Lecture 23: Sorting with Lambda

Guest Lecture by Elyse Cornwall

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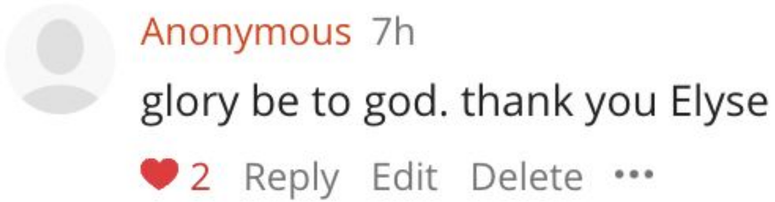
Wed 11am-12pm, Durand 311

Thurs 10:30-11:30am, Zoom

Fri 10am-12pm, Durand 311



Anonymous 7h

glory be to god. thank you Elyse

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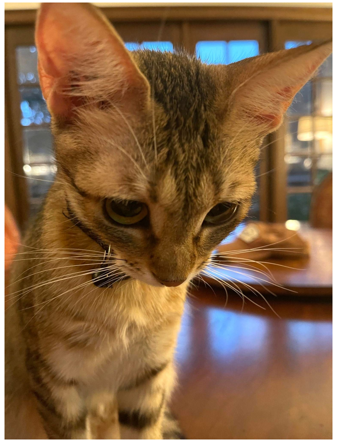
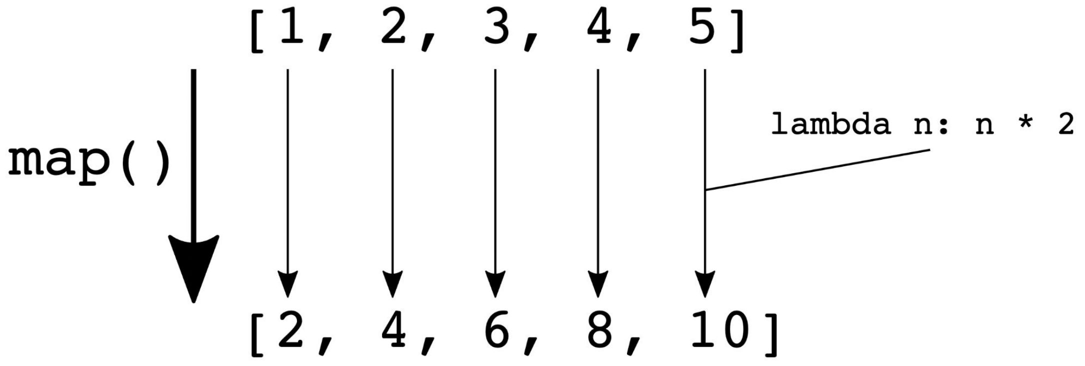


Recap: Lambda

Recall Lambda - Super Powerful!

```
>>> list(map(lambda n: n * 2, [1, 2, 3, 4, 5]))
[2, 4, 6, 8, 10]
```



1, 2, 3... Lambda

```
>>> list(map(lambda n: n * 2, [1, 2, 3, 4, 5]))
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1, 2, 3... Lambda

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>>> list(map(lambda n: n * 2, [1, 2, 3, 4, 5]))
```

