Algorithm

Insertion Sort

Code Walkthrough

Insertion Sort

```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
```

Insertion Sort

[6, 1, 8, 2, 6]

```python
def insertion_sort(lst):
    for i in range(1, len(lst)):
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        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: [6]
Unsorted portion: [1, 8, 2, 6]

We need to find the correct spot for: 1.
1 is the first element in the unsorted portion.
Now let's compare 1 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 1 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 1
Moving 6 from index 0 to index 1 (see below)
Old list: [6, 1, 8, 2, 6]
New list: [6, 6, 8, 2, 6]
See how 6 is now at index 1

Bingo!
We've found the right location for 1: index 0
The list is now: [1, 6, 8, 2, 6]
```

[6, 1, 8, 2, 6]

```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: 1

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

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: [6]
Unsorted portion: [1, 8, 2, 6]

We need to find the correct spot for: 1.
1 is the first element in the unsorted portion.
Now let's compare 1 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 1 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 1
Moving 6 from index 0 to index 1 (see below)
Old list: [6, 1, 8, 2, 6]
New list: [6, 6, 8, 2, 6]
See how 6 is now at index 1

Bingo!
We've found the right location for 1: index 0
The list is now: [1, 6, 8, 2, 6]
```


```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: 1

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

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: [6]
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Yes, it is! So we need to move 6 to the right to make room for 1
Moving 6 from index 0 to index 1 (see below)
Old list: [6, 1, 8, 2, 6]
New list: [6, 6, 8, 2, 6]
See how 6 is now at index 1

Bingo!
We've found the right location for 1: index 0
The list is now: [1, 6, 8, 2, 6]
```

[6, 1, 8, 2, 6]

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def insertion_sort(lst):
    for i in range(1, len(lst)):
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        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: 1

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

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Sorted portion: [6]
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-> Inner loop
Is the element selected 1 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 1
Moving 6 from index 0 to index 1 (see below)
Old list: [6, 1, 8, 2, 6]
New list: [6, 6, 8, 2, 6]
See how 6 is now at index 1

Bingo!
We've found the right location for 1: index 0
The list is now: [1, 6, 8, 2, 6]
```

[?, 6, 8, 2, 6]

```
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: 1

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

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: [6]
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-> Inner loop
Is the element selected 1 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 1
Moving 6 from index 0 to index 1 (see below)
Old list: [6, 1, 8, 2, 6]
New list: [6, 6, 8, 2, 6]
See how 6 is now at index 1

Bingo!
We've found the right location for 1: index 0
The list is now: [1, 6, 8, 2, 6]
```

[1, 6, 8, 2, 6]

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

        lst[i] = elem_selected
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```
==========> Starting Insertion Sort

---> Outer loop. Iteration #1 (i = 1)
Sorted portion: [6]
Unsorted portion: [1, 8, 2, 6]

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Moving 6 from index 0 to index 1 (see below)
Old list: [6, 1, 8, 2, 6]
New list: [6, 6, 8, 2, 6]
See how 6 is now at index 1

Bingo!
We've found the right location for 1: index 0
The list is now: [1, 6, 8, 2, 6]
```

[1, 6, 8, 2, 6]

```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: 8

```
---> Outer loop. Iteration #2 (i = 2)
Sorted portion: [1, 6]
Unsorted portion: [8, 2, 6]

We need to find the correct spot for: 8.
8 is the first element in the unsorted portion.
Now let's compare 8 with the elements of the sorted portion.
Let's find where it belongs...

Is the element selected (8) smaller than 6?
No, it isn't! We need to stay where we are, at index 2.
The element 8 should be there.

