

# LAMBDA AND DICTIONARIES 4

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DATA C88C

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## 1 Lambdas

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**Lambda expressions** are one-line functions that specify two things: the parameters and the return expression.

A lambda expression that takes in no arguments and returns 8:

lambda :  $\underbrace{8}_{\text{return value}}$

A lambda expression that takes two arguments and returns their product:

lambda  $\underbrace{x, y}_{\text{parameters}}$  :  $\underbrace{x * y}_{\text{return expression}}$

Unlike functions created by a `def` statement, the function object that a lambda expression creates has no intrinsic name and is not bound to any variable. In fact, nothing changes in the current environment when we evaluate a lambda expression unless we do something with this expression, such as assign it to a variable or pass it as an argument to a higher order function.

## 1. What would Python print?

```
>>> a = lambda: 5
>>> a()
```

**Solution:**

5

```
>>> a(5)
```

**Solution:**

```
TypeError: <lambda>() takes 0 positional arguments but 1
was given
```

```
>>> b = lambda: lambda x: 3
>>> b()(15)
```

**Solution:**

3

```
>>> c = lambda x, y: x + y
>>> c(4, 5)
```

**Solution:**

9

```
>>> d = lambda x: lambda y: x * y
>>> d(3)
```

**Solution:**

```
<function ...>
```

```
>>> d(3)(3)
```

**Solution:**

9

```
>>> e = d(2)
>>> e(5)
```

**Solution:**

```
10
```

```
>>> f = lambda: print(1)
```

**Solution:**

```
# No output because it was just an assignment statement,  
and the body of the lambda was not executed
```

```
>>> g = f()
```

**Solution:**

```
1
```

```
>>> g
```

**Solution:**

```
# No output because the value of g is None
```

## 2 Environment Diagrams

1. Draw the environment diagram for evaluating the following code

```
def mystery_a(lst):  
    def mystery_b(color, count):  
        lst.extend([color] * count)  
    return mystery_b
```

```
colors = ["purple", "pink", "brown"]  
f = mystery_a(colors)  
f("red", 3)  
f("blue", 1)
```

**Solution:** [python tutor link](#)

2. If on line 2 and line 4, we replace `mystery_b` with `mystery_a`, what will change in the environment diagram, if anything?

**Solution:** Only the name of frame 2 would change to `mystery_a`. Nothing else would change, as `mystery_a` would just be a new variable defined in the scope of the `f1` frame and would point to the same function object as before, the function object defined on line 2.

3. If on line 3, we change `lst.extend([color] * count)` to `lst.append([color] * count)`, what will change, if anything?

**Solution:** The list `lst` would grow in length by 1 element, where that one new element would be a list of length 'count' and every item in the list would have value equal to `color`.

4. Draw the environment diagram for evaluating the following code

```
def ross(geller, num):  
    return geller(monica(num))
```

```
def monica(num):  
    if num >= 2:  
        return tup[0]  
    return tup[num]
```

```
f = lambda x: x[-1] == "a"  
tup = ("hola", "there")  
rachel = ross(f, 5)
```

**Solution:** [python tutor link](#)

5. Draw the environment diagram for evaluating the following code

```
def anna(olaf):  
    return lambda a, b: olaf or [a] * b
```

```
hans = [1]  
elsa = anna(hans.append(4))  
kristoff = elsa(3, 4)
```

**Solution:** [python tutor link](#)

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### 3 Dictionaries

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Dictionaries are data structures which map keys to values. Dictionaries in Python are unordered, unlike real-world dictionaries — in other words, key-value pairs are not arranged in the dictionary in any particular order. Let's look at an example:

```
>>> pokemon = {'pikachu': 25, 'dragonair': 148, 'mew': 151}
>>> pokemon['pikachu']
25
>>> pokemon['jolteon'] = 135
>>> pokemon
{'jolteon': 135, 'pikachu': 25, 'dragonair': 148, 'mew': 151}
>>> pokemon['ditto'] = 25
>>> pokemon
{'jolteon': 135, 'pikachu': 25, 'dragonair': 148,
 'ditto': 25, 'mew': 151}
>>> pokemon['mew'] = 15
>>> pokemon
{'jolteon': 135, 'pikachu': 25, 'dragonair': 148,
 'ditto': 25, 'mew': 15}
```

