VE281 Writing Assignment Two

Liu Yihao 515370910207

Ex. 1

step	pivot	0	1	2	3	4	5	6	7	8	9	comment
1	5	5	7	4	1	8	9	2	6	3	10	swap arr[0] and pivot
1	5	5	3	4	1	2	9	8	6	7	10	partition
1	5	2	3	4	1	5	9	8	6	7	10	swap arr[0] and partition pos
2	2	2	3	4	1							swap arr[0] and pivot
2	2	2	1	4	3							partition
2	2	1	2	4	3							swap arr[0] and partition pos
3				3	4							insertion sort arr[2],arr[3]
4	8						8	9	6	7	10	swap arr[5] and pivot
4	8						8	7	6	9	10	partition
4	8						6	7	8	9	10	swap arr[5] and partition pos
5							6	7				insertion sort arr[5],arr[6]
6										9	10	insertion sort arr[8],arr[9]

Ex. 2

step	0	1	2	3	4	5	6	7	8	9
1			032 632	943			446 526		538 738	189 479 379
2			526	032 632 538 738	943 446			479 379	189	
3	032	189		379	446 479	526 538	632	738		943

Ex. 3

Similar to the proof in the slides, when $k = n/7$, approx at least $5/7/2 = 5/14$ is smaller than $x_{k/2}$, and at least $5/7/2 = 5/14$ is larger than $x_{k/2}$, so we can find the recurrence relationship

$$T(n) = cn + T\left(\frac{n}{7}\right) + T\left(\frac{9n}{14}\right)$$

Suppose there exists a positive constant c such that

$$T(1) \leqslant c$$

$$T(n) \leqslant cn + T\left(\frac{n}{7}\right) + T\left(\frac{9n}{14}\right)$$

Then

$$T(n) \leqslant 14cn$$

For the base case, obviously $T(1) \leqslant cn \leqslant 14cn$.
For the inductive step,

$$T(n) \leqslant cn + T\left(\frac{n}{7}\right) + T\left(\frac{9n}{14}\right) \leqslant cn + 2cn + 9cn \leqslant 14cn$$

So the runtime of this new algorithm is still $O(n)$.

Ex. 4

(a)

0	1	2	3	4	5	6	7	8	9
	4371		6173 1323	4344					1989 9679 4199

(b)

0	1	2	3	4	5	6	7	8	9
9679	4371	1989	1323	6173	4344				4199

(c)

0	1	2	3	4	5	6	7	8	9
9679	4371		1323	6173	4344			1989	4199

(d)

0	1	2	3	4	5	6	7	8	9
	4371		1323	4344	4199				6173

Then we can find that $(7 - 9679) \equiv 5 \mod 7$, however, slot 9 and 4 on the hashtable are not empty, so this element can't be inserted.

Ex. 5

(a)

0	1	2	3	4	5	6	7	8	9
4199	4371							9679	
10	11	12	13	14	15	16	17	18	
		4344 1323	1989				6173		

(b)

0	1	2	3	4	5	6	7	8	9
4199	4371							9679	
10	11	12	13	14	15	16	17	18	
		1323	1989	4344			6173		

(c)

0	1	2	3	4	5	6	7	8	9
4199	4371							9679	
10	11	12	13	14	15	16	17	18	
		1323	4344	1989			6173		

(d)

0	1	2	3	4	5	6	7	8	9
4199	4371		4344					9679	
10	11	12	13	14	15	16	17	18	
		1323	1989				6173		