



INTERMEDIATE PYTHON FOR DATA SCIENCE

# Comparison Operators



# Numpy Recap

```
In [1]: import numpy as np
In [2]: np_height = np.array([1.73, 1.68, 1.71, 1.89, 1.79])
In [3]: np_weight = np.array([65.4, 59.2, 63.6, 88.4, 68.7])
In [4]: bmi = np_weight / np_height ** 2

In [5]: bmi
Out[5]: array([ 21.852,  20.975,  21.75 ,  24.747,  21.441])

In [6]: bmi > 23
Out[6]: array([False, False, False,  True, False], dtype=bool)

In [7]: bmi[bmi > 23]
Out[7]: array([ 24.747])
```

*Code from Intro to Python for Data Science, Chapter 4*

## Comparison operators: how Python values relate

# Numeric Comparisons

```
In [8]: 2 < 3
```

```
Out[8]: True
```

```
In [9]: 2 == 3
```

```
Out[9]: False
```

```
In [10]: 2 <= 3
```

```
Out[10]: True
```

```
In [11]: 3 <= 3
```

```
Out[11]: True
```

```
In [12]: x = 2
```

```
In [13]: y = 3
```

```
In [14]: x < y
```

```
Out[14]: True
```

# Other Comparisons

```
In [15]: "carl" < "chris"
```

```
Out[15]: True
```

```
In [16]: 3 < "chris"
```

```
TypeError: unorderable types: int() < str()
```

```
In [17]: 3 < 4.1
```

```
Out[17]: True
```

```
In [18]: bmi
```

```
Out[18]: array([ 21.852,  20.975,  21.75 ,  24.747,  21.441])
```

```
In [19]: bmi > 23
```

```
Out[19]: array([False, False, False,  True, False], dtype=bool)
```



# Comparators

<	strictly less than
<=	less than or equal
>	strictly greater than
>=	greater than or equal
==	equal
!=	not equal



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# Boolean Operators

# Boolean Operators

- and
- or
- not



# and

```
In [1]: True and True  
Out[1]: True
```

```
In [2]: False and True  
Out[2]: False
```

```
In [3]: True and False  
Out[3]: False
```

```
In [4]: False and False  
Out[4]: False
```

```
In [5]: x = 12
```

```
In [6]: True x > 5 and x < True 15  
Out[6]: True
```

# or

```
In [7]: True or True  
Out[7]: True
```

```
In [8]: False or True  
Out[8]: True
```

```
In [9]: True or False  
Out[9]: True
```

```
In [10]: False or False  
Out[10]: False
```

```
In [11]: y = 5
```

```
In [12]: True False  
y < 7 or y > 13  
Out[12]: True
```

# not

```
In [13]: not True  
Out[13]: False
```

```
In [14]: not False  
Out[14]: True
```



# Numpy

```
In [19]: bmi      # calculation of bmi left out
```

```
Out[19]: array([ 21.852,  20.975,  21.75 ,  24.747,  21.441])
```

```
In [20]: bmi > 21
```

```
Out[20]: array([ True, False,  True,  True,  True], dtype=bool)
```

```
In [21]: bmi < 22
```

```
Out[22]: array([ True,  True,  True, False,  True], dtype=bool)
```

```
In [23]: bmi > 21 and bmi < 22
```

```
ValueError: The truth value of an array with more than one element  
is ambiguous. Use a.any() or a.all()
```

# Numpy

`logical_and()`  
`logical_or()`  
`logical_not()`

```
In [19]: bmi      # calculation of bmi left out
```

```
Out[19]: array([ 21.852,  20.975,  21.75 ,  24.747,  21.441])
```

```
In [20]: bmi > 21
```

```
Out[20]: array([ True, False,  True,  True,  True], dtype=bool)
```

```
In [21]: bmi < 22
```

```
Out[22]: array([ True,  True,  True, False,  True], dtype=bool)
```

```
In [23]: bmi > 21 and bmi < 22
```

```
ValueError: The truth value of an array with more than one element  
is ambiguous. Use a.any() or a.all()
```

```
In [24]: np.logical_and(bmi > 21, bmi < 22)
```

```
Out[24]: array([ True, False,  True, False,  True], dtype=bool)
```

```
In [25]: bmi[np.logical_and(bmi > 21, bmi < 22)]
```

```
Out[25]: array([ 21.852,  21.75,  21.441])
```



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**if, elif, else**

# Overview

- Comparison Operators
  - `<`, `>`, `>=`, `<=`, `==`, `!=`
- Boolean Operators
  - `and`, `or`, `not`
- Conditional Statements
  - `if`, `else`, `elif`



