

## Linked Data of Temporal Information

---

Tatsuki Sekino  
Research Institute for Humanity and Nature

### Linked Data

---

- Linked data is a web of data
- Links between data are described by RDF
- Each data (resource) is expressed as URI

## Difference in RDF between place and date.

### About PNC 2016

PNC 2016 is held in Los Angeles.

`<http://www.pnclink.org/pnc2016>`  $\xrightarrow{\text{place}}$  `<http://www.geonames.org/5368361/>`

PNC 2016 starts on 16 August 2016.

`<http://www.pnclink.org/pnc2016>`  $\xrightarrow{\text{date}}$  `"2016-08-16"^^xsd:date`

### About place and date

Events held in Los Angeles.

`<http://www.geonames.org/5368361/>`  $\xrightarrow{\text{event}}$  `<http://www.pnclink.org/pnc2016>`  
`<http://losangeles.dodgers.mlb.com/>`

Events held in on 16 August 2016.

`"2016-08-16"^^xsd:date`  $\xrightarrow{\text{event}}$  `<http://www.pnclink.org/pnc2016>`  
`<http://https://www.rio2016.com/>`

We cannot express events list held on 2016-08-16 by RDF.  
(Literal "2016-08-16" cannot become subject in RDF)

## The issue about date expression in RDF

### Information about a date cannot be described by RDF

16 August 2016 is Tuesday.

`"2016-08-16"^^xsd:date`  $\xrightarrow{\text{dayOfWeek}}$  `<https://en.wikipedia.org/wiki/Tuesday>`

18 August 2016 is full moon.

`"2016-08-18"^^xsd:date`  $\xrightarrow{\text{moonPhase}}$  `<https://en.wikipedia.org/wiki/Full_moon>`

16 August 2016 is "平成28年8月16日" in Japanese Calendar.

`"2016-08-16"^^xsd:date`  $\xrightarrow{\text{jpCalendar}}$  `"平成28年8月16日"`

### Purpose of this study

Constructing datetime resources for linked data

<http://datetime.hutime.org/>

### Integration of information about a place and a date

---

**Place**

**Los Angeles**

URI <<http://www.geonames.org/5368361/>>

Coordinate Latitude: 34.05223  
Longitude: -118.24368

Name Los Angeles, 洛杉矶, ロサンゼルス

**Date**

**2016-08-16**

URI <<http://datetime.hutime.org/2457616.5/>>

Coordinate Julian Date: 2457616.6 (total day count from 1 January B.C.E 4712)

Name "2016-08-16"

<http://s.w.s.geonames.org/5368361/>

- rd:type gn:Feature
- wgs84\_pos:lat 34.05223
- wgs84\_pos:long -118.24368
- gn:officialName
- gn:alternateName Los Angeles @en
- gn:alternateName 洛杉矶 @gan
- gn:alternateName ロサンゼルス @ja

<http://datetime.hutime.org/> (top page will be redirected to today's date resource)

www.hutime.org 5 Time Information System HuTime

### Standard Date Resource

---

**URI of Standard Date Resource**

<http://datetime.hutime.org/date/JulianDate>

*Julian Date*: Julian Date value at 00:00 (UTC) on the date

**Date resource of Today (2016-08-16)**

<http://datetime.hutime.org/date/2457616.5>

This date resource indicates a temporal interval between 2016-08-16T00:00 and 2016-08-17T00:00

2016-08-16T00:00 2016-08-17T00:00

2457616.5 2457617.5

the instant of the end point is not included in the temporal interval.

www.hutime.org 6 Time Information System HuTime

## Alias of Standard Date Resource

### URI of Standard Date Resource Alias

<http://datetime.hutime.org/date/ISO 8601 expression>

*ISO8601 Expression*: date expression according to ISO 8601 (proleptic Gregorian Calendar)

<http://datetime.hutime.org/date/2016-08-16>



redirect (HTTP Status Code 303)

