Intro to Programming for Public Policy Week 8
More Web APIs

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Missing Values

None

- `None` is the most basic missing value in python
- It's the default return value from functions that don't `return`:

```
>>> def test(): print('Hello, World')
>>> r = test()
>>> print(r)
None
```

is

Python has another comparison operator `is`:

```
>>> a, b, c = 1, 2, 1
>>> a is b
False
>>> a is c
True
```

- Same as == on “primitive” types (numbers, booleans, strings)
- Commonly used in the expression `is None` or `is not None`
    - Equivalent to `== None` or `!= None` but more readable

is

For objects like lists and dictionaries is is not equivalent to ==:

```
>>> a, b, c = [1], [2], [1]
>>> a is b
False
>>> a is c
False
```

For complex objects is is only True if the variables reference to the same data:

```
>>> a = [1]
>>> c = a
>>> a is c
True
```

NaN and NaT

- nan/NaN: provided by NumPy/pandas for missing floats (use np.nan)
  - Pandas automatically converts None to nan (which it calls NaN):

```
>>> pd.Series([1,None,3])
0    1.0
1    NaN
2    3.0
dtype: float64
```

- NaT: provided by pandas for missing Timestamps (use pd.NaT)

Comparing missing values

`NaN` and `NaT` can be used in comparisons but are always `False`

- `np.nan < x` is False regardless of what `x` is
    - Same with >, <=, >=, and ==
    - So `np.nan == np.nan` is `False`; but so is `np.nan != np.nan`
    - (R is better about this: `NA > 0` is itself `NA`
- Same is true of `pd.NaT`

Consequences

```
>>> s = pd.Series([1,None,3])
>>> (s > 2).mean()
0.33333333333333331
>>> (s <= 2).mean()
0.33333333333333331
```

Arithmetic with missing values

Any arithmetic with `nan` results in `nan`:

```
>>> 1 + np.nan
nan
>>> np.nan * 2
nan
>>> 1/np.nan
nan
```

Pandas does better, ignoring `nan`s in aggregation:

```
>>> s = pd.Series([0,None,2])
>>> s.mean()
1.0
>>> s.sum()
2.0
```

Error handling

Guantanamo code

```
def get_years(det_page):
    """
    Given detainee page get years detained
    """
    div = det_page.find('div',
                        class_='nytint-detainee-fullcol')
    matches = time_pattern.findall(div.text)
    return int(matches[0].rstrip(' year'))
```

What happens if there is no `div` of class `nytint-detainee-fullcol` on the detainee page?

Guantanamo code: raise an error

```
def get_years(det_page):
    """
    Given detainee page get years detained
    """
    div = det_page.find('div',
                        class_='nytint-detainee-fullcol')

    if div is None:
        raise ValueError("No detainee div found")
    else:
        matches = time_pattern.findall(div.text)
        return int(matches[0].rstrip(' year'))
```

Guantanamo code: ignore error

```python
def get_years(det_page):
    """
    Given detainee page get years detained
    """
    div = det_page.find('div',
                        class_='nytint-detainee-fullcol')

    if div is None:
        return None
    else:
        matches = time_pattern.findall(div.text)
        return int(matches[0].rstrip(' year'))
```

Guantanamo code: ignore error revised

```python
def get_years(det_page):
    """
    Given detainee page get years detained
    """
    div = det_page.find('div',
                        class_='nytint-detainee-fullcol')

    if div is not None:
        matches = time_pattern.findall(div.text)
        return int(matches[0].rstrip(' year'))
```

