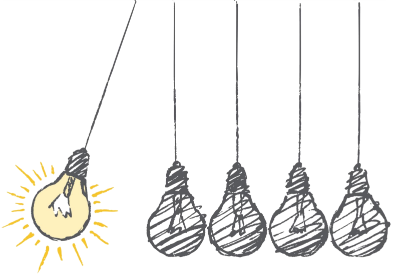
Introduction to Python for Stata Users



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The World Bank

Overview

Web scraping overview

Web scraping - Retrieving raw `html` code

Web scraping - Extracting and arranging information

Web scraping overview

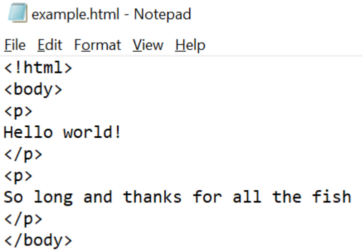
Web scraping overview

- For this second part of the session, we’ll do a web scraping exercise
- We’ll transform the table shown in this URL: `https://datatables.net/examples/basic_init/zero_configuration.html` into a csv file

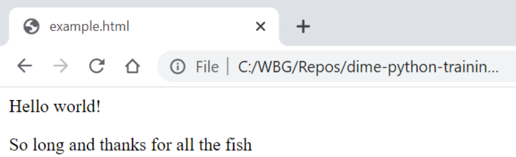
Web scraping overview

Before starting, we'll give a bit more context on web scraping

- You'll probably know that every website you visit has an underlying `html` code
- A simple example:



```
<!html>
<body>
<p>
Hello world!
</p>
<p>
So long and thanks for all the fish
</p>
</body>
```



Hello world!

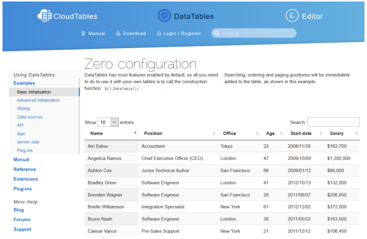
So long and thanks for all the fish

- Your web browser renders this code and shows you the result

Web scraping overview

When performing web scraping, we’re basically doing two operations

1. We retrieve the underlying raw `html` code of a website

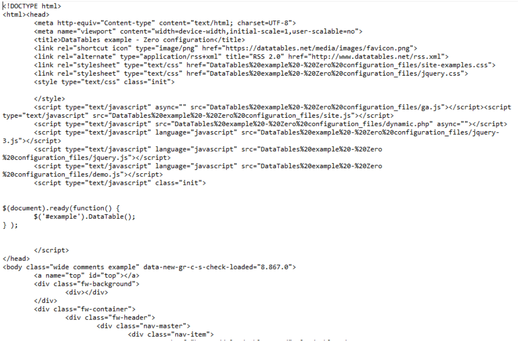


Zero configuration

DataTables has most features enabled by default, so all you need to do to use it with your own tables is to call the construction function: `$().DataTable();`.

Searching, ordering and paging goodness will be immediately added to the table, as shown in this example.

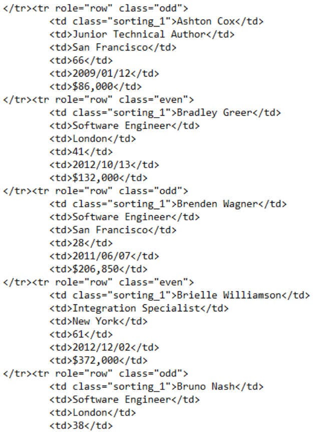
Name	Position	Office	Age	Start date	Salary
Airi Satou	Accountant	Tokyo	33	2008/11/28	$162,700
Angelica Ramos	Chief Executive Officer (CEO)	London	47	2009/10/09	$1,200,000
Ashton Cox	Junior Technical Author	San Francisco	66	2009/01/12	$86,000
Bradley Greer	Software Engineer	London	41	2012/10/13	$132,000
Brenden Wagner	Software Engineer	San Francisco	28	2011/06/07	$206,850
Brielle Williamson	Integration Specialist	New York	61	2012/12/02	$372,000
Bruno Nash	Software Engineer	London	38	2011/05/03	$163,500
Caesar Vance	Pre-Sales Support	New York	21	2011/12/12	$106,450