<http://datetime.hutime.org/date/2457616.5>

### More simple expression using prefix

@prefix hdate:

<<http://datetime.hutime.org/date/>>

hdate:2457616.5

hdate:2016-08-16

## Information about a specific date

General	rdfs:type	hutime:Date
	rdfs:label	2016-08-16
Period	hutime:begin	2016-08-16
	hutime:end	2016-08-16
JdPeriod	hutime:jdBegin	2457616.5
	hutime:jdEnd	2457617.5
Chain	hutime:previous	2016-08-15
	hutime:next	2016-08-17
Duration	hutime:dayDuration	1
Other Features	hutime:iso8601	2016-08-16
	hutime:onDayOfWeek	Tuesday



### General Information

- type
- label
- date of begin and end of the period
- Julian Date value of begin and end of the period
- previous and next resources
- duration
- iso8601 expression
- day of week

## Information about a specific date

Time Interval Relation	hutime:tMeets	2016-08-17
	hutime:tMetBy	2016-08-15
	hutime:tEquals	2457616.5
		(Julian Date)
		C.E. 2016 August 16 (Gregorian Calendar)
		C.E. 2016 August 16 (Julian/Gregorian Calendar (reformed in 1582))
		C.E. 2016 August 16 (Julian/Gregorian Calendar (reformed in 1752))
		C.E. 2016 August 03 (Julian Calendar)
		13 1437 القعدة (Hijri Calendar)
		12 5776 אב (Hebrew Calendar)
		平成28年8月16日 (Japanese Calendar (Southern Court))
		平成28年8月16日 (Japanese Calendar (Northern Court))
		平成28年7月14日 (Japanese Calendar (Old Calendar after Meiji Era))
		16 ๒๕๕๙ 2559 (Thai Buddhist Calendar)

## Other Information

- calendar date resources having the same period.

## Calendar datetime resources

## URI of Calendar Datetime Resource

<http://datetime.hutime.org/calendar/calendar ID/type/Julian Date>

**calendar ID:** ID to specify calendar (e.g. Gregorian Calendar: 2.1)  
(Please refer <http://datetime.hutime.org/calendar/>)

**type:** type of resource (e.g. date, month, year and era)

**Julian Date:** Julian Date value at the start point of the period

## Gregorian Calendar datetime resources of Today (2016-08-16)

**Date** (C.E. 2016 August 16)

<http://datetime.hutime.org/calendar/2.1/date/2457616.5>

**Month** (C.E. 2016 August: August 1 - 31)

<http://datetime.hutime.org/calendar/2.1/month/2457601.5>

**Year** (C.E. 2016: January 1 - December 31)

<http://datetime.hutime.org/calendar/2.1/year/2457388.5>

## Alias of Calendar datetime resources

---

### URI of Calendar Date Resource

[http://datetime.hutime.org/calendar/\*calendar ID\*/\*type of resource\*/\*datetime expression\*](http://datetime.hutime.org/calendar/calendar ID/type of resource/datetime expression)

*calendar ID*: ID to specify calendar (e.g. Gregorian Calendar: 2.1)  
(Please refer <http://datetime.hutime.org/calendar/>)

*type of resource*: date, month, year and era

*datetime expression*: Julian Date value at the start point of the period

### Example for Today's Gregorian Calendar **date** resource

<http://datetime.hutime.org/calendar/2.1/date/C.E. 2016 August 16>

<http://datetime.hutime.org/calendar/2.1/date/2016-08-16>

<http://datetime.hutime.org/calendar/2.1/date/2016 Aug 16>



redirect (HTTP Status Code 303)

<http://datetime.hutime.org/calendar/2.1/date/2457616.5>

## Alias of Calendar datetime resources

---

### Example for Today's Gregorian Calendar **month** resource

<http://datetime.hutime.org/calendar/2.1/month/2016-08>

<http://datetime.hutime.org/calendar/2.1/month/2016 Aug>



redirect (HTTP Status Code 303)