Pandas `read_html()`

HTML Table

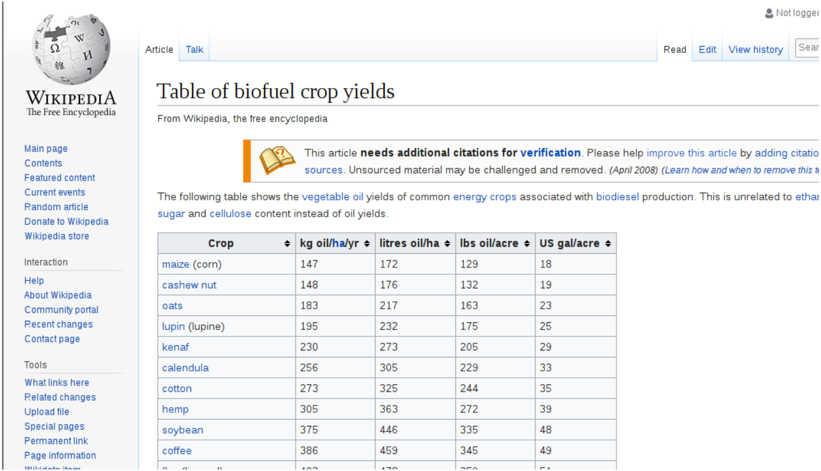


Table of biofuel crop yields

From Wikipedia, the free encyclopedia

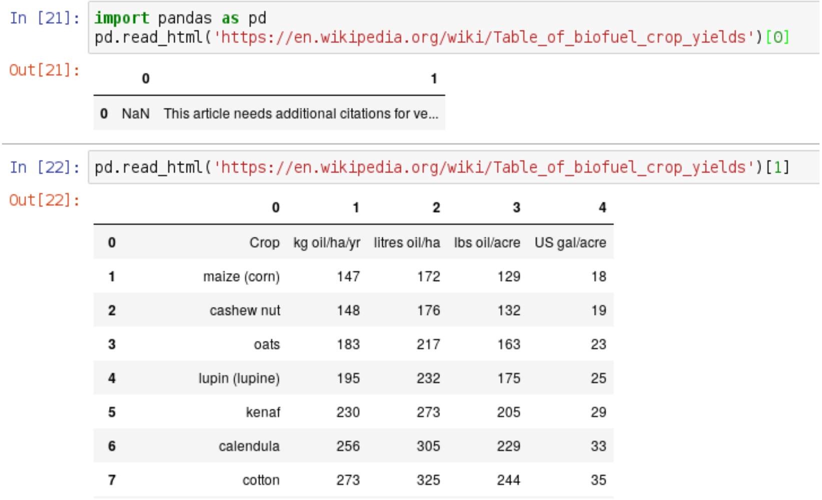
This article **needs additional citations for verification**. Please help improve this article by adding citatio sources. Unsourced material may be challenged and removed. *(April 2008) (Learn how and when to remove this t*

The following table shows the vegetable oil yields of common energy crops associated with biodiesel production. This is unrelated to ethar sugar and cellulose content instead of oil yields.

Crop	kg oil/ha/yr	litres oil/ha	lbs oil/acre	US gal/acre
maize (corn)	147	172	129	18
cashew nut	148	176	132	19
oats	183	217	163	23
lupin (lupine)	195	232	175	25
kenaf	230	273	205	29
calendula	256	305	229	33
cotton	273	325	244	35
hemp	305	363	272	39
soybean	375	446	335	48
coffee	386	459	345	49

Figure 1: https://en.wikipedia.org/wiki/Table_of_biofuel_crop_yields

read_html()



In [21]:
```
import pandas as pd
pd.read_html('https://en.wikipedia.org/wiki/Table_of_biofuel_crop_yields')[0]
```

Out[21]:

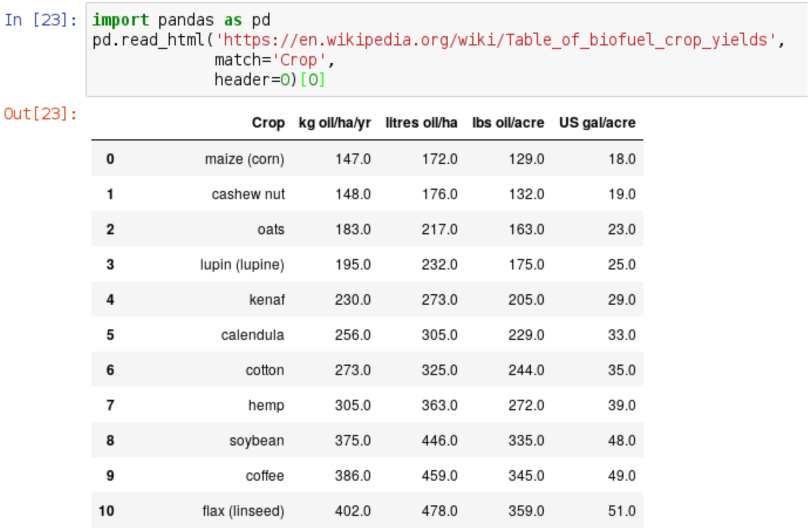
	0	1
0	NaN	This article needs additional citations for ve...

In [22]:
```
pd.read_html('https://en.wikipedia.org/wiki/Table_of_biofuel_crop_yields')[1]
```

Out[22]:

	0	1	2	3	4
0	Crop	kg oil/ha/yr	litres oil/ha	lbs oil/acre	US gal/acre
1	maize (corn)	147	172	129	18
2	cashew nut	148	176	132	19
3	oats	183	217	163	23
4	lupin (lupine)	195	232	175	25
5	kenaf	230	273	205	29
6	calendula	256	305	229	33
7	cotton	273	325	244	35

read_html() arguments



In [23]:

```
import pandas as pd
pd.read_html('https://en.wikipedia.org/wiki/Table_of_biofuel_crop_yields',
             match='Crop',
             header=0)[0]
```

Out[23]:

	Crop	kg oil/ha/yr	litres oil/ha	lbs oil/acre	US gal/acre
0	maize (corn)	147.0	172.0	129.0	18.0
1	cashew nut	148.0	176.0	132.0	19.0
2	oats	183.0	217.0	163.0	23.0
3	lupin (lupine)	195.0	232.0	175.0	25.0
4	kenaf	230.0	273.0	205.0	29.0
5	calendula	256.0	305.0	229.0	33.0
6	cotton	273.0	325.0	244.0	35.0
7	hemp	305.0	363.0	272.0	39.0
8	soybean	375.0	446.0	335.0	48.0
9	coffee	386.0	459.0	345.0	49.0
10	flax (linseed)	402.0	478.0	359.0	51.0

