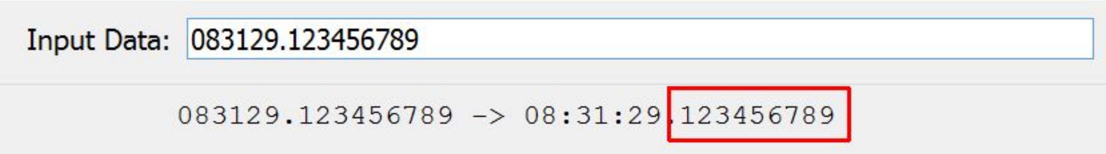
SAFE SOFTWARE™

Datetime Programming For Everyone. Everywhere.

Tai Meng | tai.meng@safe.com

PRECISION

Nanosecond Precision

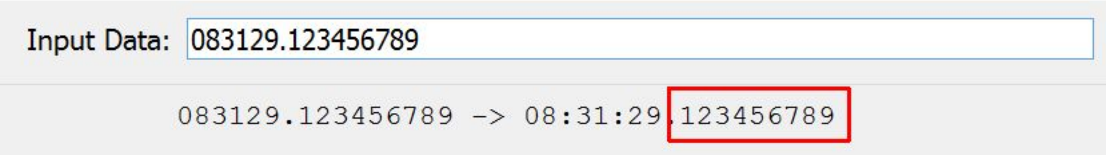


Input Data: 083129.123456789

```
083129.123456789 -> 08:31:29.123456789
```

Why?

Nanosecond Precision



Input Data: 083129.123456789

```
083129.123456789 -> 08:31:29.123456789
```

Why?

Oracle | SQL Server

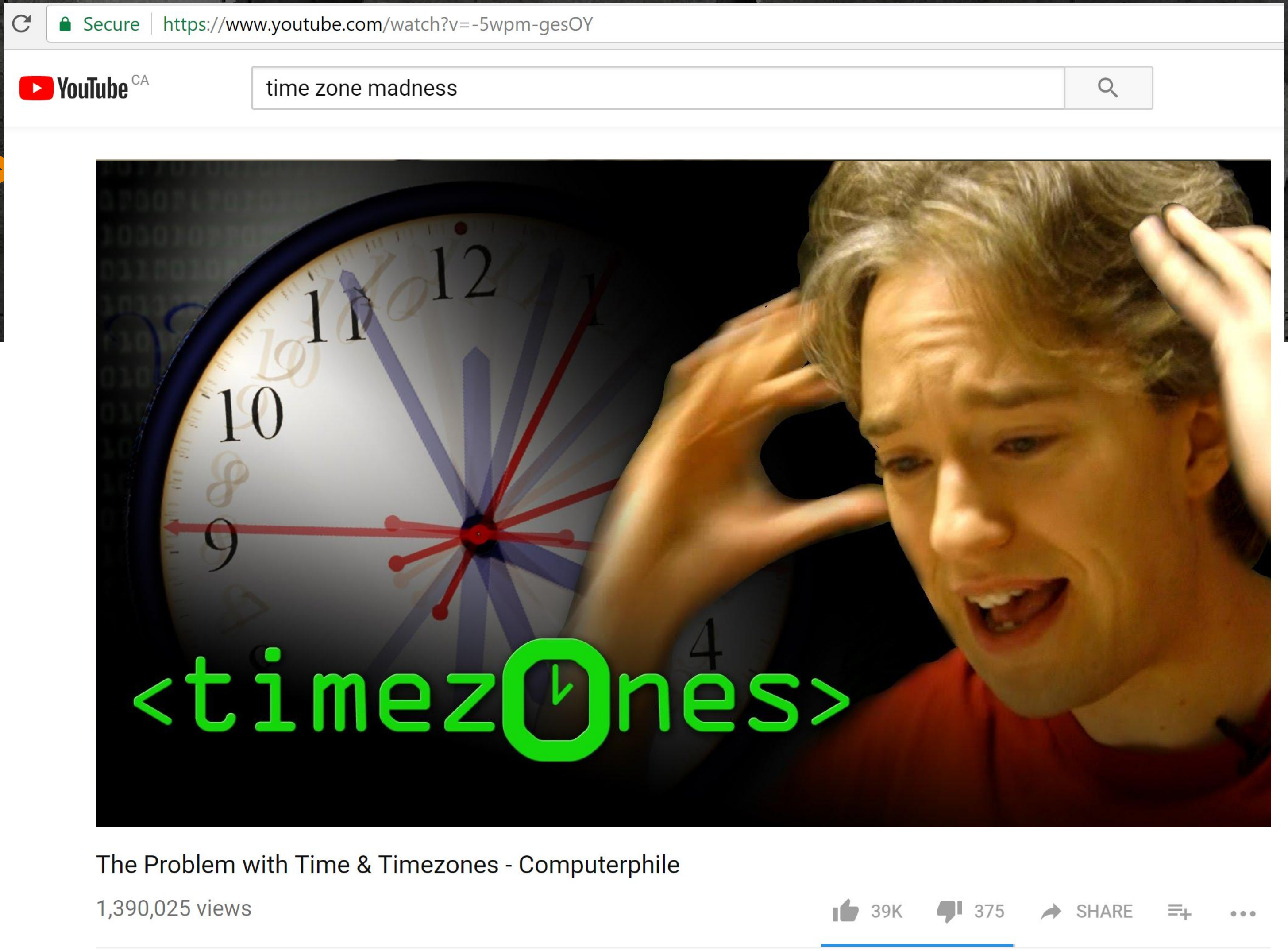
High volume transactions | Scientific data

