Week 5 Course Review

Composite Data Types in Python

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Abstraction in Different Aspects

Abstraction in Data: **Data Structures**

(Strings, Lists, Tuples, Dictionaries, etc.**)**

Programs = Algorithms + Data Structures

(1976, Niklaus Wirth)

Abstraction in Algorithms:

Functions

Review Outline

- String
- List
- Tuple
- Dictionary

Python Strings

Index

```
myStr = “Hello World”
```

Characters	H	e	l	l	o		W	o	r	l	d
Indices	0	1	2	3	4	5	6	7	8	9	10
	–11	–10	–9	–8	–7	–6	–5	–4	–3	–2	–1

We can use [ ] to access particular characters in a string.

```
print(myStr[10])
print(myStr[-1])
```
# will print ‘d’

```
print(myStr[11])
```
❗ Error

Slicing

```
myStr = "Hello World"
```

Syntax: **[start : finish : step]**

⬇

specifies the step size to jump along the sequence

Default Value:

- **start**: beginning
- **finish**: end
- **step**: 1

```
newStr = myStr[:]          # To copy a string
print(newStr)              # Will print 'Hello World'

print(myStr[::-1])         # To reverse a string     # Will print 'dlroW olleH'
```

Q1: What is the output of the following Python program?

```
myStr = "Hello World"
print(myStr[2:-4:2])
```

A. 'el '
B. 'el o'
[✓ C. 'loW']
D. 'loWr'
E. 'lo W'

Characters	H	e	l	l	o		W	o	r	l	d
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	–11	–10	–9	–8	–7	–6	–5	–4	–3	–2	–1

Basic Operations

```
opStr = "Basic"
```

Length of a string: `len()`

e.g. `len(opStr)` → **5**

Concatenate strings: `+`

e.g. `opStr + “ operations"` → **‘Basic operations’**

Repeat String: `*`

e.g. `opStr * 3` → **‘BasicBasicBasic’**

Membership Operation

Is one string contained in another?

- Operator: `in`
- `a in b`: True if string `a` is contained in string `b`

```
myStr = "abcdefg"

'c' in myStr       →  true

'cde' in myStr     →  true

'cef' in myStr     →  false

myStr in myStr     →  true
```

Q2: What is the output of the following Python program?

```python
str1 = "ababc"
str2 = "ab"

if str2 * len(str2) in str1:
    print("case1")

elif str2 in str1:
    print("case2")

else:
    print("case3")
```

A. 'case1'
   'case2'

B. 'case2'

✓ C. 'case1'

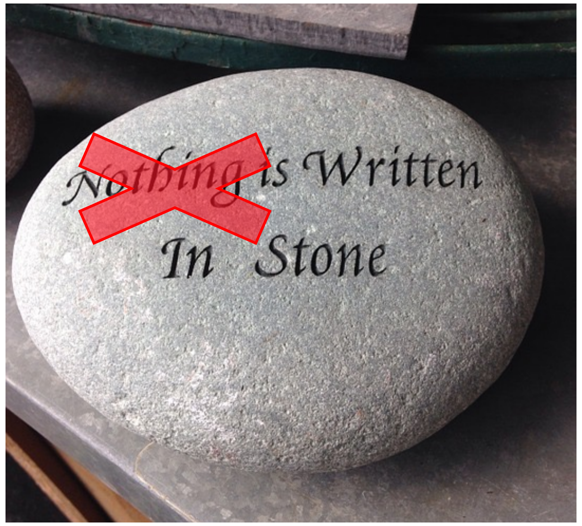
D. 'case3'

E. 'case2'
   'case3'

Strings are Immutable

- Strings are immutable, i.e., you cannot change one once you make it.
  - `aStr = 'spam'`
  - `aStr[1] = 1` → ! Error

- However, you can use it to make another string (copy it, slice it, etc.).
  - `newStr = aStr[:1] + 'l' + aStr[2:]`
  - `newStr` → **'slam'**
  - `aStr` → **'spam'**



String Method: `find()`

`find()` is another string method.

```
myStr = "Find in a string"
myStr.find('d')  ⇨  3
```

- Input: a single character or a string
- Output: the index of the character/string (first seen from left to right)
- If the character/string is not found, –1 is returned

Q3: What is the output of the following Python program?

```
str1 = "couple"
str2 = "t"

newStr = str1[::str1.find(str2)]

print(newStr)
```

A. 'couple'
B. ''
C. 'coupl'
[✓ D. 'elpuoc']
E. 'elpuo'

Python Lists

Creating a List

- As with all data structures, lists have a **constructor**.
- **Constructors** have the same name as the data structures.

