

# Reference guide: Data cleaning in Python

This reference guide contains common functions and methods that data professionals use to clean data. The reference guide contains three different tables of useful tools, each grouped by cleaning category: missing data, outliers, and label encoding.

## Missing data

The following pandas functions and methods are helpful when dealing with missing data.

### [`df.info\(\)`](#)

- **Description:** A DataFrame method that returns a concise summary of the dataframe, including a 'non-null count,' which helps you know the number of missing values

#### Example input:

```
print(df)
print()
df.info()
```

#### Example output:

	planet	radius_km	moons
0	Mercury	2440	0
1	Venus	6052	0
2	Earth	6371	1
3	Mars	3390	2
4	Jupiter	69911	80
5	Saturn	58232	83
6	Uranus	25362	27
7	Neptune	24622	14

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8 entries, 0 to 7
Data columns (total 3 columns):
planet      8 non-null object
radius_km   8 non-null int64
moons       8 non-null int64
dtypes: int64(2), object(1)
memory usage: 272.0+ bytes
```

## [df.isna\(\)](#) / `isnull()`

- **Description:** A pandas function that returns a same-sized Boolean array indicating whether each value is null (you can also use `pd.isnull()` as an alias). Note that this function also exists as a DataFrame method.

### Example input:

```
print(df)
print('\n After pd.isnull(): \n')

pd.isnull(df)
```

### Example output:

	Planet	radius_km	moons
0	Mercury	2440	NaN
1	Venus	6052	NaN
2	Earth	6371	1.0
3	Mars	3390	NaN
4	Jupiter	69911	80.0
5	Saturn	58232	83.0
6	Uranus	25362	27.0
7	Neptune	24622	14.0

After `pd.isnull()`:

	Planet	radius_km	moons
0	False	False	True
1	False	False	True
2	False	False	False
3	False	False	True
4	False	False	False
5	False	False	False
6	False	False	False
7	False	False	False

## [pd.notna\(\)](#) / `notnull()`

- **Description:** A pandas function that returns a same-sized Boolean array indicating whether each value is NOT null (you can also use `pd.notnull()` as an alias). Note that this function also exists as a DataFrame method.

### Example input:

```
print(df)
print('\n After notnull(): \n')

pd.notnull(df)
```

### Example output:

	Planet	radius_km	moons
0	Mercury	2440	NaN
1	Venus	6052	NaN
2	Earth	6371	1.0
3	Mars	3390	NaN
4	Jupiter	69911	80.0
5	Saturn	58232	83.0
6	Uranus	25362	27.0
7	Neptune	24622	14.0

After notnull():

	Planet	radius_km	moons
0	True	True	False
1	True	True	False
2	True	True	True
3	True	True	False
4	True	True	True
5	True	True	True
6	True	True	True
7	True	True	True

### [df.fillna\(\)](#)

- **Description:** A DataFrame method that fills in missing values using specified method

### Example input:

```
print(df)
print('\n After fillna(): \n')
```

```
df.fillna(2)
```

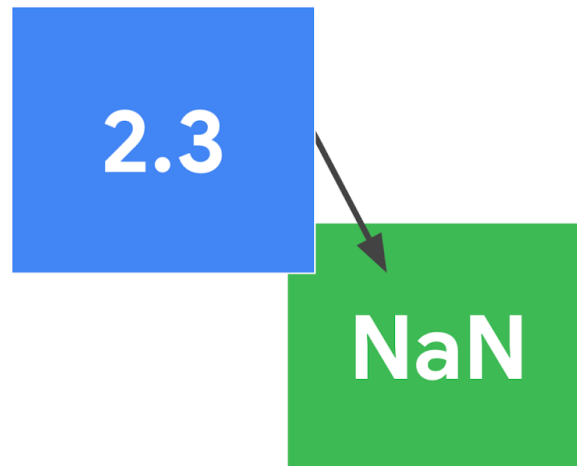
### Example output:

	animal	class	color	legs
0	cardinal	Aves	red	NaN
1	gecko	Reptilia	green	4.0
2	raven	Aves	black	NaN

After fillna():

	animal	class	color	legs
0	cardinal	Aves	red	2.0
1	gecko	Reptilia	green	4.0
2	raven	Aves	black	2.0

The following image shows a value of 2.3 replacing a NaN in a data cell.



### df.replace()

- **Description:** A DataFrame method that replaces specified values with other specified values. Can also be applied to pandas Series.

#### **Example input:**

