

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/Utils* and *src/Utils* 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  
    DT_TM2 = 9,          // e.g. 09/16/1999 13:51:04.256  
    DT_DATETIME = 10,    // e.g. 20010103 09:31:15.124  
    DT_PRECISE = 11      // e.g. 1516179600.874123908 = Epoch.Nanoseconds  
    ISO_DT_TM = 12,       // e.g. 2015-05-05 13:51:04.000234  
    ISO_DT = 13,         // e.g. 2015-05-05  
    ISO_DT_NANO = 14,    // e.g. 2015-05-05 13:51:04.123456789  
};
```

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, used in a few methods and constructors.

```
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), used by various methods.

```
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), used by various methods.

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

These constants are used for parsing data

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

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

METHODS

explicit DateTime (DT_TIME_ZONE tz = DT_TIME_ZONE::LOCAL) noexcept;
A constructor that creates a DateTime initialized to now.

tz: 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

tz: 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) MM/DD/YYYY
- (3) MM/DD/YYYY HH
- (4) MM/DD/YYYY HH:MM
- (5) MM/DD/YYYY HH:MM:SS
- (6) MM/DD/YYYY HH:MM:SS.MMM // Milliseconds
- (7) MM/DD/YYYY HH:MM:SS.IIIII // Microseconds
- (8) MM/DD/YYYY HH:MM:SS.NNNNNNNNN // Nanoseconds

EUR_STYLE:

- (9) YYYY/MM/DD
- (10) YYYY/MM/DD HH
- (11) YYYY/MM/DD HH:MM
- (12) YYYY/MM/DD HH:MM:SS
- (13) YYYY/MM/DD HH:MM:SS.MMM // Milliseconds
- (14) YYYY/MM/DD HH:MM:SS.IIIII // Microseconds
- (15) YYYY/MM/DD HH:MM:SS.NNNNNNNNN // Nanoseconds

ISO_STYLE:

- (16) YYYY-MM-DD
- (17) YYYY-MM-DD HH
- (18) YYYY-MM-DD HH:MM
- (19) YYYY-MM-DD HH:MM:SS
- (20) YYYY-MM-DD HH:MM:SS.MMM // Milliseconds
- (21) YYYY-MM-DD HH:MM:SS.IIIII // Microseconds
- (22) YYYY-MM-DD HH:MM:SS.NNNNNNNNN // Nanoseconds

s: The string to be parsed.

ds: String format from DT_DATE_STYLE above.

tz: 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()

LongTimeType long_time () const noexcept; // Nano seconds since epoch

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_nanoseconds (long nanosecs) noexcept;
void add_seconds (EpochType secs) noexcept;
void add_days (long days) noexcept;
void add_weekdays (long days) noexcept;
void add_months (long months) noexcept;
void add_years (long years) 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
