Precompiled Header (Algol 60)

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"UNIVERSITY OF "DURHAM ("ELLIOTT 303);
\BEGIN \REAL PI,PI2; \INTEGER TNT;

\REAL \PROCEDURE INPUT;
\BEGIN \REAL X; \READ K; ELLIOTT(3,0,6713,0,2,0,TNT);
INPUT:=X; \END;

\INTEGER \PROCEDURE SIGN(X); \VALUE X; \REAL X;
SIGN:=\IF X<0 \THEN -1 \ELSE 1;

\PROCEDURE CONTAIN(K); \REAL K;
K:=K-6.2831853*ENTIER((K+3.1415927)*0.15915494);

\PROCEDURE INANGLE(K); \REAL K;
\BEGIN \REAL D,M,S; D:=INPUT; \READ M,S;
S:=(3600*D+60*M+S)/206264.81;
K:=\IF (TNT=51 \OR TNT=37) \THEN -S \ELSE \IF TNT=53 \THEN
S+6.2831853 \ELSE \IF TNT=44 \THEN S-6.2831853 \ELSE S \END;

\PROCEDURE OUTANGLE(K); \VALUE K; \REAL K;
\BEGIN \INTEGER D,M,S; S:=ABS(K)*206264.81; M:=ENTIER(S/60);
D:=ENTIER(M/60); \PRINT DIGITS(3),SAMELINE,D,DIGITS(2),SAMELINE,
M-60*D,SAMELINE,S-60*M; \END;

\PROCEDURE OUTLAT(K); \VALUE K; \REAL K;
\BEGIN OUTANGLE(K); \IF K<0 \THEN \PRINT # "S  ? \ELSE \PRINT # "N  ?; \

\PROCEDURE OUTLONG(K); \VALUE K; \REAL K;
\BEGIN OUTANGLE(K); \IF K<0 \THEN \PRINT # "E  ? \ELSE \PRINT # "W  ?; \

\PROCEDURE OUTTIME(T); \VALUE T; \REAL T;
\BEGIN \INTEGER H,M,S; M:=ENTIER(T); S:=60*(T-M);
H:=ENTIER(M/60); M:=M-60*H;
\PRINT DIGITS(2),SAMELINE,LEADZERO(#0?),H,SAMELINE,SPECIAL(1),
LEADZERO(#0?),M,#.?,SAMELINE,SPECIAL(1),LEADZERO(#0?),S; \END;

\PROCEDURE FIND TIME(T); \REAL T; \BEGIN \REAL I; \INTEGER H,M,S;
\READ I; M:=ENTIER(I); H:=ENTIER(M/100); S:=100*(I-M);
M:=M-100*H; T:=M+60*H+S/60; \END;

\PROCEDURE FIND DATE(DAYS); \INTEGER DAYS;
 \COMMENT FOR 1 3 1900 TO 28 2 2100, EPOCH MIDNIGHT 0000 31 12 1899;
\BEGIN \INTEGER DATE,M,"Y,LEAP; \INTEGER \ARRAY "M[1:12];
"M[1]:=365;"M[2]:=396;"M[3]:=59;"M[4]:=90;"M[5]:=120;"M[6]:=151;
"M[7]:=181;"M[8]:=212;"M[9]:=243;"M[10]:=273;"M[11]:=304;"M[12]:=334;
\READ DATE,M,"Y;
\IF "Y>2100 \OR "Y<1900 \THEN \PRINT ##L? "OUT LIMITS? \ELSE
\PRINT DIGITS(2),SAMELINE,DATE,SAMELINE,M,DIGITS(4),SAMELINE,"Y;
"Y:="Y-1900; \IF M<3 \THEN "Y:="Y-1; LEAP:=ENTIER("Y/4);
DAYS:=365*"Y + LEAP + "M[M] + DATE \END;

PI:=3.1415927; PI2:=6.2831853;

S PRECOMPILE;
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input reads a number "input" from the input list and stores the terminating character in "tnt". The terminating character must be a space or letter. tnt(UCL(n))=n+32.

sign redeclares Algol "sign" to remove the in-consistency sign(0)=0.

contain adusts the angle k (radians) so that it lies in the range -pi to +pi.