<http://datetime.hutime.org/calendar/2.1/month/2457601.5>

### Example for Today's Gregorian Calendar **year** resource

<http://datetime.hutime.org/calendar/2.1/year/2016>



redirect (HTTP Status Code 303)

<http://datetime.hutime.org/calendar/2.1/year/2457388.5>

## Alias of Calendar datetime resources

## Application for unreadable foreign characters

## Thai Buddhism Calendar (Thai characters)

<http://datetime.hutime.org/calendar/1003.1/date/16> สิงหาคม 2559

## Hebrew Calendar (Hebrew characters)

<http://datetime.hutime.org/calendar/104.1/date/12> כסיו 5776

## Hijri Calendar (Arabic characters)

<http://datetime.hutime.org/calendar/103.1/date/13> ذو القعدة 1437

## Japanese Calendar (Chinese characters)

<http://datetime.hutime.org/calendar/1001.1/date/>平成二十八年八月十六日

## Information about a specific calendar date (16 August 2016 in Gregorian Calendar)

General	rdf:type	hutime:CalendarDate
	rdfs:label	C.E. 2016 August 16
Period	hutime:begin	2016-08-16
	hutime:end	2016-08-16
JdPeriod	hutime:jdBegin	2457616.5
	hutime:jdEnd	2457617.5
Chain	hutime:previous	C.E. 2016 August 15
	hutime:next	C.E. 2016 August 17
Duration	hutime:dayDuration	1
	hutime:calendarDuration	+0.0-1
Calendar	hutime:ofCalendar	Gregorian Calendar
	hutime:ofEra	C.E.
	hutime:ofYear	C.E. 2016
	hutime:ofMonth	C.E. 2016 August

inclusion relation among different types of resources

## Differences in linked information between types of resource

type	date	month	year
label	C.E. 2016 August 16	C.E. 2016 August	C.E. 2016
begin	2016-08-16	C.E. 2016 August 1	C.E. 2016 January 1
end	2016-08-16	C.E. 2016 August 31	C.E. 2016 December 31
jdBegin	2457616.5	2457601.5	2457388.5
jdEnd	2457617.5	2457632.5	2457754.5
previous	C.E. 2016 August 15	C.E. 2016 July	C.E. 2015
next	C.E. 2016 August 17	C.E. 2016 September	C.E. 2017
dayDuration	1	31	366
calendarDuration	+0-0-1	+0-1-0	+1-0-0
isLeap	false	false	true

## Example for usage of datetime resource

## HTML source which is embedded RDF according to RDFa

```
<html prefix="hcal: http://datetime.hutime.org/calendar/2.1/">
  ⋮
  <p about="http://www.pnclink.org/pnc2016">PNC 2016 starts from
  <span property="dc:date" resource=" hcal :date/2016-08-16"> 16 August 2016</span>
  in Los Angeles.</p>
```

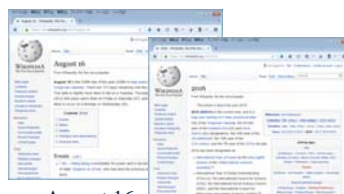
## Extracted RDF from HTML source

```
<http://www.pnclink.org/pnc2016> <-----> <http://date.hutime.org/calendar/2.1/date/2457616.5>
      dc:date
```

Corresponding dates  
in other calendar

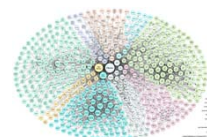
16 สิงหาคม 2559  
 12 אב 5776  
 13 ذو القعدة 1437  
 平成二十八年八月十六日

## Corresponding items in Wikipedia



August 16

2016

Other related information  
which is available through  
Linked Data Mechanism



## Summary

---

### Necessity of datetime resource

### Two types of datetime resource, and their URI

- Standard date resource
- Calendar datetime resource

### Information linked with datetime resources

### Usage of datetime resources

<http://datetime.hutime.org/>

is available as Linked Open Data under "CC By" License