The *keys* of a dictionary can be any *immutable* value, such as numbers, strings, and tuples.<sup>1</sup> Dictionaries themselves are mutable; we can add, remove, and change entries after creation. There is only one value per key, however — if we assign a new value to the same key, it overrides any previous value which might have existed.

To access the value of dictionary at key, use the syntax `dictionary[key]`.

Element selection and reassignment work similarly to sequences, except the square brackets contain the key, not an index.

- To add `val` corresponding to key *or* to replace the current value of key with `val`:  
`dictionary[key] = val`
- To iterate over a dictionary's keys:  
`for key in dictionary: #OR for key in dictionary.keys():`  
`do_stuff()`
- To iterate over a dictionary's values:  
`for value in dictionary.values():`  
`do_stuff()`

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<sup>1</sup>To be exact, keys must be *hashable*, which is out of scope for this course. This means that some mutable objects, such as classes, can be used as dictionary keys.

- To iterate over a dictionary's keys and values:  

```
for key, value in dictionary.items():  
    do_stuff()
```
- To remove an entry in a dictionary:  

```
del dictionary[key]
```
- To get the value corresponding to key and remove the entry:  

```
dictionary.pop(key)
```

### 3.1 Questions

1. What would Python display?

```
>>> pokemon  
{'jolteon': 135, 'pikachu': 25, 'dragonair': 148, 'ditto': 25,  
  'mew': 151}  
  
>>> 'mewtwo' in pokemon
```

**Solution:** False

```
>>> len(pokemon)
```

**Solution:** 5

```
>>> pokemon['ditto'] = pokemon['jolteon']  
>>> pokemon[('diglett', 'diglett', 'diglett')] = 51  
>>> pokemon[25] = 'pikachu'  
>>> pokemon
```

**Solution:**

```
{'mew': 151, 'ditto': 135, 'jolteon': 135, 25: 'pikachu',  
'pikachu': 25, ('diglett', 'diglett', 'diglett'): 51,  
'dragonair': 148}
```

```
>>> pokemon['mewtwo'] = pokemon['mew'] * 2  
>>> pokemon
```

**Solution:**

```
{'mew': 151, 'ditto': 135, 'jolteon': 135, 25: 'pikachu',  
'pikachu': 25, ('diglett', 'diglett', 'diglett'): 51,  
'mewtwo': 302, 'dragonair': 148}
```



```
>>> pokemon[['firetype', 'flying']] = 146
```

**Solution:** Error: unhashable **type**

Note that the last example demonstrates that dictionaries cannot use other mutable data structures as keys. However, dictionaries can be arbitrarily deep, meaning the *values* of a dictionary can be themselves dictionaries.

2. Write a function that takes in a sequence  $s$  and a function  $fn$  and returns a dictionary.

The values of the dictionary are lists of elements from  $s$ . Each element  $e$  in a list should be constructed such that  $fn(e)$  is the same for all elements in that list. Finally, the key for each value should be  $fn(e)$ .

```
def group_by(s, fn):  
    """  
    >>> group_by([12, 23, 14, 45], lambda p: p // 10)  
    {1: [12, 14], 2: [23], 4: [45]}  
    >>> group_by(range(-3, 4), lambda x: x * x)  
    {0: [0], 1: [-1, 1], 4: [-2, 2], 9: [-3, 3]}  
    """
```

**Solution:**

```
grouped = {}  
for x in s:  
    key = fn(x)  
    if key in grouped:  
        grouped[key].append(x)  
    else:  
        grouped[key] = [x]  
return grouped
```