Algorithm

Insertion Sort

Example | Visual

Insertion Sort

```
["Python", "Java", "JavaScript", "C"]
```

Insertion Sort

```
["Python", "Java", "JavaScript", "C"]
```

elem_selected: “Java”

Insertion Sort

"Java" < "Python"? Yes!

```
["Python", "Java", "JavaScript", "C"]
```

elem_selected: "Java"

Insertion Sort

```
[      ?      , "Python", "JavaScript", "C"]
```

elem_selected: “Java”

Insertion Sort

```
["Java", "Python", "JavaScript", "C"]
```

Insertion Sort

```
["Java", "Python", "JavaScript", "C"]
```

elem_selected: “JavaScript”

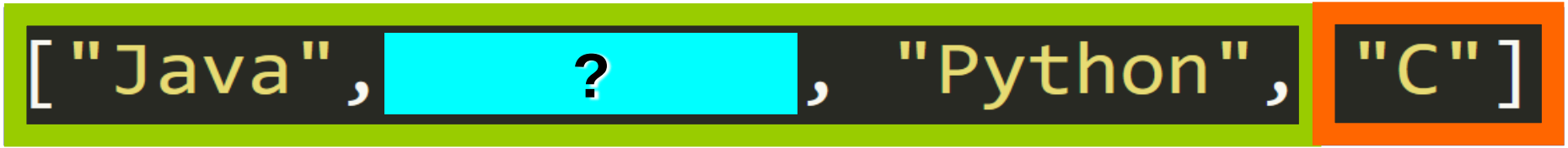
Insertion Sort

“JavaScript” < “Python”? Yes!

```
["Java", "Python", "JavaScript", "C"]
```

elem_selected: “JavaScript”

Insertion Sort



elem_selected: “JavaScript”

Insertion Sort

"JavaScript" < "Java"? No!

```
["Java",  ?  , "Python", "C"]
```

elem_selected: "JavaScript"

Insertion Sort

```
["Java", "JavaScript", "Python", "C"]
```

Insertion Sort

```
["Java", "JavaScript", "Python", "C"]
```

elem_selected: “C”

Insertion Sort

“C” < “Python”? Yes!

```
["Java", "JavaScript", "Python", "C"]
```

elem_selected: “C”

Insertion Sort

```
["Java", "JavaScript",      ?      , "Python"]
```

elem_selected: “C”

Insertion Sort

“C” < “JavaScript”? Yes!

```
["Java", "JavaScript",    ?    , "Python"]
```

elem_selected: “C”

Insertion Sort

```
["Java",      ?      , "JavaScript", "Python"]
```

elem_selected: “C”

Insertion Sort

"C" < "Java"? Yes!

```
["Java",  ?  , "JavaScript", "Python"]
```

elem_selected: "C"

Insertion Sort

```
[   ?   , "Java", "JavaScript", "Python"]
```

elem_selected: “C”

Insertion Sort

```
["C", "Java", "JavaScript", "Python"]
```

Insertion Sort

```
["C", "Java", "JavaScript", "Python"]
```

Sorted!

To the Code!

Algorithm

Insertion Sort

Example | Code

["Python", "Java", "JavaScript", "C"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

```
==========> Starting Insertion Sort

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: ['Python']
Unsorted portion: ['Java', 'JavaScript', 'C']

We need to find the correct spot for: Java.
Java is the first element in the unsorted portion.
Now let's compare Java with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected Java smaller than Python?
Yes, it is! So we need to move Python to the right to make room for Java
Moving Python from index 0 to index 1 (see below)
Old list: ['Python', 'Java', 'JavaScript', 'C']
New list: ['Python', 'Python', 'JavaScript', 'C']
See how Python is now at index 1

Bingo!
We've found the right location for Java: index 0
The list is now: ['Java', 'Python', 'JavaScript', 'C']
```

["Python", "Java", "JavaScript", "C"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “Java”

```
==========> Starting Insertion Sort

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: ['Python']
Unsorted portion: ['Java', 'JavaScript', 'C']

We need to find the correct spot for: Java.
Java is the first element in the unsorted portion.
Now let's compare Java with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected Java smaller than Python?
Yes, it is! So we need to move Python to the right to make room for Java
Moving Python from index 0 to index 1 (see below)
Old list: ['Python', 'Java', 'JavaScript', 'C']
New list: ['Python', 'Python', 'JavaScript', 'C']
See how Python is now at index 1

Bingo!
We've found the right location for Java: index 0
The list is now: ['Java', 'Python', 'JavaScript', 'C']
```

[? , "Python", "JavaScript", "C"]

```
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “Java”

