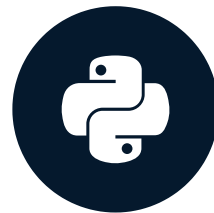


Docstrings

WRITING FUNCTIONS IN PYTHON



Shayne Miel

Software Architect @ Duo Security

A complex function

```
def split_and_stack(df, new_names):  
    half = int(len(df.columns) / 2)  
    left = df.iloc[:, :half]  
    right = df.iloc[:, half:]  
    return pd.DataFrame(  
        data=np.vstack([left.values, right.values]),  
        columns=new_names  
    )
```

```
def split_and_stack(df, new_names):
    """Split a DataFrame's columns into two halves and then stack
    them vertically, returning a new DataFrame with `new_names` as the
    column names.

    Args:
        df (DataFrame): The DataFrame to split.
        new_names (iterable of str): The column names for the new DataFrame.

    Returns:
        DataFrame
    """
    half = int(len(df.columns) / 2)
    left = df.iloc[:, :half]
    right = df.iloc[:, half:]
    return pd.DataFrame(
        data=np.vstack([left.values, right.values]),
        columns=new_names
    )
```

Anatomy of a docstring

```
def function_name(arguments):  
    """  
    Description of what the function does.  
  
    Description of the arguments, if any.  
  
    Description of the return value(s), if any.  
  
    Description of errors raised, if any.  
  
    Optional extra notes or examples of usage.  
    """
```

Docstring formats

- Google Style
- Numpydoc
- reStructuredText
- EpyText

Google Style - description

```
def function(arg_1, arg_2=42):  
    """Description of what the function does.  
    """
```

Google style - arguments

```
def function(arg_1, arg_2=42):  
    """Description of what the function does.  
  
    Args:  
        arg_1 (str): Description of arg_1 that can break onto the next line  
            if needed.  
        arg_2 (int, optional): Write optional when an argument has a default  
            value.  
    """
```

Google style - return value(s)

```
def function(arg_1, arg_2=42):  
    """Description of what the function does.  
  
    Args:  
        arg_1 (str): Description of arg_1 that can break onto the next line  
            if needed.  
        arg_2 (int, optional): Write optional when an argument has a default  
            value.  
  
    Returns:  
        bool: Optional description of the return value  
        Extra lines are not indented.  
    """
```



```
def function(arg_1, arg_2=42):  
    """Description of what the function does.  
  
    Args:  
        arg_1 (str): Description of arg_1 that can break onto the next line  
            if needed.  
        arg_2 (int, optional): Write optional when an argument has a default  
            value.  
  
    Returns:  
        bool: Optional description of the return value  
        Extra lines are not indented.  
  
    Raises:  
        ValueError: Include any error types that the function intentionally  
            raises.  
  
    Notes:  
        See https://www.datacamp.com/community/tutorials/docstrings-python  
        for more info.  
    """
```

Numpydoc

```
def function(arg_1, arg_2=42):  
    """  
    Description of what the function does.  
  
    Parameters  
    -----  
    arg_1 : expected type of arg_1  
        Description of arg_1.  
    arg_2 : int, optional  
        Write optional when an argument has a default value.  
        Default=42.  
  
    Returns  
    -----  
    The type of the return value  
        Can include a description of the return value.  
        Replace "Returns" with "Yields" if this function is a generator.  
    """
```

Retrieving docstrings

```
def the_answer():  
    """Return the answer to life,  
    the universe, and everything.  
  
    Returns:  
        int  
    """  
    return 42  
print(the_answer.__doc__)
```

```
Return the answer to life,  
the universe, and everything.  
  
Returns:  
    int
```

```
import inspect  
print(inspect.getdoc(the_answer))
```

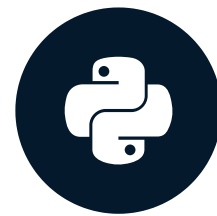
```
Return the answer to life,  
the universe, and everything.  
  
Returns:  
    int
```

Let's practice!

