

The screenshot shows a Python IDE with a file explorer on the left listing several quiz files. The main editor displays a Python script for bubble sort. The script defines a function `bubble_sort(arr)` and calls it within a `if __name__ == '__main__':` block. The array `arr` is initialized with the values `[2, 4, 2, 1, 7, 5, -1, 0]`. The output of the program is shown in the Run console, displaying the sorted array `[-1, 0, 1, 2, 2, 4, 5, 7]`.

```
14 if __name__ == '__main__':
15     arr=[2,4,2,1,7,5,-1,0]
16     print(bubble_sort(arr))

if __name__ == '__main__':
```

Run: Quiz 12 (April 15, 2021) ×

```
E:\Anaconda3\python.exe "D:/Code/Algorithm/Quiz 12 (April 15, 2021).py"
[-1, 0, 1, 2, 2, 4, 5, 7]

Process finished with exit code 0
```

Analysis:

Bubble sort: $W(n)=(n-1)(n-1) \in O(n^2)$

Insertion sort: $T(n)=n^2/2 \in O(n^2)$

Exchange sort: $W(n)=n^2/2 \in O(n^2)$

Selection sort: $T(n)=n^2/2 \in O(n^2)$

So the upper bound of these four sorting algorithms are the same.