

Programming Perspective on Time Scales

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2013-05-30

Bulletin C 45 2013-01-17

INFORMATION ON UTC - TAI

NO leap second will be introduced at the end of June 2013.
The difference between Coordinated Universal Time UTC and the
International Atomic Time TAI is :

from 2012 July 1, 0h UTC, until further notice : $UTC-TAI = -35 \text{ s}$

Leap seconds can be introduced in UTC at the end of the months of December
or June, depending on the evolution of UT1-TAI. Bulletin C is mailed every
six months, either to announce a time step in UTC, or to confirm that there
will be no time step at the next possible date.

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extract from Bulletin A XXVI(021) 2013–05–23

			MJD	x(arcsec)	y(arcsec)	UT1-UTC(sec)
2013	6	1	56444	0.1123	0.4081	0.07410
2013	7	1	56474	0.1594	0.3928	0.05516
2013	8	1	56505	0.1928	0.3540	0.04855
2013	9	1	56536	0.1988	0.3040	0.03685
2013	10	1	56566	0.1751	0.2586	0.00920
2013	11	1	56597	0.1255	0.2290	-0.03090
2013	12	1	56627	0.0654	0.2264	-0.07165
2014	1	1	56658	0.0079	0.2535	-0.10469
2014	2	1	56689	-0.0281	0.3048	-0.12997
2014	3	1	56717	-0.0321	0.3614	-0.16460
2014	4	1	56748	-0.0020	0.4196	-0.21297
2014	5	1	56778	0.0562	0.4562	-0.25734
2014	5	23	56800	0.1092	0.4641	-0.28159

tai-utc.dat in 1999

```
1961 JAN 1 =JD 2437300.5 TAI-UTC= 1.4228180 S + (MJD - 37300.) X 0.001296 S
1961 AUG 1 =JD 2437512.5 TAI-UTC= 1.3728180 S + (MJD - 37300.) X 0.001296 S
1962 JAN 1 =JD 2437665.5 TAI-UTC= 1.8458580 S + (MJD - 37665.) X 0.0011232S
1963 NOV 1 =JD 2438334.5 TAI-UTC= 1.9458580 S + (MJD - 37665.) X 0.0011232S
1964 JAN 1 =JD 2438395.5 TAI-UTC= 3.2401300 S + (MJD - 38761.) X 0.001296 S
1964 APR 1 =JD 2438486.5 TAI-UTC= 3.3401300 S + (MJD - 38761.) X 0.001296 S
1964 SEP 1 =JD 2438639.5 TAI-UTC= 3.4401300 S + (MJD - 38761.) X 0.001296 S
1965 JAN 1 =JD 2438761.5 TAI-UTC= 3.5401300 S + (MJD - 38761.) X 0.001296 S
1965 MAR 1 =JD 2438820.5 TAI-UTC= 3.6401300 S + (MJD - 38761.) X 0.001296 S
1965 JUL 1 =JD 2438942.5 TAI-UTC= 3.7401300 S + (MJD - 38761.) X 0.001296 S
[... ]
1983 JUL 1 =JD 2445516.5 TAI-UTC= 22.0 S + (MJD - 41317.) X 0.0 S
1985 JUL 1 =JD 2446247.5 TAI-UTC= 23.0 S + (MJD - 41317.) X 0.0 S
1988 JAN 1 =JD 2447161.5 TAI-UTC= 24.0 S + (MJD - 41317.) X 0.0 S
1990 JAN 1 =JD 2447892.5 TAI-UTC= 25.0 S + (MJD - 41317.) X 0.0 S
1991 JAN 1 =JD 2448257.5 TAI-UTC= 26.0 S + (MJD - 41317.) X 0.0 S
1992 JUL 1 =JD 2448804.5 TAI-UTC= 27.0 S + (MJD - 41317.) X 0.0 S
1993 JUL 1 =JD 2449169.5 TAI-UTC= 28.0 S + (MJD - 41317.) X 0.0 S
1994 JUL 1 =JD 2449534.5 TAI-UTC= 29.0 S + (MJD - 41317.) X 0.0 S
1996 JAN 1 =JD 2450083.5 TAI-UTC= 30.0 S + (MJD - 41317.) X 0.0 S
1997 JUL 1 =JD 2450630.5 TAI-UTC= 31.0 S + (MJD - 41317.) X 0.0 S
1999 JAN 1 =JD 2451179.5 TAI-UTC= 32.0 S + (MJD - 41317.) X 0.0 S
```

