
The time is 10 hours, 9 minutes and 37 seconds.
The previous sunrise was 2017-08-28 6:46:11
The previous sunset was  2017-08-27 17:53:27
The next sunrise is 2017-08-29 6:44:46
The next sunset is  2017-08-28 17:54:17
The solar noon for today at 12:20:16
Today's solar noon altitude angle 42.2 degrees.
The sun's current altitude is 33.6 degrees.
The sun's current azimuth is 39.6 degrees.
```

Demo – Ephem / Unix time – Sun Info

```
$ python3 sun_info.py -s

Status of Observer of the Sun.
       Location: Nevada Road, Hamilton, New Zealand.
       Date UTC: 2017/8/27 22:09:37
       Latitude: -37:47:10.6
      Longitude: 175:19:55.2
      Elevation: 40.0
        Horizon: 0:00:00.0
          Epoch: 2000/1/1 12:00:00
    Temperature: 10.0
       Pressure: 1010.0
```

The End of Time.