

Comparison Operators

INTERMEDIATE PYTHON



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NumPy recap

```
# Code from Intro to Python for Data Science, Chapter 4
import numpy as np
np_height = np.array([1.73, 1.68, 1.71, 1.89, 1.79])
np_weight = np.array([65.4, 59.2, 63.6, 88.4, 68.7])
bmi = np_weight / np_height ** 2
bmi
```

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

```
bmi > 23
```

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

```
bmi[bmi > 23]
```

```
array([ 24.747])
```

- Comparison operators: how Python values relate

Numeric comparisons

```
2 < 3
```

```
True
```

```
2 == 3
```

```
False
```

```
2 <= 3
```

```
True
```

```
3 <= 3
```

```
True
```

```
x = 2  
y = 3  
x < y
```

```
True
```

Other comparisons

```
"carl" < "chris"
```

```
True
```

```
3 < "chris"
```

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

```
3 < 4.1
```

```
True
```

Other comparisons

```
bmi
```

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

```
bmi > 23
```

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

Comparators

| Comparator | Meaning |
|------------|-----------------------|
| < | Strictly less than |
| <= | Less than or equal |
| > | Strictly greater than |
| >= | Greater than or equal |
| == | Equal |
| != | Not equal |

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Boolean Operators

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Boolean Operators

- `and`
- `or`
- `not`

and

True and True

True

```
x = 12
x > 5 and x < 15
# True      True
```

True

False and True

False

True and False

False

False and False

False

or

```
True or True
```

```
True
```

```
False or True
```

```
True
```

```
True or False
```

```
True
```

```
False or False
```

```
False
```

```
y = 5  
y < 7 or y > 13
```

```
True
```

not

```
not True
```

```
False
```

```
not False
```

```
True
```

NumPy

```
bmi      # calculation of bmi left out
```

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

```
bmi > 21
```

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

```
bmi < 22
```

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

```
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()`

```
np.logical_and(bmi > 21, bmi < 22)
```

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

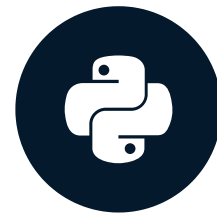
```
bmi[np.logical_and(bmi > 21, bmi < 22)]
```

```
array([21.852, 21.75, 21.441])
```

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if, elif, else

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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 :    # True  
    print("z is even")
```

```
z is even
```

if

```
if condition :  
    expression
```

- `expression` not part of `if`

`control.py`

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

```
z is even
```

if

```
if condition :  
    expression
```

control.py

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

```
checking 4  
z is even
```

if

```
if condition :  
    expression
```

control.py

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

else

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

control.py

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

```
z is odd
```

elif

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

control.py

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

```
z is divisible by 3
```

elif

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

control.py

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

```
z is divisible by 2
```


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Filtering pandas DataFrames

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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 |

Goal

| | 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 |

- Select countries with area over 8 million km2
- 3 steps
 - Select the area column
 - Do comparison on area column
 - Use result to select countries

Step 1: Get column

| | 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["area"]
```

```
BR    8.516
RU   17.100
IN    3.286
CH    9.597
SA    1.221
Name: area, dtype: float64    # - Need Pandas Series
```

- Alternatives:

```
brics.loc[:, "area"]
brics.iloc[:, 2]
```

Step 2: Compare

```
brics["area"]
```

```
BR      8.516  
RU     17.100  
IN      3.286  
CH      9.597  
SA      1.221  
Name: area, dtype: float64
```

```
brics["area"] > 8
```

```
BR      True  
RU      True  
IN     False  
CH      True  
SA     False  
Name: area, dtype: bool
```

```
is_huge = brics["area"] > 8
```

Step 3: Subset DF

```
is_huge
```

```
BR    True
RU    True
IN    False
CH    True
SA    False
Name: area, dtype: bool
```

```
brics[is_huge]
```

| | 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 |

Summary

| | 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 | 52.988 |

```
is_huge = brics["area"] > 8  
brics[is_huge]
```

| | 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 |

```
brics[brics["area"] > 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 |

Boolean operators

```
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
```

```
import numpy as np
np.logical_and(brics["area"] > 8, brics["area"] < 10)
```

```
BR    True
RU    False
IN    False
CH    True
SA    False
Name: area, dtype: bool
```

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

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

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