1. **The word “lambda”**

1, 2, 3... Lambda

```
>>> list(map(lambda n: n * 2, [1, 2, 3, 4, 5]))
```

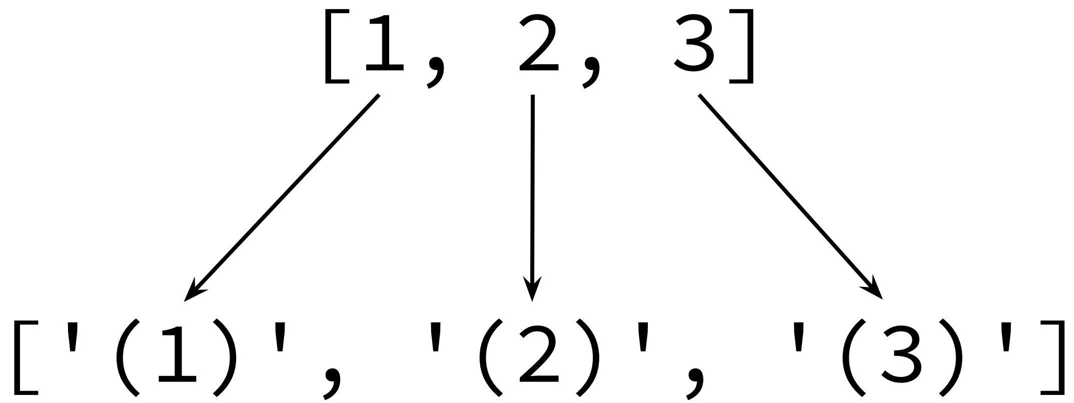
1. The word “lambda”
2. **What type of element? Choose a good parameter name.**

1, 2, 3... Lambda

```
>>> list(map(lambda n: n * 2, [1, 2, 3, 4, 5]))
```

1. The word “lambda”
2. What type of element? Choose a good parameter name.
3. **Expression to produce - no return needed.**

Practice: `int_to_str(nums)`



```
[1, 2, 3]
['(1)', '(2)', '(3)']
```

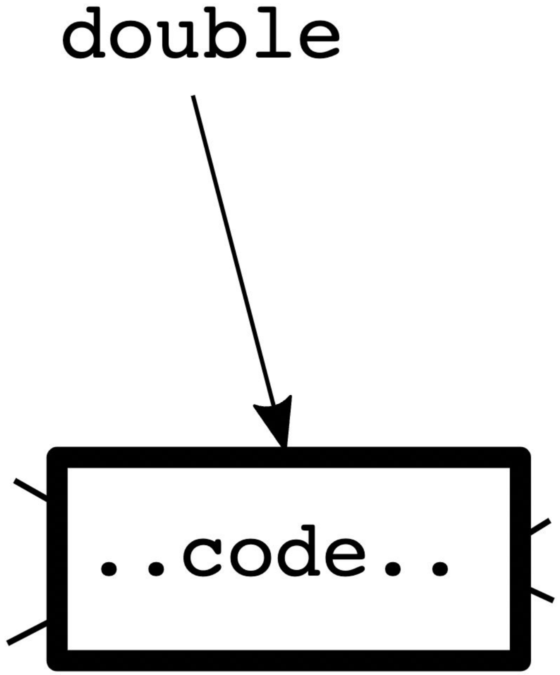
Solution

```
def int_to_str(nums):
    return map(lambda n: '(' + str(n) + ')', nums)
```

Def Functions

Gives a name to some code

```
def double(n):
    return n * 2
```



Anatomy of `Def` and `Lambda`

Python Interpreter Output

```
>>> def double(n):
...   return n * 2
...
>>> double
<function double at 0x7fcc601b9790>
>>> lambda n: n * 2
<function <lambda> at 0x7fcc601b9670>
```

Both are functions: one has a name, and one is a lambda

Def vs. Lambda

Function def

```
def double(n):

    return n * 2
```

Equivalent lambda

```
lambda n: n * 2
```

Def vs. Lambda

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def double(n):

    return n * 2
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Equivalent lambda

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lambda n: n * 2
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Can we just use lambda for everything now?

Def vs. Lambda

Function def

```
def double(n):
    return n * 2
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Equivalent lambda

```
lambda n: n * 2
```

Can we just use lambda for everything now?

No.

Features of Def

`Def` has room for real code features:

- Multiple lines
- If statements
- Variables
- Loops
- Doctests
- Inline comments

Features of Def

`Def` has room for real code features:

- Multiple lines
- If statements
- Variables
- Loops
- Doctests
- Inline comments

`Lambda` is best when we don’t need any of that - just short, 1-line code

Practice: `map_parens(strs)`

$$\begin{tikzcd}
\texttt{['xx(hi)xx',} \arrow[d] & \texttt{'abc(there)xyz',} \arrow[d] & \texttt{'fish']} \arrow[d] \\
\texttt{['hi',} & \texttt{'there',} & \texttt{'fish']}
\end{tikzcd}$$

Solution

