Mayans Would Have Done It with M

by Winfried Gerum


Winfried Gerum

You probably think there is no connection between M and the old Mayans. Obviously there are connections. The one and only written response to any of my columns recently popped out of my fax machine. It was in response to the column entitled "Internationalisation—Mission Impossible ?" (*M Computing*: volume 2, number 3) in which I presented algorithms to convert from $H-Format to Jewish or Mohammedan calendars and vice versa. My reader asked whether I did similar work on the Mayan calendar. Until then, I had little idea about the workings of the Mayan calendar. And I did not feel a urgent need to learn more about it. But this real response by a real reader—what a challenge. So I had a quick look into my library—and here it is: M is just great doing Mayan calendar computations. Even if your initial feeling is that the Mayan calendar has little relevance for you, a quick look at how things work out in M is worth a few minutes.

While the Mohammedan and Jewish calendars have a remotely familiar feeling, the Mayan calendar is completely different. In fact, it is several different systems of reckoning that have been in use simultaneously. One aspect of the Mayan calendar is quite similar to the $HOROLOG date of the M world.

First there is the civil year of 365 days (called Haab). The Haab is divided into 18 months of 20 days each plus a period called Uayeb with 5 days at the end of the year. In addition, the Mayans had a year (?) of 260 days (called Tzolkin) with 13 months of 20 days each. This was combined with a week of 13 days.

A day is designated a number "day of the week" (1 . . . 13), in succession one of twenty names (Imix, Ik, Akbal, Kan, Chichan, Cimi, Manik, Lamat, Muluc, Oc, Chuen, Eb, Pen, Ix, Men, Cib, Caban, Eznab, Canac, or Ahau), the number of the day within the current Haab month (1 . . . 20, 1 . . . 5 in Uayeb) and the name of the Haab month (Pop, Uo, Zip, Zotz, Zec, Xul, Yaxkin, Mol, Chen, Yax, Zac, Ceh, Mac, Kankin, Muan, Pax, Kayab, Cumku, plus Uayeb).

That way the combination day of the week plus Haab and Tzolkin date gives you a period of 18,980 days (equals 1,460 weeks, i.e. Mayan weeks of 13 days each, or equals 52 Haabs, or equals 73 Tzolkins). This kind of date does not specify a year of some era. But obviously it was sufficient for the transaction of civil life in Mesoamerica some centuries ago. For longer periods of time that is insufficient. The Mayans invented an additional system of reckoning ("long count") that looks strange at first glance, but it may be interpreted as a continuous count of days since 12-Aug-3114 BC (Gregorian). That notation is usually given in the form bakun.katun.tun.uinal.kin.

The starting point 0.0.0.0.0 4 Ahau 8 Cumku corresponds to 12-Aug-3113 BC. Note that with this format it is very easy to compute the number of days between any two dates.

Given the number of days since 0.0.0.0.0 it is easy to compute the number of the day of the week (take it modulo 13), the name of the day (take it modulo 20) and the date within a Haab (take it modulo 365, take that #20 for the day and \20 to get the month). Some offsets have to be added before applying the modulo, to bring the various cycles in sync with the long count. The legendary day 0.0.0.0.0 surprisingly is not a starting point for any of the four cycles: it is day #4 of the week, name of the day is "Ahau" (day #20), and this is the 8th day of "Cumku" (month #18).

Unfortunately there is conflicting evidence about the exact correlation between the Mayan and our calendar

units in the Mayan long count

kin	=				1 day
uninal	=	20 kin	("month")		
tun	=	18 uninal	("year")	=	360 days
katun	=	20 tun		=	7200 days
bactun	=	20 katun		=	144000 days
pictun	=	20 bactun		=	2880000 days
...					

```
;Remember the decimal <--> octal conversion:
DEC2OCT(X)      QUIT:X'?1.N "invalid"
     NEW R,Y
     SET Y=X,R="" FOR  SET R=Y#8_R,Y=Y\8 QUIT:'Y
     QUIT R
OCT2DEC(X)      QUIT:$TR(X,89,"AA")'?1.N "invalid"
     NEW I,R
     SET R=0 FOR I=1:1:$L(X) SET R=R*8+$E(X,I)
     QUIT R
```

system. The uncertainty is as big as 260 years! Therefore, the code for the calculation of day of the week, name of the day, etc., is not based on the $H count, but on the decimal equivalent of the long count. So if scholars change their consensus all you have to do is to replace occurrences of the value 1809186 by a revised value.

While the description of the Mayan calendar looks difficult, the arithmetic is very easy since this calendar is completely regular and does not have any variations to bring it in sync with either the sun or the moon.