`l = list()`	Creates an empty list
`l = list(arg)`	Takes an iterable data structure as an argument and add each item of **`arg`** to the constructed list **`l`**

- **Shortcut**: use of **square brackets `[]`** to indicate explicit items. → `l = [...]`

```
aList = list('abc')    # ['a','b','c']
newList = [1, 3.14159, 'a', True]
```

Operations on Lists

- **concatenate**: `+` (only for lists – not string + list)
- **repeat**: `*`
- **indexing**: the `[ ]` operator, e.g., `lst[3]` → 4th item in the list
- **slicing**: `[:]`
- **membership**: the `in` operator
- **length**: the `len()` function

Q4: What is the output of the following Python program?

```
list1 = [1, "Python", [3, 4], True]

list2 = list1[::-1] + list1[2]

print(list2)
```

A. [1, "Python", [3, 4], True]
B. [1, "Python", [3, 4], True, [3, 4]]
C. [1, "Python", [3, 4], True, 3, 4]
[✓ D. [True, [3, 4], 'Python', 1, 3, 4]]
E. [True, [3, 4], 'Python', 1, [3, 4]]
F. Error

Q5: What is the output of the following Python program?

```
list1 = [1, "Python", [3, 4], True]

if 3 in list1:
    list2 = list1[2] * len(list1[2])
    print(list2)

elif [3, 4] in list1:
    print(list1[2][1])

else:
    print(list1[2])
```

A. [3,4,3,4]
B. [3, 4]
C. [4]
✓ D. 4
E. 3
F. [3]

List Methods

A list is mutable and can be changed:

```
myList[0] = 'a'      #index assignment
myList.append(e)     // e: element to append
myList.extend(L)     // L: a list
myList.pop(i)        // i: index (default: -1)
myList.insert(i,e)
myList.remove(e)
myList.sort()
myList.reverse()
```

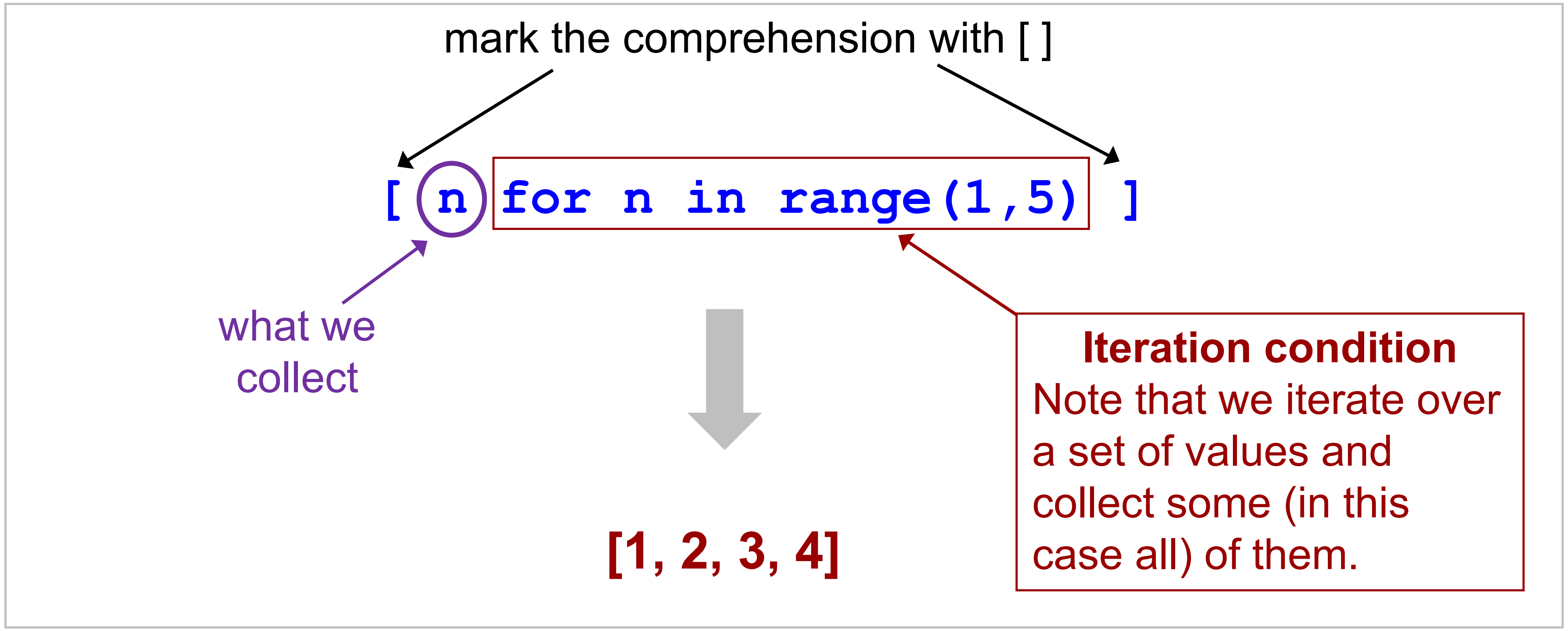
Q6: What is the output of the following Python program?

```python
list1 = ['d', 'c']
list2 = ['a', 'b’]

list1.reverse()
list2.reverse()

list3 = list1.extend(list2)

print(list3)
```

