Exercise: Quadratic Sorting Algorithms

Exercise A. Show the contents of the array after the **fourth iteration of the outer loop** for (i) Bubble Sort, (ii) Selection Sort, and (iii) Insertion Sort.

i. Bubble sort
ii. Selection sort
iii. Insertion Sort

43	7	10	23	18	4	19	5	66	14
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

Answer

i. Bubble sort

43	7	10	23	18	4	19	5	66	14	
7	43									Compared and swapped
	10	43								Compared and swapped
		23	43							Compared and swapped
			18	43						Compared and swapped
				4	43					Compared and swapped
					19	43				Compared and swapped
						5	43			Compared and swapped
							43	66		Compared, NOT swapped
								14	66	Compared and swapped
7	10	23	18	4	19	5	43	14	**66**	End 1st iteration
7	10									Compared, NOT swapped
	10	23								Compared, NOT swapped
		18	23							Compared and swapped
			4	23						Compared and swapped
				19	23					Compared and swapped
					5	23				Compared and swapped
						23	43			Compared, NOT swapped
							14	43		Compared and swapped
7	10	18	4	19	5	23	14	**43**	**66**	End 2nd iteration
7	10									Compared, NOT swapped
	10	18								Compared, NOT swapped
		4	18							Compared and swapped
			18	19						Compared, NOT swapped
				5	19					Compared and swapped
					19	23				Compared, NOT swapped
						14	23			Compared, NOT swapped
7	10	4	18	5	19	14	**23**	**43**	**66**	End 3rd iteration
7	10									Compared, NOT swapped
	4	10								Compared and swapped
		10	18							Compared, NOT swapped
			5	18						Compared and swapped
				18	19					Compared, NOT swapped
					14	19				Compared and swapped
7	4	10	5	18	14	**19**	**23**	**43**	**66**	End 4th iteration

ii. Selection sort

43	7	10	23	18	4	19	5	66	14	
43	7	10	23	18	4	19	5	66	14	Find smallest
4					43					Swap
4	7	10	23	18	43	19	5	66	14	End 1st iteration
	7	10	23	18	43	19	5	66	14	Find smallest
	5						7			Swap
4	5	10	23	18	43	19	7	66	44	End 2nd iteration
		10	23	18	43	19	7	66	44	Find smallest
		7					10			Swap
4	5	7	23	18	43	19	10	66	44	End 3rd iteration
			23	18	43	19	10	66	44	Find smallest
			10				23			Swap
4	5	7	10	18	43	19	23	66	14	End 4th iteration

iii. Insertion sort

43	7	10	23	18	4	19	5	66	14	
43	7	10	23	18	4	19	5	66	14	Start with left side sorted
	7									Hold 7,
43		10	23	18	4	19	5	66	14	Compare with 43
	43	10	23	18	4	19	5	66	14	Shift 43
7	43	10	23	18	4	19	5	66	14	Put 7 in place
7	43	10	23	18	4	19	5	66	14	End 1st iteration
		10								Hold 10
7	43									Compare with 43
7		43								Shift 43
7		43								Compare with 7 – no shift
7	10	43	23	18	4	19	5	66	14	Put 10 in place
7	10	43	23	18	4	19	5	66	14	End 2nd iteration
			23							Hold 23
7	10	43		18	4	19	5	66	14	Compare with 43
7	10		43	18	4	19	5	66	14	Shift 43
7	10		43	18	4	19	5	66	14	Compare with 10 – no shift
7	10	23	43	18	4	19	5	66	14	Put 23 in place
7	10	23	43	18	4	19	5	66	14	End 3rd iteration
				18						Hold 18
7	10	23	43		4	19	5	66	14	Compare with 43
7	10	23		43						Shift 43
7	10	23		43						Compare with 23
7	10		23	43						Shift 23
7	10		23	43						Compare with 10 – no shift
7	10	18	23	43						Put 18 in place
7	10	18	23	43						End 4th iteration

Exercise B. A sorting function is called to sort a list of 100 integers that have been read from a file. If all 100 values are zero, what would the running time (in terms of O-notation) for each of the algorithms below?

i. Bubble sort (flagged version) **O(n)**
ii. Selection sort **O(n^2)**
iii. Insertion sort **O(n)**

Exercise C. How many comparisons would be needed to sort an array containing 100 elements using **Selection sort**, if the original array values were already sorted? **4950**

Explanation:

- Go down the list to find the smallest number and swap it with the first element (99 comparisons)
- Do this again but starting from the second index (98 comparisons)
- Do this again but starting from the third index (97 comparisons)
- Do this again until you are left with the last 2 indices (1 comparison)
- So, you have made 99 + 99 + 98 + … + 1 comparisons

$$\frac{n(n+1)}{2} = \frac{99(99+1)}{2} = \frac{99*100}{2} = \frac{9900}{2} = 4950$$