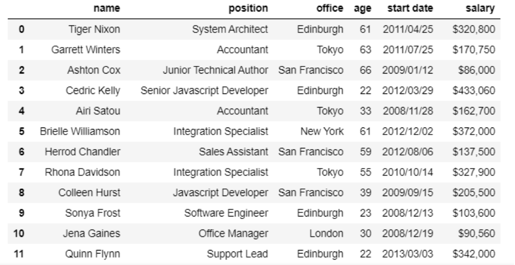
```html
<!DOCTYPE html>
<html><head>
        <meta http-equiv="Content-type" content="text/html; charset=UTF-8">
        <meta name="viewport" content="width=device-width,initial-scale=1,user-scalable=no">
        <title>DataTables example - Zero configuration</title>
        <link rel="shortcut icon" type="image/png" href="https://datatables.net/media/images/favicon.png">
        <link rel="alternate" type="application/rss+xml" title="RSS 2.0" href="http://www.datatables.net/rss.xml">
        <link rel="stylesheet" type="text/css" href="DataTables%20example%20-%20Zero%20configuration_files/site-examples.css">
        <link rel="stylesheet" type="text/css" href="DataTables%20example%20-%20Zero%20configuration_files/jquery.css">
        <style type="text/css" class="init">

        </style>
        <script type="text/javascript" async="" src="DataTables%20example%20-%20Zero%20configuration_files/ga.js"></script><script
type="text/javascript" src="DataTables%20example%20-%20Zero%20configuration_files/site.js"></script>
        <script type="text/javascript" src="DataTables%20example%20-%20Zero%20configuration_files/dynamic.php" async=""></script>
        <script type="text/javascript" language="javascript" src="DataTables%20example%20-%20Zero%20configuration_files/jquery-
3.js"></script>
        <script type="text/javascript" language="javascript" src="DataTables%20example%20-%20Zero
%20configuration_files/jquery.js"></script>
        <script type="text/javascript" language="javascript" src="DataTables%20example%20-%20Zero
%20configuration_files/demo.js"></script>
        <script type="text/javascript" class="init">


$(document).ready(function() {
        $('#example').DataTable();
} );


        </script>
</head>
<body class="wide comments example" data-new-gr-c-s-check-loaded="8.867.0">
        <a name="top" id="top"></a>
        <div class="fw-background">
                <div></div>
        </div>
        <div class="fw-container">
                <div class="fw-header">
                        <div class="nav-master">
                                <div class="nav-item">
```

Web scraping overview

2. From the raw `html` code, we locate the part that is relevant for us to extract and arrange it into an variable we can use



```
</tr><tr role="row" class="odd">
        <td class="sorting_1">Ashton Cox</td>
        <td>Junior Technical Author</td>
        <td>San Francisco</td>
        <td>66</td>
        <td>2009/01/12</td>
        <td>$86,000</td>
</tr><tr role="row" class="even">
        <td class="sorting_1">Bradley Greer</td>
        <td>Software Engineer</td>
        <td>London</td>
        <td>41</td>
        <td>2012/10/13</td>
        <td>$132,000</td>
</tr><tr role="row" class="odd">
        <td class="sorting_1">Brenden Wagner</td>
        <td>Software Engineer</td>
        <td>San Francisco</td>
        <td>28</td>
        <td>2011/06/07</td>
        <td>$206,850</td>
</tr><tr role="row" class="even">
        <td class="sorting_1">Brielle Williamson</td>
        <td>Integration Specialist</td>
        <td>New York</td>
        <td>61</td>
        <td>2012/12/02</td>
        <td>$372,000</td>
</tr><tr role="row" class="odd">
        <td class="sorting_1">Bruno Nash</td>
        <td>Software Engineer</td>
        <td>London</td>
        <td>38</td>
```