WRITING FUNCTIONS IN PYTHON

DRY and "Do One Thing"

WRITING FUNCTIONS IN PYTHON



Shayne Miel

Software Architect @ Duo Security

Don't repeat yourself (DRY)

```
train = pd.read_csv('train.csv')
train_y = train['labels'].values
train_X = train[col for col in train.columns if col != 'labels'].values
train_pca = PCA(n_components=2).fit_transform(train_X)
plt.scatter(train_pca[:,0], train_pca[:,1])
```

```
val = pd.read_csv('validation.csv')
val_y = val['labels'].values
val_X = val[col for col in val.columns if col != 'labels'].values
val_pca = PCA(n_components=2).fit_transform(val_X)
plt.scatter(val_pca[:,0], val_pca[:,1])
```

```
test = pd.read_csv('test.csv')
test_y = test['labels'].values
test_X = test[col for col in test.columns if col != 'labels'].values
test_pca = PCA(n_components=2).fit_transform(train_X)
plt.scatter(test_pca[:,0], test_pca[:,1])
```

The problem with repeating yourself

```
train = pd.read_csv('train.csv')
train_y = train['labels'].values
train_X = train[col for col in train.columns if col != 'labels'].values
train_pca = PCA(n_components=2).fit_transform(train_X)
plt.scatter(train_pca[:,0], train_pca[:,1])
```

```
val = pd.read_csv('validation.csv')
val_y = val['labels'].values
val_X = val[col for col in val.columns if col != 'labels'].values
val_pca = PCA(n_components=2).fit_transform(val_X)
plt.scatter(val_pca[:,0], val_pca[:,1])
```

```
test = pd.read_csv('test.csv')
test_y = test['labels'].values
test_X = test[col for col in test.columns if col != 'labels'].values
test_pca = PCA(n_components=2).fit_transform(train_X)  ### yikes! ###
plt.scatter(test_pca[:,0], test_pca[:,1])
```

Another problem with repeating yourself

```
train = pd.read_csv('train.csv')
train_y = train['labels'].values  ### <- there and there --v ###
train_X = train[col for col in train.columns if col != 'labels'].values
train_pca = PCA(n_components=2).fit_transform(train_X)
plt.scatter(train_pca[:,0], train_pca[:,1])
```

```
val = pd.read_csv('validation.csv')
val_y = val['labels'].values  ### <- there and there --v ###
val_X = val[col for col in val.columns if col != 'labels'].values
val_pca = PCA(n_components=2).fit_transform(val_X)
plt.scatter(val_pca[:,0], val_pca[:,1])
```

```
test = pd.read_csv('test.csv')
test_y = test['labels'].values  ### <- there and there --v ###
test_X = test[col for col in test.columns if col != 'labels'].values
test_pca = PCA(n_components=2).fit_transform(test_X)
plt.scatter(test_pca[:,0], test_pca[:,1])
```


Use functions to avoid repetition

```
def load_and_plot(path):  
    """Load a dataset and plot the first two principal components.  
  
    Args:  
        path (str): The location of a CSV file.  
  
    Returns:  
        tuple of ndarray: (features, labels)  
    """  
    data = pd.read_csv(path)  
    y = data['label'].values  
    X = data[col for col in data.columns if col != 'label'].values  
    pca = PCA(n_components=2).fit_transform(X)  
    plt.scatter(pca[:,0], pca[:,1])  
    return X, y
```

```
train_X, train_y = load_and_plot('train.csv')  
val_X, val_y = load_and_plot('validation.csv')  
test_X, test_y = load_and_plot('test.csv')
```

```
def load_and_plot(path):  
    """Load a dataset and plot the first two principal components.  
  
    Args:  
        path (str): The location of a CSV file.  
  
    Returns:  
        tuple of ndarray: (features, labels)  
    """  
    data = pd.read_csv(path)  
    y = data['label'].values  
    X = data[col for col in data.columns if col != 'label'].values  
  
    pca = PCA(n_components=2).fit_transform(X)  
    plt.scatter(pca[:,0], pca[:,1])  
  
    return X, y
```

```
def load_and_plot(path):  
    """Load a dataset and plot the first two principal components.  
  
    Args:  
        path (str): The location of a CSV file.  
  
    Returns:  
        tuple of ndarray: (features, labels)  
    """  
    # load the data  
    data = pd.read_csv(path)  
    y = data['label'].values  
    X = data[col for col in data.columns if col != 'label'].values  
  
    pca = PCA(n_components=2).fit_transform(X)  
    plt.scatter(pca[:,0], pca[:,1])  
  
    return X, y
```

```
def load_and_plot(path):
    """Load a dataset and plot the first two principal components.

    Args:
        path (str): The location of a CSV file.

    Returns:
        tuple of ndarray: (features, labels)
    """
    # load the data
    data = pd.read_csv(path)
    y = data['label'].values
    X = data[col for col in data.columns if col != 'label'].values

    # plot the first two principal components
    pca = PCA(n_components=2).fit_transform(X)
    plt.scatter(pca[:,0], pca[:,1])

    return X, y
```

```
def load_and_plot(path):  
    """Load a dataset and plot the first two principal components.  
  
    Args:  
        path (str): The location of a CSV file.  
  
    Returns:  
        tuple of ndarray: (features, labels)  
    """  
    # load the data  
    data = pd.read_csv(path)  
    y = data['label'].values  
    X = data[col for col in data.columns if col != 'label'].values  
  
    # plot the first two principle components  
    pca = PCA(n_components=2).fit_transform(X)  
    plt.scatter(pca[:,0], pca[:,1])  
  
    # return loaded data  
    return X, y
```

