Homework 3

Comp 3270

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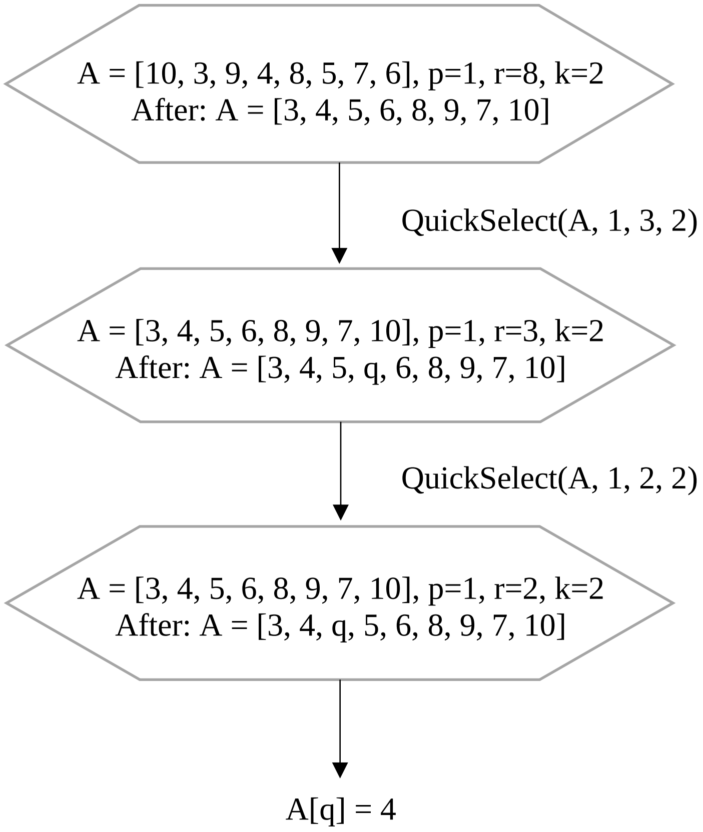
Problem 1.)

A = [6, 8, 6, 10, 12, 9, 15, 13, 14, 19, 18, 17, 16]

Problem 2.)

a.)


A = [10, 3, 9, 4, 8, 5, 7, 6], p=1, r=8, k=2
After: A = [3, 4, 5, 6, 8, 9, 7, 10]
QuickSelect(A, 1, 3, 2)
A = [3, 4, 5, 6, 8, 9, 7, 10], p=1, r=3, k=2
After: A = [3, 4, 5, q, 6, 8, 9, 7, 10]
QuickSelect(A, 1, 2, 2)
A = [3, 4, 5, 6, 8, 9, 7, 10], p=1, r=2, k=2
After: A = [3, 4, q, 5, 6, 8, 9, 7, 10]
A[q] = 4

b.)

- The first base case checks if the starting and ending indexes are the same which would mean the array has only one element.
- If this is the case, then the algorithm will execute the first step: return A[p].
- T(first base case) = **7**
- The second base case checks if the k value is equal to the pivot meaning the kth smallest value would be found.

- If this is the case, then the algorithm will run step 1 but won't return a value then it will continue executing steps 2, 3, 4, and 5.
- T(second base case) = 3 + (20n + 1) + 5 + 7 = **20n + 16 = O(n)**
- If it is not a base case, then the algorithm will run through each step, skipping the return value on step 1 and step 5, then it will either execute steps 6 and 7 or just step 8 depending on the value of k and pivotDistance.
- For the worst case: T(n) = 3 + (20n + 1) + 5 + 3 + 3 + T(n-1)
  = **n[T(n-1) + 20n + 15] = O(n^2)**
- For the best case: T(n) = 3 + (20n + 1) + 5 + 7 = **20n + 16 = O(n)**

Problem 3.)

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
0	0	0	0	0	0	1	1	0	1	1	0	1	1	1	0	1	1	0	1
0	0	0	0	0	0	1	2	2	3	4	4	5	6	7	7	8	9	9	10
0	0	0	0	0	0	0	1	2	2	3	4	4	5	6	7	7	8	9	9

A = [19, 6, 10, 7, 16, 17, 13, 14, 12, 9]

B = [6, 7, 9, 10, 12, 13, 14, 16, 17, 19]

C = [0, 0, 0, 0, 0, 0, 0, 1, 2, 2, 3, 4, 4, 5, 6, 7, 7, 8, 9, 9]

Problem 4.)

- 1st pass:
  3210
  4321
  2345
  4567
  5678

- 2nd pass:
  3210
  4321
  2345
  4567
  5678

- 3rd pass:
  3210
  4321
  2345
  4567
  5678

- 4th pass:
  2345
  3210
  4321
  4567
  5678

Problem 5.)

