Python Data Products

Course 1: Basics

Lecture: Time and date data

Learning objectives

In this lecture we will...

- Consider various **formats and structures** to represent time and date data
- Demonstrate the main **methods** to manipulate time data in python
- **Convert** time and date data between various formats

Time and date data

Dealing with time and date data can be difficult as string-formatted data doesn't admit easy comparison or feature representation:

- Which date occurs first, 4/7/2003 or 3/8/2003?
- How many days between 4/5/2003 - 7/15/2018?
- e.g. how many hours between 2/6/2013 23:02:38 - 2/7/2013 08:32:35?

Time and date data

Most of the data we've seen so far include plain-text time data, that we need to carefully manipulate:


```
{'business_id': 'FYWN1wneV18bWNgQjJ2GNg', 'attributes':
{'BusinessAcceptsCreditCards': True, 'AcceptsInsurance': True,
'ByAppointmentOnly': True}, 'longitude': -111.9785992,
'state': 'AZ', 'address': '4855 E Warner Rd, Ste B9',
'neighborhood': '', 'city': 'Ahwatukee', 'hours': {'Tuesday':
'7:30-17:00', 'Wednesday': '7:30-17:00', 'Thursday': '7:30-
17:00', 'Friday': '7:30-17:00', 'Monday': '7:30-17:00'},
'postal_code': '85044', 'review_count': 22, 'stars': 4.0,
'categories': ['Dentists', 'General Dentistry', 'Health &
Medical', 'Oral Surgeons', 'Cosmetic Dentists',
'Orthodontists'], 'is_open': 1, 'name': 'Dental by Design',
'latitude': 33.3306902}
```

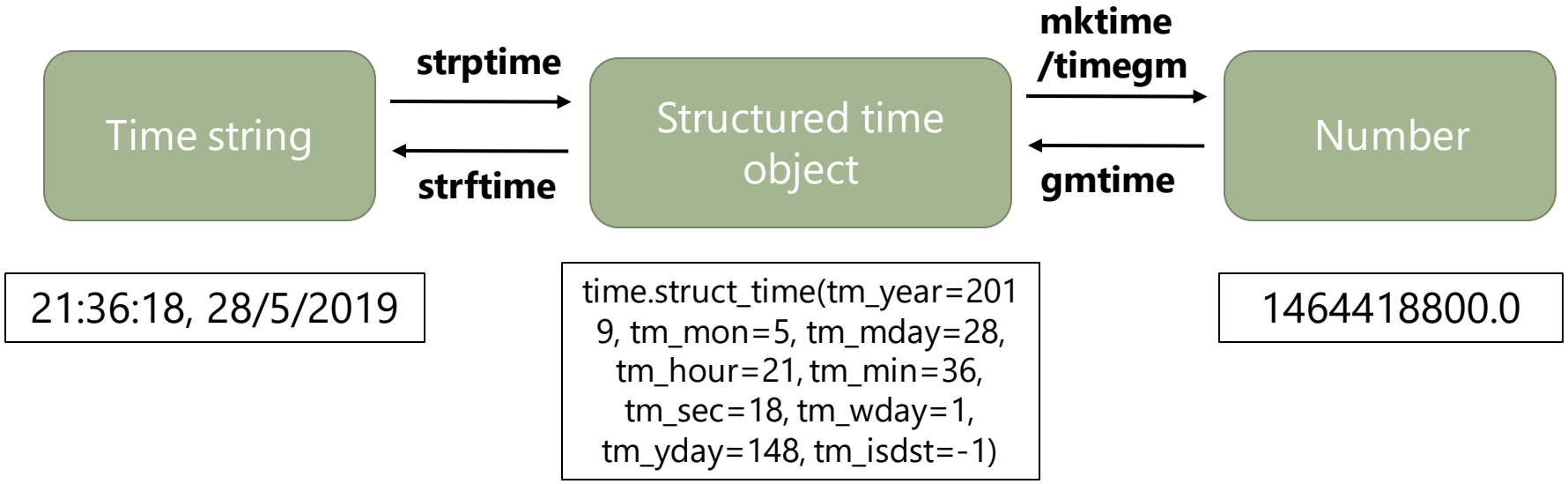
Time and date data

In this lecture we'll cover a few functions:

- Time.strptime: convert a time **string** to a structured time **object**
- Time.strftime: convert a time **object** to a **string**
- Time.mktime / calendar.timegm: convert a time **object** to a **number**
- Time.gmtime: convert a **number** to a time **object**

Time and date data

In this lecture we'll cover a few functions:



