

## MOTIVATION

Since DataFrame is a statistical library, it often deals with time-series data. So, it needs to keep track of time.

The most efficient way of indexing DataFrame by time is to use an index type of *time\_t* for second precision or *double* or *long long integer* for more precision. DateTime class provides a more elaborate handling of time. Also, it is a general handy DateTime object.

## CODE STRUCTURE

Both the header (DateTime.h) and source (DateTime.cc) files are part of the DataFrame project. They are in the usual *include* and *src* directories.

## BUILD INSTRUCTIONS

Follow the DataFrame build instructions.

## EXAMPLE

This library can have up to Nano second precision depending on what systems calls are available.

These are some example code:

```
DateTime    now;
DateTime    gmt_now (DT_TIME_ZONE::GMT);
DateTime    hk_now (DT_TIME_ZONE:: AS_HONG_KONG);

cout << "Local Time is: " << now.string_format (DT_FORMAT::DT_TM2) << std::endl;
cout << "GMT Time is: " << gmt_now.string_format (DT_FORMAT::DT_TM2) << std::endl;

double diff = now.diff_seconds (gmt_now);

now = 19721202;
gmt_now = 19721210;
diff = now.diff_weekdays (gmt_now);

now.add_days(3)
now.add_weekdays(-2);
```

For more examples see file *date\_time\_tester.cc*

## TYPES

```
enum class DT_FORMAT : unsigned short int {
    AMR_DT = 1,           // e.g. 09/16/99
    AMR_DT_CTY = 2,       // e.g. 09/16/1999
    EUR_DT = 3,           // e.g. 16/09/99
    EUR_DT_CTY = 4,       // e.g. 16/09/1999
    DT_TM = 5,            // e.g. 09/16/1999 13:51:04
    SCT_DT = 6,           // e.g. Sep 16, 1999
    DT_MMDDYYYY = 7,      // e.g. 09161999
    DT_YYYYMMDD = 8,      // e.g. 19990916
    DLR_MNY = 9,          // e.g. $ 120350045
    DLR_MNY_C = 10,       // e.g. $ 120,350,045
    DLR_MNY_C_DM = 11     // e.g. $ 120,350,045.53
    VAL_32ND = 12,        // e.g. 105-164
    VAL_64TH = 13,        // e.g. 105=33
    DT_TM2 = 14,          // e.g. 09/16/1999 13:51:04.256
    DT_DATETIME = 15,     // e.g. 20010103 09:31:15.124
    DT_FAME_DATE = 16,    // e.g. 27Sep2001
    DT_PRECISE = 17       // e.g. 1516179600.874123908 = Epoch.Nanoseconds
};
```

These constants are used for formatting date/time into strings.

```
enum class DT_TIME_ZONE : short int {
    LOCAL = -2,
    GMT = 0,
    AM_BUENOS_AIRES = 1,
    AM_CHICAGO = 2,
    AM_LOS_ANGELES = 3,
    AM_MEXICO_CITY = 4,
    AM_NEW_YORK = 5,
    AS_DUBAI = 6,
    AS_HONG_KONG = 7,
    AS_SHANGHAI = 8,
    AS_SINGAPORE = 9,
    AS_TEHRAN = 10,
    AS_TEL_AVIV = 11,
    AS_TOKYO = 12,
    AU_MELBOURNE = 13,
    AU_SYDNEY = 14,
    BR_RIO_DE_JANEIRO = 15,
    EU_BERLIN = 16,
    EU_LONDON = 17,
    EU_MOSCOW = 18,
    EU_PARIS = 19,
    EU_ROME = 20,
    EU_VIENNA = 21,
    EU_ZURICH = 22,
    UTC = 23,
```

```

AS_SEOUL = 24,
AS_TAIPEI = 25,
EU_STOCKHOLM = 26,
NZ = 27,
EU_OSLO = 28,
EU_WARSAW = 29,
EU_BUDAPEST = 30
};

```

These are the available time zones.

```

enum class DT_WEEKDAY : unsigned char {
    BAD_DAY = 0,
    SUN = 1,
    MON = 2,
    TUE = 3,
    WED = 4,
    THU = 5,
    FRI = 6,
    SAT = 7
};

```

Week days: 1 - 7 (Sunday - Saturday)

```

enum class DT_MONTH : unsigned char {
    BAD_MONTH = 0,
    JAN = 1,
    FEB = 2,
    MAR = 3,
    APR = 4,
    MAY = 5,
    JUN = 6,
    JUL = 7,
    AUG = 8,
    SEP = 9,
    OCT = 10,
    NOV = 11,
    DEC = 12
};

```

Months: 1 - 12 (January - December)

```

enum class DT_DATE_STYLE : unsigned char {
    YYYYMMDD = 1,
    AME_STYLE = 2,
    EUR_STYLE = 3
};

```

These constants are used for parsing data

|            |            |
|------------|------------|
| AME_STYLE: | MM/DD/YYYY |
| EUR_STYLE: | YYYY/MM/DD |

|   |                  |
|---|------------------|
| <i>DateType</i> = <i>unsigned int</i>           | YYYYMMDD         |
| <i>DatePartType</i> = <i>unsigned short int</i> | year, month etc. |
| <i>HourType</i> = <i>unsigned short int</i>     | 0 - 23           |
| <i>MinuteType</i> = <i>unsigned short int</i>   | 0 - 59           |
| <i>SecondType</i> = <i>unsigned short int</i>   | 0 - 59           |
| <i>MillisecondType</i> = <i>short int</i>       | 0 - 999          |
| <i>MicrosecondType</i> = <i>int</i>             | 0 - 999,999      |
| <i>NanosecondType</i> = <i>int</i>              | 0 - 999,999,999  |
| <i>EpochType</i> = <i>time_t</i>                | Signed epoch     |

## METHODS

*explicit DateTime (DT\_TIME\_ZONE the\_zone = DT\_TIME\_ZONE::LOCAL) noexcept;*  
A constructor that creates a DateTime initialized to now.

the\_zone: Desired time zone from DT\_TIME\_ZONE above.