APIs

API Overview

- Application Programming Interfaces (APIs) are web-based resources that serve data directly
- Typically in `json`, `csv`, or `xml` format
- You can access them with `requests` in python or `curl`
- The parameters are typically provided in the URL with a query string (`?param1=value1&param2=value2`)

REST

REST is a standard style for organizing API resources. The philosophy is that:

- Client and server are “stateless”, i.e. each request is independent and the server does not save state between requests
- Service is scalable and cacheable
- Typically use HTTP methods (`GET`, `DELETE`, `PUT`, etc.) meaningfully

Census API

- U.S. Census data available through API
- For example the 5-year ACS estimates
  - List of variables

  https://api.census.gov/data/2014/acs5/profile?get=DP02_0037PE,NAME&for=state:*
- Can simply `curl`

curl

```
$ curl "https://api.census.gov/data/2014/acs5/profile?get=D
    -o fertility.json
$ head fertility.json
[["DP02_0037PE","NAME","state"],
["41.7","Alabama","01"],
["34.2","Alaska","02"],
["39.7","Arizona","04"],
["37.7","Arkansas","05"],
["33.2","California","06"],
["28.3","Colorado","08"],
["33.7","Connecticut","09"],
["39.3","Delaware","10"],
["47.7","District of Columbia","11"],
...
```

What is JSON?

JSON stands for JavaScript Object Notation and is a data format that can represent both lists and dictionaries with numeric and string eleements, keys and values.

The format is basically the same as Python's own representations of lists and dictionaries.

python

-
  ```
  >>> path = "https://api.census.gov/data/2014/acs5/profi
  >>> j = requests.get(path).json()
  >>> j
  [[u'DP02_0037PE', u'NAME', u'state'],
   [u'41.7', u'Alabama', u'01'],
   [u'34.2', u'Alaska', u'02'],
   [u'39.7', u'Arizona', u'04'],
   [u'37.7', u'Arkansas', u'05'],
   [u'33.2', u'California', u'06'],
  ...
  ```

  How can we put this data in a pandas DataFrame?

python

-
  ```
  >>> path = "https://api.census.gov/data/2014/acs5/profi
  >>> j = requests.get(path).json()
  >>> j
  [[u'DP02_0037PE', u'NAME', u'state'],
   [u'41.7', u'Alabama', u'01'],
   [u'34.2', u'Alaska', u'02'],
   [u'39.7', u'Arizona', u'04'],
   [u'37.7', u'Arkansas', u'05'],
   [u'33.2', u'California', u'06'],
  ...
  ```

  How can we put this data in a pandas DataFrame?

-
  ```
  >>> pd.DataFrame(j[1:], columns=j[0])
  ```

Example: Census geocoder

The Census geocoder website geocodes addresses. I.e. given a CSV of addresses:

```
$ cat short.csv
a,"4701 Ocean View Ave","Virginia Beach","VA","23455"
b,"3630 S WELLS ST","CHICAGO","IL","60609"
c,"2957 N HOYNE AVE","CHICAGO","IL","60618"
d,"5110 N DAMEN AVE","CHICAGO","IL","60625"
e,"231 N PINE AVE","CHICAGO","IL","60644"
f,"231 N PINE AVE","CHICAGO","IL","60644"
```

it can add columns for coordinates, county, census tract, and other geographic components.

Geocoder `curl`

The geocoder can be used programmatically with `curl`:

```
$ curl -F addressFile=@short.csv \
     -F vintage=Current_Current \
     -F benchmark=Public_AR_Current \
     -F layers=9 \
     "https://geocoding.geo.census.gov/
geocoder/geographies/addressbatch"
```

See the documentation here.

Example: Google Maps API

- Well-documented APIs for geocoding, directions, distances, etc.
- For more than a few calls requires a free API key.

```
api = 'https://maps.googleapis.com/maps/api/'

geoc = 'geocode/json?address=Harris School'
key  = '&key=YOUR_KEY'

j = requests.get(api + geoc).json()
```

`params` dictionary

Instead of building the parameters into the URL manually, use the `params` argument to `get`:

```
api = 'https://maps.googleapis.com/maps/api/'
geoc = 'geocode/json'
params = {'address':'Harris School'}

j = requests.get(api + geoc, params=params).json()
```

Distance matrix

```
dist = 'distancematrix/json'
params = {'origins':'Chicago,IL|Tucson,AZ',
          'destinations':'Philly'}
j = requests.get(api + dist, params=params).json()
```

Hidden APIs

Some websites have APIs that are not publicly documented.

Example: HealthData.org

The visualization at HealthData.org shows disease data (Deaths, YLDs, DALYs) for different diseases for different subpopulations (men/women, age groups).

By loading the page with the web developer tools on, we can find that the data is transmitted through a hidden API:

`https://vizhub.healthdata.org/gbd-compare/api/metadata?lang`

We can load this JSON directly into python to analyze the data ourselves.

```python
url = ('https://vizhub.healthdata.org/'+
       'gbd-compare/api/metadata?lang=41')
j = requests.get(url).json()
```