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
};
```

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

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

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

ISO_STYLE:
(12) YYYY-MM-DD

(13) YYYY-MM-DD HH
(14) YYYY-MM-DD HH:MM
(15) YYYY-MM-DD HH:MM:SS
(16) YYYY-MM-DD HH:MM:SS.MMM

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