A. [‘c’,’d’]
B. [‘b’,’a’]
C. [‘d’,’c’,’a’,’b’]
D. [‘a’,’b’,’c’,’d’]
E. [‘c’,’d’,’b’,’a’]
✓ F. None

List Comprehension

List comprehension: syntactic structure for concise construction of lists



```
[ n for n in range(1,5) ]
```

[1, 2, 3, 4]

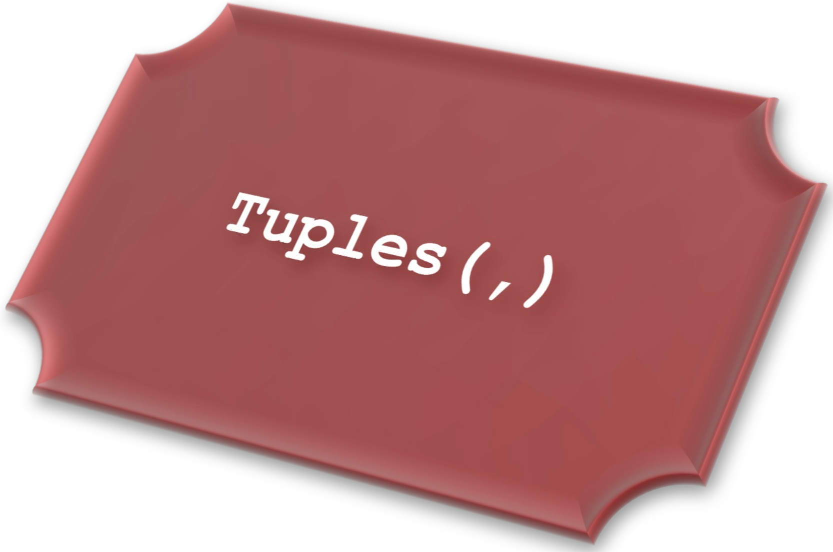
Iteration condition
Note that we iterate over a set of values and collect some (in this case all) of them.

Q7: What is the output of the following Python program?

```
list1 = ['d', 'c', 'A', 3]
list2 = ['A', 'b', '3']

result = [item for item in list1 if item in list2]

print(result)
```

A. [‘3’]
B. ‘A’
C. [3]
[✓ D. [‘A’]]
E. [‘A’,3]
F. []

Python Tuples



Tuples

Tuples (,)

Tuples are **immutable** lists.

Why Immutable Lists?

- Provides a data structure with some integrity and some permanency
- To avoid accidentally changing one

They are designated with `(,)`.