Time Zone Conversions

UTC offset

```
@TimeZoneSet(06:00:00–07:00, –04:00)
          = 09:00:00–04:00
@TimeZoneSet(2017-05-26 06:00:00+00:00, local)
          = 2017-05-25 23:00:00–07:00
```

IANA time zone
Daylight savings



https://www.youtube.com/watch?v=-5wpm-gesOY

time zone madness

The Problem with Time & Timezones - Computerphile

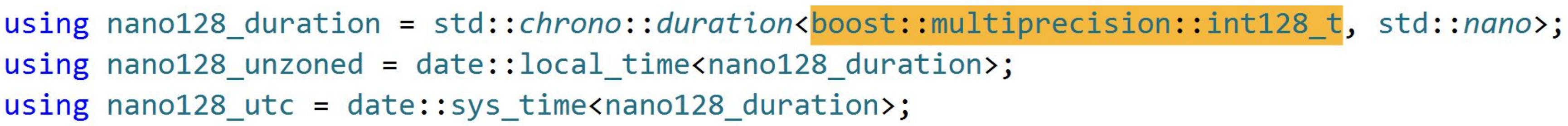
1,390,025 views

Disclaimer: if error below, contact me and I'll fix.

Company	Component	
boost C++ LIBRARIES	Date_Time	Howard's libraries: • Nanosecond precision • Full IANA time zone support • World class support! • Proposed for C++20 or later
Qt	QDate/Time	
Google	cctz*	
python	datetime	
Bloomberg	bdlt	
php	DateTime	
IBM	ICU	
Tcl	clock	
✓	date.h/tz.h	

* google/cctz is not an official Google product.