Bingo!
We've found the right location for 8: index 2
The list is now: [1, 6, 8, 2, 6]
```


```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: 8

```
---> Outer loop. Iteration #2 (i = 2)
Sorted portion: [1, 6]
Unsorted portion: [8, 2, 6]

We need to find the correct spot for: 8.
8 is the first element in the unsorted portion.
Now let's compare 8 with the elements of the sorted portion.
Let's find where it belongs...

Is the element selected (8) smaller than 6?
No, it isn't! We need to stay where we are, at index 2.
The element 8 should be there.

Bingo!
We've found the right location for 8: index 2
The list is now: [1, 6, 8, 2, 6]
```

[1, 6, 8, 2, 6]

```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: 8

```
---> Outer loop. Iteration #2 (i = 2)
Sorted portion: [1, 6]
Unsorted portion: [8, 2, 6]

We need to find the correct spot for: 8.
8 is the first element in the unsorted portion.
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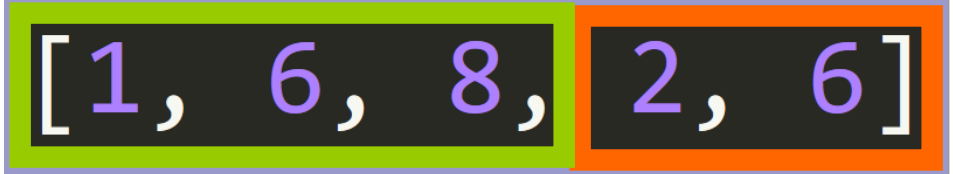
Is the element selected (8) smaller than 6?
No, it isn't! We need to stay where we are, at index 2.
The element 8 should be there.

Bingo!
We've found the right location for 8: index 2
The list is now: [1, 6, 8, 2, 6]
```

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

        lst[i] = elem_selected
```

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: [1, 6, 8]
Unsorted portion: [2, 6]

We need to find the correct spot for: 2.
2 is the first element in the unsorted portion.
Now let's compare 2 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 2 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 2
Moving 8 from index 2 to index 3 (see below)
Old list: [1, 6, 8, 2, 6]
New list: [1, 6, 8, 8, 6]
See how 8 is now at index 3

-> Inner loop
Is the element selected 2 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 2
Moving 6 from index 1 to index 2 (see below)
Old list: [1, 6, 8, 8, 6]
New list: [1, 6, 6, 8, 6]
See how 6 is now at index 2

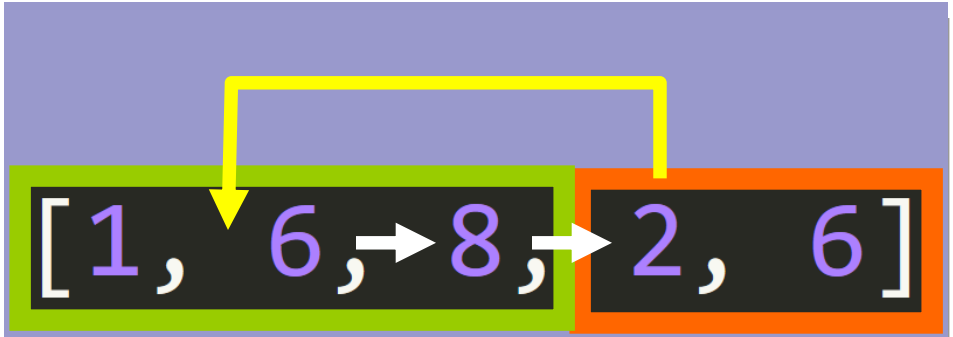
Is the element selected (2) smaller than 1?
No, it isn't! We need to stay where we are, at index 1.
The element 2 should be there.

Bingo!
We've found the right location for 2: index 1
The list is now: [1, 2, 6, 8, 6]
```


```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: 2

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: [1, 6, 8]
Unsorted portion: [2, 6]

We need to find the correct spot for: 2.
2 is the first element in the unsorted portion.
Now let's compare 2 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 2 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 2
Moving 8 from index 2 to index 3 (see below)
Old list: [1, 6, 8, 2, 6]
New list: [1, 6, 8, 8, 6]
See how 8 is now at index 3

-> Inner loop
Is the element selected 2 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 2
Moving 6 from index 1 to index 2 (see below)
Old list: [1, 6, 8, 8, 6]
New list: [1, 6, 6, 8, 6]
See how 6 is now at index 2

Is the element selected (2) smaller than 1?
No, it isn't! We need to stay where we are, at index 1.
The element 2 should be there.

