Dictionaries, Part 1

List

```
pop = [30.55, 2.77, 39.21]
countries = ["afghanistan", "albania", "algeria"]
ind_alb = countries.index("albania")
ind_alb
```

```
1
```

```
pop[ind_alb]
```

```
2.77
```

- Not convenient
- Not intuitive

Dictionary

```
pop = [30.55, 2.77, 39.21]
countries = ["afghanistan", "albania", "algeria"]

...

        {                                                    }
```

Dictionary

```
pop = [30.55, 2.77, 39.21]
countries = ["afghanistan", "albania", "algeria"]

...


        {"afghanistan":30.55,                                    }
```

Dictionary

```
pop = [30.55, 2.77, 39.21]
countries = ["afghanistan", "albania", "algeria"]

...

world = {"afghanistan":30.55, "albania":2.77, "algeria":39.21}
world["albania"]
```

```
2.77
```

Let's practice!

Dictionaries, Part 2

Recap

```
world = {"afghanistan":30.55, "albania":2.77, "algeria":39.21}
world["albania"]
```

```
2.77
```

```
world = {"afghanistan":30.55, "albania":2.77,
         "algeria":39.21, "albania":2.81}
world
```

```
{'afghanistan': 30.55, 'albania': 2.81, 'algeria': 39.21}
```

Recap

- Keys have to be "immutable" objects

```
{0:"hello", True:"dear", "two":"world"}
```

```
{0: 'hello', True: 'dear', 'two': 'world'}
```

```
{["just", "to", "test"]: "value"}
```

```
TypeError: unhashable type: 'list'
```

Principality of Sealand

[1] Source: Wikipedia

Dictionary

```
world["sealand"] = 0.000027
world
```

```
{'afghanistan': 30.55, 'albania': 2.81,
        'algeria': 39.21, 'sealand': 2.7e-05}
```

```
"sealand" in world
```

```
True
```

Dictionary

```
world["sealand"] = 0.000028
world
```

```
{'afghanistan': 30.55, 'albania': 2.81,
        'algeria': 39.21, 'sealand': 2.8e-05}
```

```
del(world["sealand"])
world
```

```
{'afghanistan': 30.55, 'albania': 2.81, 'algeria': 39.21}
```

List vs Dictionary

List vs Dictionary

List vs Dictionary

List	Dictionary
Select, update and remove: [ ]	Select, update and remove: [ ]

List vs Dictionary

List	Dictionary
Select, update and remove: [ ]	Select, update and remove: [ ]
Indexed by range of numbers	

List vs Dictionary

List	Dictionary
Select, update and remove: [ ]	Select, update and remove: [ ]
Indexed by range of numbers	Indexed by unique keys

List vs Dictionary

List	Dictionary
Select, update and remove: [ ]	Select, update and remove: [ ]
Indexed by range of numbers	Indexed by unique keys
Collection of values order matters select entire subsets	

List vs Dictionary

List	Dictionary
Select, update and remove: [ ]	Select, update and remove: [ ]
Indexed by range of numbers	Indexed by unique keys
Collection of values order matters select entire subsets	Lookup table with unique keys

Let's practice!

Pandas, Part 1

Tabular dataset examples

temperature	measured_at	location
76	2016-01-01 14:00:01	valve
86	2016-01-01 14:00:01	compressor
72	2016-01-01 15:00:01	valve
88	2016-01-01 15:00:01	compressor
68	2016-01-01 16:00:01	valve
78	2016-01-01 16:00:01	compressor

Tabular dataset examples

temperature	measured_at	location
76	2016-01-01 14:00:01	valve
86	2016-01-01 14:00:01	compressor
72	2016-01-01 15:00:01	valve
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78	2016-01-01 16:00:01	compressor

row = observations
column = variable

Tabular dataset examples

temperature	measured_at	location
76	2016-01-01 14:00:01	valve
86	2016-01-01 14:00:01	compressor
72	2016-01-01 15:00:01	valve
88	2016-01-01 15:00:01	compressor
68	2016-01-01 16:00:01	valve
78	2016-01-01 16:00:01	compressor

row = observations
column = variable

country	capital	area	population
Brazil	Brasilia	8.516	200.4
Russia	Moscow	17.10	143.5
India	New Delhi	3.286	1252
China	Beijing	9.597	1357
South	Pretoria	1.221	52.98

Datasets in Python

- 2D Numpy array?
  - One data type

Datasets in Python

country	capital	area	population
Brazil	Brasilia	8.516	200.4
Russia	Moscow	17.10	143.5
India	New Delhi	3.286	1252
China	Beijing	9.597	1357
South	Pretoria	1.221	52.98
		float	float