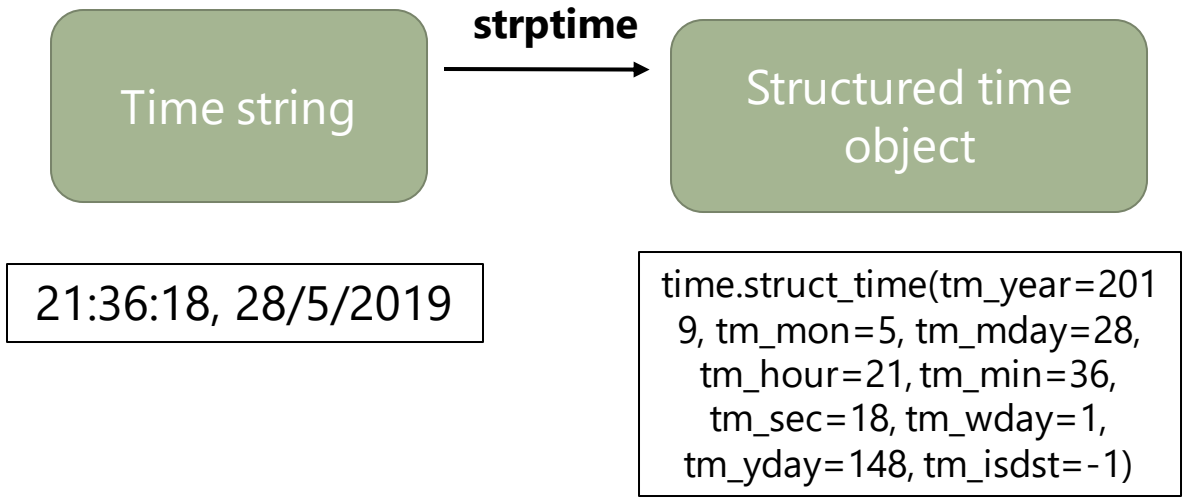
Concept: Unix time

Internally, time is often represented as a number, which allows for easy manipulation and arithmetic

- The value (Unix time) is the **number of seconds since Jan 1, 1970 in the UTC timezone**
- so I made this slide at 1532568962 = 2018-07-26 01:36:02 UTC (or 18:36:02 in my timezone)
- But real datasets generally have time as a "human readable" string
- Our goal here is to convert between these two formats

strptime

First, let's look at converting a string to a structured object (strptime)



Code: time.strptime()

```
In [1]: import time
        import calendar
```

String-formatted time data

```
In [2]: timeString = "2018-07-26 01:36:02"

In [3]: timeStruct = time.strptime(timeString, "%Y-%m-%d %H:%M:%S")

In [4]: timeStruct

Out[4]: time.struct_time(tm_year=2018, tm_mon=7, tm_mday=26, tm_hour=1, tm_min=36, tm_sec=2, tm_wday=3, tm_yday=207, tm_isds
        t=-1)

In [5]: timeStruct.tm_wday

Out[5]: 3
```

Note: this day is a Wednesday!

```
In [6]: help(time.strptime)

    Help on built-in function strptime in module time:

    strptime(...)
        strptime(string, format) -> struct_time

        Parse a string to a time tuple according to a format specification.
```

Note: different time formatting options in the help page

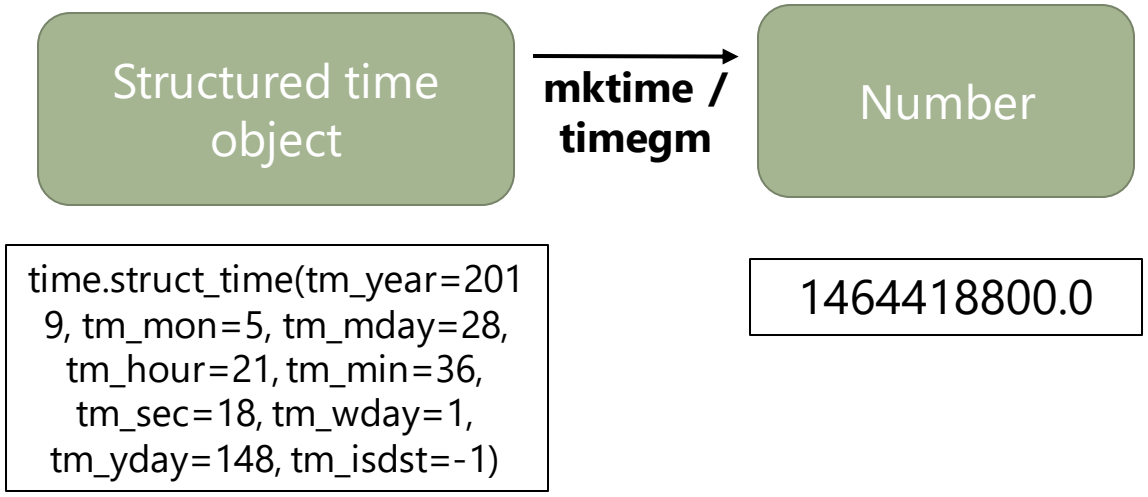
strptime

Strptime is convenient when we want to extract **features** from data

- E.g. does a date correspond to a weekday or a weekend?
- Converting month names or abbreviations (e.g. "Jan") to month numbers
- Dealing with mixed-format data by converting it to a common format
- But if we want to perform arithmetic on timestamps, converting to a number may be easier

