

# 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!

INTERMEDIATE PYTHON

# 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



<sup>1</sup> 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

# 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: [ ]

# 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!

INTERMEDIATE PYTHON

# 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
88	2016-01-01 15:00:01	compressor
68	2016-01-01 16:00:01	valve
78	2016-01-01 16:00:01	compressor

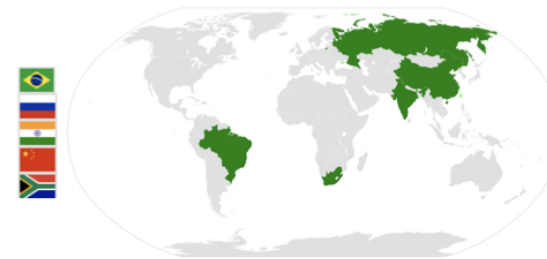
row = observations  
column = variable

# 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!

INTERMEDIATE PYTHON



# 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

# Let's practice!

INTERMEDIATE PYTHON