Do One Thing

```
def load_data(path):  
    """Load a dataset.  
  
    Args:  
        path (str): The location of a CSV file.  
  
    Returns:  
        tuple of ndarray: (features, labels)  
    """  
    data = pd.read_csv(path)  
    y = data['labels'].values  
    X = data[col for col in data.columns  
              if col != 'labels'].values  
    return X, y
```

```
def plot_data(X):  
    """Plot the first two principal components of a matrix.  
  
    Args:  
        X (numpy.ndarray): The data to plot.  
    """  
    pca = PCA(n_components=2).fit_transform(X)  
    plt.scatter(pca[:,0], pca[:,1])
```

Advantages of doing one thing

The code becomes:

- More flexible
- More easily understood
- Simpler to test
- Simpler to debug
- Easier to change

Code smells and refactoring

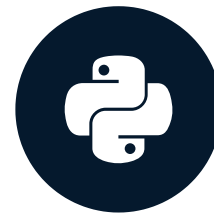
"Any fool can write code that a computer can understand. Good programmers write code that humans can understand." - Martin Fowler (1999)

Let's practice!

WRITING FUNCTIONS IN PYTHON

Pass by assignment

WRITING FUNCTIONS IN PYTHON



Shayne Miel

Software Architect @ Duo Security

A surprising example

```
def foo(x):  
    x[0] = 99  
my_list = [1, 2, 3]  
foo(my_list)  
print(my_list)
```

[99, 2, 3]

```
def bar(x):  
    x = x + 90  
my_var = 3  
bar(my_var)  
print(my_var)
```