Bingo!
We've found the right location for 2: index 1
The list is now: [1, 2, 6, 8, 6]
```

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            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: 2

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: [1, 6, 8]
Unsorted portion: [2, 6]

We need to find the correct spot for: 2.
2 is the first element in the unsorted portion.
Now let's compare 2 with the elements of the sorted portion.
Let's find where it belongs...

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Is the element selected 2 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 2
Moving 8 from index 2 to index 3 (see below)
Old list: [1, 6, 8, 2, 6]
New list: [1, 6, 8, 8, 6]
See how 8 is now at index 3

-> Inner loop
Is the element selected 2 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 2
Moving 6 from index 1 to index 2 (see below)
Old list: [1, 6, 8, 8, 6]
New list: [1, 6, 6, 8, 6]
See how 6 is now at index 2

Is the element selected (2) smaller than 1?
No, it isn't! We need to stay where we are, at index 1.
The element 2 should be there.

Bingo!
We've found the right location for 2: index 1
The list is now: [1, 2, 6, 8, 6]
```

[1, 6, 8, 2, 6]

```
def insertion_sort(lst):
    for i in range(1, len(lst)):
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        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: 2

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: [1, 6, 8]
Unsorted portion: [2, 6]

We need to find the correct spot for: 2.
2 is the first element in the unsorted portion.
Now let's compare 2 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 2 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 2
Moving 8 from index 2 to index 3 (see below)
Old list: [1, 6, 8, 2, 6]
New list: [1, 6, 8, 8, 6]
See how 8 is now at index 3

-> Inner loop
Is the element selected 2 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 2
Moving 6 from index 1 to index 2 (see below)
Old list: [1, 6, 8, 8, 6]
New list: [1, 6, 6, 8, 6]
See how 6 is now at index 2

Is the element selected (2) smaller than 1?
No, it isn't! We need to stay where we are, at index 1.
The element 2 should be there.

Bingo!
We've found the right location for 2: index 1
The list is now: [1, 2, 6, 8, 6]
```

[1, 6, ?, 8, 6]

```
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: 2

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: [1, 6, 8]
Unsorted portion: [2, 6]

We need to find the correct spot for: 2.
2 is the first element in the unsorted portion.
Now let's compare 2 with the elements of the sorted portion.
Let's find where it belongs...

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Yes, it is! So we need to move 8 to the right to make room for 2
Moving 8 from index 2 to index 3 (see below)
Old list: [1, 6, 8, 2, 6]
New list: [1, 6, 8, 8, 6]
See how 8 is now at index 3

-> Inner loop
Is the element selected 2 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 2
Moving 6 from index 1 to index 2 (see below)
Old list: [1, 6, 8, 8, 6]
New list: [1, 6, 6, 8, 6]
See how 6 is now at index 2

Is the element selected (2) smaller than 1?
No, it isn't! We need to stay where we are, at index 1.
The element 2 should be there.

Bingo!
We've found the right location for 2: index 1
The list is now: [1, 2, 6, 8, 6]
```

