

CS202

Section 1

Quiz No. 3: Quicksort

October 9, 2015

Solutions

Q-1) Sort in ascending order, use last element as the pivot (see the algorithm on the last page).

- a) 8 / 7 / 15 / 3 / 42 / 1
- b) 42 / 8 / 15 / 3 / 1 / 7
- c) 1 / 3 / 7 / 8 / 15 / 42

A-1)

a) First partition only:

Index pivot =

Index j =

Pivot = 1

8	7	15	3	42	1
i, j					r

Initial state

8	7	15	3	42	1
i, j					r

1 comparison ($A[j] \leq A[r]$)

8	7	15	3	42	1
i	j				r

1 comparison ($A[j] \leq A[r]$)

8	7	15	3	42	1
i		j			r

1 comparison ($A[j] \leq A[r]$)

8	7	15	3	42	1
i			j		r

1 comparison ($A[j] \leq A[r]$)

8	7	15	3	42	1
i				j	r

1 comparison ($A[j] \leq A[r]$)

1	7	15	3	42	8
i					j, r

1 swap ($A[i] \leftrightarrow A[r]$)

Result:

1	7	15	3	42	8
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Total number of comparisons: 5

Total number of exchanges: 1

b) Entire process

1st partition / Pivot = 7

42	8	15	3	1	7
i			j		r

4 comparison - 1 swap ($A[i] \Leftrightarrow A[j]$)

3	8	15	42	1	7
	i			j	r

1 comparison - 1 swap ($A[i] \Leftrightarrow A[j]$)

3	1	15	42	8	7
		i			j, r

1 swap ($A[i] \Leftrightarrow A[r]$)

3	1	7	42	8	15
---	---	---	----	---	----

2nd partition

Left (p = 0; r = 1) Pivot = 1

3	1	7	42	8	15
i, j	r				

1 comp ($A[j] \leq A[r]$)
 $A[r]$)

1 swap ($A[i] \Leftrightarrow A[j]$)

3	1	7	42	8	15
i	j, r				

1 swap ($A[i] \Leftrightarrow A[j]$)

$A[r]$)

1	3	7	42	8	15
j					

Right (p = 3; r = 5) Pivot = 15

1	3	7	42	8	15
			i	j	r

2 comp ($A[j] \leq$

1	3	7	8	42	15
				i	j, r

1 swap ($A[i] \Leftrightarrow$

1	3	7	8	15	42
				i	

Result:

1	3	7	8	15	42
---	---	---	---	----	----

Total number of comparisons: 8

Total number of exchanges: 6

c) First partition only

1	3	7	8	15	42
i, j					r

1	3	7	8	15	42
i, j					r

1 comparison 1 swap ($A[i] \Leftrightarrow A[j]$)

1	3	7	8	15	42
	i, j				r

1 comparison 1 swap ($A[i] \Leftrightarrow A[j]$)

1	3	7	8	15	42
		i, j			r

1 comparison 1 swap ($A[i] \Leftrightarrow A[j]$)

1	3	7	8	15	42
			i, j		r

1 comparison 1 swap ($A[i] \Leftrightarrow A[j]$)

1	3	7	8	15	42
				i, j	r

1 comparison 1 swap ($A[i] \Leftrightarrow A[j]$)

1	3	7	8	15	42
					i, j, r

1 swap ($A[i] \Leftrightarrow A[r]$)

Result:

1	3	7	8	15	42
---	---	---	---	----	----

```
quicksort(A, lo, hi) // Lomuto Partitioning
```

```
  if lo < hi
```

```
    p = partition(A, lo, hi)
```

```
    quicksort(A, lo, p - 1)
```

```
    quicksort(A, p + 1, hi)
```

```
partition(A, lo, hi)
```

```
  pivot = A[hi]
```

```
  i = lo #place for swapping
```

```
  for j = lo to hi - 1
```

```
    if A[j] <= pivot
```

```
      swap A[i] with A[j]
```

```
      i = i + 1
```

```
  swap A[i] with A[hi]
```

```
  return i
```