Example:

```
myTuple = (1, 'a', 3.14, True)
```

Lists vs. Tuples

Everything that works for a list works for a tuple **except** methods that modify the tuple.

What works?

- **indexing**
- **slicing**
- `len()`
- `print()`

What doesn't work?

Mutable methods

- `append()`
- `extend()`
- `remove(), etc.`

Q8: What is the output of the following Python program?

```python
myTuple = (4, 2, 3, [6, 5])

myTuple[0] = 7

print(myTuple)
```

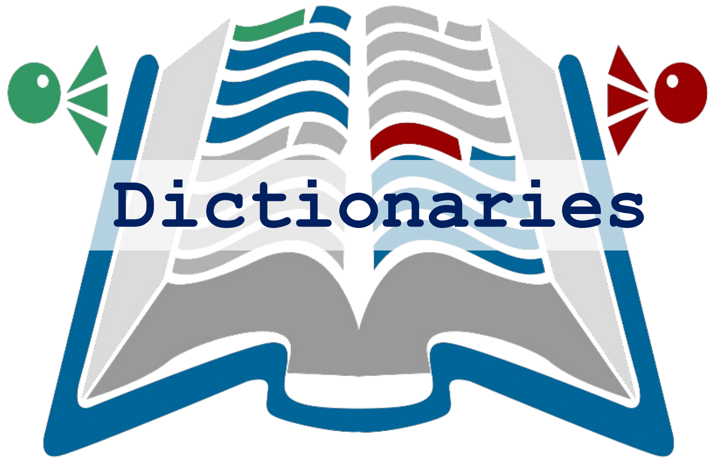
A. (4,2,3,[6,5])
B. [7,2,3,[6,5]]
C. []
[✓ D. Error]

Q9: What is the output of the following Python program?

```
tuple1 = (3, 2, 6, ['a', 'b’])

tuple2 = tuple1[::-2]

print(tuple2[0][0])
```