[1, ?, 6, 8, 6]

```
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: 2

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: [1, 6, 8]
Unsorted portion: [2, 6]

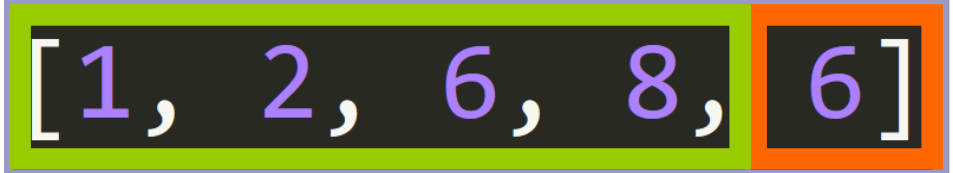
We need to find the correct spot for: 2.
2 is the first element in the unsorted portion.
Now let's compare 2 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 2 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 2
Moving 8 from index 2 to index 3 (see below)
Old list: [1, 6, 8, 2, 6]
New list: [1, 6, 8, 8, 6]
See how 8 is now at index 3

-> Inner loop
Is the element selected 2 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 2
Moving 6 from index 1 to index 2 (see below)
Old list: [1, 6, 8, 8, 6]
New list: [1, 6, 6, 8, 6]
See how 6 is now at index 2

Is the element selected (2) smaller than 1?
No, it isn't! We need to stay where we are, at index 1.
The element 2 should be there.

Bingo!
We've found the right location for 2: index 1
The list is now: [1, 2, 6, 8, 6]
```

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            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

```
---> Outer loop. Iteration #3 (i = 3)
Sorted portion: [1, 6, 8]
Unsorted portion: [2, 6]

We need to find the correct spot for: 2.
2 is the first element in the unsorted portion.
Now let's compare 2 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 2 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 2
Moving 8 from index 2 to index 3 (see below)
Old list: [1, 6, 8, 2, 6]
New list: [1, 6, 8, 8, 6]
See how 8 is now at index 3

-> Inner loop
Is the element selected 2 smaller than 6?
Yes, it is! So we need to move 6 to the right to make room for 2
Moving 6 from index 1 to index 2 (see below)
Old list: [1, 6, 8, 8, 6]
New list: [1, 6, 6, 8, 6]
See how 6 is now at index 2

Is the element selected (2) smaller than 1?
No, it isn't! We need to stay where we are, at index 1.
The element 2 should be there.

Bingo!
We've found the right location for 2: index 1
The list is now: [1, 2, 6, 8, 6]
```

[1, 2, 6, 8, 6]

```
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: 6

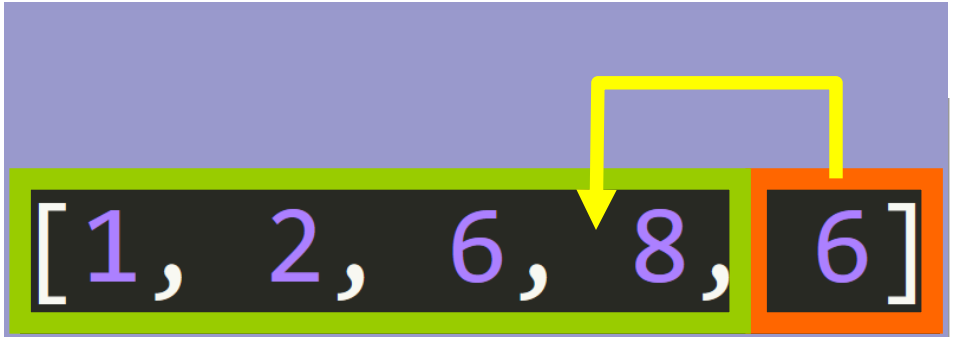
```
---> Outer loop. Iteration #4 (i = 4)
Sorted portion: [1, 2, 6, 8]
Unsorted portion: [6]

We need to find the correct spot for: 6.
6 is the first element in the unsorted portion.
Now let's compare 6 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 6 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 6
Moving 8 from index 3 to index 4 (see below)
Old list: [1, 2, 6, 8, 6]
New list: [1, 2, 6, 8, 8]
See how 8 is now at index 4

Is the element selected (6) smaller than 6?
No, it isn't! We need to stay where we are, at index 3.
The element 6 should be there.