inangle reads an angle from the input list, which must consist of THREE numbers: degrees, minutes, seconds, any or all of which may contain decimals. The terminating character of the degrees is significant. A latitude South requires the terminating character of the degrees to be "S" (not s), a longitude East requires "E"; upper and lower limb observations require U or L respectively in the case of zenith distances where a semi-diameter correction is to be applied. The terminating characters W and N may be used, although this is not essential.

outangle prints the MODULUS of k radians in degrees, minutes, seconds to the nearest second of arc.

outlat outangles k and follows with N or S as appropriate.

outlong outangles k and follows with E or W as appropriate.

outtime prints a time t minutes in the form ****.** of the 24-hour clock, to the nearest second of time.

find time reads a time in the form ****.** of the 24-hour clock and converts it to t MINUTES. The hours may exceed 24 if necessary, similarly 0000.005 would represent ½ a second after midnight.

find date reads and prints the DATE, MONTH, YEAR(A.D.) and assigns to "days" the number of whole days elapsed between midnig ht at the beginning of 31st. December 1899 and midnight at the beginning of the day concerned, PROVIDED THAT this date lies between 1st. March 1900 and 28th. February 2100. If a particular date lies outside these limits then "days" will be in error since leap years will not be properly taken account of.

The value of pi is stored in "pi" and the valu e of 2*pi in "pi2".

Follow with a new title.

Sun's Position (Algol 60)