The routine is very straightforward: The 20/20/20/18/20 notation is in principle not much different from the decimal or binary notation, except that the base is not the same for every position. So the conversion from long count to $H and back is not much different from the familiar conversion between say decimal and octal.

The zero for the Mayan calendar is 12-Aug-3114 BC (Gregorian). The zero for $H is 31-Dec-1840. To convert between these day counts you must, in addition to the base conversion, add or subtract the distance between their zeroes (i.e., 1,809,186 days). There are few data to support the exact relation of the Mayan calendar to other kind of dates. Scholars finally agreed on the equivalence of 11.16.0.0.0 13 Ahau 8 Xul with 14-Nov-1539 (Gregorian). This equivalence is the basis of our routine.

Certainly the world is much older than 0.0.0.0.0. What kind of notation might apply to the time before that? That's very easy. You can count the cycles backward and decide to designate one of the higher cycles a negative number:

-1.19.19.17.19
-1.19.19.19.17.19
-1.19.19.19.19.19.17.19

seem equally acceptable. Note that in H2DATE there are correction terms applied to negative values of D before doing the integer division. This is necessary because

```
A \ B * B + ( A # B ) = A
```

is not an identity for negative values of A. The division is symmetrical with respect to zero, which clearly is not appropriate if division is used to compute cyclical phenomena in conjunction with the modulo operator. The modulo operator is not symmetric with respect to zero, making it the perfect tool for this kind of computation.

You may note that this year's MTA conference in Chicago will be held from 12.19.2.3.9 2 Muluc 17 Zip through 12.19.2.3.13 6 Ben 1 Zotz (i.e., 05-JUNE-1995 through 09-JUNE-1995 for non-Mayans).

Now if you feel that other topics might be of more interest, please let the editor know about it. The publication is meant to meet **your** needs!

Winfried Gerum is with Winner Software GmbH in Röttenbach, Germany. Contact him by phone at 49-9195-940022 or by fax at 49-9195-940030.

```
%MAYA       ;Mayan calendar
      +1    ;$$TODAY() converts $H format to Mayan date
      +2    ; (long format plus Tzolkin date plus Haab date
      +3    ; default: today
TODAY(H)    NEW D,R
      +1    SET H=$S($G(H)="":+$H,1:H)
      +2    SET D=H+1809186
      +3    SET R=$$H2DATE(H) ;long count format
      +4    SET R=R_" "_(D+3#13+1) ;Day of Tzolkin Week
      +5    ;Name of Tzolkin day
      +6    SET R=R_" "_$P("Ahau/Imix/Ik/Akbal/Kan/Chicchan
            /Cimi/Manik/Lamat/Muluc/Oc/Chuen/Eb/Ben/Ix/Men
            /Cib/Caban/Eznab/Canac","/",D#20+1)
      +7    SET R=R_" "_(D-18#365#20+1) ;-Haab Nr.of Day
      +8    ;Haab name of month
      +9    SET R=R_" "_$P("Pop/Uo/Zip/Zotz/Zec/Xul/Yaxkin
            /Mol/Chen/Yax/Zac/Ceh/Mac/Kankin/Muan/Pax/Kayab
            /Cumku/Uayeb","/",D-18#365\20+1)
     +10    QUIT R
     +11    ;convert Mayan long count date to $H-Format
DATE2H(M)   QUIT:'$$CHKDATE(.M) "" ; invalid value
      +1    NEW H,I,J
      +2    SET H=0,J=$L(M,".")
      +3    FOR I=1:1:J S H=H*$S(J-1=I:18,1:20)+$P(M,".",I)
      +4    QUIT H-1809186
      +5    ;convert $H format to Mayan date (long count)
H2DATE(H)   NEW D,I,R
      +1    SET D=H+1809186,R=""
      +2    ;make always Baktun.Katun.Tun.Uinal.Kin
      +3    FOR I=20,18,20,20,20 DO
      +4    .SET R=D#I_"."_R,D=$S(D<0:D-I,1:D)\I
      +5    IF D<0 SET R=D_"."_R ;eventl. -Pictun and lower
      +6    ;eventually +Pictun and higher!
      +7    ELSE  IF D FOR  SET R=D#I_"."_R,D=D\I Q:'D
      +8    QUIT $E(R,1,$L(R)-1)
      +9    ;returns TRUE if M is valid Mayan long count
CHKDATE(M)  NEW I,J,R
      +1    SET J=$L(M,".")
      +2    FOR I=1:1:J SET R=$P(M,".",I) I R'?1.2N!
            (R>$S(J-1=I:17,1:19)),I=1'&(R?1"-"1.N) QUIT
      +3    QUIT '$T
```