Bingo!
We've found the right location for 6: index 3
The list is now: [1, 2, 6, 6, 8]
```

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

        lst[i] = elem_selected
```

elem_selected: 6

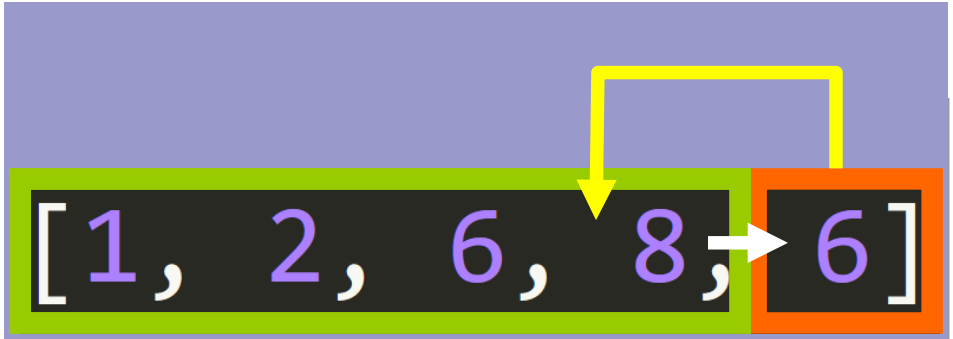
```
---> Outer loop. Iteration #4 (i = 4)
Sorted portion: [1, 2, 6, 8]
Unsorted portion: [6]

We need to find the correct spot for: 6.
6 is the first element in the unsorted portion.
Now let's compare 6 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 6 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 6
Moving 8 from index 3 to index 4 (see below)
Old list: [1, 2, 6, 8, 6]
New list: [1, 2, 6, 8, 8]
See how 8 is now at index 4

Is the element selected (6) smaller than 6?
No, it isn't! We need to stay where we are, at index 3.
The element 6 should be there.

Bingo!
We've found the right location for 6: index 3
The list is now: [1, 2, 6, 6, 8]
```

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def insertion_sort(lst):
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        while i > 0 and elem_selected < lst[i-1]:
            lst[i] = lst[i-1]
            i -= 1

        lst[i] = elem_selected
```

elem_selected: 6

```
---> Outer loop. Iteration #4 (i = 4)
Sorted portion: [1, 2, 6, 8]
Unsorted portion: [6]

We need to find the correct spot for: 6.
6 is the first element in the unsorted portion.
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-> Inner loop
Is the element selected 6 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 6
Moving 8 from index 3 to index 4 (see below)
Old list: [1, 2, 6, 8, 6]
New list: [1, 2, 6, 8, 8]
See how 8 is now at index 4

Is the element selected (6) smaller than 6?
No, it isn't! We need to stay where we are, at index 3.
The element 6 should be there.

Bingo!
We've found the right location for 6: index 3
The list is now: [1, 2, 6, 6, 8]
```

[1, 2, 6, 8, 6]

```
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: 6

```
---> Outer loop. Iteration #4 (i = 4)
Sorted portion: [1, 2, 6, 8]
Unsorted portion: [6]

We need to find the correct spot for: 6.
6 is the first element in the unsorted portion.
Now let's compare 6 with the elements of the sorted portion.
Let's find where it belongs...

-> Inner loop
Is the element selected 6 smaller than 8?
Yes, it is! So we need to move 8 to the right to make room for 6
Moving 8 from index 3 to index 4 (see below)
Old list: [1, 2, 6, 8, 6]
New list: [1, 2, 6, 8, 8]
See how 8 is now at index 4

Is the element selected (6) smaller than 6?
No, it isn't! We need to stay where we are, at index 3.
The element 6 should be there.

Bingo!
We've found the right location for 6: index 3
The list is now: [1, 2, 6, 6, 8]
```

[1, 2, 6, ?, 8]

```
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: 6

```
---> Outer loop. Iteration #4 (i = 4)
Sorted portion: [1, 2, 6, 8]
Unsorted portion: [6]

We need to find the correct spot for: 6.
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The list is now: [1, 2, 6, 6, 8]
```

```
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```

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```
---> Outer loop. Iteration #4 (i = 4)
Sorted portion: [1, 2, 6, 8]
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The element 6 should be there.

Bingo!
We've found the right location for 6: index 3
The list is now: [1, 2, 6, 6, 8]
```

Time to Practice!