3

Digging deeper



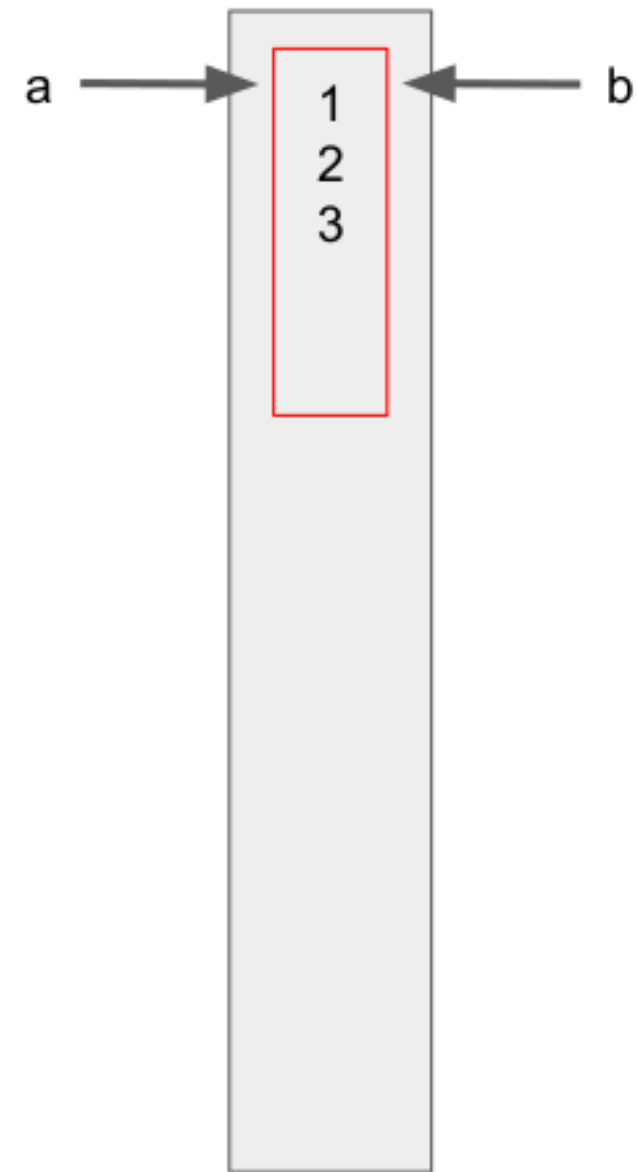
Digging deeper

```
a = [1, 2, 3]
```



Digging deeper

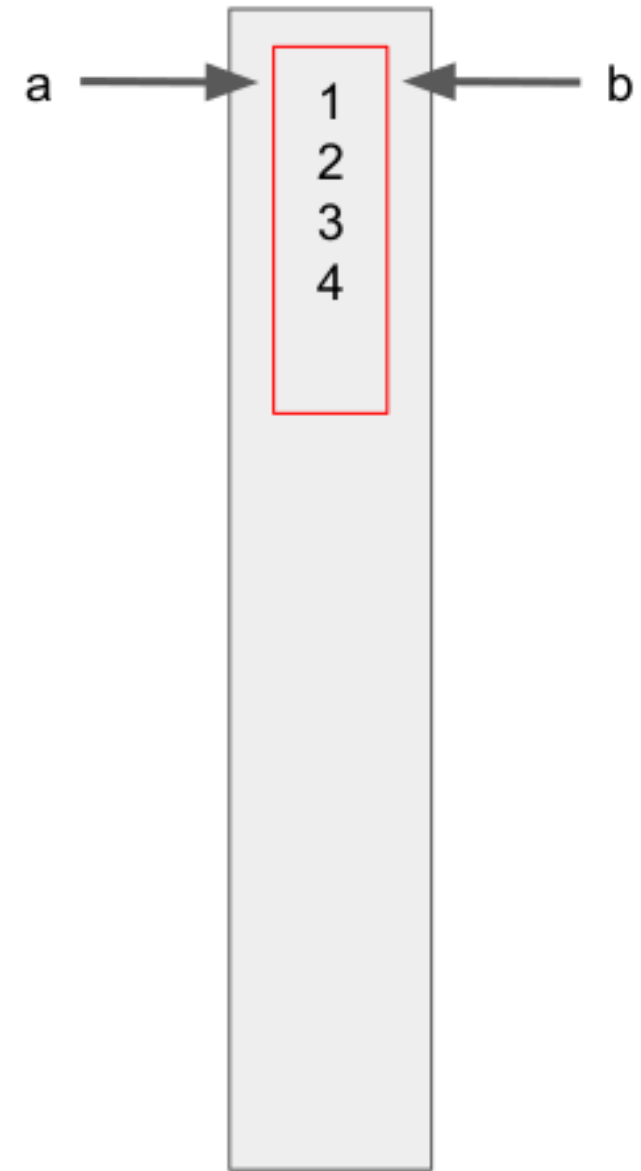
```
a = [1, 2, 3]  
b = a
```



Digging deeper

```
a = [1, 2, 3]
b = a
a.append(4)
print(b)
```

```
[1, 2, 3, 4]
```



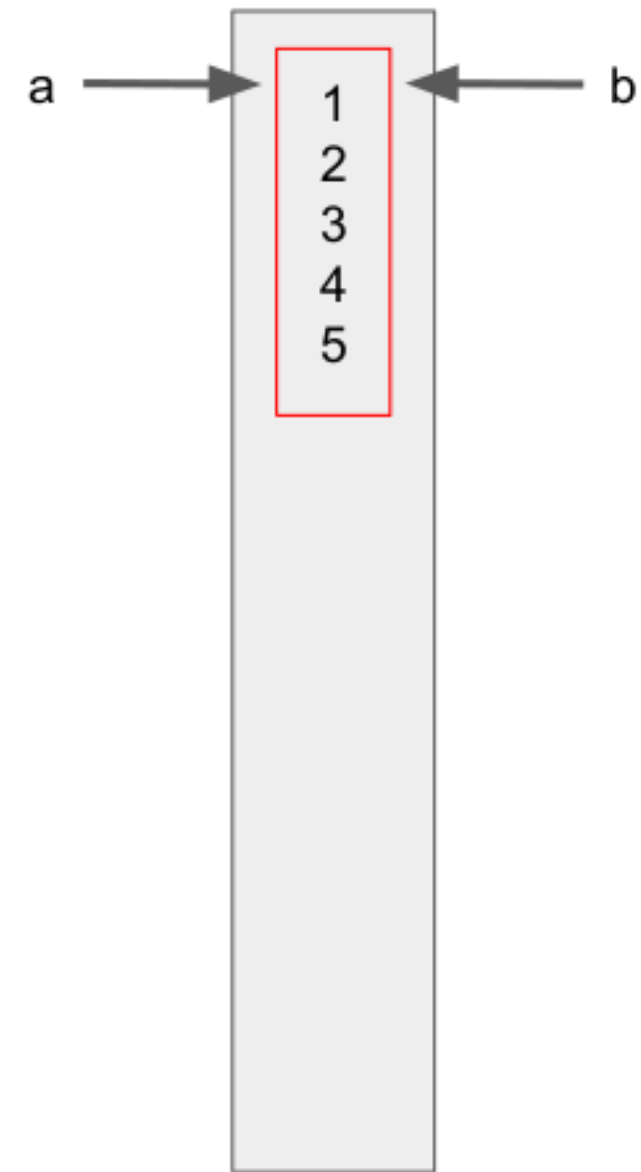
Digging deeper

```
a = [1, 2, 3]
b = a
a.append(4)
print(b)
```

```
[1, 2, 3, 4]
```

```
b.append(5)
print(a)
```

```
[1, 2, 3, 4, 5]
```