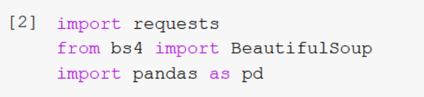
	name	position	office	age	start date	salary
0	Tiger Nixon	System Architect	Edinburgh	61	2011/04/25	$320,800
1	Garrett Winters	Accountant	Tokyo	63	2011/07/25	$170,750
2	Ashton Cox	Junior Technical Author	San Francisco	66	2009/01/12	$86,000
3	Cedric Kelly	Senior Javascript Developer	Edinburgh	22	2012/03/29	$433,060
4	Airi Satou	Accountant	Tokyo	33	2008/11/28	$162,700
5	Brielle Williamson	Integration Specialist	New York	61	2012/12/02	$372,000
6	Herrod Chandler	Sales Assistant	San Francisco	59	2012/08/06	$137,500
7	Rhona Davidson	Integration Specialist	Tokyo	55	2010/10/14	$327,900
8	Colleen Hurst	Javascript Developer	San Francisco	39	2009/09/15	$205,500
9	Sonya Frost	Software Engineer	Edinburgh	23	2008/12/13	$103,600
10	Jena Gaines	Office Manager	London	30	2008/12/19	$90,560
11	Quinn Flynn	Support Lead	Edinburgh	22	2013/03/03	$342,000

Web scraping overview

- To execute this operations, we'll need to use three Python libraries.
- Libraries are similar to the user-written Stata commands you download from the `ssc` repository, except that you have to manually load them in each new Python session you start.
- Each library has custom made data types with operations specific to the topic of the library.
- To install libraries, we would normally have to use Window's or Mac's command lines. However, we'll skip installing for now because Colab has the libraries we need already pre-installed.

Web scraping overview

To load libraries, we use `import`



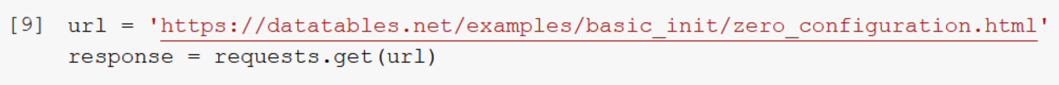
```
[2]  import requests
     from bs4 import BeautifulSoup
     import pandas as pd
```

- `requests` is an `html` requestor. We'll use it to retrieve the `html` code of our URL
- `BeautifulSoup` is a text parser. We'll use it to extract the information we need from the `html` code
- `pandas` is a dataframe manipulation library. We'll use to structure the information into a dataframe and export the result to a `csv` file

Web scraping - Retrieving raw `html` code

Web scraping - Retrieving raw `html` code

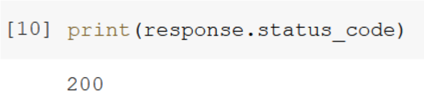
We’ll use the command `get()` from `requests` to retrieve the `html` code. We’ll start by saving the result of the request in an variable called `response`



```
[9]  url = 'https://datatables.net/examples/basic_init/zero_configuration.html'
     response = requests.get(url)
```

Web scraping - Retrieving raw `html` code

`response` is a data type that contains not only the `html` code we're looking for, but also information about our html request itself. For example, we can use `status_code` to check if our request was successful:

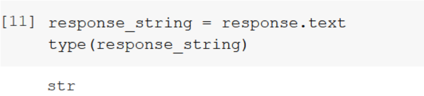


```
[10] print(response.status_code)

     200
```

A value of `200` indicates that the request worked

Web scraping - Retrieving raw `html` code

After we checked that the request was successful, we use an attribute called `.text` on the response data type to extract the html code from the page we requested. The result is a single very long string.