# if

```
if condition :  
    expression
```



 control.py

```
z = 4  
if z % 2 == 0 :  
    print("z is even")
```

Output:  
z is even



# if

 control.py

```
z = 4 True
if z % 2 == 0 :
    print("z is even")
```

Output:  
z is even

```
if condition :
    expression
expression # not part of if
```





# if

```
if condition :  
    expression
```



 control.py

```
z = 4  
if z % 2 == 0 :  
    print("checking " + str(z))  
    print("z is even")
```

Output:  
checking 4  
z is even



# if

```
if condition :  
    expression
```



 control.py

```
z = 5  
if z % 2 == 0 :  
    print("checking " + str(z))  
    print("z is even")
```

**Not executed**

Output:

# else

 control.py

```
z = 5 False
if z % 2 == 0 :
    print("z is even")
else :
    print("z is odd") ←
```

```
if condition :
    expression
else :
    expression
```



Output:  
z is odd

# elif

 control.py

```
z = 3
if z % 2 == 0 : False
    print("z is divisible by 2")
elif z % 3 == 0 : True
    print("z is divisible by 3")
else :
    print("z is neither divisible by 2 nor by 3")
```

Output:

```
z is divisible by 3
```

```
if condition :
    expression
elif condition :
    expression
else :
    expression
```



# elif

 control.py

```
z = 6
if z % 2 == 0 : True
    print("z is divisible by 2")
elif z % 3 == 0 : Never reached
    print("z is divisible by 3")
else :
    print("z is neither divisible by 2 nor by 3")
```

Output:

```
z is divisible by 2
```

```
if condition :
    expression
elif condition :
    expression
else :
    expression
```





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# Filtering Pandas DataFrame



# brics

```
In [1]: import pandas as pd
```

```
In [2]: brics = pd.read_csv("path/to/brics.csv", index_col = 0)
```

```
In [3]: brics
```

```
Out[3]:
```

	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



# Goal

- Select countries with area over 8 million km<sup>2</sup>
- 3 steps
  - Select the area column
  - Do comparison on area column
  - Use result to select countries

	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

# Step 1: Get column

```
In [4]: brics["area"]  
Out[4]:  
BR      8.516  
RU     17.100  
IN      3.286  
CH      9.597  
SA      1.221  
Name: area, dtype: float64
```

## Alternatives:

```
brics.loc[:, "area"]
```

```
brics.iloc[:, 2]
```

**Need Pandas Series**

	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

# Step 2: Compare

```
In [4]: brics["area"]
```

```
Out[4]:
```

BR	8.516
RU	17.100
IN	3.286
CH	9.597
SA	1.221

```
Name: area, dtype: float64
```

```
In [5]: brics["area"] > 8
```

```
Out[5]:
```

BR	True
RU	True
IN	False
CH	True
SA	False

```
Name: area, dtype: bool
```

```
In [6]: is_huge = brics["area"] > 8
```

	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



# Step 3: Subset DF

```
In [7]: is_huge
Out[7]:
BR      True
RU      True
IN      False
CH      True
SA      False
Name: area, dtype: bool
```

```
In [8]: brics[is_huge]
Out[8]:
```

	country	capital	area	population
BR	Brazil	Brasilia	8.516	200.4
RU	Russia	Moscow	17.100	143.5
CH	China	Beijing	9.597	1357.0

	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

# Summary

```
In [9]: is_huge = brics["area"] > 8
```

```
In [10]: brics[is_huge]
```

```
Out[10]:
```

	country	capital	area	population
BR	Brazil	Brasilia	8.516	200.4
RU	Russia	Moscow	17.100	143.5
CH	China	Beijing	9.597	1357.0



```
In [11]: brics[brics["area"] > 8]
```

```
Out[11]:
```

	country	capital	area	population
BR	Brazil	Brasilia	8.516	200.4
RU	Russia	Moscow	17.100	143.5
CH	China	Beijing	9.597	1357.0

	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

# Boolean operators

```
In [12]: import numpy as np
```

```
In [13]: np.logical_and(brics["area"] > 8, brics["area"] < 10)
```

```
Out[13]:
```

```
BR      True
```

```
RU      False
```

```
IN      False
```

```
CH      True
```

```
SA      False
```

```
Name: area, dtype: bool
```

```
In [14]: brics[np.logical_and(brics["area"] > 8, brics["area"] < 10)]
```

```
Out[14]:
```

	country	capital	area	population
BR	Brazil	Brasilia	8.516	200.4
CH	China	Beijing	9.597	1357.0

	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
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