Digging deeper

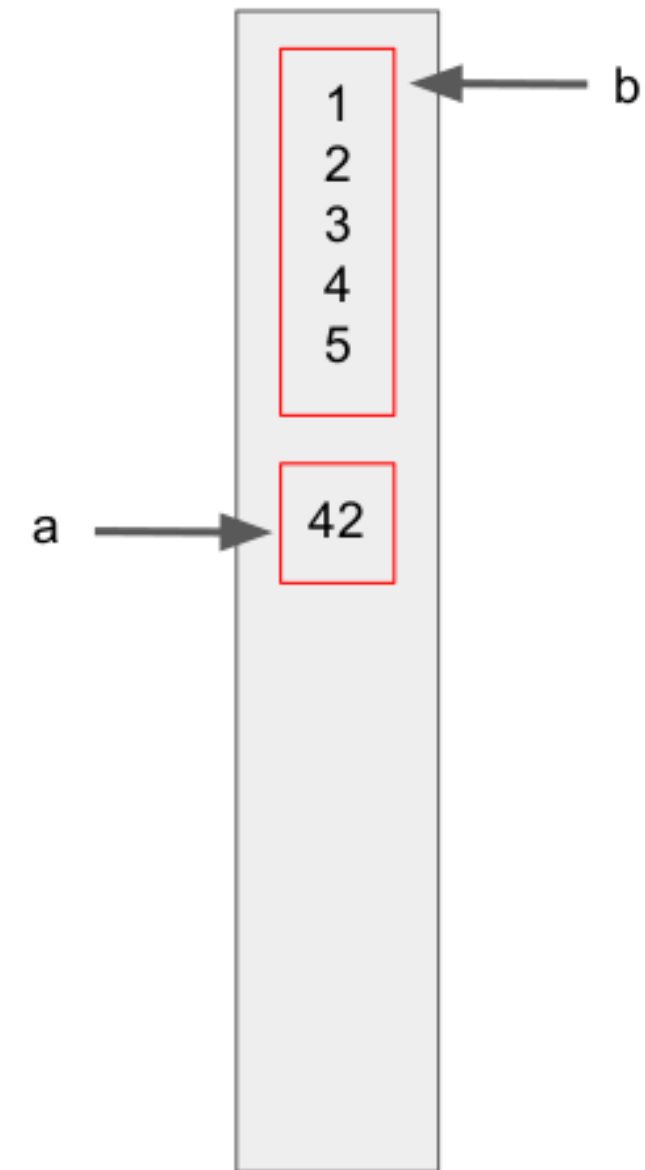
```
a = [1, 2, 3]
b = a
a.append(4)
print(b)
```

```
[1, 2, 3, 4]
```

```
b.append(5)
print(a)
```

```
[1, 2, 3, 4, 5]
```

```
a = 42
```



