Python Programming

Packing/Unpacking, `*args`/`**kwargs`, Lambdas and Uniform Cost Search

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Packing and Unpacking: Tuples

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- Now what about: `a, b, c = y`
  print the values of `a`, `b`, and `c`
- The tuple `y` is automatically *unpacked*
  then the following happens: `a, b, c = 10, 20, 30`

Packing and Unpacking: Iterable

- Put an asterisk (*) in front of a variable to mark it as an iterable (e.g. list)
- We can assign (pack) multiple values into such variables

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*a = 10, 20, 30 # print and check type of a
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- What about: `a, b, *c = 10, 20, 30, 40, 50`

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- We can unpack an iterable by placing an asterisk in front of it

```
x = [1, 2, 3]
print(x) # as a list
print(*x) # individual elements
# same as: print(x[0], x[1], x[2])
```

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- The mandatory arguments are placed at the front

```
def myFunc(arg1, arg2, *args):
    print(f"called with {2+len(args)} arguments")
```

Keyworded Arguments

- *Positional Argument*: Classical way of passing arguments

```
def foo(x, y):
    print(f'value of x is {x} and y is {y}')
...
foo(10, 20) # x=10, y=20
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Keyworded Arguments

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foo(y=20, x=10)
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- We can also do the following:

```
vals = {'x': 10, 'y': 20} # keys are arguments (as str)
foo(**vals) # unpacks the dict
```

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More on Keyworded Arguments

- We can pass keyworded variable length of arguments to a function

```
def foo(**kwargs): # received as a dict object
    for key, value in kwargs.items():
        print(f'{key} = {value}')

foo(x=10, z=30, y=20)
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```

- Careful with the ordering of `*args`, `**kwargs` and formal args

```
def foo(arg1, arg2, *args, **kwargs): # note the order
    ...
```

Creating Function Alias

- We can create aliases of a function, just like any variable

```python
def f(x):
    print(x)


h = f # h is now an alias of function f

# now both f and h can be called

h(10) # same as calling f(10)
```

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print(r) # 30
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print(r) # 30
```

Think of this as

```
def add(a, b):
    return a+b
f = add
r = f(10, 20)
print(r)
```

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- For each point `a`, `a[1]` is its y-coordinate value

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- The built-in `sort()` method can accept an argument which specifies the comparison *key*: `sort(key=some_mapping_func)`
- Given an element, the mapping function returns a value that is actually used in the sorting comparison
- For each point `a`, `a[1]` is its y-coordinate value

```
P.sort(key=lambda a: a[1]) # only by y-coordinates
print(P) # [(3, 0), (2, 1), (1, 2), (2, 2)]
```

Using Lambdas: More Examples

```
P = [(1,2), (3,0), (2,2), (2,1)]

min(P, key=lambda a: a[1])  # point having min y
max(P, key=lambda a: a[0]+a[1])  # point having max (x+y)
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students = []
students.append( {'name': 'abcd', 'marks': 90} )
students.append( {'name': 'wxyz', 'marks': 40} )
students.append( {'name': 'mnop', 'marks': 70} )
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min_student = min(students, key=lambda s: s['marks'])
print(min_student)
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# sort students by names
students.sort(key=lambda s: s['name'])
print(students)
```

Weighted Graphs

Our previous graph class

```
class Graph:
    def __init__(self, n):
        self._vertex_count = n
        self._adj_list = [ [] for _ in range(n) ]

    def add_edge(self, u, v):
        self._adj_list[u].append( v )
        self._adj_list[v].append( u )

    def get_neighbours(self, v):
        return self._adj_list[v]
```

Weighted Graphs

Store weights for each edge

```
class Graph:
    def __init__(self, n):
        self._vertex_count = n
        self._adj_list = [ [] for _ in range(n) ]

    def add_edge(self, u, v, weight): # new parameter
        self._adj_list[u].append( (v, weight) ) # tuple
        self._adj_list[v].append( (u, weight) )

    def get_neighbours(self, v):
        return self._adj_list[v] # returns a list of tuples
```

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Store weights for each edge

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class Graph:
    def __init__(self, n):
        self._vertex_count = n
        self._adj_list = [ [] for _ in range(n) ]

    def add_edge(self, u, v, weight=1): # default value
        self._adj_list[u].append( (v, weight) ) # tuple
        self._adj_list[v].append( (u, weight) )

    def get_neighbours(self, v):
        return self._adj_list[v] # returns a list of tuples
```

Weighted Graphs

Store weights for each edge: using dictionary

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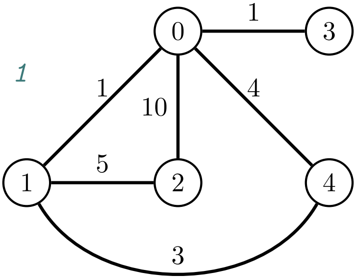
    def add_edge(self, u, v, weight=1): # default value
        self._adj_list[u].append({'node': v,'weight': weight})
        self._adj_list[v].append({'node': u,'weight': weight})

    def get_neighbours(self, v):
        return self._adj_list[v] # returns a list of tuples
```

Using the Modified Graph Class

```
g = Graph(5)
g.add_edge(0, 1) # default weight 1
g.add_edge(0, 2, 10)
g.add_edge(0, 3, 1)
g.add_edge(0, 4, 4)
g.add_edge(1, 2, 5)
g.add_edge(1, 4, 3)
```



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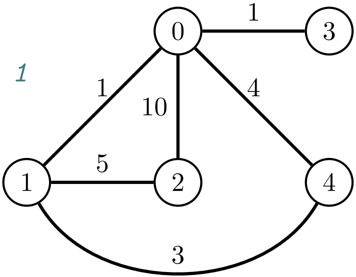

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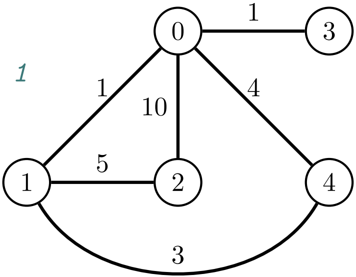

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neighbours = g.get_neighbours(1) # list of dicts
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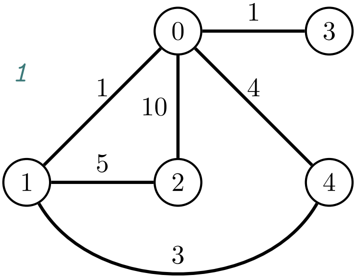

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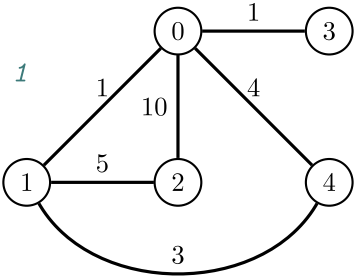

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neighbours = g.get_neighbours(1) # list of dicts
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print( min_neighbour['node'] )
```

Uniform Cost Search

Complete code: graph_UCS.py