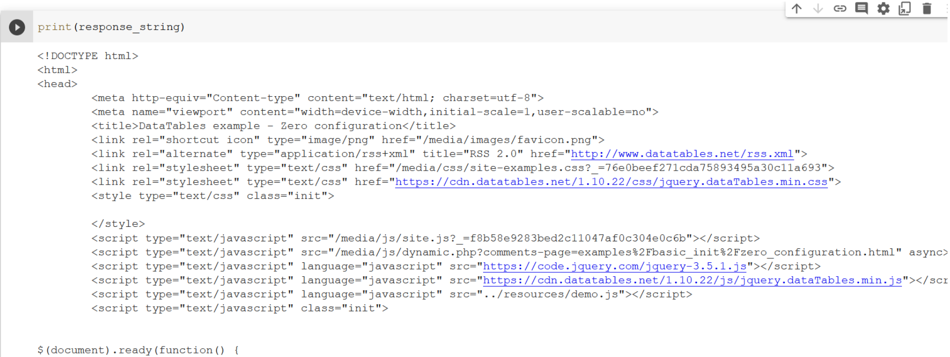
```
[11] response_string = response.text
     type(response_string)

     str
```

`response_string` contains the raw `html` code we need

Web scraping - Extracting and arranging information

Web scraping - Extracting and arranging information

Now we need to manually explore the `html` string and locate the information of interest. We can use `print()` for this

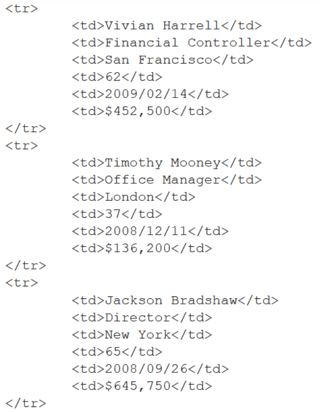


```
print(response_string)
```

```
<!DOCTYPE html>
<html>
<head>
	<meta http-equiv="Content-type" content="text/html; charset=utf-8">
	<meta name="viewport" content="width=device-width,initial-scale=1,user-scalable=no">
	<title>DataTables example - Zero configuration</title>
	<link rel="shortcut icon" type="image/png" href="/media/images/favicon.png">
	<link rel="alternate" type="application/rss+xml" title="RSS 2.0" href="http://www.datatables.net/rss.xml">
	<link rel="stylesheet" type="text/css" href="/media/css/site-examples.css?_=76e0beef271cda75893495a30c11a693">
	<link rel="stylesheet" type="text/css" href="https://cdn.datatables.net/1.10.22/css/jquery.dataTables.min.css">
	<style type="text/css" class="init">

	</style>
	<script type="text/javascript" src="/media/js/site.js?_=f8b58e9283bed2c11047af0c304e0c6b"></script>
	<script type="text/javascript" src="/media/js/dynamic.php?comments-page=examples%2Fbasic_init%2Fzero_configuration.html" async>
	<script type="text/javascript" language="javascript" src="https://code.jquery.com/jquery-3.5.1.js"></script>
	<script type="text/javascript" language="javascript" src="https://cdn.datatables.net/1.10.22/js/jquery.dataTables.min.js"></scr
	<script type="text/javascript" language="javascript" src="../resources/demo.js"></script>
	<script type="text/javascript" class="init">


$(document).ready(function() {
```

Web scraping - Extracting and arranging information

This manual inspection allow us to see that every single observation in our target table is enclosed between `tr` tags, and that every piece of information inside an observation is enclosed in `td` tags



```
<tr>
        <td>Vivian Harrell</td>
        <td>Financial Controller</td>
        <td>San Francisco</td>
        <td>62</td>
        <td>2009/02/14</td>
        <td>$452,500</td>
</tr>
<tr>
        <td>Timothy Mooney</td>
        <td>Office Manager</td>
        <td>London</td>
        <td>37</td>
        <td>2008/12/11</td>
        <td>$136,200</td>
</tr>
<tr>
        <td>Jackson Bradshaw</td>
        <td>Director</td>
        <td>New York</td>
        <td>65</td>
        <td>2008/09/26</td>
        <td>$645,750</td>
</tr>
```

- `tr` - stands for ”table row”
- `td` - stands for ”table data cell”

Web scraping - Extracting and arranging information

Then, we need to do the following:

1. From the whole string, extract every content enclosed in `tr` tags
2. For each of the contents enclosed in `tr` tags, extract every piece of information enclosed in `td` tags