```
def parens(s):
    left = s.find('(')
    right = s.find(')', left)

    if left == -1 or right == -1:
        return s
    return s[left + 1:right]


def map_parens(strs):
    return map(parens, strs)
```

Recap: Sorting

Sorting So Far

Use the `sorted()` function to sort lists:

```
>>> nums = [5, 7, 3, 4]
>>> sorted(nums)
[3, 4, 5, 7]
```

```
>>> strs = ['hi', 'bye', 'greetings', 'good day']
>>> sorted(strs)
['bye', 'good day', 'greetings', 'hi']
```

Sorting So Far

Use the `sorted()` function to sort lists:

```
>>> cities = [('tx', 'houston'), ('ca', 'palo alto'), ('ca',
'san jose'), ('tx', 'austin'), ('ca', 'aardvark')]

>>> sorted(cities)
[('ca', 'aardvark'), ('ca', 'palo alto'), ('ca', 'san
jose'), ('tx', 'austin'), ('tx', 'houston')]
```

Sorting So Far

Use the `sorted()` function to sort lists:

```
>>> cities = [('tx', 'houston'), ('ca', 'palo alto'), ('ca',
'san jose'), ('tx', 'austin'), ('ca', 'aardvark')]

>>> sorted(cities)
[('ca', 'aardvark'), ('ca', 'palo alto'), ('ca', 'san
jose'), ('tx', 'austin'), ('tx', 'houston')]
```

What if I want to sort by city name? Or length of city name?

Custom Sorting

Custom Sorting Foods

```
>>> foods = [('radish', 2, 8), ('donut', 10, 1), ('apple',
7, 9), ('broccoli', 6, 10)]
```

Each food is a length-3 food tuple: (name, tastiness 1-10, healthiness 1-10)

- food[0] = its name
- food[1] = how tasty it is 1-10
- food[2] = how healthy it is 1-10

Custom Sorting Foods

```
>>> foods = [('radish', 2, 8), ('donut', 10, 1), ('apple',
7, 9), ('broccoli', 6, 10)]

>>> sorted(foods)

[('apple', 7, 9), ('broccoli', 6, 10), ('donut', 10, 1),
('radish', 2, 8)]
```

Custom Sorting Foods

What if I want to sort by tastiness?

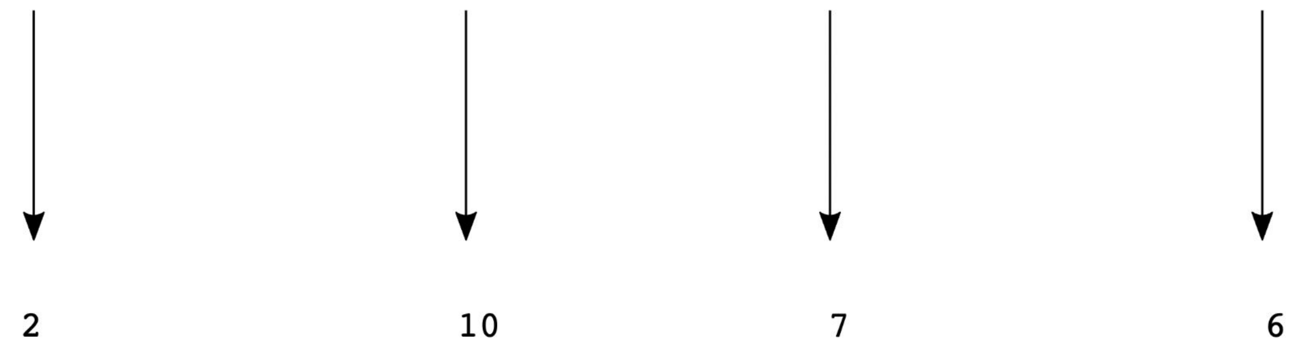
- Control how `sorted()` looks at each food tuple
- It's like drawing a circle around tasty values - sort by these!