Bucket0: (0, 0.066)
Bucket1: (0.066, 0.133)
Bucket2: (0.133, 0.200)
Bucket3: (0.200, 0.266)
Bucket4: (0.266, 0.333)
Bucket5: (0.333, 0.400)
Bucket6: (0.400, 0.466)
Bucket7: (0.466, 0.533)
Bucket8: (0.533, 0.600)
Bucket9: (0.600, 0.666)
Bucket10: (0.666, 0.733)
Bucket11: (0.733, 0.800)
Bucket12: (0.800, 0.866)
Bucket13: (0.866, 0.933)
Bucket14: (0.933, 1.000)

Bucket0: **[**0/n, 0 + 1/n**]**
Bucket1: **[**1/n, 1 + 1/n**]**
Bucket(n-2): **[**(n-2)/n, (n-1)/n**]**
Bucket(n-1): **[**(n-1)/n, n/n**]**

Problem 6.)

a. Performed arbitrarily. Make the second tree the child of the root of the first tree.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	1	1	3	3	3	1	1	8	3	3	3	3	0	14	18	16	19	20	1

b. Performed by height. If trees have same height, make the 2nd tree the child of the root of the 1st tree.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3	1	14	3	3	3	1	1	8	3	3	3	3	1	14	1	16	16	16	16

c. Performed by size. If trees have the same size, make the second tree the child of the root of the first tree.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3	1	20	3	3	3	1	1	8	3	3	3	3	3	14	3	16	16	16	16

d. For the solution to part a, perform a find with path compression on the deepest node and show the array P after find finishes.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	1	1	3	3	3	1	1	8	3	3	3	3	0	14	1	1	1	1	1

Problem 7.)

From the provided binomial trees we get:

- ⇨ First tree = 1110 = 14
- ⇨ Second tree = 1010 = 10
- ⇨ Adding these we get 11000 = 24

So, the new binomial queue will have a size of 24 nodes.

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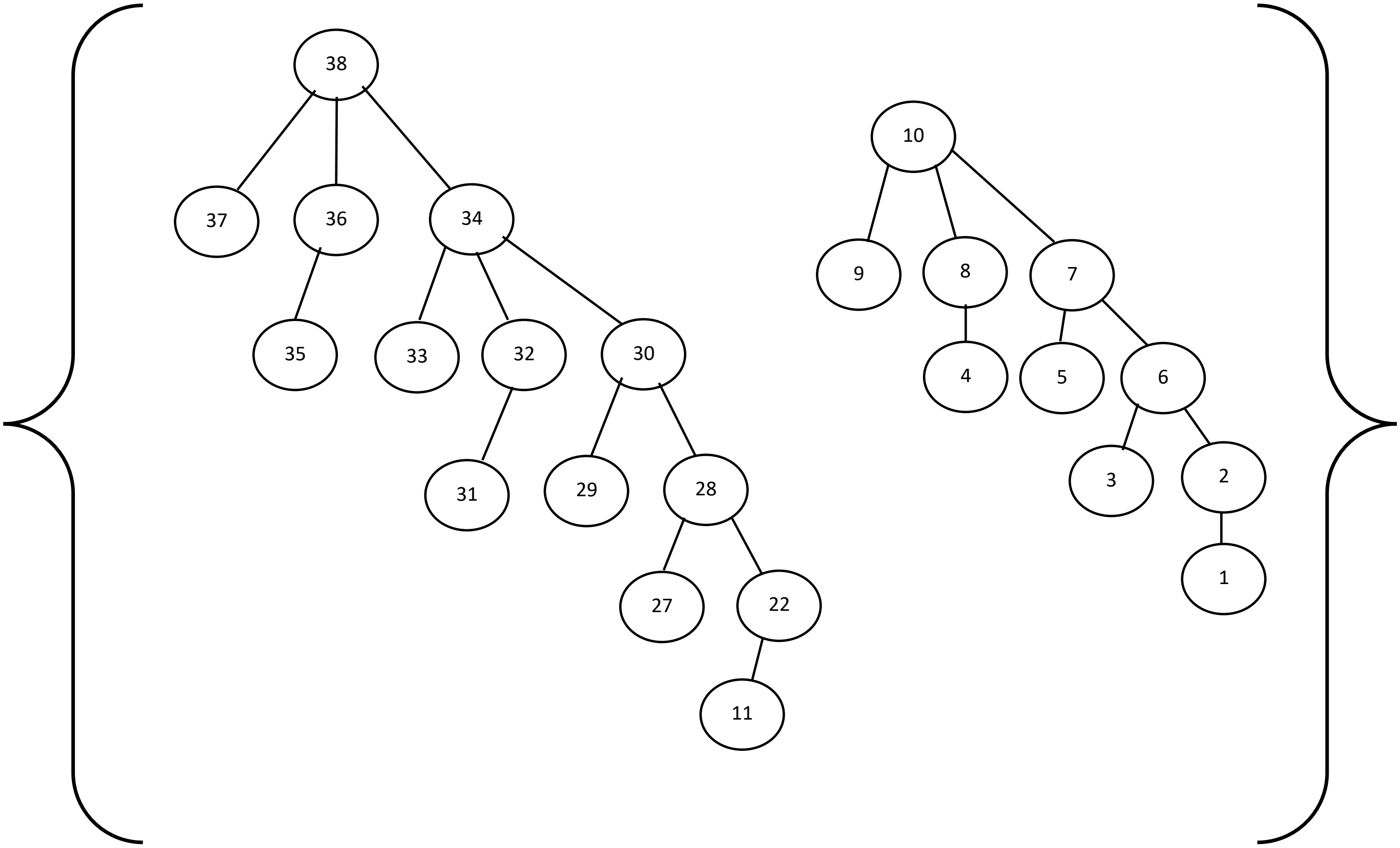
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