```
print(df)
print('\n After replace(): \n')

df.replace('Aves', 'bird')
```

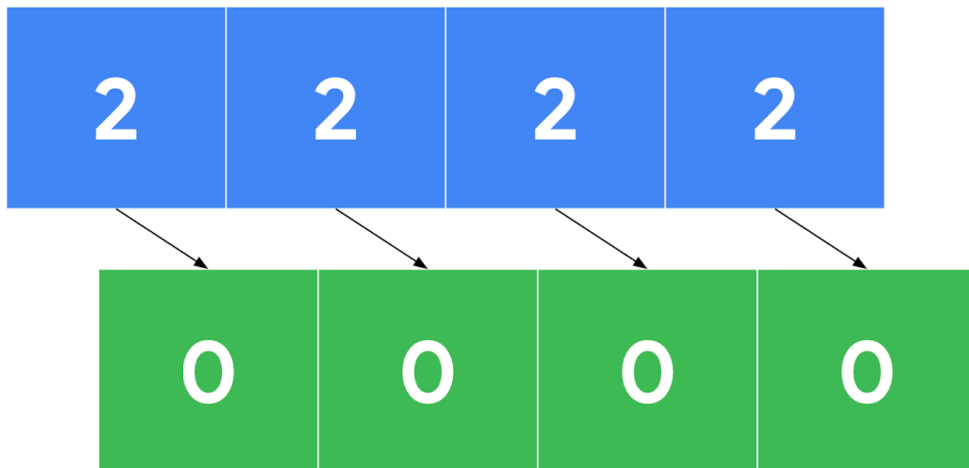
#### **Example output:**

	animal	class	color	legs
0	cardinal	Aves	red	2
1	gecko	Reptilia	green	4
2	raven	Aves	black	2

After replace():

	animal	class	color	legs
0	cardinal	bird	red	2
1	gecko	Reptilia	green	4
2	raven	bird	black	2

The following image shows that four 2s in cells are replacing 0s.



### df.dropna()

- **Description:** A DataFrame method that removes rows or columns that contain missing values, depending on the axis you specify.

#### **Example input:**

```
print('Original df: \n \n', df)
print('\n After dropna(axis=0): \n')
print(df.dropna(axis=0))

print('\n After dropna(axis=1): \n')
print(df.dropna(axis=1))
```

#### **Example output:**

Original df:

	animal	class	color	legs
0	NaN	Aves	red	2
1	gecko	Reptilia	green	4
2	raven	Aves	NaN	2

After dropna(axis=0):

	animal	class	color	legs
1	gecko	Reptilia	green	4

After dropna(axis=1):

	class	legs
0	Aves	2

```
1 Reptilia      4
2      Aves      2
```

The following image shows a sequence of numbers with missing value data cells being removed.

0	9	3	2	6	4	2
<del>1</del>	<del>NaN</del>	<del>3</del>	<del>2</del>	<del>NaN</del>	<del>4</del>	<del>2</del>
2	4	3	2	8	4	2

## Outliers

The following tools are helpful when dealing with outliers in a dataset.

### [df.describe\(\)](#)

- **Description:** A DataFrame method that returns general statistics about the dataframe which can help determine outliers

#### Example input:

```
print(df)
print()
df.describe()
```

#### Example output:

```
   planet  radius_km  moons
0  Mercury     2440      0
1   Venus     6052      0
2   Earth     6371      1
3    Mars     3390      2
4  Jupiter    69911     80
5   Saturn    58232     83
6   Uranus    25362     27
7  Neptune    24622     14
```

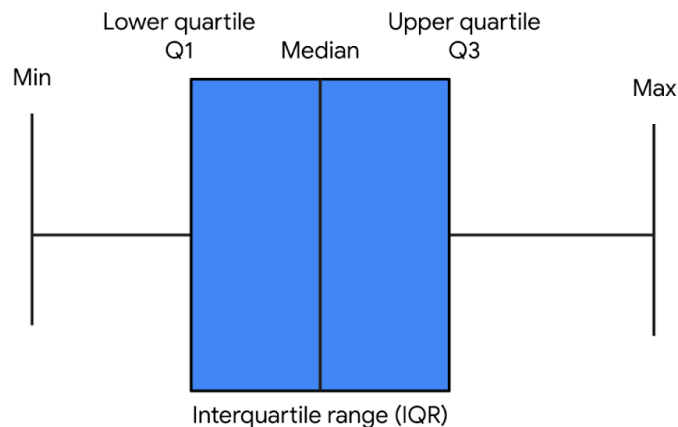
	radius_km	moons
count	8.000000	8.00000
mean	24547.500000	25.87500
std	26191.633528	35.58265
min	2440.000000	0.00000
25%	5386.500000	0.75000
50%	15496.500000	8.00000
75%	33579.500000	40.25000
max	69911.000000	83.00000

## sns.boxplot()

- **Description:** A seaborn function that generates a box plot. Data points beyond 1.5x the interquartile range are considered outliers.

### Example:

The following image shows an example graph of a box plot with min, max, lower and upper quartiles, and the median labeled.



## Label encoding

The following tools are helpful when performing label encoding.

## df.astype()

- **Description:** A DataFrame method that allows you to encode its data as a specified dtype. Note that this method can also be used on Series objects.

### Example input:

```
print(df)
```

```

print('\n Original dtypes of df: \n')

print(df.dtypes)

print('\n dtypes after casting \'class\' column as categorical: \n')

df['class'] = df['class'].astype('category')

print(df.dtypes)

```

### Example output:

```

  animal      class  color  legs
0  cardinal      Aves    red     2
1   gecko  Reptilia  green     4
2   raven      Aves  black     2

```

Original dtypes of df:

```

animal      object
class       object
color       object
legs        int64
dtype: object

```

dtypes after casting 'class' column as categorical:

```

animal      object
class       category
color       object
legs        int64
dtype: object

```

## Series.cat.codes

- **Description:** A Series attribute that returns the numeric category codes of the series

### Example input:

```

# Cast 'class' column as categorical
df['class'] = df['class'].astype('category')

print('\n \'class\' column: \n')
print(df['class'])

print('\n Category codes of \'class\' column: \n')

```



```
df['class'].cat.codes
```

### Example output:

```
'class' column:

0      Aves
1  Reptilia
2      Aves
Name: class, dtype: category
Categories (2, object): [Aves, Reptilia]

Category codes of 'class' column:


0      0
1      1
2      0
dtype: int8
```

### get\_dummies()

- **Description:** Converts categorical values into new binary columns—one for each different category

### Example:

The following image shows a rain column with values of mild, scattered, heavy, and severe is replaced with four new binary columns—one for each category.

index	rain		index	rain_mild	rain_scattered	rain_heavy	rain_severe
0	mild		0	1	0	0	0
1	mild		1	1	0	0	0
2	heavy		2	0	0	1	0
3	scattered		3	0	1	0	0
4	heavy		4	0	0	1	1
5	severe		5	0	0	0	1
6	severe		6	0	0	0	1
7	mild		7	1	0	0	0
8	heavy		8	0	0	1	0
9	scattered		9	0	1	0	0
10	scattered		10	0	1	0	0

## LabelEncoder()

- **Description:** A transformer from `skikit-learn.preprocessing` that encodes specified categories or labels with numeric codes. Note that when building predictive models it should only be used on target variables (i.e., `y` data).

### Example:

#### It can be used to normalize labels:

```
from sklearn.preprocessing import LabelEncoder

# Instantiate LabelEncoder()
encoder = LabelEncoder()

data = [1, 2, 2, 6]

# Fit to the data
encoder.fit(data)

# Transform the data
transformed = encoder.transform(data)

# Reverse the transformation
inverse = encoder.inverse_transform(transformed)

print('Data =', data)
print('\n Classes: \n', encoder.classes_)
print('\n Encoded (normalized) classes: \n', transformed)
print('\n Reverse from encoded classes to original: \n', inverse)
```

#### Output:

```
Data = [1, 2, 2, 6]

Classes:
[1 2 6]

Encoded (normalized) classes:
[0 1 1 2]

Reverse from encoded classes to original:
[1 2 2 6]
```

#### It can be used to convert categorical labels into numeric:

```

from sklearn.preprocessing import LabelEncoder

# Instantiate LabelEncoder()
encoder = LabelEncoder()

data = ['paris', 'paris', 'tokyo', 'amsterdam']

# Fit to the data
encoder.fit(data)

# Transform the data
transformed = encoder.transform(data)

# New data
new_data = [0, 2, 1, 1, 2]

# Get classes of new data
inverse = encoder.inverse_transform(new_data)

print('Data =', data)
print('\n Classes: \n', list(encoder.classes_))
print('\n Encoded classes: \n', transformed)
print('\n New data =', new_data)
print('\n Convert new_data to original classes: \n', list(inverse))

```

### Output:

```

Data = ['paris', 'paris', 'tokyo', 'amsterdam']

Classes:
['amsterdam', 'paris', 'tokyo']

Encoded classes:
[1 1 2 0]

New data = [0, 2, 1, 1, 2]

Convert new_data to original classes:
['amsterdam', 'tokyo', 'paris', 'paris', 'tokyo']

```

## Key takeaways

There are many tools that data professionals can use to perform data cleaning on a wide range of data. The information you learn from missing data, outliers, and transforming categorical to numeric data will help you prepare datasets for further analysis throughout your career.