```
[('radish', 2, 8), ('donut', 10, 1), ('apple', 7, 9), ('broccoli', 6, 10)]
```

Custom Sorting Foods

- "Project out" a value from each item
  - For each food tuple, project out its tastiness value
- Projected value is used for sorting comparisons

```
[('radish', 2, 8), ('donut', 10, 1), ('apple', 7, 9), ('broccoli', 6, 10)]
```



Custom Sorting Foods

- "Project out" a value from each item
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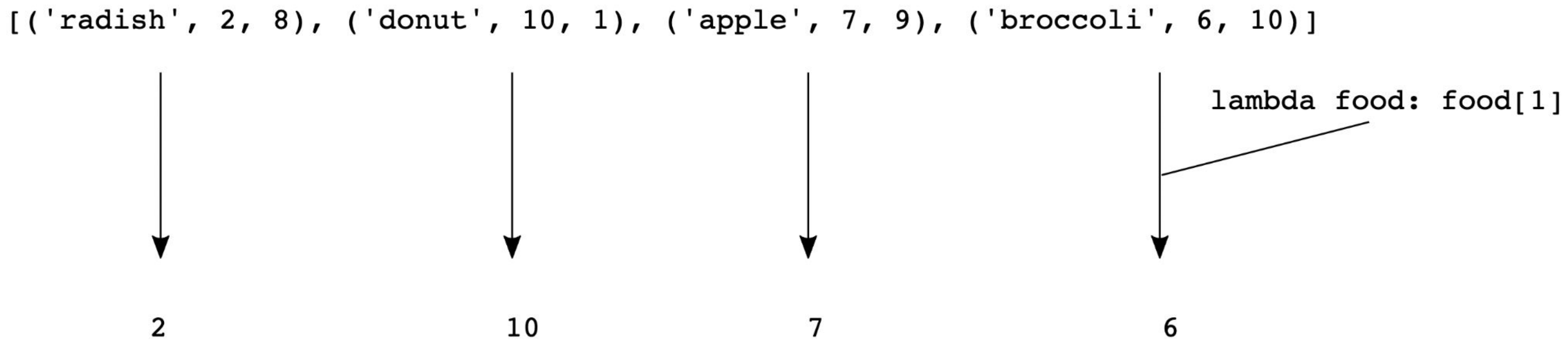


```
[('radish', 2, 8), ('donut', 10, 1), ('apple', 7, 9), ('broccoli', 6, 10)]
```

1, 2 … Custom Sort

```
>>>
```

1, 2 … Custom Sort

```
>>> sorted(foods,                               )
```

1. Call `sorted` with your list

1, 2 … Custom Sort

```
>>> sorted(foods, key=lambda food: food[1])
```

1. Call `sorted` with your list
2. Provide key = lambda to project out the sorting value

1, 2 … Custom Sort

```
>>> sorted(foods, key=lambda food: food[1], reverse=True)
```

1. Call `sorted` with your list
2. Provide key = lambda to project out the sorting value
3. Optionally, `reverse`

1, 2 … Custom Sort

```
# ascending tastiness
>>> sorted(foods, key=lambda food: food[1])
[('radish', 2, 8), ('broccoli', 6, 10), ('apple', 7, 9), ('donut', 10, 1)]

# descending tastiness
>>> sorted(foods, key=lambda food: food[1], reverse=True)
[('donut', 10, 1), ('apple', 7, 9), ('broccoli', 6, 10), ('radish', 2, 8)]

# descending healthiness
>>> sorted(foods, key=lambda food: food[2], reverse=True)
[('broccoli', 6, 10), ('apple', 7, 9), ('radish', 2, 8), ('donut', 10, 1)]

# descending composite tastiness-healthiness score
>>> sorted(foods, key=lambda food: food[1] * food[2], reverse=True)
[('apple', 7, 9), ('broccoli', 6, 10), ('radish', 2, 8), ('donut', 10, 1)]
```

Sorted, Min, and Max

What if I just want the most tasty food? Or the least tasty?

- Sorting n things is kind of expensive
- Use `max()` or `min()` – takes a key=lambda just like `sorted()`
    - All we have to do is change "sorted" to "max" or "min"

Sorted, Min, and Max