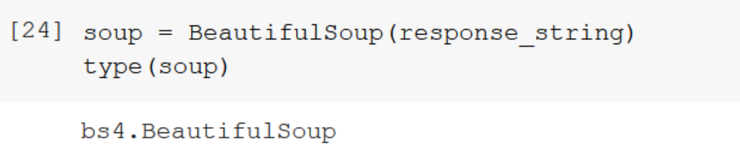
We'll use `BeautifulSoup` for this - a commonly used library to extract information from an html code

Web scraping - Extracting and arranging information

- `BeautifulSoup` parses a string by detecting symbols and spacing that creates sections and subsections in plain text
- If used in `html` code, it knows automatically that tags are used to specify sections

Web scraping - Extracting and arranging information

- To parse an `html` string, we use the following code:



```
[24] soup = BeautifulSoup(response_string)
     type(soup)
```

```
bs4.BeautifulSoup
```

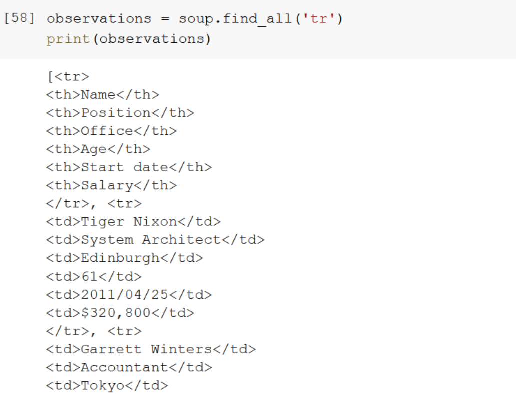
- The result is not a string anymore, but a `BeautifulSoup` data type
- You can think of it as a text with divisions and subdivisions with many operations to work with the content

Web scraping - Extracting and arranging information

- The advantage of using this type as opposed to a string is that now we can directly look for any divisions enclosed by the the `tr` tags

- We'll use the `.find_all()` attribute for this and save the result in a new variable named `observations`

- Note that `observations` is a list

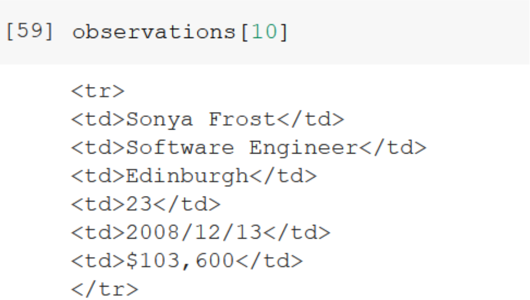


```
[58] observations = soup.find_all('tr')
     print(observations)
```

```
[<tr>
<th>Name</th>
<th>Position</th>
<th>Office</th>
<th>Age</th>
<th>Start date</th>
<th>Salary</th>
</tr>, <tr>
<td>Tiger Nixon</td>
<td>System Architect</td>
<td>Edinburgh</td>
<td>61</td>
<td>2011/04/25</td>
<td>$320,800</td>
</tr>, <tr>
<td>Garrett Winters</td>
<td>Accountant</td>
<td>Tokyo</td>
```

Web scraping - Extracting and arranging information

- `observations` is a list that contains every piece of text that was enclosed in `tr` tags, including the tags themselves
- Nonetheless, every element of it is not a string, but another `BeautifulSoup` data type
- If we inspect a single element of `observations`, we get this:



```
[59] observations[10]
```

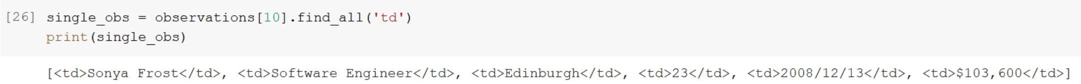
```
<tr>
<td>Sonya Frost</td>
<td>Software Engineer</td>
<td>Edinburgh</td>
<td>23</td>
<td>2008/12/13</td>
<td>$103,600</td>
</tr>
```

Web scraping - Extracting and arranging information

- You might see by now that we're getting closer to our final result!
- We basically need to iterate through the elements of `observations` and extract everything that is inside the `td` tags
- Since the elements of `observations` are still `Beautiful Soup` data types, we can use once again the `.find_all()` attribute for this

Web scraping - Extracting and arranging information

- For a single element, this would be:

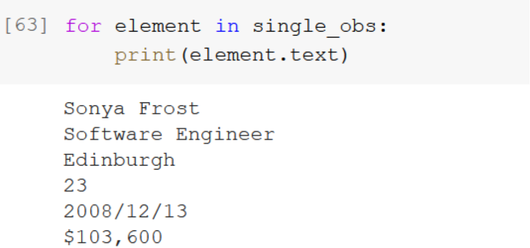


```
[26] single_obs = observations[10].find_all('td')
     print(single_obs)

     [<td>Sonya Frost</td>, <td>Software Engineer</td>, <td>Edinburgh</td>, <td>23</td>, <td>2008/12/13</td>, <td>$103,600</td>]
```

- This is *almost* what we want, except that it still includes the `td` tags

Web scraping - Extracting and arranging information

To eliminate them, we need to use `.text` with every element of `single_obs`



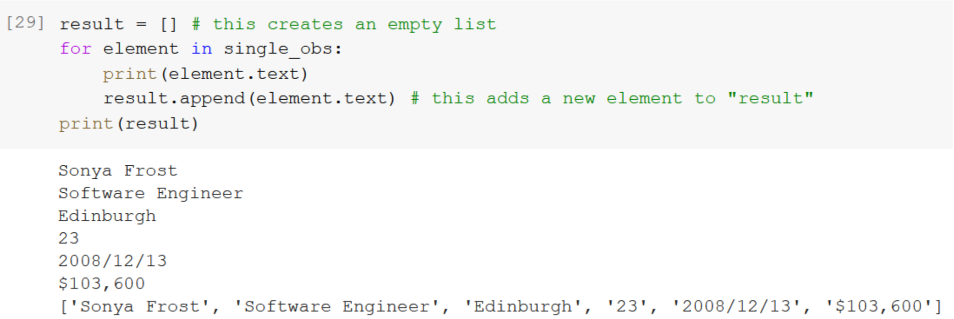
```
[63] for element in single_obs:
         print(element.text)
```

```
Sonya Frost
Software Engineer
Edinburgh
23
2008/12/13
$103,600
```

Now every one of these is a string data type again!

Web scraping - Extracting and arranging information

Furthermore, we can modify this code to save the result in a new list

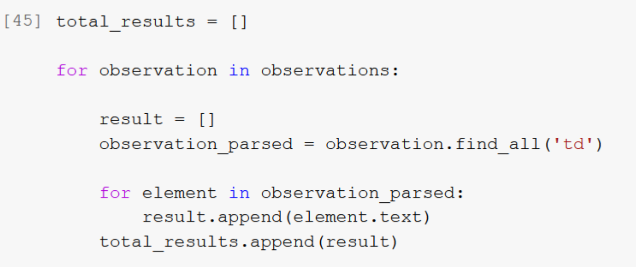


```
[29] result = [] # this creates an empty list
     for element in single_obs:
         print(element.text)
         result.append(element.text) # this adds a new element to "result"
     print(result)
```

```
     Sonya Frost
     Software Engineer
     Edinburgh
     23
     2008/12/13
     $103,600
     ['Sonya Frost', 'Software Engineer', 'Edinburgh', '23', '2008/12/13', '$103,600']
```

Web scraping - Extracting and arranging information

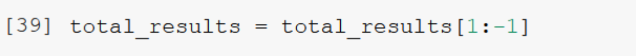
Now that we finally figured out how to extract the information we want, we just need to loop over `observations` to generalize our approach and get the entire information



```
[45] total_results = []

     for observation in observations:

         result = []
         observation_parsed = observation.find_all('td')

         for element in observation_parsed:
             result.append(element.text)
         total_results.append(result)
```

Web scraping - Extracting and arranging information

- You might have noticed that the first and last elements of `total_results` are empty lists
- This is because in our original `html` string, the first and last elements enclosed in `tr` tags didn't contain any elements enclosed in `td` tags. Then, using `observation.find_all("td")` produced an empty lists in both cases
- We can easily eliminate these observations from `total_results` by subsetting the list and excluding the last and first elements