Pass by assignment

```
def foo(x):  
    x[0] = 99
```



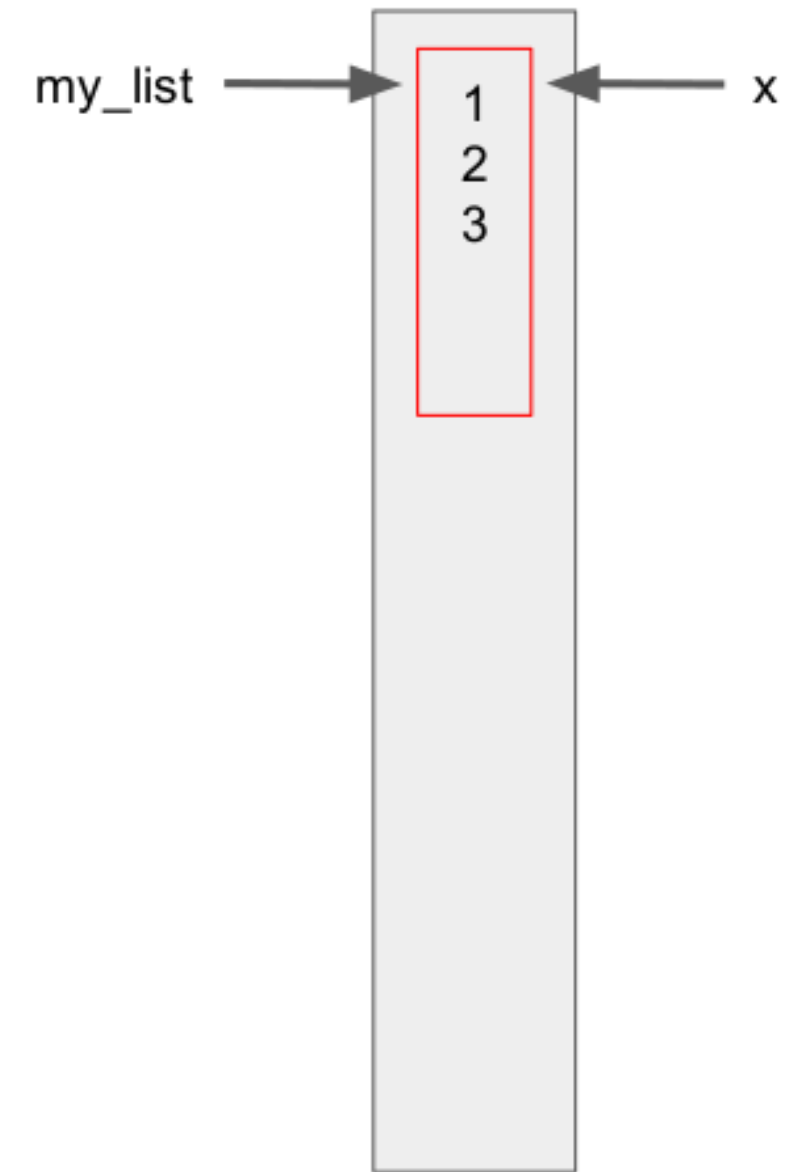
Pass by assignment

```
def foo(x):  
    x[0] = 99  
my_list = [1, 2, 3]
```



