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Pandas Brain Teasers

Exercise Your Mind

The Pragmatic Bookshelf

Raleigh, North Carolina

The Pragmatic Programmers

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Miki Tebeka

edited by Margaret Eldridge

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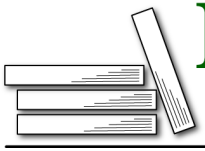

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The team that produced this book includes:

CEO: Dave Rankin
COO: Janet Furlow
Managing Editor: Tammy Coron
Development Editor: Margaret Eldridge
Copy Editor: Jennifer Whipple
Indexing: Potomac Indexing, LLC
Layout: Gilson Graphics
Founders: Andy Hunt and Dave Thomas

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To all the data nerds out there, you rock!

Puzzle 1

Rectified

relu.py

```
import pandas as pd

def relu(n):
    if n < 0:
        return 0
    return n

arr = pd.Series([-1, 0, 1])
print(relu(arr))
```

Guess the Output

Try to guess what the output is before moving to the next page.

This code will raise a ValueError.

The problematic line is if n < 0:. n is the result of arr < 0, which is a pandas.Series.

```
In [1]: import pandas as pd
In [2]: arr = pd.Series([-1, 0, 1])
In [3]: arr < 0
Out[3]:
0     True
1    False
2    False
dtype: bool
```

Once arr < 0 is computed, you use it in an if statement, which brings us to how Boolean values work in Python.

Every Python object, not just True and False, has a Boolean value. The documentation states the rules:

Everything is True except

- 0 numbers: 0, 0.0, 0+0j, ...
- Empty collections: [], {}, '', ...
- None
- False

You can test the truth value of a Python object using the built-in bool function.

In addition to these rules, any object can state its own Boolean value using the __bool__ special method. The Boolean logic for a pandas.Series is different from the one for a list or a tuple; it raises an exception.

```
In [4]: bool(arr < 0)
...
ValueError: The truth value of a Series is ambiguous.
Use a.empty, a.bool(), a.item(), a.any() or a.all().
```

The exception tells you the reasoning. It follows "The Zen of Python," which states the following:

> In the face of ambiguity, refuse the temptation to guess.

So what are your options? You can use all or any but then you'll need to check the type of n to see if it's a plain number of a pandas.Series.

A function that works both on scalar and a pandas.Series (or a numpy array) is called a ufunc, short for *universal function*. Most of the functions from numpy or Pandas, such as min or to_datetime, are ufuncs.

numpy has a vectorize decorator for these cases.

relu_vec.py
```
import numpy as np
import pandas as pd

@np.vectorize
def relu(n):
    if n < 0:
        return 0
    return n

arr = pd.Series([-1, 0, 1])
print(relu(arr))
```

Now, relu will work both on scalars (e.g., 7, 2.18, ...) and vectors (e.g., numpy array, pandas.Series, ...)

Watch Your Types

The output of relu now is numpy.ndarray, not pandas.Series as well.

Further Reading

Truth Value Testing in the Python Documentation
docs.python.org/3/library/stdtypes.html#truth-value-testing

PEP 285
python.org/dev/peps/pep-0285/

bool Type Documentation
docs.python.org/3/reference/datamodel.html#object.__bool__

Universal Functions on the numpy Docs
numpy.org/doc/stable/reference/ufuncs.html?highlight=ufunc

"The Zen of Python"
python.org/dev/peps/pep-0020/#the-zen-of-python

numpy.vectorize
numpy.org/doc/stable/reference/generated/numpy.vectorize.html#numpy.vectorize

numba.vectorize
numba.pydata.org/numba-doc/latest/user/vectorize.html