time.mktime and calendar.timegm

For this we'll use mktime to convert our structured time object to a number:



Code: time.mktime() and calendar.timegm()

Structured time data from previous slide

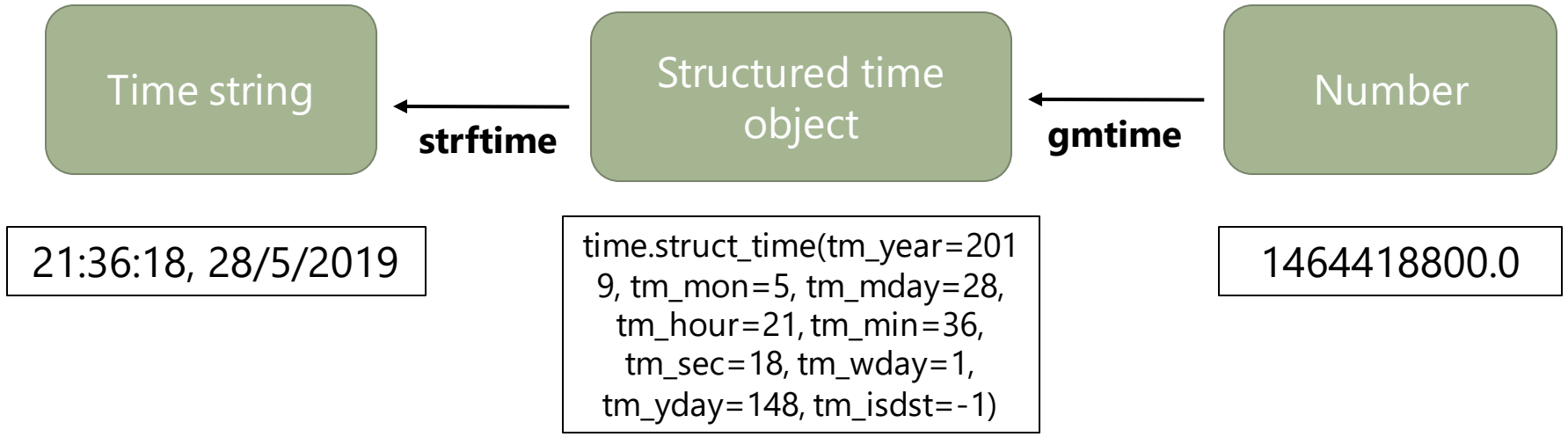
```
In [7]: t1 = calendar.timegm(timeStruct)

In [8]: t2 = time.mktime(timeStruct)

In [9]: t1, t2
Out[9]: (1532568962, 1532594162.0)

In [10]: t1 + 60*60*24*5
Out[10]: 1533000962
```

Five days later

- time.mktime() allows us to convert our structured time object to a number
- **NOTE:** mktime assumes the structure is a *local* time whereas timegm assumes the structure is a *UTC* time
- This allows for easy manipulation, arithmetic, and comparison (e.g. sorting) of time data

time.strftime and time.gmtime

Finally, both of these operations can be *reversed*, should we wish to format time data as a string or structure



Code: time.strftime() and time.gmtime()

```
In [11]: time.gmtime(t1 + 60*60*24*5)
```

Five days later than the previous time

```
Out[11]: time.struct_time(tm_year=2018, tm_mon=7, tm_mday=31, tm_hour=1, tm_min=36, tm_sec=2, tm_wday=1, tm_yday=212, tm_isdst=0)
```

```
In [12]: time.strftime("%Y-%m-%d %H:%M:%S", time.gmtime(t1 + 60*60*24*5))
```

```
Out[12]: '2018-07-31 01:36:02'
```

- These methods can be used to put adjusted times back into string format

Summary of concepts

- Understand the idea and motivation behind **unix time**
- Understand the methods strptime, strftime, mktime, and gmtime
- Be able to convert between various time formats
- Be able to read and manipulate string-formatted time data from real datasets

On your own...

- Try converting the dates in Yelp or Amazon reviews to unix time, and sorting the reviews by their date