A. ([‘a’,’b’], 2)
[✓ B. ‘a’]
C. ‘b’
D. 3
E. Error

Python Dictionary



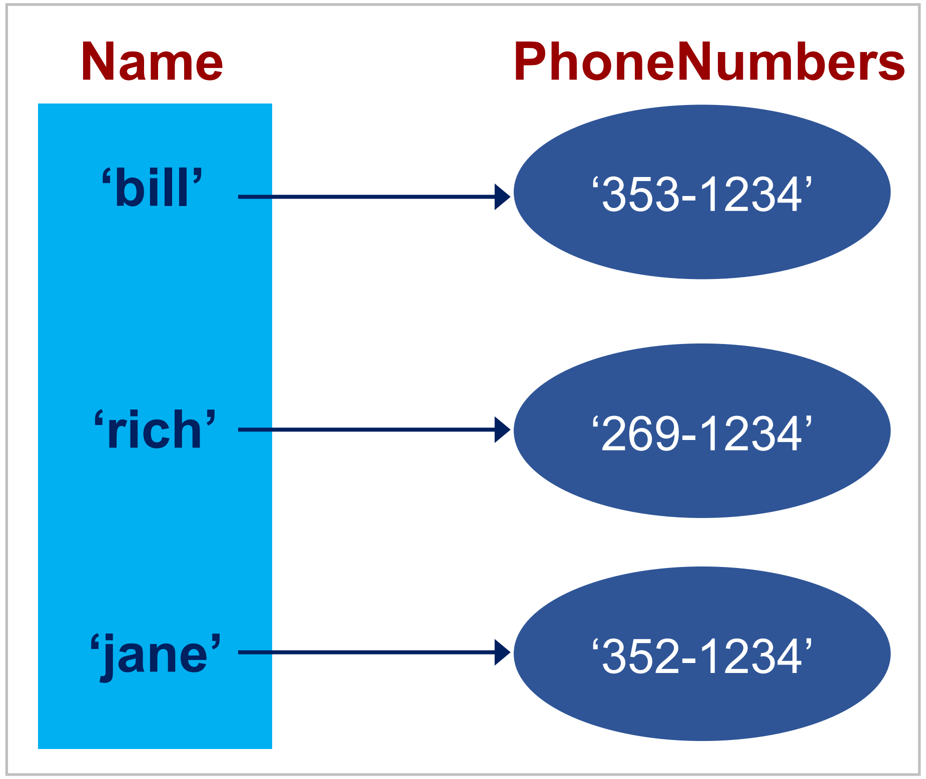
Python Dictionary

{ } marker: used to create a dictionary

: marker: used to create **key:value** pairs

```
contacts = {'bill': '353-1234',
            'rich': '269-1234',
            'jane': '352-1234'}

print(contacts)
```

```
{'jane': '352-1234',
 'bill': '353-1234',
 'rich': '269-1234'}
```

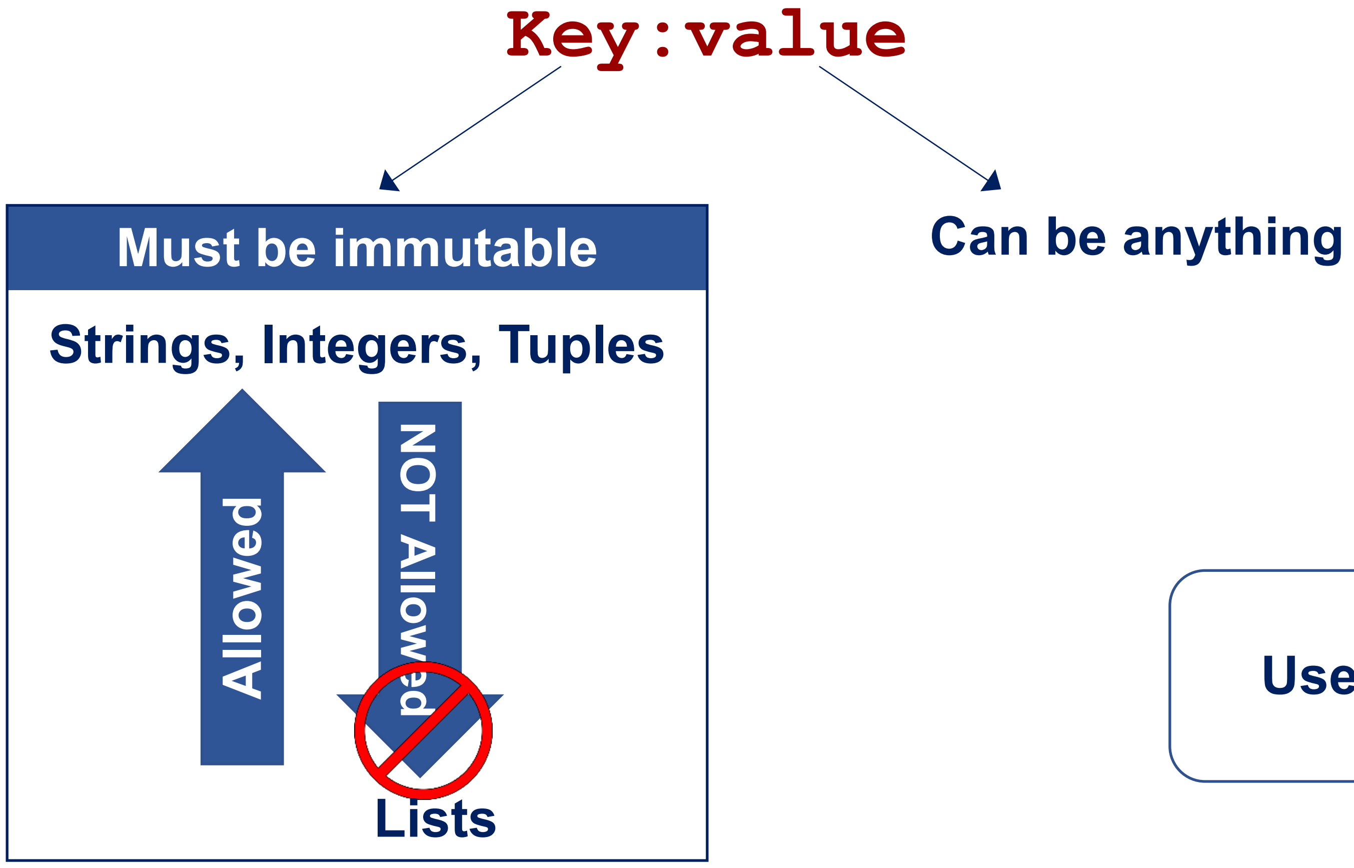


Q10: What is the output of the following Python program?

```
contacts = {
    'bill': '353-1234’,
    'rich': '269-1234’,
    'jane': '352-1234'
}

print(len(contacts))
```