followed by the input data

```
"SUNS POSITION;
\BEGIN \REAL "T,"T2,"T3,E,OB,G"A,"M"L"P,I,G,PHI,"LO"S,LONG,LAT,
CODEC,"S"H"A,SEMI D,SHAMA,SHAM,ARIES,"G"H"A;
\INTEGER N,NAME,DAYS,M;

NAME:=0; \READ M;
\FOR N:=1 \STEP 1 \UNTIL M \DO \BEGIN
FIND DATE(DAYS);
"T:=DAYS/36525;"T2:="T*"T;"T3:="T2*"T;
DAYS:=4*DAYS-1461*ENTIER(4*DAYS/1461);
E:=0.01675104-0.00004180*"T-0.000000126*"T2;
OB:=(84428.26-46.845*"T-0.0059*"T2+0.00181*"T3)/206264.81;
G"A:=(1290513.0-3420.9*"T-0.54*"T2-0.012*"T3)/206264.81 +
        6.2831853*DAYS/1461;
SHAMA:=(289112.46-2768.13*"T-1.3935*"T2)/206264.81 -
        6.2831853*DAYS/1461;
"M"L"P:=(1012395.0+6189.03*"T+1.63*"T2 +0.012*"T3)/206264.81;
"LO"S:=G"A+"M"L"P;

\IF NAME=0 \THEN \BEGIN
FIND TIME(I); I:=T-720;
G:=G"A+I/83709.132; ADJUST(G);
SEMI D:=0.0046599320/(1-E*COS(G));
SHAM:=SHAMA-I/83709.132; ADJUST(SHAM);
PHI:= G + 2*E*SIN(G) + 5*SIN(2*G)*(E↑2)/4 +
      (E↑3)*(13*SIN(3*G) - 3*SIN(G))/12;
LONG:=PHI+"M"L"P-0.0000992406; LAT:=1.5707963; \END;

ADJUST(LONG);
CODEC:=ARCCOS(COS(OB)*COS(LAT)+SIN(OB)*SIN(LAT)*SIN(LONG));
"S"H"A:=ARCSIN((COS(LAT)-COS(CODEC)*COS(OB))/(SIN(CODEC)*SIN(OB)));
"S"H"A:=\IF 1.5707964<LONG \AND LONG<4.7123891 \THEN 3.1415927-"S"H"A
\ELSE \IF "S"H"A<0 \THEN 6.2831853+"S"H"A \ELSE "S"H"A;
ARIES:=T*3.1415927/720-SHAM; ADJUST(ARIES);
"G"H"A:=ARIES+"S"H"A; ADJUST("G"H"A);
\PRINT #    ?; OUTTIME(I+720); \PRINT #    ?; OUTANGLE("G"H"A);
\PRINT #    ?; OUTLAT(CODEC); \PRINT #    ?; OUTANGLE(ARIES);
\PRINT ##L??; \END \END
\END;
12
10   1 1966   1200.00
10   2 1966   1200
10   3 1966   0000.00
20   4 1966   1800.00
20   5 1966   0600.00
15   6 1966   0000.00
15   7 1966   1232.24
15   8 1966   1200
30   9 1966   4800.00
 2  10 1966   0000.00
15  11 1966   1704.40
15  12 1966   0000.00
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Input Data		Expected result as published in the Nautical Almanac			
Date	GMT	GHA Sun	Dec Sun	GHA Aries	
		358 07.8	21 59.0	281	33.5
		356 25.7	14 24.2	320	06.8
		177 21.9	4 22.1	167	13.1
		90 16.4	11 32.6	118	22.2
		270 51.4	19 53.5	327	36.8
		179 57.4	23 17.0	262	49.6
		358 52.6	14 06.7	143	26.7
		182 35.7	3 18.7	10	15.8
			23 14.2	83	12.1
		181 18.2			

Printout

Navigation
Suns position

Free Store = 5085 to 5441

DATE	GMT	G-HA Sun	Dec. Sun	GHA Aries
10 1 1966	12 0. 0	358 7 41 -7	21 58 54 S -6	289 33 44 +14
10 2 1966	12 0. 0	356 25 25 -17	14 24 1 S -11	320 7 3 +15
10 3 1966	0 0. 0	177 21 33 -19	4 21 52 S -14	167 13 22 +16
20 4 1966	18 0. 0	90 16 6 -13	11 32 45 N +3	118 22 24 +12
20 5 1966	6 0. 0	270 53 49 -17	19 53 30 N 0	327 27 0 +17
15 6 1966	0 0. 0	179 57 17 -7	23 16 55 N -5	262 49 50 +14
15 7 1966	1232.24	6 38 29	21 33 13 N	121 0 54
15 8 1966	12 0. 0	358 52 39 +3	14 6 39 N -3	143 26 52 +10
30 9 1966	48 0. 0	182 35 39 -3	3 18 47 S +5	10 15 58 +10
2 10 1966	0 0. 0	182 35 39 -3	3 18 48 S +6	10 15 58 +10
15 11 1966	17 4.40	80 0 43	18 29 54 S	310 30 9
15 12 1966	0 0. 0	181 18 9 -3	23 14 5 S -7	83 12 14 +8

↑
All about 11" too large.

End oof program

$$T = \frac{365Y + int(Y/4) + M + Date}{36525} = \frac{d}{36525}$$

Y-1	JAN	365	JUL	181
	FEB	396	AUG	212
	MAR	59	SEP	243
	APR	90	OCT	273
	MAY	120	NOV	304
	JUN	151	DEC	334

ω = fractional part of $T/100$ $T*100$ $(t-720)$ t = gmt (minutes)

M=M+1 : IF M<4 LET M=M+12 : Y=Y-1
M=INT(30.6*M)-63

e = eccentricity $= (-1.26_{10}{}^{-7}T - 4.18_{10}{}^{-5})T + .0167504$

ϵ° = obliquity $= \left[(5.03_{10}{}^{-7}T - 1.64_{10}{}^{-6})T - 1.30125_{10}{}^{-2}\right]T + 23.452294$

Π° = Mean Long. of Perige $= \dfrac{[(.012T + 1.63)T + 6189.03]T + 1012395}{3600}$

$gha_{Aries}^\circ = (3.8708_{10}{}^{-4}T + .768925)T - 80.30901667 + 360\omega + (t-720).250684427$
(R1, R2, R3, R4)

g° = Mean Anomaly $= \dfrac{[(-.012T - .54)T - 3420.9]T + 1290513}{3600} + 360\omega + \dfrac{t-720}{1461}$

$$\phi^\circ = \left\{\left[(13\sin 3g - 3\sin g)\frac{e}{12} + 1.25\sin 2g\right]e + 2\sin g\right\}_{\text{radians}}^{e} + g$$
(1 rev, 1 min.)

$\text{long}^\circ = \phi + \Pi - .005686111$

$\cos(\text{codec}) = \sin(\text{long})\sin(\epsilon) = \sin(\text{dec})$
$\sin(\text{shea}) = \dfrac{-1}{\tan(\text{codec})\tan(\epsilon)} = -\dfrac{\tan(\text{dec})}{\tan(\epsilon)}$ shea $= 180 -$ shea iff $90 < \text{long} < 270$ ie. if $\cos(\text{long}) < 0$
$\text{gha} = \text{gha}_{\text{Aries}} + \text{shea}$

$\text{Mean long}^\circ = (3.03_{10}{}^{-4}T + .768925)T + 279.69668 + 360\omega + (t-720).250684427$