Pass by assignment

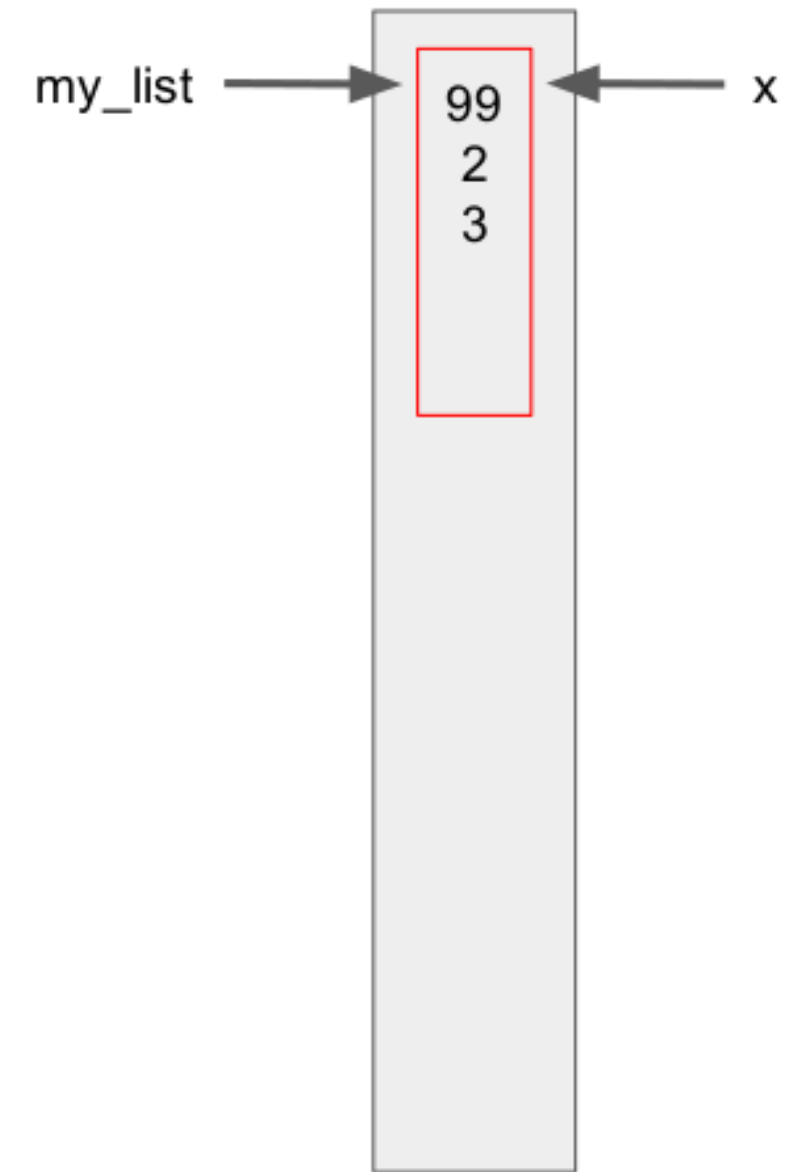
```
def foo(x):  
    x[0] = 99  
my_list = [1, 2, 3]  
foo(my_list)
```



Pass by assignment

```
def foo(x):  
    x[0] = 99  
my_list = [1, 2, 3]  
foo(my_list)  
print(my_list)
```

```
[99, 2, 3]
```



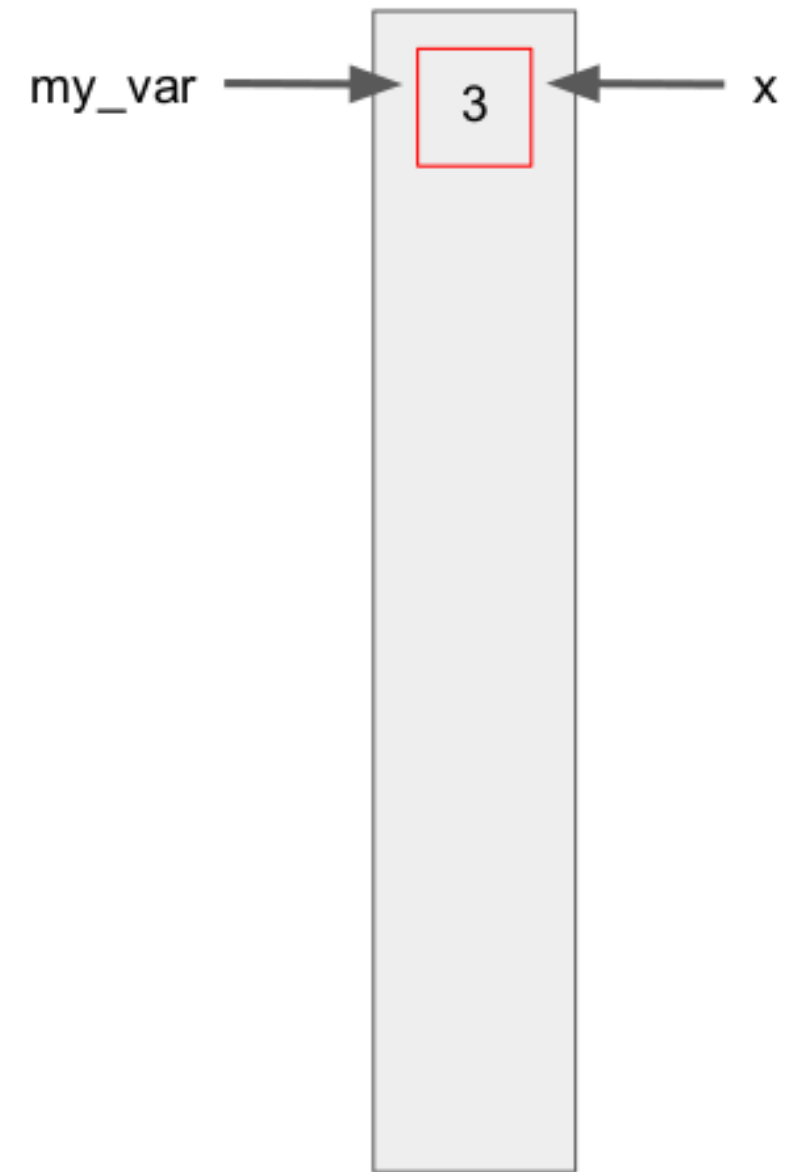
Pass by assignment

```
def bar(x):  
    x = x + 90  
my_var = 3
```