Datasets in Python

country	capital	area	population
Brazil	Brasilia	8.516	200.4
Russia	Moscow	17.10	143.5
India	New Delhi	3.286	1252
China	Beijing	9.597	1357
South	Pretoria	1.221	52.98
str	str	float	float

- pandas!
  - High level data manipulation tool
  - Wes McKinney
  - Built on Numpy
  - DataFrame

DataFrame

```
brics
```

```
        country    capital    area  population
BR       Brazil   Brasilia   8.516      200.40
RU       Russia     Moscow  17.100      143.50
IN        India  New Delhi   3.286     1252.00
CH        China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

DataFrame from Dictionary

```
dict = {
    "country":["Brazil", "Russia", "India", "China", "South Africa"],
    "capital":["Brasilia", "Moscow", "New Delhi", "Beijing", "Pretoria"],
       "area":[8.516, 17.10, 3.286, 9.597, 1.221]
 "population":[200.4, 143.5, 1252, 1357, 52.98] }
```

- keys (column labels)
- values (data, column by column)

```
import pandas as pd
brics = pd.DataFrame(dict)
```

DataFrame from Dictionary (2)

```
brics
```

```
     area    capital       country  population
0   8.516   Brasilia        Brazil      200.40
1  17.100     Moscow        Russia      143.50
2   3.286  New Delhi         India     1252.00
3   9.597    Beijing         China     1357.00
4   1.221   Pretoria  South Africa       52.98
```

```
brics.index = ["BR", "RU", "IN", "CH", "SA"]
brics
```

```
      area    capital       country  population
BR   8.516   Brasilia        Brazil      200.40
RU  17.100     Moscow        Russia      143.50
IN   3.286  New Delhi         India     1252.00
CH   9.597    Beijing         China     1357.00
SA   1.221   Pretoria  South Africa       52.98
```

DataFrame from CSV file

`brics.csv`

```
,country,capital,area,population
BR,Brazil,Brasilia,8.516,200.4
RU,Russia,Moscow,17.10,143.5
IN,India,New Delhi,3.286,1252
CH,China,Beijing,9.597,1357
SA,South Africa,Pretoria,1.221,52.98
```

- CSV = comma-separated values

DataFrame from CSV file

- `brics.csv`

```
,country,capital,area,population
BR,Brazil,Brasilia,8.516,200.4
RU,Russia,Moscow,17.10,143.5
IN,India,New Delhi,3.286,1252
CH,China,Beijing,9.597,1357
SA,South Africa,Pretoria,1.221,52.98
```

```
brics = pd.read_csv("path/to/brics.csv")
brics
```

	Unnamed: 0	country	capital	area	population
0	BR	Brazil	Brasilia	8.516	200.40
1	RU	Russia	Moscow	17.100	143.50
2	IN	India	New Delhi	3.286	1252.00
3	CH	China	Beijing	9.597	1357.00
4	SA	South Africa	Pretoria	1.221	52.98

DataFrame from CSV file

```
brics = pd.read_csv("path/to/brics.csv", index_col = 0)
brics
```

```
         country  population      area    capital
BR        Brazil         200   8515767   Brasilia
RU        Russia         144  17098242     Moscow
IN         India        1252   3287590  New Delhi
CH         China        1357   9596961    Beijing
SA  South Africa          55   1221037   Pretoria
```

Let's practice!

Pandas, Part 2

brics

```
import pandas as pd
brics = pd.read_csv("path/to/brics.csv", index_col = 0)
brics
```

```
        country    capital    area  population
BR       Brazil   Brasilia   8.516      200.40
RU       Russia     Moscow  17.100      143.50
IN        India  New Delhi   3.286     1252.00
CH        China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

Index and select data

- Square brackets
- Advanced methods
  - loc
  - iloc

Column Access [ ]

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics["country"]
```

```
BR          Brazil
RU          Russia
IN           India
CH           China
SA    South Africa
Name: country, dtype: object
```

Column Access [ ]

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
type(brics["country"])
```

```
pandas.core.series.Series
```

- 1D labelled array

Column Access [ ]

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics[["country"]]
```

```
         country
BR        Brazil
RU        Russia
IN         India
CH         China
SA  South Africa
```

Column Access [ ]

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
type(brics[["country"]])
```

```
pandas.core.frame.DataFrame
```

Column Access [ ]

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics[["country", "capital"]]
```