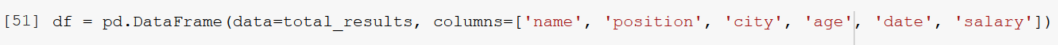
```
[39] total_results = total_results[1:-1]
```

Web scraping - Extracting and arranging information

- `total_results` contains the result we wanted to have. Great!
- The final step is to export it to a `csv` file
- Remember that we loaded the `pandas` library? We'll use it now

Web scraping - Extracting and arranging information

First, we create a `pandas` dataframe where we insert `total_results` as data. We call the dataframe `df`



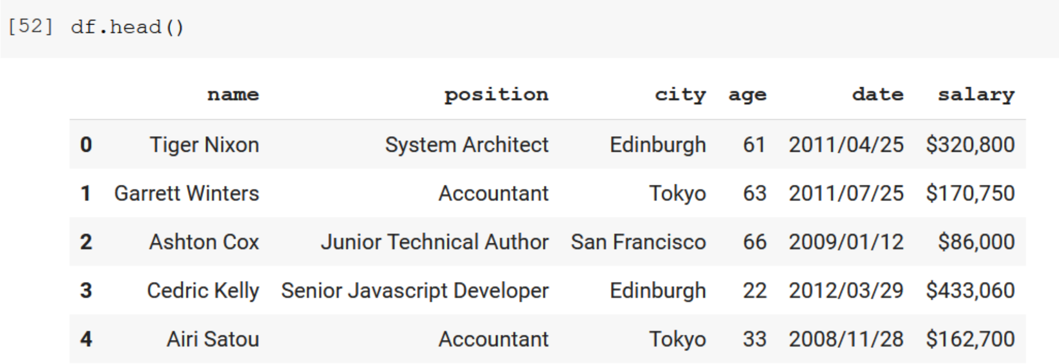
```
[51] df = pd.DataFrame(data=total_results, columns=['name', 'position', 'city', 'age', 'date', 'salary'])
```

`pd.DataFrame()` uses two arguments in this case:

1. `data`: the data we're loading to the dataframe
2. `columns`: a list of strings with the column names

Pandas dataframes are a data type that is similar to a dataset in Stata

Web scraping - Extracting and arranging information

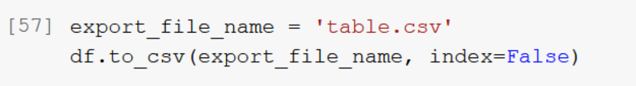


```
[52] df.head()
```

	name	position	city	age	date	salary
0	Tiger Nixon	System Architect	Edinburgh	61	2011/04/25	$320,800
1	Garrett Winters	Accountant	Tokyo	63	2011/07/25	$170,750
2	Ashton Cox	Junior Technical Author	San Francisco	66	2009/01/12	$86,000
3	Cedric Kelly	Senior Javascript Developer	Edinburgh	22	2012/03/29	$433,060
4	Airi Satou	Accountant	Tokyo	33	2008/11/28	$162,700

Web scraping - Extracting and arranging information

Finally, we export `df` into a `csv` file using the attribute `.to_csv()`

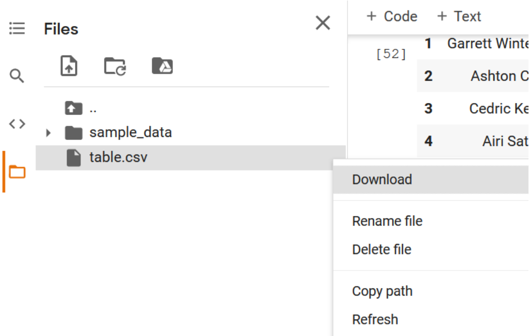


```
[57] export_file_name = 'table.csv'
     df.to_csv(export_file_name, index=False)
```

`pandas` by default exports a column with the index numbers. We use `index=False` to omit it

Web scraping - Extracting and arranging information

- Since we were using Colab in this exercise, we just exported `table.csv` to the cloud
- To download the result to your computer, click the folder icon to the left, locate your file, click on the vertical ellipsis next to it and click `Download`



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