tai-utc.dat in 2004

```
1961 JAN 1 =JD 2437300.5 TAI-UTC= 1.4228180 S + (MJD - 37300.) X 0.001296 S
1961 AUG 1 =JD 2437512.5 TAI-UTC= 1.3728180 S + (MJD - 37300.) X 0.001296 S
1962 JAN 1 =JD 2437665.5 TAI-UTC= 1.8458580 S + (MJD - 37665.) X 0.0011232S
1963 NOV 1 =JD 2438334.5 TAI-UTC= 1.9458580 S + (MJD - 37665.) X 0.0011232S
1964 JAN 1 =JD 2438395.5 TAI-UTC= 3.2401300 S + (MJD - 38761.) X 0.001296 S
1964 APR 1 =JD 2438486.5 TAI-UTC= 3.3401300 S + (MJD - 38761.) X 0.001296 S
1964 SEP 1 =JD 2438639.5 TAI-UTC= 3.4401300 S + (MJD - 38761.) X 0.001296 S
1965 JAN 1 =JD 2438761.5 TAI-UTC= 3.5401300 S + (MJD - 38761.) X 0.001296 S
1965 MAR 1 =JD 2438820.5 TAI-UTC= 3.6401300 S + (MJD - 38761.) X 0.001296 S
1965 JUL 1 =JD 2438942.5 TAI-UTC= 3.7401300 S + (MJD - 38761.) X 0.001296 S
[... ]
1983 JUL 1 =JD 2445516.5 TAI-UTC= 22.0 S + (MJD - 41317.) X 0.0 S
1985 JUL 1 =JD 2446247.5 TAI-UTC= 23.0 S + (MJD - 41317.) X 0.0 S
1988 JAN 1 =JD 2447161.5 TAI-UTC= 24.0 S + (MJD - 41317.) X 0.0 S
1990 JAN 1 =JD 2447892.5 TAI-UTC= 25.0 S + (MJD - 41317.) X 0.0 S
1991 JAN 1 =JD 2448257.5 TAI-UTC= 26.0 S + (MJD - 41317.) X 0.0 S
1992 JUL 1 =JD 2448804.5 TAI-UTC= 27.0 S + (MJD - 41317.) X 0.0 S
1993 JUL 1 =JD 2449169.5 TAI-UTC= 28.0 S + (MJD - 41317.) X 0.0 S
1994 JUL 1 =JD 2449534.5 TAI-UTC= 29.0 S + (MJD - 41317.) X 0.0 S
1996 JAN 1 =JD 2450083.5 TAI-UTC= 30.0 S + (MJD - 41317.) X 0.0 S
1997 JUL 1 =JD 2450630.5 TAI-UTC= 31.0 S + (MJD - 41317.) X 0.0 S
1999 JAN 1 =JD 2451179.5 TAI-UTC= 32.0 S + (MJD - 41317.) X 0.0 S
```

tai-utc.dat in 2006

```
1961 JAN 1 =JD 2437300.5 TAI-UTC= 1.4228180 S + (MJD - 37300.) X 0.001296 S
1961 AUG 1 =JD 2437512.5 TAI-UTC= 1.3728180 S + (MJD - 37300.) X 0.001296 S
1962 JAN 1 =JD 2437665.5 TAI-UTC= 1.8458580 S + (MJD - 37665.) X 0.0011232S
1963 NOV 1 =JD 2438334.5 TAI-UTC= 1.9458580 S + (MJD - 37665.) X 0.0011232S
1964 JAN 1 =JD 2438395.5 TAI-UTC= 3.2401300 S + (MJD - 38761.) X 0.001296 S
1964 APR 1 =JD 2438486.5 TAI-UTC= 3.3401300 S + (MJD - 38761.) X 0.001296 S
1964 SEP 1 =JD 2438639.5 TAI-UTC= 3.4401300 S + (MJD - 38761.) X 0.001296 S
1965 JAN 1 =JD 2438761.5 TAI-UTC= 3.5401300 S + (MJD - 38761.) X 0.001296 S
1965 MAR 1 =JD 2438820.5 TAI-UTC= 3.6401300 S + (MJD - 38761.) X 0.001296 S
1965 JUL 1 =JD 2438942.5 TAI-UTC= 3.7401300 S + (MJD - 38761.) X 0.001296 S
[... ]
1983 JUL 1 =JD 2445516.5 TAI-UTC= 22.0 S + (MJD - 41317.) X 0.0 S
1985 JUL 1 =JD 2446247.5 TAI-UTC= 23.0 S + (MJD - 41317.) X 0.0 S
1988 JAN 1 =JD 2447161.5 TAI-UTC= 24.0 S + (MJD - 41317.) X 0.0 S
1990 JAN 1 =JD 2447892.5 TAI-UTC= 25.0 S + (MJD - 41317.) X 0.0 S
1991 JAN 1 =JD 2448257.5 TAI-UTC= 26.0 S + (MJD - 41317.) X 0.0 S
1992 JUL 1 =JD 2448804.5 TAI-UTC= 27.0 S + (MJD - 41317.) X 0.0 S
1993 JUL 1 =JD 2449169.5 TAI-UTC= 28.0 S + (MJD - 41317.) X 0.0 S
1994 JUL 1 =JD 2449534.5 TAI-UTC= 29.0 S + (MJD - 41317.) X 0.0 S
1996 JAN 1 =JD 2450083.5 TAI-UTC= 30.0 S + (MJD - 41317.) X 0.0 S
1997 JUL 1 =JD 2450630.5 TAI-UTC= 31.0 S + (MJD - 41317.) X 0.0 S
1999 JAN 1 =JD 2451179.5 TAI-UTC= 32.0 S + (MJD - 41317.) X 0.0 S
2006 JAN 1 =JD 2453736.5 TAI-UTC= 33.0 S + (MJD - 41317.) X 0.0 S
```

```
(define-class <time-scale> ())  
(define-class <time-label> ())  
(define-class <time-value> ()  
  (scale #:init-keyword #:scale #:getter time-value-scale)  
  (label #:init-keyword #:label #:getter time-value-label))  
(define (make-time-value s l)  
  (make <time-value> #:scale s #:label l))
```

(make-time-value *scale label*) → *time*

(time-value-scale *time*) → *scale*

(time-value-label *time*) → *label*

(convert-time *src-time* *tgt-scale*)

→ *tgt-time*


```
(time-converter src-scale tgt-scale)
```

→ *func*

```
(define-generic time-converter)
```

```
(define (convert-time src-time tgt-scale)
```

```
  (make-time-value tgt-scale
```

```
    ((time-converter (time-value-scale src-time) tgt-scale)
```

```
      (time-value-label src-time))))
```

```
(define-method (time-converter (src (singleton UT2)) tgt)
  (let ((convert-UT1-to-tgt (time-converter UT1 tgt)))
    (lambda (src-time)
      (convert-UT1-to-tgt (convert-UT2-to-UT1 src-time)))))
```

(convert-time *src-time* *tgt-scale* *subject*)

→ *tgt-time*