```
         country    capital
BR        Brazil   Brasilia
RU        Russia     Moscow
IN         India  New Delhi
CH         China    Beijing
SA  South Africa   Pretoria
```

Row Access [ ]

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics[1:4]
```

```
   country    capital    area  population
RU  Russia     Moscow  17.100       143.5
IN   India  New Delhi   3.286      1252.0
CH   China    Beijing   9.597      1357.0
```

Row Access [ ]

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40    * 0 *
RU        Russia     Moscow  17.100      143.50    * 1 *
IN         India  New Delhi   3.286     1252.00    * 2 *
CH         China    Beijing   9.597     1357.00    * 3 *
SA  South Africa   Pretoria   1.221       52.98    * 4 *
```

```
brics[1:4]
```

```
   country    capital    area  population
RU  Russia     Moscow  17.100       143.5
IN   India  New Delhi   3.286      1252.0
CH   China    Beijing   9.597      1357.0
```

Discussion [ ]

- Square brackets: limited functionality
- Ideally
  - 2D Numpy arrays
  - `my_array[rows, columns]`
- pandas
  - `loc` (label-based)
  - `iloc` (integer position-based)

Row Access loc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc["RU"]
```

```
country       Russia
capital       Moscow
area            17.1
population     143.5
Name: RU, dtype: object
```

- Row as pandas Series

Row Access loc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[["RU"]]
```

```
   country capital  area  population
RU  Russia  Moscow  17.1       143.5
```

- DataFrame

Row Access loc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[["RU", "IN", "CH"]]
```

```
   country    capital    area  population
RU  Russia     Moscow  17.100       143.5
IN   India  New Delhi   3.286      1252.0
CH   China    Beijing   9.597      1357.0
```

Row & Column loc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[["RU", "IN", "CH"], ["country", "capital"]]
```

```
   country    capital
RU  Russia     Moscow
IN   India  New Delhi
CH   China    Beijing
```

Row & Column loc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[:, ["country", "capital"]]
```

```
         country    capital
BR        Brazil   Brasilia
RU        Russia     Moscow
IN         India  New Delhi
CH         China    Beijing
SA  South Africa   Pretoria
```

Recap

- Square brackets
  - Column access `brics[["country", "capital"]]`
  - Row access: only through slicing `brics[1:4]`
- loc (label-based)
  - Row access `brics.loc[["RU", "IN", "CH"]]`
  - Column access `brics.loc[:, ["country", "capital"]]`
  - Row & Column access

```
brics.loc[
["RU", "IN", "CH"],
["country", "capital"]
]
```

Row Access iloc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[["RU"]]
```

```
   country capital  area  population
RU  Russia  Moscow  17.1       143.5
```

```
brics.iloc[[1]]
```

```
   country capital  area  population
RU  Russia  Moscow  17.1       143.5
```

Row Access iloc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[["RU", "IN", "CH"]]
```

```
   country    capital    area  population
RU  Russia     Moscow  17.100       143.5
IN   India  New Delhi   3.286      1252.0
CH   China    Beijing   9.597      1357.0
```

Row Access iloc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.iloc[[1,2,3]]
```

```
   country    capital    area  population
RU  Russia     Moscow  17.100       143.5
IN   India  New Delhi   3.286      1252.0
CH   China    Beijing   9.597      1357.0
```

Row & Column iloc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[["RU", "IN", "CH"], ["country", "capital"]]
```

```
   country    capital
RU  Russia     Moscow
IN   India  New Delhi
CH   China    Beijing
```

Row & Column iloc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.iloc[[1,2,3], [0, 1]]
```

```
   country    capital
RU  Russia     Moscow
IN   India  New Delhi
CH   China    Beijing
```

Row & Column iloc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.loc[:, ["country", "capital"]]
```

```
         country    capital
BR        Brazil   Brasilia
RU        Russia     Moscow
IN         India  New Delhi
CH         China    Beijing
SA  South Africa   Pretoria
```

Row & Column iloc

```
         country    capital    area  population
BR        Brazil   Brasilia   8.516      200.40
RU        Russia     Moscow  17.100      143.50
IN         India  New Delhi   3.286     1252.00
CH         China    Beijing   9.597     1357.00
SA  South Africa   Pretoria   1.221       52.98
```

```
brics.iloc[:, [0,1]]
```

```
         country    capital
BR        Brazil   Brasilia
RU        Russia     Moscow
IN         India  New Delhi
CH         China    Beijing
SA  South Africa   Pretoria
```