*explicit DateTime (DateType d,  
HourType hr = 0,  
MinuteType mn = 0,  
SecondType sc = 0,  
NanosecondType ns = 0,  
DT\_TIME\_ZONE tz = DT\_TIME\_ZONE::LOCAL) noexcept;*

The constructor that creates a DateTime based on parameters passed.

d: Date e.g. 20180112

hr: Hour e.g. 13

mn: Minute e.g. 45

sc: Second e.g. 45

ns: Nano-second e.g. 123456789

the\_zone: Desired time zone from DT\_TIME\_ZONE above.

*explicit DateTime (const char \*s,  
DT\_DATE\_STYLE ds = DT\_DATE\_STYLE::YYYYMMDD,  
DT\_TIME\_ZONE tz = DT\_TIME\_ZONE::LOCAL);*

The constructor that creates a DateTime by parsing a string and based on parameters passed.

Currently, the following formats are supported:

- (1) YYYYMMDD
- AME\_STYLE:
- (2) DD/MM/YYYY
  - (3) DD/MM/YYYY HH
  - (4) DD/MM/YYYY HH:MM
  - (5) DD/MM/YYYY HH:MM:SS
  - (6) DD/MM/YYYY HH:MM:SS.MMM

EUR\_STYLE:

- (7) YYYY/MM/DD

- (8) YYYY/MM/DD HH
- (9) YYYY/MM/DD HH:MM
- (10) YYYY/MM/DD HH:MM:SS
- (11) YYYY/MM/DD HH:MM:SS.MMM

s: The string to be parsed

ds: String format from DT\_DATE\_STYLE above

the\_zone: Desired time zone from DT\_TIME\_ZONE above.

*void set\_time (EpochType the\_time, NanosecondType nanosec = 0) noexcept;*

A convenient method, if you already have a DateTime instance and want to change the date/time quickly.

the\_time: Time as epoch

nanosec: Nano seconds

*void set\_timezone (DT\_TIME\_ZONE tz);*

Changes the time zone to desired time zone.

NOTE: This method is not multithread-safe. This method modifies the TZ environment variable which changes the time zone for the entire program.

tz: Desired time zone

*DT\_TIME\_ZONE get\_timezone () const;*

Returns the current time zone.

*DateTime &operator = (DateType rhs);*

Sets self to right-hand-side.

rhs: A date e.g. dt = 20181215;

*DateTime &operator = (const char \*rhs);*

Sets self to right-hand-side.

Currently, the following formats are supported:

- 1) YYYYMMDD [LOCAL | GMT]
- 2) YYYYMMDD HH:MM:SS.MMM [LOCAL | GMT]

rhs: A date/time string e.g. dt = "20181215";

*int dt\_compare(const DateTime &rhs) const;*

Compares self with right-hand-side and returns an integer result accordingly.

rhs: Another DateTime instance

*DateType date () const noexcept;*

*// e.g. 20020303*

```

DatePartType year () const noexcept;           // e.g. 1990
DT_MONTH month () const noexcept;              // JAN - DEC
DatePartType dmonth () const noexcept;         // 1 - 31
DatePartType dyear () const noexcept;         // 1 - 366
DT_WEEKDAY dweek () const noexcept;           // SUN - SAT
HourType hour () const noexcept;              // 0 - 23
MinuteType minute () const noexcept;          // 0 - 59
SecondType sec () const noexcept;             // 0 - 59
MillisecondType msec () const noexcept;        // 0 - 999
MicrosecondType microsec () const noexcept;   // 0 - 999,999
NanosecondType nanosec () const noexcept;     // 0 - 999,999,999
EpochType time () const noexcept;            // Like time()

```

These methods return the corresponding date/time parts.

```

DatePartType days_in_month () const noexcept;  // 28, 29, 30, 31

```

It returns the number of days in the month represented in self

```

double diff_seconds (const DateTime &that) const;
double diff_minutes (const DateTime &that) const noexcept;
double diff_hours (const DateTime &that) const noexcept;
double diff_days (const DateTime &that) const noexcept;
double diff_weekdays (const DateTime &that) const noexcept;
double diff_weeks (const DateTime &that) const noexcept;

```

These return the diff including the fraction of the unit. This is why they return a double. The diff could be +/- based on "this - that"

that: Another instance of DateTime

```

void add_seconds (EpochType secs) noexcept;
void add_days (long days) noexcept;
void add_weekdays (long days) noexcept;

```

These methods either advance or pullback the time accordingly. The parameter to these methods could be +/-.

secs, days: A positive or negative number representing the units to change time

```

template<typename T>
void date_to_str (DT_FORMAT format, T &result) const;
std::string string_format (DT_FORMAT format) const;

```

These methods format the date/time into a string based on the format parameter

T: Type of string

result: a string instance to store the formatted date/time

format: String format parameter based on DT\_FORMAT above