[✓ A. 3]
B. 6
C. Error

What are Keys and Values?



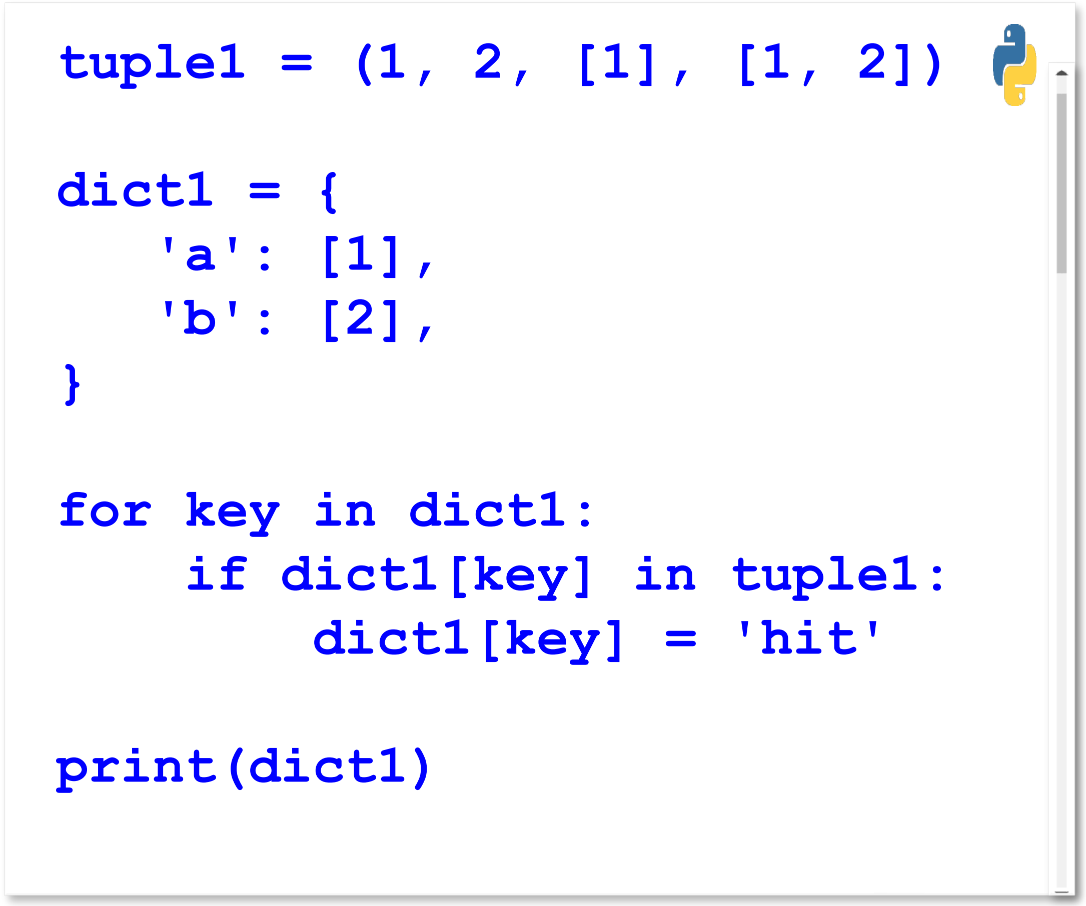
Use **Keys** to access the values

Q11: What is the output of the following Python program?

```
contacts = {
    ['Bill', 'Male']: '353-1234’,
    ['Rich', 'Male']: '269-1234’,
    ['Jane', 'Femal']: '352-1234'
}

print(len(contacts))
```