Howard + Boost

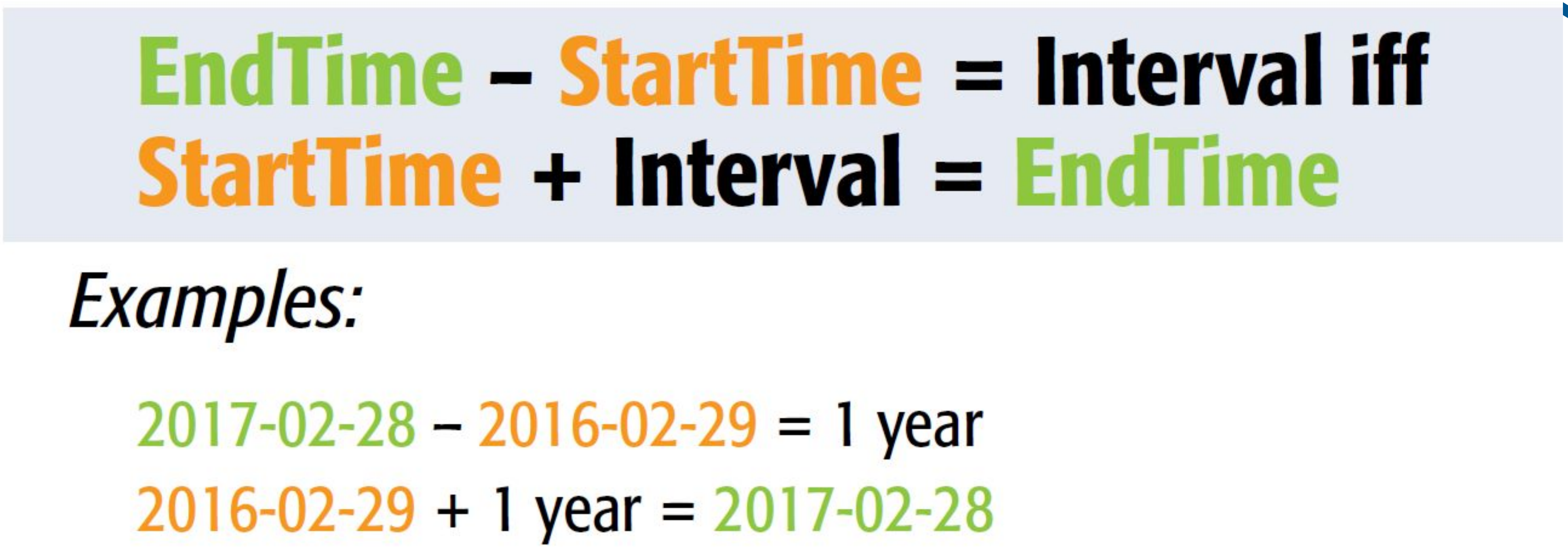


```
using nano128_duration = std::chrono::duration<boost::multiprecision::int128_t, std::nano>;
using nano128_unzoned = date::local_time<nano128_duration>;
using nano128_utc = date::sys_time<nano128_duration>;
```

There!

Nanosecond precision & IANA time zone support!

Math Invariant



EndTime – StartTime = Interval iff StartTime + Interval = EndTime

Examples:

2017-02-28 – 2016-02-29 = 1 year

2016-02-29 + 1 year = 2017-02-28

Type Conversions

Five Datetime Types:

1. Date
2. Time
3. Datetime
4. Time with UTC offset
5. Datetime with UTC offset

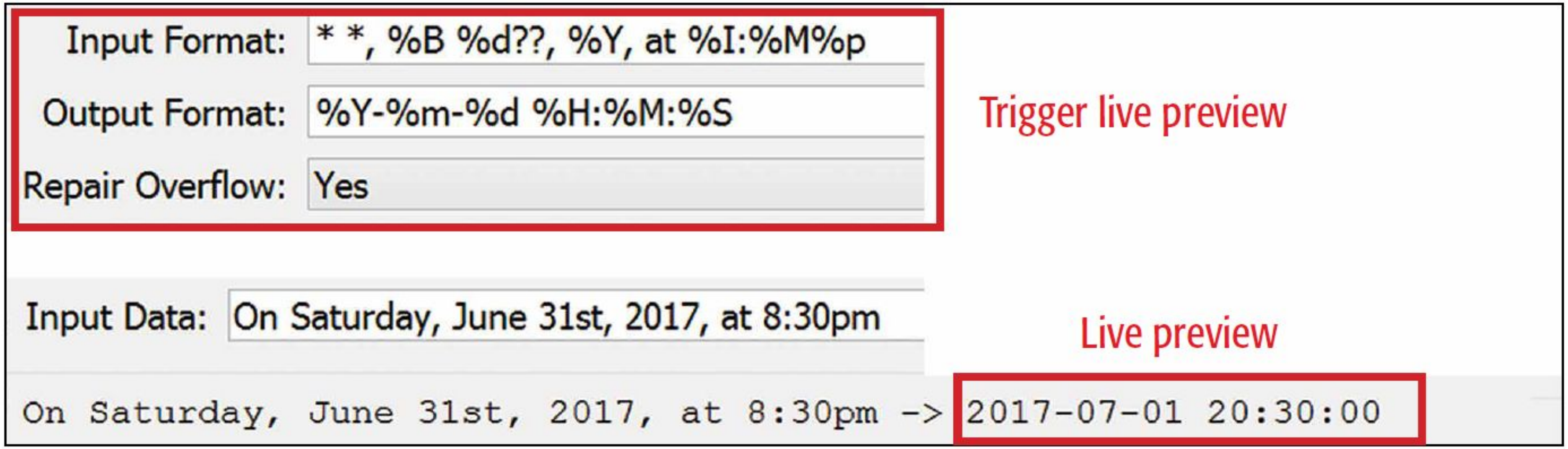
Math

- ✓ Dates autocast into datetimes by adding midnight.
- ✗ All other implicit casts are forbidden.

Writing Datetime Values

- ✓ Drop unneeded date, time, and/or UTC offset.
- ✓ Fabricate midnight.
- ✓ Round if extra precision. Don't trim.
- ✗ Do not fabricate date.
- ✗ Do not fabricate UTC offset (or time zone).

Validation & Repair



Input Format: * *, %B %d??, %Y, at %I:%M%p

Output Format: %Y-%m-%d %H:%M:%S

Repair Overflow: Yes

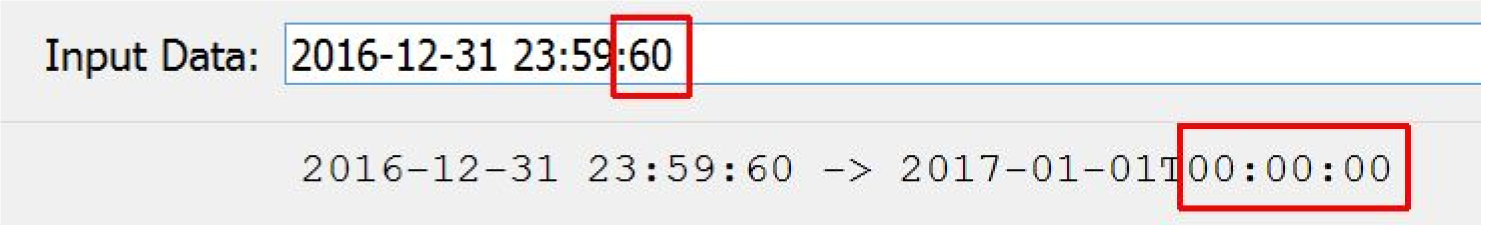
Trigger live preview

Input Data: On Saturday, June 31st, 2017, at 8:30pm

Live preview

```
On Saturday, June 31st, 2017, at 8:30pm -> 2017-07-01 20:30:00
```

Leap Seconds



Input Data: 2016-12-31 23:59:60

```
2016-12-31 23:59:60 -> 2017-01-01T00:00:00
```

Use Howard’s date/tz Libraries!

Proposed for C++20 (or later)

Howard’s date/tz libraries

- Open source: *https://github.com/HowardHinnant/date*

- World class support: *https://gitter.im/HowardHinnant/date*

- Email: *howard.hinnant@gmail.com*

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Thank you!

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