```
==========> Starting Insertion Sort

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: ['Python']
Unsorted portion: ['Java', 'JavaScript', 'C']

We need to find the correct spot for: Java.
Java is the first element in the unsorted portion.
Now let's compare Java with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected Java smaller than Python?
Yes, it is! So we need to move Python to the right to make room for Java
Moving Python from index 0 to index 1 (see below)
Old list: ['Python', 'Java', 'JavaScript', 'C']
New list: ['Python', 'Python', 'JavaScript', 'C']
See how Python is now at index 1

Bingo!
We've found the right location for Java: index 0
The list is now: ['Java', 'Python', 'JavaScript', 'C']
```

["Java", "Python", "JavaScript", "C"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

```
==========> Starting Insertion Sort

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: ['Python']
Unsorted portion: ['Java', 'JavaScript', 'C']

We need to find the correct spot for: Java.
Java is the first element in the unsorted portion.
Now let's compare Java with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected Java smaller than Python?
Yes, it is! So we need to move Python to the right to make room for Java
Moving Python from index 0 to index 1 (see below)
Old list: ['Python', 'Java', 'JavaScript', 'C']
New list: ['Python', 'Python', 'JavaScript', 'C']
See how Python is now at index 1

Bingo!
We've found the right location for Java: index 0
The list is now: ['Java', 'Python', 'JavaScript', 'C']
```

["Java", "Python", "JavaScript", "C"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “JavaScript”

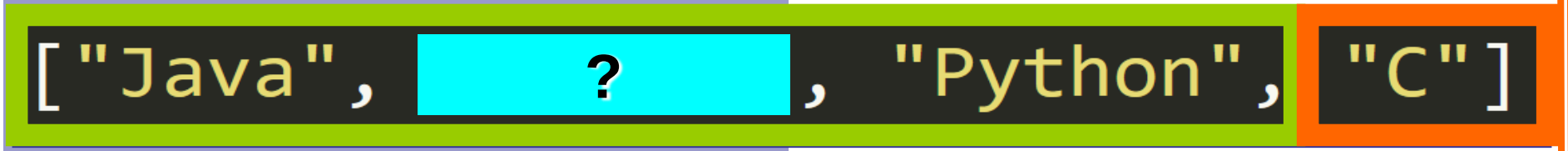
```
---> Outer loop. Iteration #2 (i = 2)
Sorted portion: ['Java', 'Python']
Unsorted portion: ['JavaScript', 'C']

We need to find the correct spot for: JavaScript.
JavaScript is the first element in the unsorted portion.
Now let's compare JavaScript with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected JavaScript smaller than Python?
Yes, it is! So we need to move Python to the right to make room for JavaScript
Moving Python from index 1 to index 2 (see below)
Old list: ['Java', 'Python', 'JavaScript', 'C']
New list: ['Java', 'Python', 'Python', 'C']
See how Python is now at index 2

Is the element selected (JavaScript) smaller than Java?
No, it isn't! We need to stay where we are, at index 1.
The element JavaScript should be there.

Bingo!
We've found the right location for JavaScript: index 1
The list is now: ['Java', 'JavaScript', 'Python', 'C']
```




```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “JavaScript”

```
---> Outer loop. Iteration #2 (i = 2)
Sorted portion: ['Java', 'Python']
Unsorted portion: ['JavaScript', 'C']

We need to find the correct spot for: JavaScript.
JavaScript is the first element in the unsorted portion.
Now let's compare JavaScript with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected JavaScript smaller than Python?
Yes, it is! So we need to move Python to the right to make room for JavaScript
Moving Python from index 1 to index 2 (see below)
Old list: ['Java', 'Python', 'JavaScript', 'C']
New list: ['Java', 'Python', 'Python', 'C']
See how Python is now at index 2

Is the element selected (JavaScript) smaller than Java?
No, it isn't! We need to stay where we are, at index 1.
The element JavaScript should be there.

Bingo!
We've found the right location for JavaScript: index 1
The list is now: ['Java', 'JavaScript', 'Python', 'C']
```

["Java", "JavaScript", "Python" "C"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

```
---> Outer loop. Iteration #2 (i = 2)
Sorted portion: ['Java', 'Python']
Unsorted portion: ['JavaScript', 'C']

We need to find the correct spot for: JavaScript.
JavaScript is the first element in the unsorted portion.
Now let's compare JavaScript with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected JavaScript smaller than Python?
Yes, it is! So we need to move Python to the right to make room for JavaScript
Moving Python from index 1 to index 2 (see below)
Old list: ['Java', 'Python', 'JavaScript', 'C']
New list: ['Java', 'Python', 'Python', 'C']
See how Python is now at index 2

Is the element selected (JavaScript) smaller than Java?
No, it isn't! We need to stay where we are, at index 1.
The element JavaScript should be there.

Bingo!
We've found the right location for JavaScript: index 1
The list is now: ['Java', 'JavaScript', 'Python', 'C']
```