A. 3
B. 6
[✓ C. Error]

Q12: What is the output of the following Python program?



```python
tuple1 = (1, 2, [1], [1, 2])

dict1 = {
    'a': [1],
    'b': [2],
}

for key in dict1:
    if dict1[key] in tuple1:
        dict1[key] = 'hit'

print(dict1)
```

A. {‘a’:[1], ‘b’:[2]}
B. {‘a’:’hit’, ‘b’:’hit’}
C. {‘hit’:[1], ‘hit’:[2]}
D. {‘hit’:[1], ‘b’:[2]}
[✓ E. {‘a’:’hit’, ‘b’:[2]}]
F. Error

Methods on Dictionaries

`myDict.items()` → return all the **key:value** pairs

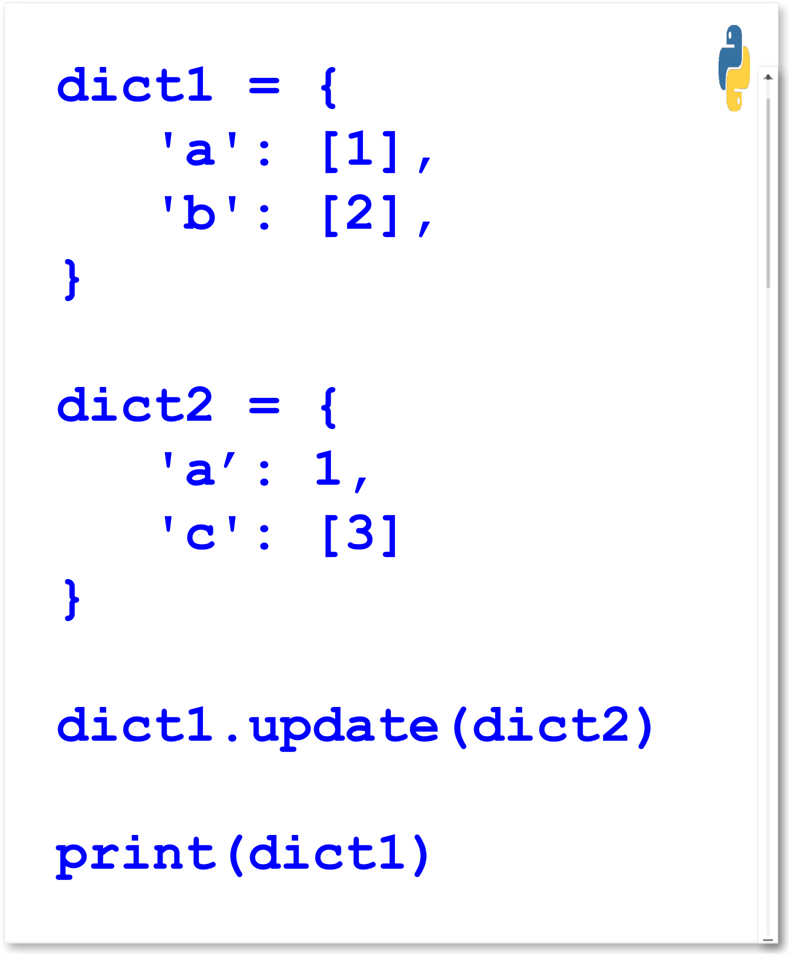
`myDict.keys()` → return all the keys

`myDict.values()` → return all the values

`myDict.clear()` → empty the dictionary

`myDict.update(yourDict)` → for each key in `yourDict`, update `myDict` with that **key:value** pair

Q13: What is the output of the following Python program?



```python
dict1 = {
    'a': [1],
    'b': [2],
}

dict2 = {
    'a′: 1,
    'c': [3]
}

dict1.update(dict2)

print(dict1)
```

A. {‘a’:[1], ‘b’:[2]}
B. {‘c’:[3]}
C. {‘a’:[1], ‘b’:[2], ‘c’:[1]}
D. {‘a’:[1], ‘b’:[2], ‘c’:[3]}
[✓ E. {‘a’: 1, ‘b’:[2], ‘c’:[3]}]
F. Error