Pass by assignment

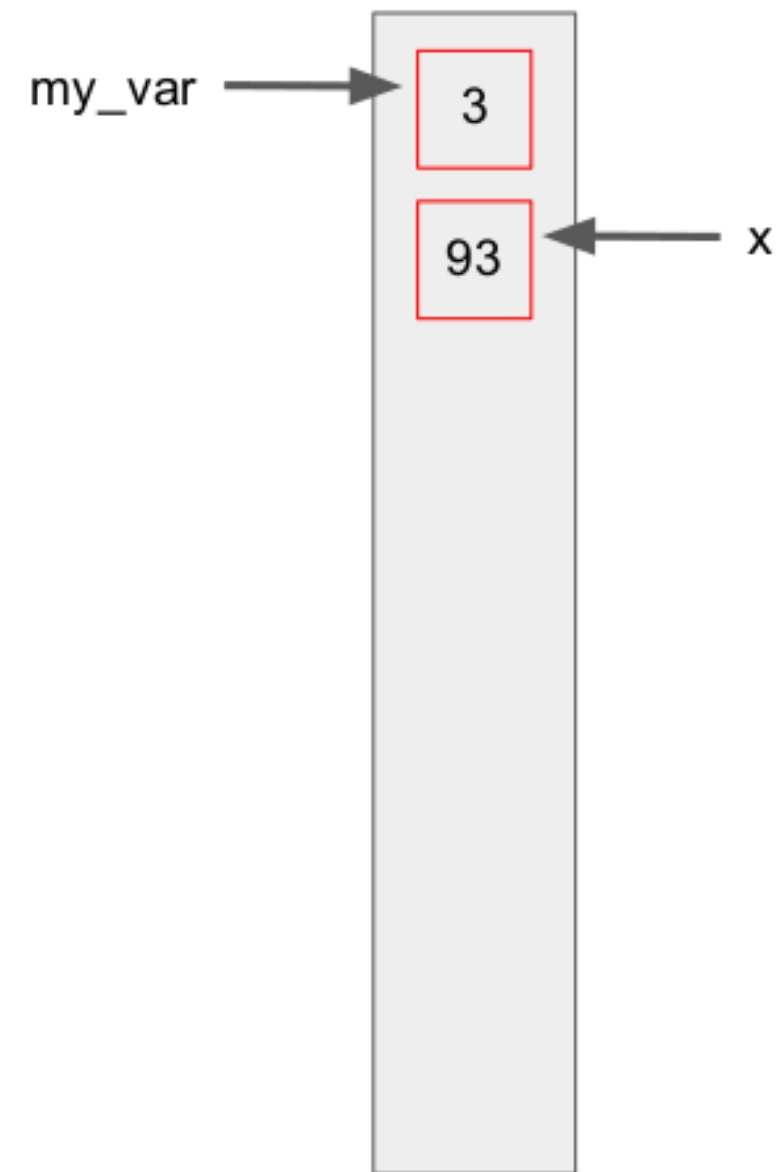
```
def bar(x):  
    x = x + 90  
my_var = 3  
bar(my_var)
```



Pass by assignment

```
def bar(x):  
    x = x + 90  
my_var = 3  
bar(my_var)  
my_var
```

3



Immutable or Mutable?

Immutable

- int
- float
- bool
- string
- bytes
- tuple
- frozenset
- None

Mutable

- list
- dict
- set
- bytearray
- objects
- functions
- almost everything else!

Mutable default arguments are dangerous!

```
def foo(var=[]):  
    var.append(1)  
    return var  
foo()
```

```
[1]
```

```
foo()
```

```
[1, 1]
```

```
def foo(var=None):  
    if var is None:  
        var = []  
    var.append(1)  
    return var  
foo()
```

```
[1]
```

```
foo()
```

```
[1]
```

Let's practice!

WRITING FUNCTIONS IN PYTHON