["Java", "JavaScript", "Python" "C"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “C”

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: ['Java', 'JavaScript', 'Python']
Unsorted portion: ['C']

We need to find the correct spot for: C.
C is the first element in the unsorted portion.
Now let's compare C with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected C smaller than Python?
Yes, it is! So we need to move Python to the right to make room for C
Moving Python from index 2 to index 3 (see below)
Old list: ['Java', 'JavaScript', 'Python', 'C']
New list: ['Java', 'JavaScript', 'Python', 'Python']
See how Python is now at index 3
```


```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “C”

```
-> Inner loop
Is the element selected C smaller than JavaScript?
Yes, it is! So we need to move JavaScript to the right to make room for C
Moving JavaScript from index 1 to index 2 (see below)
Old list: ['Java', 'JavaScript', 'Python', 'Python']
New list: ['Java', 'JavaScript', 'JavaScript', 'Python']
See how JavaScript is now at index 2

-> Inner loop
Is the element selected C smaller than Java?
Yes, it is! So we need to move Java to the right to make room for C
Moving Java from index 0 to index 1 (see below)
Old list: ['Java', 'JavaScript', 'JavaScript', 'Python']
New list: ['Java', 'Java', 'JavaScript', 'Python']
See how Java is now at index 1

Bingo!
We've found the right location for C: index 0
The list is now: ['C', 'Java', 'JavaScript', 'Python']
The list is now sorted!
```

["Java", ? , "JavaScript", "Python"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “C”

```
-> Inner loop
Is the element selected C smaller than JavaScript?
Yes, it is! So we need to move JavaScript to the right to make room for C
Moving JavaScript from index 1 to index 2 (see below)
Old list: ['Java', 'JavaScript', 'Python', 'Python']
New list: ['Java', 'JavaScript', 'JavaScript', 'Python']
See how JavaScript is now at index 2

-> Inner loop
Is the element selected C smaller than Java?
Yes, it is! So we need to move Java to the right to make room for C
Moving Java from index 0 to index 1 (see below)
Old list: ['Java', 'JavaScript', 'JavaScript', 'Python']
New list: ['Java', 'Java', 'JavaScript', 'Python']
See how Java is now at index 1

Bingo!
We've found the right location for C: index 0
The list is now: ['C', 'Java', 'JavaScript', 'Python']
The list is now sorted!
```

[? , "Java", "JavaScript", "Python"]

```
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: “C”

```
-> Inner loop
Is the element selected C smaller than JavaScript?
Yes, it is! So we need to move JavaScript to the right to make room for C
Moving JavaScript from index 1 to index 2 (see below)
Old list: ['Java', 'JavaScript', 'Python', 'Python']
New list: ['Java', 'JavaScript', 'JavaScript', 'Python']
See how JavaScript is now at index 2

-> Inner loop
Is the element selected C smaller than Java?
Yes, it is! So we need to move Java to the right to make room for C
Moving Java from index 0 to index 1 (see below)
Old list: ['Java', 'JavaScript', 'JavaScript', 'Python']
New list: ['Java', 'Java', 'JavaScript', 'Python']
See how Java is now at index 1

Bingo!
We've found the right location for C: index 0
The list is now: ['C', 'Java', 'JavaScript', 'Python']
The list is now sorted!
```

["C", "Java", "JavaScript", "Python"]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
        elem_selected = lst[i]

        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

```
-> Inner loop
Is the element selected C smaller than JavaScript?
Yes, it is! So we need to move JavaScript to the right to make room for C
Moving JavaScript from index 1 to index 2 (see below)
Old list: ['Java', 'JavaScript', 'Python', 'Python']
New list: ['Java', 'JavaScript', 'JavaScript', 'Python']
See how JavaScript is now at index 2

-> Inner loop
Is the element selected C smaller than Java?
Yes, it is! So we need to move Java to the right to make room for C
Moving Java from index 0 to index 1 (see below)
Old list: ['Java', 'JavaScript', 'JavaScript', 'Python']
New list: ['Java', 'Java', 'JavaScript', 'Python']
See how Java is now at index 1

Bingo!
We've found the right location for C: index 0
The list is now: ['C', 'Java', 'JavaScript', 'Python']
The list is now sorted!
```

Time to Practice!