```
# uses index 0 (name) by default - tragic!
>>> max(foods)
('radish', 2, 8)

# most tasty
>>> max(foods, key=lambda food: food[1])
('donut', 10, 1)

# least tasty
>>> min(foods, key=lambda food: food[1])
('radish', 2, 8)
```

Movie Sorting

```
movies = [('alien', 8, 1), ('titanic', 6, 9), ('parasite',
10, 6), ('caddyshack', 4, 5)]
```

Each movie is a length-3 tuple: (name, score, date-score)

- movie[0] = its name
- movie[1] = how good it is 1-10
- movie[2] = how appropriate for a date it is 1-10

Practice: `sort_score(movies)`

```
[('alien', 8, 1), ('titanic', 6, 9), ('parasite', 10, 6), ('caddyshack', 4, 5)]
```

Practice: `sort_date(movies)`

```
[('alien', 8, 1), ('titanic', 6, 9), ('parasite', 10, 6), ('caddyshack', 4, 5)]

      ↓                 ↓                    ↓                       ↓

      1                 9                    6                       5
```

Remember wordcount.py?

- Reads in a text file
- Builds a counts dictionary for all words in the file
- Here's the zip file

```
$ python3 wordcount.py tale-of-two-cities.txt
a 2866
a-a-a-business 1
a-a-matter 1
a-buzz 1
a-tiptoe 1
aback 1
...
```

Let’s implement print_top()

```
$ python3 wordcount.py -top 5 tale-of-two-cities.txt
the 7838
and 4833
of 3933
to 3397
a 2866
```

Let’s implement print_top()

```
>>> counts = {'a': 2866, 'tale': 2, 'of': 3933, 'two': 206,
'cities': 2}
```

Let’s implement print_top()

```
>>> counts = {'a': 2866, 'tale': 2, 'of': 3933, 'two': 206,
'cities': 2}

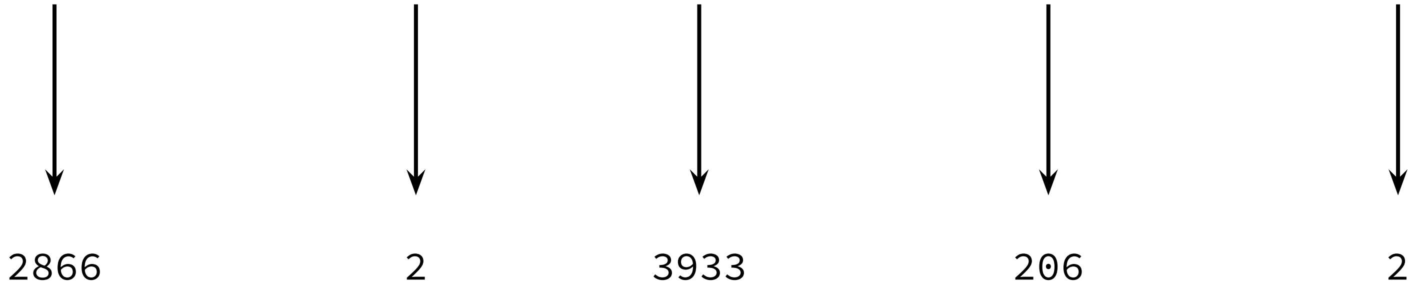
>>> counts.keys()  # list of keys
dict_keys(['a', 'tale', 'of', 'two', 'cities'])

>>> counts.values()  # list of values
dict_values([2866, 2, 3933, 206, 2])

>>> counts.items()  # list of key, value tuples
dict_items([('a', 2866), ('tale', 2), ('of', 3933), ('two',
206), ('cities', 2)])
```

Let’s implement print_top()

```
[('a', 2866), ('tale', 2), ('of', 3933), ('two', 206), ('cities', 2)]
```



Solution

```
# 1. Sort largest count first
items = sorted(items, key=lambda pair: pair[1], reverse=True)

# 2. Print first N
for word, count in items[:n]:
    print(word, count)
```

Thank you!